



MANAGING URBAN FLOODING – ENCOURAGING DESIGNING FOR EXCEEDANCE

In recent years, we have seen increased flooding from a range of sources. One of the main challenges (and opportunities) is to better manage rainfall and surface water in our urban areas. This is where our drainage systems normally convey and or store surface water runoff before releasing it to watercourses and treat a proportion of it. However, our drainage systems have a finite capacity and at some point, their capacity will be exceeded. So is our only option to keep increasing the size of our below ground drainage infrastructure to cope with bigger and longer rainfall events?



By Dr Chris Digman
Integrated urban drainage expert and Senior Principal Engineer, MWH

I believe we have choices:

1. We can invest heavily in below ground drainage systems making them bigger and in some places, this will be necessary to provide a drainage system that can take most rainfall. We typically design sewers to manage rainfall that has a chance of occurring once every 30 years to solve existing flooding. However, going beyond this design standard is unsustainable both financially and practicably.
2. We can 'let it happen' allowing water that escapes from drainage or cannot enter into systems in the first place to find its own pathways and ponds in natural depressions. We can then manage the final consequences once people's homes are flooded or transport

disrupted. There will always come a point when this may happen when the rainfall is extreme. However, there is an alternative to manage rainfall that exceeds the capacity of the drainage but is not what we may call "extreme".

3. We can manage the excess water the drainage cannot cope with on the surface within the existing urban environment; designing flood pathways; making changes to create multi-functional, shared spaces. We call this "designing for exceedance".

Designing for exceedance helps to manage the excess flow that may occasionally occur and so reduce its impact on vulnerable assets such as homes and infrastructure. It's about making the most of shared surfaces and areas so they have more than one function or use. For example, we can use roads to channel and convey exceedance by strategically increasing the height of kerbs to direct it. In the urban area, it is often the minor changes that can have greatest impact such as changing the profile of a footpath, creating or removing a drop kerb. We can store water in car parks or open green space. We can build permanent flood walls around properties and

install property protection measures such as flood gates and air brick covers.

CIRIA (Construction Industry Research & Information Association) supported by the Environment Agency has recently completed a project with MWH to encourage the uptake of designing for exceedance. The project investigated why uptake of the concept has been slow since the publication of guidance in 2006: C635 Designing for exceedance in urban drainage systems – good practice, despite many documents referencing the guidance both in the UK and internationally. The aim of the project is to help encourage those responsible (decision makers) for managing water and the relevant practitioners (including a wider range of disciplines such as planners, drainage and highway engineers, architects) to design for exceedance. It has identified critical success factors, learning from good designing for exceedance examples that have been built. We collated a series of case studies to help promote and give confidence to practitioners, that designing for exceedance is possible and effective.

To be successful in applying this approach, we have to work together. This was a key recommendation



1. In Aston, Rotherham Metropolitan Borough Council lowered the local playing field to store excess surface water when the drainage reaches capacity and reduce the chance of homes flooding
2. A drop kerb built in Aston near Rotherham to divert surface water that collects on the highway and floods properties

from Sir Michael Pitt's review of the 2007 flooding which was legislated for in the Flood and Water Management Act of 2010 placing a duty on risk management authorities to work together. Key players will include Lead Local Flood Authorities, Water and Sewerage Companies and the Environment Agency. AMP6, the next planning cycle for water companies may help facilitate more joint working, especially as they move from pre-defined outputs to an outcomes approach, establishing and working together in partnerships.

It is not just risk management authorities, the community also play a vital role, especially when retrofitting to solve existing problems. When engaged, they can help practitioners understand the extent of the problem and help develop and implement solutions. This may involve channelling water across the highway temporarily and agreeing how to do this safely. We have seen examples of this on roads with a speed limit of 30mph or less. In one example in Oxfordshire, community representatives work to an agreed procedure for when they need to close and divert a road. By working together (including with the community), we can assess the different risks posed to different people and design appropriately to mitigate those risks. Designing



3. In Witney, Oxfordshire, high kerbs help to channel water along the highway when a culvert reaches its capacity and floods on to the surface
4. Witney, Oxfordshire where a new wall, flood gate, flood proof door and air brick cover prevents the house from flooding when a culvert flood. This forms part of a scheme to manage the flooding and channel it along the highway

for exceedance is a step change. It means we are deciding to manage risk better, rather than letting flooding take its own course and managing the consequences during or after the event.

We can also 'design for exceedance' when we build new development. Managing exceedance is a requirement, referred to in the National Planning Policy Framework for England, Sewers for Adoption (7th edition) and the draft national standards for sustainable drainage. However, despite the requirements, we are not yet seeing exceedance being assessed consistently and designed for in new development. This is a missed opportunity to make new development more resilient. Using measures to convey and store water is easier to accommodate in new development. If we consider drainage and exceedance from the outset of the development process, as part of the Masterplanning process you can make the most of shared space. A simple example of this is a swale that drains rainfall alongside a cycle path. The cycle path acts as an exceedance channel, and is easy for a user to see when its purpose changes.

This approach applies equally to relatively simple or complex problems. Where small changes to

topography can be made with limited analysis, there are examples of practitioners 'getting on with it' by understanding the surface topography and creating pathways and storage, such as in Aston, Rotherham. Many of the examples are affordable because they make best use of available space above ground. Problems that are more complex may often require a computer model of the drainage system to simulate its performance with the surface topography added into the model. This allows more detailed analysis and solution development, with the performance of the solution being understood.

A key question is how frequently we use such approaches? The answer depends upon many factors. An important one is the source of the flooding. We are more likely to accept water from a surface water system than from a combined sewer (carrying surface water and sewage). For complex problems, where there are many sources of flooding, we may decide to design for exceedance as part of a phased approach, it being a first step that can be completed more quickly while a larger solution is developed and funded.

Designing for exceedance may not be the whole answer to managing flooding, but it provides a realistic, affordable and practical response to managing the results of persistent and heavy rainfall that our urban drainage systems may not cope with. This can help with heavy rainfall now and help us adapt to be more resilient in the future. Whilst such designs may themselves become overwhelmed by extreme rainfall, designing for exceedance and its components should now form part of the practitioners 'tool box' to manage the impacts of flooding and potential future impacts on new development. We can and should 'design for exceedance'.