FEATURE

Sustainable drainage: overcoming the challenges to a more secure future

Wilhelmina Drayton outlines how the UK's drainage methods can exacerbate flooding mechanisms, and discusses the opportunities of, and barriers to, SuDS implementation.

▲ **Figure 1. When surface water sewers surcharge the results can sometimes be very dramatic! (© Gerrald Isaaman)**

▲ **Figure 2. Gullies frequently become overwhelmed, restricting any further water from entering the drainage system. (© Wilhelmina Drayton)**

The current interpretation of water security is heavily biased towards supply and quality. However, the discourse needs to be broadened to cover matters of flood risk and managing stormwater. Earlier this year the UK once again experienced devastating flooding, an occurrence we are facing with seemingly increasing frequency. This intensification is borne out by the data, with four of the five wettest years on record having occurred since 2000[1]. The Department for Environment, Food & Rural Affairs (Defra) has identified flooding as the most significant threat from climate change facing the UK[2].

INADEQUATE DRAINAGE CAPACITY

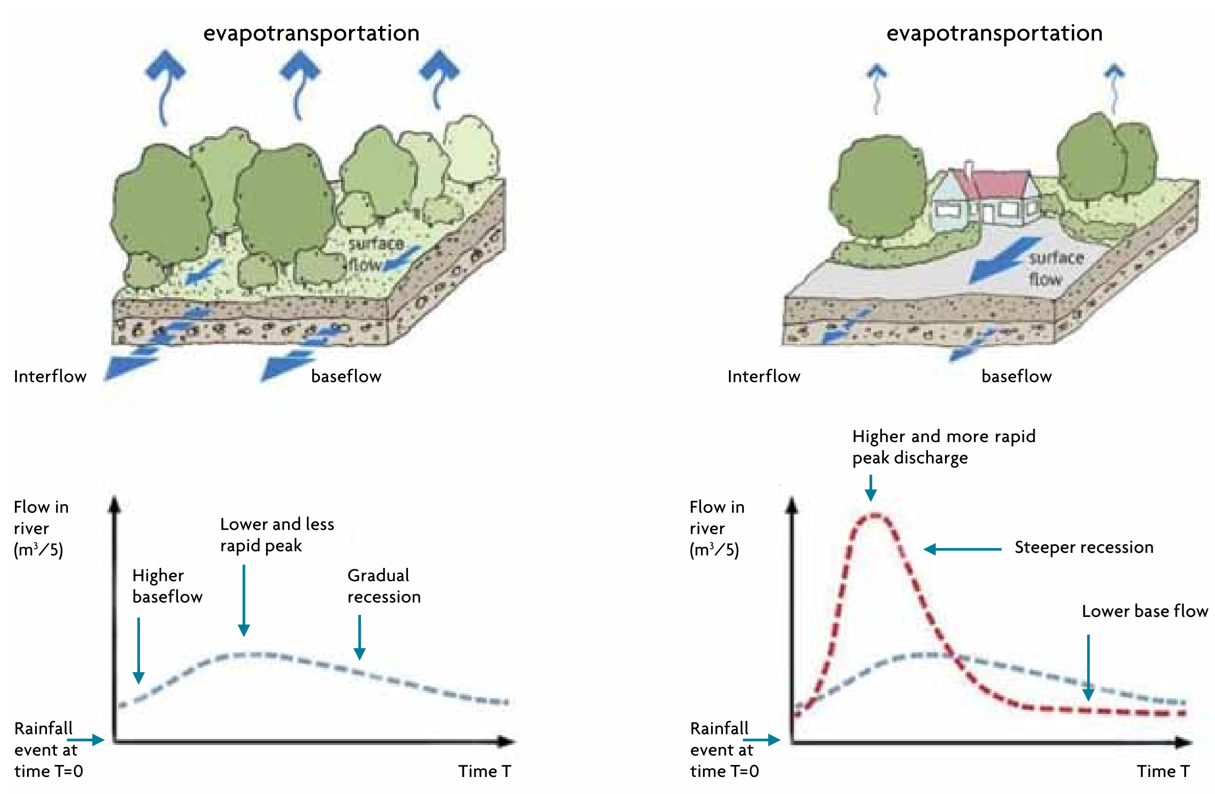
With a backdrop of wetter years and more intense rainfall events, the challenge of surface water management is compounded by traditional drainage infrastructure that is, in many cases, woefully inadequate. Surface water drainage systems in densely populated urban areas are increasingly having to handle volumes of water far in excess of what they were designed for. This can result in the system frequently becoming overwhelmed, and on occasion surcharging, as pipes running at full bore back up and excess overland flows are then prevented from entering the system (see **Figures 1** and **2**).

This capacity issue is responsible for creating low-level flooding and nuisance waters (which in turn causes damage to infrastructure, such as road surfacing) on a regular basis. During heavy rainfall events this can contribute to more serious flooding issues, even transferring flood waters and risk from one area to another. Many of these aging surface-water systems were designed for less intense rainfall events and for a built environment where much more surface water was allowed to infiltrate directly into the ground.

LOSS OF PERMEABLE SURFACES

Increased development and the proliferation of gardens that have been paved over have dramatically reduced the amount of permeable surfaces through which water can infiltrate. The impact on the water cycle is pronounced. When rainwater falls on undeveloped, more natural

▲ **Figure 3. Traditional drainage approaches can result in surface water from the entire catchment reaching the watercourse in very short time periods, leading to it becoming overwhelmed. (© Wilhelmina Drayton)**



▲ **Figure 4. The Impact of impermeability on the water cycle. (Source: susdrain[4]).**

ground a greater proportion of it will infiltrate, leaving some to become runoff. Runoff that is flowing over land coverings such as grass will travel considerably more slowly than that which falls on hard paved surfaces. This slower-moving (and already reduced in quantity) runoff therefore has more opportunity to infiltrate the ground. Some water that infiltrates will eventually become groundwater or baseflow how in local watercourses – an important resource in water security – and some will be used in the process of evapotranspiration.

In contrast, water falling on hard-surfaced areas will flow quickly into often undersized drainage pipes via gullies. In pipes it will flow at increased velocity to a discharge point (assuming there are no blockages or surcharging of the system on the way, which are likely to lead to flooding at some scale). Often these systems discharge into watercourses, resulting in high volumes of water entering the watercourse from the entire catchment in a very short time following the peak of the storm. This short lag period increases the likelihood of the river becoming overwhelmed, flowing out of bank and therefore flooding (see **Figures 3** and **4**).

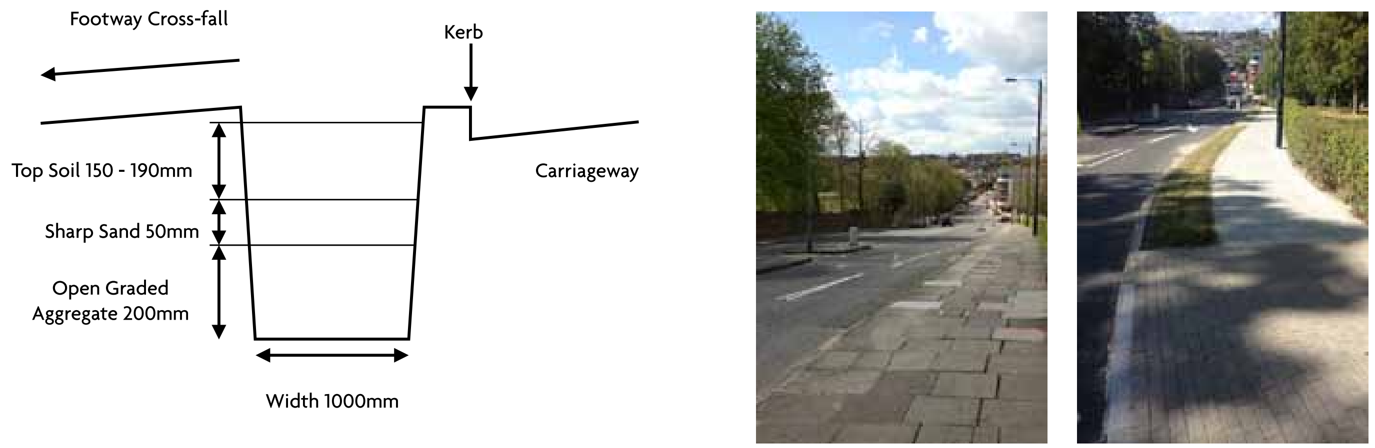
In the case of combined sewers, where surface water and foul sewerage flow within a single system, there is also the increased threat of combined sewer overflows (CSOs) discharging untreated sewerage directly into watercourses when the CSOs become overwhelmed with surface water. This can have a dramatic impact on water quality and the ecology of the watercourse[3].

SUSTAINABLE DRAINAGE TECHNIQUES

The issue of overwhelmed, undersized drainage systems can be resolved in two ways: by increasing the capacity of the system, or by reducing the volume of water entering it. Laying larger pipes or installing offline storage involves considerable expense and disruption (road closures, etc.) and is likely to result in a greater volume of water being discharged into the receiving watercourse at the peak of the storm, further aggravating flood risk. In order to decrease the burden on the drainage system another solution has to be employed, providing rainwater with alternative routing and infiltration options before it can enter the system (see, for example, **Figure 5**).

By increasing permeable ground covering within urban areas, rainwater and overland flows will have greater opportunity to infiltrate into the ground, thereby reducing the burden on surface-water drainage systems, and allowing rainfall from the catchment to reach the receiving watercourse over a longer period. This will not only assist in reducing the likelihood of flooding, but will also offer other benefits.

More than half of all rainfall events produce rainfall of less than 5 mm[3], and these small frequent events



▲ **Figure 5. There are opportunities to increase infiltration everywhere. The introduction of this green verge, designed with additional storage in the subbase to allow more water to be accommodated, improves the urban environment, reduces diffuse pollution and reduces flood risk. (Source: from Owen Davies)**

also result in the most-polluted runoff, an occurrence known as first flush, where pollutants that have built up on impermeable surfaces during dry periods become entrained in the first flush of rainfall and are transported to sewers and watercourses. If the vast majority of runoff from small, frequent events were allowed to permeate into the ground, where natural processes could be employed to break down the pollutants, this would result in a substantial reduction in diffuse pollution, which in turn would have a significant positive impact on river water quality.

Selection of the most appropriate techniques and sustainable drainage systems (SuDS) is vital as they can also provide the opportunity to increase biodiversity by greening the urban environment, and, if the correct locations are selected and systems sympathetically designed, the amenity value of the land can also be increased[5]. Alongside this, some studies have shown that green urban areas have a beneficial effect on the mental well-being of people living within them[6], and can even reduce crime rates.

The reasons for increasing and promoting permeable ground coverings and sustainable drainage techniques are clear, but there is a challenge around the land take that may be required to fully realise their benefit. This is of particular concern in densely populated residential areas, as redevelopment of large areas of land, where

▲ **Figure 6. Streets with no green or permeable areas are an all-too-common sight. Water has no option but to pond until there is available capacity in the drainage system. (© Wilhelmina Drayton)**

▲ **Figure 7. Vehicles can still be parked on these very attractive front gardens, but they are permeable, reducing the burden on traditional drainage systems. (© Robert Smith)**

water-sensitive design can be employed, is infrequent. Within our towns and cities many front and indeed rear residential gardens have been paved over, often to create space for off-street parking or patios (see **Figure 6**). These choices have significantly contributed to the increase in surface water runoff.

While a change in permitted development rights in 2008 stated that driveways could only be installed without planning permission if they were permeable, or rainwater was directed to a lawn to drain naturally, enforcement is inconsistent and not retrospective. A study of London concluded that in the 10 years prior to 2008, the amount of hard surfacing in gardens had increased by 26 per cent, equating to a loss of vegetated garden land equivalent to two Hyde Parks every year[7].

To reduce the proportion of rainfall entering traditional piped systems, opportunities for 're-permeating' or 'de-paving' small plots of developed ground, such as gardens, must be sought (see, for examples, **Figure 7**). If large numbers of these small plots of land can be reclaimed to allow water to infiltrate and to slow the flow following a rainfall event, the aggregate effect will significantly reduce runoff. In turn this will decrease the volume of water entering the public sewerage system, along with reducing diffuse pollution, as water will be managed at source as opposed to flowing over surfaces, accumulating sediment and pollutants on its journey.

LEGAL BACKING FOR SUDS

Uptake of SuDS in England has been sporadic, and although there are some excellent case studies in the UK (susdrain[4] is a good source for examples and information on SuDS) these techniques are still not the first choice for too many developers, despite numerous case studies showing them to be less expensive than traditional drainage approaches. The Flood and Water Management Act 2010 gave some recognition to the significance of SuDS, with Schedule 3 of the Act creating a new SuDS approving body (SAB), responsible for approving the drainage plans of all developments and ensuring that drainage approaches are selected from a hierarchy, with SuDS as the first choice.

The adoption and future maintenance of most approved SuDS features also fall to the SAB, the first time that adoption has been legally set out. However, commencement of this vital part of the Act has been delayed by the Government time and time again. Expectations of an October 2014 commencement date were dashed in May 2014 when Defra issued a briefing detailing their concern that implementation of the legislation might have an adverse impact on development.

Given that the Act was brought in prior to the coalition Government coming to power, it now looks unlikely that Schedule 3 will commence before the next general election. In that time many opportunities for SuDS have been lost, and, where they have been realised, the issue of adoption and long-term suitable maintenance regimes cannot be assured, as legislation is not in place to guarantee it.

Living with the disruption and devastation of flooding is a reality for many people in this country, and that very real pain can go on for numerous months after the waters have receded. Giving rainwater places to go, that does not involve getting it into pipes as fast as possible, is an imperative step in managing and reducing the frequency and impact of floods. This needs to be realised and acted upon seriously by us all – individual house owners, developers, planners and Government. **ES**

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