An Introduction to Sustainable Urban Drainage

A UK Rainwater Management Association Guide

Preface

This Guide has been produced for designers and specifiers of sustainable urban drainage systems (SUDS); it uses domestic developments as an example, but similar principles apply to commercial developments.

The guide also abstracts material from the report of Government-funded studies, a full copy of which can be down-loaded at http://uk-sda.co.uk/downloads/developer-guidelines

In particular the guide highlights the strong synergy between stresses on national water-supplies, on the one hand, and the need for new developments to avoid increasing flood risks on the other. It also highlights the role of rainwater harvesting (RWH) in addressing both these issues simultaneously, thus improving the cost-effectiveness of both.

Background

For many years, Government has stressed the need to economise on the use of water by avoiding waste (drips & leaks) and by switching to water-efficient appliances, by the use of smaller baths and sinks/basins, the use of smaller and dual-flush toilet cisterns, and the use of aerated taps and shower-heads.

Over time, this need to reduce mains water consumption has been exacerbated by climate-induced changes to patterns of rainfall, and by population growth.

Alongside the need to economise on mains-water usage, lies the equally pressing requirement to ensure that new developments do not increase local or down-stream flood risks, particularly when extreme weather events are experienced; in recent years, these too have become more frequent and have also been attributed to climate-change factors.

Until recently, the planning system and development industry response to this relied mainly on water attenuation systems to regulate surface water employing Sustainable Drainage Systems (SUDS), key features of which include:

- Their cost, without a compensating pay-back to the development itself
- Uncertainty about their future maintenance and thus effectiveness
- Making no contribution to the water-shortage side of the equation

Reflecting these limitations, the national approach to SUDS is now in the process of changing, following the passing of the ***"Flood and Water Management Act 2010"***.

General Principles

Given the need to control surface water on new development sites, not only to regulate normal flows but also to prevent any potential impact from surface water flooding, under the new Legislation, SUDS will in future be required for all planning applications.

Alongside this, local SUDS Adoption Boards are to be established to take responsibility for the associated installations, their future maintenance requirements, and their whole-life effectiveness; these Boards are likely to be the responsibility of existing regulatory bodies (Councils or Utility Companies), in a similar way to Highway Authorities.

The clear implications of these changes include an insistence by the local SUDS Adoption Boards that they approve their aspects of all planning applications, and an associated requirement that the systems themselves can be cost-effectively maintained. Through the Act, there will also be a requirement for SUDS to meets other environmental objectives.

A New Approach to SUDS

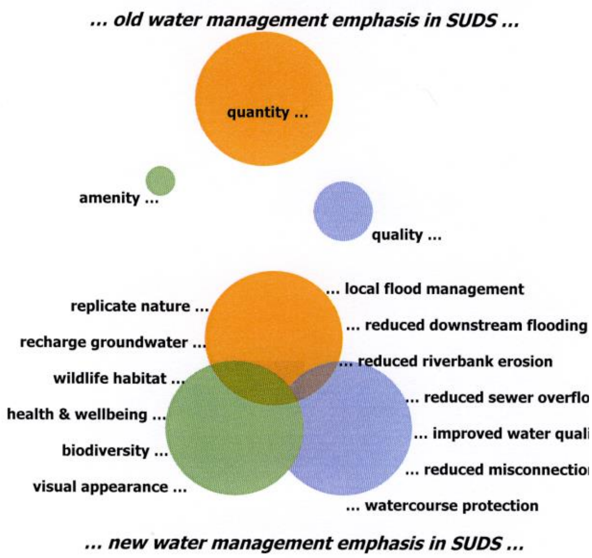
The purpose of future SUDS will be to mimic the way in which rainwater is gradually absorbed or flows across land naturally pre-development before reaching a ditch, water course or drain (see diagram on the next page); this is as an alternative to rapid discharge from hard surfaces through gullies and pipes directly to a drain or sewer.

SUDS must allow surface water from development sites to be controlled, and help prevent flooding down-stream that result from a new rapid discharge created by replacing soft vegetative cover with buildings and paving.

Traditional drainage systems of pipes, gullies and attenuation tanks only deal with water quantity, make little improvement to water quality, and rarely benefit amenity or biodiversity. SUDS of the future will be required to address all of these aspects, affording equal priority to each.

SUDS schemes in the future will help to cleanse water, removing hydrocarbons, dirt and pollution, by the use of filters and utilising the ability of plants to absorb them as water flows across their surface. The overall aim is that future SUDS schemes will be cheaper to construct and create attractive features that become an economic asset and make adjacent houses easier to sell and/or more valuable. They must also make efficient use of amenity space, and contribute toward achieving Code for Sustainable Homes and BREEAM credits.

Whilst helping to prevent flooding, their design must improve biodiversity and help to maintain natural water-flow regimes. They should also assist with water consumption compliance



Very importantly, under the new legislation, they need to be adoptable, and thus by implication be capable of being inspected and maintained.

Design Principles

Generally, the discharge rate for water from a "greenfield" site must be no more than if the site remained undeveloped (ie "the greenfield runoff rate").

In doing so, best-practice guidance advises that any man-made SUDS should work as closely as possible in sympathy with the natural cycle of surface water management. Broadly, given reasonably steady rainfall the bulk of surface water either evaporates back to atmosphere or infiltrates the surface, perhaps forming puddles or ponds before the excess overflows into nearby water-courses (as depicted opposite).

To mirror this behaviour once a site is developed, the quanity of water that must be stored on-site (the "storage volume") needs to be calculated specifically for each site and will depend upon the nature of the soil, underlying rocks, local rainfall levels and the percentage of the site that is to be developed.

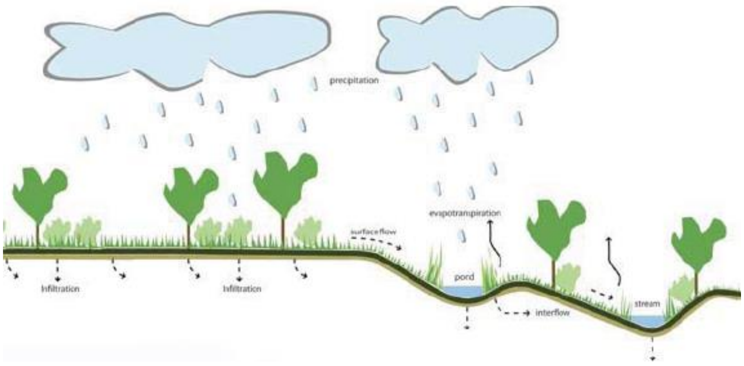
The approving authority then requires the storage volume to be calculated to accommodate the volume of water that will be generated within a 24-hour period during a 1-in-100-year flood event. To this is then usually added a 20% margin to allow for climate change, although in some instances a 1-in-200-Year flood event capacity may be required. Brownfield sites are treated differently, the expectation being that there will be significant improvement of the existing discharge from the site, in terms of quantity, quality, amenity and biodiversity.

The ideal water management train for SUDS of the future therefore comprises:

- **Source Control:** The smallest and most regularly used feature, located close to where water is being discharged; ideally, these should deal with water runoff up to 1-in-1 year events; these should then overflow into:

- **Site Control:** Which should deal with water runoff up to 1-in-30 years events; which then overflow into:

- **Regional Control:** Features that will deal with anything up to to 1-in-100 year events (or more if required by the planning authority), such as well-landscaped balancing pond or streetscape swales.



An elegant solution

Employing dedicated RWH systems on all suitable properties as the main means of "source control" (Level-1), and communal RWH systems for groups of higher-density properties (Level-2) provides a particularly elegant and cost-effective integrated approach that tackles both water shortages and surface water management.

From an adoption point of view, it also means that all three levels of the system are maintainable, the RWH systems necessarily as they are the source of non-wholesome water for the properties being served, and the balancing pond/swales being open to visual inspection and periodic cleansing when needed

The advantage of this integrated approach to incorporating RWH into SUDS has been internationally recognised with some countries introducing mandatory inclusion of RWH in all new developments for SUDS, rather than water-shortages, reasons.