Appendix F

Sustainable Drainage systems

Traditionally, built developments have utilised piped drainage systems to manage storm water and convey surface water run-off away from developed areas as quickly as possible. Typically these systems connect to the public sewer system for treatment and/or disposal to local watercourses. Whilst this approach rapidly transfers storm water from developed areas, the alteration of natural drainage processes can potentially impact on downstream areas by increasing flood risk and reducing water quality. Receiving watercourses are therefore much more sensitive to rainfall intensity, volume and catchment land uses after a catchment or areas of a catchment have been developed.

Due to the difficulties associated with updating sewer systems it is uncommon for sewer and drainage systems to keep pace with the rate of development/re-development and the increasingly stringent controls placed on discharges to watercourses. As development progresses and/or urban areas expand these systems become inadequate for the volumes and rates of storm water they receive, resulting in increased flood risk and/or pollution of watercourses. Allied to this are the implications of climate change on rainfall intensities, leading to flashier catchment/site responses and surcharging of piped systems.

In addition, as flood risk has increased in importance within planning policy, a disparity has emerged between the design standard of conventional sewer systems (1 in 30 year) and the typical design standard flood (1 in 100 year). This results in drainage inadequacies for the flood return period developments need to consider, often resulting in potential flood risk from surface water/combined sewer systems.

A sustainable solution to these issues is to reduce the volume and rate of water entering the sewer system and watercourses.

What are Sustainable Drainage Systems?

Sustainable Drainage Systems (SuDS) are the preferred method for managing the surface water run-off generated by developed sites. Buildings Regulations (Approved Document Part H), PPS 25 Annex F and the Environment Agency advocate the use of SuDS for surface water runoff. PPS25 notes that regional planning bodies and Local Authorities should promote their use for the management of runoff. SuDS seek to manage surface water as close to its source as possible, mimicking surface water flows arising from the site, prior to the proposed development. Typically this approach involves a move away from piped systems to softer engineering solutions inspired by natural drainage processes.

Discharge rates from a developed area vary depending on the characteristics of the site pre development. If the site was originally Greenfield in nature surface water discharge rates should mimic the Greenfield rate. In accordance with PPS25 peak flow rates of surface water leaving a developed site should be no greater than the rates prior to the proposed development, unless specific off-site arrangements can be made that result in the same net effect. Where possible, efforts should be made to improve the current situation with regard to discharge from the site, particularly in areas known to suffer from surface water inundation.

SuDS should be designed to take into account the surface water run-off quantity, rates and also water quality ensuring their effective operation up to and including the 1 in 100 year design standard flood including an increase in peak rainfall of 30% to account for climate change. In addition, these systems must be proven to be effective for the lifetime of the development, 100 years for residential developments and 60 years for commercial (as outlined by PPS25).

Wherever possible, a SuDS technique should seek to contribute to each of the three goals identified below with the favoured system contributing significantly to each objective:
- Reduce flood risk (to the site and neighbouring areas),
- Reduce pollution, and,
- Provide landscape and wildlife benefit.

The goals of SuDS can be achieved by utilising a management plan incorporating a chain of techniques, (as outlined in Interim Code of Practice for Sustainable Drainage Systems 2004), where each component adds to the performance of the whole system:

- Prevention: good site design and upkeep to prevent runoff and pollution (e.g. limited paved areas, regular pavement sweeping)
- Source control: runoff control at/near to source (e.g. rainwater harvesting, green roofs, pervious pavements) •
- Site control: water management from a multitude of catchments (e.g. route water from roofs, impermeable paved areas to one infiltration/holding site)•
- Regional control: integrate runoff manage from a number of sites (e.g. into a detention pond)

In keeping with the guidance of PPS25 local authorities should encourage the application of SuDS techniques. This chapter presents a summary of the SuDS techniques currently available and a review of the soils and geology of the Mid Suffolk area, enabling the local authorities to identify where SuDS techniques could be employed in development schemes.

The application of SuDS techniques is not limited to one technique per site. Often a successful SuDS solution will utilise a number of techniques in combination, providing flood risk, pollution and landscape/wildlife benefits. In addition, SuDS can be employed on a strategic scale, for example with a number of sites contributing to large scale jointly funded and managed SuDS.

Planning

All relevant organisations should meet at an early stage to agree on the most appropriate drainage system for the particular development. These organisations may include the Local Authority, the sewage undertaker, Highways Authority, and the Environment Agency. There are, at present, no legally binding obligations relating to the provision and maintenance of SuDS. However, PPS25 states that:
"where the surface water system is provided solely to serve any particular development, the construction and ongoing maintenance costs should be fully funded by the developer."

The most appropriate agreement is under Section 106 of the Town and Country Planning Act. Under this agreement a SuDS maintenance procedure can be determined.

When a decision has been made regarding a SuDS method, the various organizations involved should agree on a management and responsibility strategy. Problems arise when this has not been decided upon prior to adoption and the SuDS system can fail.

SuDS Techniques

SuDS techniques can be used to reduce the rate and volume and improve the water quality of surface water discharges from sites to the receiving environment (i.e. natural watercourse or public sewer etc). Various SuDS techniques are available, however the technique operate on two main principles:

- Infiltration
- Attenuation

All systems generally fall into one of two categories, or a combination of the two.

The design of SuDS measures should be undertaken as part of the drainage strategy and design for a development site. A ground investigation will be required to assess the suitability of using infiltration measures, with this information being used to assess the required volume of on-site storage. Hydrological analysis should be undertaken using industry approved procedures such as the Flood Estimation Handbook to ensure a robust design storage volume is obtained.

During the design process, liaison should take place with the Local Planning Authority, the EA (if the site is over 1ha in size or identified as situated within a critical drainage area), and Anglian Water in order to establish that the design methodology is satisfactory and to also agree on a permitted rate of discharge from the site.

Infiltration SuDS

This type of Sustainable Drainage System relies on discharges to ground, where suitable ground conditions allow. Therefore, infiltration SuDS are reliant on the local ground conditions (i.e. permeability of soils and geology, the groundwater table depth and the importance of underlying aquifers as water resources etc) for their successful operation. Before implementing this type of SuDS, detailed ground investigation should be carried out as there is the potential for mobilization of contamination if any is present

Various infiltration SuDS techniques are available for directing the surface water run-off to ground. However, development pressures and a desire to maximise development potential often result in typically small areas available for infiltration systems. These small areas, allied to the rapid rates of run off generation, often require some form of attenuation as part of the infiltration system. The storage may be provided in the sub-base of a permeable surface, within the chamber of a soakaway or as a pond/water feature.

Infiltration measures include the use of permeable surfaces and other systems that are generally located below ground.

Attenuation SuDS

Should it be found that the ground conditions are not favourable for infiltration techniques, the surface water run-off discharged from a site will need to be attenuated using on-site storage. While this is a SuDS technique that will reduce the rate of discharge from the site, the overall volume will not be minimised using on-site storage alone. An important factor that needs to be taken into consideration when assessing the suitability of on-site storage as part of a proposed development is the volume required and the associated impacts the storage will impose on development proposals and risks to neighbouring properties.

An allowable rate of discharge from the site will need to be agreed with the Environment Agency, Anglian Water, and the Local Planning Authority. This can have significant implications to the proposed development with regards to the large volume of storage that may be required. On-site storage can be constructed both above ground and below ground with the above ground systems usually being the cheaper option on a cost per metre cubed of storage basis. It should be noted however that the below ground systems may pose less constraints on the developable area of the site.

On site storage measures include basins, ponds, and other more engineered forms of storage underground, (the reader is directed to The SuDS Manual for further information regarding SuDS techniques).

Alternative Forms of Attenuation

In many situations the development of a site may involve proposals that would inhibit the use of basins or ponds as a means of managing the surface water run-off discharged from the site. This may be due to space limitations, economic feasibility, or other issues such as health and safety etc. In these situations it may be appropriate to use a storage option that is viewed as being more 'engineered' than an open basin or pond. Most of these methods involve the provision of storage beneath the ground surface, which may be advantageous with regards to the developable area of the site; however consideration needs to be given to construction methods, maintenance access and to any development that takes place over an underground storage facility. The provision of large volumes of storage underground also has potential cost implications.

Methods for providing alternative attenuation include:

- Deep Shafts
- Geocellular Systems
- Oversized Pipes
- Rainwater Harvesting
- Tanks
- Green Roofs

Combined Infiltration / Attenuation Systems

In most situations, SuDS systems include both infiltration and storage. Most of the techniques identified above can be used in combination; however dedicated infiltration and attenuation systems include swales and filter strips.

Combined systems often meet all three goals of Sustainable Drainage Systems, whilst also reducing the land take required to accommodate them.

SuDS Suitability in the Mid Suffolk Areas

The underlying ground conditions of a development site will often determine the type of SuDS approach to be used at development sites. This will need to be determined through ground investigations carried out on-site; however an initial assessment of the suitability of a site to the use of SuDS can be obtained from a review of the available soils/geological survey of the area.

Table E-1 indicates the types of soils, drift deposits and solid geology that are present in the Mid Suffolk area, and their likely suitability to infiltration measures. This is based on a review of:

- the Soil Survey of England and Wales 1993 – 1:250,000 Soils Maps (Sheets 4 & 6), and
- the Geological Survey of Great Britain (England and Wales) 1:50,000 Series Solid
- and Drift Edition Sheets 207, 176 (1996), 191 (1996) and Sheets 208 & 225 (2001).

The Soils Map Legend was also consulted as part of this assessment.

The table presents the ground conditions found within MSDC in terms of their permeability (impermeable, variably permeable and permeable) and the types of SuDS techniques that may be suitable for a site located on these materials. These definitions are based on a review of available information and our experience and should not supersede site-specific data and ground investigations.

In the design of any drainage system and SuDS approach, consideration should be given to site-specific characteristics and where possible be based on primary data from site investigations. The information presented in table E-1 is provided as a guide and should not be used to accept or refuse SuDS techniques.

Table E 1 Soil Type, Solid and Drift Geology and Appropriate SuDS Techniques

Location	Soil Association	Drift Geology	Solid Geology	General drainage/ Soil Characteristics	Groundwater Vulnerability	Appropriate SuDS Techniques	FRA Requirements
Bacton	Ashley	Chalky till and glaciofluvial drift	Chalk	Moderately drained, seasonally waterlogged	Minor- high and intermediate	Combined Infiltration/ Attenuation systems	
Bramford	Ashley	Chalky till and glaciofluvial drift	Chalk	Moderately drained, seasonally waterlogged	Major- high and intermediate	Combined Infiltration/ Attenuation systems	Situated on a major aquifer with high vulnerability- FRA should carefully consider suitable SuDS techniques
Claydon	Melford	River deposits, alluvium, clay silt and sand	Chalk	Permeable and well drained	Major- High and Intermediate	Infiltration and Combined Infiltration/ Attenuation systems	Situated on a major aquifer with high vulnerability- FRA should carefully consider suitable SuDS techniques
Debenham	Burlingham 3	Chalky till and glaciofluvial drift	Norwich crag, red crag and Chillisford clay	Deep fine loamy soils with slowly permeable subsoils and slight seasonal waterlogging. Some similar fine or coarse loamy over clayey soils.	Minor- intermediate	Infiltration and Combined Infiltration/ Attenuation systems	
Elmswell	Worlingham	Till, diamicton and river terrace deposits	Norwich crag, red crag and Chillisford clay	Permeable, well drained	Minor, high, intermediate and low	Infiltration and Combined Infiltration/ Attenuation systems	
Eye	Ashley	Chalky till and glaciofluvial drift	Norwich crag, red crag and Chillisford clay	Moderately drained, seasonally waterlogged	Minor- high and intermediate	Combined Infiltration/ Attenuation systems	
Haughley	Worlingham	Till and diamicton	Norwich crag, red crag and Chillisford clay	Permeable, well drained	Minor, high, intermediate and low	Infiltration and Combined Infiltration/ Attenuation systems	
Mendlesham	Newport 3	Glaciofluvial drift and chalky till	Norwich crag, red crag and Chillisford clay	Deep well drained sandy and coarse loamy soils. Some coarse and fine loamy soils with slowly permeable subsoils and slight seasonal waterlogging.	Minor- low	Infiltration and Combined Infiltration/ Attenuation systems	
Needham Market	Ludford	Glacial sand and gravel, clay silt and sand	Chalk	Permeable and well drained	Major- high and intermediate	Infiltration and Combined Infiltration/ Attenuation systems	Situated on a major aquifer with high vulnerability- FRA should carefully consider suitable SuDS techniques
Rickinghall with Botesdale	Newport 3	Glaciofluvial drift and chalky till	Norwich crag, red crag and Chillisford clay	Deep well drained sandy and coarse loamy soils. Some coarse and fine loamy soils with slowly permeable subsoils and slight seasonal waterlogging.	Major- intermediate	Infiltration and Combined Infiltration/ Attenuation systems	
Stowmarket	Beccles 3	Chalky till and glaciofluvial drift	Norwich crag, red crag and Chillisford clay	Seasonally waterlogged	Minor high and intermediate, major- high	Combined Infiltration/ Attenuation systems	Situated on a major aquifer with high vulnerability- FRA should carefully consider suitable SuDS techniques
Stowupland	Ludford	Till and diamicton	Chalk	Permeable and well drained	Minor- high, intermediate and low	Infiltration and Combined Infiltration/ Attenuation systems	
Stradbroke	Newport 3	Glaciofluvial drift and chalky till	Norwich crag, red crag and Chillisford clay	Deep well drained sandy and coarse loamy soils. Some coarse and fine loamy soils with slowly permeable subsoils and slight seasonal waterlogging.	Minor- low	Infiltration and Combined Infiltration/ Attenuation systems	
Thurston	Worlingham	Till, diamicton, glacial sand and gravel	Chalk	Permeable, well drained	Major high, minor- low	Infiltration and Combined Infiltration/ Attenuation systems	Situated on a major aquifer with high vulnerability- FRA should carefully consider suitable SuDS techniques
Woolpit	Worlingham	River terrace deposits, sand gravel, till and diamicton	Chalk	Permeable, well drained	Major high, minor- low	Infiltration and Combined Infiltration/ Attenuation systems	Situated on a major aquifer with high vulnerability- FRA should carefully consider suitable SuDS techniques