

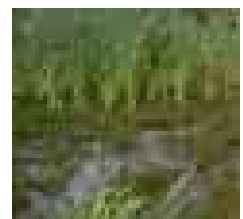
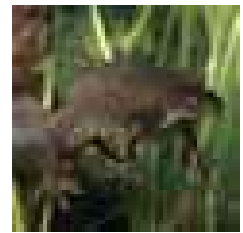
Sustainable drainage systems (SuDS)

What are SuDS?

SuDS, or Sustainable Drainage Systems, are alternatives to traditional piped drainage systems that utilise natural drainage processes to convey, reduce the quantity, and improve the quality, of surface water runoff generated by urban development.

There are four main categories/techniques of SuDS that can be used to attenuate and treat surface runoff:

- filter strips and swales,
- filter drains and permeable surfaces,
- infiltration devices,
- basins and ponds.



Capability statement

Entec

Entec is one of the UK's largest environmental and engineering consultancies. Our technical and business skills are dedicated to delivering strategic, technical and engineering solutions which bring commercial benefit to customers at home and overseas. This know-how is based on over 60 years' consulting experience in the public and private sectors.



Certificate No. EMS 69090

Certificate No. FS13881

Entec operates a Quality Management System in accordance with the latest requirements of the international standard BS EN ISO 9001 and an Environmental Management System compliant with BS EN ISO 14001. Both are audited by BSI Management Systems.



Why use SuDS?

Unlocking site development

Where once surface water from a site was transported via piped systems to a potentially remote discharge point, control at source is often now required, together with restrictions on discharge rate and volume. Incorporating SuDS into a development can provide an effective solution, while yielding additional benefits such as habitat creation and biodiversity through the establishment of ponds or wetlands. Landscaping features may also be utilised such as swales, basins and filter strips. Schemes can be incorporated into, and enhance, public amenity areas.



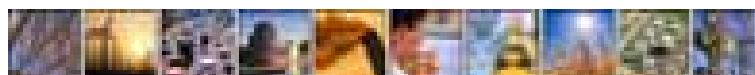
Overcoming restrictions on developers and planners

The Government published Planning Policy Guidance Note 25: Development and Flood Risk (PPG 25)* in 2001 to explain how flood risk should be considered at all stages of the planning and development process to reduce future damage to property and loss of life. It also recommends the use of the precautionary principle and consideration of climate change.

It is essential that the surface runoff from a proposed development is investigated early in the planning process. PPG25 recommends that all interested parties (local planning authorities, the Environment Agency, sewerage undertakers, navigation authorities and prospective developers) liaise to control surface runoff as near to the source as possible via SuDS where appropriate. Part H of the Building Regulations 2000 has introduced a discharge hierarchy for surface runoff from buildings, which effectively dissuades against connection to the public sewerage system. This provides the developer with alternatives such as discharge to an infiltration system or connection to a watercourse. However, incorporating such systems may not always be possible due to underlying ground conditions or the location of the site and so connection to a sewer may be the only alternative. It may be appropriate to undertake a drainage impact assessment to determine the most suitable method of disposal of surface runoff from a development.

With the implementation of PPG25 and Part H there is increasing pressure on developers and regulators to find alternative means of dealing with surface water runoff from new developments. If a site is to drain to a watercourse the EA/ Local Authority may impose a restriction on the rate of runoff limited to 'greenfield' equivalent, i.e. the rate and volume of discharge from an undeveloped site.

* National Planning Policy Guideline 7 (NPPG7) - Planning and Flooding in Scotland



Sustainable Drainage Systems

Mitigating flood risk

The objective when incorporating SuDS into a development is to minimise the impact of the surface water runoff on the public sewerage system, local watercourse or ground water, in the form of discharge rate, discharge volume and/or the pollution loading. Traditional drainage systems are designed to rapidly convey runoff to a discharge point with no treatment of pollutants, however SuDS can attenuate and store runoff close to source providing some treatment.

SuDS may be designed to allow surface runoff to infiltrate into the underlying strata, if appropriate, or to convey the runoff to a suitable discharge point. SuDS can be used to attenuate and store surface runoff from a development enabling some evaporation and/or infiltration to take place.

By attenuating the discharge entering a watercourse or public sewer, SuDS can reduce the need for investment in flood management and protection schemes. SuDS can also remove pollutants that may otherwise enter a watercourse, by microbial processes, by uptake into reeds and other plants, or by simple settlement. By designing SuDS as a series of interlinked components that form one composite system we can determine whether the level of protection provided is adequate.



Incorporating SuDS into a development can benefit the local community, and help planners and developers promote a site as a place to work or live:

- local amenities can be created/enhanced;
- local wildlife habitats can be created/enhanced;
- Local authority planners can meet Local Agenda 21 sustainability objectives.

Additionally,

- the Environment Agency/SEPA will see the positive effects of reduced runoff volume and improved runoff quality if discharging to a watercourse or groundwaters;
- water companies will see benefit from reduced runoff if discharging to the public sewerage system.





Entec's approach

Entec can liaise with the regulatory bodies and local planning authority to ensure that the most appropriate system is designed for a particular site, and that any proposal is compatible with the overall development. Our SuDS design team provides systems that enhance local amenity value and promote creation of wildlife habitats. Some SuDS techniques may not be suitable for the local ground conditions. For example, where there are impermeable sub strata, or if groundwaters are at risk, infiltration techniques may not be appropriate. Entec has in-house expertise in geotechnics, for ground investigation, and hydrology/hydrogeology for groundwater movement and existing natural and artificial drainage systems.

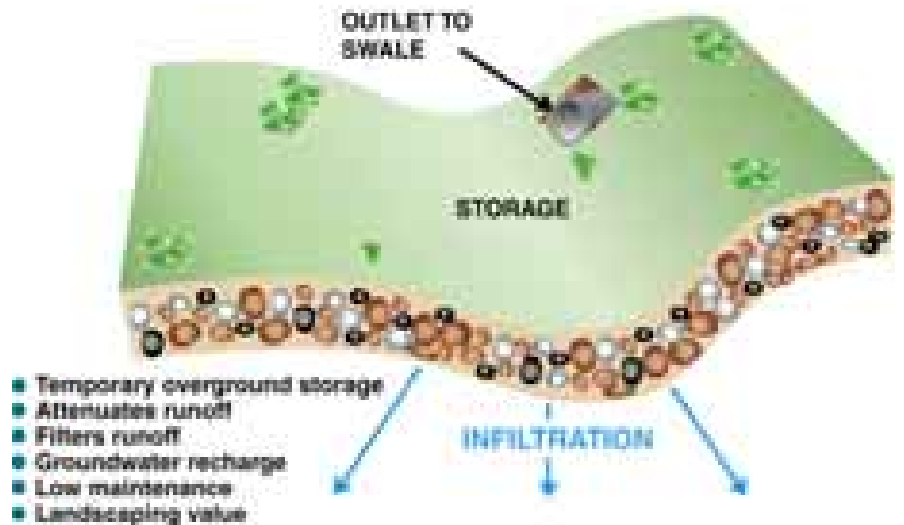
Entec has designed a number of SuDS schemes for residential and commercial developments to provide alternative means of dealing with surface runoff and, in some cases, unlocking the site for development, where previously the discharge of surface runoff would have either prevented the development of a site or attenuation and storage requirements would have been too costly.

To determine the effectiveness of SuDS prior to construction it may be necessary to model the effects of any proposals on:

- existing natural and artificial drainage systems
- existing hydrological conditions
- existing hydrogeological conditions
- flood management and protection schemes
- water quality
- wildlife habitats.



Sustainable Drainage Systems



The service

We have a diverse range of skills required to meet your needs including:

- Mathematical modelling
- Hydrogeology
- Hydrology
- Ecology
- Landscape design
- Planning
- Geotechnics
- Civil engineering feasibility & design
- Construction management

Developers and local authorities often commission Entec to design SuDS schemes because the necessary expertise to design and assess the effects upon the receiving system is usually not available in-house. Entec can design a SuDS scheme for a site that is compatible with the local conditions, and the requirements of the regulatory bodies and local planning authority, providing all requirements in an integrated package. Critically, our skills in SuDS development fit seamlessly into our broader expertise across the water management, development planning and engineering disciplines.

Drainage Impact Assessments

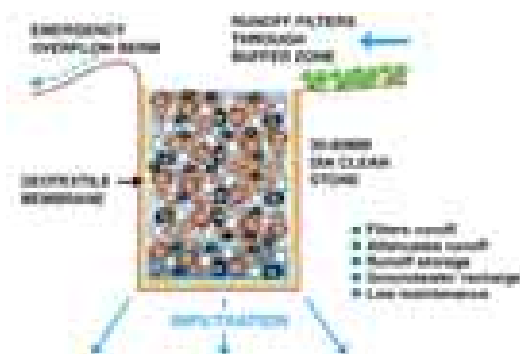
The scope of a Drainage Impact Assessment (DIA) will be dependent upon the type, size and location of a development. Drainage is a material consideration at the planning stage of a development and due consideration must be given to the impact of the proposed development on the catchment area, including an assessment of potential for both flood risk and pollution. Ideally a DIA should be submitted with the first planning application, either outline or full, for any development which requires waste or surface water to be drained.

The following types of development would usually not require a DIA:

- individual householder applications/minor modifications to properties
- developments of less than ten new dwelling houses, unless the development may affect a sensitive area
- changes of use not involving new buildings or hardsurfacing.

Each DIA is site explicit and should look at the options available for the specific location, development type, development size and disposal options.

Surface water runoff, generated as a result of the increased impermeable area in a development should be drained according to the principles of SuDS.



Sustainable Drainage Systems

Implementing SuDS effectively requires an integrated project approach; Entec can help from optioneering through to design completion and construction management.



Case studies

The following pages demonstrate Entec's capabilities in the area of Sustainable drainage systems, using case study examples. ►



Medburn Sustainable Drainage Systems Miller Homes (North East) Ltd

Miller Homes were interested in developing part of a proposed residential development within an existing hamlet. Medburn is situated approximately three miles from Ponteland in Northumberland. Miller Homes were the lead developer with the remainder of the properties being constructed by others.

The site consisted of several plots of land owned by the existing residents of Medburn which had been used for grazing animals and informal, extended gardens for a number of years. The new development incorporated the existing properties into the overall design. The Med Burn, a small watercourse, flows through the north west corner of the site and a small drainage ditch flows from south to north to the eastern end of the site.

It was intended that the foul drainage from the proposed site would connect to an existing 150mm diameter combined public sewer flowing east through the centre of the site. Northumbrian Water was concerned that this sewer would have insufficient capacity to accept surface water runoff from the development during storm periods, but wanted alternatives to

traditional storage solutions and Miller Homes was keen to pursue alternative, environmentally friendly solutions to the disposal of the on-site surface runoff. The local authority, Castle Morpeth Borough Council (CMBC), was also keen to promote sustainability on the site. Miller Homes commissioned Entec to investigate alternative designs for dealing with the surface water runoff from the new development. Entec proposed that sustainable drainage systems (SuDS) be used throughout the proposed development to reduce the rate and volume of the surface runoff from the development prior to discharge to the Med Burn and the drainage ditch. In some cases this also involved treatment of the water.

The recommendations were subsequently adopted by CMBC in the Medburn Master Plan for the whole of the development site.

The proposals included the incorporation of water butts at each property, permeable highways and ponds prior to controlled discharge into the watercourses. The incorporation of such features also enabled the drainage ditch to be modified as an amenity and landscape feature. All arterial highways were designed as traditional impermeable pavement with runoff conveyed to permeable paving for attenuation and storage.

Facts and Figures

Project

Medburn Sustainable Drainage Systems

Client

Miller Homes (North East) Ltd

Location

Ponteland, Northumberland

Entec Services

- Drainage design and associated hydraulic modelling.
- Design of SuDS scheme.
- Extended Phase 1 Habitat Survey (Institute of Environmental Assessment, 1995) of existing site.
- Water vole survey of the Med Burn.
- Assistance with CMBC Medburn Master Plan to include a provision for SuDS within the development



Pursuing alternative solutions to the disposal of on-site runoff



White Moss Business Park Sustainable Drainage Systems (SuDS) West Lancashire District Council

West Lancashire District Council (WLDC) required the drainage from the proposed site of the business park to be dealt with in an environmentally friendly manner and requested that Entec advise of a possible solution to dealing with the surface water runoff. The client also asked us to estimate the likely costs for the proposed scheme.

The portion of the site under WLDC ownership is approximately 5½ hectares and was formerly a council depot and nursery. The remainder of the site is approximately 6½Ha and owned by others. WLDC proposed to develop an office based (Class B1) business park on the whole site.

The foul drainage from the proposed site would connect to an existing 150mm diameter foul sewer located next to the proposed development.

An existing 525-725mm diameter surface water culvert is situated close to the proposed site although there is insufficient capacity in this sewer to accept increased flows. WLDC was keen to pursue alternative, environmentally friendly solutions to the disposal of the on-site surface runoff.

Entec recommended that a viable alternative to using traditional drainage systems, which convey the surface runoff from the site as quickly as possible, would be to use more sustainable techniques. Sustainable drainage systems (SuDS) could be used to attenuate and reduce the rate of the surface runoff from the site, so that impact to the drainage system would be kept within acceptable limits.

By using SuDS on the White Moss development the surface water runoff would be conveyed to constructed ponds or wetlands situated in the land to the west of the site, minimising the effects of surface water runoff from the site in terms of flow and pollution. The SuDS techniques used on this scheme included:

- permeable paving;
- water butts;
- ponds / wetlands; and
- swales.



Facts and Figures

Project

White Moss Business Park
Sustainable Drainage System

Client

West Lancashire District Council

Location

West Lancashire, UK

Entec Services

- Drainage design and associated hydraulic modelling
- Design of SuDS scheme
- Extended Phase 1 Habitat Survey (Institute of Environmental Assessment, 1995) of existing site
- Great crested newt survey of existing site
- Planning application for the proposed wetlands and ponds

Environmentally friendly drainage design



River Medway - Flood Risk Assessment Confidential Client

A major property development company is interested in the long-term development of land on greenfield sites at the fringes of the River Medway floodplain. The whole area is currently classified as lying within the indicative floodplain on the Environment Agency (EA) Indicative Floodplain Maps and the EA had objected to the scheme.

The EA indicative flood risk maps show the majority of the area as being at risk from fluvial flooding but do not differentiate as to cause and type. In fact, flooding problems in the area are of a diverse nature and scale, and it has been necessary to carry out a more detailed study to separate out the different causes and types of flooding and to arrive at technically more sustainable solutions.

Work has included liaison with the EA and Internal Drainage Board, review of floodplain constraints using GIS datasets, hydrological / hydraulic study of local drainage networks, integration with the Medway Flood Model and formulation of potential mitigation methods including local and strategic flood storage solutions and incorporation of Sustainable Drainage Systems (SuDS) within the development. Recommended solutions include stream diversions and the creation of wetland storage and washland areas, thereby maximising the nature conservation potential of the surrounding area.

Entec has assisted the developer in compiling representations on flood risk and PPG 25 to inform the Local Plan and is currently conducting further consultation with the EA in working up the scheme.

The work has shown that flood risk in areas nominally marked as 'blue' on the Agency's maps may be due to a variety of causes and that a more detailed assessment can result in a potentially sustainable development, which overcomes many of the problems and demonstrates best practice. The opportunity also exists to improve the existing drainage network and overcome existing constraints that cause regular and disruptive localised flooding.

*Providing a
long-term strategy
for development in
the floodplain*



Nottingham Arboretum Engineering Support Nottingham City Council

Located in Nottingham City Centre, Nottingham Arboretum is an historic 19th Century park, covering approximately eight hectares.

In Spring 2002, Nottingham City Council approached Entec to provide engineering support for a Heritage Lottery bid to revitalise the Arboretum.

The council had been experiencing a number of problems including leakage and deterioration of the lake structure, failure of the lake's fountain and waterfall feature, poor lake water quality and inadequate park-wide drainage, resulting in the deposition of sediment and ponding in low areas of the park.

The client asked Entec to undertake a feasibility study to determine their options to overcome the drainage problems, together with an accurate costing to enable them to progress with an application for Heritage Lottery Funds.

Under a tight time scale, Entec utilised part of their diverse range of in-house services, producing a study advising the council on ecological and engineering solutions to the park's problems.

Following the completion of this report, the scope of Entec's works were then expanded to determine the full extent of the deterioration to the lake structure and ancillary equipment and the conceptual design of a sustainable drainage system within the park, again with full costing of the options.

As a result of Entec's work, Nottingham City Council was able to accurately assess the work required within the park, together with the associated costs to allow a Heritage Lottery submission to be made.



Assessing water drainage issues at an historic location



Reclamation of Former Colliery Land at Riddochhill Bing West Lothian Council

Riddochhill Bing near Bathgate in West Lothian has been suffering the effects of spontaneous combustion for over 30 years and attempts during the 1970s and 80s to extinguish the burning within the colliery spoil have failed to achieve a solution to the problem.

In 1998, Entec was appointed to undertake a feasibility study, which would not only look at ways to remediate the effects of the burning, but would also deal with the other mining legacies associated with the 40 ha site. These included the problem of shallow mining instability over outcropping coal seams and the problem of rising minewater within the old workings of the nearby former Polkemmet Colliery.

Entec recommended a solution based on the shallow excavation of coal. This would enable the areas of ground instability to be removed and a suitable excavation created in which to backfill and compact the existing burning material under controlled conditions. The design of the scheme would also enable valuable development land close to the M8 Motorway to be brought into productive use and the site could also provide the means for the

treatment of minewater from both the operational site and as a long-term solution to the Polkemmet minewater problem.

The design was developed following the completion of an extensive ground investigation which was undertaken in Summer 2000. This was followed by extensive planning related consultations, which culminated in the preparation of a detailed EIA, covering a wide range of technical disciplines with particular focus on ground and surface water management and a detailed odour assessment. The EIA accompanied a planning application submitted in Summer 2002.

The odour assessment at Riddochhill Bing also represents a new approach to the problems associated with burning colliery spoil. Sulphurous odours have been emitted from the site over a period of many years and have been a source of concern to the local population. To identify the extent of the odour problem, Entec undertook a field monitoring programme during 2001, followed by a computer generated modelling exercise. This has been accompanied by ongoing continuous monitoring funded by West Lothian

Council and the results have been used to assess the environmental effects of the existing situation and to identify the likely effects while the site is being remediated. A detailed odour and dust management plan has also been prepared, with details included in the Environmental Statement, and this will form an integral part of the remediation strategy which if planning permission is received, will be implemented with the site reclamation in 2003



*Remediation advice
helps unlock the
development
potential of
former colliery
land*



Industrial Park Drainage System Hambleton District Council

As part of their regeneration plans, Hambleton District Council (HDC) planned to develop a new industrial park in order to stimulate opportunities for employment and economic prosperity within their administrative area.

Due to our proven infrastructure track record and specific knowledge of sustainable drainage systems (SuDS), HDC gave Entec the brief to deal with both on and off site sewerage related issues.

We produced a feasibility report, which considered drainage opportunities to deal with surface water runoff from the site including SuDS solutions. Issues including the future maintenance and adoption, were investigated in detail.

Due to a lack of capacity in the sewerage network adjacent to the site, an on-site attenuation system discharging to a tributary of the River Wiske was

recommended. Our geotechnical and sewer modelling engineers provided vital input into the selection of an appropriate solution. In the end, site ground conditions became the deciding factor, with the final solution being a 2500m³ offline storm water attenuation pond. The solution had to be sustainable, attenuating outflow such that flows from the pond would produce the equivalent agricultural rate of runoff, to ensure no additional risk of flooding in an already vulnerable catchment.

Our in-house environmental specialists provided advice on incorporating permanently wetted areas together with wetland and marsh areas, planting and future maintenance philosophies.

Positioning of the storage pond was crucial as this had to minimise the sterilisation of developable land. This in itself introduced it's own technical difficulties, as the obvious place for it's location was at the low point in the site, adjacent to Railtrack's East Coast Mainline. Entec co-ordinated the production of key geotechnical parameters to check both short and long term stability issues associated with the railway embankment.

Entec was able to satisfy the concerns of Railtrack, the Internal Drainage Board and Yorkshire Water, whilst at the same time maximising the extent of the sewerage system capable of adoption, thus providing a major milestone for HDC on the path to site development.

*Sustainable drainage system
allows industrial park development to proceed*



Facts and Figures

Project
Industrial Park Drainage System

Client
Hambleton District Council

Location
Northallerton, North Yorkshire, UK

Capital Project Value
£300k

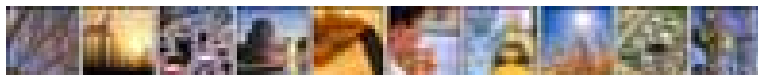
Entec Services

- Feasibility study
- Detailed design
- Preparation of contract documentation
- Site investigation, specification and supervision
- Geotechnical analysis of embankment
- Third party agreements



Sample client list

Miller Homes
Hambleton District Council
West Lancashire District Council
Nottingham City Council
Countryside Properties
West Lothian Council



Entec

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