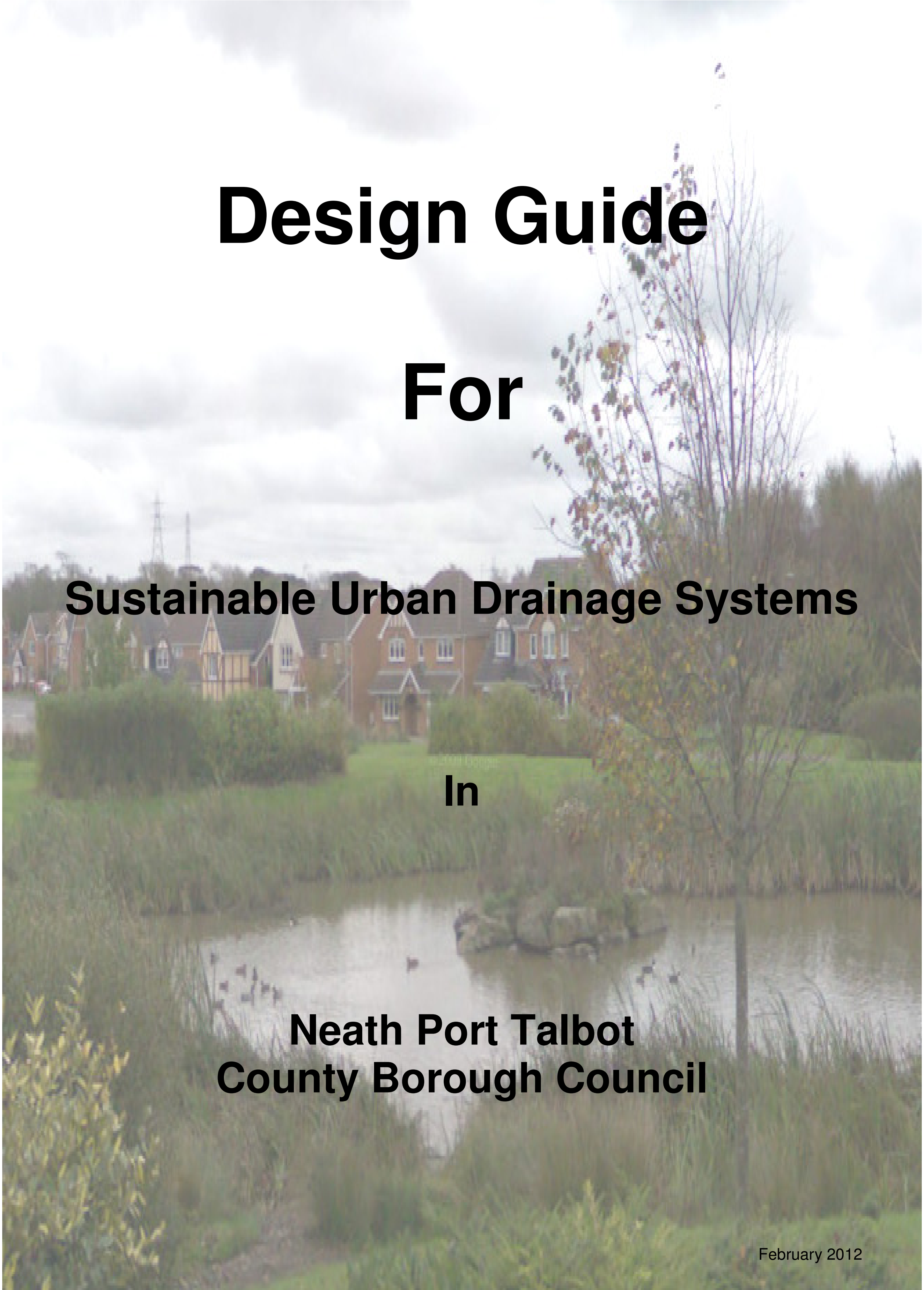


Design Guide

For

Sustainable Urban Drainage Systems

In

Neath Port Talbot
County Borough Council

February 2012

Contents **Page No.**

DESIGN GUIDE FOR SUDS

Foreword

Neath Port Talbot County Borough Council shall be encouraging the utilisation of Sustainable Urban Drainage Systems (SUDS), for new developments as they can play a large part in shaping high quality neighbourhoods, creating nature conservation, and landscape and amenity benefits. This would present opportunities for leisure, play and education within open spaces.

It will give an opportunity to assist the ecology of an area as evidence has shown that wildlife thrives in well designed SUDS and is significant in dealing with landscape and drainage issues. Together with this they can deliver a cost effective drainage method that can be applied to a wide range of development types and contribute to the protection and enhancement of ground water quality.

This Design and Adoption Guide will provide developers with the necessary information required to meet our adoption standards, in providing a cost effective drainage method that can be applied to a wide range of development types and contribute to the protection and enhancement of ground water quality.

This publication is not intended to provide legal advice or any other professional or technical service, and whilst every effort has been made by Neath Port Talbot County Borough Council to ensure its accuracy and completeness, no liability or responsibility of any kind (including liability for negligence) can be accepted by Neath Port Talbot County Borough Council to any person or entity for any loss or damage arising from its use. Readers of this guide are reminded that they are responsible for observing the technical and regulatory standards relevant to their project and for the appropriate application of this document to such projects.

The information contained in this design guide has been based on information in The Cambridge Sustainable Urban Drainage Design Guide and Information from Oxfordshire County Council Design Criteria.

The drafting of these standards have been undertaken by David Adlam of Neath Port Talbot County Borough Council.

Introduction

Latest research has demonstrated that there are many benefits to the use of SUDS for development sites which will have to be incorporated into new developments due to the new Flood and Water Management Act 2010. Successful schemes should look to deliver the following:

Community Benefits
Enhance Quality of Life
Improve Biodiversity
Reduce the Risks of Flooding to Residents
Greater resistance to the impacts of Climate Change

The use of SUDS will ensure that nearby watercourses will not suffer any detrimental effects on water quality from any new development discharges into them.

The Authority will be responsible in ensuring all SUDS features within a system are maintained in accordance with the criteria set on page 10 and remain effective throughout the life of the development. This is in keeping with the Flood and Water Management Act 2010 with the approaching set up of SUDS Approving Bodies, (SABs).

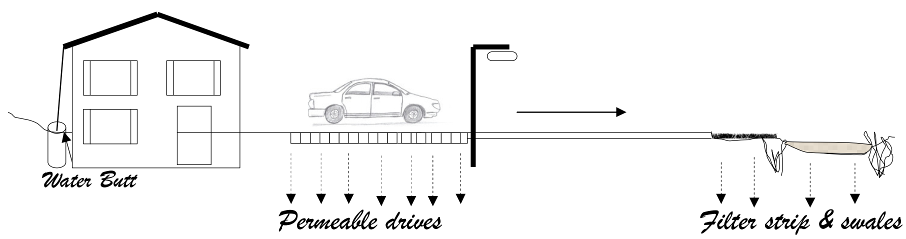
This guide will be reviewed regularly and updated in line with advice and guidance published by the Welsh Government. It will also reflect local policies ENV11 and ENV12 of the Neath Port Talbot County Borough Council Unitary Development Plan 2008, and any subsequent policies within the Local development Plan requiring the use of SUDS on new developments, available at www.npt.gov.uk. Based on this proposals for developments will be resisted unless they have taken reasonable steps to ensure that surface water run off is controlled and treated as near to source as possible through the use of accepted SUDS.

Purpose of this Guide

This guide is intended for use by developers or their consultants to produce a SUDS scheme that can be adopted by Neath Port Talbot County Borough Council (NPTCBC) conforming with the Flood and Water Management Act 2010.

Information relating to the design and adoption requirements, that Neath Port Talbot County Borough Council are contained within this guide, to ensure an effective scheme is submitted for adoption.

Presently this guide does not have any formal planning status under either the Neath Port Talbot adopted Unitary Development Plan 2008 or emerging Local Development Plan, but will be processed through the consultation process to gain Supplementary Planning Guidance status.



Source Control Management close to where the rain falls

What are Sustainable Drainage Systems?

In well designed SUDS there are a number of different features provided in sequence, known as the management train. This is an approach to managing rainfall from hard surfaces without using traditional positive drainage methods. The features that can be used are more natural such as ponds, wetlands and shallow ditches called swales. Hard engineered elements can be used in high density areas such as commercial and industrial developments. These include the use of permeable paving, canals, treatment channels, attenuation storage and soakaways.

It is important to understand that SUDS should mimic the natural drainage of a site prior to development. The principle of this is achieved through the capturing of rainfall, allowing it to evaporate or soak into the ground as much as possible where it falls. The rest of the run off should then be conveyed to the nearest watercourse through a series of treatment stages and released at the same rate and volume as prior to the development. Through this process pollutants such as metals and hydrocarbons from roads and car parks should be reduced, presenting cleaner water entering a watercourse reducing harm to wildlife habitats.

SUDS are seen as a means to control surface water which provide a valuable amenity asset for local residents and new habitats for wildlife. They generally replace traditional underground, piped systems at street level, and problems that occur they are more easily identified than with a conventional system and normally cheaper to rectify.

With the increase of rainfall events SUDS are becoming more important in the control of surface water, and providing benefits such as passive cooling.

All SUDS schemes should ensure that they are of high quality and that they reduce flood risk. They should be easy to maintain and maximise amenity, landscape and bio-diversity potential. The schemes are to be based on current best practice design guidance and practical experience from around the country, and emerging guidance from the Welsh Government and Defra. Technical design guidance should be formed on the basis of organisations such as British Standards, CIRIA and Interpave.

The Environment Agency and the County Borough Council place the responsibility of ensuring a scheme is designed to their requirements on the designer.

There are a number of benefits in the use of SUDs namely

- It reduces the risk of surface water flooding and related sewer surcharging through the provision of on site storage.
- It improves water quality.
- Enhances the quality and attractiveness of the public realm.
- It can enhance biodiversity.
- Offers natural techniques for irrigation of landscapes.
- Provides clean water for re-use, rainwater butts, rainwater recycling for toilets.
- Reduces capital and maintenance costs against conventional drainage systems.
- Store or safely pass run off water.
- Ensure natural flow of water from a site is maintained into an existing water course.

Who Will Use this Guide?

This guide is mainly for developers but also will include the following:

Highway Engineers
Drainage Engineers
Landscape Designers
Architect & Urban Designers
County Borough Council Maintenance Team

Adoption Process

This process will follow the same as the SUDS Manual (CIRCA C697) for the design of SUDS. The table below sets out the adoption process.

Planning Stage		**Development Process/ Required Information (from the SUDS Manual)**	**Drainage Design Process (from the SUDS Manual)**	**Adoption Process**
Pre application discussions and submission of FULL Application	Pre application discussions and submission of outline application	Submission of a drainage strategy in line with TAN15. Identification of likely SUDS methods to satisfy planning policy	Conceptual drainage design flow routes through the site and storage locations. Outline drainage design and drainage impact assessment. Demonstrate storage areas and volumes, conveyance routes and controls	Initial consultation with Neath Port Talbot Council on adoption – locations and design requirements
Negotiation of Full submission and Section 106 discussions	Negotitaion of Outline submission and Section 106 discussions	Submission of any amendments (if necessary)	Submission of any Amendments (if necessary)	Agreement with the County Borough Council of outline drainage design and agreement to adopt in principle (or option to adopt in principle)
	Outline permission granted and Section 106 agreed			
	Design coding	Principles of the detailed design agreed site wide	Principles of the detailed design agreed site wide	Agreement with the County Borough Council that the detailed design is compliant with adoption guide and S106 agreement
	Reserved matters applications	Detailed plans in line with agreed design code	Final submitted design with location and size, depth, etc. compliant with approved details	Submitted design compliant with adoption guide
Full approval/ S106 approval	Reserved matters approval			
Construction of development	Construction of development	Discharge outstanding conditions	Construction of drainage system	Verification for construction to agreed design and specification
Formal adoption of SUDS and monies paid to the Council as per the trigger/amount agreed in the S106				

Adoption Model

The County Borough Council will normally adopt SUDS that are located within the public highway and public open spaces.

SUDS within private property will not be adopted, but will require source control features within the curtilage of the property, which will be the responsibility of the house holder.

The adoption model is shown in the table below:-

Type			
SUDS in open spaces	Ponds and wetlands. Infiltration and retention basins Filter strips Swales Rain gardens (bio retention) Filter drains Canal and rills	Public Open Space	Will be adopted by NPTCBC in public open spaces being adopted by NPTCBC
SUDS in roads	Filter strips Swales Bio-retention Filter drains Canals and rills Cellular Storage	Roads	Adoption route must be identified as part of management train. Will be adopted by NPTCBC
Private SUDS	Green roofs Permeable driveway and parking Soak-away Geo-cellular storage combined with rain water harvesting	With boundaries of private properties	Located in privately owned land not to be adopted by NPTCBC

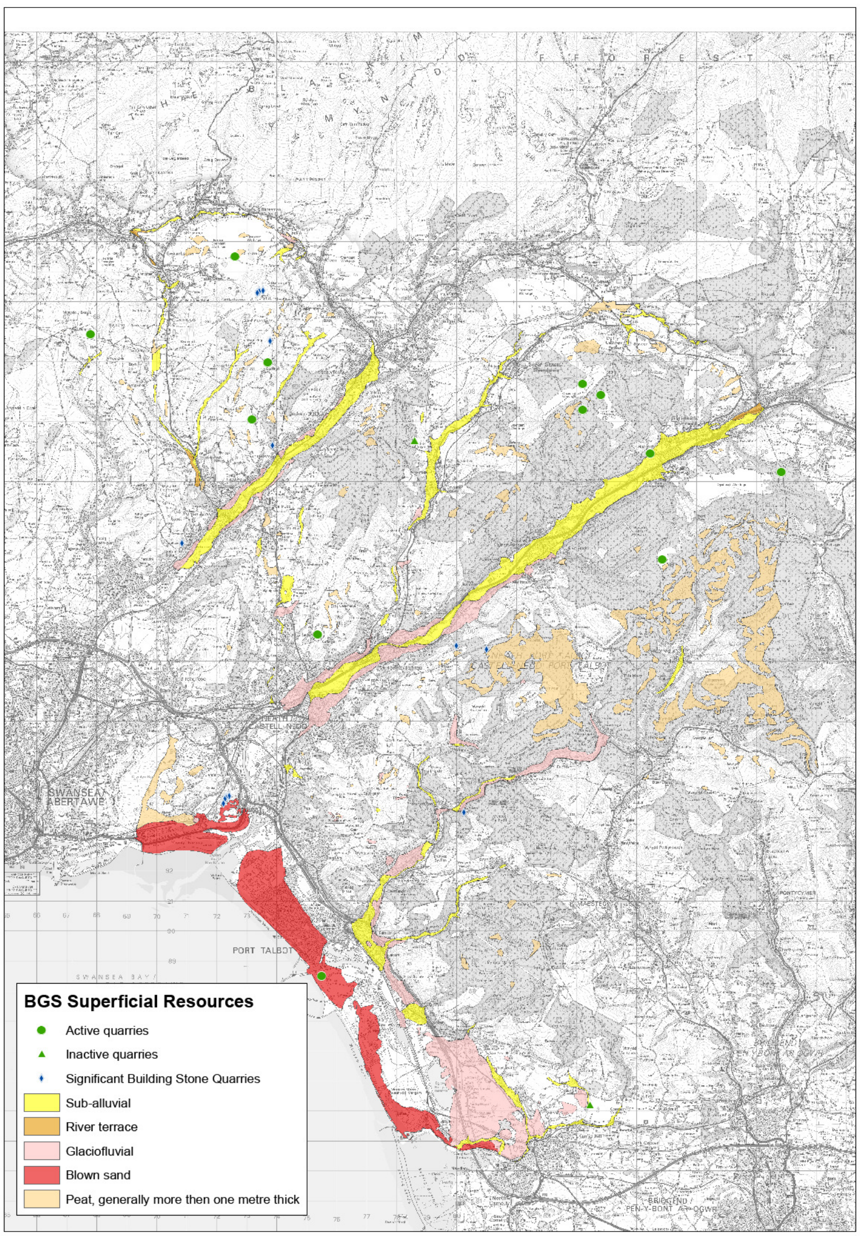
Whether the SUDS system is to be adopted or not it will still need approval by this Authority.

<u>Specific Constraints to the County Borough of Neath Port Talbot</u>

Sites should be evaluated on their own merits by undertaking comprehensive testing to BS 5930: 1999, Code of Practice for investigations, including infiltration testing and ground water level monitoring. This is to identify opportunities for infiltration.

Where clay soils prevent the use of a infiltration solution other SUDS feature such as ponds, wetlands and swales can be used (unlined swales will allow some water to soak in but should not be included in any drainage design calculations.).

(A Map of Geology of NPTCBC)



Landscape and Nature Conservation Consideration for SUDS

The main criteria of any SUDS scheme are to provide effective drainage and increase water quality. This may result in some common landscape and ecological design requirements being adopted to suit the SUDS flower rich vegetation being sacrificed for robust grass surfaces that resist erosion in the first instance.

Common practises in landscape design can be modified for SUDS:

- Lowering adjacent surfaces to hard surfaces and dished where possible to minimise excessive volumes of silt washing onto permeable surfaces.

- Grass edges to be 20 to 25mm below the edge of the hard surface, when grass is cut to a height of 50 to 100mm.

- Where sides of slopes of SUDS are to be vegetated features should have a maximum gradient of 1:3 to avoid soil slippage to ensure the establishment of vegetation.

- The excessive tracking of sub-soils and top-soils should be avoided to prevent compaction and roots not being able to penetrate soil producing anaerobic soil conditions.

- Where drainage systems are to be planted the area of grass or dense ground cover is preferable without the use of mulch. Consideration should be given to the surrounding area or urban character when selecting plant species. Look at what would be appropriate in high or low density areas.

- The SUDS designer should liaise with biodiversity when making a choice of plant as within a swale for example the soil/moisture profile at the top of the bank (very dry) is different to the bottom of the bank (very wet). The use of SUDS should look to create new habitats enhancing nature conservation and amenity space.

- A minimum of 50mm topsoil blinding should be used on wildflower areas adjacent to SUDS and 100 - 150mm topsoil used on vegetated SUDS features.

- Planting areas should avoid the use of fertilisers, herbicide or other chemical applications which can cause pollution.

SUDS in High Density Developments

Where there is limited space for landscape features within high density housing developments or commercial and industrial developments SUDS features might take the form of permeable pavements or treatment channels. Where buildings have flat or gently sloping roofs, living roofs (green roofs) could be used as a feature for both green and brown field sites. Further information on this can be attained on http://www.npt.gov.uk/default.aspx?page=5749

Legislation and Guidance

Flood and Water Management Act 2010 will in the near future commence with SUDS being mandatory in the formation of Sustainable Urban Drainage Approving Bodies (SAB's).

Currently Building Regulations Part H, Drainage and Waste Disposal, states that infiltration should be the first considered option for rainwater disposal. Failing this discharge should be into a watercourse, with discharge into a sewer being last resort, where any other forms are not practicable.

Technical Advice Note 15 promotes the use of SUDS in all developments, and should deal with both water quantity and quality. Also Policy ENV11 and ENV12 of the Neath Port Talbot County Borough Council Unitary Development Plan 2008 require the use of SUDS on new developments. This supports Planning Policy Wales Edition 4 2011 which promotes the use of SUDS and delivering sustainable developments.

Any culverting or works affecting the flow of a watercourse or drainage ditch requires prior written consent of NPTCBC under the terms of the Land Drainage Act 1991/Water Resources Act 1991. The Environment Agency and NPTCBC usually do not permit the culverting of a watercourse or drainage ditch unless as means of access.

The main design of SUDS systems will be affected by the Flood and Water Management Act 2010 and the emerging design guidance associated with this.

Existing culverts on a site shall be subject to a 3m easement either side from the centreline of the culvert pipe which shall preclude and part of any building being constructed within this area.

Principles of Adoption

These follow four key principles:-

1. Performance	-	Reduce flood risk Improve water quality Delivery bio-diversity benefits Provide amenity for residents
2. High Quality Design	-	Micro managed bespoke design Integration with wider landscape setting Use of robust, low impact materials Designed to be attractive all year round
3. Ease of Maintenance	-	Simple surface features Minimum use of grills and other engineering features Shallow gradients Appropriate planting for ease of maintenance Enhance bio-diversity unless erosion prevention is a priority. This would acceptable where all means of controlling erosion through biodiversity techniques cannot be incorporated.
4. Integrated Approach	-	Identifiable feature and risks Shallow gradients Barriers created using planting and design

In the design of SUDS other important considerations are:

- The SUDS management train
- Source control
- Consideration of drainage exceedance

Key Stages in Designing SUDS

1. **Identifying flow routes through the site**.

   An assessment shall be undertaken of the natural drainage of the site and how this will be changed by the development. The modification of a route will be determined by the topography and geology combined with the historical drainage measures that have taken place on a site such as land drainage, culverts and the sewer network. A framework should be created for appropriate SUDS techniques to collect, clean and store runoff (management train) before discharging to a water course. Flow routes should be identified to provide corridors for day to day low flows, overflows when surcharges occur and when there is exceptional rainfall, exceedance pathways shall be identified to deal with over whelmed SUDS features.

   Three levels of runoff destination should be followed.
   Level 1 – filtration
   Level 2 – watercourse
   Level 3 – existing sewer

   Level 1 should be sought first. Level 2 should be accepted when failure to attain the necessary filtration level and connection to an existing sewer is a last resort and should not be used as a cost saving option.

2. **Sub-catchment identification**

   On larger sites sub-catchments can be designated on the identification of flow routes. They will deal with their own rainfall with appropriate treatment stages, first flush volume and separate flow controls. When there are large volumes of clean water due to bigger storms they may bypass controls to reach further structures down the management train.

3. **Building up the design**

   a. Flow pattern determined.
   b. Sub-catchments established.
   c. Select best suited SUDs features to conditions.
   d. Agree design criteria for quantity, quality and amenity for SUDS scheme.

Major components should be looked at first e.g. roofs, pedestrian areas, car parking for drainage opportunities. Each surface considered for appropriate SUDs solution e.g. green roofs, permeable paving and soft landscaping areas. Once assessed in performing a drainage function each component can be linked by surface conveyance methods such as rills, channels, linear wetland channels or other surface features. On small site it may not be possible to establish flow routes and sub-catchment areas.

Soil Types

Soil	1	2	3	4	5
SPR	0.1	0.3	0.37	0.47	0.53

The SPR is Soil Percentage Runoff attached to W.R.A.P.

The W.R.A.P. soil classifications are defined as follows:

1 (i) Well drained permeable sandy or loamy soils and shallower analogues over highly permeable limestone, chalk, sandstone or related drifts.
(ii) Earthy peat soils drained by dikes and pumps
(iii) Less permeable loamy over clayey soils on plateaux adjacent to very permeable soils in valleys.

2 (i) Very permeable soils with shallow ground-water
(ii) Permeable soils over rock or fragipan, commonly on slopes in western Britain associated with smaller areas of less permeable wet soils
(iii) Moderately permeable soils, some with slowly permeable sub-soils

3 (i) Relatively impermeable soils in boulder and sedimentary clays, and in alluvium, especially in eastern England
(ii) Permeable soils with shallow ground-water in low lying areas
(iii) Mixed areas of permeable and impermeable soils, in approximately equal proportions

4 Clayey, or loamy over clayey soils with an impermeable layer at shallow depth

5 Soils of the wet uplands, (i) with peaty or humose surface horizons and impermeable layers at shallow depth, (ii) deep raw peat associated with gentle upland slopes or basin sites, (iii) bare rock cliffs and (iv) shallow, permeable rocky soils on steep slopes

Ponds and Wetlands

Ponds and wetlands provide important benefits both environmentally and in the control of water. They should be designed to allow water levels within them to rise during rainfall events providing temporary storage. They are useful in assisting the removal of pollution from surface water run-off. Ponds can accommodate greater storage than wetlands, whereas wetlands have better pollution treatment and take up less land use and can be designed as multiple smaller features.

How they Work

Ponds and wetlands provide a final removal of any remaining pollution, by creating a slow flow of water through a pond over an extended period of time, known as residence time.

The greater the ponds the slower the water flow allowing silt to drop to the bottom of the pond allowing vegetation and other organisms to remove pollution.

By keeping the permanent water shallow allows oxygen to reach the bottom of the pond allowing the bio-degradation of oils by natural organisms in the ponds.

Specific Design Considerations

The form of ponds and wetlands depends on the topography and ground/soil conditions together with its orientation and proximity to other landscape feature or buildings.

In green areas they should have soft edges and forms that flow into the surrounding area. Hard edges and straight lines can be used in hard urban landscapes.

Ponds and wetlands should be overlooked by housing and not hidden and form small natural features. Ponds should have varying depths and should include deep (1m) over wintering areas as refuge for wildlife during severe winters.

Requirements for artificial lighting within a development site should be located away from ponds and wetlands to avoid its effect on foraging bats.

The retention of native trees and vegetation and should accord with BS5837:2005.

Careful consideration should be taken to avoid placing ponds or wetlands adjacent to a road unless designated routes for wildlife to bypass the road are provided.

Where resting birds or waterfowl are to be supported, islands should be at least 3m clear of any bank.

Planting

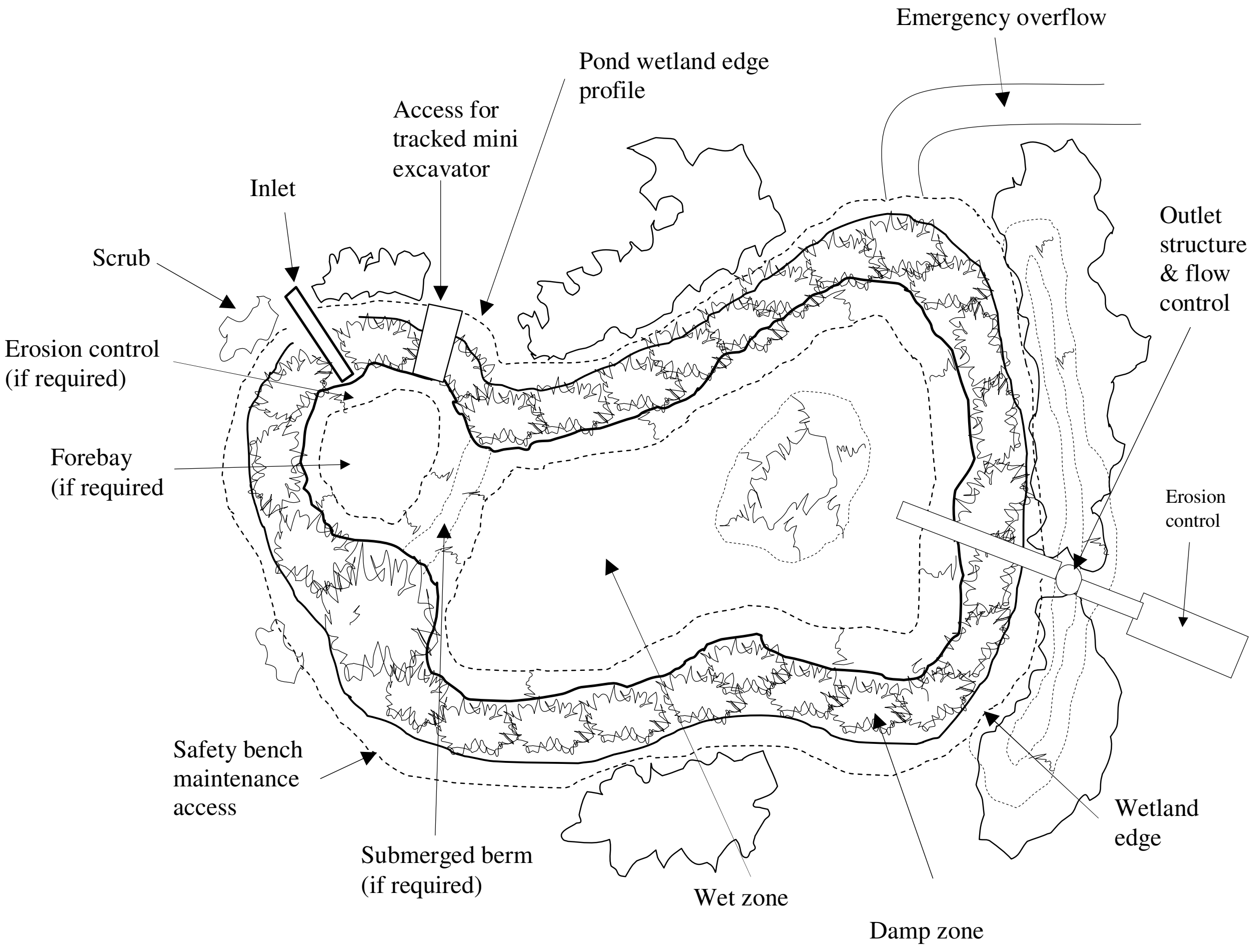
Any planting undertaken to enhance bio-diversity must ensure there is no conflict with the SUDS operation of the pond or wetland.

With regard to the species mix advice can be found on page 24 together with advice from the Authority's biodiversity web-pages or unit. All planting should be native and ideally of local provenance and no plants listed under Schedule 9 of the Wildlife and Countryside Act 1981 (as amended) are included. Good construction practice is essential to overcome problems that have occurred through lack of attention to detail during design and construction. CIRIA publication C698, Site Handbook for the Construction of SUDS contains practicable construction help and advice.

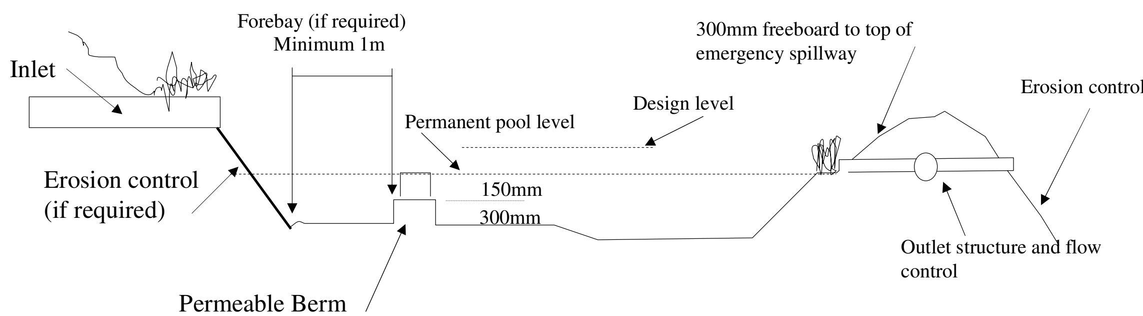
Practical Issues and Solutions	
Problem: Silt build up during construction.	**Solution:** Manage construction runoff and prevent it entering the pond by using straw bales or geotextile traps. If the pond is used to control construction runoff remove silt at end of project.
Problem: Erosion during construction before planting is established.	**Solution:** The easiest solution is to reuse topsoil without any application of weed killer. This allows existing vegetation in the topsoil to establish quickly. Another alternative is to use biodegradable erosion control mats.
Problem: Water is not retained in the pond.	**Solution:** Ensure that soils below the pond are suitable to retain water. If not provide a clay subsoil that is compacted correctly over

	base of pond or use a liner.
Problem: Pond liner exposed around edges of pond or wetland.	**Solution:** Correct detailing and construction to ensure that liner has sufficient cover of stable soil at the edges (300mm minimum) and slopes do not exceed a gradient of 1:3; steeper slopes would encourage soil slippage.
Problem: Erosion at inlets. This is almost always a sign that source control is not provide upstream.	**Solution:** Water flows into ponds and wetlands should normally be at low rates because surface control has been provided upstream. The Council will not adopt ponds or wetlands that do not have source control provision upstream.
Problem: Poor establishment of marginal plants due to over compaction of slide slopes and anaerobic conditions.	**Solution:** Correct construction to avoid excessive tracking of machinery. Sub-soils should be ripped prior to top-soils being placed above.

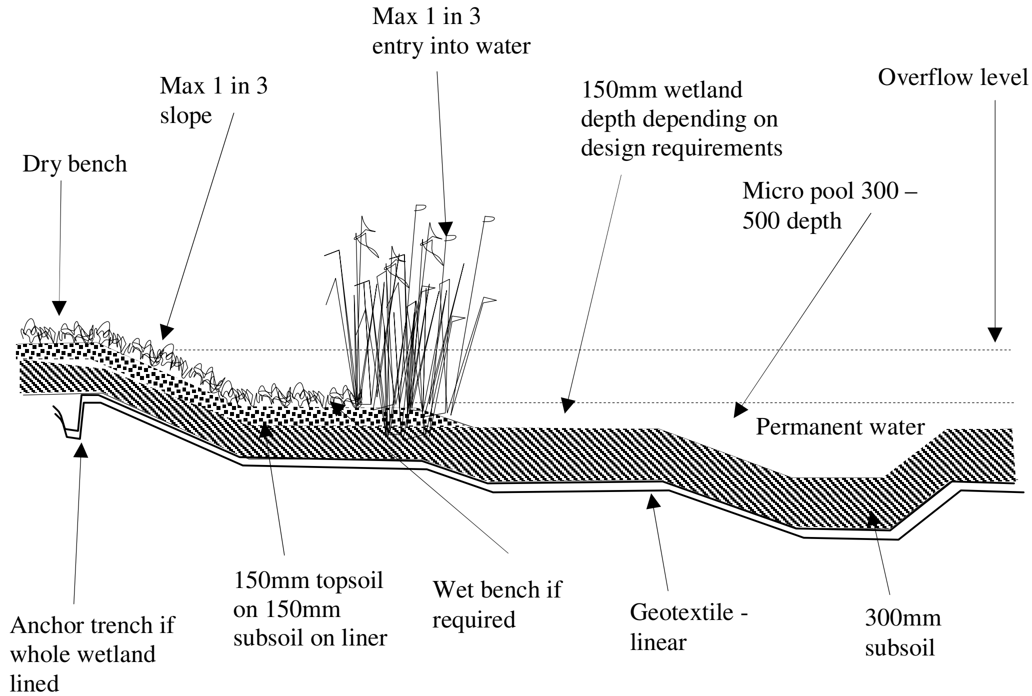
Pond/wetland diagram



Sections



(Woods-Ballard et al 2007)



Specification

- Should be designed to have a permanent volume of water.
- A sedimentation forebay or pre-treatment is required.
- A permeable berm to trap incoming sediment is required for forebays.
- A 150mm head of water at permanent level should be above a berm.
- Length to width ratio of a pond to be between 3:1 and 5:1.
- Vegetation around pond is required to limit accessibility to the public.
- All in/out structures should have easy access.
- Maximum variation in water depth 450mm.
- The size of ponds should be able to hold at least 1:100 year event +30% climate change.
- An outlet control which does not allow the accumulation of debris should be used to limited discharges to Greenfield runoff.
- Signs for health and safety and education should be erected on site.
- A 300mm freeboard should be incorporated for the design event.

Construction

- An emergency spillway is required.
- At in/outflow structures an erosion control is required.
- Around the pond a safety bench is required, >3.5m at 1:15.

- Where there is high ground water vulnerability or inflow are highly polluted a liner should be used.
- To prevent human entrance pipes should be sized <600mm or use an appropriate grill.

Maintenance Requirements

- To ensure maintenance can be undertaken of all in/outflow structures, spillways, pre-treatments and forebays easy access shall be made from the Highway.
- Grass cutting and litter removal to be undertaken monthly.
- Sediment removal should be undertaken from forebay, pre-treatment structures together with the inspection of flow control structures and vegetation removal/cut back on an annual basis.
- Repair to flow structures, aeration of pond, erosion repair and sediment removal from pond shall be undertaken as required.

Maintenance work such as silt or vegetation removal should be undertaken during September or November to minimise the impact on wildlife.

Only 25% to 30% of the pond area on one occasion each year to be carried out to remove any silt or vegetation, to minimise the pact on bio-diversity.

The design of ponds and wetlands should be carried out to avoid the need of special machinery for future maintenance.

Further Information

All details based on Woods-Ballard et al 2007. Chapter 17, 17-1 to 17-14.

Planting List for SUDS Ponds/Wetlands

Aquatics – submerged and floating, plant with weights, in permanently wet zone, equate to National Vegetation Communities, and group A11. *Potamogeton crispus* (curled pond weed). *Pontamogeton natans* (broad – leaved pond weed). *Myriophyllum spicatum* (spiked water-milfoil) *Sparganium emersum* (unbranched bur-reed). *Ranunculus aquatilis* (common water-crowfoot). *Potamogeton berchtoldii* (small pondweed).	**Wet zone –** emergents, plant in 0-250mm of water, as plugs in groups of 5-10Nr. plants to create stands. *Sparganium erectum* (branched bur-reed) *Typha angustifolia* (lesser bulrush) *Schoenoplectus lacustris* (common clubrush) *Iris pseudacorus* (yellow flag iris) *Glyceria fluitans* (floating sweet-grass) *Carex acutiformis* (lesser pond sedge) *Alisma plantago-aquatica* (water-plantain) *Glyceria maxima* (reed sweet-grass(*Veronica scutellata* (marsh speedwell)
Damp Zone – inundation-tolerant, plant up to 250mm above anticipated normal water level as plugs in groups of 5-10Nr plants to create stands. *Persicaria amphibia* (amphibious bistort) *Caltha palustris* (marsh marigold) *Phalaris arundinacea* (reed canary grass) *Veronica beccabunga* (brookline) *Angelica sylvestris* (wild angelica) *Lythrum salicaria* (purple loosestrife) *Lotus pendunculatus* (greater bird's-foot trefoil) *Lycopus europaeus* (gypsywort) *Myosotis scorpiodes* (water forget-me-not) *Apium nodiflorum* (fool's-water-cress) *Lychnis flos-cuculi* (ragged robin)	**Dry Zone –** plant on upper slopes and bank-top as seed. Seed suitable wildflower meadow/grassland mix for soil conditions. Refer to Bumblebee and Development leaflet on biodiversity web pages for some examples. http://www.npt.gov.uk/default.aspx?page=4179

Mentha aquatica (water mint) *Cardamine pratensis* (cuckoo flower) *Ranunculus flammula* (lesser spearwort) *Juncus articulatus* (jointed rush) *Carex rostrata* (bottle sedge) *Stachys palustris* (marsh woundwort) *Scrophularia auriculata* (water figwort)	

Retention and Infiltration Basins

These are areas of grass that are open, usually flat and normally dry. They can double up as play areas as they are usually flat and fill with water during heavy rainfall.

Retention basins will provide short-term storage for excess rainwater, with the shallow depression providing large areas of storage.

Infiltration basins although similar to basins the store water soaks into the ground below the basin. For this to work the soil below has to be sufficiently permeable to allow water to soak in quickly enough. To assist in areas where the soil may be marginal for infiltration then the use of trenches below the basin will enhance its drainage capability.

The use of basins will still require a source control upstream to assist in the removal of pollution from rainwater.

Neath Port Talbot Specific Design Considerations

Retention basins are suitable to be used where there is clayey soils, as generally this type of soil does not allow water to soak in, unless after a long dry period.

They shall be designed to an appropriate scale and form to suit the surrounding landscape character, with attractive landscape areas and not simply grass.

The position of retention and infiltration basins should be overlooked and not placed in an unseen area of a development.

All proposals should accord with BS5837: 2005 and the erection of small interpretation boards relating to information of the function of the basin and local fauna and flora being supported.

Planting

Landscaping requirements will take precedence over enhancing bio-diversity when planting basins and the following should be considered:-

- planting should provide a permanent ground cover to prevent bare soil from washing out of the basin

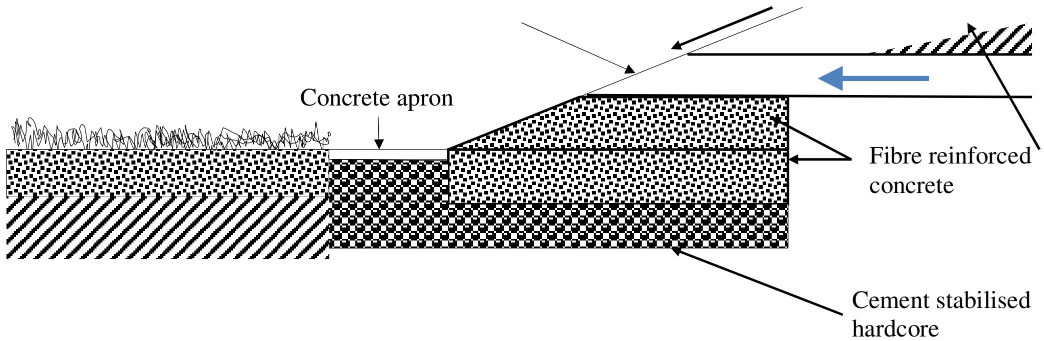
- the type of planting has to tolerate periodic cover by water up to 1m depth for up to 48 hours

- Planting used in improving ecology can make infiltration basins work more effectively as it slows down water flows keeping the soil free draining.

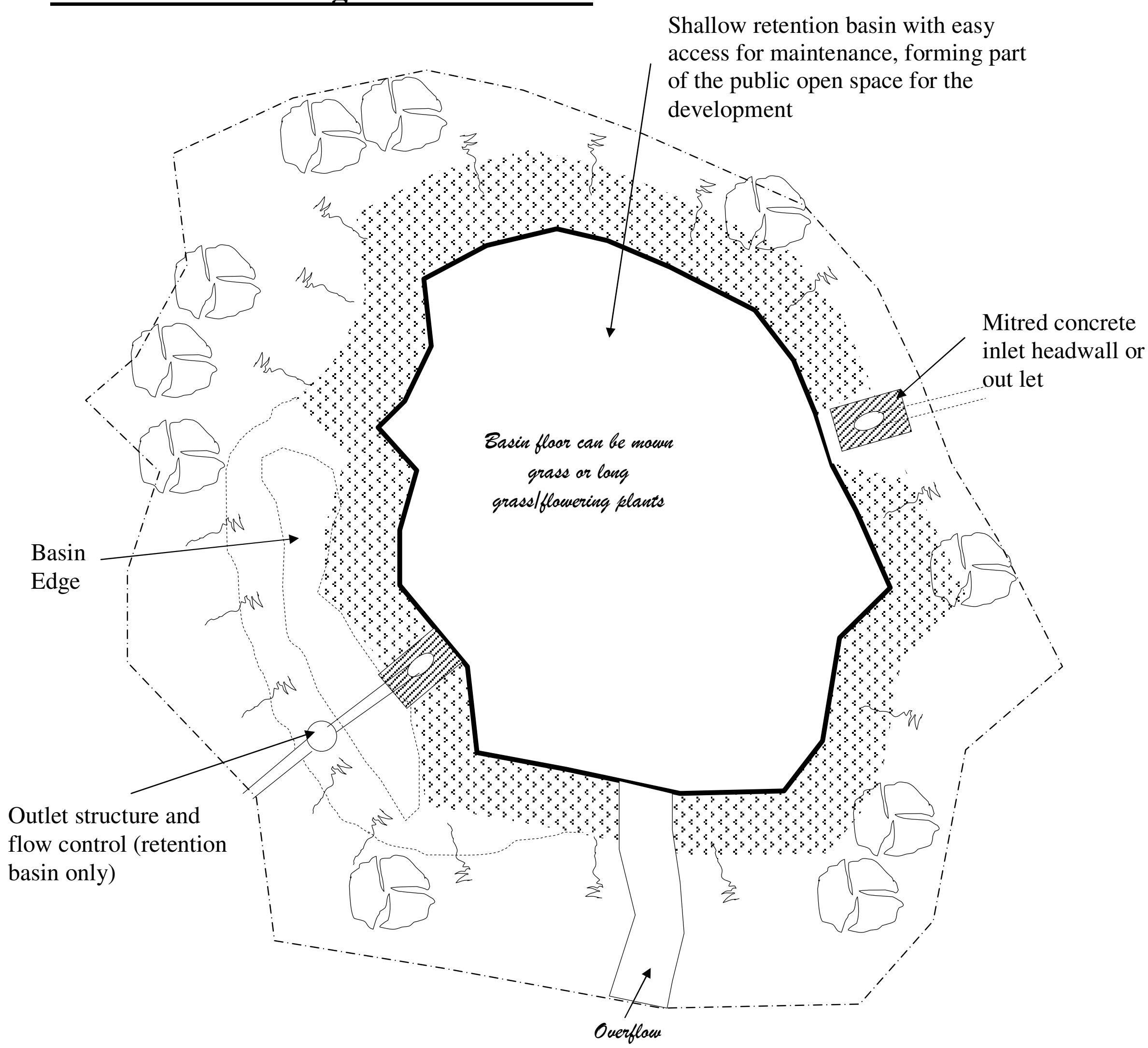
Practical Issues and Solutions

Problem: Compaction of soil in base of infiltration basing during construction, resulting in reduced infiltration rate.	**Solution:** Manage construction plant and prevent heavy plant using the basis as an access route.
Problem: Topsoil is not sufficiently permeable.	**Solution:** Use a root zone mix that has a high sand content to maximise the permeability.
Problem: Wet or boggy patches develop in base, especially close to inlets, where not expected.	**Solution:** This often occurs because the base has not been constructed to the correct levels. Use a root zone material to cover the base or a short length of infiltration trench at the inlets. The bottom of flat basins should be constructed to quite tight tolerances of 10mm level difference in 3m.
Problem: Silt build up during construction.	**Solution:** Manage construction run off and prevent it entering the basin by using straw bales or geotextile traps. If the basin is used to control construction run off remove silt at end of project.
Problem: Erosion during construction before planting is established.	**Solution:** The easiest solution is to reuse topsoil without any application of weed killer. This allows existing vegetation seed in the topsoil to establish quickly. Another alternative is to use bio-degradable erosion control mats.

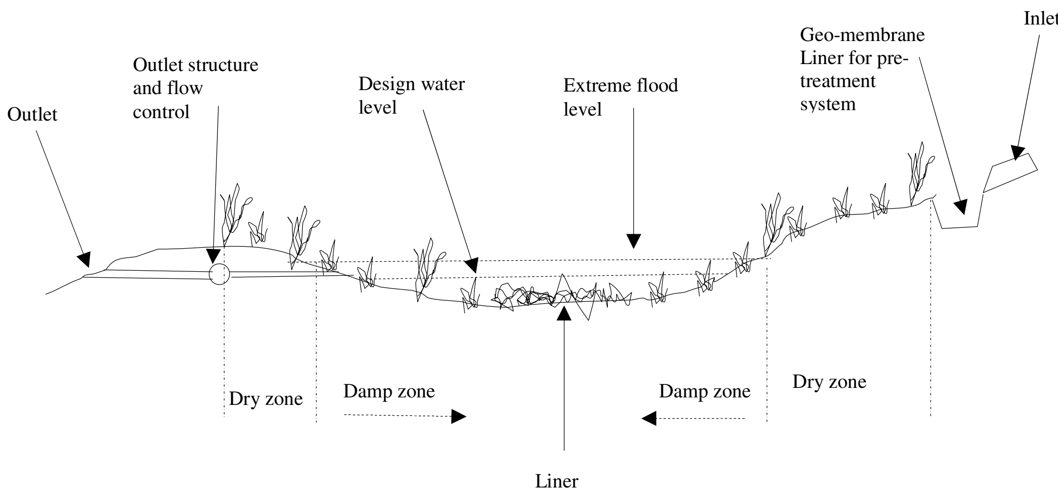
Mitred Concrete Headwall



Cross section through retention basin



Cross section through retention basin



(Woods-Ballard et al 2007)

Specification

- ❖ Pre-treatment required immediately upstream.
- ❖ Prior to siting appropriate ground surveys should be undertaken.
- ❖ A minimum infiltration rate of $1x10^{-5}$m/s.
- ❖ In areas of ground water vulnerability or high pollutants from inflows this system should not be used.
- ❖ Side slopes not to exceed 1 in 3.
- ❖ Basins should half empty in 24 hours.
- ❖ Water tolerant grass dense turf in nature should be used to reduce erosion.
- ❖ Public access should be reduced using grill at in/outlet structures.
- ❖ Dual use basins and basins near public areas should have education and health and safety boards.
- ❖ Discharge for the structures needs to be at Greenfield runoff rates unless joining another SUD structure.

Construction

- ❖ The basin floor should be as level as possible to maximise infiltration.
- ❖ Inlet and overflow points should have appropriate erosion control.
- ❖ Head walls should be constructed using natural stone.

Maintenance Requirements

- ❖ All flow structures should have easy access from the Highway.

- ❖ Grass cutting and litter removal should have easy access and undertaken as agreed.
- ❖ Once a year inspect banks and structures, remove nuisance plants, manage vegetation, reseed areas of poor growth, and remove sediment from pre-treatment, clear grilles. In addition when required:
  - o Repair erosion.
  - o Repair flow structures.
  - o Re-grade uneven areas.

Basins all relatively straight forward and should have a small amount of additional works, whereas the more intensive maintenance work like silt removal being required intermittently.

Grass cutting at the bottom of basins **should not** be carried out when wet.

Further Information
All details based on Woods-Ballard et al 2007. Chapter 15, 15-1 to 15-8

Cellular Storage

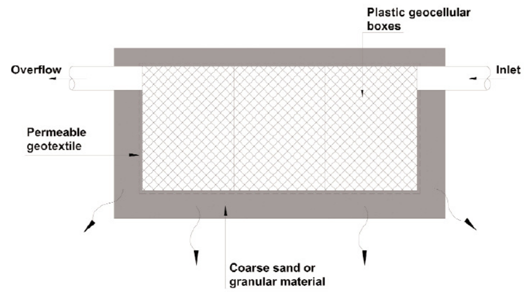
Description
These are man made prefabricated sections which are placed under ground and should contain easy access for maintenance purposes. They would either percolate into the surrounding ground or positively drain through the use of a hydro-brake.

How They Work
They are used as water storage as part of the SUDs Management Train. They can be used below a swales or filter drain or other at source treatment and to attenuate the flow of water for large catchment areas.

Neath Port Talbot Specific Design Considerations
Appropriate geotextile membrane to be selected as a result of ground survey, namely permeable or impermeable. These systems must be used in conjunction with other source treatment for water quality improvement.

Practical Issues and Solutions

Problem: Can become silted up.	**Solution;** Use products that are suitable for jetting and have silt traps built into their design, which can be easily accessed by tankers.
Problem: When life time of system has expired renewal would involve total replacement. If constructed under the highway would result in excavating large areas of highway.	**Solution:** Systems to be constructed in verge or public open space areas for ease of future maintenance.



(Woods-Ballard et al 2007)

Specification

- ❖ Must be set at least 5m from a building foundation when used for infiltration.
- ❖ To be used in areas where seasonally high water table and agreed infiltration rates allow when used for infiltration.
- ❖ Comprehensive ground surveys shall be undertaken prior to siting, testing all characteristics of the surrounding soil, (stability, water content, etc.)

Further Information
All details based on Woods-Ballard et al 2007.

Filter Drains

Description

These are gravel filled trenches that collect and move water, and through this process treat pollution. Its construction is a trench filled with free draining gravel with a perforated pipe at its bottom to collect water.

A geotextile is used just below the surface as a silt trap to prevent the gravel from clogging lower down in the trench. A small filter strip can be used as a way of preventing silt clogging the trench.

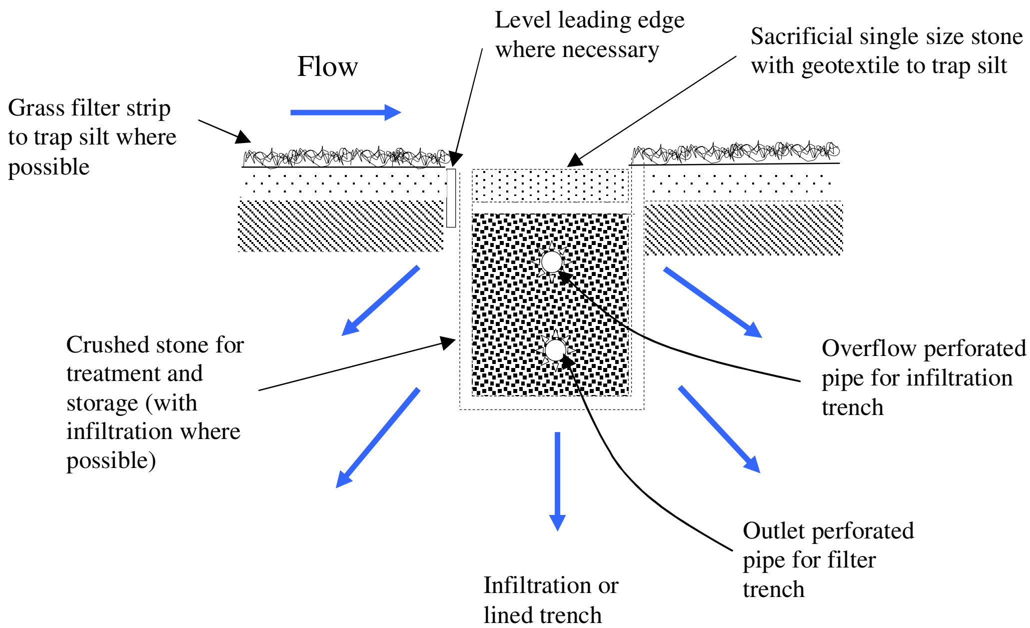
How They Work

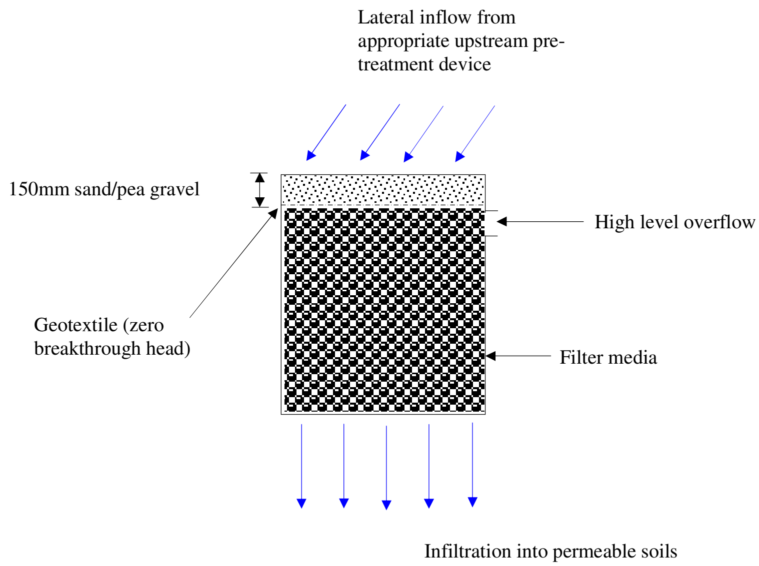
The run off of water from hard surfaces flow into the filter drain. This flows down through the gravel removing some pollution. Storage of water is attained due to the gaps between the pieces of gravel.

Neath Port Talbot Specific Design Consideration

As filter drains are an engineering feature and should be used as a last resort where no other feature will work.

Cross Section of a Filter Drain





Practical Issues and Solutions

Many problems that have occurred with filter drains are due to a lack of attention to detail during design and construction. Some of the most common pitfalls and solutions are discussed below. CIRIA publication C698: Site Handbook for the Construction of SUDS also contains practical construction help and advice.	
Problem: Using a geomembrane instead of a geotextile just below the surface (geotextiles are specified to be permeable whereas geomembranes do not allow water through).	**Solution:** Good site supervision and communication to the staff that are constructing the drain about the purpose of the different materials.
Problem: Filter drains cause problems when mowing surrounding grass if they become overgrown (the stones are thrown up and can damage mowers if they go over them).	**Solution:** Regular cutting back of grass is required to keep the surface clear and visible.
Problem: Silt build up during construction.	**Solution:** Manage construction run off and prevent it entering the filter drain by using straw bales or geotextile traps. Filter drains should not be used to control construction run off because of the high silt loads.

Filter Drain Specification

- Must be sited a minimum distance of 5m away from any foundations including carriageway.
- Ground slopes should not exceed 4% (1 in 25).
- A pre-treatment is required before water enters filter drain. (i.e. catch pit from piped system, or a filter strip when used with impermeable surface. *1) Minimum 6m wide, with suitable vegetative surface, 2) Max 1 in 20 gradient.*
- Where there is high ground water vulnerability or high pollution this type of system shall not be used.
- There are no minimum infiltration rates, however an overflow pipe shall be used when permeability is less than $1x10^{-5}$m/s and sized accordingly. A geotechnical survey must be carried out.
- All trenches shall half drain in 24 hours.
- Filter drains designed for conveyance, collector pipes when used to transfer water to an outfall, shall have perforations not exceeding 10mm and terminate 300mm before any connection.
- A freeboard of 300mm should be included above the design event depth.
- To limit the transportation of sediment into the aggregate a geotextile layer needs to be used below surface layer.
- To allow for slopes up to 10% (1 in 10) internal weirs or check dams may wish to be used.
- Discharge rates from the structure needs to be limited to Greenfield runoff rates, unless it joins with another SUD structure.

Construction

- Depth of trench to be 1m to 2m deep.
- The width of trenches to be between 450mm to 900mm.
- An appropriate aggregate with voids ratio of 0.3, (40-60mm) shall be used to fill the trench.
- The position of access points to be every 50m.
- To prevent soil piping a geotextile membrane should be used on the inside of the trench with a higher permeability than the surrounding soil.

Maintenance Schedule and Costs

Maintenance is straight forward and should be constructed in accordance with the SUDS Manual (CIRIA C697), incorporating a sacrificial geotextile close to the surface.

1) Access points for the system need to be within easy access of the Highway.
2) Routine in removing debris and litter from the surface and cutting back vegetation.
3) Annually cleanse exposed stones, remove nuisance vegetation, remove sediment from pre-treatment, inspect chambers, aerate filter strip.
4) Recondition trench, clear pipe work as required.
5) Removing and replacing the surface level of gravel once to every five or ten years.

<u>Further Information</u>

All details based on Woods-Ballard et al, 2007. Chapter 10, 10-1 to 10-10 and Chapter 8, 8-1 to 8-8.

Swales and Filter Strips

Description

Swales are channels which are shallow and used to collect and move water whilst dealing with any pollution in the surface water. They are normally covered in grass but other vegetation can be used, their construction normally involves shallow sides and flat bottoms to allow water to flow in a thick layer through the grass or other vegetation.

Filter strips are formed as gently sloping areas of grass allowing water to flow across towards a swale or filter drain. This is normally to remove any silt in the water to prevent any clogging of the swale or filter drain.

How They Work

They are a source control element of SUDS, allowing grass or vegetation to slow down water and trap some of it by allowing it to soak into the ground. Some evaporation via the plants will occur and pollution from the water will be filtered out.

Normally the swale will have a wet base, behaving similarly to a wetland. Where this is not desirable a perforated pipe and sand or gravel can be placed under the drain. A variation of this is the use of an enhanced vegetated swale and filtration which are commonly known as bio-retention areas, namely depressed landscape areas designed to collect and treat rainwater.

The use of small filter strips 1m to 2m long leading to the slope of a swale are ideal for allowing water to enter the swale.

Neath Port Talbot Specific Design Considerations

The swales profile will depend on a number of factors:

- ground levels
- topography
- ground and soil conditions
- orientation
- aspect and proximity to other landscape features, buildings, etc.

Its scale and form should suit the surrounding landscape character. In open green spaces they should have soft edges and forms that flow into the surrounding area. Within hard urban landscapes hard edges may be used. Proposals should accord with BS5837:2005, and small interpretation boards should be provided.

Planting

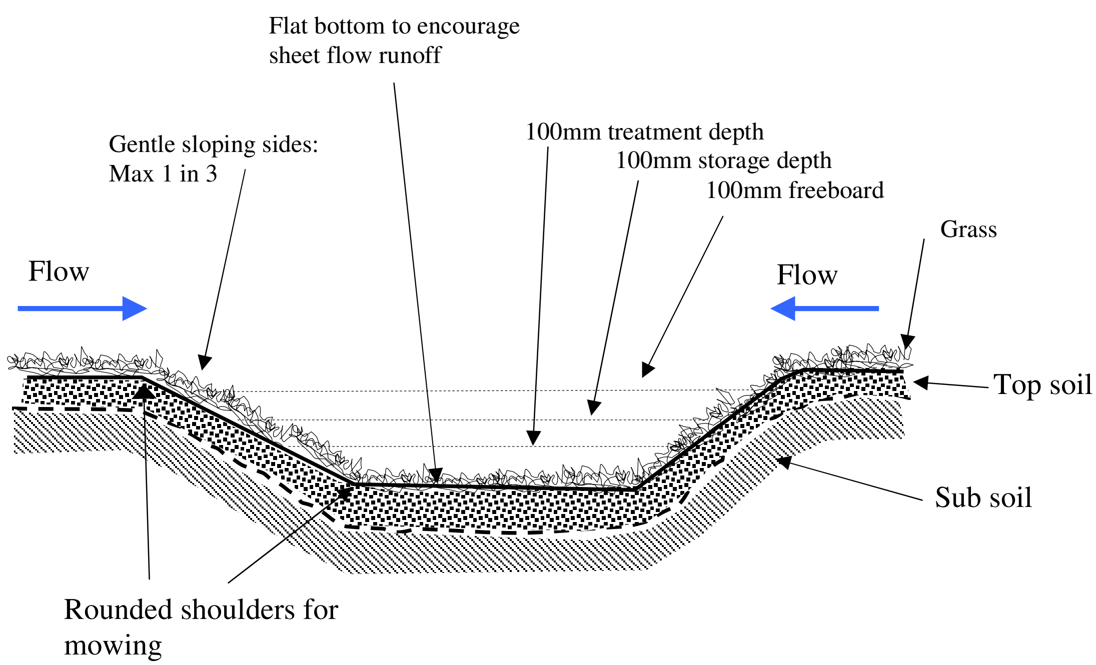
To meet bio-diversity considerations they should include:

- Links to existing wildlife corridors.
- The provision of a diverse range of planting suitable for the conditions they will be approved to as part of a SUDS swale, including varying water levels and pollution.

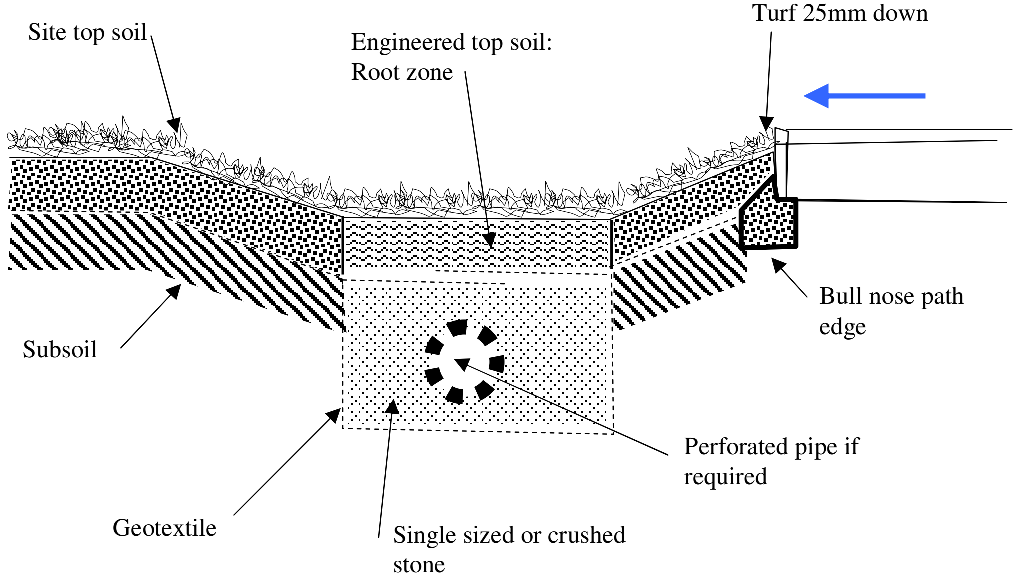
It is essential to plant in a swale or filter strip to stabilise the slopes, reduce erosion and slow water flows to aid sedimentation and nutrient take up.

It is important to establish the planting quickly and measures implemented to prevent water entering the swale until the vegetation is established.

Cross section through swale



Cross section through enhanced or dry swale with under drain



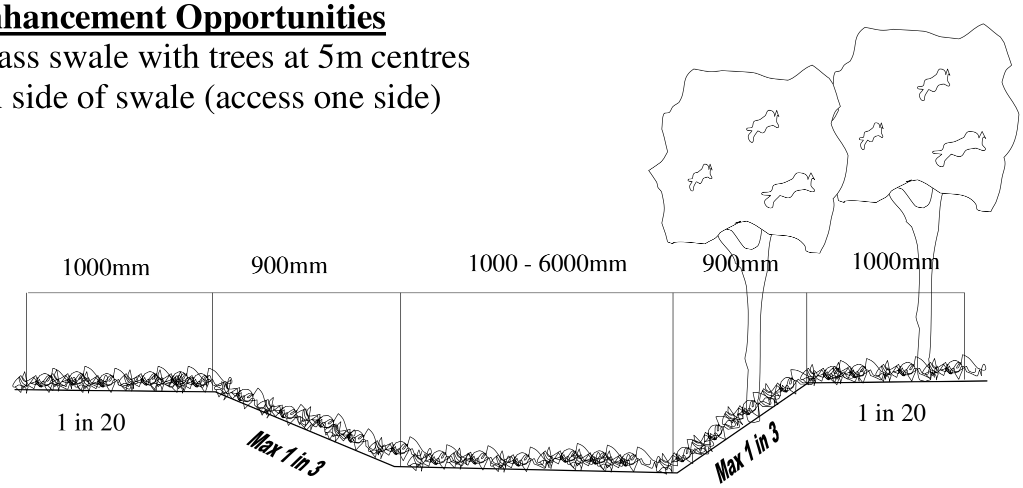
Practical Issues and Solutions

Many problems that have occurred with swales are due to a lack of attention during design and construction. Some of the most common pitfalls and solutions are discussed below. CIRIA publication C698: Site Handbook for the construction of SUDS also contains practical construction help and advice.	
Problem: Wet or boggy patches develop in base where not designed for.	**Solution:** This often occurs because the base has not been constructed to the correct levels and there may be a low point in the swale. Construct to correct levels and possibly use a root zone material to cover the base, and/or an under drain.
Problem: Silt build up during construction.	**Solution:** Manage construction runoff and prevent it entering the swale by using straw bales or geotextile traps. If the swale is used to control construction runoff remove silt at end of project.
Problem: Erosion during construction before planting is established.	**Solution**: The easiest solution is to reuse topsoil without any application of weed killer. This allows existing vegetation in the

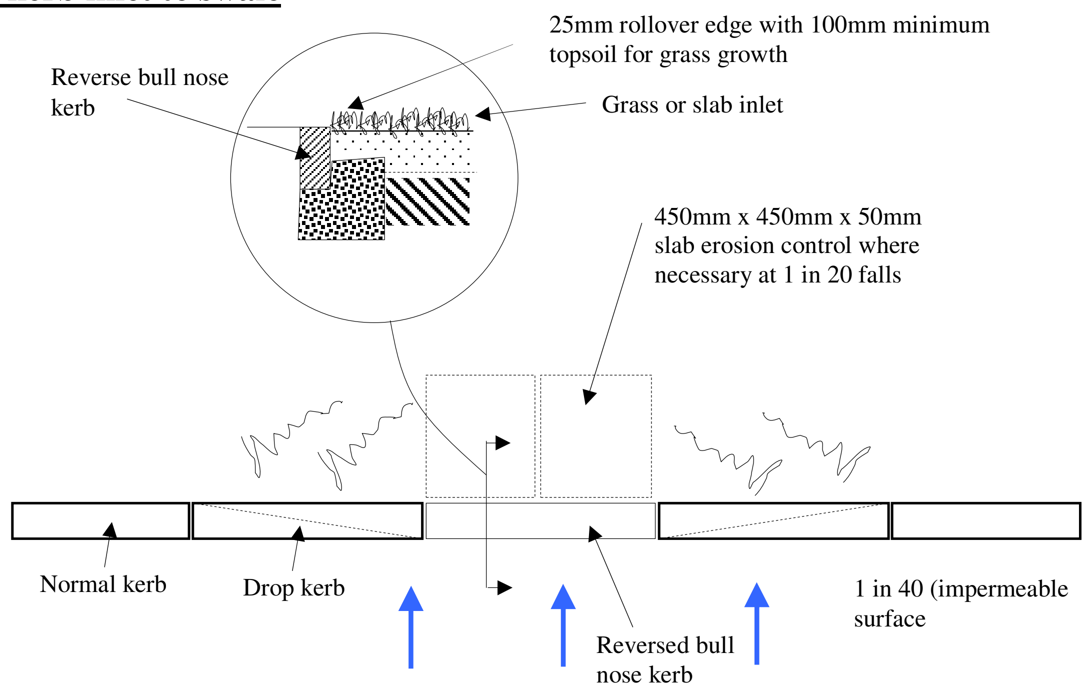
	topsoil to establish quickly. Another alternative is to use biodegradable erosion control mats or turf.
Problem: Erosion after planting is established. Occurs if the water is forming channels due to incorrect levels, or the filter strip vegetation is higher than the edge of the paved area it is draining.	**Solution:** Correct detailing and tolerances during construction. Drop from edge of hard area to filter strip or swale should be 20mm to 25mm and the tolerance on construction of a filter strip should be 10mm level difference in 3m at right angles to the water flow.
Problem: Water does not flow over edge into swale along whole length (where designed to do so) and enters via preferential route and concentrates flows and silt in one area.	**Solution:** Ensure that where over-the-edge drainage is required the grass is 20mm to 25mm below the edge of the hard surface to be drained.

Enhancement Opportunities

Grass swale with trees at 5m centres
On side of swale (access one side)



Cross kerb inlet to swale



Maintenance Requirements

Normally straight forward regarding routine maintenance, with intensive maintenance such as silt removal being required intermittently. However grass cutting should not be carried out when swale or filter strip is wet.

Further Information

All details based on Woods-Ballard et al 2007.

Inlets, Outlets and Controls

Description

There are features that limit the rate of water flow along and in and out of the system.

How They Work

They are restrictions in a pipe or other outlet that limit the rate at which water can leave the SUDS feature. During the rain storm water backs up and fills the storage area (e.g. pond, swale, basin, etc).

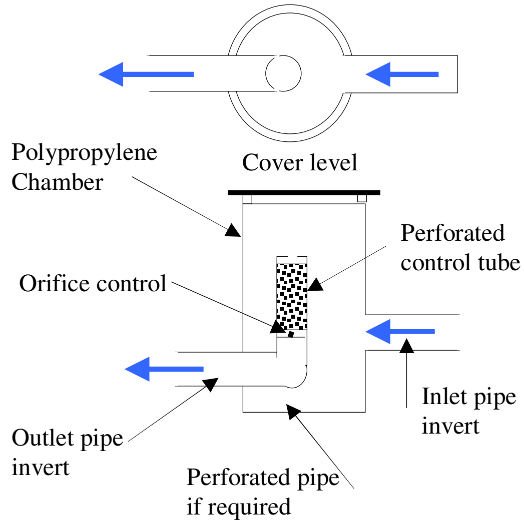
Neath Port Talbot Specific Design Considerations

Design considerations should give ease of access and maintenance for inlets, outlets and controls. These can be a simple orifice or slot weirs avoiding below ground in inspection chambers or manholes.

They help reduce the risk of erosion and the use of large erosion control features and vertical headwalls.

Outlet Control Feature

Pond/Wetland outlet structure and flow control



Specification

- To prevent blocking use a minimum opening size of 100mm.
- Upstream of an orifice and/or Hydrobrake requires pre-treatment.
- Orifices should be raised at least 150mm to reduce silt blockage.

Construction

- Depending on the nature of flow controls, they should be constructed within own chamber or behind a grille.
- Protection through the use of a T-piece, perforated riser or debris screen to minimise blockages occurring shall be used for Orifices.

Maintenance Requirements

- Monthly inspection to ensure the removal of any debris or litter.
- Remove sediment from pre-treatment; inspect condition of flow control annually.
- Repair any damage, unblock flow control as required.

Further Information

All details based on Woods-Ballard et al 2007. Chapter 19, 19-1 to 19-24

Canals, Rills and Other Channel System

Description

These are open surface water channel with hard edges. As they are engineered they can form a variety of designs and cross sections to suit the Urban Landscape, and can be planted to provide water treatment. They are in an effective way of providing SUDS in dense urban developments where space is at a premium.

How They Work

They can be used to collect water from hard surfaces and convey it, as they are simply channels that water flow along.

As treatment channels they collect water, slow it down, providing storage for silt and oil that is captured.

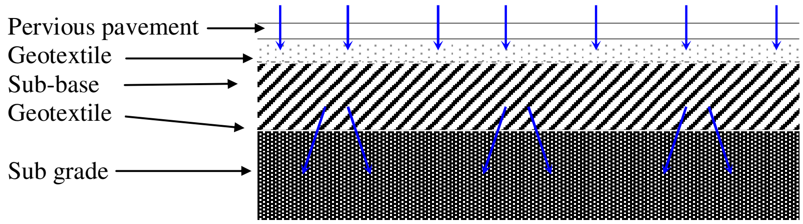
Practical Issues and Solutions

It is easy to construct canals, rills and treatment channels that meet the aspirations of the Council. However, many problems that have occurred with these systems are due to a lack of attention during design and construction. Some of the most common pitfalls and solutions are discussed below. CIRIA publication C698: Site Handbook for the Construction of SUDS also contains practical construction help and advice.	
Problem: Sparse planting in canals.	**Solution:** Good site supervision and communication to the staff and adherence to the SUDS planting specification.
Problem: Silt build up in canals often occurs due to incorrect planting of the surrounding area.	**Solution:** Planting of adjacent landscape areas should provide good ground cover and bind the soil together. Bare soil or mulch areas are not acceptable.

Maintenance Schedule

They should be constructed in accordance with The SUDS Manual making maintenance straight forward. Routine maintenance involves the removal of debris and litter, with more intensive maintenance work such as removing silt being once every 5 years.

Pervious Surfaces



(Woods-Ballard et al, 2007)

Specification

- Infiltration of the surface should be higher than the design of the rainfall intensity.
- Surrounding landscape should slope away from the paving to prevent soil and other materials from contaminating the pavement surface.
- Should an outflow not be incorporated to allow the sub base to half empty in 24 hours, soil infiltration rates need to be better than $1x10^{-5}$m/s?
- Where the water table is high, or infiltration is not desirable lined systems can be used.
- To be used in areas which have low traffic speeds of less than 20 mph, low traffic volumes and axles loads.
- Additional geotextiles membranes can be used in sensitive areas.
- To prevent sediment accumulation any surrounding soft landscaping should be at least 50mm below paving surface.
- If a pipe system is to enter the sub base, a catch pit or suitable pre-treatment should be used.
- Where there are high levels of silt loads on the surface, pervious surfaces should not be used.
- When developing on steeper sites internal dams can be used to maximise storage.
- When collector pipes are used to convey water to an outfall, perforations should not exceed 10mm in diameter and terminate 300mm before any connection.
- When joining into another SUD structure, the discharge from the previous structure shall be limited to Greenfield runoff rates.

Construction

- Depending on the surface requirements, the top surface can be block paving, gravel or turf.
- Depths of materials should be determined by the necessary ground condition surveys.

- A permeable aggregate shall be used for the sub base with void ratios of approximately 0.3, and be able to support the loadings without deformation.
- To limit the transmittal of sedimentation to the sub base a geotextile membrane should be used beneath the surface course.

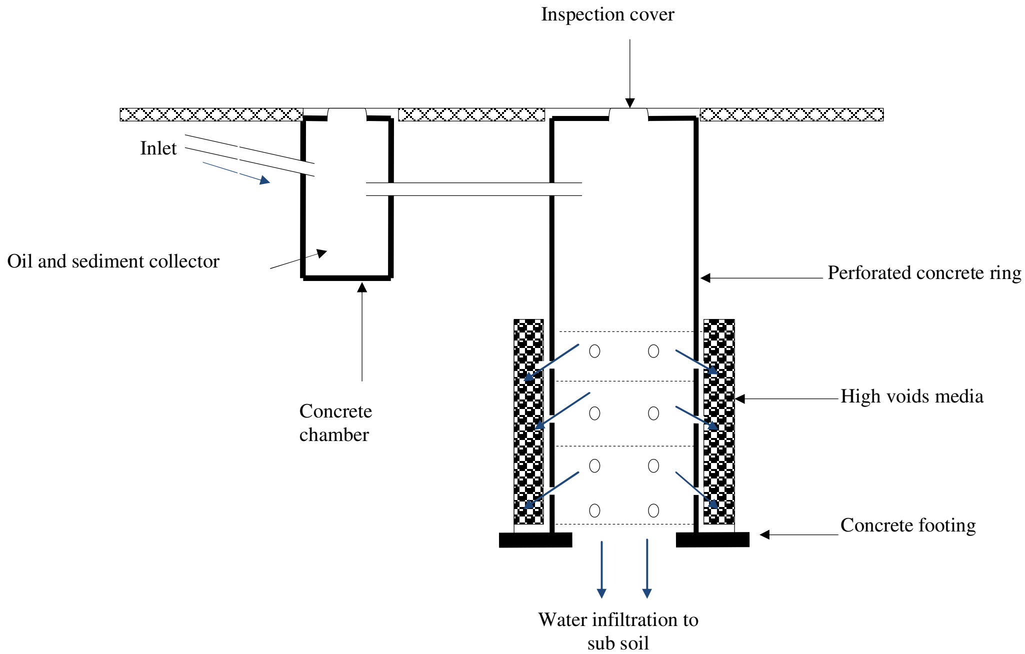
Maintenance

- Inspection chambers should be easily accessible and in light traffic areas.
- The surface should be brushed and vacuumed twice a year.
- Once a year an inspection should be carried out to pre-treatments and inspection chambers regarding silt accumulation.
- The removal of weeds and remediation of landscaping that has been raised to within 50mm of the paving shall be carried as required.

Further Information

Details are based on Woods-Ballard et al, 2007. Chapter 12, 21-1 to 12-24.

Soak-away



(Woods –Ballard et al, 2007)

Specification

- ❖ To be positioned at least 5m from building.
- ❖ To be used where agreed infiltration rates allow.
- ❖ Immediately upstream of soak-away an oil interceptor should be used.
- ❖ Determination of soil types and infiltration rates should be undertaken through appropriate ground surveys.
- ❖ Minimum infiltration rates of $1x10^{-5}$m/s should be attained.
- ❖ Minimum design of 1 in 30 year event.
- ❖ Surrounding land should be stable and a maximum slope of 1 in 10 (10%).
- ❖ They should be able to empty in a 24 hour period.
- ❖ Must be positioned to avoid structural damage through vegetation root intrusion.
- ❖ Where infiltration rates suggest or in areas of high surrounding vulnerability overflow devices should be considered.

Construction

Construction of soakaways to conform to Neath Port Talbot County Borough Council's Standard Details.

- ❖ Granular material to have void ratio >0.3.

Maintenance

- Siting should be in areas of easy access off the highway and parking areas but easily accessible from the highway.
- Soakaway inspection, sediment removal and testing to ensure the soakaway is working effectively should be undertaken annually.
- Recondition or replace soakaway as required.
- Regular maintenance and cleaning of the area draining into the soakaway should be undertaken to reduce on going maintenance.

Further Information

All details based on Woods-Ballard et al 2007. Chapter 6, 6-16 to 6-21.

Source Control

Green Roofs, Water Butts and Longitudinal Soakaways

Specification

Living Roofs (Green Roofs)

- Minimum pitch 1 in 80, maximum pitch 1 in 3.
- To reduce the risk of blockages multiple outlets should be used.
- Light weight soil medium and vegetation should be used.
- 25mm to 125mm growing medium.
- To avoid root penetration a suitable waterproof membrane should be used.
- A 2 year return period should be attenuated.
- Water capacity should never exceed 65% by volume to avoid water logging.
- A 1m wide gravel or slab fire break should be used every 40m.
- Further advice available at: http://www.npt.gov.uk/default.aspx?page=5749

Water Butt

- Provision of an overflow must be made.
- A tight fitting cover should be used.
- They should be on a stand high enough to allow convenient water withdrawal.

Longitudinal Soakaways

- See soakaways
- They should use perforated pipes; perforations should not exceed 10mm.
- Pipe gradients maximum 1:100.
- The trench of the pipe to have a cross section width at least twice the diameter of the pipe.
- Void ratio of aggregate in trench to be at least 0.3.

Maintenance

- Clean inlet drains and mow grass every 6 months.
- Inspect underside of roofs for leakages, clean water butts, clear nuisance vegetation and replace dead vegetation once a year.
- As required repair erosion channel and movement of growth medium.

Further Information

All details based on Woods-Ballard et al 2007. Chapter 6, 6-1 to 6-36.

Adoption Requirements

The drainage requirements and design should be in accordance with The SUDS Manual (CIRIA C697). The table below must be used in conjunction with the previous chapter when design SUDS features.

Rainfall Terminology

Annual Probability (chance) of happening or being exceeded	Return Period	
1%	1 in 100 year	The SUDS Manual and the design is normally based on a rainfall event that has a 1% chance of happening in any one year, plus a 30% additional rainfall intensity for climate change.
3.33%	1 in 30 years	Any SUDS system has to be robust to minimise future liabilities to the Council. In the event of a system being overwhelmed over land flow routes need to be identified to minimise the flooding of buildings or sensitive locations. This rainfall intensity normally will apply to structures under ground such as attenuation tanks.
10%	1 in 10 years	
50%	1 in 2 year	

Requirements

An overland route could be the use of a road to direct water to the lower level land within a site.
To help maintain the high quality appearance of SUDS a specific route for flows up to 1 in 1 year should be catered for using low flow channels.
System features should be as shallow as possible to avoid steep side slopes and maintain shallow water depths.
The use of vertical head walls or rip rap that is poorly designed will not be acceptable.
Outlet flow controls should be provided on all features that store water to regulate flows to a watercourse at the agreed rates.
Overflow routes shall be provided that direct flows away from buildings or other sensitive infrastructure.
Features should be designed in accordance with The SUDS Manual (CIRIA C697)
Features such as basin should be provided with flat areas of at least 2m wide around it, to provide easy access. Access for this type of feature should be provided from the nearest road.
The outlet flow control should be designed and maintained to ensure the feature continuous to work correctly.

SUDS Treatment Requirements

Runoff Pollution Content	Catchment Characteristics	No. of Treatment Stages or Features
Low	Roofs, school playgrounds	1
Medium	Residential roads, parking areas, commercial zones.	2
High	Refuse collection and industrial areas, loading bays, lorry parks, distributor roads and other highways.	3 -4

Source: The SUDS Manual

Checklist for adoption in appendix A

Further Specific Adoption Requirements

Specific Pond Adoption Requirements

A permanent varying water depth shall be provided to add interest and habitat but have a maximum depth of 1200mm. A maximum rise in water level of 500mm is to be maintained in a 1 in 30 years or greater rainfall event.
The edge of the pond shall not exceed a 1 in 3 gradient. If a steeper slope is to be used it must be where that edge is less accessible and should only be used in isolation.
The use of the 1 in 3 gradient should marry in to an underwater bench with a depth of 150mm. This maximises the ponds ability to provide a higher biodiversity value.
Natural colonisation of the pond should be considered first before the devising of any planting schemes. If erosion occurs it will be necessary to provide planting which should be non-invasive. An agreement will need to be entered into to overcome any unsatisfactory natural regeneration which shall require at the developers expense supplementary and replacement planting 12 months after the first operation of the pond.
Fencing should not generally be required where shallow gradients have been used. Where fencing is required care should be made to make it visually attractive, toddler proof but give easy access by adults in an emergency.
In usual cases liners should not be used unless it is necessary to create permanently wet areas or for contamination prevention. If used liners should be puncture resistant and covered with a minimum depth of 300mm mix of topsoil and subsoil.
A 150mm layer of topsoil should be applied on the banks between the permanent water level and maximum water level. Topsoil should not be placed over the subsoil below the permanent water level beyond the wet bench to assist rapid and permanent vegetation to resist erosion. (This approach is contrary to ecological best practice, but is necessary for the reasons above)

Specific Basin Adoption Requirements

In a 30 year or greater rainfall event the water level must not rise more than 1000mm and should drain down in 48 hours maximum.
Slopes shall have a maximum gradient of 1 in 3 down to the bottom of the basin. If due to spatial constraints steeper slopes are required these should be used only in extreme circumstances and less accessible areas of a basin.
The use of fencing is not required if the slopes are shallow and water is stored infrequently. Where fences are deemed necessary they should be visually attractive and toddler proof, but not prevent access to adults.
Root zone soil should cover up to the maximum water level on the base and sides of the infiltration basin, which must be sufficiently permeable to allow water to soak through. It must also contain sufficient organic content to support vegetation.
A 150mm layer of topsoil should be applied on the banks between the permanent water level and maximum water level. (This approach is contrary to ecological best practice, but is necessary for the reasons above)
The use of liners is not permitted.

Specific Swale Adoption Requirements

The swale should have slopes with a maximum gradient of 1 in 3 and a maximum depth of 450mm.
Gullies should not be used to collect and pass water into swales; water should flow over the edge across either a small filter strip or via shallow inlets.
Where ponds are fed by a swale the swale depth should be kept shallower.
During a 1 in 30 years or greater rainfall event, the water level of the swale must not rise greater than 150mm to 300mm. A 50mm flow depth across a filter strip is rarely exceeded.
Generally as swales are shallow they should not require any fencing to prevent access, however in a street situation some form of barriers will be required to prevent cars parking in the swale.
Unless it is required to prevent water soaking into the ground where there is contamination liners should not be used. If a liner is necessary then it should be covered with a minimum depth to 300mm of mixed top soil and subsoil including the edges.
A 150mm layer of topsoil should be applied on the banks between the

permanent water level and maximum water level. ***(This approach is contrary to ecological best practice, but is necessary for the reasons above)***

Specific Filter Drain Adoption Requirements

Water which passes into filter drains should not be from gullies. It should be from source control features that remove silt such as small over the edge drainage such as small filter strips.
Unless it is required to prevent water soaking into the ground where there is contamination liners should not be used.

Specific Canal Adoption requirements

Channels including canals and rills should have a maximum depth of water of 150mm.

Specific Inlet Adoption requirements

Where there is a sloping side of ponds, basins or swales which have an inlet or outlet the pipes should be chamfered to suit the angle of the slope.
Within open spaces vertical headwalls will not be acceptable.
Where orifices and weirs are used as control features they should be on the surface. If control structures are used below ground they should be accessible from the surface for maintenance avoiding the need for entry into chambers.
All control features should have an overflow route around them in case of blockages.

Temporary Control of Water during Construction

Identify the locations of any watercourse, wetlands, flows routes, storage working distances from watercourses need to be considered.
Identify protected habitats such as SSSI's, SAC's, and RAMSAR sites.
Potential flood risk to the site during construction to be assessed
Identify potential sources of pollution by considering methods of disposing contaminated water.
Temporary features during construction stages
Emergency procedure at the project stage to think through the possible incidents that may include, spillages, failures of temporary works,

vandalism, heavy rainfall, etc.
Monitoring requirements to determine if construction works are impacting the surrounding environment.

Verifying the Construction Works

All SUDs works to be adopted by Neath Port Talbot CBC shall be constructed in accordance with the agreed design and specification. To meet verifying standards they will take the form of developer supplied documentation and inspection by NPTCBC during each stage of construction.
All schemes will be subject to attaining planning permission prior to starting work on site. A programme of works and notification of the commencement of works on site shall be submitted to the Highway Development Control Section two weeks prior to the start of construction. Any changes to the programme shall be notified to the Council immediately.
The Council's SUDs Engineer shall be permitted free access to inspect the works at all times relating to the SUDs or works that might effect the operation of the SUDS.
Throughout construction the developer will be required to prove the thickness and type of material or layer if it has been covered prior to inspection. When the appropriate notice has not been received for works undertaken, the works in question will be required to be re-opened for inspection and reinstated at no expense to the Council.
To ensure construction run-off will not clog constructed SUDS features or pollute down stream features a pre-excavation inspection shall be required.
Works should be inspected by the developers' consultant to include the construction and materials used. The consultant should produce a verification report and a site inspection plan. This should be site specific and include the following as a minimum:
1. Confirmation of – Soil conditions, Levels, Profiles, General earthworks and Photographs of excavations.

2. Details (if appropriate) of manufacturers – Inlets, Outlets Any control structures, together with Photographs
3. Confirmation of topsoil sources with appropriate certificates.
4. A planting method statement, initial maintenance regime, a full planting list and confirmation of plant sources.
5. Subsoil and topsoil depths to be confirmed.
6. Method statement of the installation of filter drains together with confirmation of gravel fill specifications and sources.
7. Membrane liners when used shall have confirmation of sources and test certificates. They should have welded joints, inspected and joints tested after installation. All records of testing shall be provided.
8. Features should be photographed before and after planting.
9. A topographical survey and full as constructed drawing shall be submitted.
10. Initial maintenance regimes to be confirmed.

A maintenance period of 1 year after completion after the whole development served by SUDs is required by the Council. This period should be used to review the performance of the SUDS features and based on the observed performance minor adjustments and refinements should be carried out as required.

These costs shall be met by the developer, and at the end of the maintenance period a final inspection shall be carried out. The accumulation of silt and any areas of erosion or other defects shall be dealt with at this time.

The Council, where the system is not designed in accordance with the essential adoption requirements and not verified as detailed within this document, shall not adopt the scheme.

<u>Health and Safety</u>

Ponds shall be small with gentle side slopes.
Proposals shall accord with Construction, Design and Management regulations 2007. 1. Hazards should be removed where possible rather than mitigated to

manage risk.
E.g. A pond shall have gentle slopes, wet benches, rather than large deep ponds that require a fence.

2. Child safety must be considered in pond and wetland design.
   Shallow sides, minimise water bodies of any depth and use peripheral planting.
   Fencing should be low level to prevent toddlers gaining access to the features, where they would be present, but would allow an adult access quickly if required.
3. Written evidence of health and safety risk assessments of the proposals by the developer and their advisors shall be presented to the Council prior to construction.
4. The risk assessments should consider all work phases and include construction, long term maintenance work and risks to the public during operations.

Waste Management and Other Environmental Issues

Although waste is predominately grass or other vegetation, there is a need to comply with relevant waste management legislation, especially is waste is to be transported off site.

Disposal options will be determined by the characteristics of the material at each site.

Green waste can be managed in several ways:

The surface spreading of shredded material.
Placed in piles to provide habitat.
On site compost piles.
Removed off site to composting facilities.
Removal from site to tip (least sustainable)

Waste material such as silt should be tested to determine extent and nature of possible pollution. However, if the management train is in low risk areas such as housing pollutant levels should be low within the definition as a hazardous waste.

Silt should only be removed by an authorised carrier and taken to authorised disposal locations and the necessary paper work produced to verify this. When silt and vegetation is stored on site the relevant evidence of an exemption from the Environment Agency will be required.

The management of waste from SUDS in low risk areas should be agreed with the Environment Agency.

Appendix A

Checklist of Adoption requirements

Ref No.	Item	Date agreed with NPTCBC
1.	**Conceptual design**	
	The SUDS Manual requirements	
	❖ Provide a clear explanation of the SUDS proposal following CIRIA C697 (The SUDS Manual) guidance	
	❖ Flow routes through development	
	❖ Attenuation storage locations identified	
	❖ Source control provision and interception storage identified	
	❖ Long term storage identified	
	❖ Landscape and ecology criteria defined	
	❖ Treatment levels identified	
	NPTCBC specific requirements	
	❖ Mimic natural drainage patterns and landscape of NPTCBC	
	❖ SUDS as shallow as possible	

2.	**Outline design**	
	The SUDS manual requirements	
	❖ Drainage design criteria agreed with Environment Agency including Greenfield runoff rates and frequency of volumes	
	❖ Source control and interception storage provided and volumes defined – runoff from site for events up to 5mm (or stated value)	
	❖ Attenuation storage provided and volumes defined – storage for 1% and 3.3% annual probability.	
	❖ Long term storage provided and volumes defined – storage for 1% annual probability, 6 hour duration event released to infiltration or at rate of 2l/s/ha.	
	❖ Conveyance – describe flow routes, low flow recurrence intervals.	
	❖ Control structures defined and sized.	
	❖ Sufficient number of treatment stages provided	
	❖ Exceedance and overland flow routes	

3.	**Detailed drainage design**	
	General – The SUDS Manual	
	❖ Detail – check drainage pathways reflect natural storage patterns	
	❖ Detail – check interception, attenuation and long term storage volumes provided	
	❖ Detail – check flow controls provided in correct place to ensure operates when required	
	❖ Detail - check sufficient treatment stages provided.	
	❖ Detail – check biodiversity design requirements provided	
	Ponds and wetlands – NPTCBC specific	
	❖ Design in accordance with The SUDS Manual	
	❖ Access provision for maintenance	
	❖ Side slopes less than 1 in 3 and safety bench	
	❖ Underwater slopes less than 1in 3 and 150mm wet bench	
	❖ Biodiversity design considerations	
	Fencing provision appropriate (fencing not normally required)	
	❖ 150mm topsoil to slopes	
	❖ Interpretative boards	
	❖ If liner used is it covered by 300mm top soil?	
	Retention and infiltration basins – NPTCBC specific	
	❖ Design in accordance with The SUDS Manual	
	❖ Access provision for maintenance	
	❖ Side slopes less than 1 in 3	
	❖ Biodiversity design considerations	
	Fencing provision appropriate (fencing not normally required)	
	❖ 150mm topsoil to slopes	
	❖ Interpretative boards	
	❖ If liner used is it covered by 300mm top soil?	
	❖ Root zone in base of under drained swales	
	❖ Drainage to swale does not use gullies	
	Filter drains – NPTCBC specific	
	❖ Design in accordance with The SUDS Manual	
	❖ Access provision for maintenance	
	❖ Drainage to filter drain does not use gullies	
	❖ Interpretative boards	
	Canals, rills and other channels –NPTCBC specific	
	❖ Design in accordance with The SUDS Manual	
	❖ Access provision for maintenance	
	❖ Interpretative boards	
	Inlets, outlets and controls – NPTCBC specific	
	❖ Design in accordance with The SUDS Manual	
	❖ Simple orifices or weirs located at surface wherever possible	

	❖ Overflow route provided to bypass control if it becomes blocked	

4.	**Health and Safety**	
	❖ Provide CDM designer's risk assessment – for all SUDS features, inlets, outlets and controls.	
	❖ Hazards designed out wherever possible (e.g. entry to confined spaces eliminated, deep excavation eliminated)	

5.	**Construction - Verification**	
	❖ Contractor method statement – control of silt and other contamination during construction.	
	❖ Photographs of excavations and confirmation of soil conditions	
	❖ Photographs and details of as built inlets, outlets and controls	
	❖ Topsoil/root zone sources, certificates and depths	
	❖ Planting list, method statement and initial maintenance regime	
	❖ Subsoil depth confirmed	
	❖ Filter drain material sources and certificates	
	❖ Source and test certificates for membrane liners (if used)	
	❖ Installation CQA sheets and test results for membrane (if used)	
	❖ Photos of completed feature	
	❖ As constructed drawings	

Glossary

Algae	Simple plants ranging from single cells to large plants	Bund	Earthworks formed as a barrier, dam or mound to contain water or exclude from other parts of a site
Amenity	The quality of being pleasant or attractive, agreeableness. A feature that increase attractiveness or value, especially of a piece of real estate or a geographic location	Catchment	The area contributing surface water flow to a point on a drainage or river system, and can be divided into sub-catchments.
Attenuation	Reduction of peak flow and increased duration of a flow event.	Construction design and Management Regulations 2007 (CDM)	Emphasises the importance of addressing construction health and safety issues at the design phase of the construction project
Balancing pond	A pond designed to attenuate flows by storing runoff during the storm and releasing it at a controlled rate during and after the storm. The pond always contains water.	Construction Quality Assurance (CQA)	Document management system designed to provide adequate confidence that items or services meet contractual requirements and will perform adequately in service. CQA normally includes inspection and testing of installed components and recording the results
Basin	A ground depression acting as a flow control or water treatment structure that is normally dry and has a proper outfall, but is designed to retain storm water temporarily	Conventional drainage	Traditional method of surface water drainage using pipes and storage tanks.
Berm	A mound of earth formed to control the flow of surface water.	Conveyance	Water moving from one location to another
Biodiversity	The diversity of plant and animal life in their habitat	Curtilage	Area of land within property boundaries

Bioretention area	Known as rain gardens, a landscape area depressed to collect runoff, to percolate through the soil into an underdrain, to promote pollutant removal.	Deposition	Laying down of matter via a natural process
Block paving	Flexible modular paving system of pre-cast concrete or clay brick size	Dewatering	The removal of ground water/surface water to lower the water table

Dry	Free of water under dry weather flow conditions	Impermeable	Water can not pass through it
Erosion	The way material is worn away from the earths surface through weathering, dissolution, abrasion, corrosion and transportation	Impermeable surface	Non porous surface which generates a surface water runoff
Filter drain	A linear drain which is a trench filled with a permeable material, often with a perforated pipe in its base.	Infiltration (to the ground)	Passage of surface water into the ground
Filter strip	Gently vegetated sloping ground designed to drain water off evenly from an impermeable area filtering out silts and other particulates	Infiltration basin	A dry basin designed to allow surface water to infiltrate into the ground
Filtration	The removal of sediment from a fluid by passing it through a filter	Infiltration device	A device designed specifically to allow surface water to infiltrate into the ground
Forebay	A small basin or pond designed upstream above the main drainage feature to trap sediment	Infiltration trench	A trench filled with permeable granular material
Formation level	Surface of an excavation prepared to support a pavement	Open water	Clear water surface i.e. free from submerged or floating vegetation
Freeboard	Distance between the design water level and the top of a structure, to provide a safety measure against early system failure	Pavement	The road or car park usually asphalt, concrete or block paving
Geo-cellular structure	A plastic box structure in the ground used to attenuate flows	Permeable pavement	A surface which is paved and drains through voids between

			solid parts of pavement
Geo-membrane	An impermeable plastic sheet	Permeable surface	A surface formed by material which is itself impermeable but by virtue of voids through the surface allows infiltration of water to the sub –base.
Geo-textile	A plastic fabric that is permeable	Pervious surface	A surface which allows inflow of water into the underlying construction
Green roof	A roof with plants growing on its surface contributing to the local biodiversity	Pollution	Changes in physical, chemical, radiological or biological quality of a resource caused by mans activity
Groundwater	Water below ground within a saturation zone	Pond	Permanent wet depression to retain storm water as a pool, permitting settlement of suspended solids and removal of biological solids
Habitat	The area or environment where an organism or ecological community occurs	Porous surface	A surface that infiltrates water to the sub-base e.g. grass, gravel, porous concrete & asphalt
Porous paving	A permeable surface that drains through voids which are integral to the pavement.	Storm	An occurrence of rainfall, snow or hail.
Public open space	Land used for the purpose of public recreation with unimpeded public access	Sub-base	A layer of material that provides a foundation for a pavement
Rainfall event	A single occurrence of rainfall before and after which there is a dry period that is sufficient to allow its effect on the drainage system to be defined	SUDS	A sequence of management practices and control structures designed to drain surface water in a more sustainable fashion
Rainwater harvesting	A system that collects rainwater from where it falls rather than allowing it to drain away	Sump	A pit lined or unlined used to collect water and sediments before being pumped out
Recycling	Collecting and separating materials from waste to be re-	Surface water	Water that appears on the land surface e.g.

	used as suitable materials		lakes, rivers, streams, etc.
Risk	The chance of an adverse event	Swale	A shallow vegetated channel to conduct and retain water and can permit infiltration
Risk assessment	A careful evaluation of risks that might arise from hazards identified combining their various factors	Treatment	Improving the quality of water by physical, chemical or biological means
Runoff	Water flow over ground surface to a drainage system	Vortex flow control	An induction of a spiral/vortex flow of water in a chamber used to control or restrict the flow
Sediments	Layers of particles that cover the bottom of water features such as lakes, ponds, rivers and reservoirs.	Waste	Substance that is intended to discard
Sewer	A pipe or channel taking foul and/or surface water from buildings and associated paths and hard standings	Wetland	Flooded area which the water is shallow enough to enable the growth of bottom rooted plants
Silt	Particles with grain size of 4 – 63µm i.e. between clay and sand		
Soak-away	Sub-surface structure which surface water is conveyed		
Soil	Medium of various particles covering the ground		

References

Cambridge City Council, 2009 Cambridge SUDS Design & Adoption Guide, Cambridge.
Oxfordshire County Council, Design Criteria for SUDS
Woods-Ballard et al, 2007, SUDS Manual, London