

Introduction

How to satisfy the SUDS philosophy of mimicking the natural drainage by providing optimum Quantity, Quality and Amenity (Biodiversity) value is often raised.

This paper explores how site specific details should be analysed strategically before embarking upon the detailed design of an integrated SUDS system.

A diligent approach at this stage can ensure that the most appropriate range of solutions are utilised to best suit the site.

Preliminary Design Process

The work process comprises of five stages;

- 1) Identify the greenfield discharge rates
- 2) Assess the infiltration coefficient of the soil/s
- 3) Carry out a storage estimate
- 4) Study the site characteristics
- 5) Results: Decide on the most appropriate combination to produce a SUDS system

1) Identify the greenfield discharge rates

There are three potential methodologies used to calculate the greenfield discharge rates;

- a) FEH
- b) ADAS 345
- c) IH124

If you are working on a new development the Interim Code of Practice for SUDS and the Code for Sustainable Homes generally recommend using IH124. If the site is less than 50ha a pro rata calculation is made. If the site is greater than 200ha a check with the FEH method is recommended.

The greenfield peak discharge rates for the 1, 30 and 100 year return periods are calculated and used as targets for the post-development condition.

The screenshot shows the 'ICP SUDS' input section with the following values: Return Period (Years) 2, Area (ha) 10,000, SAAR (mm) 706, Soil 0.450, Growth Curve (None), and Partly Urbanised Catchment (QBAR) Urban 0.000. The Results section shows QBAR rural (l/s) 44.4 and QBAR urban (l/s) 44.4.

Return Period Flood	Region	QBAR (l/s)	Q (2yrs) (l/s)	Q (1 yrs) (l/s)	Q (30 yrs) (l/s)	Q (100 yrs) (l/s)
IH 124	Region 4	44.4	39.8	36.8	86.9	114.0
	Region 5	44.4	39.7	36.6	106.6	158.0
ICP SUDS	Region 6/Region 7	44.4	39.1	37.7	100.6	141.5
	Region 8	44.4	39.2	34.6	84.6	107.4
ADAS 345	Region 9	44.4	41.2	39.0	78.2	96.7
	FEH	44.4				



2) Assess the infiltration coefficient of the soil/s

The ideal solution to satisfy regulatory requirements would be to discharge through infiltration into the ground.

BRE Digest 365 describes how to undertake a soil percolation test.

Test pits should be replicated at suitable intervals around the site. The depth of the test pit should be approximately the same as the anticipated depth of the full infiltration system.

The size of the test pit should be related to the size of the area to be drained. If the area to be drained is less than 100m² then the volume of water used for the test should be at least 0.5 m³. Otherwise at least 1m³ of water should be used.

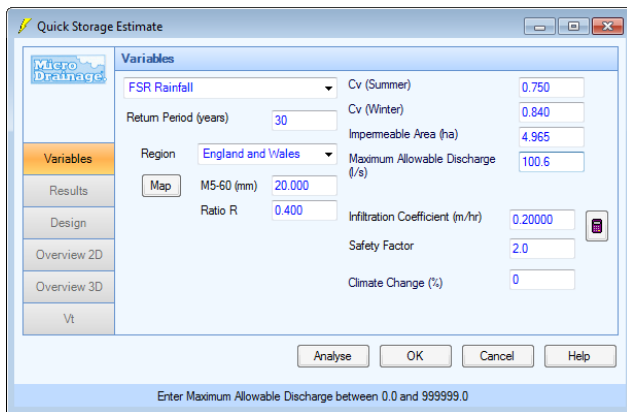
Results from the test pits enable the infiltration coefficient of the soil at each test pit location to be calculated.

The dialog box shows the following input values: Volume of test pit between 75% and 25% of depth (m³) 1.0, Time taken to drain from 75% to 25% of depth (hrs) 1,000, and Wetted area of pit at 50% of depth (m²) 5. The Result section shows an Infiltration Coefficient (m/hr) of 0.20000.

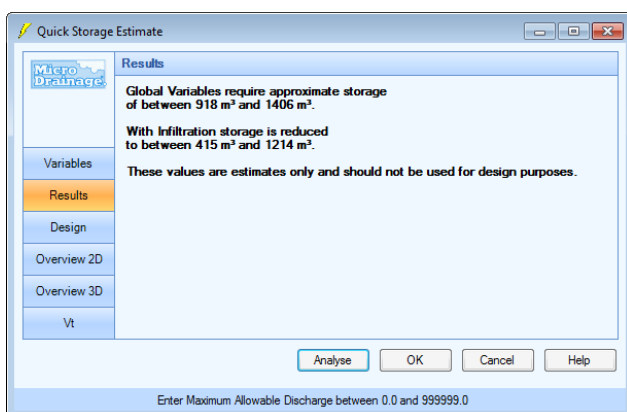
3) Carry out a storage estimate

The ability to infiltrate into the soil will not only satisfy regulatory requirements, it will reduce the volume of below ground storage. Below ground storage can be expensive and reducing storage will help to reduce costs. Therefore assessing the soil characteristics before estimating storage volumes could help to satisfy both the needs of the client as well as the approving authorities.

The key inputs required to carry out a storage estimate are the rainfall characteristics, impermeable area of the site, discharge rate and soil infiltration coefficient.



A comparison can be made between estimates for storage volumes required whether through attenuation or infiltration.



In this case it can be seen that infiltration into the ground could save below ground storage.

4) Study the site characteristics

The insight gained so far can now be utilised, in conjunction with the site characteristics, to identify the most appropriate SUDS strategy.

The study comprises of five categories;

- Hydrological
- Land Use
- Physical Site Features
- Community and Environment
- Economic and Maintenance

A range of structures are weighted against each of the criteria within the categories.

The scores used are:

- Very Poor / Very Low / Very High Cost
- Poor / Low / High Cost
- Moderate
- Good / High / Low Cost
- Very Good / Very High / Very Low Cost

The Hydrological category covers the issues of pollution removal, water quantity control, flow rates and groundwater recharge.

Land Use looks at the nature of the proposed development to identify areas that could affect diffuse pollution.

Site Features characterises the sub-catchment areas, slope across the site, space limitations, soil infiltration rate and water table depth.

Feature	Total	Sub-Catchment Area			
		< 2 ha	2 - 8 ha	> 8 ha	
Weighting	0. N/A	0. N/A	2. Essential	2. Essential	
Pervious Pavements	37	5	5	5	
Green Roofs	45	5	5	5	
Bioretention Area	29	5	1	1	
Filtration Techniques	31	5	3	1	
Grassed Filter Strip	24	5	1	1	
Grassed Swales	26	5	1	1	
Hydrological	Infiltration Trench / Soakaway	29	5	3	1
Land Use	Filter Drains	25	5	3	1
	Infiltration Basin	29	5	2	1
Site Features	Dry Detention	35	1	2	5
	Wet Ponds	31	1	2	5
Community & Environment	Stormwater Wetlands	29	1	2	5
Economic & Maintenance	Online / Offline Storage	41	5	5	5

Community and Environment can often be overlooked but is becoming increasingly important with a strategy towards more localisation. This category helps to focus on the amenity and biodiversity aspects of a project.

Economics and Maintenance ensures that consideration is made of the longer term maintenance as well as initial installation costs.

Completing all sections will ensure that the core criteria have been considered and any critical issues have been identified early in the process.

5) Results: Decide on the most appropriate combination to produce a SUDS system

The results from the study indicate the most appropriate structures to consider.

The study is helpful in eliminating unsuitable options at an early stage and assists the communication process with the design team, client and approving authorities.

	Quick Rank View	Hydrological	Land Use	Site Features	Total
Pervious Pavements	(1, 8, 5)	28 (1st)	27 (3rd)	37 (3rd)	92 (1st)
Online / Offline Storage	(1, 8, 8)	18 (10th)	33 (1st)	41 (2nd)	92 (1st)
Green Roofs	(3, 5, 2)	26 (2nd)	15 (13th)	45 (1st)	86 (3rd)
Infiltration Trench / Soakaway	(4, 12, 8)	24 (3rd)	30 (2nd)	29 (7th)	83 (4th)
Wet Ponds	(5, 2, 1)	24 (3rd)	27 (3rd)	31 (5th)	82 (5th)
Dry Detention	(5, 6, 2)	20 (8th)	27 (3rd)	35 (4th)	82 (5th)
Stormwater Wetlands	(7, 1, 5)	22 (6th)	27 (3rd)	29 (7th)	78 (7th)
Infiltration Basin	(7, 8, 8)	24 (3rd)	25 (9th)	29 (7th)	78 (7th)
Bioswale Area	(9, 3, 11)	18 (10th)	27 (3rd)	29 (7th)	74 (9th)
Grassed Swales	(9, 6, 5)	22 (6th)	26 (8th)	26 (11th)	74 (9th)
Filtration Techniques	(11, 8, 13)	16 (12th)	24 (11th)	31 (5th)	71 (11th)
Filter Drains	(12, 12, 11)	20 (8th)	25 (9th)	25 (12th)	70 (12th)
Grassed Filter Strip	(13, 4, 2)	12 (13th)	23 (12th)	24 (13th)	59 (13th)

All aspects of this paper are covered in the WinDes training series.

Micro Drainage Training Course F covers the vast majority of the content of this paper, with the exception of the calculation of greenfield discharge rates which is covered in Training Course G.



Summary

The process will help to reassure the design team, client and approving authorities that the key issues have been considered specific to the particular development and a degree of objectivity has been applied with a healthy dose of common sense.

It is one step further down the path of applying a systematic approach to SUDS design.

SUDS Series of Papers

In the next paper the issue of detailed design for SUDS is covered.

The complete series will comprise of the following papers;

- ⊕ Legislation for SUDS Implementation
- ⊕ Planning for SUDS
- ⊕ Preliminary Design for SUDS
- ⊕ Detailed Design for SUDS
- ⊕ Auditing SUDS for extreme rainfall

Contact Details

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To share your views, keep abreast of legislation and research visit Piped Up! The Micro Drainage blog at <http://pipedup.wordpress.com>