

		CALCULATIONS		DOCUMENT No 7011-UA001881-UP21B-02				
OFFICE CARDIFF			PROJECT TITLE NW Bicester Eco Development					
SUBJECT Exemplar Site - SUDS Storage Structure Design Calculation					SHEET No 1 OF 37			
ISSUE	TOTAL SHEETS	AUTHOR	DATE	CHECKED BY	DATE	APPROVED BY	DATE	COMMENTS
1	25	DCB	25/11/10	MP	25/11/10	SAD	25/11/10	
2	25	MP	05/04/11	DCB	05/04/11	SAD	05/04/11	
3								
4								
5								
SUPERSEDES DOC No								DATE

DESIGN BASIS STATEMENT (Inc. sources of info/data, assumptions made, standards, etc.)

Introduction

This calculation has been prepared to assess the sizes of SUDS infiltration features throughout the site. Features have also been assessed with a restricted discharge to simulate worst case scenarion of discharge to watercourse at existing greenfield rates.

Each basin has been assessed using WinDES (an industry standard drainge design package produced by Microdrainage).

Assumptions

- 1) Contributing area as per calculation 7015
- 2) Design to accommodate 100 year rainfall events with a variety of durations in accordance with EA requirements
- 3) Climate change factor of 30% applied to rainfall
- 4) Existing greenfield runoff rate calculated as 40 l/s (Ref. Report 3501-UA001881 Flood Risk Assessment - Exemplar Site)
- 5) In 'no infiltration' worst case scenario SuDS catchments 1,2,3,4 and 5 discharge to catchment 6.
- 6) In 'no infiltration' worst case scenario SuDS catchment 6 discharges to catchment 7.
- 7) In 'no infiltration' worst case scenario SuDS catchments 7, 8 and 9 discharge to the watercourse.

Results

A caclulation titled 'infiltration' is for a SuDS feature tested for discharge by infiltration alone.

A caclulation titled 'no infiltration' is for a SuDS feature tested for discharge to watercourse.

Catchment	Storage volume (m ³)	Discharge rate in 'no infiltration' scenario
1	250	5
2	245	5
3	120	5
4	190	5
5	165	5
6	55	15
7	135	20
8	175	10
9	405	10

Combined discharge to watercourse = 20 + 10 + 10 = 40 l/s

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Half Drain Time : 458 minutes.

	Storm	Max	Max	Max	Max	Max	Max	Status
	Event	Level	Depth	Infiltration	Control	E Outflow	Volume	
		(m)	(m)	(l/s)	(l/s)	(l/s)	(m³)	
15 min	Summer	91.238	0.438	0.0	4.9	4.9	114.5	O K
30 min	Summer	91.305	0.505	0.0	4.9	4.9	148.7	O K
60 min	Summer	91.362	0.562	0.0	4.9	4.9	180.8	O K
120 min	Summer	91.404	0.604	0.0	4.9	4.9	206.4	O K
180 min	Summer	91.418	0.618	0.0	4.9	4.9	215.1	O K
240 min	Summer	91.421	0.621	0.0	4.9	4.9	216.7	O K
360 min	Summer	91.413	0.613	0.0	4.9	4.9	212.0	O K
480 min	Summer	91.402	0.602	0.0	4.9	4.9	205.1	O K
600 min	Summer	91.392	0.592	0.0	4.9	4.9	198.4	O K
720 min	Summer	91.381	0.581	0.0	4.9	4.9	192.1	O K
960 min	Summer	91.362	0.562	0.0	4.9	4.9	180.4	O K
1440 min	Summer	91.323	0.523	0.0	4.9	4.9	158.6	O K
2160 min	Summer	91.265	0.465	0.0	4.9	4.9	128.0	O K
2880 min	Summer	91.206	0.406	0.0	4.9	4.9	99.8	O K
4320 min	Summer	91.089	0.289	0.0	4.9	4.9	53.6	O K
5760 min	Summer	91.004	0.204	0.0	4.9	4.9	27.7	O K
7200 min	Summer	90.958	0.158	0.0	4.6	4.6	16.4	O K
8640 min	Summer	90.935	0.135	0.0	4.2	4.2	11.6	O K
10080 min	Summer	90.919	0.119	0.0	3.7	3.7	8.8	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Summer	128.285	25
30 min Summer	84.226	40
60 min Summer	52.662	68
120 min Summer	31.800	126
180 min Summer	23.353	186
240 min Summer	18.644	244
360 min Summer	13.543	354
480 min Summer	10.792	408
600 min Summer	9.043	468
720 min Summer	7.823	530
960 min Summer	6.219	666
1440 min Summer	4.493	940
2160 min Summer	3.241	1344
2880 min Summer	2.568	1728
4320 min Summer	1.847	2420
5760 min Summer	1.461	3056
7200 min Summer	1.217	3680
8640 min Summer	1.048	4408
10080 min Summer	0.923	5136

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Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m ³)	Status
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15 min Winter	91.267	0.467	0.0	4.9	4.9	128.9	O K
30 min Winter	91.340	0.540	0.0	4.9	4.9	167.7	O K
60 min Winter	91.402	0.602	0.0	4.9	4.9	204.6	O K
120 min Winter	91.449	0.649	0.0	4.9	4.9	235.4	O K
180 min Winter	91.467	0.667	0.0	4.9	4.9	247.2	O K
240 min Winter	91.472	0.672	0.0	4.9	4.9	250.9	O K
360 min Winter	91.470	0.670	0.0	4.9	4.9	249.1	O K
480 min Winter	91.459	0.659	0.0	4.9	4.9	241.9	O K
600 min Winter	91.445	0.645	0.0	4.9	4.9	232.6	O K
720 min Winter	91.433	0.633	0.0	4.9	4.9	224.7	O K
960 min Winter	91.408	0.608	0.0	4.9	4.9	208.6	O K
1440 min Winter	91.355	0.555	0.0	4.9	4.9	176.5	O K
2160 min Winter	91.269	0.469	0.0	4.9	4.9	129.9	O K
2880 min Winter	91.175	0.375	0.0	4.9	4.9	86.2	O K
4320 min Winter	91.001	0.201	0.0	4.9	4.9	27.0	O K
5760 min Winter	90.938	0.138	0.0	4.2	4.2	12.2	O K
7200 min Winter	90.914	0.114	0.0	3.6	3.6	8.1	O K
8640 min Winter	90.900	0.100	0.0	3.1	3.1	6.0	O K
10080 min Winter	90.890	0.090	0.0	2.7	2.7	4.8	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Winter	128.285	25
30 min Winter	84.226	39
60 min Winter	52.662	68
120 min Winter	31.800	124
180 min Winter	23.353	182
240 min Winter	18.644	238
360 min Winter	13.543	350
480 min Winter	10.792	456
600 min Winter	9.043	498
720 min Winter	7.823	568
960 min Winter	6.219	720
1440 min Winter	4.493	1022
2160 min Winter	3.241	1448
2880 min Winter	2.568	1820
4320 min Winter	1.847	2384
5760 min Winter	1.461	2992
7200 min Winter	1.217	3680
8640 min Winter	1.048	4400
10080 min Winter	0.923	5120

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5th Floor, The Pithay All Saints Street Bristol BS1 2NL		
Date 25/03/2011 15:58 File CAT1 SWALE NO INFILTRA...	Designed By mp49220 Checked By	
Micro Drainage	Source Control W.12.4	

Model Details

Storage is Online Cover Level (m) 91.800

Swale Structure

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	150.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	3.0
Safety Factor	2.0	Slope (1:X)	1000.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	90.800	Cap Infiltration Depth (m)	0.000
Base Width (m)	1.0		

Hydro-Brake® Outflow Control

Design Head (m)	0.700	Diameter (mm)	101
Design Flow (l/s)	5.0	Invert Level (m)	90.800
Hydro-Brake® Type Md6 SW Only			

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.1	1.200	6.4	3.000	10.1	7.000	15.4
0.200	4.9	1.400	6.9	3.500	10.9	7.500	15.9
0.300	4.7	1.600	7.4	4.000	11.6	8.000	16.5
0.400	4.5	1.800	7.8	4.500	12.3	8.500	17.0
0.500	4.5	2.000	8.2	5.000	13.0	9.000	17.5
0.600	4.7	2.200	8.6	5.500	13.6	9.500	17.9
0.800	5.2	2.400	9.0	6.000	14.3		
1.000	5.8	2.600	9.4	6.500	14.8		

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File Catl swale infiltratio...	Checked By	
Micro Drainage	Source Control W.12.4	

Summary of Results for 100 year Return Period (+30%)

Half Drain Time : 448 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	91.242	0.442	3.9	116.5	O K
30 min Summer	91.310	0.510	4.4	151.3	O K
60 min Summer	91.369	0.569	4.8	184.8	O K
120 min Summer	91.415	0.615	5.2	213.0	O K
180 min Summer	91.432	0.632	5.3	224.1	O K
240 min Summer	91.438	0.638	5.3	227.9	O K
360 min Summer	91.438	0.638	5.3	227.8	O K
480 min Summer	91.435	0.635	5.3	226.1	O K
600 min Summer	91.431	0.631	5.3	223.5	O K
720 min Summer	91.426	0.626	5.3	220.3	O K
960 min Summer	91.415	0.615	5.2	212.8	O K
1440 min Summer	91.389	0.589	5.0	196.6	O K
2160 min Summer	91.351	0.551	4.7	174.0	O K
2880 min Summer	91.317	0.517	4.4	154.9	O K
4320 min Summer	91.259	0.459	4.0	124.6	O K
5760 min Summer	91.211	0.411	3.7	102.1	O K
7200 min Summer	91.171	0.371	3.4	84.8	O K
8640 min Summer	91.138	0.338	3.1	71.3	O K
10080 min Summer	91.108	0.308	2.9	60.3	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Summer	128.285	26
30 min Summer	84.226	40
60 min Summer	52.662	68
120 min Summer	31.800	126
180 min Summer	23.353	184
240 min Summer	18.644	242
360 min Summer	13.543	324
480 min Summer	10.792	384
600 min Summer	9.043	446
720 min Summer	7.823	512
960 min Summer	6.219	650
1440 min Summer	4.493	926
2160 min Summer	3.241	1328
2880 min Summer	2.568	1732
4320 min Summer	1.847	2476
5760 min Summer	1.461	3232
7200 min Summer	1.217	3960
8640 min Summer	1.048	4672
10080 min Summer	0.923	5360

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Micro Drainage		Source Control W.12.4				
<u>Summary of Results for 100 year Return Period (+30%)</u>						
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status	
15 min Winter	91.271	0.471	4.1	130.7	O K	
30 min Winter	91.344	0.544	4.6	170.0	O K	
60 min Winter	91.407	0.607	5.1	208.0	O K	
120 min Winter	91.457	0.657	5.5	240.8	O K	
180 min Winter	91.477	0.677	5.6	254.4	O K	
240 min Winter	91.485	0.685	5.7	259.9	O K	
360 min Winter	91.487	0.687	5.7	261.5	O K	
480 min Winter	91.482	0.682	5.7	257.8	O K	
600 min Winter	91.477	0.677	5.6	254.5	O K	
720 min Winter	91.471	0.671	5.6	250.2	O K	
960 min Winter	91.456	0.656	5.5	239.6	O K	
1440 min Winter	91.420	0.620	5.2	216.4	O K	
2160 min Winter	91.368	0.568	4.8	184.0	O K	
2880 min Winter	91.321	0.521	4.5	157.1	O K	
4320 min Winter	91.242	0.442	3.9	116.7	O K	
5760 min Winter	91.180	0.380	3.4	88.5	O K	
7200 min Winter	91.130	0.330	3.1	68.2	O K	
8640 min Winter	91.089	0.289	2.7	53.4	O K	
10080 min Winter	91.055	0.255	2.5	42.3	O K	
Storm Event	Rain (mm/hr)		Time-Peak (mins)			
15 min Winter	128.285		26			
30 min Winter	84.226		39			
60 min Winter	52.662		68			
120 min Winter	31.800		124			
180 min Winter	23.353		182			
240 min Winter	18.644		238			
360 min Winter	13.543		346			
480 min Winter	10.792		404			
600 min Winter	9.043		472			
720 min Winter	7.823		548			
960 min Winter	6.219		702			
1440 min Winter	4.493		1000			
2160 min Winter	3.241		1428			
2880 min Winter	2.568		1824			
4320 min Winter	1.847		2600			
5760 min Winter	1.461		3352			
7200 min Winter	1.217		4104			
8640 min Winter	1.048		4768			
10080 min Winter	0.923		5544			
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File Cat1 swale infiltratio...	Checked By	
Micro Drainage	Source Control W.12.4	
<u>Model Details</u> Storage is Online Cover Level (m) 91.800 <u>Swale Structure</u>		
Infiltration Coefficient Base (m/hr)	0.05600	Length (m) 150.0
Infiltration Coefficient Side (m/hr)	0.05600	Side Slope (1:X) 3.0
Safety Factor	2.0	Slope (1:X) 1000.0
Porosity	1.00	Cap Volume Depth (m) 0.000
Invert Level (m)	90.800	Cap Infiltration Depth (m) 0.000
Base Width (m)	1.0	
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Micro Drainage	Source Control W.12.4	

Summary of Results for 100 year Return Period (+30%)

Half Drain Time : 468 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	91.043	0.443	0.0	4.9	4.9	116.9	O K
30 min Summer	91.111	0.511	0.0	4.9	4.9	151.8	O K
60 min Summer	91.169	0.569	0.0	4.9	4.9	184.7	O K
120 min Summer	91.212	0.612	0.0	4.9	4.9	211.0	O K
180 min Summer	91.226	0.626	0.0	4.9	4.9	220.2	O K
240 min Summer	91.229	0.629	0.0	4.9	4.9	222.1	O K
360 min Summer	91.222	0.622	0.0	4.9	4.9	217.6	O K
480 min Summer	91.211	0.611	0.0	4.9	4.9	210.6	O K
600 min Summer	91.200	0.600	0.0	4.9	4.9	203.9	O K
720 min Summer	91.190	0.590	0.0	4.9	4.9	197.6	O K
960 min Summer	91.171	0.571	0.0	4.9	4.9	185.8	O K
1440 min Summer	91.133	0.533	0.0	4.9	4.9	163.9	O K
2160 min Summer	91.076	0.476	0.0	4.9	4.9	133.2	O K
2880 min Summer	91.017	0.417	0.0	4.9	4.9	104.9	O K
4320 min Summer	90.900	0.300	0.0	4.9	4.9	57.5	O K
5760 min Summer	90.812	0.212	0.0	4.9	4.9	29.8	O K
7200 min Summer	90.762	0.162	0.0	4.6	4.6	17.3	O K
8640 min Summer	90.738	0.138	0.0	4.2	4.2	12.1	O K
10080 min Summer	90.722	0.122	0.0	3.8	3.8	9.2	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Summer	128.285	25
30 min Summer	84.226	40
60 min Summer	52.662	68
120 min Summer	31.800	126
180 min Summer	23.353	186
240 min Summer	18.644	244
360 min Summer	13.543	358
480 min Summer	10.792	410
600 min Summer	9.043	472
720 min Summer	7.823	534
960 min Summer	6.219	668
1440 min Summer	4.493	942
2160 min Summer	3.241	1344
2880 min Summer	2.568	1732
4320 min Summer	1.847	2424
5760 min Summer	1.461	3056
7200 min Summer	1.217	3688
8640 min Summer	1.048	4408
10080 min Summer	0.923	5136

5th Floor, The Pithay
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Date 25/03/2011 16:04
File Cat2 swale no infiltra...

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Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
15 min Winter	91.073	0.473	0.0	4.9	4.9	131.6	O K
30 min Winter	91.146	0.546	0.0	4.9	4.9	171.2	O K
60 min Winter	91.209	0.609	0.0	4.9	4.9	209.0	O K
120 min Winter	91.257	0.657	0.0	4.9	4.9	240.6	O K
180 min Winter	91.275	0.675	0.0	4.9	4.9	252.9	O K
240 min Winter	91.281	0.681	0.0	4.9	4.9	256.9	O K
360 min Winter	91.279	0.679	0.0	4.9	4.9	255.6	O K
480 min Winter	91.269	0.669	0.0	4.9	4.9	248.5	O K
600 min Winter	91.255	0.655	0.0	4.9	4.9	239.1	O K
720 min Winter	91.243	0.643	0.0	4.9	4.9	231.2	O K
960 min Winter	91.218	0.618	0.0	4.9	4.9	215.1	O K
1440 min Winter	91.166	0.566	0.0	4.9	4.9	183.0	O K
2160 min Winter	91.082	0.482	0.0	4.9	4.9	136.4	O K
2880 min Winter	90.989	0.389	0.0	4.9	4.9	92.4	O K
4320 min Winter	90.811	0.211	0.0	4.9	4.9	29.7	O K
5760 min Winter	90.742	0.142	0.0	4.3	4.3	12.9	O K
7200 min Winter	90.717	0.117	0.0	3.6	3.6	8.4	O K
8640 min Winter	90.702	0.102	0.0	3.1	3.1	6.3	O K
10080 min Winter	90.692	0.092	0.0	2.8	2.8	5.0	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Winter	128.285	25
30 min Winter	84.226	39
60 min Winter	52.662	68
120 min Winter	31.800	124
180 min Winter	23.353	182
240 min Winter	18.644	240
360 min Winter	13.543	350
480 min Winter	10.792	456
600 min Winter	9.043	504
720 min Winter	7.823	570
960 min Winter	6.219	722
1440 min Winter	4.493	1026
2160 min Winter	3.241	1452
2880 min Winter	2.568	1840
4320 min Winter	1.847	2424
5760 min Winter	1.461	3000
7200 min Winter	1.217	3672
8640 min Winter	1.048	4408
10080 min Winter	0.923	5072

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Model Details

Storage is Online Cover Level (m) 91.600

Swale Structure

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	150.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	3.0
Safety Factor	2.0	Slope (1:X)	1000.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	90.600	Cap Infiltration Depth (m)	0.000
Base Width (m)	1.0		

Hydro-Brake® Outflow Control

Design Head (m)	0.700	Diameter (mm)	101
Design Flow (l/s)	5.0	Invert Level (m)	90.600
Hydro-Brake® Type Md6 SW Only			

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.1	1.200	6.4	3.000	10.1	7.000	15.4
0.200	4.9	1.400	6.9	3.500	10.9	7.500	15.9
0.300	4.7	1.600	7.4	4.000	11.6	8.000	16.5
0.400	4.5	1.800	7.8	4.500	12.3	8.500	17.0
0.500	4.5	2.000	8.2	5.000	13.0	9.000	17.5
0.600	4.7	2.200	8.6	5.500	13.6	9.500	17.9
0.800	5.2	2.400	9.0	6.000	14.3		
1.000	5.8	2.600	9.4	6.500	14.8		

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Date 25/03/2011 16:10 File Cat2 swale infiltratio...		Designed By mp49220 Checked By			
Micro Drainage		Source Control W.12.4			
<u>Summary of Results for 100 year Return Period (+30%)</u>					
Half Drain Time : 453 minutes.					
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	91.047	0.447	3.9	118.8	O K
30 min Summer	91.116	0.516	4.4	154.4	O K
60 min Summer	91.175	0.575	4.9	188.6	O K
120 min Summer	91.222	0.622	5.2	217.5	O K
180 min Summer	91.240	0.640	5.4	229.0	O K
240 min Summer	91.246	0.646	5.4	233.0	O K
360 min Summer	91.246	0.646	5.4	233.0	O K
480 min Summer	91.243	0.643	5.4	231.3	O K
600 min Summer	91.239	0.639	5.4	228.7	O K
720 min Summer	91.234	0.634	5.3	225.5	O K
960 min Summer	91.223	0.623	5.2	218.0	O K
1440 min Summer	91.197	0.597	5.0	201.6	O K
2160 min Summer	91.159	0.559	4.8	178.7	O K
2880 min Summer	91.125	0.525	4.5	159.2	O K
4320 min Summer	91.066	0.466	4.1	128.4	O K
5760 min Summer	91.018	0.418	3.7	105.4	O K
7200 min Summer	90.978	0.378	3.4	87.7	O K
8640 min Summer	90.944	0.344	3.2	73.8	O K
10080 min Summer	90.914	0.314	2.9	62.5	O K
Storm Event	Rain (mm/hr)		Time-Peak (mins)		
15 min Summer	128.285		26		
30 min Summer	84.226		40		
60 min Summer	52.662		68		
120 min Summer	31.800		126		
180 min Summer	23.353		184		
240 min Summer	18.644		242		
360 min Summer	13.543		326		
480 min Summer	10.792		386		
600 min Summer	9.043		448		
720 min Summer	7.823		514		
960 min Summer	6.219		652		
1440 min Summer	4.493		926		
2160 min Summer	3.241		1328		
2880 min Summer	2.568		1732		
4320 min Summer	1.847		2504		
5760 min Summer	1.461		3232		
7200 min Summer	1.217		3968		
8640 min Summer	1.048		4672		
10080 min Summer	0.923		5440		
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5th Floor, The Pithay All Saints Street Bristol BS1 2NL						
Date 25/03/2011 16:10		Designed By mp49220				
File Cat2 swale infiltratio...		Checked By				
Micro Drainage		Source Control W.12.4				
<u>Summary of Results for 100 year Return Period (+30%)</u>						
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status	
15 min Winter	91.076	0.476	4.1	133.4	O K	
30 min Winter	91.150	0.550	4.7	173.5	O K	
60 min Winter	91.214	0.614	5.2	212.3	O K	
120 min Winter	91.265	0.665	5.5	245.9	O K	
180 min Winter	91.285	0.685	5.7	259.9	O K	
240 min Winter	91.293	0.693	5.8	265.7	O K	
360 min Winter	91.296	0.696	5.8	267.5	O K	
480 min Winter	91.291	0.691	5.7	263.8	O K	
600 min Winter	91.286	0.686	5.7	260.5	O K	
720 min Winter	91.280	0.680	5.7	256.2	O K	
960 min Winter	91.264	0.664	5.5	245.6	O K	
1440 min Winter	91.229	0.629	5.3	222.1	O K	
2160 min Winter	91.176	0.576	4.9	189.2	O K	
2880 min Winter	91.129	0.529	4.5	161.8	O K	
4320 min Winter	91.050	0.450	3.9	120.5	O K	
5760 min Winter	90.987	0.387	3.5	91.6	O K	
7200 min Winter	90.937	0.337	3.1	70.9	O K	
8640 min Winter	90.895	0.295	2.8	55.6	O K	
10080 min Winter	90.861	0.261	2.5	44.2	O K	
Storm Event	Rain (mm/hr)	Time-Peak (mins)				
15 min Winter	128.285	26				
30 min Winter	84.226	39				
60 min Winter	52.662	68				
120 min Winter	31.800	124				
180 min Winter	23.353	182				
240 min Winter	18.644	238				
360 min Winter	13.543	346				
480 min Winter	10.792	408				
600 min Winter	9.043	472				
720 min Winter	7.823	550				
960 min Winter	6.219	702				
1440 min Winter	4.493	1000				
2160 min Winter	3.241	1428				
2880 min Winter	2.568	1828				
4320 min Winter	1.847	2600				
5760 min Winter	1.461	3352				
7200 min Winter	1.217	4104				
8640 min Winter	1.048	4832				
10080 min Winter	0.923	5544				
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5th Floor, The Pithay All Saints Street Bristol BS1 2NL		
Date 25/03/2011 16:10	Designed By mp49220	
File Cat2 swale infiltratio...	Checked By	
Micro Drainage	Source Control W.12.4	

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time / Area Diagram

Total Area (ha) 0.510

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.128	4-8	0.255	8-12	0.127

5th Floor, The Pithay
All Saints Street
Bristol BS1 2NL

Date 25/03/2011 16:10

File Cat2 swale infiltratio...

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Micro Drainage

Source Control W.12.4



Model Details

Storage is Online Cover Level (m) 91.600

Swale Structure

Infiltration Coefficient Base (m/hr)	0.05600	Length (m)	150.0
Infiltration Coefficient Side (m/hr)	0.05600	Side Slope (1:X)	3.0
Safety Factor	2.0	Slope (1:X)	1000.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	90.600	Cap Infiltration Depth (m)	0.000
Base Width (m)	1.0		

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Source Control W.12.4

Half Drain Time : 225 minutes.

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Summer	128.285	18
30 min Summer	84.226	33
60 min Summer	52.662	62
120 min Summer	31.800	120
180 min Summer	23.353	170
240 min Summer	18.644	198
360 min Summer	13.543	262
480 min Summer	10.792	330
600 min Summer	9.043	400
720 min Summer	7.823	470
960 min Summer	6.219	606
1440 min Summer	4.493	878
2160 min Summer	3.241	1252
2880 min Summer	2.568	1584
4320 min Summer	1.847	2208
5760 min Summer	1.461	2936
7200 min Summer	1.217	3672
8640 min Summer	1.048	4400
10080 min Summer	0.923	5088

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Source Control W.12.4

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Winter	90.634	0.634	0.0	4.1	4.1	70.4	O K
30 min Winter	90.779	0.779	0.0	4.5	4.5	90.1	Flood Risk
60 min Winter	90.904	0.904	0.0	4.8	4.8	107.2	Flood Risk
120 min Winter	90.983	0.983	0.0	5.0	5.0	118.0	Flood Risk
180 min Winter	90.989	0.989	0.0	5.0	5.0	118.8	Flood Risk
240 min Winter	90.967	0.967	0.0	5.0	5.0	115.9	Flood Risk
360 min Winter	90.920	0.920	0.0	4.8	4.8	109.4	Flood Risk
480 min Winter	90.873	0.873	0.0	4.7	4.7	103.0	Flood Risk
600 min Winter	90.826	0.826	0.0	4.6	4.6	96.6	Flood Risk
720 min Winter	90.780	0.780	0.0	4.5	4.5	90.3	Flood Risk
960 min Winter	90.692	0.692	0.0	4.2	4.2	78.2	O K
1440 min Winter	90.526	0.526	0.0	4.1	4.1	55.5	O K
2160 min Winter	90.290	0.290	0.0	4.1	4.1	23.2	O K
2880 min Winter	90.163	0.163	0.0	4.0	4.0	7.6	O K
4320 min Winter	90.107	0.107	0.0	3.0	3.0	3.2	O K
5760 min Winter	90.087	0.087	0.0	2.4	2.4	2.1	O K
7200 min Winter	90.075	0.075	0.0	2.0	2.0	1.6	O K
8640 min Winter	90.067	0.067	0.0	1.7	1.7	1.3	O K
10080 min Winter	90.062	0.062	0.0	1.5	1.5	1.1	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Winter	128.285	18
30 min Winter	84.226	32
60 min Winter	52.662	62
120 min Winter	31.800	118
180 min Winter	23.353	174
240 min Winter	18.644	224
360 min Winter	13.543	278
480 min Winter	10.792	356
600 min Winter	9.043	434
720 min Winter	7.823	508
960 min Winter	6.219	656
1440 min Winter	4.493	938
2160 min Winter	3.241	1280
2880 min Winter	2.568	1528
4320 min Winter	1.847	2204
5760 min Winter	1.461	2936
7200 min Winter	1.217	3584
8640 min Winter	1.048	4400
10080 min Winter	0.923	5136

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Date 25/03/2011 16:14 File Cat3 roadside no infil...	Designed By mp49220 Checked By	
Micro Drainage	Source Control W.12.4	

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time / Area Diagram

Total Area (ha) 0.275

Time	Area
(mins)	(ha)

0-4 0.275

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File Cat3 roadside no infil...	Checked By	
Micro Drainage		Source Control W.12.4

Model Details

Storage is Online Cover Level (m) 91.000

Infiltration Trench Structure

Infiltration Coefficient Base (m/hr)	0.00000	Trench Width (m)	1.9
Infiltration Coefficient Side (m/hr)	0.00000	Trench Length (m)	240.0
Safety Factor	2.0	Slope (1:X)	1000.0
Porosity	0.30	Cap Volume Depth (m)	0.000
Invert Level (m)	90.000	Cap Infiltration Depth (m)	0.000

Hydro-Brake® Outflow Control

Design Head (m)	1.000	Diameter (mm)	94
Design Flow (l/s)	5.0	Invert Level (m)	90.000

Hydro-Brake® Type Md6 SW Only

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.8	1.200	5.5	3.000	8.7	7.000	13.3
0.200	4.1	1.400	6.0	3.500	9.4	7.500	13.8
0.300	3.9	1.600	6.4	4.000	10.1	8.000	14.3
0.400	3.8	1.800	6.8	4.500	10.7	8.500	14.7
0.500	3.8	2.000	7.1	5.000	11.3	9.000	15.1
0.600	4.0	2.200	7.5	5.500	11.8	9.500	15.5
0.800	4.5	2.400	7.8	6.000	12.3		
1.000	5.0	2.600	8.1	6.500	12.9		

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Date 25/03/2011 16:15	Designed By mp49220	
File Cat3 roadside infiltra...	Checked By	
Micro Drainage	Source Control W.12.4	

Summary of Results for 100 year Return Period (+30%)

Half Drain Time : 161 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	90.575	0.575	5.3	62.2	O K
30 min Summer	90.697	0.697	5.7	79.0	O K
60 min Summer	90.797	0.797	6.1	92.6	Flood Risk
120 min Summer	90.842	0.842	6.3	98.7	Flood Risk
180 min Summer	90.839	0.839	6.3	98.3	Flood Risk
240 min Summer	90.825	0.825	6.2	96.4	Flood Risk
360 min Summer	90.790	0.790	6.1	91.6	Flood Risk
480 min Summer	90.753	0.753	5.9	86.5	Flood Risk
600 min Summer	90.716	0.716	5.8	81.6	Flood Risk
720 min Summer	90.682	0.682	5.7	76.8	O K
960 min Summer	90.618	0.618	5.4	68.2	O K
1440 min Summer	90.512	0.512	5.0	53.7	O K
2160 min Summer	90.394	0.394	4.6	37.4	O K
2880 min Summer	90.311	0.311	4.3	26.1	O K
4320 min Summer	90.227	0.227	3.8	14.7	O K
5760 min Summer	90.191	0.191	3.1	10.4	O K
7200 min Summer	90.165	0.165	2.7	7.8	O K
8640 min Summer	90.146	0.146	2.3	6.0	O K
10080 min Summer	90.130	0.130	2.1	4.8	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Summer	128.285	18
30 min Summer	84.226	33
60 min Summer	52.662	62
120 min Summer	31.800	116
180 min Summer	23.353	144
240 min Summer	18.644	176
360 min Summer	13.543	244
480 min Summer	10.792	314
600 min Summer	9.043	382
720 min Summer	7.823	450
960 min Summer	6.219	580
1440 min Summer	4.493	838
2160 min Summer	3.241	1208
2880 min Summer	2.568	1556
4320 min Summer	1.847	2244
5760 min Summer	1.461	2944
7200 min Summer	1.217	3672
8640 min Summer	1.048	4408
10080 min Summer	0.923	5136

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Date 25/03/2011 16:15		Designed By mp49220			
File Cat3 roadside infiltra...		Checked By			
Micro Drainage		Source Control W.12.4			
Summary of Results for 100 year Return Period (+30%)					
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Winter	90.632	0.632	5.5	70.0	O K
30 min Winter	90.772	0.772	6.0	89.3	Flood Risk
60 min Winter	90.889	0.889	6.4	105.2	Flood Risk
120 min Winter	90.951	0.951	6.7	113.7	Flood Risk
180 min Winter	90.944	0.944	6.6	112.7	Flood Risk
240 min Winter	90.927	0.927	6.6	110.4	Flood Risk
360 min Winter	90.879	0.879	6.4	103.8	Flood Risk
480 min Winter	90.825	0.825	6.2	96.5	Flood Risk
600 min Winter	90.772	0.772	6.0	89.2	Flood Risk
720 min Winter	90.722	0.722	5.8	82.3	Flood Risk
960 min Winter	90.630	0.630	5.5	69.8	O K
1440 min Winter	90.482	0.482	4.9	49.5	O K
2160 min Winter	90.325	0.325	4.3	28.1	O K
2880 min Winter	90.238	0.238	4.0	16.2	O K
4320 min Winter	90.181	0.181	2.9	9.4	O K
5760 min Winter	90.147	0.147	2.3	6.2	O K
7200 min Winter	90.125	0.125	2.0	4.4	O K
8640 min Winter	90.109	0.109	1.7	3.4	O K
10080 min Winter	90.096	0.096	1.5	2.6	O K
Storm Event	Rain (mm/hr)		Time-Peak (mins)		
15 min Winter	128.285		18		
30 min Winter	84.226		32		
60 min Winter	52.662		60		
120 min Winter	31.800		116		
180 min Winter	23.353		162		
240 min Winter	18.644		186		
360 min Winter	13.543		264		
480 min Winter	10.792		340		
600 min Winter	9.043		412		
720 min Winter	7.823		484		
960 min Winter	6.219		624		
1440 min Winter	4.493		882		
2160 min Winter	3.241		1236		
2880 min Winter	2.568		1528		
4320 min Winter	1.847		2248		
5760 min Winter	1.461		2944		
7200 min Winter	1.217		3672		
8640 min Winter	1.048		4368		
10080 min Winter	0.923		5136		
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Date 25/03/2011 16:15
File Cat3 roadside infiltra...

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Micro Drainage

Source Control W.12.4



Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time / Area Diagram

Total Area (ha) 0.275

Time	Area
(mins)	(ha)

0-4 0.275

Date 25/03/2011 16:15
File Cat3 roadside infiltra...

Checked By

Source Control W.12.4



Storage is Online Cover Level (m) 91.000

Infiltration Coefficient Base (m/hr)	0.05600	Trench Width (m)	1.9
Infiltration Coefficient Side (m/hr)	0.05600	Trench Length (m)	240.0
Safety Factor	2.0	Slope (1:X)	1000.0
Porosity	0.30	Cap Volume Depth (m)	0.000
Invert Level (m)	90.000	Cap Infiltration Depth (m)	0.000

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Checked By



Source Control W.12.4

Half Drain Time : 328 minutes.

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Summer	128.285	25
30 min Summer	84.226	39
60 min Summer	52.662	68
120 min Summer	31.800	126
180 min Summer	23.353	184
240 min Summer	18.644	240
360 min Summer	13.543	300
480 min Summer	10.792	362
600 min Summer	9.043	428
720 min Summer	7.823	496
960 min Summer	6.219	632
1440 min Summer	4.493	900
2160 min Summer	3.241	1280
2880 min Summer	2.568	1624
4320 min Summer	1.847	2256
5760 min Summer	1.461	2944
7200 min Summer	1.217	3672
8640 min Summer	1.048	4400
10080 min Summer	0.923	5136

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Source Control W.12.4

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m ³)	Status
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Storm Event	Rain (mm/hr)	Time-Peak (mins)
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15 min Winter	128.285	25
30 min Winter	84.226	39
60 min Winter	52.662	66
120 min Winter	31.800	124
180 min Winter	23.353	180
240 min Winter	18.644	236
360 min Winter	13.543	340
480 min Winter	10.792	384
600 min Winter	9.043	462
720 min Winter	7.823	538
960 min Winter	6.219	688
1440 min Winter	4.493	974
2160 min Winter	3.241	1348
2880 min Winter	2.568	1644
4320 min Winter	1.847	2248
5760 min Winter	1.461	2936
7200 min Winter	1.217	3672
8640 min Winter	1.048	4408
10080 min Winter	0.923	5048

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Source Control W.12.4

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Date 25/03/2011 16:17	Designed By mp49220	
File Cat4 swale no infiltra...	Checked By	
Micro Drainage		Source Control W.12.4

Model Details

Storage is Online Cover Level (m) 90.500

Swale Structure

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	100.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	3.0
Safety Factor	2.0	Slope (1:X)	1000.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	89.500	Cap Infiltration Depth (m)	0.000
Base Width (m)	1.0		

Hydro-Brake® Outflow Control

Design Head (m)	0.700	Diameter (mm)	101
Design Flow (l/s)	5.0	Invert Level (m)	89.500
Hydro-Brake® Type Md6 SW Only			

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.1	1.200	6.4	3.000	10.1	7.000	15.4
0.200	4.9	1.400	6.9	3.500	10.9	7.500	15.9
0.300	4.7	1.600	7.4	4.000	11.6	8.000	16.5
0.400	4.5	1.800	7.8	4.500	12.3	8.500	17.0
0.500	4.5	2.000	8.2	5.000	13.0	9.000	17.5
0.600	4.7	2.200	8.6	5.500	13.6	9.500	17.9
0.800	5.2	2.400	9.0	6.000	14.3		
1.000	5.8	2.600	9.4	6.500	14.8		

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Date 25/03/2011 16:18		Designed By mp49220			
File Cat4 swale infiltratio...		Checked By			
Micro Drainage		Source Control W.12.4			
<u>Summary of Results for 100 year Return Period (+30%)</u> Half Drain Time : 486 minutes.					
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	89.951	0.451	2.8	88.7	O K
30 min Summer	90.024	0.524	3.1	115.2	O K
60 min Summer	90.088	0.588	3.4	141.0	O K
120 min Summer	90.138	0.638	3.7	162.9	O K
180 min Summer	90.158	0.658	3.8	171.9	O K
240 min Summer	90.165	0.665	3.8	175.4	O K
360 min Summer	90.166	0.666	3.8	175.9	O K
480 min Summer	90.164	0.664	3.8	174.8	O K
600 min Summer	90.160	0.660	3.8	173.0	O K
720 min Summer	90.156	0.656	3.8	170.8	O K
960 min Summer	90.144	0.644	3.7	165.6	O K
1440 min Summer	90.118	0.618	3.6	153.9	O K
2160 min Summer	90.079	0.579	3.4	137.2	O K
2880 min Summer	90.044	0.544	3.2	122.9	O K
4320 min Summer	89.984	0.484	2.9	100.2	O K
5760 min Summer	89.934	0.434	2.7	82.9	O K
7200 min Summer	89.892	0.392	2.5	69.7	O K
8640 min Summer	89.856	0.356	2.3	59.0	O K
10080 min Summer	89.825	0.325	2.1	50.6	O K
Storm Event	Rain (mm/hr)		Time-Peak (mins)		
15 min Summer	128.285		26		
30 min Summer	84.226		40		
60 min Summer	52.662		68		
120 min Summer	31.800		126		
180 min Summer	23.353		184		
240 min Summer	18.644		244		
360 min Summer	13.543		338		
480 min Summer	10.792		394		
600 min Summer	9.043		456		
720 min Summer	7.823		520		
960 min Summer	6.219		658		
1440 min Summer	4.493		930		
2160 min Summer	3.241		1344		
2880 min Summer	2.568		1736		
4320 min Summer	1.847		2512		
5760 min Summer	1.461		3240		
7200 min Summer	1.217		3968		
8640 min Summer	1.048		4680		
10080 min Summer	0.923		5448		
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Micro Drainage		Source Control W.12.4				
Summary of Results for 100 year Return Period (+30%)						
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status	
15 min Winter	89.982	0.482	2.9	99.5	O K	
30 min Winter	90.060	0.560	3.3	129.5	O K	
60 min Winter	90.129	0.629	3.6	158.7	O K	
120 min Winter	90.184	0.684	3.9	184.2	O K	
180 min Winter	90.206	0.706	4.0	195.1	Flood Risk	
240 min Winter	90.216	0.716	4.1	199.8	Flood Risk	
360 min Winter	90.220	0.720	4.1	201.9	Flood Risk	
480 min Winter	90.216	0.716	4.1	199.8	Flood Risk	
600 min Winter	90.211	0.711	4.1	197.2	Flood Risk	
720 min Winter	90.205	0.705	4.0	194.4	Flood Risk	
960 min Winter	90.190	0.690	4.0	187.1	O K	
1440 min Winter	90.155	0.655	3.8	170.4	O K	
2160 min Winter	90.101	0.601	3.5	146.6	O K	
2880 min Winter	90.053	0.553	3.3	126.3	O K	
4320 min Winter	89.971	0.471	2.9	95.5	O K	
5760 min Winter	89.905	0.405	2.5	73.7	O K	
7200 min Winter	89.852	0.352	2.3	57.8	O K	
8640 min Winter	89.808	0.308	2.1	45.9	O K	
10080 min Winter	89.771	0.271	1.9	36.9	O K	
Storm Event	Rain (mm/hr)		Time-Peak (mins)			
15 min Winter	128.285		26			
30 min Winter	84.226		39			
60 min Winter	52.662		68			
120 min Winter	31.800		124			
180 min Winter	23.353		182			
240 min Winter	18.644		238			
360 min Winter	13.543		348			
480 min Winter	10.792		446			
600 min Winter	9.043		478			
720 min Winter	7.823		554			
960 min Winter	6.219		708			
1440 min Winter	4.493		1010			
2160 min Winter	3.241		1436			
2880 min Winter	2.568		1848			
4320 min Winter	1.847		2640			
5760 min Winter	1.461		3400			
7200 min Winter	1.217		4112			
8640 min Winter	1.048		4840			
10080 min Winter	0.923		5552			
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Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.095	4-8	0.190	8-12	0.095

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Micro Drainage	Source Control W.12.4	

Model Details

Storage is Online Cover Level (m) 90.500

Swale Structure

Infiltration Coefficient Base (m/hr)	0.05600	Length (m)	100.0
Infiltration Coefficient Side (m/hr)	0.05600	Side Slope (1:X)	3.0
Safety Factor	2.0	Slope (1:X)	1000.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	89.500	Cap Infiltration Depth (m)	0.000
Base Width (m)	1.0		

Source Control W.12.4



Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m ³)	Status
----------------	---------------------	---------------------	------------------------------	-------------------------	---------------------------	------------------------------------	--------

15 min Winter	89.989	0.489	0.0	4.9	4.9	88.7	O K
30 min Winter	90.070	0.570	0.0	4.9	4.9	114.8	O K
60 min Winter	90.136	0.636	0.0	4.9	4.9	138.5	O K
120 min Winter	90.181	0.681	0.0	4.9	4.9	155.6	O K
180 min Winter	90.191	0.691	0.0	4.9	4.9	159.6	O K
240 min Winter	90.187	0.687	0.0	4.9	4.9	158.2	O K
360 min Winter	90.167	0.667	0.0	4.9	4.9	150.2	O K
480 min Winter	90.147	0.647	0.0	4.9	4.9	142.6	O K
600 min Winter	90.126	0.626	0.0	4.9	4.9	134.9	O K
720 min Winter	90.104	0.604	0.0	4.9	4.9	127.0	O K
960 min Winter	90.060	0.560	0.0	4.9	4.9	111.4	O K
1440 min Winter	89.964	0.464	0.0	4.9	4.9	81.1	O K
2160 min Winter	89.805	0.305	0.0	4.9	4.9	39.9	O K
2880 min Winter	89.688	0.188	0.0	4.8	4.8	16.8	O K
4320 min Winter	89.621	0.121	0.0	3.8	3.8	6.8	O K
5760 min Winter	89.598	0.098	0.0	3.0	3.0	4.3	O K
7200 min Winter	89.585	0.085	0.0	2.5	2.5	3.2	O K
8640 min Winter	89.576	0.076	0.0	2.2	2.2	2.5	O K
10080 min Winter	89.569	0.069	0.0	1.9	1.9	2.1	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Winter	128.285	25
30 min Winter	84.226	39
60 min Winter	52.662	66
120 min Winter	31.800	124
180 min Winter	23.353	180
240 min Winter	18.644	234
360 min Winter	13.543	330
480 min Winter	10.792	376
600 min Winter	9.043	454
720 min Winter	7.823	530
960 min Winter	6.219	678
1440 min Winter	4.493	958
2160 min Winter	3.241	1308
2880 min Winter	2.568	1588
4320 min Winter	1.847	2212
5760 min Winter	1.461	2920
7200 min Winter	1.217	3632
8640 min Winter	1.048	4352
10080 min Winter	0.923	5112

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Source Control W.12.4



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Micro Drainage	Source Control W.12.4	

Model Details

Storage is Online Cover Level (m) 90.500

Swale Structure

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	150.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	1.5
Safety Factor	2.0	Slope (1:X)	1000.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	89.500	Cap Infiltration Depth (m)	0.000
Base Width (m)	0.8		

Hydro-Brake® Outflow Control

Design Head (m)	0.700	Diameter (mm)	101
Design Flow (l/s)	5.0	Invert Level (m)	89.500
Hydro-Brake® Type Md6 SW Only			

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.1	1.200	6.4	3.000	10.1	7.000	15.4
0.200	4.9	1.400	6.9	3.500	10.9	7.500	15.9
0.300	4.7	1.600	7.4	4.000	11.6	8.000	16.5
0.400	4.5	1.800	7.8	4.500	12.3	8.500	17.0
0.500	4.5	2.000	8.2	5.000	13.0	9.000	17.5
0.600	4.7	2.200	8.6	5.500	13.6	9.500	17.9
0.800	5.2	2.400	9.0	6.000	14.3		
1.000	5.8	2.600	9.4	6.500	14.8		

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Micro Drainage			Source Control W.12.4		
<u>Summary of Results for 100 year Return Period (+30%)</u>					
Half Drain Time : 480 minutes.					
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	89.966	0.466	2.6	81.6	O K
30 min Summer	90.044	0.544	2.9	106.1	O K
60 min Summer	90.112	0.612	3.2	129.7	O K
120 min Summer	90.166	0.666	3.4	149.8	O K
180 min Summer	90.187	0.687	3.5	158.0	O K
240 min Summer	90.194	0.694	3.6	161.0	O K
360 min Summer	90.195	0.695	3.6	161.3	O K
480 min Summer	90.192	0.692	3.5	160.1	O K
600 min Summer	90.188	0.688	3.5	158.4	O K
720 min Summer	90.182	0.682	3.5	156.2	O K
960 min Summer	90.169	0.669	3.4	151.2	O K
1440 min Summer	90.140	0.640	3.3	140.2	O K
2160 min Summer	90.098	0.598	3.1	124.7	O K
2880 min Summer	90.060	0.560	3.0	111.5	O K
4320 min Summer	89.994	0.494	2.7	90.3	O K
5760 min Summer	89.940	0.440	2.5	74.3	O K
7200 min Summer	89.895	0.395	2.3	61.8	O K
8640 min Summer	89.856	0.356	2.1	51.9	O K
10080 min Summer	89.822	0.322	2.0	43.9	O K
Storm Event	Rain (mm/hr)		Time-Peak (mins)		
15 min Summer	128.285		26		
30 min Summer	84.226		40		
60 min Summer	52.662		68		
120 min Summer	31.800		126		
180 min Summer	23.353		184		
240 min Summer	18.644		244		
360 min Summer	13.543		338		
480 min Summer	10.792		392		
600 min Summer	9.043		454		
720 min Summer	7.823		520		
960 min Summer	6.219		658		
1440 min Summer	4.493		930		
2160 min Summer	3.241		1344		
2880 min Summer	2.568		1736		
4320 min Summer	1.847		2512		
5760 min Summer	1.461		3240		
7200 min Summer	1.217		3968		
8640 min Summer	1.048		4680		
10080 min Summer	0.923		5448		
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Micro Drainage		Source Control W.12.4			
Summary of Results for 100 year Return Period (+30%)					
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Winter	89.999	0.499	2.7	91.6	O K
30 min Winter	90.082	0.582	3.1	119.2	O K
60 min Winter	90.156	0.656	3.4	146.0	O K
120 min Winter	90.215	0.715	3.6	169.4	Flood Risk
180 min Winter	90.239	0.739	3.7	179.3	Flood Risk
240 min Winter	90.249	0.749	3.8	183.5	Flood Risk
360 min Winter	90.253	0.753	3.8	185.3	Flood Risk
480 min Winter	90.248	0.748	3.8	183.1	Flood Risk
600 min Winter	90.242	0.742	3.8	180.7	Flood Risk
720 min Winter	90.236	0.736	3.7	177.9	Flood Risk
960 min Winter	90.219	0.719	3.7	170.9	Flood Risk
1440 min Winter	90.180	0.680	3.5	155.2	O K
2160 min Winter	90.121	0.621	3.2	133.1	O K
2880 min Winter	90.068	0.568	3.0	114.4	O K
4320 min Winter	89.979	0.479	2.6	85.7	O K
5760 min Winter	89.908	0.408	2.3	65.3	O K
7200 min Winter	89.850	0.350	2.1	50.4	O K
8640 min Winter	89.802	0.302	1.9	39.3	O K
10080 min Winter	89.762	0.262	1.7	30.8	O K
Storm Event	Rain (mm/hr)		Time-Peak (mins)		
15 min Winter	128.285		26		
30 min Winter	84.226		39		
60 min Winter	52.662		68		
120 min Winter	31.800		124		
180 min Winter	23.353		182		
240 min Winter	18.644		238		
360 min Winter	13.543		348		
480 min Winter	10.792		444		
600 min Winter	9.043		478		
720 min Winter	7.823		554		
960 min Winter	6.219		708		
1440 min Winter	4.493		1008		
2160 min Winter	3.241		1432		
2880 min Winter	2.568		1848		
4320 min Winter	1.847		2640		
5760 min Winter	1.461		3400		
7200 min Winter	1.217		4112		
8640 min Winter	1.048		4840		
10080 min Winter	0.923		5552		

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Source Control W.12.4



Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Total Area (ha) 0.350

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.088	4-8	0.175	8-12	0.087

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Micro Drainage		Source Control W.12.4

Model Details

Storage is Online Cover Level (m) 90.500

Swale Structure

Infiltration Coefficient Base (m/hr)	0.05600	Length (m)	150.0
Infiltration Coefficient Side (m/hr)	0.05600	Side Slope (1:X)	1.5
Safety Factor	2.0	Slope (1:X)	1000.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	89.500	Cap Infiltration Depth (m)	0.000
Base Width (m)	0.8		

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Micro Drainage		Source Control W.12.4			
<u>Summary of Results for 100 year Return Period (+30%)</u> Half Drain Time : 72 minutes.					
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	89.325	0.025	3.5	22.1	O K
30 min Summer	89.330	0.030	4.3	27.3	O K
60 min Summer	89.334	0.034	4.8	30.4	O K
120 min Summer	89.335	0.035	5.0	31.8	O K
180 min Summer	89.335	0.035	4.9	31.5	O K
240 min Summer	89.334	0.034	4.8	30.5	O K
360 min Summer	89.332	0.032	4.5	28.4	O K
480 min Summer	89.329	0.029	4.1	26.4	O K
600 min Summer	89.327	0.027	3.8	24.7	O K
720 min Summer	89.326	0.026	3.6	23.1	O K
960 min Summer	89.323	0.023	3.2	20.6	O K
1440 min Summer	89.319	0.019	2.6	17.0	O K
2160 min Summer	89.315	0.015	2.1	13.6	O K
2880 min Summer	89.313	0.013	1.8	11.4	O K
4320 min Summer	89.310	0.010	1.4	8.7	O K
5760 min Summer	89.308	0.008	1.1	7.2	O K
7200 min Summer	89.307	0.007	1.0	6.0	O K
8640 min Summer	89.306	0.006	0.8	5.3	O K
10080 min Summer	89.305	0.005	0.7	4.6	O K
Storm Event	Rain (mm/hr)		Time-Peak (mins)		
15 min Summer	128.285		17		
30 min Summer	84.226		31		
60 min Summer	52.662		52		
120 min Summer	31.800		84		
180 min Summer	23.353		118		
240 min Summer	18.644		152		
360 min Summer	13.543		218		
480 min Summer	10.792		284		
600 min Summer	9.043		348		
720 min Summer	7.823		412		
960 min Summer	6.219		538		
1440 min Summer	4.493		780		
2160 min Summer	3.241		1144		
2880 min Summer	2.568		1500		
4320 min Summer	1.847		2244		
5760 min Summer	1.461		2952		
7200 min Summer	1.217		3680		
8640 min Summer	1.048		4416		
10080 min Summer	0.923		5144		
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Micro Drainage		Source Control W.12.4				
Summary of Results for 100 year Return Period (+30%)						
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status	
15 min Winter	89.328	0.028	3.9	24.9	O K	
30 min Winter	89.334	0.034	4.8	30.7	O K	
60 min Winter	89.338	0.038	5.3	34.2	O K	
120 min Winter	89.339	0.039	5.5	35.2	O K	
180 min Winter	89.338	0.038	5.3	34.1	O K	
240 min Winter	89.336	0.036	5.1	32.5	O K	
360 min Winter	89.333	0.033	4.6	29.3	O K	
480 min Winter	89.329	0.029	4.1	26.5	O K	
600 min Winter	89.327	0.027	3.8	24.1	O K	
720 min Winter	89.325	0.025	3.5	22.1	O K	
960 min Winter	89.321	0.021	3.0	19.1	O K	
1440 min Winter	89.317	0.017	2.4	14.9	O K	
2160 min Winter	89.313	0.013	1.8	11.3	O K	
2880 min Winter	89.310	0.010	1.4	9.2	O K	
4320 min Winter	89.308	0.008	1.1	6.8	O K	
5760 min Winter	89.306	0.006	0.9	5.4	O K	
7200 min Winter	89.305	0.005	0.7	4.5	O K	
8640 min Winter	89.304	0.004	0.6	3.9	O K	
10080 min Winter	89.304	0.004	0.5	3.5	O K	
Storm Event	Rain (mm/hr)		Time-Peak (mins)			
15 min Winter	128.285		17			
30 min Winter	84.226		31			
60 min Winter	52.662		56			
120 min Winter	31.800		90			
180 min Winter	23.353		126			
240 min Winter	18.644		162			
360 min Winter	13.543		232			
480 min Winter	10.792		300			
600 min Winter	9.043		364			
720 min Winter	7.823		428			
960 min Winter	6.219		556			
1440 min Winter	4.493		796			
2160 min Winter	3.241		1164			
2880 min Winter	2.568		1528			
4320 min Winter	1.847		2216			
5760 min Winter	1.461		2912			
7200 min Winter	1.217		3616			
8640 min Winter	1.048		4504			
10080 min Winter	0.923		5256			
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File Cat6 basin infiltratio...

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Micro Drainage

Source Control W.12.4

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time / Area Diagram

Total Area (ha) 0.100

Time (mins)	Area (ha)
----------------	--------------

0-4	0.100
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All Saints Street
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File Cat6 basin infiltratio...

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Micro Drainage

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Model Details

Storage is Online Cover Level (m) 90.300

Infiltration Basin Structure

Invert Level (m)	89.300	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.05600	Porosity	1.00
Infiltration Coefficient Side (m/hr)	0.05600		

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	900.0	1.000	900.0

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Micro Drainage		Source Control W.12.4				
Summary of Results for 100 year Return Period (+30%)						
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status	
15 min Summer	89.327	0.027	0.4	23.9	O K	
30 min Summer	89.334	0.034	0.6	31.0	O K	
60 min Summer	89.342	0.042	1.0	38.0	O K	
120 min Summer	89.349	0.049	1.3	43.7	O K	
180 min Summer	89.351	0.051	1.4	45.8	O K	
240 min Summer	89.352	0.052	1.4	46.4	O K	
360 min Summer	89.353	0.053	1.5	47.3	O K	
480 min Summer	89.353	0.053	1.5	47.8	O K	
600 min Summer	89.353	0.053	1.5	48.1	O K	
720 min Summer	89.353	0.053	1.5	48.1	O K	
960 min Summer	89.353	0.053	1.5	47.8	O K	
1440 min Summer	89.352	0.052	1.4	46.4	O K	
2160 min Summer	89.349	0.049	1.3	44.1	O K	
2880 min Summer	89.347	0.047	1.2	41.9	O K	
4320 min Summer	89.343	0.043	1.0	38.4	O K	
5760 min Summer	89.340	0.040	0.9	35.6	O K	
7200 min Summer	89.337	0.037	0.8	33.4	O K	
8640 min Summer	89.335	0.035	0.7	31.7	O K	
10080 min Summer	89.334	0.034	0.6	30.2	O K	
15 min Winter	89.330	0.030	0.5	26.7	O K	
Storm Event	Rain (mm/hr)		Time-Peak (mins)			
15 min Summer	128.285		19			
30 min Summer	84.226		34			
60 min Summer	52.662		62			
120 min Summer	31.800		122			
180 min Summer	23.353		180			
240 min Summer	18.644		218			
360 min Summer	13.543		272			
480 min Summer	10.792		336			
600 min Summer	9.043		404			
720 min Summer	7.823		470			
960 min Summer	6.219		606			
1440 min Summer	4.493		868			
2160 min Summer	3.241		1256			
2880 min Summer	2.568		1644			
4320 min Summer	1.847		2380			
5760 min Summer	1.461		3120			
7200 min Summer	1.217		3888			
8640 min Summer	1.048		4584			
10080 min Summer	0.923		5344			
15 min Winter	128.285		19			
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5th Floor, The Pithay
All Saints Street
Bristol BS1 2NL

Date 25/03/2011 16:29

Designed By mp49220

File Cat6 basin no infiltra...

Checked By



Micro Drainage

Source Control W.12.4

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
30 min Winter	89.339	0.039	0.8	34.7	O K
60 min Winter	89.347	0.047	1.2	42.4	O K
120 min Winter	89.354	0.054	1.6	48.7	O K
180 min Winter	89.357	0.057	1.7	51.0	O K
240 min Winter	89.357	0.057	1.7	51.7	O K
360 min Winter	89.358	0.058	1.8	52.3	O K
480 min Winter	89.358	0.058	1.8	52.5	O K
600 min Winter	89.358	0.058	1.8	52.3	O K
720 min Winter	89.358	0.058	1.8	51.8	O K
960 min Winter	89.356	0.056	1.7	50.6	O K
1440 min Winter	89.353	0.053	1.5	47.9	O K
2160 min Winter	89.349	0.049	1.3	44.2	O K
2880 min Winter	89.346	0.046	1.1	41.3	O K
4320 min Winter	89.341	0.041	0.9	36.7	O K
5760 min Winter	89.337	0.037	0.8	33.5	O K
7200 min Winter	89.335	0.035	0.7	31.1	O K
8640 min Winter	89.332	0.032	0.6	29.2	O K
10080 min Winter	89.331	0.031	0.5	27.6	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
30 min Winter	84.226	33
60 min Winter	52.662	62
120 min Winter	31.800	118
180 min Winter	23.353	174
240 min Winter	18.644	226
360 min Winter	13.543	278
480 min Winter	10.792	354
600 min Winter	9.043	428
720 min Winter	7.823	500
960 min Winter	6.219	644
1440 min Winter	4.493	922
2160 min Winter	3.241	1320
2880 min Winter	2.568	1704
4320 min Winter	1.847	2468
5760 min Winter	1.461	3224
7200 min Winter	1.217	3960
8640 min Winter	1.048	4752
10080 min Winter	0.923	5448

Date 25/03/2011 16:29
File Cat6 basin no infiltra...

Designed By mp49220
Checked By



Source Control W.12.4

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Total Area (ha) 0.100

0-4 0.100

Source Control W.12.4



Storage is Online Cover Level (m) 90.300

Invert Level (m) 89.300

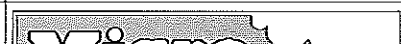
Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	900.0	1.000	900.0

Design Head (m)	0.500	Hydro-Brake® Type	Md2	Invert Level (m)	89.300
Design Flow (l/s)	10.0	Diameter (mm)	117		

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.6	1.200	15.7	3.000	24.7	7.000	37.8
0.200	8.8	1.400	16.9	3.500	26.7	7.500	39.1
0.300	8.4	1.600	18.1	4.000	28.6	8.000	40.4
0.400	9.1	1.800	19.2	4.500	30.3	8.500	41.7
0.500	10.1	2.000	20.2	5.000	31.9	9.000	42.9
0.600	11.1	2.200	21.2	5.500	33.5	9.500	44.0
0.800	12.8	2.400	22.1	6.000	35.0		
1.000	14.3	2.600	23.0	6.500	36.4		

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5th Floor, The Pithay All Saints Street Bristol BS1 2NL					
Date 05/04/2011 14:37		Designed By mp49220			
File Cat7 swale infiltratio...		Checked By			
Micro Drainage		Source Control W.12.4			
Summary of Results for 100 year Return Period (+30%)					
Half Drain Time : 715 minutes.					
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	84.326	0.526	2.1	94.1	O K
30 min Summer	84.430	0.630	2.4	122.6	O K
60 min Summer	84.523	0.723	2.6	150.8	Flood Risk
120 min Summer	84.602	0.802	2.8	176.5	Flood Risk
180 min Summer	84.636	0.836	2.9	188.6	Flood Risk
240 min Summer	84.654	0.854	2.9	194.7	Flood Risk
360 min Summer	84.668	0.868	3.0	199.8	Flood Risk
480 min Summer	84.669	0.869	3.0	200.2	Flood Risk
600 min Summer	84.666	0.866	3.0	199.1	Flood Risk
720 min Summer	84.662	0.862	3.0	197.7	Flood Risk
960 min Summer	84.652	0.852	2.9	194.0	Flood Risk
1440 min Summer	84.626	0.826	2.9	185.1	Flood Risk
2160 min Summer	84.583	0.783	2.8	170.4	Flood Risk
2880 min Summer	84.542	0.742	2.7	156.7	Flood Risk
4320 min Summer	84.469	0.669	2.5	134.1	O K
5760 min Summer	84.406	0.606	2.3	115.7	O K
7200 min Summer	84.351	0.551	2.2	100.6	O K
8640 min Summer	84.302	0.502	2.0	88.0	O K
10080 min Summer	84.258	0.458	1.9	77.3	O K
Storm Event	Rain (mm/hr)		Time-Peak (mins)		
15 min Summer	128.285		26		
30 min Summer	84.226		40		
60 min Summer	52.662		70		
120 min Summer	31.800		128		
180 min Summer	23.353		186		
240 min Summer	18.644		246		
360 min Summer	13.543		364		
480 min Summer	10.792		476		
600 min Summer	9.043		522		
720 min Summer	7.823		582		
960 min Summer	6.219		708		
1440 min Summer	4.493		982		
2160 min Summer	3.241		1392		
2880 min Summer	2.568		1796		
4320 min Summer	1.847		2600		
5760 min Summer	1.461		3360		
7200 min Summer	1.217		4112		
8640 min Summer	1.048		4848		
10080 min Summer	0.923		5560		
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Date 05/04/2011 14:37		Designed By mp49220				
File Cat7 swale infiltratio...		Checked By				
Micro Drainage		Source Control W.12.4				
Summary of Results for 100 year Return Period (+30%)						
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status	
15 min Winter	84.369	0.569	2.2	105.5	O K	
30 min Winter	84.481	0.681	2.5	137.7	O K	
60 min Winter	84.581	0.781	2.8	169.6	Flood Risk	
120 min Winter	84.666	0.866	3.0	199.1	Flood Risk	
180 min Winter	84.705	0.905	3.1	213.2	Flood Risk	
240 min Winter	84.725	0.925	3.1	220.8	Flood Risk	
360 min Winter	84.744	0.944	3.2	227.9	Flood Risk	
480 min Winter	84.749	0.949	3.2	229.8	Flood Risk	
600 min Winter	84.746	0.946	3.2	228.8	Flood Risk	
720 min Winter	84.739	0.939	3.2	226.2	Flood Risk	
960 min Winter	84.727	0.927	3.1	221.6	Flood Risk	
1440 min Winter	84.695	0.895	3.0	209.7	Flood Risk	
2160 min Winter	84.638	0.838	2.9	189.3	Flood Risk	
2880 min Winter	84.582	0.782	2.8	169.8	Flood Risk	
4320 min Winter	84.480	0.680	2.5	137.4	O K	
5760 min Winter	84.394	0.594	2.3	112.5	O K	
7200 min Winter	84.321	0.521	2.1	92.8	O K	
8640 min Winter	84.257	0.457	1.9	76.9	O K	
10080 min Winter	84.201	0.401	1.8	64.2	O K	
Storm Event		Rain (mm/hr)	Time-Peak (mins)			
15 min Winter		128.285	26			
30 min Winter		84.226	40			
60 min Winter		52.662	68			
120 min Winter		31.800	126			
180 min Winter		23.353	184			
240 min Winter		18.644	240			
360 min Winter		13.543	354			
480 min Winter		10.792	464			
600 min Winter		9.043	570			
720 min Winter		7.823	662			
960 min Winter		6.219	750			
1440 min Winter		4.493	1058			
2160 min Winter		3.241	1504			
2880 min Winter		2.568	1936			
4320 min Winter		1.847	2768			
5760 min Winter		1.461	3568			
7200 min Winter		1.217	4328			
8640 min Winter		1.048	5096			
10080 min Winter		0.923	5768			
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5th Floor, The Pithay All Saints Street Bristol BS1 2NL		
Date 05/04/2011 14:37	Designed By mp49220	
File Cat7 swale infiltratio...	Checked By	
Micro Drainage	Source Control W.12.4	

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time / Area Diagram

Total Area (ha) 0.400

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.100	4-8	0.200	8-12	0.100

Hyder Consulting Limited		Page 4
5th Floor, The Pithay All Saints Street Bristol BS1 2NL		
Date 05/04/2011 14:37 File Cat7 swale infiltratio...	Designed By mp49220 Checked By	
Micro Drainage	Source Control W.12.4	

Model Details

Storage is Online Cover Level (m) 84.800

Swale Structure

Infiltration Coefficient Base (m/hr)	0.05600	Length (m)	50.0
Infiltration Coefficient Side (m/hr)	0.05600	Side Slope (1:X)	3.0
Safety Factor	2.0	Slope (1:X)	0.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	83.800	Cap Infiltration Depth (m)	0.000
Base Width (m)	2.0		

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5th Floor, The Pithay All Saints Street Bristol BS1 2NL						
Date 05/04/2011 14:27 File Cat7 swale no infiltra...		Designed By mp49220 Checked By				
Micro Drainage		Source Control W.12.4				
Summary of Results for 100 year Return Period (+30%)						
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status	
15 min Summer	84.216	0.416	16.9	83.2	O K	
30 min Summer	84.322	0.522	17.2	104.4	O K	
60 min Summer	84.384	0.584	18.2	116.7	O K	
120 min Summer	84.394	0.594	18.4	118.9	O K	
180 min Summer	84.371	0.571	18.0	114.2	O K	
240 min Summer	84.338	0.538	17.5	107.6	O K	
360 min Summer	84.270	0.470	16.9	94.0	O K	
480 min Summer	84.205	0.405	16.9	81.0	O K	
600 min Summer	84.142	0.342	16.9	68.4	O K	
720 min Summer	84.092	0.292	16.9	58.3	O K	
960 min Summer	84.035	0.235	15.9	47.0	O K	
1440 min Summer	83.979	0.179	13.1	35.9	O K	
2160 min Summer	83.944	0.144	10.1	28.7	O K	
2880 min Summer	83.924	0.124	8.1	24.9	O K	
4320 min Summer	83.903	0.103	6.0	20.5	O K	
5760 min Summer	83.890	0.090	4.8	18.0	O K	
7200 min Summer	83.882	0.082	4.0	16.3	O K	
8640 min Summer	83.875	0.075	3.4	15.0	O K	
10080 min Summer	83.870	0.070	3.0	14.1	O K	
15 min Winter	84.270	0.470	16.9	94.0	O K	
30 min Winter	84.391	0.591	18.3	118.1	O K	
Storm Event	Rain (mm/hr)		Time-Peak (mins)			
15 min Summer	128.285		22			
30 min Summer	84.226		35			
60 min Summer	52.662		56			
120 min Summer	31.800		90			
180 min Summer	23.353		124			
240 min Summer	18.644		158			
360 min Summer	13.543		226			
480 min Summer	10.792		290			
600 min Summer	9.043		348			
720 min Summer	7.823		402			
960 min Summer	6.219		516			
1440 min Summer	4.493		752			
2160 min Summer	3.241		1108			
2880 min Summer	2.568		1472			
4320 min Summer	1.847		2204			
5760 min Summer	1.461		2936			
7200 min Summer	1.217		3664			
8640 min Summer	1.048		4400			
10080 min Summer	0.923		5136			
15 min Winter	128.285		23			
30 min Winter	84.226		35			
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5th Floor, The Pithay All Saints Street Bristol BS1 2NL					
Date 05/04/2011 14:27 File Cat7 swale no infiltra...		Designed By mp49220 Checked By			
Micro Drainage		Source Control W.12.4			
<u>Summary of Results for 100 year Return Period (+30%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	84.463	0.663	19.4	132.5	O K
120 min Winter	84.465	0.665	19.4	132.9	O K
180 min Winter	84.426	0.626	18.8	125.2	O K
240 min Winter	84.376	0.576	18.1	115.1	O K
360 min Winter	84.274	0.474	16.9	94.8	O K
480 min Winter	84.173	0.373	16.9	74.6	O K
600 min Winter	84.085	0.285	16.9	57.0	O K
720 min Winter	84.039	0.239	16.1	47.9	O K
960 min Winter	83.989	0.189	13.8	37.8	O K
1440 min Winter	83.947	0.147	10.4	29.4	O K
2160 min Winter	83.919	0.119	7.6	23.7	O K
2880 min Winter	83.903	0.103	6.0	20.7	O K
4320 min Winter	83.886	0.086	4.3	17.1	O K
5760 min Winter	83.876	0.076	3.5	15.1	O K
7200 min Winter	83.869	0.069	2.9	13.7	O K
8640 min Winter	83.864	0.064	2.5	12.7	O K
10080 min Winter	83.860	0.060	2.2	11.9	O K
Storm Event		Rain (mm/hr)		Time-Peak (mins)	
60 min Winter		52.662		60	
120 min Winter		31.800		96	
180 min Winter		23.353		134	
240 min Winter		18.644		170	
360 min Winter		13.543		242	
480 min Winter		10.792		306	
600 min Winter		9.043		354	
720 min Winter		7.823		408	
960 min Winter		6.219		520	
1440 min Winter		4.493		756	
2160 min Winter		3.241		1108	
2880 min Winter		2.568		1476	
4320 min Winter		1.847		2204	
5760 min Winter		1.461		2936	
7200 min Winter		1.217		3656	
8640 min Winter		1.048		4376	
10080 min Winter		0.923		5048	
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Source Control W.12.4

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5th Floor, The Pithay All Saints Street Bristol BS1 2NL		
Date 05/04/2011 14:27 File Cat7 swale no infiltra...	Designed By mp49220 Checked By	
Micro Drainage	Source Control W.12.4	

Model Details

Storage is Online Cover Level (m) 84.800

Tank or Pond Structure

Invert Level (m) 83.800

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	200.0	1.000	200.0

Hydro-Brake® Outflow Control

Design Head (m) 0.700 Hydro-Brake® Type Md2 Invert Level (m) 83.800
Design Flow (l/s) 20.0 Diameter (mm) 151

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.7	1.200	26.1	3.000	41.2	7.000	63.0
0.200	14.5	1.400	28.2	3.500	44.5	7.500	65.2
0.300	16.8	1.600	30.1	4.000	47.6	8.000	67.3
0.400	15.8	1.800	31.9	4.500	50.5	8.500	69.4
0.500	16.9	2.000	33.7	5.000	53.2	9.000	71.4
0.600	18.4	2.200	35.3	5.500	55.8	9.500	73.3
0.800	21.3	2.400	36.9	6.000	58.3		
1.000	23.8	2.600	38.4	6.500	60.7		

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All Saints Street	Exemplar Site	
Bristol BS1 2NL	SUDS Storage Structure 5	
Date 05/04/2011 14:44	Designed By mp49220	
File Cat8 swale infiltratio...	Checked By	
Micro Drainage	Source Control W.12.4	

Summary of Results for 100 year Return Period (+30%)

Half Drain Time : 733 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	99.492	0.492	2.2	99.0	O K
30 min Summer	99.598	0.598	2.4	129.0	O K
60 min Summer	99.694	0.694	2.6	158.6	O K
120 min Summer	99.775	0.775	2.8	185.6	Flood Risk
180 min Summer	99.811	0.811	2.9	198.3	Flood Risk
240 min Summer	99.829	0.829	3.0	204.8	Flood Risk
360 min Summer	99.845	0.845	3.0	210.4	Flood Risk
480 min Summer	99.846	0.846	3.0	211.0	Flood Risk
600 min Summer	99.842	0.842	3.0	209.5	Flood Risk
720 min Summer	99.838	0.838	3.0	207.8	Flood Risk
960 min Summer	99.826	0.826	2.9	203.6	Flood Risk
1440 min Summer	99.798	0.798	2.9	193.6	Flood Risk
2160 min Summer	99.752	0.752	2.8	177.7	Flood Risk
2880 min Summer	99.709	0.709	2.7	163.6	Flood Risk
4320 min Summer	99.634	0.634	2.5	139.7	O K
5760 min Summer	99.567	0.567	2.3	120.1	O K
7200 min Summer	99.509	0.509	2.2	103.6	O K
8640 min Summer	99.456	0.456	2.1	89.7	O K
10080 min Summer	99.410	0.410	2.0	78.0	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Summer	128.285	23
30 min Summer	84.226	37
60 min Summer	52.662	66
120 min Summer	31.800	126
180 min Summer	23.353	184
240 min Summer	18.644	244
360 min Summer	13.543	362
480 min Summer	10.792	480
600 min Summer	9.043	536
720 min Summer	7.823	594
960 min Summer	6.219	718
1440 min Summer	4.493	986
2160 min Summer	3.241	1404
2880 min Summer	2.568	1816
4320 min Summer	1.847	2600
5760 min Summer	1.461	3400
7200 min Summer	1.217	4176
8640 min Summer	1.048	4848
10080 min Summer	0.923	5640

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5th Floor, The Pithay	7011-UA001881-UP21B-01	
All Saints Street	Exemplar Site	
Bristol BS1 2NL	SUDS Storage Structure 5	
Date 05/04/2011 14:44	Designed By mp49220	
File Cat8 swale infiltratio...	Checked By	
Micro Drainage	Source Control W.12.4	

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Winter	99.536	0.536	2.3	111.1	O K
30 min Winter	99.650	0.650	2.5	144.8	O K
60 min Winter	99.754	0.754	2.8	178.4	Flood Risk
120 min Winter	99.842	0.842	3.0	209.3	Flood Risk
180 min Winter	99.883	0.883	3.1	224.3	Flood Risk
240 min Winter	99.904	0.904	3.1	232.3	Flood Risk
360 min Winter	99.924	0.924	3.2	240.1	Flood Risk
480 min Winter	99.930	0.930	3.2	242.4	Flood Risk
600 min Winter	99.928	0.928	3.2	241.5	Flood Risk
720 min Winter	99.921	0.921	3.2	238.9	Flood Risk
960 min Winter	99.907	0.907	3.1	233.5	Flood Risk
1440 min Winter	99.873	0.873	3.1	220.7	Flood Risk
2160 min Winter	99.813	0.813	2.9	198.8	Flood Risk
2880 min Winter	99.753	0.753	2.8	178.2	Flood Risk
4320 min Winter	99.648	0.648	2.5	144.2	O K
5760 min Winter	99.557	0.557	2.3	117.2	O K
7200 min Winter	99.478	0.478	2.1	95.4	O K
8640 min Winter	99.409	0.409	2.0	77.9	O K
10080 min Winter	99.349	0.349	1.8	63.5	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Winter	128.285	22
30 min Winter	84.226	37
60 min Winter	52.662	66
120 min Winter	31.800	124
180 min Winter	23.353	182
240 min Winter	18.644	238
360 min Winter	13.543	354
480 min Winter	10.792	464
600 min Winter	9.043	572
720 min Winter	7.823	670
960 min Winter	6.219	756
1440 min Winter	4.493	1066
2160 min Winter	3.241	1516
2880 min Winter	2.568	1960
4320 min Winter	1.847	2772
5760 min Winter	1.461	3576
7200 min Winter	1.217	4328
8640 min Winter	1.048	5104
10080 min Winter	0.923	5848

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5th Floor, The Pithay
All Saints Street
Bristol BS1 2NL

7011-UA001881-UP21B-01
Exemplar Site
SUDS Storage Structure 5

Date 05/04/2011 14:44

Designed By mp49220

File Cat8 swale infiltratio...

Checked By



Micro Drainage

Source Control W.12.4

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time / Area Diagram

Total Area (ha) 0.420

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.210	4-8	0.210

Hyder Consulting Limited		Page 21
5th Floor, The Pithay All Saints Street Bristol BS1 2NL	7011-UA001881-UP21B-01 Exemplar Site SUDS Storage Structure 5	
Date 05/04/2011 14:44 File Cat8 swale infiltratio...	Designed By mp49220 Checked By	
Micro Drainage	Source Control W.12.4	

Model Details

Storage is Online Cover Level (m) 100.000

Swale Structure

Infiltration Coefficient Base (m/hr)	0.05600	Length (m)	45.0
Infiltration Coefficient Side (m/hr)	0.05600	Side Slope (1:X)	3.0
Safety Factor	2.0	Slope (1:X)	0.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	99.000	Cap Infiltration Depth (m)	0.000
Base Width (m)	3.0		

Hyder Consulting Limited			Page 18	
5th Floor, The Pithay All Saints Street Bristol BS1 2NL		7011-UA001881-UP21B-01 Exemplar Site SUDS Storage Structure 5		
Date 05/04/2011 14:39		Designed By mp49220		
File Cat8 swale no infiltra...		Checked By		
Micro Drainage		Source Control W.12.4		

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.534	0.534	9.5	93.4	O K
30 min Summer	99.683	0.683	9.5	119.6	O K
60 min Summer	99.804	0.804	9.5	140.8	Flood Risk
120 min Summer	99.859	0.859	9.5	150.4	Flood Risk
180 min Summer	99.852	0.852	9.5	149.1	Flood Risk
240 min Summer	99.832	0.832	9.5	145.5	Flood Risk
360 min Summer	99.782	0.782	9.5	136.8	Flood Risk
480 min Summer	99.729	0.729	9.5	127.5	Flood Risk
600 min Summer	99.676	0.676	9.5	118.2	O K
720 min Summer	99.623	0.623	9.5	109.0	O K
960 min Summer	99.522	0.522	9.5	91.4	O K
1440 min Summer	99.353	0.353	9.5	61.7	O K
2160 min Summer	99.224	0.224	9.2	39.2	O K
2880 min Summer	99.175	0.175	8.1	30.6	O K
4320 min Summer	99.133	0.133	6.1	23.3	O K
5760 min Summer	99.111	0.111	4.9	19.5	O K
7200 min Summer	99.097	0.097	4.1	17.0	O K
8640 min Summer	99.088	0.088	3.6	15.3	O K
10080 min Summer	99.080	0.080	3.2	14.0	O K
15 min Winter	99.602	0.602	9.5	105.4	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Summer	128.285	21
30 min Summer	84.226	35
60 min Summer	52.662	64
120 min Summer	31.800	120
180 min Summer	23.353	148
240 min Summer	18.644	180
360 min Summer	13.543	248
480 min Summer	10.792	316
600 min Summer	9.043	384
720 min Summer	7.823	452
960 min Summer	6.219	580
1440 min Summer	4.493	810
2160 min Summer	3.241	1144
2880 min Summer	2.568	1480
4320 min Summer	1.847	2208
5760 min Summer	1.461	2936
7200 min Summer	1.217	3672
8640 min Summer	1.048	4400
10080 min Summer	0.923	5136
15 min Winter	128.285	21

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5th Floor, The Pithay All Saints Street Bristol BS1 2NL		7011-UA001881-UP21B-01 Exemplar Site SUDS Storage Structure 5			
Date 05/04/2011 14:39		Designed By mp49220			
File Cat8 swale no infiltra...		Checked By			
Micro Drainage		Source Control W.12.4			
<u>Summary of Results for 100 year Return Period (+30%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
30 min Winter	99.772	0.772	9.5	135.1	Flood Risk
60 min Winter	99.913	0.913	9.7	159.7	Flood Risk
120 min Winter	99.986	0.986	10.0	172.6	Flood Risk
180 min Winter	99.974	0.974	9.9	170.5	Flood Risk
240 min Winter	99.948	0.948	9.8	165.8	Flood Risk
360 min Winter	99.878	0.878	9.5	153.7	Flood Risk
480 min Winter	99.801	0.801	9.5	140.2	Flood Risk
600 min Winter	99.722	0.722	9.5	126.4	Flood Risk
720 min Winter	99.642	0.642	9.5	112.4	O K
960 min Winter	99.485	0.485	9.5	84.8	O K
1440 min Winter	99.261	0.261	9.5	45.7	O K
2160 min Winter	99.167	0.167	7.8	29.3	O K
2880 min Winter	99.135	0.135	6.3	23.7	O K
4320 min Winter	99.104	0.104	4.5	18.3	O K
5760 min Winter	99.088	0.088	3.6	15.4	O K
7200 min Winter	99.078	0.078	3.0	13.6	O K
8640 min Winter	99.070	0.070	2.6	12.3	O K
10080 min Winter	99.065	0.065	2.3	11.3	O K
Storm Event	Rain (mm/hr)	Time-Peak (mins)			
30 min Winter	84.226	35			
60 min Winter	52.662	62			
120 min Winter	31.800	118			
180 min Winter	23.353	166			
240 min Winter	18.644	190			
360 min Winter	13.543	268			
480 min Winter	10.792	342			
600 min Winter	9.043	416			
720 min Winter	7.823	488			
960 min Winter	6.219	616			
1440 min Winter	4.493	820			
2160 min Winter	3.241	1144			
2880 min Winter	2.568	1496			
4320 min Winter	1.847	2208			
5760 min Winter	1.461	2936			
7200 min Winter	1.217	3672			
8640 min Winter	1.048	4400			
10080 min Winter	0.923	5120			
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7011-UA001881-UP21B-01
Exemplar Site
SUDS Storage Structure 5



Designed By mp49220
Checked By

Source Control W.12.4

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Total Area (ha) 0.420

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.210	4-8	0.210

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5th Floor, The Pithay	7011-UA001881-UP21B-01	
All Saints Street	Exemplar Site	
Bristol BS1 2NL	SUDS Storage Structure 5	
Date 05/04/2011 14:39	Designed By mp49220	
File Cat8 swale no infiltra...	Checked By	
Micro Drainage	Source Control W.12.4	

Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 99.000

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	175.0	1.000	175.0

Hydro-Brake® Outflow Control

Design Head (m) 1.000 Diameter (mm) 132

Design Flow (l/s) 10.0 Invert Level (m) 99.000

Hydro-Brake® Type Md6 SW Only

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.3	1.200	10.9	3.000	17.2	7.000	26.3
0.200	8.8	1.400	11.8	3.500	18.6	7.500	27.2
0.300	9.5	1.600	12.6	4.000	19.9	8.000	28.1
0.400	9.2	1.800	13.3	4.500	21.1	8.500	29.0
0.500	8.9	2.000	14.1	5.000	22.2	9.000	29.8
0.600	8.8	2.200	14.7	5.500	23.3	9.500	30.6
0.800	9.2	2.400	15.4	6.000	24.4		
1.000	10.0	2.600	16.0	6.500	25.3		

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5th Floor, The Pithay All Saints Street Bristol BS1 2NL					
Date 05/04/2011 15:00		Designed By mp49220			
File Cat9 swale infiltratio...		Checked By			
Micro Drainage		Source Control W.12.4			
<u>Summary of Results for 100 year Return Period (+30%)</u> Half Drain Time : 316 minutes.					
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	86.557	0.557	9.6	192.2	O K
30 min Summer	86.673	0.673	10.2	248.9	O K
60 min Summer	86.780	0.780	10.7	301.2	Flood Risk
120 min Summer	86.861	0.861	11.1	340.7	Flood Risk
180 min Summer	86.884	0.884	11.3	351.7	Flood Risk
240 min Summer	86.883	0.883	11.3	351.1	Flood Risk
360 min Summer	86.869	0.869	11.2	344.3	Flood Risk
480 min Summer	86.852	0.852	11.1	335.9	Flood Risk
600 min Summer	86.832	0.832	11.0	326.5	Flood Risk
720 min Summer	86.812	0.812	10.9	316.4	Flood Risk
960 min Summer	86.770	0.770	10.7	296.1	Flood Risk
1440 min Summer	86.692	0.692	10.3	258.1	O K
2160 min Summer	86.592	0.592	9.8	209.6	O K
2880 min Summer	86.511	0.511	9.4	169.8	O K
4320 min Summer	86.392	0.392	8.8	112.1	O K
5760 min Summer	86.323	0.323	8.3	78.1	O K
7200 min Summer	86.287	0.287	7.3	61.6	O K
8640 min Summer	86.257	0.257	6.5	49.7	O K
10080 min Summer	86.234	0.234	5.9	41.2	O K
Storm Event	Rain (mm/hr)		Time-Peak (mins)		
15 min Summer	128.285		25		
30 min Summer	84.226		39		
60 min Summer	52.662		68		
120 min Summer	31.800		126		
180 min Summer	23.353		182		
240 min Summer	18.644		234		
360 min Summer	13.543		290		
480 min Summer	10.792		352		
600 min Summer	9.043		420		
720 min Summer	7.823		490		
960 min Summer	6.219		626		
1440 min Summer	4.493		898		
2160 min Summer	3.241		1284		
2880 min Summer	2.568		1656		
4320 min Summer	1.847		2380		
5760 min Summer	1.461		3048		
7200 min Summer	1.217		3752		
8640 min Summer	1.048		4488		
10080 min Summer	0.923		5152		
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5th Floor, The Pithay All Saints Street Bristol BS1 2NL						
Date 05/04/2011 15:00		Designed By mp49220				
File Cat9 swale infiltratio...		Checked By				
Micro Drainage		Source Control W.12.4				
Summary of Results for 100 year Return Period (+30%)						
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status	
15 min Winter	86.606	0.606	9.8	216.1	O K	
30 min Winter	86.737	0.737	10.5	280.3	Flood Risk	
60 min Winter	86.861	0.861	11.1	340.4	Flood Risk	
120 min Winter	86.958	0.958	11.6	387.6	Flood Risk	
180 min Winter	86.989	0.989	11.8	402.9	Flood Risk	
240 min Winter	86.993	0.993	11.8	405.0	Flood Risk	
360 min Winter	86.973	0.973	11.7	395.2	Flood Risk	
480 min Winter	86.952	0.952	11.6	384.8	Flood Risk	
600 min Winter	86.926	0.926	11.5	372.2	Flood Risk	
720 min Winter	86.897	0.897	11.3	358.2	Flood Risk	
960 min Winter	86.837	0.837	11.0	329.0	Flood Risk	
1440 min Winter	86.723	0.723	10.4	273.5	Flood Risk	
2160 min Winter	86.579	0.579	9.7	203.2	O K	
2880 min Winter	86.466	0.466	9.1	147.9	O K	
4320 min Winter	86.324	0.324	8.4	78.7	O K	
5760 min Winter	86.271	0.271	6.9	54.9	O K	
7200 min Winter	86.233	0.233	5.9	40.6	O K	
8640 min Winter	86.204	0.204	5.1	31.3	O K	
10080 min Winter	86.182	0.182	4.5	24.9	O K	
Storm Event		Rain (mm/hr)		Time-Peak (mins)		
15 min Winter		128.285		25		
30 min Winter		84.226		39		
60 min Winter		52.662		66		
120 min Winter		31.800		124		
180 min Winter		23.353		180		
240 min Winter		18.644		234		
360 min Winter		13.543		328		
480 min Winter		10.792		376		
600 min Winter		9.043		454		
720 min Winter		7.823		530		
960 min Winter		6.219		680		
1440 min Winter		4.493		968		
2160 min Winter		3.241		1368		
2880 min Winter		2.568		1736		
4320 min Winter		1.847		2376		
5760 min Winter		1.461		3064		
7200 min Winter		1.217		3752		
8640 min Winter		1.048		4496		
10080 min Winter		0.923		5160		
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5th Floor, The Pithay All Saints Street Bristol BS1 2NL		
Date 05/04/2011 15:00	Designed By mp49220	
File Cat9 swale infiltratio...	Checked By	
Micro Drainage		Source Control W.12.4
<u>Rainfall Details</u>		
Rainfall Model	FSR	Winter Storms Yes
Return Period (years)	100	Cv (Summer) 0.750
Region	England and Wales	Cv (Winter) 0.840
M5-60 (mm)	20.000	Shortest Storm (mins) 15
Ratio R	0.400	Longest Storm (mins) 10080
Summer Storms	Yes	Climate Change % +30
<u>Time / Area Diagram</u>		
Total Area (ha) 0.840		
Time (mins)	Area (ha)	Time (mins)
0-4	0.210	4-8
		0.420
		8-12
		0.210
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Checked By



Source Control W.12.4

Storage is Online Cover Level (m) 87.000

Infiltration Coefficient Base (m/hr)	0.05600	Trench Width (m)	3.0
Infiltration Coefficient Side (m/hr)	0.05600	Trench Length (m)	325.0
Safety Factor	2.0	Slope (1:X)	1000.0
Porosity	0.50	Cap Volume Depth (m)	0.000
Invert Level (m)	86.000	Cap Infiltration Depth (m)	0.000

Hyder Consulting Limited		Page 1
5th Floor, The Pithay All Saints Street Bristol BS1 2NL		
Date 05/04/2011 15:03	Designed By mp49220	
File Cat9 swale no infiltra...	Checked By	
Micro Drainage	Source Control W.12.4	

Summary of Results for 100 year Return Period (+30%)

Half Drain Time : 365 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	86.555	0.555	0.0	9.5	9.5	191.1	O K
30 min Summer	86.671	0.671	0.0	9.5	9.5	247.8	O K
60 min Summer	86.778	0.778	0.0	9.5	9.5	299.9	Flood Risk
120 min Summer	86.857	0.857	0.0	9.5	9.5	338.8	Flood Risk
180 min Summer	86.879	0.879	0.0	9.5	9.5	349.5	Flood Risk
240 min Summer	86.878	0.878	0.0	9.5	9.5	348.6	Flood Risk
360 min Summer	86.853	0.853	0.0	9.5	9.5	336.6	Flood Risk
480 min Summer	86.828	0.828	0.0	9.5	9.5	324.5	Flood Risk
600 min Summer	86.804	0.804	0.0	9.5	9.5	312.8	Flood Risk
720 min Summer	86.781	0.781	0.0	9.5	9.5	301.6	Flood Risk
960 min Summer	86.737	0.737	0.0	9.5	9.5	280.0	Flood Risk
1440 min Summer	86.653	0.653	0.0	9.5	9.5	239.2	O K
2160 min Summer	86.535	0.535	0.0	9.5	9.5	181.8	O K
2880 min Summer	86.430	0.430	0.0	9.5	9.5	130.5	O K
4320 min Summer	86.288	0.288	0.0	9.5	9.5	62.4	O K
5760 min Summer	86.212	0.212	0.0	9.1	9.1	33.6	O K
7200 min Summer	86.175	0.175	0.0	8.1	8.1	22.9	O K
8640 min Summer	86.152	0.152	0.0	7.1	7.1	17.3	O K
10080 min Summer	86.136	0.136	0.0	6.3	6.3	13.9	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Summer	128.285	25
30 min Summer	84.226	39
60 min Summer	52.662	68
120 min Summer	31.800	126
180 min Summer	23.353	184
240 min Summer	18.644	242
360 min Summer	13.543	314
480 min Summer	10.792	378
600 min Summer	9.043	440
720 min Summer	7.823	508
960 min Summer	6.219	646
1440 min Summer	4.493	916
2160 min Summer	3.241	1304
2880 min Summer	2.568	1676
4320 min Summer	1.847	2336
5760 min Summer	1.461	2992
7200 min Summer	1.217	3680
8640 min Summer	1.048	4408
10080 min Summer	0.923	5136

Source Control W.12.4



Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
15 min Winter	86.604	0.604	0.0	9.5	9.5	215.3	O K
30 min Winter	86.736	0.736	0.0	9.5	9.5	279.6	Flood Risk
60 min Winter	86.859	0.859	0.0	9.5	9.5	339.6	Flood Risk
120 min Winter	86.956	0.956	0.0	9.9	9.9	387.0	Flood Risk
180 min Winter	86.988	0.988	0.0	10.0	10.0	402.5	Flood Risk
240 min Winter	86.993	0.993	0.0	10.0	10.0	404.7	Flood Risk
360 min Winter	86.972	0.972	0.0	9.9	9.9	394.7	Flood Risk
480 min Winter	86.939	0.939	0.0	9.8	9.8	378.5	Flood Risk
600 min Winter	86.909	0.909	0.0	9.7	9.7	364.0	Flood Risk
720 min Winter	86.878	0.878	0.0	9.5	9.5	348.9	Flood Risk
960 min Winter	86.815	0.815	0.0	9.5	9.5	318.2	Flood Risk
1440 min Winter	86.690	0.690	0.0	9.5	9.5	257.4	O K
2160 min Winter	86.508	0.508	0.0	9.5	9.5	168.6	O K
2880 min Winter	86.353	0.353	0.0	9.5	9.5	92.9	O K
4320 min Winter	86.200	0.200	0.0	8.8	8.8	29.9	O K
5760 min Winter	86.154	0.154	0.0	7.2	7.2	17.8	O K
7200 min Winter	86.131	0.131	0.0	6.0	6.0	12.8	O K
8640 min Winter	86.116	0.116	0.0	5.2	5.2	10.0	O K
10080 min Winter	86.105	0.105	0.0	4.6	4.6	8.3	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Winter	128.285	25
30 min Winter	84.226	39
60 min Winter	52.662	68
120 min Winter	31.800	124
180 min Winter	23.353	180
240 min Winter	18.644	236
360 min Winter	13.543	344
480 min Winter	10.792	396
600 min Winter	9.043	470
720 min Winter	7.823	546
960 min Winter	6.219	700
1440 min Winter	4.493	998
2160 min Winter	3.241	1396
2880 min Winter	2.568	1728
4320 min Winter	1.847	2292
5760 min Winter	1.461	2944
7200 min Winter	1.217	3672
8640 min Winter	1.048	4400
10080 min Winter	0.923	5136

5th Floor, The Pithay
All Saints Street
Bristol BS1 2NL

Date 05/04/2011 15:03
File Cat9 swale no infiltra...

Designed By mp49220
Checked By



Micro Drainage

Source Control W.12.4

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time / Area Diagram

Total Area (ha) 0.840

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.210	4-8	0.420	8-12	0.210

Hyder Consulting Limited		Page 4
5th Floor, The Pithay All Saints Street Bristol BS1 2NL		
Date 05/04/2011 15:03 File Cat9 swale no infiltra...	Designed By mp49220 Checked By	
Micro Drainage Source Control W.12.4		

Model Details

Storage is Online Cover Level (m) 87.000

Infiltration Trench Structure

Infiltration Coefficient Base (m/hr)	0.00000	Trench Width (m)	3.0
Infiltration Coefficient Side (m/hr)	0.00000	Trench Length (m)	325.0
Safety Factor	2.0	Slope (1:X)	1000.0
Porosity	0.50	Cap Volume Depth (m)	0.000
Invert Level (m)	86.000	Cap Infiltration Depth (m)	0.000

Hydro-Brake® Outflow Control

Design Head (m)	1.000	Diameter (mm)	132
Design Flow (l/s)	10.0	Invert Level (m)	86.000
Hydro-Brake® Type Md6 SW Only			

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.3	1.200	10.9	3.000	17.2	7.000	26.2
0.200	8.8	1.400	11.7	3.500	18.6	7.500	27.2
0.300	9.5	1.600	12.6	4.000	19.8	8.000	28.1
0.400	9.2	1.800	13.3	4.500	21.0	8.500	28.9
0.500	8.8	2.000	14.0	5.000	22.2	9.000	29.8
0.600	8.8	2.200	14.7	5.500	23.3	9.500	30.6
0.800	9.2	2.400	15.4	6.000	24.3		
1.000	10.0	2.600	16.0	6.500	25.3		

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CALCULATIONS

DOCUMENT No

7015-UA001881-UP21B-01

OFFICE

CARDIFF

PROJECT TITLE

NW Bicester Eco Development

SUBJECT

Surface Water Catchment Areas

SHEET No

1 OF 1

ISSUE	TOTAL SHEETS	AUTHOR	DATE	CHECKED BY	DATE	APPROVED BY	DATE	COMMENTS
1	1	MP	25/03/11	DCB	25/03/11	SAD	25/03/11	
2								
3								
4								
5								

SUPERSEDES DOC No

DATE

DESIGN BASIS STATEMENT (Inc. sources of info/data, assumptions made, standards, etc.)

Introduction

This calculation has been prepared to establish the contributing impermeable area for each group of SuDS features based on topographically derived catchment areas.

Assumptions

- Catchment areas are as shown on drawings 7160 & 7161 UA001881-UP21D-02, and have been measured for this calculation using AutoCAD.
- Contributing areas are derived from the area of impermeable paving adjacent to the SuDS features within the catchment, plus 20% of the remaining impermeable area for the catchment.
- Main commercial areas are assumed to provide surface water storage within the plot boundary, and have been omitted from these calculations.

Calculation

Catchment	Total Catchment Area (ha)	Impermeable Paving (ha)	20% of Remaining Catchment (ha)	Contributing Area (ha)
1	2.00	0.13	0.38	0.50
2	2.15	0.10	0.41	0.51
3		0.28		0.28
4	1.55	0.09	0.29	0.38
5	1.45	0.08	0.28	0.35
6		0.10		0.10
7	1.45	0.15	0.26	0.41
8	1.20	0.22	0.20	0.42
9	2.85	0.34	0.50	0.84

		CALCULATIONS				DOCUMENT No 7016-UA001881-UP21B-01		
OFFICE Cardiff				PROJECT TITLE NW Bicester Eco-Town				
SUBJECT Greenfield Runoff - Volumetric Calculation							SHEET No 1 OF 1	
ISSUE	TOTAL SHEETS	AUTHOR	DATE	CHECKED BY	DATE	APPROVED BY	DATE	COMMENTS
1	1	DCB	25/03/11	MP	25/03/11	SAD	25/03/11	
2								
3								
4								
5								
SUPERSEDES DOC No							DATE	

DESIGN BASIS STATEMENT (Inc. sources of info/data, assumptions made, standards, etc.) Introduction This calculation has been prepared to assess the greenfield runoff volume in accordance with The SUDS Manual (CIRIA) - Section 4.2.2: Estimating greenfield runoff volumes. For the purpose of this calculation we have used the FSSR 16 runoff model - fixed percentage runoff, assuming larger rainfall depths. Assumptions 1) Catchment Area = 17.5 Ha 2) SPR = 13.1 (obtained from FEH descriptors) 3) CWI = 103 (obtained from The SUDS Manual - Fig 4.4 for an annual average rainfall of 647mm) 4) Rainfall Depth (P) = 62.5mm (obtained through Windes modelling for the 100 year 360 minute storm) Results The SUDS Manual - Box 4.3: $\text{Percentage Runoff (PR}_{\text{RURAL}}) = \text{SPR} + \text{DPR}_{\text{CWI}} + \text{DPR}_{\text{RAIN}}$ Where: • $\text{DPR}_{\text{CWI}} = 0.25 \times (\text{CWI} - 125) = -5.5$ • $\text{DPR}_{\text{RAIN}} = 0.45 (\text{P} - 40)^{0.7} = 4.0$ Therefore: $\text{PR}_{\text{RURAL}} = 13.1 + (-5.5) + 4.0 = 11.6 \%$ The SUDS Manual - Section 4.2.2: $\begin{aligned} \text{Runoff Volume} &= \text{Percentage Runoff (PR)} \times \text{Catchment Area} \times \text{Rainfall Depth} \\ &= 0.116 \times 175,000 \times 0.0625 \\ &= \underline{1,270 \text{ m}^3} \end{aligned}$ The above runoff volume represents the approximate existing greenfield runoff for the undeveloped Exemplar Site. Assuming the proposed development is to be limited to the same runoff volume of 1,270m³, this would equate to the discharge volume from a developed area of approximately 25,400m² (2.5 Ha), assuming a PR of 80%.

Appendix E

FOUL WATER LOADINGS

7006-UA001881- Site Sewage Generation

		CALCULATIONS		DOCUMENT No 7006-UA001881-UP21B-03				
OFFICE CARDIFF			PROJECT TITLE NW Bicester Eco Development					
SUBJECT Exemplar Site Sewage Generation Calculation					SHEET No 1 OF 2			
ISSUE	TOTAL SHEETS	AUTHOR	DATE	CHECKED BY	DATE	APPROVED BY	DATE	COMMENTS
1	2	DB	02/09/10	SD	02/09/10	SD	02/09/10	
2	2	DB	12/11/10	MP	12/11/10	SD	12/11/10	
3	2	DB	25/11/10	MP	25/11/10	SD	25/11/10	
4								
5								
SUPERSEDES DOC No								DATE

DESIGN BASIS STATEMENT (Inc. sources of info/data, assumptions made, standards, etc.) <i>Property information (use, size, etc.):</i> Plot areas and land use split in accordance with data provided within the Exemplar Site masterplan non-residential buildings brief (4/11/2010) and Accommodation Schedule (29/10/1010). <i>Water Demand:</i> Conventional Development Rates: Thames Water Guidelines for Undertaking Sewerage Modelling (November 2005) Sustainable Development Rates: Code For Sustainable Homes Technical Guide (May 2009 - Version 2) BREEAM Offices - Assessment Prediction Checklist
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NW Bicester Eco Development
7006-UA001881-UP21B-03
Exemplar Site Sewage Generation Calculation

Land Use	Area (m2)	Number of Properties	Total Population	Water Consumption (l/person(m2)/day)	Rainwater Harvesting Contribution (l/person(m2)/day)	Average Discharge (l/day)	Average Discharge (l/s)	Peak Discharge (l/s)
Residential		400	1151	80	12.00	105,928.80	3.68	22.07
Social / Community	540	N/A	123	6.5	0.98	920.45	0.03	0.19
Commercial	3,610	N/A	820	6.5	0.98	6,153.41	0.21	1.28
Restaurant	300	N/A	68	162	24.30	12,702.27	0.44	2.65
Retail / Leisure	660	N/A	N/A	2.4	0.36	1,821.60	0.06	0.38
Education	1,110	N/A	139	48	7.20	7,658.00	0.27	1.60
						135,185.54	4.69	28.16
Development Total						135,186	5	28

Assumptions:

Factors

Peaking Factor	6	[Conversion from average discharge rate to peak discharge rate]
Infiltration	0%	
Rainwater Harvesting	15%	[Additional contribution to foul discharge rates]

Residential:

Baseline for Conventional Development	150 l/person/day	[Thames Water Guidelines for Undertaking Sewerage Modelling (November 2005): General Housing = 600 l/property/day]
Sustainable Development	80 l/person/day	[Code for Sustainable Homes (Level 6)]
Residential split		
Affordable	123	
Private	270	
Residents per property		
Affordable	4.40	
Private	2.26	
Water consumption assumed to be over an	8 hour day	

Commercial (Offices / Hairdressers) and Social / Community:

Baseline for Conventional Development	33 l/person/day	[Thames Water Guidelines for Undertaking Sewerage Modelling (November 2005): Offices = 750 l/100m2/day (population density as below)]
Sustainable Development	6.5 l/person/day	[BREEAM Offices 2005 (16-24 points): 1.5m3 per person per year (assume 230 working days per year)]
Staff density	4.4 m2/person	[The Workplace (Health, Safety & Welfare) Regulations 1992: Minimum working space = 11m3 (assume 2.5m high)]
Water consumption assumed to be over an	8 hour day	

Restaurant (Take-away / Pub):

Baseline for Conventional Development	270 l/person/day	[Thames Water Guidelines for Undertaking Sewerage Modelling (November 2005): Restaurant = 270 l/seat/day (population density as below)]
Sustainable Development	162 l/person/day	[Assume 40% reduction from baseline]
Staff / customer density	4.4 m2/person	[Assumption - The Workplace (Health, Safety & Welfare) Regulations 1992: Minimum working space = 11m3 (assume 2.5m high)]
Water consumption assumed to be over an	8 hour day	

Retail / Leisure:

Baseline for Conventional Development	4 l/m2/day	[Thames Water Guidelines for Undertaking Sewerage Modelling (November 2005): Shopping Centre = 400 l/100m2/day]
Sustainable Development	2.4 l/m2/day	[Assume 40% reduction from baseline]
Water consumption assumed to be over an	8 hour day	

Education:

Baseline for Conventional Development	80 l/person/day	[Thames Water Guidelines for Undertaking Sewerage Modelling (November 2005): School]
Sustainable Development	48 l/person/day	[Assume 40% reduction from baseline]
Pupil density	8 m2/pupil	[Assumption]
Water consumption assumed to be over an	8 hour day	

Appendix F

CORRESPONDENCE

TW email 23 Nov 2010

Subject: FW: NW Bicester eco-town - Kick-off meeting with Thames Water

-----Original Message-----

From: Andrew.Forestiero@thameswater.co.uk
[mailto:Andrew.Forestiero@thameswater.co.uk]

Sent: 22 November 2010 23:13

To: Michael Pearson

Cc: Angela.Barugh@thameswater.co.uk; Geoff.Nokes@thameswater.co.uk;
Karl.Tuchscherer@thameswater.co.uk; Nick.Ayling@thameswater.co.uk;
Pete.Pearce@thameswater.co.uk

Subject: RE: NW Bicester eco-town - Kick-off meeting with Thames Water

Dear Mike,

Apologies for the delay in responding. Geoff Nokes made the following point in relation to the Exemplar site:

A Grampian condition will be imposed on this planned development to ensure that any identified reinforcement works will be carried out prior to occupation and thus avoid detrimental impact on our wastewater network. It should be possible to accommodate much of the Exemplar site without reinforcement but the trigger point will need to be identified prior to occupation and this will be the condition, especially as the Mid Level Sustainability Peak Discharge may have not yet been agreed on this first phase.

I understand that you are progressing matters with Karl regarding water network reinforcement.

Hope this helps.

Kind regards,

Andy

Andy Forestiero
Customer Led Manager
Developer Services
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Int. 42805