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Dean Clarke House Southernhay East Exeter EX1 1AP	Barwell Medical Centre Attenuation Design Calculation 100yr + 40% CC Events	
Date 26/03/2021 10:25 File Attenuation Design Calculatio...	Designed by Gavin Swift Checked by	
Causeway	Source Control 2018.1.1	

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 315 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	10.348	0.348	0.0	3.1	3.1	52.9	0 K
30 min Summer	10.449	0.449	0.0	3.1	3.1	68.2	0 K
60 min Summer	10.542	0.542	0.0	3.1	3.1	82.4	0 K
120 min Summer	10.616	0.616	0.0	3.1	3.1	93.7	0 K
180 min Summer	10.640	0.640	0.0	3.1	3.1	97.3	0 K
240 min Summer	10.641	0.641	0.0	3.1	3.1	97.5	0 K
360 min Summer	10.621	0.621	0.0	3.1	3.1	94.4	0 K
480 min Summer	10.597	0.597	0.0	3.1	3.1	90.7	0 K
600 min Summer	10.572	0.572	0.0	3.1	3.1	87.0	0 K
720 min Summer	10.548	0.548	0.0	3.1	3.1	83.3	0 K
960 min Summer	10.501	0.501	0.0	3.1	3.1	76.1	0 K
1440 min Summer	10.415	0.415	0.0	3.1	3.1	63.0	0 K
2160 min Summer	10.308	0.308	0.0	3.1	3.1	46.9	0 K
2880 min Summer	10.231	0.231	0.0	3.1	3.1	35.1	0 K
4320 min Summer	10.142	0.142	0.0	2.8	2.8	21.5	0 K
5760 min Summer	10.103	0.103	0.0	2.6	2.6	15.7	0 K
7200 min Summer	10.087	0.087	0.0	2.2	2.2	13.3	0 K
8640 min Summer	10.077	0.077	0.0	1.9	1.9	11.7	0 K
10080 min Summer	10.070	0.070	0.0	1.7	1.7	10.6	0 K
15 min Winter	10.391	0.391	0.0	3.1	3.1	59.5	0 K
30 min Winter	10.506	0.506	0.0	3.1	3.1	76.9	0 K
60 min Winter	10.615	0.615	0.0	3.1	3.1	93.4	0 K
120 min Winter	10.703	0.703	0.0	3.1	3.1	106.8	0 K
180 min Winter	10.732	0.732	0.0	3.1	3.1	111.3	0 K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	137.396	0.0	54.5	18
30 min Summer	90.218	0.0	71.7	33
60 min Summer	56.422	0.0	90.3	62
120 min Summer	34.083	0.0	109.1	122
180 min Summer	25.037	0.0	120.2	182
240 min Summer	19.995	0.0	128.0	240
360 min Summer	14.522	0.0	139.5	314
480 min Summer	11.573	0.0	148.2	368
600 min Summer	9.697	0.0	155.3	428
720 min Summer	8.389	0.0	161.2	492
960 min Summer	6.669	0.0	170.8	624
1440 min Summer	4.819	0.0	185.1	882
2160 min Summer	3.477	0.0	200.7	1256
2880 min Summer	2.755	0.0	212.0	1612
4320 min Summer	1.982	0.0	228.6	2288
5760 min Summer	1.567	0.0	241.4	2944
7200 min Summer	1.306	0.0	251.3	3672
8640 min Summer	1.124	0.0	259.6	4408
10080 min Summer	0.991	0.0	266.7	5136
15 min Winter	137.396	0.0	61.1	18
30 min Winter	90.218	0.0	80.4	33
60 min Winter	56.422	0.0	101.1	62
120 min Winter	34.083	0.0	122.2	120
180 min Winter	25.037	0.0	134.7	178

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Summary of Results for 100 year Return Period (+40%)

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
240 min Winter	10.738	0.738	0.0	3.1	3.1	112.1	0 K
360 min Winter	10.722	0.722	0.0	3.1	3.1	109.7	0 K
480 min Winter	10.692	0.692	0.0	3.1	3.1	105.2	0 K
600 min Winter	10.663	0.663	0.0	3.1	3.1	100.8	0 K
720 min Winter	10.631	0.631	0.0	3.1	3.1	95.9	0 K
960 min Winter	10.555	0.555	0.0	3.1	3.1	84.3	0 K
1440 min Winter	10.419	0.419	0.0	3.1	3.1	63.7	0 K
2160 min Winter	10.265	0.265	0.0	3.1	3.1	40.3	0 K
2880 min Winter	10.171	0.171	0.0	2.9	2.9	26.0	0 K
4320 min Winter	10.098	0.098	0.0	2.4	2.4	14.9	0 K
5760 min Winter	10.078	0.078	0.0	2.0	2.0	11.9	0 K
7200 min Winter	10.067	0.067	0.0	1.6	1.6	10.2	0 K
8640 min Winter	10.061	0.061	0.0	1.4	1.4	9.2	0 K
10080 min Winter	10.056	0.056	0.0	1.3	1.3	8.5	0 K

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Discharge Volume (m ³)	Time-Peak (mins)
240 min Winter	19.995	0.0	143.4	234
360 min Winter	14.522	0.0	156.3	342
480 min Winter	11.573	0.0	166.0	398
600 min Winter	9.697	0.0	173.9	468
720 min Winter	8.389	0.0	180.5	548
960 min Winter	6.669	0.0	191.4	684
1440 min Winter	4.819	0.0	207.4	952
2160 min Winter	3.477	0.0	224.8	1316
2880 min Winter	2.755	0.0	237.5	1640
4320 min Winter	1.982	0.0	256.0	2248
5760 min Winter	1.567	0.0	270.3	2944
7200 min Winter	1.306	0.0	281.5	3672
8640 min Winter	1.124	0.0	290.8	4408
10080 min Winter	0.991	0.0	298.7	5136

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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)	19.900	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.214

Time (mins)	Area
From: To:	(ha)

0	4	0.214
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Model Details

Storage is Online Cover Level (m) 20.000

Cellular Storage Structure

Invert Level (m) 10.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	160.0	160.0	0.750	160.0	197.9	0.751	0.0	198.0

Hydro-Brake® Optimum Outflow Control

Unit Reference MD-SHE-0084-3100-1000-3100
Design Head (m) 1.000
Design Flow (l/s) 3.1
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 84
Invert Level (m) 10.000
Minimum Outlet Pipe Diameter (mm) 100
Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	3.1	Kick-Flo®	0.623	2.5
Flush-Flo™	0.297	3.1	Mean Flow over Head Range	-	2.7

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.5	0.800	2.8	2.000	4.3	4.000	5.9	7.000	7.7
0.200	3.0	1.000	3.1	2.200	4.5	4.500	6.2	7.500	7.9
0.300	3.1	1.200	3.4	2.400	4.6	5.000	6.6	8.000	8.2
0.400	3.0	1.400	3.6	2.600	4.8	5.500	6.9	8.500	8.4
0.500	2.9	1.600	3.8	3.000	5.2	6.000	7.1	9.000	8.7
0.600	2.6	1.800	4.1	3.500	5.5	6.500	7.4	9.500	8.9