1 Broughton Park
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N

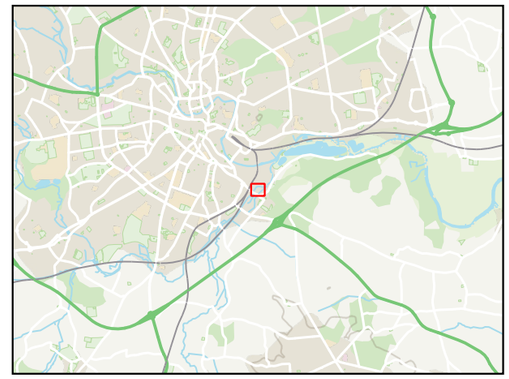
YARE-001-A
Flow Restriction: 0.86 l/s
Storage Volume: 356m3
Discharge into River Yare

YARE-001-A

YARE-001-B

YARE-001-B
Flow Restriction: 1.77 l/s
Storage Volume: 656m3
Discharge into River Yare

0 30 60 90 m



SuDS Strategy - Yare edge

Legend

- Site Boundary
- Drainage Zones
- Master Plan
- Hydrobrake
- Drainage
- Tree Pits
- Rain Garden / Pond
- Green Roof
- Underground Storage

All volumes 1%AEp +CC45%

Drawing to be read in conjunction with Appendix H in FRA (DEALG-JBAU-XX-XX-FRA-0001-S3-P01)

Drawn By:	PB	Date: 15/06/2023	Scale:
Checked By:	GH	Date: 15/06/2023	1:1,000
Approved By:	GH	Date: 15/06/2023	Original at
Status:	S1	Revision: P01	
Figure Title:	SuDS Strategy - Yare edge		
File Name:	0-JBAU-00-00-MX-Z-0002-Dealground_Figures_PB.qgz		

SUDS - MicroDrainage Summary Table

Project Title:	Dealground
Project Code:	2022-0896
Date:	15/06/2023
Prepared by:	Adam Odell
Reviewed by:	Gavin Hodson
BIM reference:	DEALG-XX-XX-SUDS-TBL-001-S3-P01

This table contains estimated storage depths, volumes and critical storm durations for 1% AEP + CC45% and 3.3% AEP + 45% CC.

Calculations were completed using MicroDrainage Version 2020.1

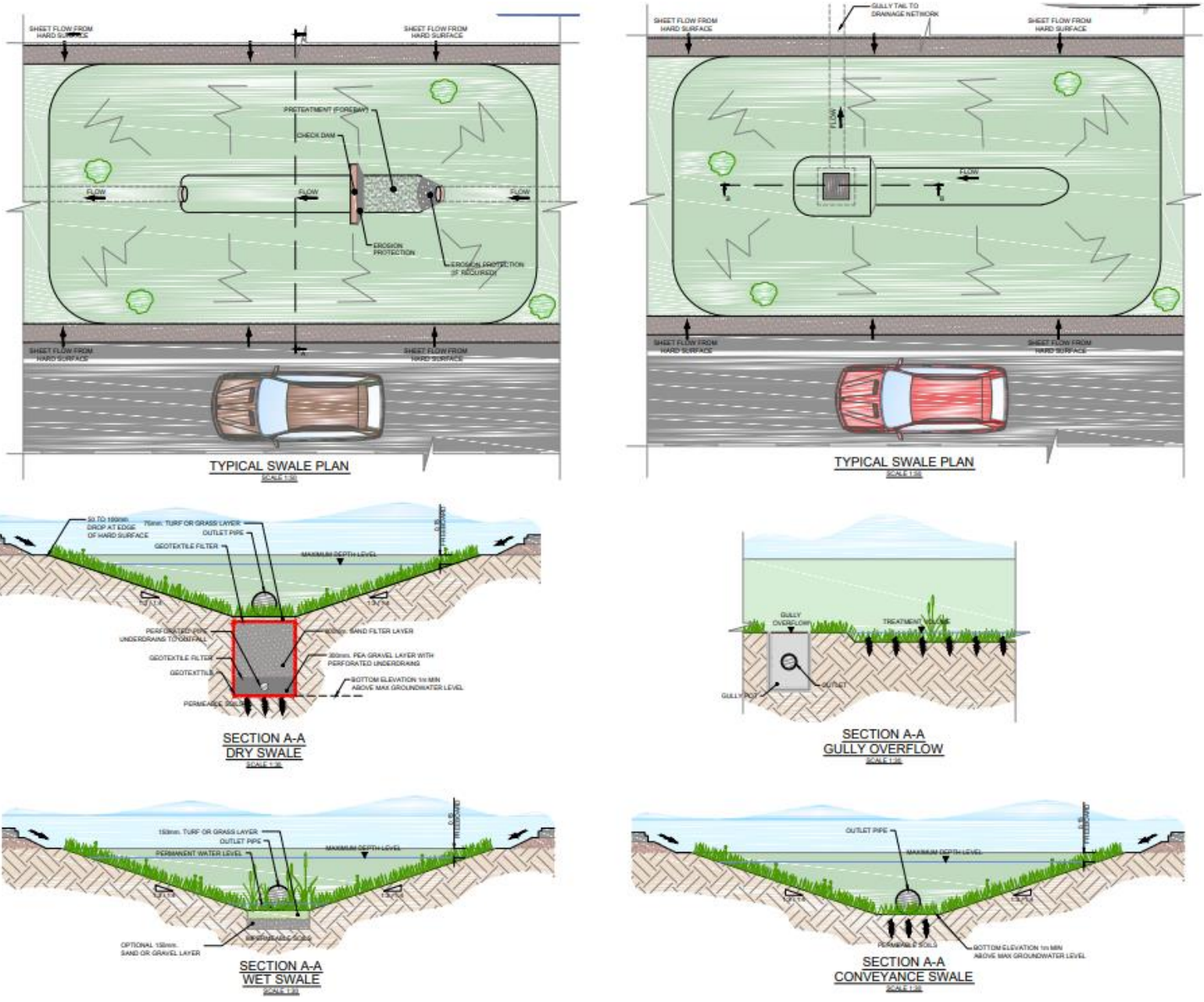
							3.33% AEP + CC45%			1% AEP + CC45%		
Area	Imp Area (ha)	Urban Creep Adjustion (10%)	Discharge rate (l/s)	Urban creep Justification	Available area m^2	Indicative Ground levels (mAOD)	Volume m^3	Storage Depth (m)	Critical Storm (mins)	Volume m^3	Storage Depth (m)	Critical Storm (mins)
Wensum Edge												
WEN-001-ABC	0.85	n/a	2.21	No (Whole area considered impermeable)	3234.00	3	641.1	0.668	1440	928.9	0.986	1440
WEN-001-D	0.09	n/a	0.22	No (Whole area considered impermeable)								
WEN-001-E	0.63	0.70	1.81	Yes (residential area with green space)	2718.00	3	491.5	0.603	2880	684.2	0.84	2880
WEN-001-F	0.51	0.56	1.46	Yes (residential area with green space)	2037.00	3.2	389.1	0.683	2880	540.1	0.885	2880
The Views												
VIEW-001-A	0.61	n/a	1.60	No (Whole area considered impermeable)	2425.00	3	428.2	0.589	2880	595.2	0.819	2880
VIEW-001-B	0.59	n/a	1.53	No (Whole area considered impermeable)	1953.00	3	405.5	0.693	2880	563.1	0.963	2880
VIEW-001-C	0.75	n/a	1.95	No (Whole area considered impermeable)	2665.00	3	515.5	0.643	2880	719	0.899	2880
Yare Edge												
YARE-001-A	0.33	0.36	0.86	Yes (residential area with green space)	1281.927	3	258.7	0.684	2880	356	0.924	2880
YARE-001-B	0.62	0.68	1.77	Yes (residential area with green space)	2307.652	3	472.7	0.67	2880	656.6	0.931	2880

Additonal Notes

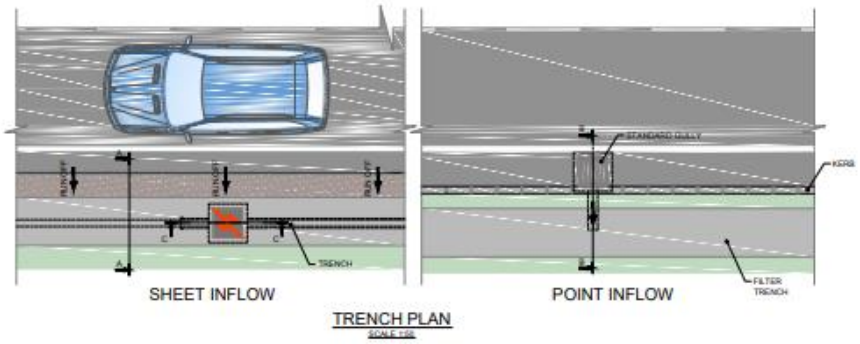
1. Full MicroDrainage printouts are provided in Appedix H of the FRA and Surface Water Management Strategy document
2. Table should be read in conjuction with the following drawings:
    a) DEALG-XX-XX-SUDS-DRG-001-S3-P01 (Wensum Edge SUDS Strategy)
    b) DEALG-XX-XX-SUDS-DRG-002-S3-P01 (The Views North SUDS Strategy)
    c) DEALG-XX-XX-SUDS-DRG-003-S3-P01 (The Views South SUDS Strategy)
    d) DEALG-XX-XX-SUDS-DRG-004-S3-P01 (Yare Edge SUDS Strategy)
3) Volumes calculated using source control module and can be considered convservative as addtional storage provided in green space is currently not confirmed
4) Runoff rates based on 2.6 l/s/ha

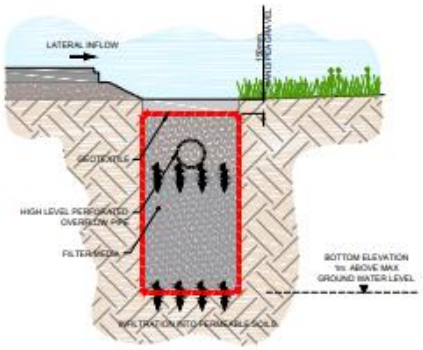
H.2 Typical details

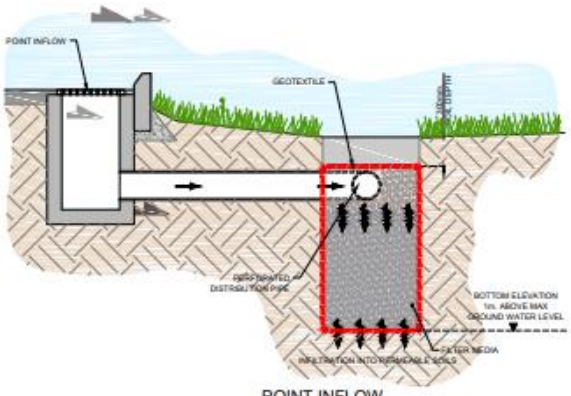
Swales are to be sued across the proposed development (Yare Edge and adopted highway) in both traditional and engineered form. H2-A and H2-B demonstrates how swales could be configured.

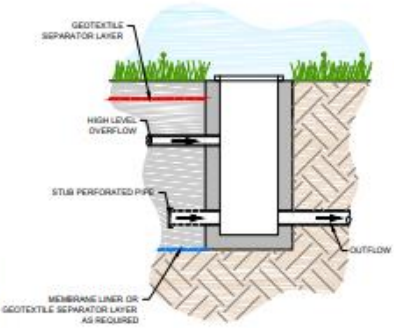


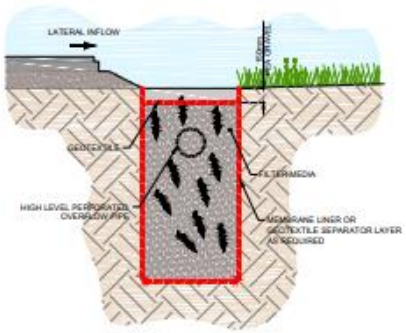
H2-A - Typical swale details

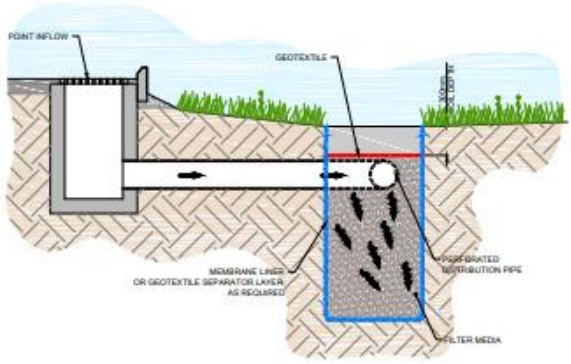






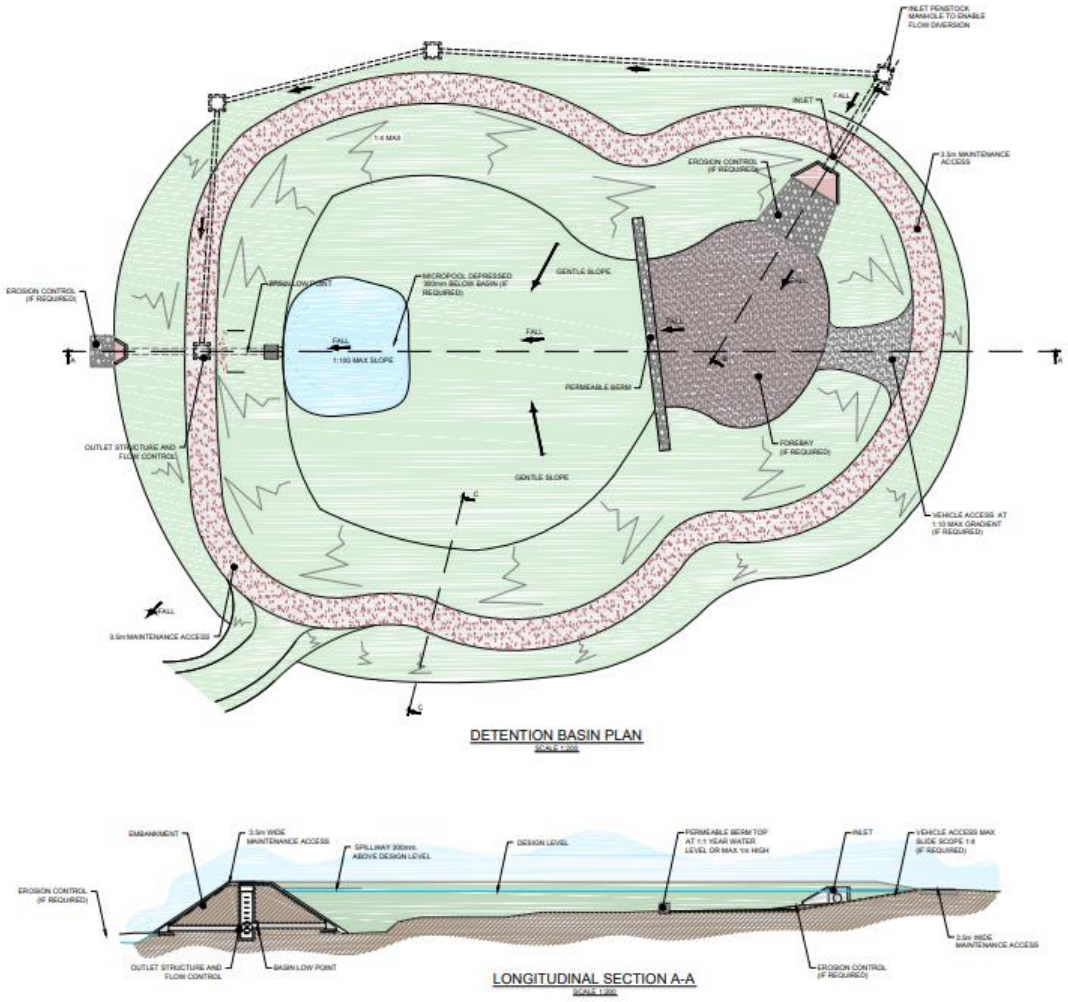






H2-B - Typical filter strip / Engineered swale details

Within the Views the communal areas will also provide a SuDS benefitting acting as a raingarden / detention basin. Permeable paving will be connected to these features before discharging into the CWS. H2-C provides an example of a detention basin. This feature will be enhanced with landscape and planting in the setting of the Views.



H2-C - Typical Detention basin details

Other SuDS elements such as Green roofs and underground storage will be provided following feedback from LLFA.

H.3 Storage Calculations

Summary of Results for 100 year Return Period (+45%)

Half Drain Time : 3455 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	2.341	0.341	0.0	1.5	0.0	1.5	247.9	O K
30 min Summer	2.381	0.381	0.0	1.5	0.0	1.5	277.0	O K
60 min Summer	2.425	0.425	0.0	1.5	0.0	1.5	308.5	O K
120 min Summer	2.471	0.471	0.0	1.5	0.0	1.5	342.0	O K
180 min Summer	2.498	0.498	0.0	1.5	0.0	1.5	361.9	O K
240 min Summer	2.517	0.517	0.0	1.5	0.0	1.5	376.0	O K
360 min Summer	2.543	0.543	0.0	1.5	0.0	1.5	394.9	O K
480 min Summer	2.560	0.560	0.0	1.5	0.0	1.5	407.1	O K
600 min Summer	2.572	0.572	0.0	1.5	0.0	1.5	415.5	O K
720 min Summer	2.580	0.580	0.0	1.5	0.0	1.5	421.2	O K
960 min Summer	2.615	0.615	0.0	1.5	0.0	1.5	446.7	O K
1440 min Summer	2.658	0.658	0.0	1.5	0.0	1.5	478.1	O K
2160 min Summer	2.688	0.688	0.0	1.5	0.0	1.5	500.1	O K
2880 min Summer	2.697	0.697	0.0	1.5	0.0	1.5	506.8	O K
4320 min Summer	2.647	0.647	0.0	1.5	0.0	1.5	469.9	O K
5760 min Summer	2.602	0.602	0.0	1.5	0.0	1.5	437.7	O K
7200 min Summer	2.561	0.561	0.0	1.5	0.0	1.5	407.8	O K
8640 min Summer	2.519	0.519	0.0	1.5	0.0	1.5	377.0	O K
10080 min Summer	2.478	0.478	0.0	1.5	0.0	1.5	347.3	O K
15 min Winter	2.389	0.389	0.0	1.5	0.0	1.5	282.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	228.747	0.0	125.6	0.0	27
30 min Summer	127.487	0.0	125.1	0.0	42
60 min Summer	71.052	0.0	244.8	0.0	72
120 min Summer	39.599	0.0	244.8	0.0	130
180 min Summer	28.130	0.0	241.7	0.0	190
240 min Summer	22.070	0.0	237.9	0.0	250
360 min Summer	15.678	0.0	230.4	0.0	370
480 min Summer	12.300	0.0	224.4	0.0	488
600 min Summer	10.190	0.0	219.4	0.0	608
720 min Summer	8.738	0.0	215.0	0.0	728
960 min Summer	7.123	0.0	206.0	0.0	966
1440 min Summer	5.340	0.0	197.1	0.0	1444
2160 min Summer	4.004	0.0	425.6	0.0	2160
2880 min Summer	3.264	0.0	409.7	0.0	2740
4320 min Summer	2.296	0.0	376.1	0.0	3412
5760 min Summer	1.789	0.0	732.1	0.0	4152
7200 min Summer	1.474	0.0	741.7	0.0	4976
8640 min Summer	1.258	0.0	743.3	0.0	5792
10080 min Summer	1.101	0.0	729.9	0.0	6464
15 min Winter	228.747	0.0	125.5	0.0	27

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Summary of Results for 100 year Return Period (+45%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	2.435	0.435	0.0	1.5	0.0	1.5	315.8	O K
60 min Winter	2.484	0.484	0.0	1.5	0.0	1.5	351.8	O K
120 min Winter	2.537	0.537	0.0	1.5	0.0	1.5	390.4	O K
180 min Winter	2.569	0.569	0.0	1.5	0.0	1.5	413.5	O K
240 min Winter	2.591	0.591	0.0	1.5	0.0	1.5	429.8	O K
360 min Winter	2.622	0.622	0.0	1.5	0.0	1.5	451.8	O K
480 min Winter	2.642	0.642	0.0	1.5	0.0	1.5	466.3	O K
600 min Winter	2.655	0.655	0.0	1.5	0.0	1.5	476.3	O K
720 min Winter	2.665	0.665	0.0	1.5	0.0	1.5	483.5	O K
960 min Winter	2.707	0.707	0.0	1.5	0.0	1.5	513.6	Flood Risk
1440 min Winter	2.760	0.760	0.0	1.5	0.0	1.5	552.3	Flood Risk
2160 min Winter	2.801	0.801	0.0	1.5	0.0	1.5	582.5	Flood Risk
2880 min Winter	2.819	0.819	0.0	1.5	0.0	1.5	595.2	Flood Risk
4320 min Winter	2.755	0.755	0.0	1.5	0.0	1.5	548.8	Flood Risk
5760 min Winter	2.702	0.702	0.0	1.5	0.0	1.5	509.8	Flood Risk
7200 min Winter	2.649	0.649	0.0	1.5	0.0	1.5	471.6	O K
8640 min Winter	2.597	0.597	0.0	1.5	0.0	1.5	433.7	O K
10080 min Winter	2.543	0.543	0.0	1.5	0.0	1.5	394.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
30 min Winter	127.487	0.0	123.7	0.0	41
60 min Winter	71.052	0.0	245.8	0.0	70
120 min Winter	39.599	0.0	238.6	0.0	130
180 min Winter	28.130	0.0	232.3	0.0	188
240 min Winter	22.070	0.0	227.8	0.0	246
360 min Winter	15.678	0.0	221.5	0.0	364
480 min Winter	12.300	0.0	217.1	0.0	482
600 min Winter	10.190	0.0	213.7	0.0	598
720 min Winter	8.738	0.0	210.8	0.0	716
960 min Winter	7.123	0.0	208.0	0.0	950
1440 min Winter	5.340	0.0	209.6	0.0	1414
2160 min Winter	4.004	0.0	431.2	0.0	2096
2880 min Winter	3.264	0.0	423.7	0.0	2748
4320 min Winter	2.296	0.0	401.4	0.0	3588
5760 min Winter	1.789	0.0	822.3	0.0	4432
7200 min Winter	1.474	0.0	809.2	0.0	5336
8640 min Winter	1.258	0.0	774.6	0.0	6304
10080 min Winter	1.101	0.0	745.6	0.0	7176

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 624550 306900 TG 24550 06900
C (1km)	-0.024
D1 (1km)	0.267
D2 (1km)	0.400
D3 (1km)	0.243
E (1km)	0.308
F (1km)	2.475
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.850
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+45

Time Area Diagram

Total Area (ha) 0.610

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.203	4	8	0.203	8	12	0.203

Model Details

Storage is Online Cover Level (m) 3.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	32.3
Membrane Percolation (mm/hr)	1000	Length (m)	75.0
Max Percolation (l/s)	672.9	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	2.000	Membrane Depth (m)	0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0060-1600-1000-1600
Design Head (m)	1.000
Design Flow (l/s)	1.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	60
Invert Level (m)	2.000
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	1.6
Flush-Flo™	0.262	1.5
Kick-Flo®	0.531	1.2
Mean Flow over Head Range	-	1.3

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)
0.100	1.3	1.200	1.7	3.000	2.6	7.000	3.9
0.200	1.5	1.400	1.9	3.500	2.8	7.500	4.0
0.300	1.5	1.600	2.0	4.000	3.0	8.000	4.2
0.400	1.4	1.800	2.1	4.500	3.2	8.500	4.3
0.500	1.3	2.000	2.2	5.000	3.3	9.000	4.4
0.600	1.3	2.200	2.3	5.500	3.5	9.500	4.5
0.800	1.4	2.400	2.4	6.000	3.6		
1.000	1.6	2.600	2.5	6.500	3.8		

Weir Overflow Control

Discharge Coef 0.100 Width (m) 0.600 Invert Level (m) 3.000

Summary of Results for 100 year Return Period (+45%)

Half Drain Time : 3284 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	2.413	0.413	0.0	1.5	0.0	1.5	241.6	O K
30 min Summer	2.461	0.461	0.0	1.5	0.0	1.5	269.8	O K
60 min Summer	2.513	0.513	0.0	1.5	0.0	1.5	300.4	O K
120 min Summer	2.569	0.569	0.0	1.5	0.0	1.5	332.7	O K
180 min Summer	2.602	0.602	0.0	1.5	0.0	1.5	351.9	O K
240 min Summer	2.624	0.624	0.0	1.5	0.0	1.5	365.2	O K
360 min Summer	2.654	0.654	0.0	1.5	0.0	1.5	382.9	O K
480 min Summer	2.673	0.673	0.0	1.5	0.0	1.5	394.0	O K
600 min Summer	2.686	0.686	0.0	1.5	0.0	1.5	401.4	O K
720 min Summer	2.694	0.694	0.0	1.5	0.0	1.5	406.3	O K
960 min Summer	2.734	0.734	0.0	1.5	0.0	1.5	429.2	Flood Risk
1440 min Summer	2.781	0.781	0.0	1.5	0.0	1.5	456.7	Flood Risk
2160 min Summer	2.810	0.810	0.0	1.5	0.0	1.5	473.9	Flood Risk
2880 min Summer	2.818	0.818	0.0	1.5	0.0	1.5	478.5	Flood Risk
4320 min Summer	2.756	0.756	0.0	1.5	0.0	1.5	442.3	Flood Risk
5760 min Summer	2.703	0.703	0.0	1.5	0.0	1.5	411.4	Flood Risk
7200 min Summer	2.655	0.655	0.0	1.5	0.0	1.5	383.4	O K
8640 min Summer	2.611	0.611	0.0	1.5	0.0	1.5	357.4	O K
10080 min Summer	2.568	0.568	0.0	1.5	0.0	1.5	332.4	O K
15 min Winter	2.471	0.471	0.0	1.5	0.0	1.5	275.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	228.747	0.0	124.1	0.0	27
30 min Summer	127.487	0.0	121.9	0.0	42
60 min Summer	71.052	0.0	240.4	0.0	72
120 min Summer	39.599	0.0	234.7	0.0	132
180 min Summer	28.130	0.0	230.0	0.0	190
240 min Summer	22.070	0.0	226.5	0.0	250
360 min Summer	15.678	0.0	221.3	0.0	370
480 min Summer	12.300	0.0	217.4	0.0	488
600 min Summer	10.190	0.0	214.3	0.0	608
720 min Summer	8.738	0.0	211.5	0.0	728
960 min Summer	7.123	0.0	208.4	0.0	966
1440 min Summer	5.340	0.0	209.5	0.0	1444
2160 min Summer	4.004	0.0	434.2	0.0	2160
2880 min Summer	3.264	0.0	422.8	0.0	2564
4320 min Summer	2.296	0.0	393.6	0.0	3280
5760 min Summer	1.789	0.0	719.5	0.0	4040
7200 min Summer	1.474	0.0	732.1	0.0	4896
8640 min Summer	1.258	0.0	733.9	0.0	5712
10080 min Summer	1.101	0.0	712.8	0.0	6560
15 min Winter	228.747	0.0	121.9	0.0	27

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Summary of Results for 100 year Return Period (+45%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	2.526	0.526	0.0	1.5	0.0	1.5	307.4	O K
60 min Winter	2.585	0.585	0.0	1.5	0.0	1.5	342.2	O K
120 min Winter	2.648	0.648	0.0	1.5	0.0	1.5	379.2	O K
180 min Winter	2.686	0.686	0.0	1.5	0.0	1.5	401.3	O K
240 min Winter	2.712	0.712	0.0	1.5	0.0	1.5	416.7	Flood Risk
360 min Winter	2.748	0.748	0.0	1.5	0.0	1.5	437.4	Flood Risk
480 min Winter	2.771	0.771	0.0	1.5	0.0	1.5	450.7	Flood Risk
600 min Winter	2.786	0.786	0.0	1.5	0.0	1.5	459.9	Flood Risk
720 min Winter	2.797	0.797	0.0	1.5	0.0	1.5	466.2	Flood Risk
960 min Winter	2.844	0.844	0.0	1.5	0.0	1.5	493.9	Flood Risk
1440 min Winter	2.904	0.904	0.0	1.5	0.0	1.5	528.7	Flood Risk
2160 min Winter	2.947	0.947	0.0	1.5	0.0	1.5	554.2	Flood Risk
2880 min Winter	2.963	0.963	0.0	1.6	0.0	1.6	563.1	Flood Risk
4320 min Winter	2.884	0.884	0.0	1.5	0.0	1.5	517.4	Flood Risk
5760 min Winter	2.818	0.818	0.0	1.5	0.0	1.5	478.7	Flood Risk
7200 min Winter	2.755	0.755	0.0	1.5	0.0	1.5	441.4	Flood Risk
8640 min Winter	2.693	0.693	0.0	1.5	0.0	1.5	405.7	O K
10080 min Winter	2.634	0.634	0.0	1.5	0.0	1.5	371.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
30 min Winter	127.487	0.0	116.8	0.0	41
60 min Winter	71.052	0.0	235.0	0.0	70
120 min Winter	39.599	0.0	228.3	0.0	130
180 min Winter	28.130	0.0	224.7	0.0	188
240 min Winter	22.070	0.0	222.4	0.0	246
360 min Winter	15.678	0.0	219.4	0.0	364
480 min Winter	12.300	0.0	217.7	0.0	482
600 min Winter	10.190	0.0	216.8	0.0	598
720 min Winter	8.738	0.0	216.3	0.0	716
960 min Winter	7.123	0.0	220.4	0.0	948
1440 min Winter	5.340	0.0	223.1	0.0	1408
2160 min Winter	4.004	0.0	446.4	0.0	2080
2880 min Winter	3.264	0.0	445.8	0.0	2736
4320 min Winter	2.296	0.0	423.0	0.0	3424
5760 min Winter	1.789	0.0	814.5	0.0	4336
7200 min Winter	1.474	0.0	816.2	0.0	5264
8640 min Winter	1.258	0.0	784.0	0.0	6216
10080 min Winter	1.101	0.0	741.1	0.0	7072

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 624550 306900 TG 24550 06900
C (1km)	-0.024
D1 (1km)	0.267
D2 (1km)	0.400
D3 (1km)	0.243
E (1km)	0.308
F (1km)	2.475
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.850
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+45

Time Area Diagram

Total Area (ha) 0.590

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.197	4	8	0.197	8	12	0.197

Model Details

Storage is Online Cover Level (m) 3.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	26.0
Membrane Percolation (mm/hr)	1000	Length (m)	75.0
Max Percolation (l/s)	541.7	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	2.000	Membrane Depth (m)	0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0059-1590-1000-1590
Design Head (m)	1.000
Design Flow (l/s)	1.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	59
Invert Level (m)	2.000
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	1.6
Flush-Flo™	0.262	1.5
Kick-Flo®	0.531	1.2
Mean Flow over Head Range	-	1.3

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)
0.100	1.3	1.200	1.7	3.000	2.6	7.000	3.9
0.200	1.5	1.400	1.9	3.500	2.8	7.500	4.0
0.300	1.5	1.600	2.0	4.000	3.0	8.000	4.2
0.400	1.4	1.800	2.1	4.500	3.2	8.500	4.3
0.500	1.3	2.000	2.2	5.000	3.3	9.000	4.4
0.600	1.3	2.200	2.3	5.500	3.5	9.500	4.5
0.800	1.4	2.400	2.4	6.000	3.6		
1.000	1.6	2.600	2.5	6.500	3.8		

Weir Overflow Control

Discharge Coef 0.100 Width (m) 0.600 Invert Level (m) 3.000

Summary of Results for 100 year Return Period (+45%)

Half Drain Time : 3134 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	2.383	0.383	0.0	1.9	0.0	1.9	306.2	O K
30 min Summer	2.427	0.427	0.0	1.9	0.0	1.9	341.9	O K
60 min Summer	2.476	0.476	0.0	1.9	0.0	1.9	380.5	O K
120 min Summer	2.527	0.527	0.0	1.9	0.0	1.9	421.3	O K
180 min Summer	2.557	0.557	0.0	1.9	0.0	1.9	445.5	O K
240 min Summer	2.578	0.578	0.0	1.9	0.0	1.9	462.4	O K
360 min Summer	2.606	0.606	0.0	1.9	0.0	1.9	485.1	O K
480 min Summer	2.624	0.624	0.0	1.9	0.0	1.9	499.5	O K
600 min Summer	2.637	0.637	0.0	1.9	0.0	1.9	509.2	O K
720 min Summer	2.645	0.645	0.0	1.9	0.0	1.9	515.7	O K
960 min Summer	2.682	0.682	0.0	1.9	0.0	1.9	545.8	O K
1440 min Summer	2.728	0.728	0.0	1.9	0.0	1.9	582.1	Flood Risk
2160 min Summer	2.757	0.757	0.0	1.9	0.0	1.9	605.6	Flood Risk
2880 min Summer	2.765	0.765	0.0	1.9	0.0	1.9	611.7	Flood Risk
4320 min Summer	2.706	0.706	0.0	1.9	0.0	1.9	564.5	Flood Risk
5760 min Summer	2.654	0.654	0.0	1.9	0.0	1.9	522.9	O K
7200 min Summer	2.604	0.604	0.0	1.9	0.0	1.9	483.0	O K
8640 min Summer	2.552	0.552	0.0	1.9	0.0	1.9	441.6	O K
10080 min Summer	2.507	0.507	0.0	1.9	0.0	1.9	405.3	O K
15 min Winter	2.436	0.436	0.0	1.9	0.0	1.9	349.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	228.747	0.0	165.9	0.0	27
30 min Summer	127.487	0.0	165.6	0.0	42
60 min Summer	71.052	0.0	320.4	0.0	72
120 min Summer	39.599	0.0	323.0	0.0	130
180 min Summer	28.130	0.0	320.1	0.0	190
240 min Summer	22.070	0.0	316.0	0.0	250
360 min Summer	15.678	0.0	306.9	0.0	370
480 min Summer	12.300	0.0	299.1	0.0	488
600 min Summer	10.190	0.0	292.5	0.0	608
720 min Summer	8.738	0.0	286.8	0.0	728
960 min Summer	7.123	0.0	274.2	0.0	966
1440 min Summer	5.340	0.0	260.1	0.0	1444
2160 min Summer	4.004	0.0	565.4	0.0	2160
2880 min Summer	3.264	0.0	543.2	0.0	2628
4320 min Summer	2.296	0.0	496.2	0.0	3332
5760 min Summer	1.789	0.0	909.8	0.0	4096
7200 min Summer	1.474	0.0	927.2	0.0	4904
8640 min Summer	1.258	0.0	938.7	0.0	5624
10080 min Summer	1.101	0.0	939.5	0.0	6368
15 min Winter	228.747	0.0	166.2	0.0	27

The Library
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Summary of Results for 100 year Return Period (+45%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	2.487	0.487	0.0	1.9	0.0	1.9	389.7	O K
60 min Winter	2.542	0.542	0.0	1.9	0.0	1.9	433.8	O K
120 min Winter	2.601	0.601	0.0	1.9	0.0	1.9	480.8	O K
180 min Winter	2.636	0.636	0.0	1.9	0.0	1.9	509.0	O K
240 min Winter	2.661	0.661	0.0	1.9	0.0	1.9	528.7	O K
360 min Winter	2.694	0.694	0.0	1.9	0.0	1.9	555.2	O K
480 min Winter	2.715	0.715	0.0	1.9	0.0	1.9	572.3	Flood Risk
600 min Winter	2.730	0.730	0.0	1.9	0.0	1.9	584.0	Flood Risk
720 min Winter	2.740	0.740	0.0	1.9	0.0	1.9	592.2	Flood Risk
960 min Winter	2.785	0.785	0.0	1.9	0.0	1.9	628.0	Flood Risk
1440 min Winter	2.841	0.841	0.0	1.9	0.0	1.9	673.1	Flood Risk
2160 min Winter	2.883	0.883	0.0	1.9	0.0	1.9	706.6	Flood Risk
2880 min Winter	2.899	0.899	0.0	1.9	0.0	1.9	719.0	Flood Risk
4320 min Winter	2.824	0.824	0.0	1.9	0.0	1.9	659.2	Flood Risk
5760 min Winter	2.760	0.760	0.0	1.9	0.0	1.9	608.3	Flood Risk
7200 min Winter	2.698	0.698	0.0	1.9	0.0	1.9	558.1	O K
8640 min Winter	2.635	0.635	0.0	1.9	0.0	1.9	507.6	O K
10080 min Winter	2.564	0.564	0.0	1.9	0.0	1.9	450.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
30 min Winter	127.487	0.0	164.0	0.0	41
60 min Winter	71.052	0.0	324.6	0.0	70
120 min Winter	39.599	0.0	317.1	0.0	130
180 min Winter	28.130	0.0	309.1	0.0	188
240 min Winter	22.070	0.0	303.3	0.0	246
360 min Winter	15.678	0.0	294.9	0.0	364
480 min Winter	12.300	0.0	288.8	0.0	482
600 min Winter	10.190	0.0	284.0	0.0	598
720 min Winter	8.738	0.0	279.9	0.0	716
960 min Winter	7.123	0.0	274.2	0.0	950
1440 min Winter	5.340	0.0	274.7	0.0	1410
2160 min Winter	4.004	0.0	570.6	0.0	2084
2880 min Winter	3.264	0.0	556.6	0.0	2740
4320 min Winter	2.296	0.0	524.3	0.0	3468
5760 min Winter	1.789	0.0	1031.1	0.0	4384
7200 min Winter	1.474	0.0	1040.7	0.0	5328
8640 min Winter	1.258	0.0	1023.5	0.0	6232
10080 min Winter	1.101	0.0	1007.2	0.0	7064

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 624550 306900 TG 24550 06900
C (1km)	-0.024
D1 (1km)	0.267
D2 (1km)	0.400
D3 (1km)	0.243
E (1km)	0.308
F (1km)	2.475
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.850
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+45

Time Area Diagram

Total Area (ha) 0.750

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.250	4	8	0.250	8	12	0.250

Model Details

Storage is Online Cover Level (m) 3.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	30.3
Membrane Percolation (mm/hr)	1000	Length (m)	88.0
Max Percolation (l/s)	740.7	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	2.000	Membrane Depth (m)	0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0067-2000-1000-2000
Design Head (m)	1.000
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	67
Invert Level (m)	2.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	2.0
Flush-Flo™	0.296	1.9
Kick-Flo®	0.599	1.6
Mean Flow over Head Range	-	1.7

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)
0.100	1.6	1.200	2.2	3.000	3.3	7.000	4.9
0.200	1.9	1.400	2.3	3.500	3.5	7.500	5.1
0.300	1.9	1.600	2.5	4.000	3.8	8.000	5.2
0.400	1.9	1.800	2.6	4.500	4.0	8.500	5.4
0.500	1.8	2.000	2.7	5.000	4.2	9.000	5.5
0.600	1.6	2.200	2.9	5.500	4.4	9.500	5.7
0.800	1.8	2.400	3.0	6.000	4.6		
1.000	2.0	2.600	3.1	6.500	4.7		

Weir Overflow Control

Discharge Coef 0.100 Width (m) 0.600 Invert Level (m) 3.000

Summary of Results for 100 year Return Period (+45%)

Half Drain Time : 3626 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	2.252	0.252	0.0	2.2	0.0	2.2	242.0	O K
30 min Summer	2.336	0.336	0.0	2.2	0.0	2.2	322.1	O K
60 min Summer	2.420	0.420	0.0	2.2	0.0	2.2	403.5	O K
120 min Summer	2.512	0.512	0.0	2.2	0.0	2.2	491.9	O K
180 min Summer	2.579	0.579	0.0	2.2	0.0	2.2	555.6	O K
240 min Summer	2.630	0.630	0.0	2.2	0.0	2.2	605.1	O K
360 min Summer	2.704	0.704	0.0	2.2	0.0	2.2	675.8	Flood Risk
480 min Summer	2.753	0.753	0.0	2.2	0.0	2.2	722.7	Flood Risk
600 min Summer	2.786	0.786	0.0	2.2	0.0	2.2	754.6	Flood Risk
720 min Summer	2.809	0.809	0.0	2.2	0.0	2.2	776.8	Flood Risk
960 min Summer	2.835	0.835	0.0	2.2	0.0	2.2	802.1	Flood Risk
1440 min Summer	2.850	0.850	0.0	2.2	0.0	2.2	816.3	Flood Risk
2160 min Summer	2.834	0.834	0.0	2.2	0.0	2.2	800.4	Flood Risk
2880 min Summer	2.803	0.803	0.0	2.2	0.0	2.2	770.5	Flood Risk
4320 min Summer	2.746	0.746	0.0	2.2	0.0	2.2	715.7	Flood Risk
5760 min Summer	2.699	0.699	0.0	2.2	0.0	2.2	671.0	O K
7200 min Summer	2.661	0.661	0.0	2.2	0.0	2.2	634.1	O K
8640 min Summer	2.625	0.625	0.0	2.2	0.0	2.2	599.7	O K
10080 min Summer	2.589	0.589	0.0	2.2	0.0	2.2	565.7	O K
15 min Winter	2.285	0.285	0.0	2.2	0.0	2.2	273.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	163.329	0.0	170.8	0.0	27
30 min Summer	107.213	0.0	183.7	0.0	42
60 min Summer	66.819	0.0	349.4	0.0	72
120 min Summer	40.799	0.0	365.3	0.0	130
180 min Summer	30.824	0.0	360.4	0.0	190
240 min Summer	25.274	0.0	348.8	0.0	250
360 min Summer	19.000	0.0	330.0	0.0	370
480 min Summer	15.410	0.0	320.1	0.0	490
600 min Summer	13.024	0.0	314.5	0.0	608
720 min Summer	11.309	0.0	311.3	0.0	728
960 min Summer	8.976	0.0	308.6	0.0	966
1440 min Summer	6.404	0.0	304.9	0.0	1444
2160 min Summer	4.519	0.0	631.1	0.0	2160
2880 min Summer	3.522	0.0	606.5	0.0	2796
4320 min Summer	2.481	0.0	557.8	0.0	3424
5760 min Summer	1.941	0.0	1111.9	0.0	4208
7200 min Summer	1.614	0.0	1132.5	0.0	5040
8640 min Summer	1.393	0.0	1127.0	0.0	5872
10080 min Summer	1.234	0.0	1095.4	0.0	6568
15 min Winter	163.329	0.0	178.2	0.0	27

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Summary of Results for 100 year Return Period (+45%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	2.378	0.378	0.0	2.2	0.0	2.2	363.0	O K
60 min Winter	2.473	0.473	0.0	2.2	0.0	2.2	454.5	O K
120 min Winter	2.577	0.577	0.0	2.2	0.0	2.2	554.3	O K
180 min Winter	2.653	0.653	0.0	2.2	0.0	2.2	626.5	O K
240 min Winter	2.711	0.711	0.0	2.2	0.0	2.2	682.2	Flood Risk
360 min Winter	2.794	0.794	0.0	2.2	0.0	2.2	761.9	Flood Risk
480 min Winter	2.849	0.849	0.0	2.2	0.0	2.2	815.3	Flood Risk
600 min Winter	2.888	0.888	0.0	2.2	0.0	2.2	852.1	Flood Risk
720 min Winter	2.915	0.915	0.0	2.2	0.0	2.2	878.0	Flood Risk
960 min Winter	2.946	0.946	0.0	2.2	0.0	2.2	908.5	Flood Risk
1440 min Winter	2.968	0.968	0.0	2.2	0.0	2.2	928.9	Flood Risk
2160 min Winter	2.956	0.956	0.0	2.2	0.0	2.2	917.9	Flood Risk
2880 min Winter	2.928	0.928	0.0	2.2	0.0	2.2	891.0	Flood Risk
4320 min Winter	2.858	0.858	0.0	2.2	0.0	2.2	823.9	Flood Risk
5760 min Winter	2.802	0.802	0.0	2.2	0.0	2.2	769.8	Flood Risk
7200 min Winter	2.752	0.752	0.0	2.2	0.0	2.2	722.3	Flood Risk
8640 min Winter	2.706	0.706	0.0	2.2	0.0	2.2	677.6	Flood Risk
10080 min Winter	2.661	0.661	0.0	2.2	0.0	2.2	634.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
30 min Winter	107.213	0.0	186.1	0.0	41
60 min Winter	66.819	0.0	363.9	0.0	70
120 min Winter	40.799	0.0	363.1	0.0	130
180 min Winter	30.824	0.0	347.0	0.0	188
240 min Winter	25.274	0.0	334.5	0.0	246
360 min Winter	19.000	0.0	322.4	0.0	364
480 min Winter	15.410	0.0	319.3	0.0	482
600 min Winter	13.024	0.0	320.9	0.0	600
720 min Winter	11.309	0.0	324.2	0.0	718
960 min Winter	8.976	0.0	326.5	0.0	952
1440 min Winter	6.404	0.0	322.7	0.0	1416
2160 min Winter	4.519	0.0	640.4	0.0	2100
2880 min Winter	3.522	0.0	622.7	0.0	2764
4320 min Winter	2.481	0.0	590.7	0.0	3896
5760 min Winter	1.941	0.0	1229.1	0.0	4448
7200 min Winter	1.614	0.0	1206.1	0.0	5400
8640 min Winter	1.393	0.0	1154.5	0.0	6312
10080 min Winter	1.234	0.0	1104.9	0.0	7264

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 624621 307427 TG 24621 07427
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+45

Time Area Diagram

Total Area (ha) 0.850

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.283	4	8	0.283	8	12	0.283

Model Details

Storage is Online Cover Level (m) 3.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	32.0
Membrane Percolation (mm/hr)	1000	Length (m)	100.0
Max Percolation (l/s)	888.9	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	2.000	Membrane Depth (m)	0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0070-2200-1000-2200
Design Head (m)	1.000
Design Flow (l/s)	2.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	70
Invert Level (m)	2.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	2.2
Flush-Flo™	0.307	2.2
Kick-Flo®	0.625	1.8
Mean Flow over Head Range	-	1.9

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)
0.100	1.8	1.200	2.4	3.000	3.6	7.000	5.4
0.200	2.1	1.400	2.6	3.500	3.9	7.500	5.6
0.300	2.2	1.600	2.7	4.000	4.2	8.000	5.8
0.400	2.2	1.800	2.9	4.500	4.4	8.500	5.9
0.500	2.1	2.000	3.0	5.000	4.6	9.000	6.1
0.600	1.9	2.200	3.2	5.500	4.8	9.500	6.3
0.800	2.0	2.400	3.3	6.000	5.0		
1.000	2.2	2.600	3.4	6.500	5.2		

Orifice Overflow Control

Diameter (m) 0.100 Discharge Coefficient 0.600 Invert Level (m) 3.000

The Library
St Philips Courtyard
Coleshill B46 3AD

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Micro Drainage | Source Control 2020.1.3

Summary of Results for 100 year Return Period (+45%)

Half Drain Time : 3419 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	2.350	0.350	0.0	1.7	0.0	1.7	284.7	O K
30 min Summer	2.390	0.390	0.0	1.7	0.0	1.7	318.1	O K
60 min Summer	2.435	0.435	0.0	1.7	0.0	1.7	354.3	O K
120 min Summer	2.482	0.482	0.0	1.7	0.0	1.7	392.7	O K
180 min Summer	2.510	0.510	0.0	1.7	0.0	1.7	415.5	O K
240 min Summer	2.530	0.530	0.0	1.7	0.0	1.7	431.5	O K
360 min Summer	2.556	0.556	0.0	1.7	0.0	1.7	453.1	O K
480 min Summer	2.573	0.573	0.0	1.7	0.0	1.7	467.1	O K
600 min Summer	2.585	0.585	0.0	1.7	0.0	1.7	476.8	O K
720 min Summer	2.593	0.593	0.0	1.7	0.0	1.7	483.4	O K
960 min Summer	2.630	0.630	0.0	1.7	0.0	1.7	512.9	O K
1440 min Summer	2.674	0.674	0.0	1.7	0.0	1.7	549.3	O K
2160 min Summer	2.706	0.706	0.0	1.7	0.0	1.7	574.9	Flood Risk
2880 min Summer	2.715	0.715	0.0	1.7	0.0	1.7	582.9	Flood Risk
4320 min Summer	2.663	0.663	0.0	1.7	0.0	1.7	540.1	O K
5760 min Summer	2.617	0.617	0.0	1.7	0.0	1.7	502.6	O K
7200 min Summer	2.573	0.573	0.0	1.7	0.0	1.7	467.0	O K
8640 min Summer	2.528	0.528	0.0	1.7	0.0	1.7	429.8	O K
10080 min Summer	2.487	0.487	0.0	1.7	0.0	1.7	396.8	O K
15 min Winter	2.399	0.399	0.0	1.7	0.0	1.7	324.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	228.747	0.0	145.3	0.0	27
30 min Summer	127.487	0.0	145.0	0.0	42
60 min Summer	71.052	0.0	283.0	0.0	72
120 min Summer	39.599	0.0	284.0	0.0	130
180 min Summer	28.130	0.0	281.4	0.0	190
240 min Summer	22.070	0.0	277.8	0.0	250
360 min Summer	15.678	0.0	270.2	0.0	370
480 min Summer	12.300	0.0	262.9	0.0	488
600 min Summer	10.190	0.0	256.8	0.0	608
720 min Summer	8.738	0.0	251.4	0.0	728
960 min Summer	7.123	0.0	239.5	0.0	966
1440 min Summer	5.340	0.0	226.3	0.0	1444
2160 min Summer	4.004	0.0	491.5	0.0	2160
2880 min Summer	3.264	0.0	472.0	0.0	2744
4320 min Summer	2.296	0.0	432.2	0.0	3416
5760 min Summer	1.789	0.0	840.9	0.0	4160
7200 min Summer	1.474	0.0	853.2	0.0	4976
8640 min Summer	1.258	0.0	858.2	0.0	5712
10080 min Summer	1.101	0.0	844.9	0.0	6456
15 min Winter	228.747	0.0	145.6	0.0	27

The Library
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Summary of Results for 100 year Return Period (+45%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	2.445	0.445	0.0	1.7	0.0	1.7	362.7	O K
60 min Winter	2.496	0.496	0.0	1.7	0.0	1.7	404.0	O K
120 min Winter	2.550	0.550	0.0	1.7	0.0	1.7	448.1	O K
180 min Winter	2.583	0.583	0.0	1.7	0.0	1.7	474.7	O K
240 min Winter	2.606	0.606	0.0	1.7	0.0	1.7	493.4	O K
360 min Winter	2.637	0.637	0.0	1.7	0.0	1.7	518.8	O K
480 min Winter	2.657	0.657	0.0	1.7	0.0	1.7	535.4	O K
600 min Winter	2.671	0.671	0.0	1.7	0.0	1.7	546.9	O K
720 min Winter	2.681	0.681	0.0	1.7	0.0	1.7	555.2	O K
960 min Winter	2.724	0.724	0.0	1.7	0.0	1.7	589.8	Flood Risk
1440 min Winter	2.779	0.779	0.0	1.7	0.0	1.7	634.5	Flood Risk
2160 min Winter	2.822	0.822	0.0	1.7	0.0	1.7	669.4	Flood Risk
2880 min Winter	2.840	0.840	0.0	1.7	0.0	1.7	684.2	Flood Risk
4320 min Winter	2.774	0.774	0.0	1.7	0.0	1.7	630.8	Flood Risk
5760 min Winter	2.719	0.719	0.0	1.7	0.0	1.7	585.6	Flood Risk
7200 min Winter	2.664	0.664	0.0	1.7	0.0	1.7	541.1	O K
8640 min Winter	2.610	0.610	0.0	1.7	0.0	1.7	496.6	O K
10080 min Winter	2.550	0.550	0.0	1.7	0.0	1.7	448.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
30 min Winter	127.487	0.0	143.8	0.0	41
60 min Winter	71.052	0.0	285.6	0.0	70
120 min Winter	39.599	0.0	279.3	0.0	130
180 min Winter	28.130	0.0	271.8	0.0	188
240 min Winter	22.070	0.0	266.1	0.0	246
360 min Winter	15.678	0.0	258.1	0.0	364
480 min Winter	12.300	0.0	252.3	0.0	482
600 min Winter	10.190	0.0	247.8	0.0	600
720 min Winter	8.738	0.0	244.1	0.0	716
960 min Winter	7.123	0.0	238.7	0.0	950
1440 min Winter	5.340	0.0	239.1	0.0	1414
2160 min Winter	4.004	0.0	495.9	0.0	2096
2880 min Winter	3.264	0.0	485.1	0.0	2748
4320 min Winter	2.296	0.0	458.8	0.0	3632
5760 min Winter	1.789	0.0	945.0	0.0	4440
7200 min Winter	1.474	0.0	932.5	0.0	5344
8640 min Winter	1.258	0.0	896.5	0.0	6312
10080 min Winter	1.101	0.0	874.6	0.0	7168

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 624550 306900 TG 24550 06900
C (1km)	-0.024
D1 (1km)	0.267
D2 (1km)	0.400
D3 (1km)	0.243
E (1km)	0.308
F (1km)	2.475
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.850
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+45

Time Area Diagram

Total Area (ha) 0.700

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.233	4	8	0.233	8	12	0.233

Model Details

Storage is Online Cover Level (m) 3.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	21.9
Membrane Percolation (mm/hr)	1000	Length (m)	124.0
Max Percolation (l/s)	754.3	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	2.000	Membrane Depth (m)	0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0063-1800-1000-1800
Design Head (m)	1.000
Design Flow (l/s)	1.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	63
Invert Level (m)	2.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	1.8
Flush-Flo™	0.280	1.7
Kick-Flo®	0.565	1.4
Mean Flow over Head Range	-	1.5

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)
0.100	1.5	1.200	2.0	3.000	3.0	7.000	4.4
0.200	1.7	1.400	2.1	3.500	3.2	7.500	4.6
0.300	1.7	1.600	2.2	4.000	3.4	8.000	4.7
0.400	1.7	1.800	2.3	4.500	3.6	8.500	4.8
0.500	1.6	2.000	2.5	5.000	3.8	9.000	5.0
0.600	1.4	2.200	2.6	5.500	3.9	9.500	5.1
0.800	1.6	2.400	2.7	6.000	4.1		
1.000	1.8	2.600	2.8	6.500	4.3		

Weir Overflow Control

Discharge Coef 0.100 Width (m) 0.600 Invert Level (m) 3.000

Summary of Results for 100 year Return Period (+45%)

Half Drain Time : 3366 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	2.375	0.375	0.0	1.4	0.0	1.4	228.5	O K
30 min Summer	2.418	0.418	0.0	1.4	0.0	1.4	255.2	O K
60 min Summer	2.466	0.466	0.0	1.4	0.0	1.4	284.2	O K
120 min Summer	2.516	0.516	0.0	1.4	0.0	1.4	315.0	O K
180 min Summer	2.546	0.546	0.0	1.4	0.0	1.4	333.3	O K
240 min Summer	2.567	0.567	0.0	1.4	0.0	1.4	346.2	O K
360 min Summer	2.595	0.595	0.0	1.4	0.0	1.4	363.2	O K
480 min Summer	2.613	0.613	0.0	1.4	0.0	1.4	374.1	O K
600 min Summer	2.625	0.625	0.0	1.4	0.0	1.4	381.4	O K
720 min Summer	2.633	0.633	0.0	1.4	0.0	1.4	386.3	O K
960 min Summer	2.670	0.670	0.0	1.4	0.0	1.4	408.7	O K
1440 min Summer	2.715	0.715	0.0	1.4	0.0	1.4	436.1	O K
2160 min Summer	2.744	0.744	0.0	1.4	0.0	1.4	454.1	O K
2880 min Summer	2.753	0.753	0.0	1.4	0.0	1.4	459.2	O K
4320 min Summer	2.697	0.697	0.0	1.4	0.0	1.4	425.3	O K
5760 min Summer	2.649	0.649	0.0	1.4	0.0	1.4	396.0	O K
7200 min Summer	2.606	0.606	0.0	1.4	0.0	1.4	369.4	O K
8640 min Summer	2.564	0.564	0.0	1.4	0.0	1.4	344.3	O K
10080 min Summer	2.524	0.524	0.0	1.4	0.0	1.4	319.5	O K
15 min Winter	2.427	0.427	0.0	1.4	0.0	1.4	260.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	228.747	0.0	116.2	0.0	27
30 min Summer	127.487	0.0	114.8	0.0	42
60 min Summer	71.052	0.0	226.1	0.0	72
120 min Summer	39.599	0.0	222.2	0.0	132
180 min Summer	28.130	0.0	217.1	0.0	190
240 min Summer	22.070	0.0	213.2	0.0	250
360 min Summer	15.678	0.0	207.4	0.0	370
480 min Summer	12.300	0.0	203.1	0.0	488
600 min Summer	10.190	0.0	199.5	0.0	608
720 min Summer	8.738	0.0	196.5	0.0	728
960 min Summer	7.123	0.0	191.6	0.0	966
1440 min Summer	5.340	0.0	190.3	0.0	1444
2160 min Summer	4.004	0.0	399.7	0.0	2160
2880 min Summer	3.264	0.0	387.8	0.0	2628
4320 min Summer	2.296	0.0	359.4	0.0	3332
5760 min Summer	1.789	0.0	678.0	0.0	4096
7200 min Summer	1.474	0.0	688.1	0.0	4904
8640 min Summer	1.258	0.0	686.4	0.0	5784
10080 min Summer	1.101	0.0	666.2	0.0	6560
15 min Winter	228.747	0.0	115.0	0.0	27

Summary of Results for 100 year Return Period (+45%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	2.477	0.477	0.0	1.4	0.0	1.4	290.9	O K
60 min Winter	2.531	0.531	0.0	1.4	0.0	1.4	324.0	O K
120 min Winter	2.589	0.589	0.0	1.4	0.0	1.4	359.2	O K
180 min Winter	2.623	0.623	0.0	1.4	0.0	1.4	380.3	O K
240 min Winter	2.648	0.648	0.0	1.4	0.0	1.4	395.1	O K
360 min Winter	2.680	0.680	0.0	1.4	0.0	1.4	415.0	O K
480 min Winter	2.702	0.702	0.0	1.4	0.0	1.4	428.0	O K
600 min Winter	2.716	0.716	0.0	1.4	0.0	1.4	436.9	O K
720 min Winter	2.726	0.726	0.0	1.4	0.0	1.4	443.2	O K
960 min Winter	2.771	0.771	0.0	1.4	0.0	1.4	470.1	O K
1440 min Winter	2.827	0.827	0.0	1.4	0.0	1.4	504.3	O K
2160 min Winter	2.869	0.869	0.0	1.4	0.0	1.4	530.1	O K
2880 min Winter	2.885	0.885	0.0	1.4	0.0	1.4	540.1	O K
4320 min Winter	2.815	0.815	0.0	1.4	0.0	1.4	497.1	O K
5760 min Winter	2.756	0.756	0.0	1.4	0.0	1.4	461.0	O K
7200 min Winter	2.698	0.698	0.0	1.4	0.0	1.4	426.0	O K
8640 min Winter	2.643	0.643	0.0	1.4	0.0	1.4	392.1	O K
10080 min Winter	2.588	0.588	0.0	1.4	0.0	1.4	358.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
30 min Winter	127.487	0.0	111.7	0.0	41
60 min Winter	71.052	0.0	222.1	0.0	70
120 min Winter	39.599	0.0	214.6	0.0	130
180 min Winter	28.130	0.0	210.3	0.0	188
240 min Winter	22.070	0.0	207.4	0.0	246
360 min Winter	15.678	0.0	203.5	0.0	364
480 min Winter	12.300	0.0	201.0	0.0	482
600 min Winter	10.190	0.0	199.3	0.0	598
720 min Winter	8.738	0.0	198.1	0.0	716
960 min Winter	7.123	0.0	200.4	0.0	950
1440 min Winter	5.340	0.0	202.8	0.0	1412
2160 min Winter	4.004	0.0	409.2	0.0	2084
2880 min Winter	3.264	0.0	407.0	0.0	2740
4320 min Winter	2.296	0.0	386.1	0.0	3468
5760 min Winter	1.789	0.0	765.1	0.0	4384
7200 min Winter	1.474	0.0	758.5	0.0	5328
8640 min Winter	1.258	0.0	725.1	0.0	6232
10080 min Winter	1.101	0.0	687.3	0.0	7160

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 624550 306900 TG 24550 06900
C (1km)	-0.024
D1 (1km)	0.267
D2 (1km)	0.400
D3 (1km)	0.243
E (1km)	0.308
F (1km)	2.475
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.850
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+45

Time Area Diagram

Total Area (ha) 0.560

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.187	4	8	0.187	8	12	0.187

Model Details

Storage is Online Cover Level (m) 3.200

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	24.5
Membrane Percolation (mm/hr)	1000	Length (m)	83.0
Max Percolation (l/s)	564.9	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	2.000	Membrane Depth (m)	0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0058-1500-1000-1500
Design Head (m)	1.000
Design Flow (l/s)	1.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	58
Invert Level (m)	2.000
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	1.5
Flush-Flo™	0.253	1.4
Kick-Flo®	0.515	1.1
Mean Flow over Head Range	-	1.2

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)
0.100	1.2	1.200	1.6	3.000	2.5	7.000	3.7
0.200	1.4	1.400	1.7	3.500	2.7	7.500	3.8
0.300	1.4	1.600	1.9	4.000	2.8	8.000	3.9
0.400	1.3	1.800	2.0	4.500	3.0	8.500	4.0
0.500	1.2	2.000	2.0	5.000	3.1	9.000	4.1
0.600	1.2	2.200	2.1	5.500	3.3	9.500	4.2
0.800	1.4	2.400	2.2	6.000	3.4		
1.000	1.5	2.600	2.3	6.500	3.5		

Weir Overflow Control

Discharge Coef 0.100 Width (m) 0.600 Invert Level (m) 3.000

The Library
St Philips Courtyard
Coleshill B46 3AD

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Summary of Results for 100 year Return Period (+45%)

Half Drain Time : 3919 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	2.390	0.390	0.0	0.7	0.0	0.7	147.3	O K
30 min Summer	2.435	0.435	0.0	0.7	0.0	0.7	164.6	O K
60 min Summer	2.485	0.485	0.0	0.7	0.0	0.7	183.4	O K
120 min Summer	2.538	0.538	0.0	0.7	0.0	0.7	203.3	O K
180 min Summer	2.569	0.569	0.0	0.7	0.0	0.7	215.2	O K
240 min Summer	2.591	0.591	0.0	0.7	0.0	0.7	223.6	O K
360 min Summer	2.621	0.621	0.0	0.7	0.0	0.7	234.8	O K
480 min Summer	2.641	0.641	0.0	0.7	0.0	0.7	242.1	O K
600 min Summer	2.654	0.654	0.0	0.7	0.0	0.7	247.1	O K
720 min Summer	2.663	0.663	0.0	0.7	0.0	0.7	250.6	O K
960 min Summer	2.703	0.703	0.0	0.8	0.0	0.8	265.6	Flood Risk
1440 min Summer	2.752	0.752	0.0	0.8	0.0	0.8	284.4	Flood Risk
2160 min Summer	2.788	0.788	0.0	0.8	0.0	0.8	297.9	Flood Risk
2880 min Summer	2.800	0.800	0.0	0.8	0.0	0.8	302.4	Flood Risk
4320 min Summer	2.746	0.746	0.0	0.8	0.0	0.8	282.0	Flood Risk
5760 min Summer	2.700	0.700	0.0	0.8	0.0	0.8	264.7	Flood Risk
7200 min Summer	2.660	0.660	0.0	0.7	0.0	0.7	249.3	O K
8640 min Summer	2.623	0.623	0.0	0.7	0.0	0.7	235.4	O K
10080 min Summer	2.589	0.589	0.0	0.7	0.0	0.7	222.5	O K
15 min Winter	2.444	0.444	0.0	0.7	0.0	0.7	167.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	228.747	0.0	58.4	0.0	27
30 min Summer	127.487	0.0	55.3	0.0	42
60 min Summer	71.052	0.0	114.4	0.0	72
120 min Summer	39.599	0.0	112.2	0.0	132
180 min Summer	28.130	0.0	111.4	0.0	190
240 min Summer	22.070	0.0	111.0	0.0	250
360 min Summer	15.678	0.0	111.0	0.0	370
480 min Summer	12.300	0.0	111.6	0.0	488
600 min Summer	10.190	0.0	112.4	0.0	608
720 min Summer	8.738	0.0	112.7	0.0	728
960 min Summer	7.123	0.0	114.9	0.0	966
1440 min Summer	5.340	0.0	116.0	0.0	1444
2160 min Summer	4.004	0.0	230.8	0.0	2160
2880 min Summer	3.264	0.0	232.8	0.0	2692
4320 min Summer	2.296	0.0	219.5	0.0	3376
5760 min Summer	1.789	0.0	429.3	0.0	4144
7200 min Summer	1.474	0.0	416.2	0.0	4968
8640 min Summer	1.258	0.0	393.4	0.0	5792
10080 min Summer	1.101	0.0	368.2	0.0	6568
15 min Winter	228.747	0.0	55.2	0.0	27

The Library
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Coleshill B46 3AD

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Summary of Results for 100 year Return Period (+45%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	2.496	0.496	0.0	0.7	0.0	0.7	187.5	O K
60 min Winter	2.552	0.552	0.0	0.7	0.0	0.7	208.8	O K
120 min Winter	2.613	0.613	0.0	0.7	0.0	0.7	231.6	O K
180 min Winter	2.649	0.649	0.0	0.7	0.0	0.7	245.4	O K
240 min Winter	2.675	0.675	0.0	0.8	0.0	0.8	255.0	O K
360 min Winter	2.710	0.710	0.0	0.8	0.0	0.8	268.2	Flood Risk
480 min Winter	2.733	0.733	0.0	0.8	0.0	0.8	276.9	Flood Risk
600 min Winter	2.749	0.749	0.0	0.8	0.0	0.8	283.0	Flood Risk
720 min Winter	2.760	0.760	0.0	0.8	0.0	0.8	287.4	Flood Risk
960 min Winter	2.808	0.808	0.0	0.8	0.0	0.8	305.5	Flood Risk
1440 min Winter	2.870	0.870	0.0	0.8	0.0	0.8	328.9	Flood Risk
2160 min Winter	2.919	0.919	0.0	0.9	0.0	0.9	347.6	Flood Risk
2880 min Winter	2.942	0.942	0.0	0.9	0.0	0.9	356.0	Flood Risk
4320 min Winter	2.875	0.875	0.0	0.8	0.0	0.8	330.6	Flood Risk
5760 min Winter	2.820	0.820	0.0	0.8	0.0	0.8	309.8	Flood Risk
7200 min Winter	2.767	0.767	0.0	0.8	0.0	0.8	289.9	Flood Risk
8640 min Winter	2.717	0.717	0.0	0.8	0.0	0.8	270.9	Flood Risk
10080 min Winter	2.669	0.669	0.0	0.8	0.0	0.8	252.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
30 min Winter	127.487	0.0	54.0	0.0	41
60 min Winter	71.052	0.0	112.8	0.0	70
120 min Winter	39.599	0.0	112.6	0.0	130
180 min Winter	28.130	0.0	113.6	0.0	188
240 min Winter	22.070	0.0	115.0	0.0	246
360 min Winter	15.678	0.0	117.6	0.0	364
480 min Winter	12.300	0.0	119.0	0.0	482
600 min Winter	10.190	0.0	119.8	0.0	598
720 min Winter	8.738	0.0	120.1	0.0	716
960 min Winter	7.123	0.0	122.3	0.0	950
1440 min Winter	5.340	0.0	123.1	0.0	1412
2160 min Winter	4.004	0.0	247.1	0.0	2096
2880 min Winter	3.264	0.0	248.8	0.0	2744
4320 min Winter	2.296	0.0	234.4	0.0	3548
5760 min Winter	1.789	0.0	455.5	0.0	4392
7200 min Winter	1.474	0.0	436.4	0.0	5336
8640 min Winter	1.258	0.0	415.5	0.0	6232
10080 min Winter	1.101	0.0	394.5	0.0	7160

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 624550 306900 TG 24550 06900
C (1km)	-0.024
D1 (1km)	0.267
D2 (1km)	0.400
D3 (1km)	0.243
E (1km)	0.308
F (1km)	2.475
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.850
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+45

Time Area Diagram

Total Area (ha) 0.360

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.120	4	8	0.120	8	12	0.120

Model Details

Storage is Online Cover Level (m) 3.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	14.0
Membrane Percolation (mm/hr)	1000	Length (m)	90.0
Max Percolation (l/s)	350.0	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	2.000	Membrane Depth (m)	0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0044-9000-1000-9000
Design Head (m)	1.000
Design Flow (l/s)	0.9
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	44
Invert Level (m)	2.000
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	0.9
Flush-Flo™	0.194	0.7
Kick-Flo®	0.394	0.6
Mean Flow over Head Range	-	0.7

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)
0.100	0.7	1.200	1.0	3.000	1.5	7.000	2.2
0.200	0.7	1.400	1.0	3.500	1.6	7.500	2.2
0.300	0.7	1.600	1.1	4.000	1.7	8.000	2.3
0.400	0.6	1.800	1.2	4.500	1.8	8.500	2.4
0.500	0.7	2.000	1.2	5.000	1.9	9.000	2.4
0.600	0.7	2.200	1.3	5.500	1.9	9.500	2.5
0.800	0.8	2.400	1.3	6.000	2.0		
1.000	0.9	2.600	1.4	6.500	2.1		

Weir Overflow Control

Discharge Coef 0.100 Width (m) 0.600 Invert Level (m) 3.000

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St Philips Courtyard
Coleshill B46 3AD

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Summary of Results for 100 year Return Period (+45%)

Half Drain Time : 3338 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	2.394	0.394	0.0	1.7	0.0	1.7	278.0	O K
30 min Summer	2.440	0.440	0.0	1.7	0.0	1.7	310.4	O K
60 min Summer	2.490	0.490	0.0	1.7	0.0	1.7	345.6	O K
120 min Summer	2.543	0.543	0.0	1.7	0.0	1.7	382.9	O K
180 min Summer	2.574	0.574	0.0	1.7	0.0	1.7	405.2	O K
240 min Summer	2.596	0.596	0.0	1.7	0.0	1.7	420.8	O K
360 min Summer	2.626	0.626	0.0	1.7	0.0	1.7	441.5	O K
480 min Summer	2.644	0.644	0.0	1.7	0.0	1.7	454.7	O K
600 min Summer	2.657	0.657	0.0	1.7	0.0	1.7	463.6	O K
720 min Summer	2.666	0.666	0.0	1.7	0.0	1.7	469.6	O K
960 min Summer	2.704	0.704	0.0	1.7	0.0	1.7	496.9	Flood Risk
1440 min Summer	2.751	0.751	0.0	1.7	0.0	1.7	530.2	Flood Risk
2160 min Summer	2.783	0.783	0.0	1.7	0.0	1.7	552.3	Flood Risk
2880 min Summer	2.791	0.791	0.0	1.7	0.0	1.7	558.4	Flood Risk
4320 min Summer	2.733	0.733	0.0	1.7	0.0	1.7	516.9	Flood Risk
5760 min Summer	2.682	0.682	0.0	1.7	0.0	1.7	481.0	O K
7200 min Summer	2.635	0.635	0.0	1.7	0.0	1.7	448.2	O K
8640 min Summer	2.591	0.591	0.0	1.7	0.0	1.7	416.8	O K
10080 min Summer	2.544	0.544	0.0	1.7	0.0	1.7	383.8	O K
15 min Winter	2.449	0.449	0.0	1.7	0.0	1.7	316.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	228.747	0.0	143.0	0.0	27
30 min Summer	127.487	0.0	141.6	0.0	42
60 min Summer	71.052	0.0	278.1	0.0	72
120 min Summer	39.599	0.0	275.2	0.0	132
180 min Summer	28.130	0.0	269.3	0.0	190
240 min Summer	22.070	0.0	264.2	0.0	250
360 min Summer	15.678	0.0	256.6	0.0	370
480 min Summer	12.300	0.0	250.8	0.0	488
600 min Summer	10.190	0.0	246.0	0.0	608
720 min Summer	8.738	0.0	241.9	0.0	728
960 min Summer	7.123	0.0	234.6	0.0	966
1440 min Summer	5.340	0.0	230.7	0.0	1444
2160 min Summer	4.004	0.0	489.2	0.0	2160
2880 min Summer	3.264	0.0	473.4	0.0	2632
4320 min Summer	2.296	0.0	437.2	0.0	3332
5760 min Summer	1.789	0.0	825.2	0.0	4096
7200 min Summer	1.474	0.0	838.3	0.0	4912
8640 min Summer	1.258	0.0	839.7	0.0	5792
10080 min Summer	1.101	0.0	825.9	0.0	6560
15 min Winter	228.747	0.0	141.9	0.0	27

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Summary of Results for 100 year Return Period (+45%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	2.501	0.501	0.0	1.7	0.0	1.7	353.8	O K
60 min Winter	2.558	0.558	0.0	1.7	0.0	1.7	393.9	O K
120 min Winter	2.619	0.619	0.0	1.7	0.0	1.7	436.8	O K
180 min Winter	2.655	0.655	0.0	1.7	0.0	1.7	462.3	O K
240 min Winter	2.681	0.681	0.0	1.7	0.0	1.7	480.3	O K
360 min Winter	2.715	0.715	0.0	1.7	0.0	1.7	504.5	Flood Risk
480 min Winter	2.737	0.737	0.0	1.7	0.0	1.7	520.2	Flood Risk
600 min Winter	2.753	0.753	0.0	1.7	0.0	1.7	531.1	Flood Risk
720 min Winter	2.763	0.763	0.0	1.7	0.0	1.7	538.7	Flood Risk
960 min Winter	2.810	0.810	0.0	1.7	0.0	1.7	571.4	Flood Risk
1440 min Winter	2.869	0.869	0.0	1.7	0.0	1.7	613.0	Flood Risk
2160 min Winter	2.913	0.913	0.0	1.7	0.0	1.7	644.4	Flood Risk
2880 min Winter	2.931	0.931	0.0	1.7	0.0	1.7	656.6	Flood Risk
4320 min Winter	2.856	0.856	0.0	1.7	0.0	1.7	604.1	Flood Risk
5760 min Winter	2.793	0.793	0.0	1.7	0.0	1.7	559.9	Flood Risk
7200 min Winter	2.733	0.733	0.0	1.7	0.0	1.7	516.9	Flood Risk
8640 min Winter	2.673	0.673	0.0	1.7	0.0	1.7	475.1	O K
10080 min Winter	2.614	0.614	0.0	1.7	0.0	1.7	433.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
30 min Winter	127.487	0.0	138.6	0.0	41
60 min Winter	71.052	0.0	275.4	0.0	70
120 min Winter	39.599	0.0	265.5	0.0	130
180 min Winter	28.130	0.0	259.6	0.0	188
240 min Winter	22.070	0.0	255.6	0.0	246
360 min Winter	15.678	0.0	250.2	0.0	364
480 min Winter	12.300	0.0	246.5	0.0	482
600 min Winter	10.190	0.0	243.7	0.0	598
720 min Winter	8.738	0.0	241.6	0.0	716
960 min Winter	7.123	0.0	242.8	0.0	950
1440 min Winter	5.340	0.0	245.9	0.0	1412
2160 min Winter	4.004	0.0	498.8	0.0	2084
2880 min Winter	3.264	0.0	493.6	0.0	2744
4320 min Winter	2.296	0.0	468.9	0.0	3500
5760 min Winter	1.789	0.0	931.5	0.0	4384
7200 min Winter	1.474	0.0	926.4	0.0	5328
8640 min Winter	1.258	0.0	887.9	0.0	6232
10080 min Winter	1.101	0.0	846.1	0.0	7160

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 624550 306900 TG 24550 06900
C (1km)	-0.024
D1 (1km)	0.267
D2 (1km)	0.400
D3 (1km)	0.243
E (1km)	0.308
F (1km)	2.475
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.850
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+45

Time Area Diagram

Total Area (ha) 0.680

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.227	4	8	0.227	8	12	0.227

Model Details

Storage is Online Cover Level (m) 3.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	21.0
Membrane Percolation (mm/hr)	1000	Length (m)	112.0
Max Percolation (l/s)	653.3	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	2.000	Membrane Depth (m)	0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0063-1770-1000-1770
Design Head (m)	1.000
Design Flow (l/s)	1.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	63
Invert Level (m)	2.000
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	1.8
Flush-Flo™	0.277	1.7
Kick-Flo®	0.562	1.4
Mean Flow over Head Range	-	1.5

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)
0.100	1.5	1.200	2.0	3.000	3.0	7.000	4.4
0.200	1.7	1.400	2.1	3.500	3.2	7.500	4.6
0.300	1.7	1.600	2.2	4.000	3.4	8.000	4.7
0.400	1.7	1.800	2.3	4.500	3.6	8.500	4.8
0.500	1.6	2.000	2.5	5.000	3.8	9.000	5.0
0.600	1.4	2.200	2.6	5.500	3.9	9.500	5.1
0.800	1.6	2.400	2.7	6.000	4.1		
1.000	1.8	2.600	2.8	6.500	4.3		

Weir Overflow Control

Discharge Coef 0.100 Width (m) 0.600 Invert Level (m) 3.000

Summary of Results for 30 year Return Period (+45%)

Half Drain Time : 2441 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	2.219	0.219	0.0	1.5	0.0	1.5	159.1	O K
30 min Summer	2.250	0.250	0.0	1.5	0.0	1.5	182.0	O K
60 min Summer	2.285	0.285	0.0	1.5	0.0	1.5	207.2	O K
120 min Summer	2.322	0.322	0.0	1.5	0.0	1.5	234.3	O K
180 min Summer	2.345	0.345	0.0	1.5	0.0	1.5	250.4	O K
240 min Summer	2.360	0.360	0.0	1.5	0.0	1.5	261.6	O K
360 min Summer	2.381	0.381	0.0	1.5	0.0	1.5	276.6	O K
480 min Summer	2.393	0.393	0.0	1.5	0.0	1.5	286.0	O K
600 min Summer	2.402	0.402	0.0	1.5	0.0	1.5	292.1	O K
720 min Summer	2.407	0.407	0.0	1.5	0.0	1.5	296.1	O K
960 min Summer	2.433	0.433	0.0	1.5	0.0	1.5	314.4	O K
1440 min Summer	2.463	0.463	0.0	1.5	0.0	1.5	336.5	O K
2160 min Summer	2.484	0.484	0.0	1.5	0.0	1.5	351.7	O K
2880 min Summer	2.494	0.494	0.0	1.5	0.0	1.5	359.3	O K
4320 min Summer	2.455	0.455	0.0	1.5	0.0	1.5	330.8	O K
5760 min Summer	2.419	0.419	0.0	1.5	0.0	1.5	304.7	O K
7200 min Summer	2.386	0.386	0.0	1.5	0.0	1.5	280.4	O K
8640 min Summer	2.355	0.355	0.0	1.5	0.0	1.5	257.8	O K
10080 min Summer	2.326	0.326	0.0	1.5	0.0	1.5	236.8	O K
15 min Winter	2.251	0.251	0.0	1.5	0.0	1.5	182.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	151.060	0.0	114.2	0.0	27
30 min Summer	85.910	0.0	119.6	0.0	41
60 min Summer	48.858	0.0	192.3	0.0	72
120 min Summer	27.786	0.0	215.3	0.0	130
180 min Summer	19.974	0.0	226.6	0.0	190
240 min Summer	15.803	0.0	232.4	0.0	250
360 min Summer	11.359	0.0	235.8	0.0	368
480 min Summer	8.987	0.0	234.9	0.0	488
600 min Summer	7.494	0.0	232.9	0.0	606
720 min Summer	6.460	0.0	230.3	0.0	726
960 min Summer	5.310	0.0	224.1	0.0	964
1440 min Summer	4.029	0.0	209.4	0.0	1442
2160 min Summer	3.056	0.0	431.4	0.0	1976
2880 min Summer	2.513	0.0	419.7	0.0	2368
4320 min Summer	1.789	0.0	388.6	0.0	3068
5760 min Summer	1.405	0.0	570.6	0.0	3856
7200 min Summer	1.166	0.0	584.9	0.0	4616
8640 min Summer	1.000	0.0	595.0	0.0	5440
10080 min Summer	0.879	0.0	601.1	0.0	6160
15 min Winter	151.060	0.0	120.0	0.0	27

Summary of Results for 30 year Return Period (+45%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	2.286	0.286	0.0	1.5	0.0	1.5	208.2	O K
60 min Winter	2.326	0.326	0.0	1.5	0.0	1.5	236.9	O K
120 min Winter	2.369	0.369	0.0	1.5	0.0	1.5	268.0	O K
180 min Winter	2.394	0.394	0.0	1.5	0.0	1.5	286.7	O K
240 min Winter	2.413	0.413	0.0	1.5	0.0	1.5	299.9	O K
360 min Winter	2.437	0.437	0.0	1.5	0.0	1.5	317.7	O K
480 min Winter	2.453	0.453	0.0	1.5	0.0	1.5	329.3	O K
600 min Winter	2.464	0.464	0.0	1.5	0.0	1.5	337.3	O K
720 min Winter	2.472	0.472	0.0	1.5	0.0	1.5	342.9	O K
960 min Winter	2.504	0.504	0.0	1.5	0.0	1.5	366.1	O K
1440 min Winter	2.546	0.546	0.0	1.5	0.0	1.5	397.1	O K
2160 min Winter	2.578	0.578	0.0	1.5	0.0	1.5	419.8	O K
2880 min Winter	2.589	0.589	0.0	1.5	0.0	1.5	428.2	O K
4320 min Winter	2.538	0.538	0.0	1.5	0.0	1.5	390.7	O K
5760 min Winter	2.484	0.484	0.0	1.5	0.0	1.5	351.8	O K
7200 min Winter	2.433	0.433	0.0	1.5	0.0	1.5	314.8	O K
8640 min Winter	2.386	0.386	0.0	1.5	0.0	1.5	280.3	O K
10080 min Winter	2.342	0.342	0.0	1.5	0.0	1.5	248.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
30 min Winter	85.910	0.0	123.0	0.0	41
60 min Winter	48.858	0.0	215.4	0.0	70
120 min Winter	27.786	0.0	234.5	0.0	128
180 min Winter	19.974	0.0	240.1	0.0	186
240 min Winter	15.803	0.0	241.1	0.0	246
360 min Winter	11.359	0.0	239.7	0.0	362
480 min Winter	8.987	0.0	236.8	0.0	480
600 min Winter	7.494	0.0	233.4	0.0	596
720 min Winter	6.460	0.0	229.8	0.0	714
960 min Winter	5.310	0.0	220.3	0.0	946
1440 min Winter	4.029	0.0	201.1	0.0	1406
2160 min Winter	3.056	0.0	430.7	0.0	2080
2880 min Winter	2.513	0.0	412.0	0.0	2716
4320 min Winter	1.789	0.0	379.1	0.0	3416
5760 min Winter	1.405	0.0	651.4	0.0	4264
7200 min Winter	1.166	0.0	668.4	0.0	5112
8640 min Winter	1.000	0.0	680.4	0.0	5888
10080 min Winter	0.879	0.0	687.0	0.0	6664

Rainfall Details

Rainfall Model	FEH
Return Period (years)	30
FEH Rainfall Version	1999
Site Location	GB 624550 306900 TG 24550 06900
C (1km)	-0.024
D1 (1km)	0.267
D2 (1km)	0.400
D3 (1km)	0.243
E (1km)	0.308
F (1km)	2.475
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.850
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+45

Time Area Diagram

Total Area (ha) 0.610

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.203	4	8	0.203	8	12	0.203

Model Details

Storage is Online Cover Level (m) 3.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	32.3
Membrane Percolation (mm/hr)	1000	Length (m)	75.0
Max Percolation (l/s)	672.9	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	2.000	Membrane Depth (m)	0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0060-1600-1000-1600
Design Head (m)	1.000
Design Flow (l/s)	1.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	60
Invert Level (m)	2.000
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	1.6
Flush-Flo™	0.262	1.5
Kick-Flo®	0.531	1.2
Mean Flow over Head Range	-	1.3

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)
0.100	1.3	1.200	1.7	3.000	2.6	7.000	3.9
0.200	1.5	1.400	1.9	3.500	2.8	7.500	4.0
0.300	1.5	1.600	2.0	4.000	3.0	8.000	4.2
0.400	1.4	1.800	2.1	4.500	3.2	8.500	4.3
0.500	1.3	2.000	2.2	5.000	3.3	9.000	4.4
0.600	1.3	2.200	2.3	5.500	3.5	9.500	4.5
0.800	1.4	2.400	2.4	6.000	3.6		
1.000	1.6	2.600	2.5	6.500	3.8		

Weir Overflow Control

Discharge Coef 0.100 Width (m) 0.600 Invert Level (m) 3.000

Summary of Results for 30 year Return Period (+45%)

Half Drain Time : 2340 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	2.266	0.266	0.0	1.5	0.0	1.5	155.8	O K
30 min Summer	2.304	0.304	0.0	1.5	0.0	1.5	177.9	O K
60 min Summer	2.346	0.346	0.0	1.5	0.0	1.5	202.2	O K
120 min Summer	2.390	0.390	0.0	1.5	0.0	1.5	228.3	O K
180 min Summer	2.417	0.417	0.0	1.5	0.0	1.5	243.7	O K
240 min Summer	2.435	0.435	0.0	1.5	0.0	1.5	254.5	O K
360 min Summer	2.459	0.459	0.0	1.5	0.0	1.5	268.8	O K
480 min Summer	2.475	0.475	0.0	1.5	0.0	1.5	277.8	O K
600 min Summer	2.485	0.485	0.0	1.5	0.0	1.5	283.7	O K
720 min Summer	2.492	0.492	0.0	1.5	0.0	1.5	287.5	O K
960 min Summer	2.523	0.523	0.0	1.5	0.0	1.5	305.8	O K
1440 min Summer	2.561	0.561	0.0	1.5	0.0	1.5	328.0	O K
2160 min Summer	2.582	0.582	0.0	1.5	0.0	1.5	340.6	O K
2880 min Summer	2.591	0.591	0.0	1.5	0.0	1.5	345.8	O K
4320 min Summer	2.544	0.544	0.0	1.5	0.0	1.5	318.2	O K
5760 min Summer	2.495	0.495	0.0	1.5	0.0	1.5	289.5	O K
7200 min Summer	2.451	0.451	0.0	1.5	0.0	1.5	263.7	O K
8640 min Summer	2.411	0.411	0.0	1.5	0.0	1.5	240.5	O K
10080 min Summer	2.375	0.375	0.0	1.5	0.0	1.5	219.3	O K
15 min Winter	2.304	0.304	0.0	1.5	0.0	1.5	178.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	151.060	0.0	117.2	0.0	27
30 min Summer	85.910	0.0	121.2	0.0	41
60 min Summer	48.858	0.0	192.8	0.0	72
120 min Summer	27.786	0.0	216.1	0.0	130
180 min Summer	19.974	0.0	227.6	0.0	190
240 min Summer	15.803	0.0	232.9	0.0	250
360 min Summer	11.359	0.0	234.6	0.0	368
480 min Summer	8.987	0.0	232.6	0.0	488
600 min Summer	7.494	0.0	229.6	0.0	606
720 min Summer	6.460	0.0	226.2	0.0	726
960 min Summer	5.310	0.0	216.2	0.0	964
1440 min Summer	4.029	0.0	197.8	0.0	1442
2160 min Summer	3.056	0.0	422.5	0.0	2052
2880 min Summer	2.513	0.0	409.0	0.0	2392
4320 min Summer	1.789	0.0	371.7	0.0	3124
5760 min Summer	1.405	0.0	560.2	0.0	3880
7200 min Summer	1.166	0.0	575.7	0.0	4624
8640 min Summer	1.000	0.0	587.3	0.0	5448
10080 min Summer	0.879	0.0	595.4	0.0	6160
15 min Winter	151.060	0.0	121.6	0.0	27

Summary of Results for 30 year Return Period (+45%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	2.347	0.347	0.0	1.5	0.0	1.5	203.2	O K
60 min Winter	2.395	0.395	0.0	1.5	0.0	1.5	231.0	O K
120 min Winter	2.446	0.446	0.0	1.5	0.0	1.5	260.9	O K
180 min Winter	2.477	0.477	0.0	1.5	0.0	1.5	279.0	O K
240 min Winter	2.499	0.499	0.0	1.5	0.0	1.5	291.7	O K
360 min Winter	2.528	0.528	0.0	1.5	0.0	1.5	309.1	O K
480 min Winter	2.548	0.548	0.0	1.5	0.0	1.5	320.5	O K
600 min Winter	2.561	0.561	0.0	1.5	0.0	1.5	328.3	O K
720 min Winter	2.570	0.570	0.0	1.5	0.0	1.5	333.6	O K
960 min Winter	2.607	0.607	0.0	1.5	0.0	1.5	355.2	O K
1440 min Winter	2.652	0.652	0.0	1.5	0.0	1.5	381.7	O K
2160 min Winter	2.684	0.684	0.0	1.5	0.0	1.5	400.0	O K
2880 min Winter	2.693	0.693	0.0	1.5	0.0	1.5	405.5	O K
4320 min Winter	2.635	0.635	0.0	1.5	0.0	1.5	371.2	O K
5760 min Winter	2.577	0.577	0.0	1.5	0.0	1.5	337.5	O K
7200 min Winter	2.512	0.512	0.0	1.5	0.0	1.5	299.8	O K
8640 min Winter	2.448	0.448	0.0	1.5	0.0	1.5	262.2	O K
10080 min Winter	2.392	0.392	0.0	1.5	0.0	1.5	229.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
30 min Winter	85.910	0.0	123.5	0.0	41
60 min Winter	48.858	0.0	216.1	0.0	70
120 min Winter	27.786	0.0	234.7	0.0	128
180 min Winter	19.974	0.0	238.3	0.0	188
240 min Winter	15.803	0.0	237.5	0.0	246
360 min Winter	11.359	0.0	232.7	0.0	362
480 min Winter	8.987	0.0	227.3	0.0	480
600 min Winter	7.494	0.0	222.5	0.0	598
720 min Winter	6.460	0.0	218.3	0.0	714
960 min Winter	5.310	0.0	209.1	0.0	944
1440 min Winter	4.029	0.0	197.8	0.0	1402
2160 min Winter	3.056	0.0	429.6	0.0	2060
2880 min Winter	2.513	0.0	414.2	0.0	2684
4320 min Winter	1.789	0.0	380.2	0.0	3336
5760 min Winter	1.405	0.0	638.7	0.0	4272
7200 min Winter	1.166	0.0	656.8	0.0	5184
8640 min Winter	1.000	0.0	670.6	0.0	5960
10080 min Winter	0.879	0.0	680.1	0.0	6664

Rainfall Details

Rainfall Model	FEH
Return Period (years)	30
FEH Rainfall Version	1999
Site Location	GB 624550 306900 TG 24550 06900
C (1km)	-0.024
D1 (1km)	0.267
D2 (1km)	0.400
D3 (1km)	0.243
E (1km)	0.308
F (1km)	2.475
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.850
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+45

Time Area Diagram

Total Area (ha) 0.590

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.197	4	8	0.197	8	12	0.197

Model Details

Storage is Online Cover Level (m) 3.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	26.0
Membrane Percolation (mm/hr)	1000	Length (m)	75.0
Max Percolation (l/s)	541.7	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	2.000	Membrane Depth (m)	0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0059-1590-1000-1590
Design Head (m)	1.000
Design Flow (l/s)	1.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	59
Invert Level (m)	2.000
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	1.6
Flush-Flo™	0.262	1.5
Kick-Flo®	0.531	1.2
Mean Flow over Head Range	-	1.3

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)
0.100	1.3	1.200	1.7	3.000	2.6	7.000	3.9
0.200	1.5	1.400	1.9	3.500	2.8	7.500	4.0
0.300	1.5	1.600	2.0	4.000	3.0	8.000	4.2
0.400	1.4	1.800	2.1	4.500	3.2	8.500	4.3
0.500	1.3	2.000	2.2	5.000	3.3	9.000	4.4
0.600	1.3	2.200	2.3	5.500	3.5	9.500	4.5
0.800	1.4	2.400	2.4	6.000	3.6		
1.000	1.6	2.600	2.5	6.500	3.8		

Weir Overflow Control

Discharge Coef 0.100 Width (m) 0.600 Invert Level (m) 3.000

Summary of Results for 30 year Return Period (+45%)

Half Drain Time : 2217 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	2.246	0.246	0.0	1.9	0.0	1.9	197.1	O K
30 min Summer	2.281	0.281	0.0	1.9	0.0	1.9	225.2	O K
60 min Summer	2.320	0.320	0.0	1.9	0.0	1.9	256.0	O K
120 min Summer	2.361	0.361	0.0	1.9	0.0	1.9	289.0	O K
180 min Summer	2.386	0.386	0.0	1.9	0.0	1.9	308.5	O K
240 min Summer	2.402	0.402	0.0	1.9	0.0	1.9	321.9	O K
360 min Summer	2.425	0.425	0.0	1.9	0.0	1.9	339.7	O K
480 min Summer	2.438	0.438	0.0	1.9	0.0	1.9	350.5	O K
600 min Summer	2.447	0.447	0.0	1.9	0.0	1.9	357.4	O K
720 min Summer	2.452	0.452	0.0	1.9	0.0	1.9	361.7	O K
960 min Summer	2.478	0.478	0.0	1.9	0.0	1.9	382.7	O K
1440 min Summer	2.509	0.509	0.0	1.9	0.0	1.9	407.0	O K
2160 min Summer	2.529	0.529	0.0	1.9	0.0	1.9	423.3	O K
2880 min Summer	2.539	0.539	0.0	1.9	0.0	1.9	430.9	O K
4320 min Summer	2.493	0.493	0.0	1.9	0.0	1.9	394.5	O K
5760 min Summer	2.451	0.451	0.0	1.9	0.0	1.9	360.9	O K
7200 min Summer	2.412	0.412	0.0	1.9	0.0	1.9	329.9	O K
8640 min Summer	2.377	0.377	0.0	1.9	0.0	1.9	301.4	O K
10080 min Summer	2.344	0.344	0.0	1.9	0.0	1.9	275.1	O K
15 min Winter	2.282	0.282	0.0	1.9	0.0	1.9	225.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	151.060	0.0	148.4	0.0	27
30 min Summer	85.910	0.0	156.9	0.0	41
60 min Summer	48.858	0.0	241.5	0.0	72
120 min Summer	27.786	0.0	272.1	0.0	130
180 min Summer	19.974	0.0	289.0	0.0	190
240 min Summer	15.803	0.0	299.1	0.0	248
360 min Summer	11.359	0.0	307.8	0.0	368
480 min Summer	8.987	0.0	308.7	0.0	486
600 min Summer	7.494	0.0	307.0	0.0	606
720 min Summer	6.460	0.0	304.3	0.0	724
960 min Summer	5.310	0.0	297.4	0.0	964
1440 min Summer	4.029	0.0	279.3	0.0	1440
2160 min Summer	3.056	0.0	556.2	0.0	1868
2880 min Summer	2.513	0.0	557.4	0.0	2280
4320 min Summer	1.789	0.0	518.3	0.0	2988
5760 min Summer	1.405	0.0	707.9	0.0	3800
7200 min Summer	1.166	0.0	726.8	0.0	4552
8640 min Summer	1.000	0.0	740.7	0.0	5360
10080 min Summer	0.879	0.0	749.8	0.0	6152
15 min Winter	151.060	0.0	157.4	0.0	27

Summary of Results for 30 year Return Period (+45%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	2.322	0.322	0.0	1.9	0.0	1.9	257.3	O K
60 min Winter	2.366	0.366	0.0	1.9	0.0	1.9	292.5	O K
120 min Winter	2.413	0.413	0.0	1.9	0.0	1.9	330.4	O K
180 min Winter	2.441	0.441	0.0	1.9	0.0	1.9	353.0	O K
240 min Winter	2.461	0.461	0.0	1.9	0.0	1.9	368.9	O K
360 min Winter	2.488	0.488	0.0	1.9	0.0	1.9	390.2	O K
480 min Winter	2.505	0.505	0.0	1.9	0.0	1.9	403.8	O K
600 min Winter	2.516	0.516	0.0	1.9	0.0	1.9	413.0	O K
720 min Winter	2.524	0.524	0.0	1.9	0.0	1.9	419.2	O K
960 min Winter	2.558	0.558	0.0	1.9	0.0	1.9	446.3	O K
1440 min Winter	2.602	0.602	0.0	1.9	0.0	1.9	481.8	O K
2160 min Winter	2.634	0.634	0.0	1.9	0.0	1.9	507.1	O K
2880 min Winter	2.643	0.643	0.0	1.9	0.0	1.9	514.5	O K
4320 min Winter	2.579	0.579	0.0	1.9	0.0	1.9	463.1	O K
5760 min Winter	2.516	0.516	0.0	1.9	0.0	1.9	413.0	O K
7200 min Winter	2.457	0.457	0.0	1.9	0.0	1.9	365.8	O K
8640 min Winter	2.403	0.403	0.0	1.9	0.0	1.9	322.3	O K
10080 min Winter	2.353	0.353	0.0	1.9	0.0	1.9	282.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
30 min Winter	85.910	0.0	161.9	0.0	41
60 min Winter	48.858	0.0	272.1	0.0	70
120 min Winter	27.786	0.0	300.9	0.0	128
180 min Winter	19.974	0.0	312.4	0.0	186
240 min Winter	15.803	0.0	316.2	0.0	246
360 min Winter	11.359	0.0	316.2	0.0	362
480 min Winter	8.987	0.0	313.3	0.0	480
600 min Winter	7.494	0.0	309.5	0.0	596
720 min Winter	6.460	0.0	305.2	0.0	712
960 min Winter	5.310	0.0	293.9	0.0	944
1440 min Winter	4.029	0.0	269.5	0.0	1404
2160 min Winter	3.056	0.0	571.0	0.0	2076
2880 min Winter	2.513	0.0	549.0	0.0	2708
4320 min Winter	1.789	0.0	514.2	0.0	3332
5760 min Winter	1.405	0.0	808.0	0.0	4160
7200 min Winter	1.166	0.0	830.4	0.0	5040
8640 min Winter	1.000	0.0	847.1	0.0	5800
10080 min Winter	0.879	0.0	858.5	0.0	6568

Rainfall Details

Rainfall Model	FEH
Return Period (years)	30
FEH Rainfall Version	1999
Site Location	GB 624550 306900 TG 24550 06900
C (1km)	-0.024
D1 (1km)	0.267
D2 (1km)	0.400
D3 (1km)	0.243
E (1km)	0.308
F (1km)	2.475
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.850
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+45

Time Area Diagram

Total Area (ha) 0.750

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.250	4	8	0.250	8	12	0.250

Model Details

Storage is Online Cover Level (m) 3.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	30.3
Membrane Percolation (mm/hr)	1000	Length (m)	88.0
Max Percolation (l/s)	740.7	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	2.000	Membrane Depth (m)	0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0067-2000-1000-2000
Design Head (m)	1.000
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	67
Invert Level (m)	2.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	2.0
Flush-Flo™	0.296	1.9
Kick-Flo®	0.599	1.6
Mean Flow over Head Range	-	1.7

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)
0.100	1.6	1.200	2.2	3.000	3.3	7.000	4.9
0.200	1.9	1.400	2.3	3.500	3.5	7.500	5.1
0.300	1.9	1.600	2.5	4.000	3.8	8.000	5.2
0.400	1.9	1.800	2.6	4.500	4.0	8.500	5.4
0.500	1.8	2.000	2.7	5.000	4.2	9.000	5.5
0.600	1.6	2.200	2.9	5.500	4.4	9.500	5.7
0.800	1.8	2.400	3.0	6.000	4.6		
1.000	2.0	2.600	3.1	6.500	4.7		

Weir Overflow Control

Discharge Coef 0.100 Width (m) 0.600 Invert Level (m) 3.000

Summary of Results for 30 year Return Period (+45%)

Half Drain Time : 2446 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	2.190	0.190	0.0	2.1	0.0	2.1	182.6	O K
30 min Summer	2.251	0.251	0.0	2.2	0.0	2.2	241.0	O K
60 min Summer	2.313	0.313	0.0	2.2	0.0	2.2	300.5	O K
120 min Summer	2.379	0.379	0.0	2.2	0.0	2.2	363.9	O K
180 min Summer	2.421	0.421	0.0	2.2	0.0	2.2	404.1	O K
240 min Summer	2.452	0.452	0.0	2.2	0.0	2.2	433.5	O K
360 min Summer	2.494	0.494	0.0	2.2	0.0	2.2	474.5	O K
480 min Summer	2.523	0.523	0.0	2.2	0.0	2.2	502.3	O K
600 min Summer	2.543	0.543	0.0	2.2	0.0	2.2	521.4	O K
720 min Summer	2.557	0.557	0.0	2.2	0.0	2.2	534.8	O K
960 min Summer	2.573	0.573	0.0	2.2	0.0	2.2	549.8	O K
1440 min Summer	2.577	0.577	0.0	2.2	0.0	2.2	554.3	O K
2160 min Summer	2.555	0.555	0.0	2.2	0.0	2.2	532.6	O K
2880 min Summer	2.532	0.532	0.0	2.2	0.0	2.2	510.3	O K
4320 min Summer	2.493	0.493	0.0	2.2	0.0	2.2	473.1	O K
5760 min Summer	2.460	0.460	0.0	2.2	0.0	2.2	441.2	O K
7200 min Summer	2.432	0.432	0.0	2.2	0.0	2.2	414.5	O K
8640 min Summer	2.407	0.407	0.0	2.2	0.0	2.2	391.0	O K
10080 min Summer	2.385	0.385	0.0	2.2	0.0	2.2	370.0	O K
15 min Winter	2.215	0.215	0.0	2.1	0.0	2.1	206.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	125.894	0.0	141.5	0.0	27
30 min Summer	81.693	0.0	170.2	0.0	41
60 min Summer	50.606	0.0	278.4	0.0	72
120 min Summer	30.710	0.0	329.3	0.0	130
180 min Summer	22.879	0.0	350.4	0.0	190
240 min Summer	18.538	0.0	356.7	0.0	250
360 min Summer	13.736	0.0	357.0	0.0	368
480 min Summer	11.075	0.0	352.6	0.0	488
600 min Summer	9.342	0.0	346.8	0.0	608
720 min Summer	8.112	0.0	340.7	0.0	726
960 min Summer	6.457	0.0	328.9	0.0	966
1440 min Summer	4.636	0.0	308.6	0.0	1442
2160 min Summer	3.298	0.0	646.7	0.0	2008
2880 min Summer	2.590	0.0	631.0	0.0	2284
4320 min Summer	1.851	0.0	583.2	0.0	3028
5760 min Summer	1.467	0.0	834.8	0.0	3808
7200 min Summer	1.233	0.0	869.0	0.0	4616
8640 min Summer	1.075	0.0	899.7	0.0	5448
10080 min Summer	0.961	0.0	925.7	0.0	6248
15 min Winter	125.894	0.0	155.7	0.0	27

Summary of Results for 30 year Return Period (+45%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Outflow Σ (l/s)	Max Volume (m³)	Status
30 min Winter	2.283	0.283	0.0	2.2	0.0	2.2	272.2	O K
60 min Winter	2.353	0.353	0.0	2.2	0.0	2.2	339.1	O K
120 min Winter	2.428	0.428	0.0	2.2	0.0	2.2	410.6	O K
180 min Winter	2.475	0.475	0.0	2.2	0.0	2.2	456.3	O K
240 min Winter	2.510	0.510	0.0	2.2	0.0	2.2	489.8	O K
360 min Winter	2.560	0.560	0.0	2.2	0.0	2.2	537.3	O K
480 min Winter	2.594	0.594	0.0	2.2	0.0	2.2	570.0	O K
600 min Winter	2.618	0.618	0.0	2.2	0.0	2.2	593.3	O K
720 min Winter	2.636	0.636	0.0	2.2	0.0	2.2	610.1	O K
960 min Winter	2.656	0.656	0.0	2.2	0.0	2.2	630.0	O K
1440 min Winter	2.668	0.668	0.0	2.2	0.0	2.2	641.1	O K
2160 min Winter	2.653	0.653	0.0	2.2	0.0	2.2	627.2	O K
2880 min Winter	2.625	0.625	0.0	2.2	0.0	2.2	600.4	O K
4320 min Winter	2.566	0.566	0.0	2.2	0.0	2.2	543.7	O K
5760 min Winter	2.517	0.517	0.0	2.2	0.0	2.2	496.4	O K
7200 min Winter	2.474	0.474	0.0	2.2	0.0	2.2	454.7	O K
8640 min Winter	2.434	0.434	0.0	2.2	0.0	2.2	416.9	O K
10080 min Winter	2.399	0.399	0.0	2.2	0.0	2.2	382.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
30 min Winter	81.693	0.0	177.5	0.0	41
60 min Winter	50.606	0.0	309.5	0.0	70
120 min Winter	30.710	0.0	352.8	0.0	128
180 min Winter	22.879	0.0	361.4	0.0	188
240 min Winter	18.538	0.0	361.8	0.0	246
360 min Winter	13.736	0.0	355.7	0.0	364
480 min Winter	11.075	0.0	346.7	0.0	480
600 min Winter	9.342	0.0	337.2	0.0	598
720 min Winter	8.112	0.0	328.2	0.0	716
960 min Winter	6.457	0.0	314.5	0.0	950
1440 min Winter	4.636	0.0	295.1	0.0	1408
2160 min Winter	3.298	0.0	643.4	0.0	2080
2880 min Winter	2.590	0.0	622.0	0.0	2716
4320 min Winter	1.851	0.0	586.6	0.0	3328
5760 min Winter	1.467	0.0	940.9	0.0	4208
7200 min Winter	1.233	0.0	980.0	0.0	5048
8640 min Winter	1.075	0.0	1014.5	0.0	5888
10080 min Winter	0.961	0.0	1041.7	0.0	6752

Rainfall Details

Rainfall Model	FEH
Return Period (years)	30
FEH Rainfall Version	2013
Site Location	GB 624621 307427 TG 24621 07427
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+45

Time Area Diagram

Total Area (ha) 0.850

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.283	4	8	0.283	8	12	0.283

Model Details

Storage is Online Cover Level (m) 3.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	32.0
Membrane Percolation (mm/hr)	1000	Length (m)	100.0
Max Percolation (l/s)	888.9	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	2.000	Membrane Depth (m)	0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0070-2200-1000-2200
Design Head (m)	1.000
Design Flow (l/s)	2.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	70
Invert Level (m)	2.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	2.2
Flush-Flo™	0.307	2.2
Kick-Flo®	0.625	1.8
Mean Flow over Head Range	-	1.9

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)
0.100	1.8	1.200	2.4	3.000	3.6	7.000	5.4
0.200	2.1	1.400	2.6	3.500	3.9	7.500	5.6
0.300	2.2	1.600	2.7	4.000	4.2	8.000	5.8
0.400	2.2	1.800	2.9	4.500	4.4	8.500	5.9
0.500	2.1	2.000	3.0	5.000	4.6	9.000	6.1
0.600	1.9	2.200	3.2	5.500	4.8	9.500	6.3
0.800	2.0	2.400	3.3	6.000	5.0		
1.000	2.2	2.600	3.4	6.500	5.2		

Orifice Overflow Control

Diameter (m) 0.100 Discharge Coefficient 0.600 Invert Level (m) 3.000

The Library
St Philips Courtyard
Coleshill B46 3AD

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Micro Drainage | Source Control 2020.1.3

Summary of Results for 30 year Return Period (+45%)

Half Drain Time : 2413 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	2.225	0.225	0.0	1.7	0.0	1.7	182.9	O K
30 min Summer	2.257	0.257	0.0	1.7	0.0	1.7	209.2	O K
60 min Summer	2.292	0.292	0.0	1.7	0.0	1.7	238.1	O K
120 min Summer	2.330	0.330	0.0	1.7	0.0	1.7	269.2	O K
180 min Summer	2.353	0.353	0.0	1.7	0.0	1.7	287.6	O K
240 min Summer	2.369	0.369	0.0	1.7	0.0	1.7	300.5	O K
360 min Summer	2.390	0.390	0.0	1.7	0.0	1.7	317.6	O K
480 min Summer	2.403	0.403	0.0	1.7	0.0	1.7	328.3	O K
600 min Summer	2.412	0.412	0.0	1.7	0.0	1.7	335.3	O K
720 min Summer	2.417	0.417	0.0	1.7	0.0	1.7	339.8	O K
960 min Summer	2.443	0.443	0.0	1.7	0.0	1.7	360.5	O K
1440 min Summer	2.473	0.473	0.0	1.7	0.0	1.7	385.4	O K
2160 min Summer	2.494	0.494	0.0	1.7	0.0	1.7	402.3	O K
2880 min Summer	2.504	0.504	0.0	1.7	0.0	1.7	410.9	O K
4320 min Summer	2.465	0.465	0.0	1.7	0.0	1.7	379.0	O K
5760 min Summer	2.429	0.429	0.0	1.7	0.0	1.7	349.2	O K
7200 min Summer	2.395	0.395	0.0	1.7	0.0	1.7	321.5	O K
8640 min Summer	2.363	0.363	0.0	1.7	0.0	1.7	295.6	O K
10080 min Summer	2.334	0.334	0.0	1.7	0.0	1.7	271.7	O K
15 min Winter	2.257	0.257	0.0	1.7	0.0	1.7	209.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	151.060	0.0	131.1	0.0	27
30 min Summer	85.910	0.0	137.7	0.0	41
60 min Summer	48.858	0.0	220.5	0.0	72
120 min Summer	27.786	0.0	247.0	0.0	130
180 min Summer	19.974	0.0	260.4	0.0	190
240 min Summer	15.803	0.0	267.4	0.0	250
360 min Summer	11.359	0.0	272.1	0.0	368
480 min Summer	8.987	0.0	271.5	0.0	486
600 min Summer	7.494	0.0	269.5	0.0	606
720 min Summer	6.460	0.0	266.7	0.0	726
960 min Summer	5.310	0.0	260.0	0.0	964
1440 min Summer	4.029	0.0	243.9	0.0	1442
2160 min Summer	3.056	0.0	499.0	0.0	1932
2880 min Summer	2.513	0.0	488.9	0.0	2336
4320 min Summer	1.789	0.0	451.8	0.0	3032
5760 min Summer	1.405	0.0	655.6	0.0	3816
7200 min Summer	1.166	0.0	672.1	0.0	4616
8640 min Summer	1.000	0.0	683.9	0.0	5440
10080 min Summer	0.879	0.0	691.0	0.0	6160
15 min Winter	151.060	0.0	138.2	0.0	27

The Library
St Philips Courtyard
Coleshill B46 3AD

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Summary of Results for 30 year Return Period (+45%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	2.294	0.294	0.0	1.7	0.0	1.7	239.2	O K
60 min Winter	2.334	0.334	0.0	1.7	0.0	1.7	272.2	O K
120 min Winter	2.378	0.378	0.0	1.7	0.0	1.7	307.8	O K
180 min Winter	2.404	0.404	0.0	1.7	0.0	1.7	329.2	O K
240 min Winter	2.423	0.423	0.0	1.7	0.0	1.7	344.3	O K
360 min Winter	2.448	0.448	0.0	1.7	0.0	1.7	364.7	O K
480 min Winter	2.464	0.464	0.0	1.7	0.0	1.7	378.0	O K
600 min Winter	2.475	0.475	0.0	1.7	0.0	1.7	387.0	O K
720 min Winter	2.483	0.483	0.0	1.7	0.0	1.7	393.3	O K
960 min Winter	2.515	0.515	0.0	1.7	0.0	1.7	419.6	O K
1440 min Winter	2.558	0.558	0.0	1.7	0.0	1.7	454.4	O K
2160 min Winter	2.591	0.591	0.0	1.7	0.0	1.7	481.6	O K
2880 min Winter	2.603	0.603	0.0	1.7	0.0	1.7	491.5	O K
4320 min Winter	2.547	0.547	0.0	1.7	0.0	1.7	445.6	O K
5760 min Winter	2.493	0.493	0.0	1.7	0.0	1.7	401.9	O K
7200 min Winter	2.442	0.442	0.0	1.7	0.0	1.7	360.0	O K
8640 min Winter	2.394	0.394	0.0	1.7	0.0	1.7	320.8	O K
10080 min Winter	2.349	0.349	0.0	1.7	0.0	1.7	284.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
30 min Winter	85.910	0.0	141.9	0.0	41
60 min Winter	48.858	0.0	247.2	0.0	70
120 min Winter	27.786	0.0	269.8	0.0	128
180 min Winter	19.974	0.0	277.1	0.0	186
240 min Winter	15.803	0.0	278.6	0.0	246
360 min Winter	11.359	0.0	277.7	0.0	362
480 min Winter	8.987	0.0	274.8	0.0	480
600 min Winter	7.494	0.0	271.2	0.0	596
720 min Winter	6.460	0.0	267.3	0.0	712
960 min Winter	5.310	0.0	257.5	0.0	944
1440 min Winter	4.029	0.0	236.7	0.0	1406
2160 min Winter	3.056	0.0	500.3	0.0	2080
2880 min Winter	2.513	0.0	478.2	0.0	2716
4320 min Winter	1.789	0.0	446.9	0.0	3376
5760 min Winter	1.405	0.0	748.5	0.0	4216
7200 min Winter	1.166	0.0	768.1	0.0	5048
8640 min Winter	1.000	0.0	781.9	0.0	5880
10080 min Winter	0.879	0.0	789.7	0.0	6664

Rainfall Details

Rainfall Model	FEH
Return Period (years)	30
FEH Rainfall Version	1999
Site Location	GB 624550 306900 TG 24550 06900
C (1km)	-0.024
D1 (1km)	0.267
D2 (1km)	0.400
D3 (1km)	0.243
E (1km)	0.308
F (1km)	2.475
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.850
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+45

Time Area Diagram

Total Area (ha) 0.700

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.233	4	8	0.233	8	12	0.233

Model Details

Storage is Online Cover Level (m) 3.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	21.9
Membrane Percolation (mm/hr)	1000	Length (m)	124.0
Max Percolation (l/s)	754.3	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	2.000	Membrane Depth (m)	0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0063-1800-1000-1800
Design Head (m)	1.000
Design Flow (l/s)	1.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	63
Invert Level (m)	2.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	1.8
Flush-Flo™	0.280	1.7
Kick-Flo®	0.565	1.4
Mean Flow over Head Range	-	1.5

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)
0.100	1.5	1.200	2.0	3.000	3.0	7.000	4.4
0.200	1.7	1.400	2.1	3.500	3.2	7.500	4.6
0.300	1.7	1.600	2.2	4.000	3.4	8.000	4.7
0.400	1.7	1.800	2.3	4.500	3.6	8.500	4.8
0.500	1.6	2.000	2.5	5.000	3.8	9.000	5.0
0.600	1.4	2.200	2.6	5.500	3.9	9.500	5.1
0.800	1.6	2.400	2.7	6.000	4.1		
1.000	1.8	2.600	2.8	6.500	4.3		

Weir Overflow Control

Discharge Coef 0.100 Width (m) 0.600 Invert Level (m) 3.000

Summary of Results for 30 year Return Period (+45%)

Half Drain Time : 2405 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	2.241	0.241	0.0	1.4	0.0	1.4	147.0	O K
30 min Summer	2.275	0.275	0.0	1.4	0.0	1.4	168.0	O K
60 min Summer	2.313	0.313	0.0	1.4	0.0	1.4	191.1	O K
120 min Summer	2.354	0.354	0.0	1.4	0.0	1.4	215.9	O K
180 min Summer	2.378	0.378	0.0	1.4	0.0	1.4	230.6	O K
240 min Summer	2.395	0.395	0.0	1.4	0.0	1.4	240.9	O K
360 min Summer	2.417	0.417	0.0	1.4	0.0	1.4	254.6	O K
480 min Summer	2.431	0.431	0.0	1.4	0.0	1.4	263.1	O K
600 min Summer	2.441	0.441	0.0	1.4	0.0	1.4	268.8	O K
720 min Summer	2.447	0.447	0.0	1.4	0.0	1.4	272.5	O K
960 min Summer	2.475	0.475	0.0	1.4	0.0	1.4	289.5	O K
1440 min Summer	2.510	0.510	0.0	1.4	0.0	1.4	311.2	O K
2160 min Summer	2.534	0.534	0.0	1.4	0.0	1.4	325.7	O K
2880 min Summer	2.543	0.543	0.0	1.4	0.0	1.4	331.2	O K
4320 min Summer	2.497	0.497	0.0	1.4	0.0	1.4	303.2	O K
5760 min Summer	2.454	0.454	0.0	1.4	0.0	1.4	277.2	O K
7200 min Summer	2.416	0.416	0.0	1.4	0.0	1.4	253.8	O K
8640 min Summer	2.381	0.381	0.0	1.4	0.0	1.4	232.4	O K
10080 min Summer	2.348	0.348	0.0	1.4	0.0	1.4	212.6	O K
15 min Winter	2.276	0.276	0.0	1.4	0.0	1.4	168.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	151.060	0.0	108.3	0.0	27
30 min Summer	85.910	0.0	112.5	0.0	41
60 min Summer	48.858	0.0	180.3	0.0	72
120 min Summer	27.786	0.0	201.8	0.0	130
180 min Summer	19.974	0.0	212.2	0.0	190
240 min Summer	15.803	0.0	217.2	0.0	250
360 min Summer	11.359	0.0	219.2	0.0	368
480 min Summer	8.987	0.0	217.8	0.0	488
600 min Summer	7.494	0.0	215.3	0.0	606
720 min Summer	6.460	0.0	212.4	0.0	726
960 min Summer	5.310	0.0	204.8	0.0	964
1440 min Summer	4.029	0.0	187.8	0.0	1442
2160 min Summer	3.056	0.0	394.3	0.0	2100
2880 min Summer	2.513	0.0	380.3	0.0	2428
4320 min Summer	1.789	0.0	352.6	0.0	3120
5760 min Summer	1.405	0.0	528.1	0.0	3864
7200 min Summer	1.166	0.0	542.0	0.0	4624
8640 min Summer	1.000	0.0	552.3	0.0	5448
10080 min Summer	0.879	0.0	559.0	0.0	6168
15 min Winter	151.060	0.0	112.8	0.0	27

The Library
St Philips Courtyard
Coleshill B46 3AD

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Summary of Results for 30 year Return Period (+45%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	2.315	0.315	0.0	1.4	0.0	1.4	192.0	O K
60 min Winter	2.358	0.358	0.0	1.4	0.0	1.4	218.4	O K
120 min Winter	2.405	0.405	0.0	1.4	0.0	1.4	246.9	O K
180 min Winter	2.433	0.433	0.0	1.4	0.0	1.4	264.0	O K
240 min Winter	2.453	0.453	0.0	1.4	0.0	1.4	276.1	O K
360 min Winter	2.480	0.480	0.0	1.4	0.0	1.4	292.6	O K
480 min Winter	2.497	0.497	0.0	1.4	0.0	1.4	303.4	O K
600 min Winter	2.510	0.510	0.0	1.4	0.0	1.4	310.9	O K
720 min Winter	2.518	0.518	0.0	1.4	0.0	1.4	316.3	O K
960 min Winter	2.553	0.553	0.0	1.4	0.0	1.4	337.6	O K
1440 min Winter	2.597	0.597	0.0	1.4	0.0	1.4	363.9	O K
2160 min Winter	2.627	0.627	0.0	1.4	0.0	1.4	382.7	O K
2880 min Winter	2.638	0.638	0.0	1.4	0.0	1.4	389.1	O K
4320 min Winter	2.584	0.584	0.0	1.4	0.0	1.4	356.3	O K
5760 min Winter	2.531	0.531	0.0	1.4	0.0	1.4	323.9	O K
7200 min Winter	2.471	0.471	0.0	1.4	0.0	1.4	287.1	O K
8640 min Winter	2.415	0.415	0.0	1.4	0.0	1.4	253.3	O K
10080 min Winter	2.366	0.366	0.0	1.4	0.0	1.4	223.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
30 min Winter	85.910	0.0	114.9	0.0	41
60 min Winter	48.858	0.0	201.9	0.0	70
120 min Winter	27.786	0.0	219.0	0.0	128
180 min Winter	19.974	0.0	223.0	0.0	186
240 min Winter	15.803	0.0	222.9	0.0	246
360 min Winter	11.359	0.0	219.9	0.0	362
480 min Winter	8.987	0.0	215.7	0.0	480
600 min Winter	7.494	0.0	211.2	0.0	598
720 min Winter	6.460	0.0	206.9	0.0	714
960 min Winter	5.310	0.0	196.4	0.0	946
1440 min Winter	4.029	0.0	183.2	0.0	1404
2160 min Winter	3.056	0.0	398.5	0.0	2072
2880 min Winter	2.513	0.0	382.9	0.0	2708
4320 min Winter	1.789	0.0	351.3	0.0	3372
5760 min Winter	1.405	0.0	602.3	0.0	4320
7200 min Winter	1.166	0.0	618.9	0.0	5120
8640 min Winter	1.000	0.0	631.0	0.0	5896
10080 min Winter	0.879	0.0	638.7	0.0	6672

Rainfall Details

Rainfall Model	FEH
Return Period (years)	30
FEH Rainfall Version	1999
Site Location	GB 624550 306900 TG 24550 06900
C (1km)	-0.024
D1 (1km)	0.267
D2 (1km)	0.400
D3 (1km)	0.243
E (1km)	0.308
F (1km)	2.475
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.850
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+45

Time Area Diagram

Total Area (ha) 0.560

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.187	4	8	0.187	8	12	0.187

Model Details

Storage is Online Cover Level (m) 3.200

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	24.5
Membrane Percolation (mm/hr)	1000	Length (m)	83.0
Max Percolation (l/s)	564.9	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	2.000	Membrane Depth (m)	0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0058-1500-1000-1500
Design Head (m)	1.000
Design Flow (l/s)	1.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	58
Invert Level (m)	2.000
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	1.5
Flush-Flo™	0.253	1.4
Kick-Flo®	0.515	1.1
Mean Flow over Head Range	-	1.2

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)
0.100	1.2	1.200	1.6	3.000	2.5	7.000	3.7
0.200	1.4	1.400	1.7	3.500	2.7	7.500	3.8
0.300	1.4	1.600	1.9	4.000	2.8	8.000	3.9
0.400	1.3	1.800	2.0	4.500	3.0	8.500	4.0
0.500	1.2	2.000	2.0	5.000	3.1	9.000	4.1
0.600	1.2	2.200	2.1	5.500	3.3	9.500	4.2
0.800	1.4	2.400	2.2	6.000	3.4		
1.000	1.5	2.600	2.3	6.500	3.5		

Weir Overflow Control

Discharge Coef 0.100 Width (m) 0.600 Invert Level (m) 3.000

Summary of Results for 30 year Return Period (+45%)

Half Drain Time : 3025 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	2.251	0.251	0.0	0.7	0.0	0.7	94.9	O K
30 min Summer	2.287	0.287	0.0	0.7	0.0	0.7	108.4	O K
60 min Summer	2.327	0.327	0.0	0.7	0.0	0.7	123.5	O K
120 min Summer	2.370	0.370	0.0	0.7	0.0	0.7	139.8	O K
180 min Summer	2.396	0.396	0.0	0.7	0.0	0.7	149.7	O K
240 min Summer	2.415	0.415	0.0	0.7	0.0	0.7	156.8	O K
360 min Summer	2.440	0.440	0.0	0.7	0.0	0.7	166.4	O K
480 min Summer	2.457	0.457	0.0	0.7	0.0	0.7	172.6	O K
600 min Summer	2.468	0.468	0.0	0.7	0.0	0.7	176.9	O K
720 min Summer	2.476	0.476	0.0	0.7	0.0	0.7	179.9	O K
960 min Summer	2.507	0.507	0.0	0.7	0.0	0.7	191.6	O K
1440 min Summer	2.545	0.545	0.0	0.7	0.0	0.7	206.0	O K
2160 min Summer	2.571	0.571	0.0	0.7	0.0	0.7	215.8	O K
2880 min Summer	2.582	0.582	0.0	0.7	0.0	0.7	220.0	O K
4320 min Summer	2.545	0.545	0.0	0.7	0.0	0.7	206.0	O K
5760 min Summer	2.511	0.511	0.0	0.7	0.0	0.7	193.2	O K
7200 min Summer	2.479	0.479	0.0	0.7	0.0	0.7	181.2	O K
8640 min Summer	2.449	0.449	0.0	0.7	0.0	0.7	169.7	O K
10080 min Summer	2.419	0.419	0.0	0.7	0.0	0.7	158.5	O K
15 min Winter	2.287	0.287	0.0	0.7	0.0	0.7	108.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	151.060	0.0	60.8	0.0	27
30 min Summer	85.910	0.0	61.1	0.0	42
60 min Summer	48.858	0.0	112.7	0.0	72
120 min Summer	27.786	0.0	118.0	0.0	130
180 min Summer	19.974	0.0	116.9	0.0	190
240 min Summer	15.803	0.0	115.1	0.0	250
360 min Summer	11.359	0.0	112.0	0.0	370
480 min Summer	8.987	0.0	109.5	0.0	488
600 min Summer	7.494	0.0	107.4	0.0	608
720 min Summer	6.460	0.0	105.6	0.0	726
960 min Summer	5.310	0.0	102.5	0.0	966
1440 min Summer	4.029	0.0	100.4	0.0	1442
2160 min Summer	3.056	0.0	213.7	0.0	2144
2880 min Summer	2.513	0.0	207.1	0.0	2476
4320 min Summer	1.789	0.0	190.7	0.0	3204
5760 min Summer	1.405	0.0	339.8	0.0	4032
7200 min Summer	1.166	0.0	347.8	0.0	4832
8640 min Summer	1.000	0.0	351.8	0.0	5704
10080 min Summer	0.879	0.0	347.4	0.0	6464
15 min Winter	151.060	0.0	61.3	0.0	27

Summary of Results for 30 year Return Period (+45%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	2.328	0.328	0.0	0.7	0.0	0.7	123.9	O K
60 min Winter	2.373	0.373	0.0	0.7	0.0	0.7	141.1	O K
120 min Winter	2.423	0.423	0.0	0.7	0.0	0.7	159.8	O K
180 min Winter	2.453	0.453	0.0	0.7	0.0	0.7	171.2	O K
240 min Winter	2.474	0.474	0.0	0.7	0.0	0.7	179.3	O K
360 min Winter	2.504	0.504	0.0	0.7	0.0	0.7	190.4	O K
480 min Winter	2.523	0.523	0.0	0.7	0.0	0.7	197.8	O K
600 min Winter	2.537	0.537	0.0	0.7	0.0	0.7	203.0	O K
720 min Winter	2.547	0.547	0.0	0.7	0.0	0.7	206.8	O K
960 min Winter	2.584	0.584	0.0	0.7	0.0	0.7	220.8	O K
1440 min Winter	2.632	0.632	0.0	0.7	0.0	0.7	238.9	O K
2160 min Winter	2.669	0.669	0.0	0.8	0.0	0.8	252.9	O K
2880 min Winter	2.684	0.684	0.0	0.8	0.0	0.8	258.7	O K
4320 min Winter	2.637	0.637	0.0	0.7	0.0	0.7	240.7	O K
5760 min Winter	2.593	0.593	0.0	0.7	0.0	0.7	224.2	O K
7200 min Winter	2.550	0.550	0.0	0.7	0.0	0.7	207.8	O K
8640 min Winter	2.507	0.507	0.0	0.7	0.0	0.7	191.7	O K
10080 min Winter	2.465	0.465	0.0	0.7	0.0	0.7	175.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
30 min Winter	85.910	0.0	60.7	0.0	41
60 min Winter	48.858	0.0	118.5	0.0	70
120 min Winter	27.786	0.0	116.4	0.0	130
180 min Winter	19.974	0.0	114.1	0.0	188
240 min Winter	15.803	0.0	112.4	0.0	246
360 min Winter	11.359	0.0	109.9	0.0	364
480 min Winter	8.987	0.0	108.2	0.0	480
600 min Winter	7.494	0.0	106.8	0.0	598
720 min Winter	6.460	0.0	105.8	0.0	714
960 min Winter	5.310	0.0	105.6	0.0	946
1440 min Winter	4.029	0.0	107.2	0.0	1406
2160 min Winter	3.056	0.0	218.7	0.0	2076
2880 min Winter	2.513	0.0	215.9	0.0	2712
4320 min Winter	1.789	0.0	205.0	0.0	3380
5760 min Winter	1.405	0.0	386.5	0.0	4320
7200 min Winter	1.166	0.0	392.9	0.0	5256
8640 min Winter	1.000	0.0	384.2	0.0	6144
10080 min Winter	0.879	0.0	364.7	0.0	7064

Rainfall Details

Rainfall Model	FEH
Return Period (years)	30
FEH Rainfall Version	1999
Site Location	GB 624550 306900 TG 24550 06900
C (1km)	-0.024
D1 (1km)	0.267
D2 (1km)	0.400
D3 (1km)	0.243
E (1km)	0.308
F (1km)	2.475
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.850
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+45

Time Area Diagram

Total Area (ha) 0.360

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.120	4	8	0.120	8	12	0.120

Model Details

Storage is Online Cover Level (m) 3.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	14.0
Membrane Percolation (mm/hr)	1000	Length (m)	90.0
Max Percolation (l/s)	350.0	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	2.000	Membrane Depth (m)	0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0044-9000-1000-9000
Design Head (m)	1.000
Design Flow (l/s)	0.9
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	44
Invert Level (m)	2.000
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	0.9
Flush-Flo™	0.194	0.7
Kick-Flo®	0.394	0.6
Mean Flow over Head Range	-	0.7

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)
0.100	0.7	1.200	1.0	3.000	1.5	7.000	2.2
0.200	0.7	1.400	1.0	3.500	1.6	7.500	2.2
0.300	0.7	1.600	1.1	4.000	1.7	8.000	2.3
0.400	0.6	1.800	1.2	4.500	1.8	8.500	2.4
0.500	0.7	2.000	1.2	5.000	1.9	9.000	2.4
0.600	0.7	2.200	1.3	5.500	1.9	9.500	2.5
0.800	0.8	2.400	1.3	6.000	2.0		
1.000	0.9	2.600	1.4	6.500	2.1		

Weir Overflow Control

Discharge Coef 0.100 Width (m) 0.600 Invert Level (m) 3.000

Summary of Results for 30 year Return Period (+45%)

Half Drain Time : 2371 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	2.254	0.254	0.0	1.7	0.0	1.7	179.1	O K
30 min Summer	2.290	0.290	0.0	1.7	0.0	1.7	204.6	O K
60 min Summer	2.330	0.330	0.0	1.7	0.0	1.7	232.6	O K
120 min Summer	2.372	0.372	0.0	1.7	0.0	1.7	262.7	O K
180 min Summer	2.398	0.398	0.0	1.7	0.0	1.7	280.5	O K
240 min Summer	2.415	0.415	0.0	1.7	0.0	1.7	293.0	O K
360 min Summer	2.439	0.439	0.0	1.7	0.0	1.7	309.4	O K
480 min Summer	2.453	0.453	0.0	1.7	0.0	1.7	319.7	O K
600 min Summer	2.463	0.463	0.0	1.7	0.0	1.7	326.4	O K
720 min Summer	2.469	0.469	0.0	1.7	0.0	1.7	330.8	O K
960 min Summer	2.498	0.498	0.0	1.7	0.0	1.7	351.1	O K
1440 min Summer	2.533	0.533	0.0	1.7	0.0	1.7	376.3	O K
2160 min Summer	2.559	0.559	0.0	1.7	0.0	1.7	394.2	O K
2880 min Summer	2.569	0.569	0.0	1.7	0.0	1.7	401.5	O K
4320 min Summer	2.519	0.519	0.0	1.7	0.0	1.7	366.2	O K
5760 min Summer	2.475	0.475	0.0	1.7	0.0	1.7	335.2	O K
7200 min Summer	2.435	0.435	0.0	1.7	0.0	1.7	307.0	O K
8640 min Summer	2.398	0.398	0.0	1.7	0.0	1.7	281.0	O K
10080 min Summer	2.364	0.364	0.0	1.7	0.0	1.7	257.2	O K
15 min Winter	2.290	0.290	0.0	1.7	0.0	1.7	204.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	151.060	0.0	132.2	0.0	27
30 min Summer	85.910	0.0	137.7	0.0	41
60 min Summer	48.858	0.0	219.3	0.0	72
120 min Summer	27.786	0.0	245.7	0.0	130
180 min Summer	19.974	0.0	259.0	0.0	190
240 min Summer	15.803	0.0	265.6	0.0	250
360 min Summer	11.359	0.0	269.1	0.0	368
480 min Summer	8.987	0.0	267.8	0.0	488
600 min Summer	7.494	0.0	265.2	0.0	606
720 min Summer	6.460	0.0	262.0	0.0	726
960 min Summer	5.310	0.0	253.6	0.0	964
1440 min Summer	4.029	0.0	234.6	0.0	1442
2160 min Summer	3.056	0.0	485.8	0.0	2100
2880 min Summer	2.513	0.0	469.0	0.0	2448
4320 min Summer	1.789	0.0	439.4	0.0	3076
5760 min Summer	1.405	0.0	643.1	0.0	3864
7200 min Summer	1.166	0.0	660.4	0.0	4616
8640 min Summer	1.000	0.0	673.1	0.0	5440
10080 min Summer	0.879	0.0	681.7	0.0	6160
15 min Winter	151.060	0.0	138.1	0.0	27

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Summary of Results for 30 year Return Period (+45%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	2.331	0.331	0.0	1.7	0.0	1.7	233.7	O K
60 min Winter	2.377	0.377	0.0	1.7	0.0	1.7	265.7	O K
120 min Winter	2.426	0.426	0.0	1.7	0.0	1.7	300.3	O K
180 min Winter	2.455	0.455	0.0	1.7	0.0	1.7	321.0	O K
240 min Winter	2.476	0.476	0.0	1.7	0.0	1.7	335.7	O K
360 min Winter	2.504	0.504	0.0	1.7	0.0	1.7	355.5	O K
480 min Winter	2.522	0.522	0.0	1.7	0.0	1.7	368.4	O K
600 min Winter	2.535	0.535	0.0	1.7	0.0	1.7	377.4	O K
720 min Winter	2.544	0.544	0.0	1.7	0.0	1.7	383.7	O K
960 min Winter	2.581	0.581	0.0	1.7	0.0	1.7	409.8	O K
1440 min Winter	2.627	0.627	0.0	1.7	0.0	1.7	442.1	O K
2160 min Winter	2.659	0.659	0.0	1.7	0.0	1.7	465.0	O K
2880 min Winter	2.670	0.670	0.0	1.7	0.0	1.7	472.7	O K
4320 min Winter	2.612	0.612	0.0	1.7	0.0	1.7	432.0	O K
5760 min Winter	2.553	0.553	0.0	1.7	0.0	1.7	390.2	O K
7200 min Winter	2.490	0.490	0.0	1.7	0.0	1.7	345.6	O K
8640 min Winter	2.433	0.433	0.0	1.7	0.0	1.7	305.3	O K
10080 min Winter	2.381	0.381	0.0	1.7	0.0	1.7	268.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
30 min Winter	85.910	0.0	141.0	0.0	41
60 min Winter	48.858	0.0	245.8	0.0	70
120 min Winter	27.786	0.0	267.7	0.0	128
180 min Winter	19.974	0.0	273.7	0.0	186
240 min Winter	15.803	0.0	274.2	0.0	246
360 min Winter	11.359	0.0	271.5	0.0	362
480 min Winter	8.987	0.0	267.1	0.0	480
600 min Winter	7.494	0.0	262.3	0.0	596
720 min Winter	6.460	0.0	257.4	0.0	714
960 min Winter	5.310	0.0	243.9	0.0	946
1440 min Winter	4.029	0.0	225.7	0.0	1404
2160 min Winter	3.056	0.0	489.9	0.0	2076
2880 min Winter	2.513	0.0	470.3	0.0	2708
4320 min Winter	1.789	0.0	431.6	0.0	3376
5760 min Winter	1.405	0.0	733.3	0.0	4280
7200 min Winter	1.166	0.0	753.8	0.0	5112
8640 min Winter	1.000	0.0	768.9	0.0	5888
10080 min Winter	0.879	0.0	778.7	0.0	6664

Rainfall Details

Rainfall Model	FEH
Return Period (years)	30
FEH Rainfall Version	1999
Site Location	GB 624550 306900 TG 24550 06900
C (1km)	-0.024
D1 (1km)	0.267
D2 (1km)	0.400
D3 (1km)	0.243
E (1km)	0.308
F (1km)	2.475
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.850
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+45

Time Area Diagram

Total Area (ha) 0.680

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.227	4	8	0.227	8	12	0.227

Model Details

Storage is Online Cover Level (m) 3.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	21.0
Membrane Percolation (mm/hr)	1000	Length (m)	112.0
Max Percolation (l/s)	653.3	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	2.000	Membrane Depth (m)	0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0063-1770-1000-1770
Design Head (m)	1.000
Design Flow (l/s)	1.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	63
Invert Level (m)	2.000
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	1.8
Flush-Flo™	0.277	1.7
Kick-Flo®	0.562	1.4
Mean Flow over Head Range	-	1.5

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)
0.100	1.5	1.200	2.0	3.000	3.0	7.000	4.4
0.200	1.7	1.400	2.1	3.500	3.2	7.500	4.6
0.300	1.7	1.600	2.2	4.000	3.4	8.000	4.7
0.400	1.7	1.800	2.3	4.500	3.6	8.500	4.8
0.500	1.6	2.000	2.5	5.000	3.8	9.000	5.0
0.600	1.4	2.200	2.6	5.500	3.9	9.500	5.1
0.800	1.6	2.400	2.7	6.000	4.1		
1.000	1.8	2.600	2.8	6.500	4.3		

Weir Overflow Control

Discharge Coef 0.100 Width (m) 0.600 Invert Level (m) 3.000

H.4 Treatment

Simple Index Approach tool (SIA) Results

Project Title:	Dealground
Project Code:	2022-0896
Date:	12/06/2023
Prepared by:	Adam Odell
Reviewed by:	Gavin Hodson
BIM reference:	DEALG-XX-XX-SUDS-TBL-001-S3-P01

This table shows the results of the Simple Index tool (SIA), developed by SEPA, HR Wallingford, and Ciria. The SIA is described in Section 26.7.1 of the Mannual and this text should be referred too when interpretting the results of this table.

Location	Pollution Hazard Indices				Aggregated Surface Water Pollution Mititigation Index			Combined Pollution Mitigation Indices			Sufficiency of Pollution Mitigation Indices		
	Hazard Level	Suspended Solids	Metals	Hydrocarbons	Total Suspended Solids	Metals	Hydrocarbons	Total Suspended Solids	Metals	Hydrocarbons	Suspended Solids	Metals	Hydrocarbons
View-001-A	Low	0.5	0.4	0.4	>0.95	0.95	0.95	>0.95	0.95	0.95	Sufficient	Sufficient	Sufficient
View-001-B	Low	0.5	0.4	0.4	>0.95	0.95	0.95	>0.95	0.95	0.95	Sufficient	Sufficient	Sufficient
View-001-C	Low	0.5	0.4	0.4	>0.95	0.95	0.95	>0.95	0.95	0.95	Sufficient	Sufficient	Sufficient
WE-001-A	Low	0.5	0.4	0.4	0.7	0.6	0.7	0.7	0.6	0.7	Sufficient	Sufficient	Sufficient
WE-001-B	Low	0.5	0.4	0.4	0.7	0.6	0.7	0.7	0.6	0.7	Sufficient	Sufficient	Sufficient
WE-001-C	Low	0.5	0.4	0.4	0.7	0.6	0.7	0.7	0.6	0.7	Sufficient	Sufficient	Sufficient
WE-001-D	Low	0.5	0.4	0.4	0.7	0.6	0.7	0.7	0.6	0.7	Sufficient	Sufficient	Sufficient
WE-001-E	Low	0.5	0.4	0.4	0.7	0.6	0.7	0.7	0.6	0.7	Sufficient	Sufficient	Sufficient
YE-001-A	Low	0.5	0.4	0.4	0.7	0.6	0.7	0.7	0.6	0.7	Sufficient	Sufficient	Sufficient
YE-001-B	Low	0.5	0.4	0.4	0.7	0.6	0.7	0.7	0.6	0.7	Sufficient	Sufficient	Sufficient
Highway-001	Medium	0.7	0.6	0.7	0.7	0.6	0.7	0.7	0.6	0.7	Sufficient	Sufficient	Sufficient
Highway-002	Medium	0.7	0.6	0.7	0.7	0.6	0.7	0.7	0.6	0.7	Sufficient	Sufficient	Sufficient

H.5 Maintenance

SUDS Maintenance Strategy

Dealground

June 2023

1 Introduction

This report identifies the SuDS maintenance plan for the 'Dealground' development, Norwich.

For the purpose of this report maintenance is referred to as:

1. Inspection required to identify asset performance to identify and plan maintenance needs.
2. Operation and maintenance of the drainage system

The SuDS features on site compromise of:

1. Pervious Paving
2. Green Roofs
3. Swales
4. Attenuation Storage Tanks
5. Bioretention Systems (rain gardens)
6. Inlet, Outlets and Inspection Chambers

The responsibility for the maintenance of SUDs is as following:

1. Where SuDS features are located within the curtilage of individual properties, maintenance responsibilities are completed by the homeowner. Any maintenance responsibilities for homeowners should be clearly outlined within property deeds.
2. The Management company, on behalf of the residents, is responsible for the maintenance of communal SuDS features.
3. The surface drainage system within the public highway, including both the attenuation tank and surface water pumping station, will be offered for adoption, who will be responsible for its maintenance.
4. Should Norfolk Country Council highways not adopt the road, then maintenance rests with the management company.

2 Maintenance Activities

2.1 Operation and Maintenance

Maintenance activities can be categorised as:

1. Regular maintenance (including inspections)
2. Occasional maintenance
3. Remedial maintenance

Regular maintenance tasks are to be carried on a predictable. This includes regular inspections/monitoring, and debris and litter removal.

Occasional maintenance task is required less frequently than regular tasks, but still periodically (e.g.filter replacement).

Remedial maintenances are required infrequently to rectify faults that are identified. Regular maintenance will reduce the likelihood of remedial maintenance. Therefore, remedial maintenance is likely to be unforeseen events that are difficult to predict and site specific. (e.g. erosion repairs, clearance of blockages).

The tables below show the maintenance plans for each of the SuDs features (CIRIA C753).

Table 2-1. Attenuation Storage Tank maintenance plan

Maintenance Schedule	Required action	Typical frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then annually
	Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
	For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae or other matter- remove and replace surface infiltration medium as necessary	Annually
	Remove sediment from pre-treatment structures and/ or internal forebays	Annually, or as required
Remedial actions	Repair/rehabilitate inlets, outlet, overflows and vents	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required

Table 2-2. Pervious Paving maintenance plan

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site specific observations of clogging or manufacturers recommendations - pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional maintenance	Stabilise and mow contributing and adjacent areas	As Required
	Removal of weeds or management using glyphospate applied directly into the weeds by an applicator rather than spraying	As required - once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving	As Required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a Hazard to users, and replace lost jointing material	As Required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging
Monitoring	Initial inspection	Monthly for three months after installation
	inspect for evidence of poor operation and or weed growth - if required, take remedial action	Three monthly, 48 h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

Table 2-3 Green Roof maintenance plan

Maintenance schedule	Required Action	Typical frequnecy
Regular inspections	Inspect all components including soil substrate, vegetation, drains, irrigation systems (if applicable), membranes and roof structure for proper operation, integrity of waterproofing and structural stability	Annually and after severe storms
	Inspect soil substrate for evidence of erosion channels and identify any sediment sources	
	Inspect drain inlets to ensure unrestricted runoff from the drainage layer to the conveyance or roof drain system	
	Inspect underside of roof for evidence of leakage	
Regular maintenance	Remove debris and litter to prevent clogging of inlet drains and interference with plant growth	Six monthly and annually or as required
	During establishment (ie year one), replace dead plants as required	Monthly (but usually responsibility of manufacturer)
	Post establishment, replace dead plants as required where (> 5% of coverage)	Annually (in autumn)
	Remove fallen leaves and debris from deciduous plant foliage	Six monthly or as required
	Remove nuisance and invasive vegetation, including weeds	Six monthly or as required
	Mow grasses, prune shrubs and manage other planting (if appropriate) as required – clippings should be removed and not allowed to accumulate	Six monthly or as required
Remedial Actions	If erosion channels are evident, these should be stabilised with extra soil substrate similar to the original material, and sources of erosion damage should be identified and controlled	As required
	If drain inlet has settled, cracked or moved, investigate and repair as appropriate	As required

Table 2-4. Swale Maintenance Schedule

Maintenance schedule	Required action	Typical frequency
Regular Maintenance	Remove litter and debris	Monthly, or as required
	Cut grass – to retain grass height within specified design range	Monthly (during growing season), or as required
	Manage other vegetation and remove nuisance plants	Monthly at start, then as required
	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
	Inspect infiltration surfaces for ponding, compaction, silt accumulation, record areas where water is ponding for > 48 hours	Monthly, or when required
	Inspect vegetation coverage	Monthly for 6 months, quarterly for 2 years, then half yearly
	Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies	Half yearly
Occasional maintenance	Reseed areas of poor vegetation growth, alter plant types to better suit conditions, if required	As required or if bare soil is exposed over 10% or more of the swale treatment area
Remedial Actions	Repair erosion or other damage by re-turfing or reseeding	As required
	Relevel uneven surfaces and reinstate design levels	
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface	
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip	
	Remove and dispose of oils or petrol residues using safe standard practices	

Table 2-5. Bioretention system Maintenance schedule

Maintenance Schedule	Required action	Typical frequency
Regular inspections	Inspect infiltration surfaces for silting and ponding, record de-watering time of the facility and assess standing water levels in underdrain (if appropriate) to determine if maintenance is necessary.	Quarterly
	Check operation of underdrains by inspection of flows after rain	Annually
	Assess plants for disease infection, poor growth, invasive species etc and replace as necessary	Quarterly
	Inspect inlets and outlets for blockage	Quarterly
Regular maintenance	Remove litter surface debris and weeds	Quarterly (or more frequently for tidiness or aesthetic reasons)
	Replace any plants, to maintain planting density	As required
	Remove sediment, litter and debris build-up from around inlets or from forebays	Quarterly to biannually
Occasional maintenance	Infill any holes or scour in the filter medium, improve erosion protection if required	As required
	Repair minor accumulations of silt by raking away surface mulch, scarifying surface of medium and replacing mulch	As required
Remedial actions	Remove and replace filter medium and vegetation above	As required but likely to be > 20 years

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