

Appendix E

MICRO DRAINAGE CALCULATIONS

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Date 06/03/2017 15:53

Designed by UKTTH001

File Commercial Area

Checked by



XP Solutions

Source Control 2015.1

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m ³)	Status
15 min Summer	99.698	0.198	5.8	69.3	O K
30 min Summer	99.768	0.268	6.0	93.8	Flood Risk
60 min Summer	99.837	0.337	6.3	117.8	Flood Risk
120 min Summer	99.886	0.386	6.5	135.1	Flood Risk
180 min Summer	99.893	0.393	6.5	137.6	Flood Risk
240 min Summer	99.889	0.389	6.5	136.3	Flood Risk
15 min Winter	99.724	0.224	5.9	78.5	Flood Risk
30 min Winter	99.805	0.305	6.2	106.6	Flood Risk
60 min Winter	99.885	0.385	6.5	134.8	Flood Risk
120 min Winter	99.948	0.448	6.7	156.9	Flood Risk
180 min Winter	99.963	0.463	6.7	162.1	Flood Risk
240 min Winter	99.962	0.462	6.7	161.6	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Discharge Volume (m ³)	Time-Peak (mins)
15 min Summer	124.925	0.0	77.2	25
30 min Summer	86.152	0.0	106.3	38
60 min Summer	56.713	0.0	140.0	66
120 min Summer	35.885	0.0	177.4	122
180 min Summer	26.921	0.0	199.5	176
240 min Summer	21.875	0.0	216.5	204
15 min Winter	124.925	0.0	86.3	25
30 min Winter	86.152	0.0	119.2	39
60 min Winter	56.713	0.0	156.9	66
120 min Winter	35.885	0.0	198.9	122
180 min Winter	26.921	0.0	223.7	176
240 min Winter	21.875	0.0	242.5	228

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Source Control 2015.1

Rainfall Details

Table with rainfall parameters: Rainfall Model (FSR), Return Period (100 years), Region (England and Wales), M5-60 (20.000 mm), Ratio R (0.300), Summer Storms (Yes), Winter Storms (Yes), Cv (Summer) (0.750), Cv (Winter) (0.840), Shortest Storm (15 mins), Longest Storm (240 mins), Climate Change % (+40).

Time Area Diagram

Total Area (ha) 0.330

Table with 3 columns of Time (mins) and Area (ha) data points: (0, 4, 0.110), (4, 8, 0.110), (8, 12, 0.110).

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Source Control 2015.1

Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 99.500

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	350.0	0.500	350.0

Hydro-Brake Optimum® Outflow Control

Unit Reference MD-SHE-0112-5000-0500-5000
 Design Head (m) 0.500
 Design Flow (l/s) 5.0
 Flush-Flo™ Calculated
 Objective Minimise upstream storage
 Diameter (mm) 112
 Invert Level (m) 99.000
 Minimum Outlet Pipe Diameter (mm) 150
 Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.500	5.0	Kick-Flo®	0.370	4.3
Flush-Flo™	0.178	4.9	Mean Flow over Head Range	-	4.1

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	3.9	1.200	7.4	3.000	11.5	7.000	17.3
0.200	4.9	1.400	8.0	3.500	12.4	7.500	17.9
0.300	4.7	1.600	8.5	4.000	13.2	8.000	18.5
0.400	4.5	1.800	9.0	4.500	13.9	8.500	19.0
0.500	5.0	2.000	9.5	5.000	14.7	9.000	19.6
0.600	5.4	2.200	9.9	5.500	15.3	9.500	20.1
0.800	6.2	2.400	10.3	6.000	16.0		
1.000	6.8	2.600	10.7	6.500	16.6		

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Date 06/03/2017 15:56
File CATCHMENT 2 - 100

Designed by UKTTH001
Checked by

XP Solutions Source Control 2015.1

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m ³)	Status
15 min Summer	99.691	0.191	5.8	86.0	O K
30 min Summer	99.760	0.260	6.0	116.9	Flood Risk
60 min Summer	99.829	0.329	6.3	148.1	Flood Risk
120 min Summer	99.885	0.385	6.5	173.4	Flood Risk
180 min Summer	99.901	0.401	6.5	180.4	Flood Risk
240 min Summer	99.902	0.402	6.5	180.8	Flood Risk
360 min Summer	99.894	0.394	6.5	177.3	Flood Risk
15 min Winter	99.716	0.216	5.9	97.3	Flood Risk
30 min Winter	99.795	0.295	6.1	132.6	Flood Risk
60 min Winter	99.875	0.375	6.4	168.9	Flood Risk
120 min Winter	99.944	0.444	6.7	199.8	Flood Risk
180 min Winter	99.967	0.467	6.7	210.3	Flood Risk
240 min Winter	99.974	0.474	6.8	213.2	Flood Risk
360 min Winter	99.967	0.467	6.7	209.9	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Discharge Volume (m ³)	Time-Peak (mins)
15 min Summer	124.925	0.0	94.0	25
30 min Summer	86.152	0.0	129.8	39
60 min Summer	56.713	0.0	170.8	68
120 min Summer	35.885	0.0	216.0	124
180 min Summer	26.921	0.0	243.5	182
240 min Summer	21.875	0.0	263.4	228
360 min Summer	16.309	0.0	294.9	290
15 min Winter	124.925	0.0	105.2	25
30 min Winter	86.152	0.0	145.2	39
60 min Winter	56.713	0.0	191.4	66
120 min Winter	35.885	0.0	242.1	122
180 min Winter	26.921	0.0	272.6	180
240 min Winter	21.875	0.0	295.1	234
360 min Winter	16.309	0.0	330.4	330

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Date 06/03/2017 15:56
File CATCHMENT 2 - 100

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XP Solutions

Source Control 2015.1

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.300	Longest Storm (mins)	360
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.402

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
From:	To:	From:	To:	From:	To:
0	4	4	8	8	12
	0.134		0.134		0.134

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Date 06/03/2017 15:56
File CATCHMENT 2 - 100

Designed by UKTTH001
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Source Control 2015.1

Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 99.500

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	450.0	0.500	450.0

Hydro-Brake Optimum® Outflow Control

Unit Reference MD-SHE-0112-5000-0500-5000
 Design Head (m) 0.500
 Design Flow (l/s) 5.0
 Flush-Flo™ Calculated
 Objective Minimise upstream storage
 Diameter (mm) 112
 Invert Level (m) 99.000
 Minimum Outlet Pipe Diameter (mm) 150
 Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.500	5.0	Kick-Flo®	0.370	4.3
Flush-Flo™	0.178	4.9	Mean Flow over Head Range	-	4.1

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	3.9	1.200	7.4	3.000	11.5	7.000	17.3
0.200	4.9	1.400	8.0	3.500	12.4	7.500	17.9
0.300	4.7	1.600	8.5	4.000	13.2	8.000	18.5
0.400	4.5	1.800	9.0	4.500	13.9	8.500	19.0
0.500	5.0	2.000	9.5	5.000	14.7	9.000	19.6
0.600	5.4	2.200	9.9	5.500	15.3	9.500	20.1
0.800	6.2	2.400	10.3	6.000	16.0		
1.000	6.8	2.600	10.7	6.500	16.6		

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Date 06/03/2017 15:59
File Area B2 - 100year

Designed by UKTTH001
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XP Solutions

Source Control 2015.1

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m ³)	Status
15 min Summer	99.691	0.191	5.8	86.0	O K
30 min Summer	99.760	0.260	6.0	116.9	Flood Risk
60 min Summer	99.829	0.329	6.3	148.1	Flood Risk
120 min Summer	99.885	0.385	6.5	173.4	Flood Risk
180 min Summer	99.901	0.401	6.5	180.4	Flood Risk
240 min Summer	99.902	0.402	6.5	180.8	Flood Risk
360 min Summer	99.894	0.394	6.5	177.3	Flood Risk
15 min Winter	99.716	0.216	5.9	97.3	Flood Risk
30 min Winter	99.795	0.295	6.1	132.6	Flood Risk
60 min Winter	99.875	0.375	6.4	168.9	Flood Risk
120 min Winter	99.944	0.444	6.7	199.8	Flood Risk
180 min Winter	99.967	0.467	6.7	210.3	Flood Risk
240 min Winter	99.974	0.474	6.8	213.2	Flood Risk
360 min Winter	99.967	0.467	6.7	209.9	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Discharge Volume (m ³)	Time-Peak (mins)
15 min Summer	124.925	0.0	94.0	25
30 min Summer	86.152	0.0	129.8	39
60 min Summer	56.713	0.0	170.8	68
120 min Summer	35.885	0.0	216.0	124
180 min Summer	26.921	0.0	243.5	182
240 min Summer	21.875	0.0	263.4	228
360 min Summer	16.309	0.0	294.9	290
15 min Winter	124.925	0.0	105.2	25
30 min Winter	86.152	0.0	145.2	39
60 min Winter	56.713	0.0	191.4	66
120 min Winter	35.885	0.0	242.1	122
180 min Winter	26.921	0.0	272.6	180
240 min Winter	21.875	0.0	295.1	234
360 min Winter	16.309	0.0	330.4	330

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File Area B2 - 100year

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Source Control 2015.1

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.300	Longest Storm (mins)	360
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.402

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
From:	To:	From:	To:	From:	To:
0	4	4	8	8	12
	0.134		0.134		0.134

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File Area B2 - 100year

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Source Control 2015.1

Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 99.500

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	450.0	0.500	450.0

Hydro-Brake Optimum® Outflow Control

Unit Reference MD-SHE-0112-5000-0500-5000
 Design Head (m) 0.500
 Design Flow (l/s) 5.0
 Flush-Flo™ Calculated
 Objective Minimise upstream storage
 Diameter (mm) 112
 Invert Level (m) 99.000
 Minimum Outlet Pipe Diameter (mm) 150
 Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.500	5.0	Kick-Flo®	0.370	4.3
Flush-Flo™	0.178	4.9	Mean Flow over Head Range	-	4.1

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	3.9	1.200	7.4	3.000	11.5	7.000	17.3
0.200	4.9	1.400	8.0	3.500	12.4	7.500	17.9
0.300	4.7	1.600	8.5	4.000	13.2	8.000	18.5
0.400	4.5	1.800	9.0	4.500	13.9	8.500	19.0
0.500	5.0	2.000	9.5	5.000	14.7	9.000	19.6
0.600	5.4	2.200	9.9	5.500	15.3	9.500	20.1
0.800	6.2	2.400	10.3	6.000	16.0		
1.000	6.8	2.600	10.7	6.500	16.6		

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Date 06/03/2017 16:05
File Area B3 - 100year

Designed by UKTTH001
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XP Solutions Source Control 2015.1

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m ³)	Status
15 min Summer	99.679	0.179	5.7	125.3	O K
30 min Summer	99.744	0.244	6.0	171.0	Flood Risk
60 min Summer	99.813	0.313	6.2	219.3	Flood Risk
120 min Summer	99.876	0.376	6.4	263.3	Flood Risk
180 min Summer	99.902	0.402	6.5	281.2	Flood Risk
240 min Summer	99.914	0.414	6.6	289.5	Flood Risk
360 min Summer	99.918	0.418	6.6	292.8	Flood Risk
480 min Summer	99.913	0.413	6.6	289.3	Flood Risk
600 min Summer	99.906	0.406	6.5	284.2	Flood Risk
15 min Winter	99.702	0.202	5.8	141.3	Flood Risk
30 min Winter	99.776	0.276	6.1	193.2	Flood Risk
60 min Winter	99.855	0.355	6.4	248.6	Flood Risk
120 min Winter	99.930	0.430	6.6	300.7	Flood Risk
180 min Winter	99.962	0.462	6.7	323.5	Flood Risk
240 min Winter	99.979	0.479	6.8	335.4	Flood Risk
360 min Winter	99.992	0.492	6.8	344.5	Flood Risk
480 min Winter	99.990	0.490	6.8	342.8	Flood Risk
600 min Winter	99.980	0.480	6.8	336.3	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Discharge Volume (m ³)	Time-Peak (mins)
15 min Summer	124.925	0.0	133.0	26
30 min Summer	86.152	0.0	183.9	40
60 min Summer	56.713	0.0	241.8	68
120 min Summer	35.885	0.0	306.5	126
180 min Summer	26.921	0.0	344.6	184
240 min Summer	21.875	0.0	373.9	242
360 min Summer	16.309	0.0	418.0	352
480 min Summer	13.215	0.0	451.9	408
600 min Summer	11.214	0.0	479.0	472
15 min Winter	124.925	0.0	149.3	26
30 min Winter	86.152	0.0	205.9	40
60 min Winter	56.713	0.0	271.2	68
120 min Winter	35.885	0.0	343.4	124
180 min Winter	26.921	0.0	386.2	182
240 min Winter	21.875	0.0	418.6	238
360 min Winter	16.309	0.0	468.1	350
480 min Winter	13.215	0.0	505.6	456
600 min Winter	11.214	0.0	536.6	500

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File Area B3 - 100year

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Source Control 2015.1

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.300	Longest Storm (mins)	600
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.570

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From:	To:	From:	To:	From:	To:
	(ha)		(ha)		(ha)
0	4 0.190	4	8 0.190	8	12 0.190

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Date 06/03/2017 16:05
File Area B3 - 100year

Designed by UKTTH001
Checked by



XP Solutions

Source Control 2015.1

Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 99.500

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	700.0	0.500	700.0

Hydro-Brake Optimum® Outflow Control

Unit Reference MD-SHE-0112-5000-0500-5000
 Design Head (m) 0.500
 Design Flow (l/s) 5.0
 Flush-Flo™ Calculated
 Objective Minimise upstream storage
 Diameter (mm) 112
 Invert Level (m) 99.000
 Minimum Outlet Pipe Diameter (mm) 150
 Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.500	5.0	Kick-Flo®	0.370	4.3
Flush-Flo™	0.178	4.9	Mean Flow over Head Range	-	4.1

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	3.9	1.200	7.4	3.000	11.5	7.000	17.3
0.200	4.9	1.400	8.0	3.500	12.4	7.500	17.9
0.300	4.7	1.600	8.5	4.000	13.2	8.000	18.5
0.400	4.5	1.800	9.0	4.500	13.9	8.500	19.0
0.500	5.0	2.000	9.5	5.000	14.7	9.000	19.6
0.600	5.4	2.200	9.9	5.500	15.3	9.500	20.1
0.800	6.2	2.400	10.3	6.000	16.0		
1.000	6.8	2.600	10.7	6.500	16.6		

