



SUPPLEMENTARY SURFACE WATER DRAINAGE CALCULATIONS

for

**Proposed Residential Development
Blendworth Crescent
Leigh Park
Havant
Hampshire**

Client:

PMC Construction and Development
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Issue		A	B
Issued By	Allen Rushby		
Date	January 2016		
Purpose	For Approval		
Approved By			

Project No. PMC 238

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CALCULATIONS

Job Title	BLENDWORTH CRESCENT HANAPOT.		Job No.	PMC238		Sht. No.	51	
Element	SURFACE WATER DRAINAGE.		Prepared	PL		Date	01 '17	
						Checked	Date	

TOTAL SITE AREA 11670 m^2 (1.16 Ha)

POST DEVELOPMENT SITE IMPERMEABLE AREAS

BUILDINGS	HOUSES	155 m^2
	HOUSES	290 m^2
	HOUSES	290 m^2
	HOUSES	320 m^2
	HOUSES	155 m^2
	FLATS	790 m^2
TOTAL BUILDINGS		2000 m^2

ACCESS ROAD 1145 m^2

PARKING AREAS 1495 m^2

TOTAL HARD SURFACES 4640 m^2

CHECK ATTENUATION STORAGE REQUIRED FOR 1 IN 100 YEAR + 40% CLIMATE CHANGE EVENT FOR WHOLE SITE

SEE 'TEDDS' ANALYSIS OVER

FOR 1 IN 1 YEAR EVENT

ATTENUATION STORAGE REQUIRED = 106.4 m^3

FOR 1 IN 100 YEAR + 40% CC EVENT

ATTENUATION STORAGE REQUIRED = 267.4 m^3

FOR SIMPLIFICATION ASSUME ALL PERMEABLE SUB-BASE TO ROAD AND PARKING AREAS = 350 DEEP. 30% Voids

STORAGE VOLUME PROVIDED = $2640 \times 0.35 \times 0.3 = 277 \text{ m}^3$

ATTENUATION TANK VOLUME = 40 m^3

TOTAL 317 m^3

Greenfield runoff estimation for sites

Site name: Blendworth Crescent
Site location: Havant

Site coordinates

Latitude: 50.86150° N
Longitude: 0.98681° W

This is an estimation of the greenfield runoff rate limits that are needed to meet normal best practice criteria in line with Environment Agency guidance "Preliminary rainfall runoff management for developments", W5-074/A/TR1/1 rev. E (2012) and the CIRIA SUDS Manual (2007). It is not to be used for detailed design of drainage systems. It is recommended that every drainage scheme uses hydraulic modelling software to finalise volume requirements and design details before drawings are produced.

Reference: gcp33e13twv1 / 1.16

Date: 12 Mar 2016

Site characteristics

Total site area	1.16	ha
Significant public open space	0	ha
Area positively drained	1.16	ha

Methodology

Greenfield runoff method	IH124
Qbar estimation method	Calculate from SPR and SAAR
SPR estimation method	Calculate from SOIL type
SOIL type	4
HOST class	N/A
SPR	0.47

Hydrological characteristics

	Default	Edited	
SAAR	743	743	mm
M5-60 Rainfall Depth	20	20	mm
'r' Ratio M5-60/M5-2 day	0.4	0.4	
FEH/FSR conversion factor	0.84	0.84	
Hydrological region	7	7	
Growth curve factor: 1 year	0.85	0.85	
Growth curve factor: 10 year	1.62	1.62	
Growth curve factor: 30 year	2.3	2.3	
Growth curve factor: 100 year	3.19	3.19	

Greenfield runoff rates

	Default	Edited	
Qbar	6.00	6.00	l/s
1 in 1 year	5.10	5.10	l/s
1 in 30 years	13.81	13.81	l/s
1 in 100 years	19.16	19.16	l/s

Please note that a minimum flow of 5 l/s applies to any site

 ARCH ASSOCIATES CONSULTING CIVIL AND STRUCTURAL ENGINEERS Arch Associates	Project			Blendworth Crescent, Havant		Job no. PMC238	
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	AWR	05/01/2017					

ATTENUATION DESIGN

In accordance with CIRIA publication C697 - The SUDS Manual

Tedds calculation version 1.0.02

Pre post runoff method

Site characteristics

Location	Other
Hydrological region	7
Soil type (Wallingford Procedure W.R.A.P map)	4
Standard percentage runoff	SPR = 0.47
Average annual rainfall	SAAR = 720 mm
5 year return period rainfall of 60 minute duration	M5_60min = 19.0 mm
Ratio 60-minute to 2 day rainfalls of 5 year return	r = 0.36
Rainfall intensity increase due to global warming	p _{climate} = 40%
Routing coefficient	C _r = 1.30
Volumetric runoff coefficient	C _v = 0.75

Catchment details

Subcatchment	Name	Area (ha)	PIMP (%)	Impermeable area (ha)
1	Whole Site	1.16	40.0	0.46
Total		1.16	40.0	0.46

Greenfield runoff rates

Catchment area	AREA = 50.00 hectare
Greenfield runoff rate (50 hectare site)	$\bar{Q}_{\text{rural}} = 0.00108 \text{ m}^3/\text{s} \times (\text{AREA}/1\text{km}^2)^{0.89} \times (\text{SAAR}/1\text{mm})^{1.17} \times \text{SPR}^{2.17} =$ 249.5 l / s
Greenfield runoff rate	$\bar{Q} = \bar{Q}_{\text{rural}} / \text{AREA} \times A =$ 5.8 l / s
Greenfield runoff rate per unit area	$\bar{Q}_A = \bar{Q} / A =$ 5.0 l / s / hectare

Estimated site discharges

FSR growth rate (1 year)	FSR _{1yr} = 0.85
Discharge (1 year)	Q _{1yr} = $\bar{Q} \times \text{FSR}_{1\text{yr}} =$ 4.9 l/s
FSR growth rate (30 year)	FSR _{30yr} = 2.30
Discharge (30 year)	Q _{30yr} = $\bar{Q} \times \text{FSR}_{30\text{yr}} =$ 13.3 l/s
FSR growth rate (100 year)	FSR _{100yr} = 3.19
Discharge (100 year)	Q _{100yr} = $\bar{Q} \times \text{FSR}_{100\text{yr}} =$ 18.5 l/s

Table equations

Peak flow	Q _{post_imp} = C _r × I _{max} × A _{imp}
Runoff volume	V _{post_imp} = Q _{post_imp} × D / C _r
Post development runoff	$\bar{Q}_{\text{post}} = Q_{\text{post_imp}} + Q_{\text{post_open}}$
Permitted discharge	O _{exist} = Q × D
Post development runoff volume	I _{post} = Q _{post_open} × D + V _{post_imp}
Storage volume required	S _{post} = I _{post} - O _{exist}

Required storage for period of 1 year

Discharge per hectare	Q _{1yr_area} = Q _{1yr} / A = 4.2 l/s/hectare
Greenfield runoff rate post development	Q _{1yr_post_open} = Q _{1yr_area} × A _{imp} = 2.0 l/s

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AWR	05/01/2017					

Duration (min)	1 year rainfall (mm)	Rainfall intensity (mm/hr)	Peak flow (m³/s)	Runoff volume (m³)	Post dev. runoff (m³/s)	Permit dischrge (m³)	Post dev. runoff vol (m³)	Storage vol. reqd (m³)
5	5.8	70.2	0.12	27.1	0.12	1.48	27.73	26.26
10	8.4	50.2	0.08	38.8	0.09	2.95	40.03	37.08
15	10.3	41.3	0.07	47.9	0.07	4.43	49.67	45.24
30	13.5	27.1	0.05	62.8	0.05	8.86	66.34	57.49
60	17.7	17.7	0.03	82.2	0.03	17.71	89.33	71.62
120	22.2	11.1	0.02	103.1	0.02	35.42	117.30	81.88
240	27.5	6.9	0.01	127.6	0.01	70.84	155.97	85.13
360	31.5	5.2	0.01	146.1	0.01	106.27	188.61	82.35
600	36.4	3.6	0.01	169.0	0.01	177.11	239.89	62.78
1440	47.8	2.0	0.00	221.9	0.01	425.07	391.95	-33.12

Attenuation storage required

Vol. increase due to head-discharge relationship

$$p_{\text{hydro}} = 1.25$$

Maximum attenuation storage required

$$V_{\text{req_max}} = V_{\text{max_1yr}} \times p_{\text{hydro}} = 106.4 \text{ m}^3$$

Required storage for period of 30 year

Discharge per hectare

$$Q_{30\text{yr_area}} = Q_{30\text{yr}} / A = 11.5 \text{ l/s/hectare}$$

Greenfield runoff rate post development

$$Q_{30\text{yr_post_open}} = Q_{30\text{yr_area}} \times A_{\text{imp}} = 5.3 \text{ l/s}$$

Duration (min)	30 year rainfall (mm)	Rainfall intensity (mm/hr)	Peak flow (m³/s)	Runoff volume (m³)	Post dev. runoff (m³/s)	Permit dischrge (m³)	Post dev. runoff vol (m³)	Storage vol. reqd (m³)
5	14.2	170.6	0.29	66.0	0.29	3.99	67.56	63.57
10	20.6	123.4	0.21	95.4	0.21	7.99	98.63	90.64
15	25.3	101.0	0.17	117.2	0.17	11.98	122.00	110.02
30	32.4	64.8	0.11	150.3	0.11	23.96	159.87	135.91
60	40.6	40.6	0.07	188.5	0.07	47.92	207.63	159.71
120	48.7	24.4	0.04	226.2	0.05	95.85	264.49	168.64
240	57.9	14.5	0.02	268.5	0.03	191.70	345.13	153.43
360	64.2	10.7	0.02	298.1	0.02	287.55	413.07	125.53
600	71.7	7.2	0.01	332.6	0.02	479.24	524.31	45.06
1440	88.6	3.7	0.01	411.0	0.01	1150.19	871.04	-279.14

Attenuation storage required

Vol. increase due to head-discharge relationship

$$p_{\text{hydro}} = 1.25$$

Maximum attenuation storage required

$$V_{\text{req_max}} = V_{\text{max_30yr}} \times p_{\text{hydro}} = 210.8 \text{ m}^3$$

Required storage for period of 100 year

Discharge per hectare

$$Q_{100\text{yr_area}} = Q_{100\text{yr}} / A = 15.9 \text{ l/s/hectare}$$

Greenfield runoff rate post development

$$Q_{100\text{yr_post_open}} = Q_{100\text{yr_area}} \times A_{\text{imp}} = 7.4 \text{ l/s}$$

Duration (min)	100 year rainfall (mm)	Rainfall intensity (mm/hr)	Peak flow (m³/s)	Runoff volume (m³)	Post dev. runoff (m³/s)	Permit dischrge (m³)	Post dev. runoff vol (m³)	Storage vol. reqd (m³)
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AWR	05/01/2017					

Duration (min)	100 year rainfall (mm)	Rainfall intensity (mm/hr)	Peak flow (m³/s)	Runoff volume (m³)	Post dev. runoff (m³/s)	Permit dischrge (m³)	Post dev. runoff vol (m³)	Storage vol. reqd (m³)
5	18.2	218.3	0.37	84.4	0.37	5.54	86.63	81.09
10	26.7	160.1	0.27	123.8	0.28	11.08	128.25	117.17
15	33.0	132.1	0.22	153.2	0.23	16.62	159.84	143.22
30	42.6	85.1	0.14	197.5	0.15	33.23	210.83	177.60
60	53.1	53.1	0.09	246.5	0.10	66.47	273.09	206.62
120	63.3	31.6	0.05	293.7	0.06	132.94	346.86	213.92
240	74.6	18.7	0.03	346.2	0.04	265.88	452.52	186.64
360	82.4	13.7	0.02	382.3	0.03	398.81	541.80	142.98
600	91.3	9.1	0.02	423.6	0.02	664.69	689.47	24.78
1440	110.2	4.6	0.01	511.4	0.02	1595.26	1149.53	-445.72

Attenuation storage required

Vol. increase due to head-discharge relationship

$$p_{\text{hydro}} = 1.25$$

Maximum attenuation storage required

$$V_{\text{req_max}} = V_{\text{max_100yr}} \times p_{\text{hydro}} = 267.4 \text{ m}^3$$

Interception storage

Interception rainfall depth

$$d_{\text{int}} = 5 \text{ mm}$$

Volume of interception storage required

$$V_{\text{int_req}} = 0.8 \times A_{\text{imp}} \times d_{\text{int}} = 18.56 \text{ m}^3$$

CALCULATIONS

Job Title	BLUNDWORTH CRESCENT HAVANT		Job No.	PMC 238	Sht. No.	58
Element		Prepared	Date	Checked	Date	
		PR				

CONSIDERATION OF URBAN CREEP

FACTOR 10% INCREASE IN IMPERMEABLE AREAS.

CURRENT TOTAL HARD SURFACES. 4640 m^2

WITH URBAN CREEP ALLOWANCE = 5104 m^2

CHECK ATTENUATION STORAGE REQUIRED FOR THIS INCREASED AREA, AGAIN FOR THE 1 IN 100 YEAR + 40% CE EVENT.

SEE 'TENDS' ANALYSIS OVER.

MAX ATTENUATION STORAGE REQUIRED = 310 m^3 .

FROM PREVIOUS CALCULATION SHEET

STORAGE VOLUME PROVIDED IS GREATER THAN 317 m^3

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AWR	05/01/2017				

ATTENUATION DESIGN

In accordance with CIRIA publication C697 - The SUDS Manual

Tedds calculation version 1.0.02

Pre post runoff method

Site characteristics

Location	Other
Hydrological region	7
Soil type (Wallingford Procedure W.R.A.P map)	4
Standard percentage runoff	SPR = 0.47
Average annual rainfall	SAAR = 720 mm
5 year return period rainfall of 60 minute duration	M5_60min = 19.0 mm
Ratio 60-minute to 2 day rainfalls of 5 year return	r = 0.36
Rainfall intensity increase due to global warming	p _{climate} = 40%
Routing coefficient	C _r = 1.30
Volumetric runoff coefficient	C _v = 0.75

Catchment details

Subcatchment	Name	Area (ha)	PIMP (%)	Impermeable area (ha)
1	Whole Site	1.16	44.0	0.51
Total		1.16	44.0	0.51

ADDITIONAL 10% ALLOWANCE FOR URBAN CATCH

Greenfield runoff rates

Catchment area	AREA = 50.00 hectare
Greenfield runoff rate (50 hectare site)	$\bar{Q}_{\text{rural}} = 0.00108 \text{ m}^3/\text{s} \times (\text{AREA}/1 \text{ km}^2)^{0.89} \times (\text{SAAR}/1 \text{ mm})^{1.17} \times \text{SPR}^{2.17} = 249.5 \text{ l/s}$
Greenfield runoff rate	$\bar{Q} = \bar{Q}_{\text{rural}} / \text{AREA} \times A = 5.8 \text{ l/s}$
Greenfield runoff rate per unit area	$\bar{Q}_A = \bar{Q} / A = 5.0 \text{ l/s/hectare}$

Estimated site discharges

FSR growth rate (1 year)	FSR _{1yr} = 0.85
Discharge (1 year)	$Q_{1\text{yr}} = \bar{Q} \times \text{FSR}_{1\text{yr}} = 4.9 \text{ l/s}$
FSR growth rate (30 year)	FSR _{30yr} = 2.30
Discharge (30 year)	$Q_{30\text{yr}} = \bar{Q} \times \text{FSR}_{30\text{yr}} = 13.3 \text{ l/s}$
FSR growth rate (100 year)	FSR _{100yr} = 3.19
Discharge (100 year)	$Q_{100\text{yr}} = \bar{Q} \times \text{FSR}_{100\text{yr}} = 18.5 \text{ l/s}$

Table equations

Peak flow	$Q_{\text{post_imp}} = C_r \times I_{\text{max}} \times A_{\text{imp}}$
Runoff volume	$V_{\text{post_imp}} = Q_{\text{post_imp}} \times D / C_r$
Post development runoff	$\bar{Q}_{\text{post}} = Q_{\text{post_imp}} + Q_{\text{post_open}}$
Permitted discharge	$O_{\text{exist}} = Q \times D$
Post development runoff volume	$I_{\text{post}} = Q_{\text{post_open}} \times D + V_{\text{post_imp}}$
Storage volume required	$S_{\text{post}} = I_{\text{post}} - O_{\text{exist}}$

Required storage for period of 1 year

Discharge per hectare	$Q_{1\text{yr_area}} = Q_{1\text{yr}} / A = 4.2 \text{ l/s/hectare}$
Greenfield runoff rate post development	$Q_{1\text{yr_post_open}} = Q_{1\text{yr_area}} \times A_{\text{imp}} = 2.2 \text{ l/s}$

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AWR	05/01/2017					

Duration (min)	1 year rainfall (mm)	Rainfall intensity (mm/hr)	Peak flow (m³/s)	Runoff volume (m³)	Post dev. runoff (m³/s)	Permit dischrge (m³)	Post dev. runoff vol (m³)	Storage vol. reqd (m³)
5	5.8	70.2	0.13	29.9	0.13	1.48	30.51	29.03
10	8.4	50.2	0.09	42.7	0.09	2.95	44.03	41.08
15	10.3	41.3	0.08	52.7	0.08	4.43	54.64	50.21
30	13.5	27.1	0.05	69.1	0.05	8.86	72.97	64.12
60	17.7	17.7	0.03	90.5	0.03	17.71	98.27	80.56
120	22.2	11.1	0.02	113.4	0.02	35.42	129.03	93.61
240	27.5	6.9	0.01	140.4	0.01	70.84	171.57	100.73
360	31.5	5.2	0.01	160.7	0.01	106.27	207.47	101.21
600	36.4	3.6	0.01	186.0	0.01	177.11	263.88	86.77
1440	47.8	2.0	0.00	244.1	0.01	425.07	431.14	6.08

Attenuation storage required

Vol. increase due to head-discharge relationship

$$p_{hydro} = 1.25$$

Maximum attenuation storage required

$$V_{req_max} = V_{max_1yr} \times p_{hydro} = 126.5 \text{ m}^3$$

Required storage for period of 30 year

Discharge per hectare

$$Q_{30yr_area} = Q_{30yr} / A = 11.5 \text{ l/s/hectare}$$

Greenfield runoff rate post development

$$Q_{30yr_post_open} = Q_{30yr_area} \times A_{imp} = 5.9 \text{ l/s}$$

Duration (min)	30 year rainfall (mm)	Rainfall intensity (mm/hr)	Peak flow (m³/s)	Runoff volume (m³)	Post dev. runoff (m³/s)	Permit dischrge (m³)	Post dev. runoff vol (m³)	Storage vol. reqd (m³)
5	14.2	170.6	0.31	72.6	0.32	3.99	74.32	70.33
10	20.6	123.4	0.23	105.0	0.23	7.99	108.49	100.51
15	25.3	101.0	0.19	128.9	0.19	11.98	134.20	122.22
30	32.4	64.8	0.12	165.3	0.13	23.96	175.86	151.89
60	40.6	40.6	0.07	207.3	0.08	47.92	228.39	180.47
120	48.7	24.4	0.04	248.8	0.05	95.85	290.94	195.09
240	57.9	14.5	0.03	295.3	0.03	191.70	379.64	187.95
360	64.2	10.7	0.02	327.9	0.03	287.55	454.38	166.83
600	71.7	7.2	0.01	365.9	0.02	479.24	576.74	97.49
1440	88.6	3.7	0.01	452.1	0.01	1150.19	958.15	-192.04

Attenuation storage required

Vol. increase due to head-discharge relationship

$$p_{hydro} = 1.25$$

Maximum attenuation storage required

$$V_{req_max} = V_{max_30yr} \times p_{hydro} = 243.9 \text{ m}^3$$

Required storage for period of 100 year

Discharge per hectare

$$Q_{100yr_area} = Q_{100yr} / A = 15.9 \text{ l/s/hectare}$$

Greenfield runoff rate post development

$$Q_{100yr_post_open} = Q_{100yr_area} \times A_{imp} = 8.1 \text{ l/s}$$

Duration (min)	100 year rainfall (mm)	Rainfall intensity (mm/hr)	Peak flow (m³/s)	Runoff volume (m³)	Post dev. runoff (m³/s)	Permit dischrge (m³)	Post dev. runoff vol (m³)	Storage vol. reqd (m³)
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AWR	05/01/2017					

Duration (min)	100 year rainfall (mm)	Rainfall intensity (mm/hr)	Peak flow (m³/s)	Runoff volume (m³)	Post dev. runoff (m³/s)	Permit dischrge (m³)	Post dev. runoff vol (m³)	Storage vol. reqd (m³)
5	18.2	218.3	0.40	92.9	0.41	5.54	95.29	89.75
10	26.7	160.1	0.30	136.2	0.30	11.08	141.08	130.00
15	33.0	132.1	0.24	168.5	0.25	16.62	175.82	159.21
30	42.6	85.1	0.16	217.3	0.17	33.23	231.92	198.68
60	53.1	53.1	0.10	271.2	0.11	66.47	300.40	233.93
120	63.3	31.6	0.06	323.1	0.07	132.94	381.54	248.61
240	74.6	18.7	0.03	380.8	0.04	265.88	497.77	231.89
360	82.4	13.7	0.03	420.5	0.03	398.81	595.98	197.16
600	91.3	9.1	0.02	466.0	0.02	664.69	758.42	93.73
1440	110.2	4.6	0.01	562.6	0.02	1595.26	1264.49	-330.77

Attenuation storage required

Vol. increase due to head-discharge relationship

$$p_{\text{hydro}} = 1.25$$

Maximum attenuation storage required

$$V_{\text{req_max}} = V_{\text{max_100yr}} \times p_{\text{hydro}} = 310.8 \text{ m}^3$$

Interception storage

Interception rainfall depth

$$d_{\text{int}} = 5 \text{ mm}$$

Volume of interception storage required

$$V_{\text{int_req}} = 0.8 \times A_{\text{imp}} \times d_{\text{int}} = 20.42 \text{ m}^3$$

Arch Associates Limited		Page 510
Town House St Geroge's Square Bishops Waltham Southampton SO32 1AF	Blendworth Crescent Leigh Park Havant	
Date Nov. 2016	Designed by AWR	
File Plots 1 to 15(1 Year).srcx	Checked by	
XP Solutions		Source Control 2016.1

Summary of Results for 1 year Return Period

Half Drain Time : 98 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m ³)	Status
15 min Summer	10.015	0.065	0.0	1.1	1.1	5.4	O K
30 min Summer	10.029	0.079	0.0	1.3	1.3	7.9	O K
60 min Summer	10.041	0.091	0.0	1.4	1.4	10.4	O K
120 min Summer	10.050	0.100	0.0	1.4	1.4	12.5	O K
180 min Summer	10.054	0.104	0.0	1.4	1.4	13.6	O K
240 min Summer	10.056	0.106	0.0	1.4	1.4	14.1	O K
360 min Summer	10.057	0.107	0.0	1.4	1.4	14.4	O K
480 min Summer	10.056	0.106	0.0	1.4	1.4	14.1	O K
600 min Summer	10.054	0.104	0.0	1.4	1.4	13.6	O K
720 min Summer	10.051	0.101	0.0	1.4	1.4	12.9	O K
960 min Summer	10.046	0.096	0.0	1.4	1.4	11.6	O K
1440 min Summer	10.036	0.086	0.0	1.4	1.4	9.2	O K
2160 min Summer	10.025	0.075	0.0	1.2	1.2	7.0	O K
2880 min Summer	10.016	0.066	0.0	1.1	1.1	5.6	O K
4320 min Summer	10.006	0.056	0.0	0.9	0.9	3.9	O K
5760 min Summer	9.999	0.049	0.0	0.8	0.8	3.1	O K
7200 min Summer	9.995	0.045	0.0	0.7	0.7	2.6	O K
8640 min Summer	9.992	0.042	0.0	0.6	0.6	2.2	O K
10080 min Summer	9.989	0.039	0.0	0.5	0.5	1.9	O K
15 min Winter	10.022	0.072	0.0	1.2	1.2	6.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Discharge Volume (m ³)	Time-Peak (mins)
15 min Summer	28.417	0.0	5.9	21
30 min Summer	18.860	0.0	9.2	34
60 min Summer	12.227	0.0	13.1	62
120 min Summer	7.783	0.0	17.7	98
180 min Summer	5.952	0.0	20.8	132
240 min Summer	4.917	0.0	23.3	168
360 min Summer	3.727	0.0	26.9	236
480 min Summer	3.055	0.0	29.6	304
600 min Summer	2.619	0.0	31.9	372
720 min Summer	2.309	0.0	33.8	436
960 min Summer	1.894	0.0	37.1	562
1440 min Summer	1.433	0.0	42.0	806
2160 min Summer	1.083	0.0	47.3	1168
2880 min Summer	0.888	0.0	51.2	1528
4320 min Summer	0.672	0.0	56.9	2212
5760 min Summer	0.552	0.0	61.0	2944
7200 min Summer	0.474	0.0	64.0	3672
8640 min Summer	0.417	0.0	66.1	4400
10080 min Summer	0.374	0.0	67.6	5136
15 min Winter	28.417	0.0	7.2	21

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XP Solutions		Source Control 2016.1

Summary of Results for 1 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	10.037	0.087	0.0	1.4	1.4	9.4	O K
60 min Winter	10.049	0.099	0.0	1.4	1.4	12.4	O K
120 min Winter	10.059	0.109	0.0	1.4	1.4	14.7	O K
180 min Winter	10.063	0.113	0.0	1.4	1.4	15.6	O K
240 min Winter	10.064	0.114	0.0	1.4	1.4	16.1	O K
360 min Winter	10.064	0.114	0.0	1.4	1.4	15.8	O K
480 min Winter	10.060	0.110	0.0	1.4	1.4	15.0	O K
600 min Winter	10.056	0.106	0.0	1.4	1.4	14.0	O K
720 min Winter	10.051	0.101	0.0	1.4	1.4	12.9	O K
960 min Winter	10.042	0.092	0.0	1.4	1.4	10.8	O K
1440 min Winter	10.028	0.078	0.0	1.3	1.3	7.8	O K
2160 min Winter	10.015	0.065	0.0	1.1	1.1	5.2	O K
2880 min Winter	10.006	0.056	0.0	0.9	0.9	3.9	O K
4320 min Winter	9.996	0.046	0.0	0.7	0.7	2.7	O K
5760 min Winter	9.991	0.041	0.0	0.6	0.6	2.1	O K
7200 min Winter	9.987	0.037	0.0	0.5	0.5	1.7	O K
8640 min Winter	9.984	0.034	0.0	0.4	0.4	1.5	O K
10080 min Winter	9.982	0.032	0.0	0.4	0.4	1.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	18.860	0.0	10.8	34
60 min Winter	12.227	0.0	15.2	62
120 min Winter	7.783	0.0	20.3	112
180 min Winter	5.952	0.0	23.9	142
240 min Winter	4.917	0.0	26.6	182
360 min Winter	3.727	0.0	30.7	256
480 min Winter	3.055	0.0	33.8	330
600 min Winter	2.619	0.0	36.3	398
720 min Winter	2.309	0.0	38.5	466
960 min Winter	1.894	0.0	42.2	592
1440 min Winter	1.433	0.0	47.9	828
2160 min Winter	1.083	0.0	54.0	1176
2880 min Winter	0.888	0.0	58.5	1532
4320 min Winter	0.672	0.0	65.2	2208
5760 min Winter	0.552	0.0	70.1	2976
7200 min Winter	0.474	0.0	73.8	3680
8640 min Winter	0.417	0.0	76.5	4384
10080 min Winter	0.374	0.0	78.6	5144

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XP Solutions	Source Control 2016.1	

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.200	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.188

Time (mins)	Area	Time (mins)	Area
From:	To: (ha)	From:	To: (ha)
0	4 0.094	4	8 0.094

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Model Details

Storage is Online Cover Level (m) 10.550

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	16.8
Membrane Percolation (mm/hr)	1000	Length (m)	48.0
Max Percolation (l/s)	224.0	Slope (1:X)	500.0
Safety Factor	1.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	9.950	Membrane Depth (m)	0

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0064-1500-0600-1500		
Design Head (m)	0.600		
Design Flow (l/s)	1.5		
Flush-Flo™	Calculated		
Objective	Minimise upstream storage		
Application	Surface		
Sump Available	Yes		
Diameter (mm)	64		
Invert Level (m)	9.950		
Minimum Outlet Pipe Diameter (mm)	100		
Suggested Manhole Diameter (mm)	1200		

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.600	1.5
Flush-Flo™	0.179	1.5
Kick-Flo®	0.391	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	1.4	1.200	2.1	3.000	3.1	7.000	4.7
0.200	1.5	1.400	2.2	3.500	3.4	7.500	4.8
0.300	1.4	1.600	2.3	4.000	3.6	8.000	5.0
0.400	1.3	1.800	2.5	4.500	3.8	8.500	5.1
0.500	1.4	2.000	2.6	5.000	4.0	9.000	5.3
0.600	1.5	2.200	2.7	5.500	4.1	9.500	5.4
0.800	1.7	2.400	2.8	6.000	4.3		
1.000	1.9	2.600	2.9	6.500	4.5		

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XP Solutions		Source Control 2016.1

Summary of Results for 1 year Return Period

Half Drain Time : 30 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m ³)	Status
15 min Summer	10.777	0.127	0.0	1.5	1.5	2.2	O K
30 min Summer	10.799	0.149	0.0	1.5	1.5	3.0	O K
60 min Summer	10.814	0.164	0.0	1.5	1.5	3.6	O K
120 min Summer	10.818	0.168	0.0	1.5	1.5	3.8	O K
180 min Summer	10.812	0.162	0.0	1.5	1.5	3.6	O K
240 min Summer	10.803	0.153	0.0	1.5	1.5	3.2	O K
360 min Summer	10.783	0.133	0.0	1.5	1.5	2.4	O K
480 min Summer	10.765	0.115	0.0	1.4	1.4	1.8	O K
600 min Summer	10.749	0.099	0.0	1.4	1.4	1.3	O K
720 min Summer	10.737	0.087	0.0	1.4	1.4	1.0	O K
960 min Summer	10.724	0.074	0.0	1.2	1.2	0.7	O K
1440 min Summer	10.709	0.059	0.0	1.0	1.0	0.5	O K
2160 min Summer	10.698	0.048	0.0	0.7	0.7	0.3	O K
2880 min Summer	10.692	0.042	0.0	0.6	0.6	0.2	O K
4320 min Summer	10.685	0.035	0.0	0.5	0.5	0.2	O K
5760 min Summer	10.681	0.031	0.0	0.4	0.4	0.1	O K
7200 min Summer	10.679	0.029	0.0	0.3	0.3	0.1	O K
8640 min Summer	10.677	0.027	0.0	0.3	0.3	0.1	O K
10080 min Summer	10.675	0.025	0.0	0.3	0.3	0.1	O K
15 min Winter	10.791	0.141	0.0	1.5	1.5	2.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Discharge Volume (m ³)	Time-Peak (mins)
15 min Summer	28.417	0.0	3.0	18
30 min Summer	18.860	0.0	4.5	29
60 min Summer	12.227	0.0	6.3	46
120 min Summer	7.783	0.0	8.3	80
180 min Summer	5.952	0.0	9.8	114
240 min Summer	4.917	0.0	10.9	146
360 min Summer	3.727	0.0	12.5	208
480 min Summer	3.055	0.0	13.8	266
600 min Summer	2.619	0.0	14.8	324
720 min Summer	2.309	0.0	15.7	380
960 min Summer	1.894	0.0	17.2	496
1440 min Summer	1.433	0.0	19.5	736
2160 min Summer	1.083	0.0	22.0	1092
2880 min Summer	0.888	0.0	23.9	1452
4320 min Summer	0.672	0.0	26.6	2144
5760 min Summer	0.552	0.0	28.7	2888
7200 min Summer	0.474	0.0	30.2	3640
8640 min Summer	0.417	0.0	31.4	4320
10080 min Summer	0.374	0.0	32.3	5008
15 min Winter	28.417	0.0	3.6	19

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.200	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.085

Time (mins)	Area	Time (mins)	Area
From:	To: (ha)	From:	To: (ha)
0	4 0.042	4	8 0.043

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XP Solutions		Source Control 2016.1

Model Details

Storage is Online Cover Level (m) 11.250

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	6.0
Membrane Percolation (mm/hr)	1000	Length (m)	50.0
Max Percolation (l/s)	83.3	Slope (1:X)	150.0
Safety Factor	1.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	10.650	Membrane Depth (m)	0

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0064-1500-0600-1500		
Design Head (m)	0.600		
Design Flow (l/s)	1.5		
Flush-Flo™	Calculated		
Objective	Minimise upstream storage		
Application	Surface		
Sump Available	Yes		
Diameter (mm)	64		
Invert Level (m)	10.650		
Minimum Outlet Pipe Diameter (mm)	100		
Suggested Manhole Diameter (mm)	1200		

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.600	1.5
Flush-Flo™	0.179	1.5
Kick-Flo®	0.391	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	1.4	1.200	2.1	3.000	3.1	7.000	4.7
0.200	1.5	1.400	2.2	3.500	3.4	7.500	4.8
0.300	1.4	1.600	2.3	4.000	3.6	8.000	5.0
0.400	1.3	1.800	2.5	4.500	3.8	8.500	5.1
0.500	1.4	2.000	2.6	5.000	4.0	9.000	5.3
0.600	1.5	2.200	2.7	5.500	4.1	9.500	5.4
0.800	1.7	2.400	2.8	6.000	4.3		
1.000	1.9	2.600	2.9	6.500	4.5		

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Summary of Results for 1 year Return Period

Half Drain Time : 9 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m ³)	Status
15 min Summer	10.744	0.044	0.0	0.6	0.6	0.2	O K
30 min Summer	10.766	0.066	0.0	0.9	0.9	0.5	O K
60 min Summer	10.781	0.081	0.0	1.0	1.0	0.7	O K
120 min Summer	10.789	0.089	0.0	1.0	1.0	0.9	O K
180 min Summer	10.787	0.087	0.0	1.0	1.0	0.8	O K
240 min Summer	10.782	0.082	0.0	1.0	1.0	0.7	O K
360 min Summer	10.770	0.070	0.0	0.9	0.9	0.6	O K
480 min Summer	10.761	0.061	0.0	0.8	0.8	0.4	O K
600 min Summer	10.755	0.055	0.0	0.7	0.7	0.3	O K
720 min Summer	10.750	0.050	0.0	0.7	0.7	0.3	O K
960 min Summer	10.744	0.044	0.0	0.6	0.6	0.2	O K
1440 min Summer	10.737	0.037	0.0	0.4	0.4	0.1	O K
2160 min Summer	10.731	0.031	0.0	0.3	0.3	0.1	O K
2880 min Summer	10.727	0.027	0.0	0.3	0.3	0.1	O K
4320 min Summer	10.723	0.023	0.0	0.2	0.2	0.1	O K
5760 min Summer	10.721	0.021	0.0	0.2	0.2	0.0	O K
7200 min Summer	10.719	0.019	0.0	0.1	0.1	0.0	O K
8640 min Summer	10.718	0.018	0.0	0.1	0.1	0.0	O K
10080 min Summer	10.717	0.017	0.0	0.1	0.1	0.0	O K
15 min Winter	10.759	0.059	0.0	0.8	0.8	0.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Discharge Volume (m ³)	Time-Peak (mins)
15 min Summer	28.417	0.0	0.4	16
30 min Summer	18.860	0.0	1.0	24
60 min Summer	12.227	0.0	1.8	40
120 min Summer	7.783	0.0	2.7	74
180 min Summer	5.952	0.0	3.3	106
240 min Summer	4.917	0.0	3.8	134
360 min Summer	3.727	0.0	4.5	192
480 min Summer	3.055	0.0	5.0	252
600 min Summer	2.619	0.0	5.4	310
720 min Summer	2.309	0.0	5.8	370
960 min Summer	1.894	0.0	6.4	490
1440 min Summer	1.433	0.0	7.2	734
2160 min Summer	1.083	0.0	8.0	1088
2880 min Summer	0.888	0.0	8.6	1464
4320 min Summer	0.672	0.0	9.2	2192
5760 min Summer	0.552	0.0	9.6	2856
7200 min Summer	0.474	0.0	9.7	3600
8640 min Summer	0.417	0.0	9.7	4304
10080 min Summer	0.374	0.0	9.6	5032
15 min Winter	28.417	0.0	0.6	16

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Summary of Results for 1 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	10.779	0.079	0.0	1.0	1.0	0.7	O K
60 min Winter	10.792	0.092	0.0	1.0	1.0	1.0	O K
120 min Winter	10.791	0.091	0.0	1.0	1.0	0.9	O K
180 min Winter	10.781	0.081	0.0	1.0	1.0	0.7	O K
240 min Winter	10.772	0.072	0.0	1.0	1.0	0.6	O K
360 min Winter	10.758	0.058	0.0	0.8	0.8	0.4	O K
480 min Winter	10.749	0.049	0.0	0.7	0.7	0.3	O K
600 min Winter	10.744	0.044	0.0	0.6	0.6	0.2	O K
720 min Winter	10.740	0.040	0.0	0.5	0.5	0.2	O K
960 min Winter	10.735	0.035	0.0	0.4	0.4	0.1	O K
1440 min Winter	10.730	0.030	0.0	0.3	0.3	0.1	O K
2160 min Winter	10.725	0.025	0.0	0.2	0.2	0.1	O K
2880 min Winter	10.723	0.023	0.0	0.2	0.2	0.1	O K
4320 min Winter	10.719	0.019	0.0	0.1	0.1	0.0	O K
5760 min Winter	10.717	0.017	0.0	0.1	0.1	0.0	O K
7200 min Winter	10.716	0.016	0.0	0.1	0.1	0.0	O K
8640 min Winter	10.715	0.015	0.0	0.1	0.1	0.0	O K
10080 min Winter	10.714	0.014	0.0	0.1	0.1	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	18.860	0.0	1.4	25
60 min Winter	12.227	0.0	2.2	44
120 min Winter	7.783	0.0	3.3	78
180 min Winter	5.952	0.0	4.0	108
240 min Winter	4.917	0.0	4.5	136
360 min Winter	3.727	0.0	5.3	194
480 min Winter	3.055	0.0	5.9	250
600 min Winter	2.619	0.0	6.3	310
720 min Winter	2.309	0.0	6.7	368
960 min Winter	1.894	0.0	7.4	492
1440 min Winter	1.433	0.0	8.4	736
2160 min Winter	1.083	0.0	9.4	1064
2880 min Winter	0.888	0.0	10.1	1444
4320 min Winter	0.672	0.0	11.0	2196
5760 min Winter	0.552	0.0	11.5	2848
7200 min Winter	0.474	0.0	11.8	3560
8640 min Winter	0.417	0.0	11.9	4456
10080 min Winter	0.374	0.0	11.9	5064

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.200	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.038

Time (mins)	Area
From:	To: (ha)
0	4 0.038

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Town House St Geroge's Square Bishops Waltham Southampton SO32 1AF	Blendworth Crescent Leigh Park Havant	
Date Nov. 2016	Designed by AWR	
File Entrance Road (1 Year)....	Checked by	
XP Solutions	Source Control 2016.1	

Model Details

Storage is Online Cover Level (m) 11.050

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	65.0
Max Percolation (l/s)	90.3	Slope (1:X)	150.0
Safety Factor	1.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	10.700	Membrane Depth (m)	0

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0056-1000-0350-1000		
Design Head (m)	0.350		
Design Flow (l/s)	1.0		
Flush-Flo™	Calculated		
Objective	Minimise upstream storage		
Application	Surface		
Sump Available	Yes		
Diameter (mm)	56		
Invert Level (m)	10.700		
Minimum Outlet Pipe Diameter (mm)	75		
Suggested Manhole Diameter (mm)	1200		

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.350	1.0
Flush-Flo™	0.101	1.0
Kick-Flo®	0.244	0.9
Mean Flow over Head Range	-	0.8

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	1.0	1.200	1.7	3.000	2.6	7.000	4.0
0.200	0.9	1.400	1.9	3.500	2.8	7.500	4.1
0.300	0.9	1.600	2.0	4.000	3.0	8.000	4.3
0.400	1.1	1.800	2.1	4.500	3.2	8.500	4.4
0.500	1.2	2.000	2.2	5.000	3.4	9.000	4.5
0.600	1.3	2.200	2.3	5.500	3.6	9.500	4.7
0.800	1.4	2.400	2.4	6.000	3.7		
1.000	1.6	2.600	2.5	6.500	3.9		

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Town House St Geroge's Square Bishops Waltham Southampton SO32 1AF		
Date 06/01/2017 12:26	Designed by allen.rushby	
File Flats 1 year box culver...	Checked by	
XP Solutions		Source Control 2016.1

Summary of Results for 1 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	9.750	0.100	0.7	3.8	O K
30 min Summer	9.773	0.123	0.8	4.7	O K
60 min Summer	9.790	0.140	0.8	5.5	O K
120 min Summer	9.801	0.151	0.9	5.9	O K
180 min Summer	9.804	0.154	0.9	6.0	O K
240 min Summer	9.803	0.153	0.9	6.0	O K
360 min Summer	9.795	0.145	0.8	5.7	O K
480 min Summer	9.786	0.136	0.8	5.3	O K
600 min Summer	9.778	0.128	0.8	5.0	O K
720 min Summer	9.770	0.120	0.8	4.6	O K
960 min Summer	9.756	0.106	0.7	4.0	O K
1440 min Summer	9.734	0.084	0.7	3.1	O K
2160 min Summer	9.713	0.063	0.6	2.3	O K
2880 min Summer	9.703	0.053	0.5	1.8	O K
4320 min Summer	9.692	0.042	0.4	1.4	O K
5760 min Summer	9.686	0.036	0.4	1.1	O K
7200 min Summer	9.682	0.032	0.3	1.0	O K
8640 min Summer	9.680	0.030	0.3	0.8	O K
10080 min Summer	9.678	0.028	0.2	0.8	O K
15 min Winter	9.762	0.112	0.8	4.3	O K
30 min Winter	9.788	0.138	0.8	5.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	28.725	0.0	4.3	17
30 min Summer	19.076	0.0	5.7	31
60 min Summer	12.369	0.0	7.3	52
120 min Summer	7.876	0.0	9.3	86
180 min Summer	6.024	0.0	10.7	120
240 min Summer	4.978	0.0	11.8	156
360 min Summer	3.770	0.0	13.4	224
480 min Summer	3.091	0.0	14.6	290
600 min Summer	2.649	0.0	15.7	356
720 min Summer	2.336	0.0	16.6	418
960 min Summer	1.916	0.0	18.2	540
1440 min Summer	1.450	0.0	20.6	782
2160 min Summer	1.096	0.0	23.4	1128
2880 min Summer	0.898	0.0	25.6	1496
4320 min Summer	0.680	0.0	29.0	2204
5760 min Summer	0.558	0.0	31.8	2936
7200 min Summer	0.479	0.0	34.1	3672
8640 min Summer	0.421	0.0	36.0	4400
10080 min Summer	0.378	0.0	37.6	5136
15 min Winter	28.725	0.0	4.8	17
30 min Winter	19.076	0.0	6.3	31

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Summary of Results for 1 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	9.808	0.158	0.9	6.2	O K
120 min Winter	9.819	0.169	0.9	6.7	O K
180 min Winter	9.819	0.169	0.9	6.7	O K
240 min Winter	9.816	0.166	0.9	6.6	O K
360 min Winter	9.802	0.152	0.9	6.0	O K
480 min Winter	9.788	0.138	0.8	5.4	O K
600 min Winter	9.775	0.125	0.8	4.8	O K
720 min Winter	9.763	0.113	0.8	4.3	O K
960 min Winter	9.743	0.093	0.7	3.5	O K
1440 min Winter	9.716	0.066	0.6	2.4	O K
2160 min Winter	9.699	0.049	0.5	1.7	O K
2880 min Winter	9.691	0.041	0.4	1.3	O K
4320 min Winter	9.683	0.033	0.3	1.0	O K
5760 min Winter	9.679	0.029	0.3	0.8	O K
7200 min Winter	9.676	0.026	0.2	0.7	O K
8640 min Winter	9.674	0.024	0.2	0.6	O K
10080 min Winter	9.673	0.023	0.2	0.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	12.369	0.0	8.2	58
120 min Winter	7.876	0.0	10.5	92
180 min Winter	6.024	0.0	12.0	130
240 min Winter	4.978	0.0	13.2	168
360 min Winter	3.770	0.0	15.0	240
480 min Winter	3.091	0.0	16.4	308
600 min Winter	2.649	0.0	17.6	374
720 min Winter	2.336	0.0	18.6	440
960 min Winter	1.916	0.0	20.3	566
1440 min Winter	1.450	0.0	23.1	796
2160 min Winter	1.096	0.0	26.2	1144
2880 min Winter	0.898	0.0	28.6	1500
4320 min Winter	0.680	0.0	32.5	2208
5760 min Winter	0.558	0.0	35.6	2944
7200 min Winter	0.479	0.0	38.1	3672
8640 min Winter	0.421	0.0	40.3	4416
10080 min Winter	0.378	0.0	42.2	5152

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.400	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.079

Time (mins)	Area
From:	To: (ha)
0	4 0.079

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Model Details

Storage is Online Cover Level (m) 11.300

Double Box Culvert Structure

Height (m) 1.000 Slope (1:X) 500.000 Downstream Invert (m) 9.650
Width (m) 2.000 Length (m) 10.000

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SCU-0043-2000-1000-2000
Design Head (m)	1.000
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Linear discharge profile
Application	Surface
Sump Available	Yes
Diameter (mm)	43
Invert Level (m)	9.650
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	2.0
Flush-Flo™	0.065	0.6
Kick-Flo®	0.065	0.6
Mean Flow over Head Range	-	1.4

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	2.2	3.000	3.3	7.000	5.0
0.200	1.0	1.400	2.3	3.500	3.6	7.500	5.1
0.300	1.2	1.600	2.5	4.000	3.8	8.000	5.3
0.400	1.3	1.800	2.6	4.500	4.0	8.500	5.4
0.500	1.5	2.000	2.8	5.000	4.2	9.000	5.6
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	4.8		

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