STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	PIMP (%)	100
M5-60 (mm)	18.000	Add Flow / Climate Change (%)	0
Ratio R	0.357	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	22.190	0.285	77.9	0.034	5.00	0.0	0.600	o	100	Pipe/Conduit	
1.001	11.998	0.575	20.9	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
2.000	22.849	0.238	96.0	0.027	5.00	0.0	0.600	o	100	Pipe/Conduit	
3.000	12.000	0.200	60.0	0.021	5.00	0.0	0.600	o	100	Pipe/Conduit	
3.001	10.535	0.105	100.3	0.008	0.00	0.0	0.600	o	100	Pipe/Conduit	
1.002	7.028	0.154	45.6	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
4.000	45.018	0.113	400.0	0.059	5.00	0.0	0.600	o	150	Pipe/Conduit	
4.001	2.873	0.029	99.1	0.006	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.42	214.274	0.034	0.0	0.0	0.0	0.87	6.9	4.7
1.001	50.00	5.54	213.989	0.034	0.0	0.0	0.0	1.70	13.3	4.7
2.000	50.00	5.49	213.652	0.027	0.0	0.0	0.0	0.78	6.2	3.7
3.000	50.00	5.20	213.720	0.021	0.0	0.0	0.0	1.00	7.8	2.8
3.001	50.00	5.43	213.520	0.029	0.0	0.0	0.0	0.77	6.0	3.9
1.002	50.00	5.62	213.365	0.091	0.0	0.0	0.0	1.49	26.4	12.3
4.000	50.00	6.51	213.353	0.059	0.0	0.0	0.0	0.50	8.8	8.0
4.001	50.00	6.56	213.240	0.065	0.0	0.0	0.0	1.01	17.8	8.7

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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.003	1.637	0.041	39.9	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.003	50.00	6.58	213.211	0.155	0.0	0.0	0.0	1.60	28.2	21.0

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.034	0.034	0.034
1.001	-	-	100	0.000	0.000	0.000
2.000	User	-	100	0.027	0.027	0.027
3.000	User	-	100	0.021	0.021	0.021
3.001	User	-	100	0.008	0.008	0.008
1.002	-	-	100	0.000	0.000	0.000
4.000	User	-	100	0.021	0.021	0.021
	User	-	100	0.007	0.007	0.028
	User	-	100	0.007	0.007	0.035
	User	-	100	0.007	0.007	0.041
	User	-	100	0.007	0.007	0.048
	User	-	100	0.011	0.011	0.059
4.001	User	-	100	0.006	0.006	0.006
1.003	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.155	0.155	0.155

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.003		213.960	213.170	213.160	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Storm Duration (mins)	30
Ratio R	0.357		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: 9, DS/PN: 1.003, Volume (m³): 1.0

Unit Reference	MD-SHE-0109-5000-0800-5000
Design Head (m)	0.800
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	109
Invert Level (m)	213.211
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	5.0
Flush-Flo™	0.241	5.0
Kick-Flo®	0.537	4.2
Mean Flow over Head Range	-	4.3

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	3.7	1.200	6.0	3.000	9.3	7.000	13.9
0.200	5.0	1.400	6.5	3.500	10.0	7.500	14.4
0.300	5.0	1.600	6.9	4.000	10.6	8.000	14.8
0.400	4.8	1.800	7.3	4.500	11.3	8.500	15.2
0.500	4.5	2.000	7.7	5.000	11.8	9.000	15.7
0.600	4.4	2.200	8.0	5.500	12.4	9.500	16.1
0.800	5.0	2.400	8.4	6.000	12.9		
1.000	5.5	2.600	8.7	6.500	13.4		

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Storage Structures for Storm

Porous Car Park Manhole: 1, DS/PN: 1.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	22.0
Max Percolation (l/s)	30.6	Slope (1:X)	78.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	214.274	Membrane Depth (mm)	0

Porous Car Park Manhole: 3, DS/PN: 2.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	8.0
Membrane Percolation (mm/hr)	1000	Length (m)	23.0
Max Percolation (l/s)	51.1	Slope (1:X)	96.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	213.652	Membrane Depth (mm)	0

Porous Car Park Manhole: 4, DS/PN: 3.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	4.8
Membrane Percolation (mm/hr)	1000	Length (m)	12.0
Max Percolation (l/s)	16.0	Slope (1:X)	60.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	213.720	Membrane Depth (mm)	0

Porous Car Park Manhole: 7, DS/PN: 4.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	4.2
Membrane Percolation (mm/hr)	1000	Length (m)	46.0
Max Percolation (l/s)	53.7	Slope (1:X)	400.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	213.353	Membrane Depth (mm)	0

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1 year Return Period Summary of Critical Results by Maximum Flood Volume (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 4
Number of Online Controls 1 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.356
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 18.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 30

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Summer	1	+0%	30/15 Summer				214.326
1.001	2	15 Summer	1	+0%	100/30 Winter				214.024
2.000	3	15 Summer	1	+0%	30/15 Summer				213.684
3.000	4	15 Summer	1	+0%	30/15 Summer				213.758
3.001	5	15 Summer	1	+0%	30/15 Summer				213.573
1.002	6	15 Summer	1	+0%	1/30 Winter				213.450
4.000	7	15 Summer	1	+0%	30/15 Summer				213.426
4.001	8	15 Summer	1	+0%	1/15 Summer				213.437
1.003	9	15 Summer	1	+0%	1/15 Summer				213.437

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.048	0.000	0.52		4	3.5	OK	
1.001	2	-0.065	0.000	0.27			3.4	OK	
2.000	3	-0.068	0.000	0.22		5	1.3	OK	
3.000	4	-0.062	0.000	0.31		5	2.3	OK	

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1 year Return Period Summary of Critical Results by Maximum Flood Volume (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
3.001	5	-0.047	0.000	0.55			3.1	OK	
1.002	6	-0.065	0.000	0.30			6.9	OK	
4.000	7	-0.077	0.000	0.31		7	2.7	OK	
4.001	8	0.047	0.000	0.35			3.8	SURCHARGED	
1.003	9	0.076	0.000	0.39			5.0	SURCHARGED	

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30 year Return Period Summary of Critical Results by Maximum Flood Volume (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 4
Number of Online Controls 1 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.356
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 18.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 30

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Summer	30	+0%	30/15 Summer				214.388
1.001	2	15 Summer	30	+0%	100/30 Winter				214.042
2.000	3	15 Summer	30	+0%	30/15 Summer				213.763
3.000	4	15 Summer	30	+0%	30/15 Summer				213.831
3.001	5	15 Summer	30	+0%	30/15 Summer				213.808
1.002	6	15 Summer	30	+0%	1/30 Winter				213.776
4.000	7	15 Summer	30	+0%	30/15 Summer				213.573
4.001	8	15 Summer	30	+0%	1/15 Summer				213.717
1.003	9	15 Summer	30	+0%	1/15 Summer				213.750

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.014	0.000	1.03		4	6.8	SURCHARGED	
1.001	2	-0.047	0.000	0.54			6.8	OK	
2.000	3	0.011	0.000	0.73		6	4.4	SURCHARGED	
3.000	4	0.011	0.000	0.68		5	5.0	SURCHARGED	

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30 year Return Period Summary of Critical Results by Maximum Flood Volume (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
3.001	5	0.188	0.000	1.14			6.4	FLOOD RISK	
1.002	6	0.261	0.000	0.58			13.1	SURCHARGED	
4.000	7	0.070	0.000	0.56		22	4.7	SURCHARGED	
4.001	8	0.327	0.000	0.45			4.9	FLOOD RISK	
1.003	9	0.389	0.000	0.39			5.0	FLOOD RISK	

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100 year Return Period Summary of Critical Results by Maximum Flood Volume (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 4
Number of Online Controls 1 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.356
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 18.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 30

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Summer	100	+30%	30/15 Summer				214.473
1.001	2	15 Summer	100	+30%	100/30 Winter				214.047
2.000	3	15 Summer	100	+30%	30/15 Summer				213.841
3.000	4	15 Summer	100	+30%	30/15 Summer				213.932
3.001	5	15 Summer	100	+30%	30/15 Summer				213.896
1.002	6	15 Summer	100	+30%	1/30 Winter				213.837
4.000	7	15 Summer	100	+30%	30/15 Summer				213.704
4.001	8	15 Summer	100	+30%	1/15 Summer				213.772
1.003	9	15 Summer	100	+30%	1/15 Summer				213.803

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.099	0.000	1.17		6	7.7	SURCHARGED	

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100 year Return Period Summary of Critical Results by Maximum Flood Volume (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.001	2	-0.042	0.000	0.62			7.7	OK	
2.000	3	0.089	0.000	0.61		15	3.6	SURCHARGED	
3.000	4	0.112	0.000	0.67		10	4.9	SURCHARGED	
3.001	5	0.276	0.000	1.17			6.6	FLOOD RISK	
1.002	6	0.322	0.000	0.59			13.3	SURCHARGED	
4.000	7	0.201	0.000	0.54			4.6	FLOOD RISK	
4.001	8	0.382	0.000	0.43			4.6	FLOOD RISK	
1.003	9	0.442	0.000	0.39			4.9	FLOOD RISK	

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	PIMP (%)	100
M5-60 (mm)	18.000	Add Flow / Climate Change (%)	0
Ratio R	0.357	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	22.190	0.285	77.9	0.034	5.00	0.0	0.600	o	100	Pipe/Conduit	
1.001	11.998	0.575	20.9	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
2.000	22.849	0.238	96.0	0.027	5.00	0.0	0.600	o	100	Pipe/Conduit	
3.000	12.000	0.200	60.0	0.021	5.00	0.0	0.600	o	100	Pipe/Conduit	
3.001	10.535	0.105	100.3	0.008	0.00	0.0	0.600	o	100	Pipe/Conduit	
1.002	7.028	0.154	45.6	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
4.000	45.018	0.113	400.0	0.059	5.00	0.0	0.600	o	150	Pipe/Conduit	
4.001	2.873	0.029	99.1	0.006	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.42	214.274	0.034	0.0	0.0	0.0	0.87	6.9	4.7
1.001	50.00	5.54	213.989	0.034	0.0	0.0	0.0	1.70	13.3	4.7
2.000	50.00	5.49	213.652	0.027	0.0	0.0	0.0	0.78	6.2	3.7
3.000	50.00	5.20	213.720	0.021	0.0	0.0	0.0	1.00	7.8	2.8
3.001	50.00	5.43	213.520	0.029	0.0	0.0	0.0	0.77	6.0	3.9
1.002	50.00	5.62	213.365	0.091	0.0	0.0	0.0	1.49	26.4	12.3
4.000	50.00	6.51	213.353	0.059	0.0	0.0	0.0	0.50	8.8	8.0
4.001	50.00	6.56	213.240	0.065	0.0	0.0	0.0	1.01	17.8	8.7

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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.003	1.637	0.041	39.9	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.003	50.00	6.58	213.211	0.155	0.0	0.0	0.0	1.60	28.2	21.0

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.034	0.034	0.034
1.001	-	-	100	0.000	0.000	0.000
2.000	User	-	100	0.027	0.027	0.027
3.000	User	-	100	0.021	0.021	0.021
3.001	User	-	100	0.008	0.008	0.008
1.002	-	-	100	0.000	0.000	0.000
4.000	User	-	100	0.021	0.021	0.021
	User	-	100	0.007	0.007	0.028
	User	-	100	0.007	0.007	0.035
	User	-	100	0.007	0.007	0.041
	User	-	100	0.007	0.007	0.048
	User	-	100	0.011	0.011	0.059
4.001	User	-	100	0.006	0.006	0.006
1.003	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.155	0.155	0.155

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.003		213.960	213.170	213.160	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Storm Duration (mins)	30
Ratio R	0.357		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: 9, DS/PN: 1.003, Volume (m³): 1.0

Unit Reference	MD-SHE-0109-5000-0800-5000
Design Head (m)	0.800
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	109
Invert Level (m)	213.211
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	5.0
Flush-Flo™	0.241	5.0
Kick-Flo®	0.537	4.2
Mean Flow over Head Range	-	4.3

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	3.7	1.200	6.0	3.000	9.3	7.000	13.9
0.200	5.0	1.400	6.5	3.500	10.0	7.500	14.4
0.300	5.0	1.600	6.9	4.000	10.6	8.000	14.8
0.400	4.8	1.800	7.3	4.500	11.3	8.500	15.2
0.500	4.5	2.000	7.7	5.000	11.8	9.000	15.7
0.600	4.4	2.200	8.0	5.500	12.4	9.500	16.1
0.800	5.0	2.400	8.4	6.000	12.9		
1.000	5.5	2.600	8.7	6.500	13.4		

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Storage Structures for Storm

Porous Car Park Manhole: 1, DS/PN: 1.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	22.0
Max Percolation (l/s)	30.6	Slope (1:X)	78.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	214.274	Membrane Depth (mm)	0

Porous Car Park Manhole: 3, DS/PN: 2.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	8.0
Membrane Percolation (mm/hr)	1000	Length (m)	23.0
Max Percolation (l/s)	51.1	Slope (1:X)	96.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	213.652	Membrane Depth (mm)	0

Porous Car Park Manhole: 4, DS/PN: 3.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	4.8
Membrane Percolation (mm/hr)	1000	Length (m)	12.0
Max Percolation (l/s)	16.0	Slope (1:X)	60.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	213.720	Membrane Depth (mm)	0

Porous Car Park Manhole: 7, DS/PN: 4.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	4.2
Membrane Percolation (mm/hr)	1000	Length (m)	46.0
Max Percolation (l/s)	53.7	Slope (1:X)	400.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	213.353	Membrane Depth (mm)	0

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1 year Return Period Summary of Critical Results by Maximum Flood Volume (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 4
Number of Online Controls 1 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.356
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 18.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Summer	1	+0%	30/15 Summer				214.326
1.001	2	15 Summer	1	+0%	100/15 Winter				214.024
2.000	3	15 Summer	1	+0%	30/15 Summer				213.684
3.000	4	15 Summer	1	+0%	30/15 Summer				213.758
3.001	5	15 Summer	1	+0%	30/15 Summer				213.573
1.002	6	15 Summer	1	+0%	1/30 Winter				213.450
4.000	7	15 Summer	1	+0%	30/15 Summer				213.426
4.001	8	15 Summer	1	+0%	1/15 Summer				213.437
1.003	9	15 Summer	1	+0%	1/15 Summer				213.437

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.048	0.000	0.52		4	3.5	OK	
1.001	2	-0.065	0.000	0.27			3.4	OK	
2.000	3	-0.068	0.000	0.22		5	1.3	OK	
3.000	4	-0.062	0.000	0.31		5	2.3	OK	

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1 year Return Period Summary of Critical Results by Maximum Flood Volume (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
3.001	5	-0.047	0.000	0.55			3.1	OK	
1.002	6	-0.065	0.000	0.30			6.9	OK	
4.000	7	-0.077	0.000	0.31		7	2.7	OK	
4.001	8	0.047	0.000	0.35			3.8	SURCHARGED	
1.003	9	0.076	0.000	0.39			5.0	SURCHARGED	

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30 year Return Period Summary of Critical Results by Maximum Flood Volume (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 4
Number of Online Controls 1 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.356
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 18.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Summer	30	+0%	30/15 Summer				214.388
1.001	2	15 Summer	30	+0%	100/15 Winter				214.042
2.000	3	15 Summer	30	+0%	30/15 Summer				213.763
3.000	4	15 Summer	30	+0%	30/15 Summer				213.831
3.001	5	15 Summer	30	+0%	30/15 Summer				213.808
1.002	6	15 Summer	30	+0%	1/30 Winter				213.776
4.000	7	15 Summer	30	+0%	30/15 Summer				213.573
4.001	8	15 Summer	30	+0%	1/15 Summer				213.717
1.003	9	15 Summer	30	+0%	1/15 Summer				213.750

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.014	0.000	1.03		4	6.8	SURCHARGED	
1.001	2	-0.047	0.000	0.54			6.8	OK	
2.000	3	0.011	0.000	0.73		6	4.4	SURCHARGED	
3.000	4	0.011	0.000	0.68		5	5.0	SURCHARGED	

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30 year Return Period Summary of Critical Results by Maximum Flood Volume (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
3.001	5	0.188	0.000	1.14			6.4	FLOOD RISK	
1.002	6	0.261	0.000	0.58			13.1	SURCHARGED	
4.000	7	0.070	0.000	0.56		22	4.7	SURCHARGED	
4.001	8	0.327	0.000	0.45			4.9	FLOOD RISK	
1.003	9	0.389	0.000	0.39			5.0	FLOOD RISK	

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