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)	18.800	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	0.000
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

« - Indicates pipe capacity < flow

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	13.412	0.055	243.9	0.010	5.00	0.0	0.600	o	300	Pipe/Conduit	
1.001	5.958	0.025	238.3	0.010	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.000	13.841	0.055	251.7	0.125	5.00	0.0	0.600	o	300	Pipe/Conduit	
2.001	10.004	0.040	250.1	0.037	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.002	22.364	0.090	248.5	0.001	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.000	38.737	0.165	234.8	0.026	5.00	0.0	0.600	o	300	Pipe/Conduit	
3.001	14.078	0.055	256.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.003	4.440	0.020	222.0	0.008	0.00	0.0	0.600	o	300	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	5.22	2.480	0.010	0.0	0.0	0.0	1.00	70.9	1.4
1.001	50.00	5.32	2.425	0.020	0.0	0.0	0.0	1.01	71.7	2.7
2.000	50.00	5.23	2.495	0.125	0.0	0.0	0.0	0.99	69.7	16.9
2.001	50.00	5.40	2.440	0.162	0.0	0.0	0.0	0.99	70.0	21.9
1.002	50.00	5.78	2.400	0.183	0.0	0.0	0.0	0.99	70.2	24.8
3.000	50.00	5.63	2.530	0.026	0.0	0.0	0.0	1.02	72.2	3.5
3.001	50.00	5.87	2.365	0.026	0.0	0.0	0.0	0.98	69.1	3.5
1.003	50.00	5.94	2.310	0.217	0.0	0.0	0.0	1.05	74.3	29.4

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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
4.000	31.443	0.130	241.9	0.038	5.00	0.0	0.600	o	300	Pipe/Conduit	
4.001	11.530	0.050	230.6	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.004	8.825	0.020	441.3	0.000	0.00	0.0	0.600	o	225	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)
4.000	50.00	5.52	2.470	0.038	0.0	0.0	0.0	1.01	71.1	5.1
4.001	50.00	5.71	2.340	0.038	0.0	0.0	0.0	1.03	72.9	5.1
1.004	50.00	5.24	2.290	0.000	27.5	0.0	0.0	0.62	24.5«	27.5

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	3.520	1.040	Open Manhole	600	1.000	2.480	300				
2	3.530	1.105	Open Manhole	600	1.001	2.425	300	1.000	2.425	300	
3	3.370	0.875	Open Manhole	600	2.000	2.495	300				
4	3.490	1.050	Open Manhole	600	2.001	2.440	300	2.000	2.440	300	
5	3.470	1.070	Open Manhole	1200	1.002	2.400	300	1.001	2.400	300	
								2.001	2.400	300	
6	3.450	0.920	Open Manhole	600	3.000	2.530	300				
7	3.450	1.085	Open Manhole	600	3.001	2.365	300	3.000	2.365	300	
8	3.500	1.190	Open Manhole	1200	1.003	2.310	300	1.002	2.310	300	
								3.001	2.310	300	
9	3.400	0.930	Open Manhole	600	4.000	2.470	300				
10	3.450	1.110	Open Manhole	600	4.001	2.340	300	4.000	2.340	300	
11	3.390	1.100	Open Manhole	1200	1.004	2.290	225	1.003	2.290	300	
								4.001	2.290	300	
ds12	3.504	1.234	Open Manhole	600		OUTFALL		1.004	2.270	225	

No coordinates have been specified, layout information cannot be produced.

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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	300	1	3.520	2.480	0.740	Open Manhole	600
1.001	o	300	2	3.530	2.425	0.805	Open Manhole	600
2.000	o	300	3	3.370	2.495	0.575	Open Manhole	600
2.001	o	300	4	3.490	2.440	0.750	Open Manhole	600
1.002	o	300	5	3.470	2.400	0.770	Open Manhole	1200
3.000	o	300	6	3.450	2.530	0.620	Open Manhole	600
3.001	o	300	7	3.450	2.365	0.785	Open Manhole	600
1.003	o	300	8	3.500	2.310	0.890	Open Manhole	1200
4.000	o	300	9	3.400	2.470	0.630	Open Manhole	600
4.001	o	300	10	3.450	2.340	0.810	Open Manhole	600
1.004	o	225	11	3.390	2.290	0.875	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	13.412	243.9	2	3.530	2.425	0.805	Open Manhole	600
1.001	5.958	238.3	5	3.470	2.400	0.770	Open Manhole	1200
2.000	13.841	251.7	4	3.490	2.440	0.750	Open Manhole	600
2.001	10.004	250.1	5	3.470	2.400	0.770	Open Manhole	1200
1.002	22.364	248.5	8	3.500	2.310	0.890	Open Manhole	1200
3.000	38.737	234.8	7	3.450	2.365	0.785	Open Manhole	600
3.001	14.078	256.0	8	3.500	2.310	0.890	Open Manhole	1200
1.003	4.440	222.0	11	3.390	2.290	0.800	Open Manhole	1200
4.000	31.443	241.9	10	3.450	2.340	0.810	Open Manhole	600
4.001	11.530	230.6	11	3.390	2.290	0.800	Open Manhole	1200
1.004	8.825	441.3	ds12	3.504	2.270	1.009	Open Manhole	600

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)
1.004	ds12	3.504	2.270	2.270	600	0

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Online Controls for Storm

Orifice Manhole: 11, DS/PN: 1.004, Volume (m^3): 2.2

Diameter (m) 0.127 Discharge Coefficient 0.600 Invert Level (m) 2.290

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Storage Structures for Storm

Complex Manhole: 3, DS/PN: 2.000

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	15.6
Membrane Percolation (mm/hr)	1000	Length (m)	34.0
Max Percolation (l/s)	147.3	Slope (1:X)	200.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	2.800	Cap Volume Depth (m)	0.450

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	15.6
Membrane Percolation (mm/hr)	1	Length (m)	31.8
Max Percolation (l/s)	0.1	Slope (1:X)	200.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	2.800	Cap Volume Depth (m)	0.450

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1 year Return Period Summary of Critical Results by Maximum Level (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 Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	18.800
Region	England and Wales	Ratio R	0.400
Cv (Summer)	0.750		
Cv (Winter)	0.840		

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

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, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	1	60 Winter	1	+0%	30/15 Summer				2.593	-0.187	0.000
1.001	2	60 Winter	1	+0%	30/15 Summer				2.592	-0.133	0.000
2.000	3	60 Winter	1	+0%	30/15 Summer				2.602	-0.193	0.000
2.001	4	60 Winter	1	+0%	30/15 Summer				2.597	-0.143	0.000
1.002	5	60 Winter	1	+0%	30/15 Summer				2.592	-0.108	0.000
3.000	6	60 Winter	1	+0%	30/15 Summer				2.587	-0.243	0.000
3.001	7	60 Winter	1	+0%	30/15 Summer				2.585	-0.080	0.000
1.003	8	60 Winter	1	+0%	30/15 Summer				2.584	-0.026	0.000
4.000	9	60 Winter	1	+0%	30/15 Summer				2.582	-0.188	0.000
4.001	10	60 Winter	1	+0%	30/15 Summer				2.580	-0.060	0.000
1.004	11	60 Winter	1	+0%	1/15 Summer				2.579	0.064	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.01			0.6	OK	
1.001	2	0.02			0.9	OK	
2.000	3	0.14		15	8.2	OK	
2.001	4	0.18			9.8	OK	
1.002	5	0.15			9.4	OK	
3.000	6	0.03			1.7	OK	
3.001	7	0.03			1.4	OK	
1.003	8	0.20			9.5	OK	
4.000	9	0.04			2.4	OK	

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

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
4.001	10	0.03			1.6	OK	
1.004	11	0.66			10.9	SURCHARGED	

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30 year Return Period Summary of Critical Results by Maximum Level (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 Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	18.800
Region	England and Wales	Ratio R	0.400
Cv (Summer)	0.750		
Cv (Winter)	0.840		

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

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, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	1	15 Winter	30	+40%	30/15 Summer				3.035	0.255	0.000
1.001	2	15 Winter	30	+40%	30/15 Summer				3.028	0.303	0.000
2.000	3	30 Winter	30	+40%	30/15 Summer				2.958	0.163	0.000
2.001	4	30 Winter	30	+40%	30/15 Summer				2.956	0.216	0.000
1.002	5	15 Winter	30	+40%	30/15 Summer				3.022	0.322	0.000
3.000	6	15 Winter	30	+40%	30/15 Summer				3.061	0.231	0.000
3.001	7	15 Winter	30	+40%	30/15 Summer				3.051	0.386	0.000
1.003	8	15 Winter	30	+40%	30/15 Summer				3.046	0.436	0.000
4.000	9	15 Winter	30	+40%	30/15 Summer				3.065	0.295	0.000
4.001	10	15 Winter	30	+40%	30/15 Summer				3.049	0.409	0.000
1.004	11	15 Winter	30	+40%	1/15 Summer				3.043	0.528	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.08			4.8	SURCHARGED	
1.001	2	0.18			9.0	SURCHARGED	
2.000	3	0.45		16	25.9	SURCHARGED	
2.001	4	0.54			29.6	SURCHARGED	
1.002	5	0.55			34.2	SURCHARGED	
3.000	6	0.16			10.6	SURCHARGED	
3.001	7	0.19			11.0	SURCHARGED	
1.003	8	0.44			20.9	SURCHARGED	
4.000	9	0.24			15.8	SURCHARGED	

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

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
4.001	10	0.28			16.2	SURCHARGED	
1.004	11	1.47			24.4	SURCHARGED	

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100 year Return Period Summary of Critical Results by Maximum Level (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 Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm) 18.800	Cv (Summer) 0.750
Region	England and Wales	Ratio R 0.400	Cv (Winter) 0.840

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

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, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	1	15 Summer	100	+40%	30/15 Summer				3.100	0.320	0.000
1.001	2	15 Summer	100	+40%	30/15 Summer				3.093	0.368	0.000
2.000	3	60 Winter	100	+40%	30/15 Summer				3.017	0.222	0.000
2.001	4	30 Winter	100	+40%	30/15 Summer				3.015	0.275	0.000
1.002	5	15 Summer	100	+40%	30/15 Summer				3.085	0.385	0.000
3.000	6	15 Summer	100	+40%	30/15 Summer				3.177	0.347	0.000
3.001	7	15 Summer	100	+40%	30/15 Summer				3.153	0.488	0.000
1.003	8	15 Summer	100	+40%	30/15 Summer				3.142	0.532	0.000
4.000	9	15 Summer	100	+40%	30/15 Summer				3.211	0.441	0.000
4.001	10	15 Summer	100	+40%	30/15 Summer				3.161	0.521	0.000
1.004	11	15 Summer	100	+40%	1/15 Summer				3.142	0.627	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.11			6.4	SURCHARGED	
1.001	2	0.26			12.7	SURCHARGED	
2.000	3	0.35		28	20.0	SURCHARGED	
2.001	4	0.54			29.7	SURCHARGED	
1.002	5	0.66			40.6	SURCHARGED	
3.000	6	0.20			13.6	FLOOD RISK	
3.001	7	0.23			13.1	FLOOD RISK	
1.003	8	0.45			21.6	SURCHARGED	
4.000	9	0.30			19.6	FLOOD RISK	

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

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
4.001	10	0.34			20.1	FLOOD RISK	
1.004	11	1.54			25.5	FLOOD RISK	

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