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)	20.700	Add Flow / Climate Change (%)	0
Ratio R	0.440	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	550	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

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.013	4-8	0.000

Total Area Contributing (ha) = 0.013

Total Pipe Volume (m³) = 0.161

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
S1.000	5.000	0.050	100.0	0.000	5.00	0.0	0.600	o	100	Pipe/Conduit	
S1.001	5.000	0.295	16.9	0.006	0.00	0.0	0.600	o	100	Pipe/Conduit	
S1.002	2.500	0.075	33.3	0.007	0.00	0.0	0.600	o	100	Pipe/Conduit	
S2.000	2.349	0.062	37.9	0.000	5.00	0.0	0.600	o	100	Pipe/Conduit	
S1.003	2.500	0.025	100.0	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)
S1.000	178.39	5.11	9.700	0.000	0.0	0.0	0.0	0.77	6.0	0.0
S1.001	177.82	5.15	9.650	0.006	0.0	0.0	0.0	1.89	14.8	2.9
S1.002	177.41	5.18	9.355	0.013	0.0	0.0	0.0	1.34	10.5	6.2
S2.000	179.41	5.03	9.600	0.000	0.0	0.0	0.0	1.26	9.9	0.0
S1.003	176.88	5.23	9.230	0.013	0.0	0.0	0.0	1.00	17.8	6.2

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.000	0.000	0.000
1.001	-	-	100	0.006	0.006	0.006
1.002	-	-	100	0.007	0.007	0.007
2.000	-	-	100	0.000	0.000	0.000
1.003	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.013	0.013	0.013

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	1
Number of Online Controls	1	Number of Time/Area Diagrams	1
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)	20.700	Storm Duration (mins)	30
Ratio R	0.440		

Online Controls for Storm

Orifice Manhole: S5, DS/PN: S1.003, Volume (m³): 0.2

Diameter (m) 0.030 Discharge Coefficient 0.600 Invert Level (m) 9.230

Storage Structures for Storm

Porous Car Park Manhole: S2, DS/PN: S1.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	7.0
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	19.4	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	9.650	Cap Volume Depth (m)	0.150

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

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.438
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.800	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, 0, 40

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
S1.000	S1	60 minute 1 year Winter I+0%	10.000	9.711	-0.089	0.000	0.03
S1.001	S2	120 minute 1 year Winter I+0%	10.000	9.659	-0.091	0.000	0.02
S1.002	S3	15 minute 1 year Winter I+0%	10.000	9.409	-0.046	0.000	0.10
S2.000	S4	15 minute 1 year Summer I+0%	10.000	9.600	-0.100	0.000	0.00
S1.003	S5	15 minute 1 year Winter I+0%	10.000	9.407	0.027	0.000	0.07

PN	US/MH Name	Overflow (l/s)	Infil. Flow (l/s)	Infil. Vol (m³)	Maximum Vol (m³)	Discharge Vol (m³)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S1.000	S1				0.001	0.231		0.2	FLOOD RISK
S1.001	S2		0.0	0.000	0.200	0.796	35	0.3	OK
S1.002	S3				0.011	0.626		0.8	OK
S2.000	S4				0.000	0.000		0.0	OK
S1.003	S5				0.039	0.626		0.8	SURCHARGED

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

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.438
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.800	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, 0, 40

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
S1.000	S1	30 minute 30 year Winter I+0%	10.000	9.719	-0.081	0.000	0.08
S1.001	S2	60 minute 30 year Winter I+0%	10.000	9.693	-0.057	0.000	0.08
S1.002	S3	15 minute 30 year Winter I+0%	10.000	9.769	0.314	0.000	0.24
S2.000	S4	15 minute 30 year Winter I+0%	10.000	9.765	0.065	0.000	0.01
S1.003	S5	15 minute 30 year Winter I+0%	10.000	9.766	0.386	0.000	0.12

PN	US/MH Name	Overflow (l/s)	Infil. Flow (l/s)	Infil. Vol (m³)	Maximum Vol (m³)	Discharge Vol (m³)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S1.000	S1				0.002	0.652		0.4	FLOOD RISK
S1.001	S2		0.0	0.000	0.917	2.108	18	1.1	OK
S1.002	S3				0.101	2.345		1.8	FLOOD RISK
S2.000	S4				0.025	0.000		0.1	FLOOD RISK
S1.003	S5				0.115	2.345		1.3	FLOOD RISK

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

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.438
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.800	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, 0, 40

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
S1.000	S1	60 minute 100 year Winter I+40%	10.000	9.845	0.045	0.000	0.13
S1.001	S2	60 minute 100 year Winter I+40%	10.000	9.841	0.091	0.000	0.10
S1.002	S3	60 minute 100 year Winter I+40%	10.000	9.836	0.381	0.000	0.21
S2.000	S4	60 minute 100 year Winter I+40%	10.000	9.832	0.132	0.000	0.01
S1.003	S5	60 minute 100 year Winter I+40%	10.000	9.832	0.452	0.000	0.13

PN	US/MH Name	Overflow (l/s)	Infil. Flow (l/s)	Infil. Vol (m³)	Maximum Vol (m³)	Discharge Vol (m³)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S1.000	S1				0.022	1.726		0.7	FLOOD RISK
S1.001	S2		0.0	0.000	3.214	4.351	37	1.3	FLOOD RISK
S1.002	S3				0.111	7.822		1.6	FLOOD RISK
S2.000	S4				0.036	0.000		0.1	FLOOD RISK
S1.003	S5				0.126	7.822		1.4	FLOOD RISK