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 (%)	30
Ratio R	0.355	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

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.020	4-8	0.001

Total Area Contributing (ha) = 0.022

Total Pipe Volume (m³) = 0.548

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	6.949	0.069	100.7	0.001	4.00	0.0	0.600	o	100	Pipe/Conduit	
S1.001	5.075	0.051	99.5	0.001	0.00	0.0	0.600	o	100	Pipe/Conduit	
S2.000	14.798	0.443	33.4	0.003	4.00	0.0	0.600	o	100	Pipe/Conduit	
S1.002	8.836	0.088	100.4	0.003	0.00	0.0	0.600	o	100	Pipe/Conduit	
S3.000	6.602	0.066	100.0	0.002	4.00	0.0	0.600	o	100	Pipe/Conduit	
S3.001	5.777	0.142	40.7	0.003	0.00	0.0	0.600	o	100	Pipe/Conduit	
S4.000	14.818	0.531	27.9	0.004	4.00	0.0	0.600	o	100	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	50.00	4.15	80.456	0.001	0.0	0.0	0.1	0.77	6.0	0.3
S1.001	50.00	4.26	80.387	0.003	0.0	0.0	0.1	0.77	6.1	0.5
S2.000	50.00	4.18	80.779	0.003	0.0	0.0	0.1	1.34	10.5	0.5
S1.002	50.00	4.45	80.336	0.008	0.0	0.0	0.3	0.77	6.0	1.5
S3.000	50.00	4.14	80.456	0.002	0.0	0.0	0.1	0.77	6.0	0.3
S3.001	50.00	4.22	80.390	0.005	0.0	0.0	0.2	1.21	9.5	0.8
S4.000	50.00	4.17	80.779	0.004	0.0	0.0	0.2	1.47	11.5	0.8

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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
S1.003	1.334	0.013	102.6	0.004	0.00	0.0	0.600	o	100	Pipe/Conduit	
S1.004	5.641	0.465	12.1	0.000	0.00	0.0	0.600	o	100	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)
S1.003	50.00	4.48	80.248	0.022	0.0	0.0	0.9	0.76	6.0	3.8
S1.004	50.00	4.52	80.235	0.022	0.0	0.0	0.9	2.23	17.5	3.8

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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	0.001	0.001	0.001
1.001	User	-	100	0.001	0.001	0.001
2.000	User	-	100	0.003	0.003	0.003
1.002	User	-	100	0.003	0.003	0.003
3.000	User	-	100	0.002	0.002	0.002
3.001	User	-	100	0.003	0.003	0.003
4.000	User	-	100	0.004	0.004	0.004
1.003	User	-	100	0.004	0.004	0.004
1.004	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.022	0.022	0.022

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)
S1.004	S	80.780	79.770	0.000	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 Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 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	0.355		

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Online Controls for Storm

Orifice Manhole: S9, DS/PN: S1.003, Volume (m³): 1.2

Diameter (m) 0.051 Discharge Coefficient 0.600 Invert Level (m) 80.248

Volume Summary (Static)

Length Calculations based on Centre-Centre

Pipe Number	USMH Name	Manhole Volume (m³)	Pipe Volume (m³)	Storage Structure Volume (m³)	Total Volume (m³)
S1.000	S2	0.127	0.055	0.000	0.182
S1.001	S3	0.147	0.040	0.000	0.187
S2.000	S4	0.127	0.116	0.000	0.243
S1.002	S5	0.223	0.069	0.000	0.292
S3.000	S6	0.127	0.052	0.000	0.179
S3.001	S7	0.146	0.045	0.000	0.191
S4.000	S8	0.127	0.116	0.000	0.244
S1.003	S9	0.986	0.010	0.000	0.997
S1.004	S10	0.775	0.044	0.000	0.819
Total		2.786	0.548	0.000	3.334

Volume Summary (Static)

Length Calculations based on True Length

Pipe Number	USMH Name	Manhole Volume (m³)	Pipe Volume (m³)	Storage Structure Volume (m³)	Total Volume (m³)
S1.000	S2	0.127	0.050	0.000	0.177
S1.001	S3	0.147	0.035	0.000	0.182
S2.000	S4	0.127	0.112	0.000	0.239
S1.002	S5	0.223	0.062	0.000	0.285
S3.000	S6	0.127	0.047	0.000	0.174
S3.001	S7	0.146	0.038	0.000	0.184
S4.000	S8	0.127	0.109	0.000	0.237
S1.003	S9	0.986	0.001	0.000	0.987
S1.004	S10	0.775	0.040	0.000	0.814
Total		2.786	0.494	0.000	3.280

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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 0 Number of Real Time Controls 0

Synthetic Rainfall Details

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

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

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

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)
S1.000	S2	15 Winter	100	+30%	100/15 Summer				80.902	0.346
S1.001	S3	30 Winter	100	+30%	100/15 Summer				80.900	0.413
S2.000	S4	15 Winter	100	+30%	100/15 Summer				80.935	0.056
S1.002	S5	15 Winter	100	+30%	100/15 Summer				80.923	0.487
S3.000	S6	15 Summer	100	+30%	100/15 Summer	100/15 Winter			80.906	0.350
S3.001	S7	30 Winter	100	+30%	100/15 Summer				80.901	0.411
S4.000	S8	15 Winter	100	+30%	100/15 Summer				80.935	0.056
S1.003	S9	15 Winter	100	+30%	100/15 Summer				80.915	0.567
S1.004	S10	15 Winter	100	+30%					80.270	-0.065

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S2	0.000	0.09			0.5	FLOOD RISK	
S1.001	S3	0.000	0.45			2.4	FLOOD RISK	
S2.000	S4	0.000	0.14			1.4	FLOOD RISK	
S1.002	S5	0.000	0.48			2.7	FLOOD RISK	
S3.000	S6	0.000	0.08			0.4	FLOOD RISK	
S3.001	S7	0.000	0.23			1.9	FLOOD RISK	
S4.000	S8	0.000	0.21			2.3	FLOOD RISK	
S1.003	S9	0.000	1.05			4.1	FLOOD RISK	
S1.004	S10	0.000	0.27			4.1	OK	

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