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)	18.200	Add Flow / Climate Change (%)	30
Ratio R	0.343	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
S1.000	12.456	0.460	27.1	0.016	5.00	0.0	0.600	o	225	Pipe/Conduit	
S1.001	16.232	0.165	98.4	0.008	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.002	8.217	0.100	82.2	0.003	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.000	11.150	0.150	74.3	0.008	5.00	0.0	0.600	o	225	Pipe/Conduit	
S2.001	18.627	0.575	32.4	0.007	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.003	15.215	3.043	5.0	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	50.00	5.08	23.800	0.016	0.0	0.0	0.6	2.52	100.4	2.8
S1.001	50.00	5.29	23.340	0.024	0.0	0.0	1.0	1.32	52.4	4.3
S1.002	50.00	5.37	23.100	0.027	0.0	0.0	1.1	1.74	122.7	4.8
S2.000	50.00	5.12	23.800	0.008	0.0	0.0	0.3	1.52	60.4	1.3
S2.001	50.00	5.26	23.650	0.015	0.0	0.0	0.6	2.31	91.7	2.6
S1.003	50.00	5.42	23.000	0.042	0.0	0.0	1.7	4.54	80.2	7.4

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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)
S-IC1	24.650	0.850	Open Manhole	600	S1.000	23.800	225				
S-IC2	24.170	0.830	Open Manhole	600	S1.001	23.340	225	S1.000	23.340	225	
S-PC1	24.010	0.910	Open Manhole	1050	S1.002	23.100	300	S1.001	23.175	225	
S-IC4	24.630	0.830	Open Manhole	600	S2.000	23.800	225				
S-IC5	24.480	0.830	Open Manhole	600	S2.001	23.650	225	S2.000	23.650	225	
SPC2	24.010	1.010	Open Manhole	1050	S1.003	23.000	150	S1.002	23.000	300	
								S2.001	23.075	225	150
S	21.390	1.433	Open Manhole	0		OUTFALL		S1.003	19.957	150	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S-IC1	34.895	18.314	34.895	18.314	Required	
S-IC2	47.351	18.314	47.351	18.314	Required	
S-PC1	47.351	34.547	47.351	34.547	Required	
S-IC4	20.507	23.550	20.507	23.550	Required	
S-IC5	20.507	34.699	20.507	34.699	Required	
SPC2	39.133	34.533	39.133	34.533	Required	
S	37.170	49.621			No Entry	

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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)
S1.000	o	225	S-IC1	24.650	23.800	0.625	Open Manhole	600
S1.001	o	225	S-IC2	24.170	23.340	0.605	Open Manhole	600
S1.002	o	300	S-PC1	24.010	23.100	0.610	Open Manhole	1050
S2.000	o	225	S-IC4	24.630	23.800	0.605	Open Manhole	600
S2.001	o	225	S-IC5	24.480	23.650	0.605	Open Manhole	600
S1.003	o	150	SPC2	24.010	23.000	0.860	Open Manhole	1050

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)
S1.000	12.456	27.1	S-IC2	24.170	23.340	0.605	Open Manhole	600
S1.001	16.232	98.4	S-PC1	24.010	23.175	0.610	Open Manhole	1050
S1.002	8.217	82.2	SPC2	24.010	23.000	0.710	Open Manhole	1050
S2.000	11.150	74.3	S-IC5	24.480	23.650	0.605	Open Manhole	600
S2.001	18.627	32.4	SPC2	24.010	23.075	0.710	Open Manhole	1050
S1.003	15.215	5.0	S	21.390	19.957	1.283	Open Manhole	0

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)
S1.003	S	21.390	19.957	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	5.000
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	0
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

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Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.200	Storm Duration (mins)	30
Ratio R	0.343		

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Online Controls for Storm

Orifice Manhole: SPC2, DS/PN: S1.003, Volume (m³): 2.1

Diameter (m) 0.058 Discharge Coefficient 0.600 Invert Level (m) 23.000

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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 5.000
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 0
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 0.350
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 18.100 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, 180, 240, 360, 480, 600, 720, 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.
S1.000	S-IC1	15 Winter	1	+0%	100/30 Winter			
S1.001	S-IC2	15 Winter	1	+0%	30/15 Winter			
S1.002	S-PC1	15 Winter	1	+0%	30/15 Summer	100/30 Winter		
S2.000	S-IC4	15 Winter	1	+0%				
S2.001	S-IC5	15 Winter	1	+0%	100/15 Summer			
S1.003	SPC2	15 Winter	1	+0%	1/15 Summer	100/30 Winter		

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S1.000	S-IC1	23.823	-0.202	0.000	0.02			1.9	OK
S1.001	S-IC2	23.376	-0.189	0.000	0.06			2.7	OK
S1.002	S-PC1	23.225	-0.175	0.000	0.03			2.6	OK
S2.000	S-IC4	23.819	-0.206	0.000	0.02			0.9	OK
S2.001	S-IC5	23.671	-0.204	0.000	0.02			1.6	OK
S1.003	SPC2	23.224	0.074	0.000	0.04			3.1	SURCHARGED

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

PN	US/MH Name	Level Exceeded
S1.000	S-IC1	
S1.001	S-IC2	
S1.002	S-PC1	1
S2.000	S-IC4	
S2.001	S-IC5	
S1.003	SPC2	1

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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 5.000
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 0
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 0.350
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 18.100 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, 180, 240, 360, 480, 600, 720, 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.
S1.000	S-IC1	15 Winter	30	+0%	100/30 Winter			
S1.001	S-IC2	15 Winter	30	+0%	30/15 Winter			
S1.002	S-PC1	15 Winter	30	+0%	30/15 Summer	100/30 Winter		
S2.000	S-IC4	15 Winter	30	+0%				
S2.001	S-IC5	15 Winter	30	+0%	100/15 Summer			
S1.003	SPC2	15 Winter	30	+0%	1/15 Summer	100/30 Winter		

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S1.000	S-IC1	23.834	-0.191	0.000	0.05			4.7	OK
S1.001	S-IC2	23.577	0.012	0.000	0.15			6.9	SURCHARGED
S1.002	S-PC1	23.570	0.170	0.000	0.05			3.8	SURCHARGED
S2.000	S-IC4	23.830	-0.195	0.000	0.04			2.2	OK
S2.001	S-IC5	23.684	-0.191	0.000	0.05			4.4	OK
S1.003	SPC2	23.568	0.418	0.000	0.07			5.2	SURCHARGED

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

PN	US/MH Name	Level Exceeded
S1.000	S-IC1	
S1.001	S-IC2	
S1.002	S-PC1	1
S2.000	S-IC4	
S2.001	S-IC5	
S1.003	SPC2	1

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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 5.000
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 0
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 0.350
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 18.100 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
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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.
S1.000	S-IC1	30 Winter	100	+30%	100/30 Winter			
S1.001	S-IC2	30 Winter	100	+30%	30/15 Winter			
S1.002	S-PC1	30 Winter	100	+30%	30/15 Summer	100/30 Winter		
S2.000	S-IC4	30 Winter	100	+30%				
S2.001	S-IC5	30 Winter	100	+30%	100/15 Summer			
S1.003	SPC2	30 Winter	100	+30%	1/15 Summer	100/30 Winter		

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S1.000	S-IC1	24.029	0.004	0.000	0.07			6.2	SURCHARGED
S1.001	S-IC2	24.022	0.457	0.000	0.14			6.6	FLOOD RISK
S1.002	S-PC1	24.010	0.610	0.244	0.08			6.0	FLOOD
S2.000	S-IC4	24.019	-0.006	0.000	0.06			2.9	OK
S2.001	S-IC5	24.016	0.141	0.000	0.07			5.5	SURCHARGED
S1.003	SPC2	24.010	0.860	0.007	0.09			6.9	FLOOD

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

PN	US/MH Name	Level Exceeded
S1.000	S-IC1	
S1.001	S-IC2	
S1.002	S-PC1	1
S2.000	S-IC4	
S2.001	S-IC5	
S1.003	SPC2	1

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