STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for S

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	30	PIMP (%)	100
M5-60 (mm)	18.800	Add Flow / Climate Change (%)	0
Ratio R	0.325	Minimum Backdrop Height (m)	0.600
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	3.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	0.900
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 S

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	11.957	0.030	398.6	0.056	5.00	0.0	0.600	o	900	Pipe/Conduit	
2.000	10.353	0.026	398.2	0.134	5.00	0.0	0.600	o	900	Pipe/Conduit	
1.001	28.144	0.070	402.1	0.036	0.00	0.0	0.600	o	900	Pipe/Conduit	
1.002	3.036	0.048	63.3	0.046	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)
1.000	50.00	5.13	99.400	0.056	0.0	0.0	0.0	1.56	994.5	7.6
2.000	50.00	5.11	99.396	0.134	0.0	0.0	0.0	1.56	995.0	18.1
1.001	50.00	5.43	99.370	0.226	0.0	0.0	0.0	1.56	990.1	30.6
1.002	50.00	5.46	99.300	0.272	0.0	0.0	0.0	1.65	65.5	36.8

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Manhole Schedules for S

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)
S4	101.405	2.005	Open Manhole	2400	1.000	99.400	900				
S1	101.691	2.295	Open Manhole	2400	2.000	99.396	900				
S2	101.566	2.196	Open Manhole	2700	1.001	99.370	900	1.000	99.370	900	
								2.000	99.370	900	
S3	102.496	3.196	Open Manhole	2400	1.002	99.300	225	1.001	99.300	900	
MH4	103.100	3.848	Open Manhole	1200		OUTFALL		1.002	99.252	225	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S4	385261.925	404092.847	385261.925	404092.847	Required	
S1	385242.883	404082.282	385242.883	404082.282	Required	
S2	385250.512	404089.281	385250.512	404089.281	Required	
S3	385241.231	404115.851	385241.231	404115.851	Required	
MH4	385243.257	404118.113			No Entry	

Free Flowing Outfall Details for S

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.002	MH4	103.100	99.252	0.000	1200	0

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Simulation Criteria for S

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	4.000
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)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.800	Storm Duration (mins)	30
Ratio R	0.325		

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Online Controls for S

Hydro-Brake® Optimum Manhole: S3, DS/PN: 1.002, Volume (m³): 30.7

Unit Reference	MD-SHE-0146-1250-2000-1250
Design Head (m)	2.000
Design Flow (l/s)	12.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	146
Invert Level (m)	99.300
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	12.5	Kick-Flo®	1.207	9.9
Flush-Flo™	0.582	12.5	Mean Flow over Head Range	-	10.9

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	5.3	1.200	10.0	3.000	15.1	7.000	22.7
0.200	10.4	1.400	10.6	3.500	16.3	7.500	23.5
0.300	11.6	1.600	11.2	4.000	17.4	8.000	24.2
0.400	12.2	1.800	11.9	4.500	18.4	8.500	24.9
0.500	12.4	2.000	12.5	5.000	19.3	9.000	25.6
0.600	12.5	2.200	13.1	5.500	20.2	9.500	26.3
0.800	12.2	2.400	13.6	6.000	21.1		
1.000	11.6	2.600	14.2	6.500	21.9		

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Summary of Critical Results by Maximum Level (Rank 1) for S

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	4.000
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	Ratio R	0.325
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	18.800	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, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	2
Climate Change (%)	0

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	S4	30 Winter	2	+0%					99.668
2.000	S1	30 Winter	2	+0%					99.668
1.001	S2	30 Winter	2	+0%					99.668
1.002	S3	30 Winter	2	+0%	2/15 Summer				99.666

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	S4	-0.632	0.000	0.01			4.6	OK	
2.000	S1	-0.628	0.000	0.03			14.0	OK	
1.001	S2	-0.602	0.000	0.02			16.6	OK	
1.002	S3	0.141	0.000	0.39			12.0	SURCHARGED	

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