

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Building SW Network

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)	0.200
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 Building SW Network

« - 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	32.279	0.440	73.4	0.018	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	6.948	0.135	51.5	0.055	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	18.777	0.125	150.0	0.010	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.003	12.672	0.275	46.1	0.018	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.004	10.609	0.071	150.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.005	11.292	0.075	150.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	15.086	0.831	18.2	0.106	5.00	0.0	0.600	o	300	Pipe/Conduit	
1.006	6.646	0.044	150.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.000	18.645	0.093	200.0	0.074	5.00	0.0	0.600	o	225	Pipe/Conduit	
3.001	8.631	0.122	70.7	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
3.002	11.827	0.059	200.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
3.003	15.027	0.075	200.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
3.004	22.415	0.063	357.5	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)
1.000	50.00	5.46	66.376	0.018	0.0	0.0	0.0	1.18	20.8	2.4
1.001	50.00	5.54	65.935	0.073	0.0	0.0	0.0	1.41	24.8	9.9
1.002	50.00	5.92	65.800	0.083	0.0	0.0	0.0	0.82	14.5	11.2
1.003	50.00	6.06	65.675	0.101	0.0	0.0	0.0	1.49	26.3	13.7
1.004	50.00	6.28	65.400	0.101	0.0	0.0	0.0	0.82	14.5	13.7
1.005	50.00	6.51	65.329	0.101	0.0	0.0	0.0	0.82	14.5	13.7
2.000	50.00	5.07	65.935	0.106	0.0	0.0	0.0	3.71	262.1	14.4
1.006	50.00	6.60	65.104	0.207	0.0	0.0	0.0	1.28	90.6	28.0
3.000	50.00	5.34	66.315	0.074	0.0	0.0	0.0	0.92	36.6	10.0
3.001	50.00	5.43	66.222	0.074	0.0	0.0	0.0	1.56	61.9	10.0
3.002	50.00	5.64	66.100	0.074	0.0	0.0	0.0	0.92	36.6	10.0
3.003	50.00	5.92	66.041	0.074	0.0	0.0	0.0	0.92	36.6	10.0
3.004	50.00	6.46	65.966	0.074	0.0	0.0	0.0	0.69	27.3	10.0

Network Design Table for Building SW Network

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
3.005	15.351	0.077	199.4	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
4.000	13.207	0.223	59.2	0.032	5.00	0.0	0.600	o	375	Pipe/Conduit	
5.000	2.384	0.164	14.5	0.055	5.00	0.0	0.600	o	375	Pipe/Conduit	
3.006	18.045	0.255	70.8	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.007	15.967	0.052	310.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.008	10.881	-3.502	-3.1	0.000	0.00	0.0	0.600	o	375	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)
3.005	50.00	6.74	65.872	0.074	0.0	0.0	0.0	0.92	36.7	10.0
4.000	50.00	5.09	65.868	0.032	0.0	0.0	0.0	2.36	260.5	4.3
5.000	50.00	5.01	65.809	0.055	0.0	0.0	0.0	4.77	527.2	7.4
3.006	50.00	6.88	65.645	0.161	0.0	0.0	0.0	2.16	238.2	21.8
1.007	50.00	7.14	62.550	0.368	0.0	0.0	0.0	1.02	113.1	49.8
1.008	50.00	8.19	62.498	0.368	0.0	0.0	0.0	0.17	19.1«	49.8

Area Summary for Building SW Network

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.018	0.018	0.018
1.001	-	-	100	0.055	0.055	0.055
1.002	-	-	100	0.010	0.010	0.010
1.003	-	-	100	0.018	0.018	0.018
1.004	-	-	100	0.000	0.000	0.000
1.005	-	-	100	0.000	0.000	0.000
2.000	-	-	100	0.106	0.106	0.106
1.006	-	-	100	0.000	0.000	0.000
3.000	-	-	100	0.074	0.074	0.074
3.001	-	-	100	0.000	0.000	0.000
3.002	-	-	100	0.000	0.000	0.000
3.003	-	-	100	0.000	0.000	0.000
3.004	-	-	100	0.000	0.000	0.000
3.005	-	-	100	0.000	0.000	0.000
4.000	-	-	100	0.032	0.032	0.032
5.000	-	-	100	0.055	0.055	0.055
3.006	-	-	100	0.000	0.000	0.000
1.007	-	-	100	0.000	0.000	0.000
1.008	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.368	0.368	0.368

Free Flowing Outfall Details for Building SW Network

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,I (mm)	W (mm)
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1.008 66.672 66.000 0.000 150 0

Simulation Criteria for Building SW Network

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	0.000
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 4 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)	18.800	Storm Duration (mins)	30
Ratio R	0.400		

Online Controls for Building SW Network

Pump Manhole: SWPC, DS/PN: 1.008, Volume (m³): 17.0

Invert Level (m) 62.498

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.0000	0.800	1.0000	2.000	1.0000	4.000	1.0000	7.000	0.0000
0.200	1.0000	1.000	1.0000	2.200	1.0000	4.500	1.0000	7.500	0.0000
0.300	1.0000	1.200	1.0000	2.400	1.0000	5.000	1.0000	8.000	0.0000
0.400	1.0000	1.400	1.0000	2.600	1.0000	5.500	0.0000	8.500	0.0000
0.500	1.0000	1.600	1.0000	3.000	1.0000	6.000	0.0000	9.000	0.0000
0.600	1.0000	1.800	1.0000	3.500	1.0000	6.500	0.0000	9.500	0.0000

Storage Structures for Building SW Network

Infiltration Basin Manhole: Wetland 1, DS/PN: 1.002

Invert Level (m) 65.800 Safety Factor 1.5
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	5.4	1.000	90.0

Complex Manhole: Swale + Tank, DS/PN: 1.004

Cellular Storage

Invert Level (m) 65.400 Safety Factor 1.5
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	64.0	64.0	0.800	64.0	96.0	0.801	0.0	96.0

Swale

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr) 0.00000 Length (m) 14.0
Infiltration Coefficient Side (m/hr) 0.00000 Side Slope (1:X) 3.0
Safety Factor 1.5 Slope (1:X) 500.0
Porosity 1.00 Cap Volume Depth (m) 0.000
Invert Level (m) 66.400 Cap Infiltration Depth (m) 0.000
Base Width (m) 0.8 Include Swale Volume Yes

Infiltration Basin Manhole: Wetland 2, DS/PN: 3.002

Invert Level (m) 66.100 Safety Factor 1.5
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	47.0	0.680	134.7

Cellular Storage Manhole: RWH+Storage, DS/PN: 1.007

Invert Level (m) 62.550 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	46.5	0.0	1.800	46.5	0.0	1.801	0.0	0.0

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Building SW Network

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 0.000
Hot Start Level (mm) 0 Inlet Coefficient 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 4 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, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760
Return Period(s) (years) 2, 30, 100
Climate Change (%) 0, 0, 40

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level	Surcharged Depth	Flooded Volume
									(m)	(m)	(m³)
1.000	SW.08	15 Winter	2	+0%	100/15 Summer				66.415	-0.111	0.000
1.001	SW.09	15 Winter	2	+0%	30/15 Summer				66.012	-0.073	0.000
1.002	Wetland 1	15 Winter	2	+0%	30/15 Summer				65.908	-0.042	0.000
1.003	SW.10	15 Winter	2	+0%	100/15 Summer				65.758	-0.067	0.000
1.004	Swale + Tank	30 Winter	2	+0%	30/180 Winter				65.482	-0.068	0.000
1.005	SW.12	30 Winter	2	+0%	30/180 Winter				65.410	-0.069	0.000
2.000	SW.14	15 Winter	2	+0%	100/120 Winter				65.992	-0.243	0.000
1.006	SW.13	15 Winter	2	+0%	30/120 Winter				65.219	-0.185	0.000
3.000	SW.22	15 Winter	2	+0%	100/15 Summer				66.411	-0.129	0.000
3.001	SW.21	15 Winter	2	+0%	100/180 Winter				66.299	-0.148	0.000
3.002	Wetland 2	30 Winter	2	+0%	100/120 Winter				66.168	-0.157	0.000
3.003	SW.20	30 Winter	2	+0%	100/120 Winter				66.108	-0.158	0.000
3.004	SW19	30 Winter	2	+0%	100/60 Winter				66.042	-0.149	0.000
3.005	SW.18	30 Winter	2	+0%	100/60 Winter				65.939	-0.158	0.000
4.000	SW.15	15 Winter	2	+0%	100/120 Winter				65.910	-0.333	0.000
5.000	SW.16	15 Winter	2	+0%	100/60 Winter				65.868	-0.316	0.000
3.006	SW.17	15 Winter	2	+0%	100/60 Summer				65.714	-0.306	0.000
1.007	RWH+Storage	480 Winter	2	+0%	2/15 Summer				63.679	0.754	0.000
1.008	SWPC	480 Winter	2	+0%	2/15 Summer				63.700	0.827	0.000

PN	US/MH Name	Half Drain		Pipe Flow	Status	Level Exceeded
		Flow / Cap.	Overflow (l/s)	Time (mins)		
1.000	SW.08	0.15		3.0	OK	
1.001	SW.09	0.51		10.8	OK	
1.002	Wetland 1	0.86		7 11.6	OK	