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)	1	Add Flow / Climate Change (%)	0
M5-60 (mm)	18.000	Minimum Backdrop Height (m)	0.200
Ratio R	0.358	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	5	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.00	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)	Time (mins)	Area (ha)
0-4	0.248	4-8	0.966	8-12	0.056

Total Area Contributing (ha) = 1.270

Total Pipe Volume (m^3) = 25.138

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
1.000	22.000	0.180	122.2	0.089	5.00	0.0	0.600	o	300
1.001	49.000	0.300	163.3	0.125	0.00	0.0	0.600	o	300
2.000	7.000	0.100	70.0	0.065	5.00	0.0	0.600	o	225
2.001	11.000	0.111	99.1	0.096	0.00	0.0	0.600	o	225
2.002	15.000	0.146	102.7	0.018	0.00	0.0	0.600	o	225
2.003	27.000	0.178	151.7	0.046	0.00	0.0	0.600	o	225

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ Area (ha)	Σ DWF (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	5.00	5.26	85.900	0.089	0.0	0.0	0.0	1.42	100.4	1.2
1.001	5.00	5.92	85.720	0.214	0.0	0.0	0.0	1.23	86.8	2.9
2.000	5.00	5.07	85.800	0.065	0.0	0.0	0.0	1.57	62.2	0.9
2.001	5.00	5.21	85.700	0.161	0.0	0.0	0.0	1.31	52.2	2.2
2.002	5.00	5.41	85.589	0.179	0.0	0.0	0.0	1.29	51.3	2.4
2.003	5.00	5.83	85.443	0.225	0.0	0.0	0.0	1.06	42.1	3.0

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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
3.000	10.000	0.238	42.0	0.044	5.00	0.0	0.600	o	225
3.001	29.000	0.195	148.7	0.026	0.00	0.0	0.600	o	225
3.002	26.000	0.283	91.9	0.190	0.00	0.0	0.600	o	225
4.000	21.000	0.400	52.5	0.057	5.00	0.0	0.600	o	300
3.003	16.000	0.082	195.1	0.000	0.00	0.0	0.600	o	300
5.000	3.000	0.036	83.3	0.007	5.00	0.0	0.600	o	150
1.002	31.000	0.075	413.3	0.000	0.00	0.0	0.600	o	375
6.000	22.000	0.100	220.0	0.229	5.00	0.0	0.600	o	150
6.001	58.000	0.395	146.8	0.229	0.00	0.0	0.600	o	150
6.002	40.000	0.391	102.3	0.042	0.00	0.0	0.600	o	150
6.003	10.000	0.106	94.3	0.007	0.00	0.0	0.600	o	150
1.003	15.000	0.040	375.0	0.000	0.00	0.0	0.600	o	450
1.004	5.000	0.035	142.9	0.000	0.00	0.0	0.600	o	225
1.005	50.000	0.325	153.8	0.000	0.00	5.0	0.600	o	225
1.006	8.000	0.055	145.5	0.000	0.00	15.0	0.600	o	225

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ Area (ha)	Σ DWF (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
3.000	5.00	5.08	85.050	0.044	0.0	0.0	0.0	2.02	80.5	0.6
3.001	5.00	5.53	84.812	0.070	0.0	0.0	0.0	1.07	42.5	0.9
3.002	5.00	5.85	84.617	0.260	0.0	0.0	0.0	1.36	54.3	3.5
4.000	5.00	5.16	85.000	0.057	0.0	0.0	0.0	2.17	153.7	0.8
3.003	5.00	6.09	84.259	0.317	0.0	0.0	0.0	1.12	79.3	4.3
5.000	5.00	5.05	86.250	0.007	0.0	0.0	0.0	1.10	19.5	0.1
1.002	5.00	6.67	84.102	0.763	0.0	0.0	0.0	0.88	97.7	10.3
6.000	5.00	5.54	87.000	0.229	0.0	0.0	0.0	0.67	11.9	3.1
6.001	5.00	6.71	86.900	0.458	0.0	0.0	0.0	0.83	14.6	6.2
6.002	5.00	7.38	86.505	0.500	0.0	0.0	0.0	0.99	17.6	6.8
6.003	5.00	7.55	86.114	0.507	0.0	0.0	0.0	1.03	18.3	6.9
1.003	5.00	7.78	83.952	1.270	0.0	0.0	0.0	1.04	166.0	17.2
1.004	5.00	7.86	83.620	1.270	0.0	0.0	0.0	1.09	43.4	17.2
1.005	5.00	8.65	83.585	1.270	5.0	0.0	0.0	1.05	41.8	22.2
1.006	5.00	8.78	83.260	1.270	20.0	0.0	0.0	1.08	43.0	37.2

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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
1.007	36.000	1.050	34.3	0.000	0.00	0.0	0.600	o	225
1.008	11.000	0.265	41.5	0.000	0.00	0.0	0.600	o	225

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ Area (ha)	Σ DWF (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.007	5.00	9.04	81.890	1.270	20.0	0.0	0.0	2.24	89.1	37.2
1.008	5.00	9.13	80.840	1.270	20.0	0.0	0.0	2.04	81.0	37.2

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Online Controls for Storm

Hydro-Brake® Manhole: 19, DS/PN: 1.004, Volume (m³): 7.5

Design Head (m) 1.500 Hydro-Brake® Type Md4 Invert Level (m) 83.620
Design Flow (l/s) 45.0 Diameter (mm) 217

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.5	1.200	40.4	3.000	63.6	7.000	97.1
0.200	18.0	1.400	43.5	3.500	68.7	7.500	100.5
0.300	33.5	1.600	46.4	4.000	73.4	8.000	103.8
0.400	42.6	1.800	49.2	4.500	77.8	8.500	107.0
0.500	43.2	2.000	51.9	5.000	82.1	9.000	110.1
0.600	39.9	2.200	54.4	5.500	86.1	9.500	113.1
0.800	36.1	2.400	56.8	6.000	89.9		
1.000	37.5	2.600	59.2	6.500	93.6		

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Storage Structures for Storm

Tank or Pond Manhole: 19, DS/PN: 1.004

Invert Level (m) 83.620

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	105.0	1.400	105.0	2.800	0.0	4.200	0.0
0.200	105.0	1.600	105.0	3.000	0.0	4.400	0.0
0.400	105.0	1.800	105.0	3.200	0.0	4.600	0.0
0.600	105.0	2.000	105.0	3.400	0.0	4.800	0.0
0.800	105.0	2.200	0.0	3.600	0.0	5.000	0.0
1.000	105.0	2.400	0.0	3.800	0.0		
1.200	105.0	2.600	0.0	4.000	0.0		

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

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, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 30

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	15 Winter	1	0%	100/15 Summer				
1.001	15 Winter	1	0%	100/15 Summer				
2.000	15 Winter	1	0%	30/15 Summer				
2.001	15 Winter	1	0%	30/15 Summer				
2.002	15 Winter	1	0%	30/15 Summer				
2.003	15 Winter	1	0%	30/15 Summer				
3.000	15 Winter	1	0%	30/15 Summer				
3.001	15 Winter	1	0%	30/15 Summer	100/15 Summer			9
3.002	15 Winter	1	0%	30/15 Summer				
4.000	15 Winter	1	0%	100/15 Summer				
3.003	15 Winter	1	0%	30/15 Summer				
5.000	15 Winter	1	0%					
1.002	15 Winter	1	0%	30/15 Summer				
6.000	30 Winter	1	0%	1/15 Summer	30/15 Summer			32
6.001	15 Winter	1	0%	1/15 Summer	30/15 Summer			25
6.002	30 Winter	1	0%	1/15 Summer				
6.003	30 Winter	1	0%	1/15 Summer				
1.003	15 Winter	1	0%	30/15 Summer				
1.004	60 Winter	1	0%	1/15 Summer				
1.005	60 Winter	1	0%	1/30 Winter				
1.006	60 Winter	1	0%	1/15 Summer				
1.007	60 Winter	1	0%					
1.008	60 Winter	1	0%	100/120 Winter				

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

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m^3)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
1.000	1	85.969	-0.231	0.000	0.12	0.0	10.6	OK
1.001	2	85.830	-0.190	0.000	0.29	0.0	23.4	OK
2.000	3	85.864	-0.161	0.000	0.17	0.0	7.8	OK
2.001	4	85.799	-0.126	0.000	0.40	0.0	17.5	OK
2.002	5	85.693	-0.121	0.000	0.43	0.0	19.5	OK
2.003	6	85.571	-0.097	0.000	0.61	0.0	24.0	OK
3.000	7	85.092	-0.183	0.000	0.08	0.0	5.3	OK
3.001	8	84.881	-0.156	0.000	0.20	0.0	7.9	OK
3.002	9	84.735	-0.107	0.000	0.54	0.0	27.1	OK
4.000	10	85.044	-0.256	0.000	0.05	0.0	6.8	OK
3.003	11	84.426	-0.133	0.000	0.50	0.0	33.4	OK
5.000	12	86.276	-0.124	0.000	0.07	0.0	0.8	OK
1.002	12	84.389	-0.088	0.000	0.93	0.0	80.3	OK
6.000	14	87.785	0.635	0.000	0.85	0.0	9.5	FLOOD RISK
6.001	15	87.733	0.683	0.000	1.44	0.0	20.6	FLOOD RISK
6.002	16	86.953	0.298	0.000	1.25	0.0	21.3	SURCHARGED
6.003	17	86.336	0.072	0.000	1.32	0.0	21.5	SURCHARGED
1.003	18	84.276	-0.126	0.000	0.86	0.0	98.3	OK
1.004	19	84.165	0.320	0.000	1.10	0.0	32.8	SURCHARGED
1.005	20	83.848	0.038	0.000	0.94	0.0	37.8	SURCHARGED
1.006	20	83.559	0.074	0.000	1.60	0.0	52.8	SURCHARGED
1.007	21	82.019	-0.096	0.000	0.63	0.0	52.8	OK
1.008	22	80.989	-0.076	0.000	0.77	0.0	52.8	OK

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

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, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 30

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	15 Winter	30	0%	100/15 Summer				
1.001	15 Winter	30	0%	100/15 Summer				
2.000	15 Winter	30	0%	30/15 Summer				
2.001	15 Winter	30	0%	30/15 Summer				
2.002	15 Winter	30	0%	30/15 Summer				
2.003	15 Winter	30	0%	30/15 Summer				
3.000	15 Winter	30	0%	30/15 Summer				
3.001	15 Winter	30	0%	30/15 Summer	100/15 Summer			9
3.002	15 Winter	30	0%	30/15 Summer				
4.000	15 Winter	30	0%	100/15 Summer				
3.003	15 Winter	30	0%	30/15 Summer				
5.000	15 Winter	30	0%					
1.002	120 Winter	30	0%	30/15 Summer				
6.000	60 Winter	30	0%	1/15 Summer	30/15 Summer			32
6.001	30 Winter	30	0%	1/15 Summer	30/15 Summer			25
6.002	15 Winter	30	0%	1/15 Summer				
6.003	15 Winter	30	0%	1/15 Summer				
1.003	120 Winter	30	0%	30/15 Summer				
1.004	120 Winter	30	0%	1/15 Summer				
1.005	30 Summer	30	0%	1/30 Winter				
1.006	30 Summer	30	0%	1/15 Summer				
1.007	30 Summer	30	0%					
1.008	30 Summer	30	0%	100/120 Winter				

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

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m^3)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
1.000	1	86.012	-0.188	0.000	0.29	0.0	25.9	OK
1.001	2	85.925	-0.095	0.000	0.79	0.0	64.6	OK
2.000	3	86.171	0.146	0.000	0.41	0.0	18.2	SURCHARGED
2.001	4	86.154	0.229	0.000	0.96	0.0	42.4	SURCHARGED
2.002	5	86.049	0.235	0.000	1.04	0.0	46.7	SURCHARGED
2.003	6	85.888	0.220	0.000	1.49	0.0	58.3	SURCHARGED
3.000	7	85.464	0.189	0.000	0.19	0.0	12.5	SURCHARGED
3.001	8	85.450	0.413	0.000	0.52	0.0	20.8	SURCHARGED
3.002	9	85.413	0.571	0.000	1.22	0.0	61.4	SURCHARGED
4.000	10	85.070	-0.230	0.000	0.12	0.0	16.8	OK
3.003	11	84.977	0.418	0.000	1.12	0.0	75.1	SURCHARGED
5.000	12	86.292	-0.108	0.000	0.17	0.0	2.0	OK
1.002	12	84.959	0.482	0.000	0.83	0.0	71.8	SURCHARGED
6.000	14	87.871	0.721	31.051	1.72	0.0	19.3	FLOOD
6.001	15	87.855	0.805	14.643	1.50	0.0	21.4	FLOOD
6.002	16	87.428	0.773	0.000	1.56	0.0	26.6	FLOOD RISK
6.003	17	86.457	0.193	0.000	1.69	0.0	27.5	SURCHARGED
1.003	18	84.946	0.544	0.000	0.83	0.0	93.9	SURCHARGED
1.004	19	84.933	1.088	0.000	1.42	0.0	42.6	SURCHARGED
1.005	20	84.084	0.274	0.000	1.20	0.0	48.0	SURCHARGED
1.006	20	83.618	0.133	0.000	1.91	0.0	63.0	SURCHARGED
1.007	21	82.036	-0.079	0.000	0.75	0.0	63.0	OK
1.008	22	81.009	-0.056	0.000	0.92	0.0	63.0	OK

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

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, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 30

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	120 Winter	100	+30%	100/15 Summer				
1.001	120 Winter	100	+30%	100/15 Summer				
2.000	15 Winter	100	+30%	30/15 Summer				
2.001	15 Winter	100	+30%	30/15 Summer				
2.002	15 Winter	100	+30%	30/15 Summer				
2.003	15 Winter	100	+30%	30/15 Summer				
3.000	15 Winter	100	+30%	30/15 Summer				
3.001	120 Winter	100	+30%	30/15 Summer	100/15 Summer			9
3.002	120 Winter	100	+30%	30/15 Summer				
4.000	120 Winter	100	+30%	100/15 Summer				
3.003	120 Winter	100	+30%	30/15 Summer				
5.000	15 Winter	100	+30%					
1.002	120 Winter	100	+30%	30/15 Summer				
6.000	60 Winter	100	+30%	1/15 Summer	30/15 Summer			32
6.001	60 Winter	100	+30%	1/15 Summer	30/15 Summer			25
6.002	15 Winter	100	+30%	1/15 Summer				
6.003	15 Winter	100	+30%	1/15 Summer				
1.003	120 Winter	100	+30%	30/15 Summer				
1.004	120 Winter	100	+30%	1/15 Summer				
1.005	120 Winter	100	+30%	1/30 Winter				
1.006	120 Winter	100	+30%	1/15 Summer				
1.007	120 Winter	100	+30%					
1.008	120 Winter	100	+30%	100/120 Winter				

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

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m^3)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
1.000	1	86.286	0.086	0.000	0.17	0.0	15.0	SURCHARGED
1.001	2	86.260	0.240	0.000	0.44	0.0	36.1	SURCHARGED
2.000	3	87.105	1.080	0.000	0.64	0.0	28.6	FLOOD RISK
2.001	4	87.074	1.149	0.000	1.47	0.0	64.8	FLOOD RISK
2.002	5	86.822	1.008	0.000	1.60	0.0	72.4	SURCHARGED
2.003	6	86.443	0.775	0.000	2.30	0.0	89.7	SURCHARGED
3.000	7	86.046	0.771	0.000	0.32	0.0	21.4	SURCHARGED
3.001	8	86.027	0.990	17.362	0.58	0.0	23.1	FLOOD
3.002	9	86.221	1.379	0.000	0.75	0.0	37.7	SURCHARGED
4.000	10	86.251	0.951	0.000	0.07	0.0	8.9	SURCHARGED
3.003	11	86.262	1.703	0.000	0.65	0.0	43.6	SURCHARGED
5.000	12	86.305	-0.095	0.000	0.29	0.0	3.4	OK
1.002	12	86.301	1.824	0.000	1.35	0.0	116.8	SURCHARGED
6.000	14	87.908	0.758	68.266	1.72	0.0	19.4	FLOOD
6.001	15	87.882	0.832	42.456	1.51	0.0	21.6	FLOOD
6.002	16	87.498	0.843	0.000	1.61	0.0	27.4	FLOOD RISK
6.003	17	86.514	0.250	0.000	1.84	0.0	30.0	SURCHARGED
1.003	18	86.333	1.931	0.000	1.24	0.0	141.2	SURCHARGED
1.004	19	86.315	2.470	0.000	1.66	0.0	49.5	SURCHARGED
1.005	20	84.304	0.494	0.000	1.36	0.0	54.3	SURCHARGED
1.006	20	83.663	0.178	0.000	2.10	0.0	69.3	SURCHARGED
1.007	21	82.047	-0.068	0.000	0.82	0.0	69.2	OK
1.008	22	81.065	0.000	0.000	1.01	0.0	69.1	SURCHARGED

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