STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Surface

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	PIMP (%)	100
M5-60 (mm)	19.800	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	0	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 Surface

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	5.610	0.037	150.0	0.038	5.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	5.348	0.036	148.6	0.051	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	22.661	0.051	444.3	0.056	0.00	0.0	0.600	o	600	Pipe/Conduit	
1.002	22.952	0.051	450.0	0.047	0.00	0.0	0.600	o	600	Pipe/Conduit	
1.003	6.432	0.045	142.9	0.062	0.00	0.0	0.600	o	600	Pipe/Conduit	
3.000	5.829	0.039	149.5	0.030	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.004	31.274	0.070	446.8	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
4.000	4.179	0.027	154.8	0.026	5.00	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)
1.000	0.00	5.11	2.254	0.038	0.0	0.0	0.0	0.82	14.5	0.0
2.000	0.00	5.11	2.302	0.051	0.0	0.0	0.0	0.82	14.5	0.0
1.001	0.00	5.44	1.816	0.145	0.0	0.0	0.0	1.15	324.8	0.0
1.002	0.00	5.78	1.765	0.192	0.0	0.0	0.0	1.14	322.7	0.0
1.003	0.00	5.83	1.714	0.254	0.0	0.0	0.0	2.03	575.4	0.0
3.000	0.00	5.12	2.158	0.030	0.0	0.0	0.0	0.82	14.5	0.0
1.004	0.00	6.29	1.669	0.284	0.0	0.0	0.0	1.15	323.9	0.0
4.000	0.00	5.09	2.076	0.026	0.0	0.0	0.0	0.81	14.2	0.0

©1982-2017 XP Solutions

Network Design Table for Surface

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
1.005	36.555	0.082	445.8	0.098	0.00	0.0	0.600	o	600	Pipe/Conduit	
5.000	15.781	0.036	438.4	0.082	5.00	0.0	0.600	o	600	Pipe/Conduit	
5.001	17.774	0.040	444.4	0.070	0.00	0.0	0.600	o	600	Pipe/Conduit	
5.002	6.079	0.014	434.2	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
1.006	26.037	0.058	448.9	0.039	0.00	0.0	0.600	o	600	Pipe/Conduit	
6.000	5.687	0.036	158.0	0.077	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.007	31.898	0.071	449.3	0.020	0.00	0.0	0.600	o	600	Pipe/Conduit	
1.008	17.578	0.039	450.7	0.005	0.00	0.0	0.600	o	600	Pipe/Conduit	
7.000	4.376	0.029	150.9	0.071	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.009	27.082	0.061	444.0	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
1.010	24.952	0.056	445.6	0.028	0.00	0.0	0.600	o	600	Pipe/Conduit	
8.000	6.213	0.041	151.5	0.042	5.00	0.0	0.600	o	150	Pipe/Conduit	
8.001	16.140	0.036	448.3	0.041	0.00	0.0	0.600	o	600	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)
1.005	0.00	6.82	1.599	0.408	0.0	0.0	0.0	1.15	324.3	0.0
5.000	0.00	5.23	1.607	0.082	0.0	0.0	0.0	1.16	327.0	0.0
5.001	0.00	5.49	1.571	0.152	0.0	0.0	0.0	1.15	324.8	0.0
5.002	0.00	5.57	1.531	0.152	0.0	0.0	0.0	1.16	328.6	0.0
1.006	0.00	7.20	1.517	0.599	0.0	0.0	0.0	1.14	323.1	0.0
6.000	0.00	5.12	1.945	0.077	0.0	0.0	0.0	0.80	14.1	0.0
1.007	0.00	7.66	1.459	0.696	0.0	0.0	0.0	1.14	323.0	0.0
1.008	0.00	7.92	1.388	0.701	0.0	0.0	0.0	1.14	322.5	0.0
7.000	0.00	5.09	1.828	0.071	0.0	0.0	0.0	0.82	14.4	0.0
1.009	0.00	8.31	1.349	0.772	0.0	0.0	0.0	1.15	324.9	0.0
1.010	0.00	8.67	1.288	0.800	0.0	0.0	0.0	1.15	324.3	0.0
8.000	0.00	5.13	1.808	0.042	0.0	0.0	0.0	0.81	14.4	0.0
8.001	0.00	5.36	1.317	0.083	0.0	0.0	0.0	1.14	323.3	0.0

©1982-2017 XP Solutions

Network Design Table for Surface

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
9.000	6.666	0.015	444.4	0.030	5.00	0.0	0.600	o	600	Pipe/Conduit	
8.002	21.878	0.049	446.5	0.043	0.00	0.0	0.600	o	600	Pipe/Conduit	
1.011	33.966	0.080	424.6	0.090	0.00	0.0	0.600	o	600	Pipe/Conduit	
1.012	9.057	0.052	174.2	0.085	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)
9.000	0.00	5.10	1.296	0.030	0.0	0.0	0.0	1.15	324.8	0.0
8.002	0.00	5.68	1.281	0.156	0.0	0.0	0.0	1.15	324.0	0.0
1.011	0.00	9.16	1.232	1.046	0.0	0.0	0.0	1.18	332.3	0.0
1.012	0.00	9.31	1.152	1.131	0.0	0.0	0.0	0.99	39.3	0.0

©1982-2017 XP Solutions

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

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 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	8
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	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.800	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	ON
Analysis Timestep	Fine	Inertia Status	ON
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)	150
Climate Change (%)	40

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	IC01	15 Winter	150	+40%	150/15 Summer				2.578
2.000	ICS02	15 Winter	150	+40%	150/15 Summer				2.715
1.001	MHS01	180 Winter	150	+40%	150/15 Winter				2.466
1.002	MHS02	180 Winter	150	+40%	150/15 Winter				2.462
1.003	MHS03	180 Winter	150	+40%	150/15 Summer				2.455
3.000	ICS04	180 Winter	150	+40%	150/15 Summer				2.463
1.004	MHS04	180 Winter	150	+40%	150/15 Winter				2.455
4.000	ICS05	180 Winter	150	+40%	150/15 Summer				2.459
1.005	MHS05	180 Winter	150	+40%	150/15 Summer				2.453
5.000	MHS06	180 Winter	150	+40%	150/15 Winter				2.455
5.001	MHS07	180 Winter	150	+40%	150/15 Summer				2.450
5.002	MHS08	180 Winter	150	+40%	150/15 Summer				2.447
1.006	MHS09	180 Winter	150	+40%	150/15 Summer				2.447
6.000	ICS06	15 Winter	150	+40%	150/15 Summer				2.537
1.007	MHS10	180 Winter	150	+40%	150/15 Summer				2.442
1.008	MHS11	180 Winter	150	+40%	150/15 Summer				2.433
7.000	ICS07	15 Winter	150	+40%	150/15 Summer				2.538
1.009	MHS12	180 Winter	150	+40%	150/15 Summer				2.431
1.010	MHS13	180 Winter	150	+40%	150/15 Summer				2.429

©1982-2017 XP Solutions

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	IC01	0.174	0.000	2.13		25.4	SURCHARGED	
2.000	ICS02	0.263	0.000	2.86		34.0	SURCHARGED	
1.001	MHS01	0.050	0.000	0.09		21.9	SURCHARGED	
1.002	MHS02	0.097	0.000	0.11		28.1	SURCHARGED	
1.003	MHS03	0.141	0.000	0.12		37.0	SURCHARGED	
3.000	ICS04	0.155	0.000	0.40		4.8	SURCHARGED	
1.004	MHS04	0.186	0.000	0.16		41.7	SURCHARGED	
4.000	ICS05	0.233	0.000	0.38		4.1	SURCHARGED	
1.005	MHS05	0.254	0.000	0.22		60.1	SURCHARGED	
5.000	MHS06	0.248	0.000	0.06		12.5	SURCHARGED	
5.001	MHS07	0.279	0.000	0.11		23.2	FLOOD RISK	
5.002	MHS08	0.316	0.000	0.11		23.3	SURCHARGED	
1.006	MHS09	0.330	0.000	0.34		88.3	SURCHARGED	
6.000	ICS06	0.442	0.000	3.60		41.9	FLOOD RISK	
1.007	MHS10	0.383	0.000	0.39		102.4	FLOOD RISK	
1.008	MHS11	0.445	0.000	0.49		102.8	SURCHARGED	
7.000	ICS07	0.560	0.000	4.35		47.2	SURCHARGED	
1.009	MHS12	0.482	0.000	0.43		111.9	SURCHARGED	
1.010	MHS13	0.541	0.000	0.44		112.5	SURCHARGED	

©1982-2017 XP Solutions

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
8.000	ICS08	180 Winter	150	+40%	150/15 Summer			
8.001	MHS14	180 Winter	150	+40%	150/15 Winter			
9.000	MHS15	180 Winter	150	+40%	150/15 Winter	150/180 Winter		
8.002	MHS16	180 Winter	150	+40%	150/15 Summer			
1.011	MHS17	180 Winter	150	+40%	150/15 Summer			
1.012	MHS17	180 Winter	150	+40%	150/15 Summer			

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
8.000	ICS08	2.413	0.455	0.000	0.55		6.6	SURCHARGED	
8.001	MHS14	2.424	0.507	0.000	0.06		12.7	FLOOD RISK	
9.000	MHS15	2.405	0.509	5.758	0.10		20.6	FLOOD	1
8.002	MHS16	2.422	0.541	0.000	0.10		24.1	SURCHARGED	
1.011	MHS17	2.425	0.593	0.000	0.51		141.2	SURCHARGED	
1.012	MHS17	2.417	1.040	0.000	0.68		21.9	SURCHARGED	

©1982-2017 XP Solutions