STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for STORM WATER NETWORK 1 15.02.16.SWS

Pipe Sizes STORM WATER NETWORK 1 15.02.16 Manhole Sizes STORM WATER NETWORK 1 15.02.16

FSR Rainfall Model - England and Wales

Return Period (years)	2	Add Flow / Climate Change (%)	0
M5-60 (mm)	18.300	Minimum Backdrop Height (m)	5.000
Ratio R	0.361	Maximum Backdrop Height (m)	10.000
Maximum Rainfall (mm/hr)	100	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Soffits

Network Design Table for STORM WATER NETWORK 1 15.02.16.SWS

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
S1.000	18.409	0.192	95.9	0.040	4.00	0.0	0.600	o	225	
S2.000	28.743	0.192	149.7	0.076	4.00	0.0	0.600	o	225	
S1.001	16.261	0.203	80.1	0.014	0.00	0.0	0.600	o	225	
S1.002	10.217	0.076	134.4	0.022	0.00	0.0	0.600	o	225	
S1.003	27.006	1.658	16.3	0.035	0.00	0.0	0.600	o	225	
S3.000	28.951	0.058	499.2	0.043	4.00	0.0	0.600	o	750	
S4.000	3.810	0.038	100.3	0.000	4.00	0.0	0.600	o	150	
S4.001	4.981	0.064	77.8	0.000	0.00	0.0	0.600	o	150	
S4.002	20.192	0.042	480.8	0.093	0.00	0.0	0.600	o	750	

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	65.11	4.23	84.000	0.040	0.0	0.0	0.0	1.34	53.1	7.1
S2.000	63.87	4.45	84.000	0.076	0.0	0.0	0.0	1.07	42.4	13.1
S1.001	62.86	4.63	83.808	0.130	0.0	0.0	0.0	1.46	58.1	22.1
S1.002	62.06	4.79	83.605	0.152	0.0	0.0	0.0	1.13	44.8	25.5
S1.003	61.36	4.92	83.529	0.187	0.0	0.0	0.0	3.26	129.6	31.1
S3.000	64.21	4.39	81.404	0.043	0.0	0.0	0.0	1.25	550.3	7.5
S4.000	66.10	4.06	81.490	0.000	0.0	0.0	0.0	1.00	17.7	0.0
S4.001	65.66	4.14	81.452	0.000	0.0	0.0	0.0	1.14	20.2	0.0
S4.002	64.14	4.40	81.388	0.093	0.0	0.0	0.0	1.27	560.9	16.2

Network Design Table for STORM WATER NETWORK 1 15.02.16.SWS

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
S1.004	10.289	0.746	13.8	0.000	0.00	0.0	0.600	o	300	

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)
S1.004	61.16	4.96	81.346	0.323	0.0	0.0	0.0	4.26	300.8	53.5

Manhole Schedules for STORM WATER NETWORK 1 15.02.16.SWS

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)
S1	85.500	1.500	Open Manhole	1200	S1.000	84.000	225				
S3	85.438	1.438	Open Manhole	1200	S2.000	84.000	225				
S2	85.345	1.537	Open Manhole	1200	S1.001	83.808	225	S1.000	83.808	225	
								S2.000	83.808	225	
S4	85.308	1.703	Open Manhole	1200	S1.002	83.605	225	S1.001	83.605	225	
S5	85.100	1.571	Open Manhole	1200	S1.003	83.529	225	S1.002	83.529	225	
S7	84.350	2.946	Open Manhole	2100	S3.000	81.404	750				
S8	84.475	2.985	Open Manhole	1200	S4.000	81.490	150				
S9	84.475	3.023	Open Manhole	1200	S4.001	81.452	150	S4.000	81.452	150	
S10	84.475	3.087	Open Manhole	2100	S4.002	81.388	750	S4.001	81.388	150	
S6	84.472	3.126	Open Manhole	2700	S1.004	81.346	300	S1.003	81.871	225	450
								S3.000	81.346	750	
								S4.002	81.346	750	
S11	82.000	1.400	Open Manhole	0		OUTFALL		S1.004	80.600	300	

Area Summary for STORM WATER NETWORK 1 15.02.16.SWS

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.040	0.040	0.040
2.000	-	-	100	0.076	0.076	0.076
1.001	-	-	100	0.014	0.014	0.014
1.002	-	-	100	0.022	0.022	0.022
1.003	-	-	100	0.035	0.035	0.035
3.000	-	-	100	0.043	0.043	0.043
4.000	-	-	100	0.000	0.000	0.000
4.001	-	-	100	0.000	0.000	0.000
4.002	-	-	100	0.093	0.093	0.093
1.004	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.323	0.323	0.323

Free Flowing Outfall Details for STORM WATER NETWORK 1 15.02.16.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.004	S11	82.000	80.600	79.400	0	0

Simulation Criteria for STORM WATER NETWORK 1 15.02.16.SWS

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
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	1
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	1	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.900	Storm Duration (mins)	30
Ratio R	0.359		

Online Controls for STORM WATER NETWORK 1 15.02.16.SWS

Non Return Valve Manhole: S9, DS/PN: S4.001, Volume (m³): 3.5

Hydro-Brake Optimum® Manhole: S6, DS/PN: S1.004, Volume (m³): 38.5

Unit Reference	MD-SHE-0234-3200-1600-3200
Design Head (m)	1.600
Design Flow (l/s)	32.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	234
Invert Level (m)	81.346
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.600	31.7
Flush-Flo™	0.486	31.6
Kick-Flo®	1.068	26.1
Mean Flow over Head Range	-	27.1

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	7.8	1.200	27.6	3.000	42.9	7.000	64.6
0.200	23.6	1.400	29.7	3.500	46.2	7.500	66.8
0.300	30.3	1.600	31.7	4.000	49.2	8.000	68.9
0.400	31.4	1.800	33.5	4.500	52.1	8.500	71.0
0.500	31.6	2.000	35.3	5.000	54.9	9.000	73.0
0.600	31.3	2.200	36.9	5.500	57.4	9.500	74.9
0.800	30.4	2.400	38.5	6.000	59.9		
1.000	27.9	2.600	40.0	6.500	62.3		

Summary of Critical Results by Maximum Level (Rank 1) for STORM WATER NETWORK 1 15.02.16.SWS

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
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	1
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	1	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.374
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	30
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)
S1.000	S1	15 Winter	30	+0%					84.081
S2.000	S3	15 Winter	30	+0%					84.133
S1.001	S2	15 Winter	30	+0%					83.999
S1.002	S4	15 Winter	30	+0%	30/15 Summer				83.868
S1.003	S5	15 Winter	30	+0%					83.641
S3.000	S7	30 Winter	30	+0%					82.075
S4.000	S8	120 Winter	30	+0%					81.490
S4.001	S9	120 Winter	30	+0%					81.452
S4.002	S10	30 Winter	30	+0%				0	82.083
S1.004	S6	30 Winter	30	+0%	30/15 Summer				82.072

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.144	0.000	0.28		13.6	OK	
S2.000	S3	-0.092	0.000	0.65		25.5	OK	

Summary of Critical Results by Maximum Level (Rank 1) for STORM WATER NETWORK 1 15.02.16.SWS

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.001	S2	-0.034	0.000	0.80		41.4	OK	
S1.002	S4	0.038	0.000	1.28		47.9	SURCHARGED	
S1.003	S5	-0.113	0.000	0.48		58.2	OK	
S3.000	S7	-0.079	0.000	0.02		6.8	OK	
S4.000	S8	-0.150	0.000	0.00		0.0	OK	
S4.001	S9	-0.150	0.000	0.00		0.0	OK	
S4.002	S10	-0.055	0.000	0.05	0.0	19.0	OK	
S1.004	S6	0.426	0.000	0.14		31.0	SURCHARGED	