

Goodson Associates		Page 1
53 Melville Street Edinburgh EH3 7HL		
Date 07/09/2023 12:25 File P15622-Proposed Network...	Designed by PhilH Checked by	
XP Solutions		Network 2020.1.3

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)	100	PIMP (%)	100
M5-60 (mm)	19.000	Add Flow / Climate Change (%)	0
Ratio R	0.349	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

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.152	4-8	0.061

Total Area Contributing (ha) = 0.213

Total Pipe Volume (m³) = 3.106

Network Design Table for Storm

« - 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	20.377	1.698	12.0	0.046	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	11.226	0.625	18.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	18.019	0.035	514.8	0.093	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	27.094	1.220	22.2	0.016	5.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E I.Area (ha)	E Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.12	85.298	0.046	0.0	0.0	0.0	2.92	51.7	6.2
1.001	50.00	5.19	83.600	0.046	0.0	0.0	0.0	2.39	42.2	6.2
1.002	50.00	5.88	82.975	0.139	0.0	0.0	0.0	0.44	7.7«	18.8
2.000	50.00	5.21	84.160	0.016	0.0	0.0	0.0	2.15	37.9	2.2

Network Design Table for Storm

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
3.000	14.632	0.813	18.0	0.036	5.00	0.0	0.600	o	150	Pipe/Conduit	
3.001	20.444	1.135	18.0	0.022	0.00	0.0	0.600	o	150	Pipe/Conduit	
3.002	3.724	0.250	14.9	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
3.003	5.398	0.160	33.7	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.003	24.380	0.310	78.6	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)
3.000	50.00	5.10	85.298	0.036	0.0	0.0	0.0	2.39	42.2	4.9
3.001	50.00	5.25	84.485	0.058	0.0	0.0	0.0	2.38	42.1	7.9
3.002	50.00	5.27	83.350	0.058	0.0	0.0	0.0	2.62	46.4	7.9
3.003	50.00	5.32	83.100	0.058	0.0	0.0	0.0	1.74	30.7	7.9
1.003	50.00	6.16	82.940	0.213	0.0	0.0	0.0	1.48	58.7	28.8

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backd (mm)
RE1	85.950	0.652	Open Manhole	150	1.000	85.298	150				
S1	85.220	1.620	Open Manhole	600	1.001	83.600	150	1.000	83.600	150	
S2	84.950	1.975	Open Manhole	1200	1.002	82.975	150	1.001	82.975	150	
S4	85.510	1.350	Open Manhole	1200	2.000	84.160	150				
RE2	85.900	0.602	Open Manhole	150	3.000	85.298	150				
RE3	85.200	0.715	Open Manhole	150	3.001	84.485	150	3.000	84.485	150	
S5	84.850	1.500	Open Manhole	600	3.002	83.350	150	3.001	83.350	150	
S6	84.850	1.750	Open Manhole	600	3.003	83.100	150	3.002	83.100	150	
S3	84.800	1.860	Open Manhole	1800	1.003	82.940	225	1.002	82.940	150	
								2.000	82.940	150	
								3.003	82.940	150	
EX SW CEN02	84.610	1.980	Open Manhole	1200		OUTFALL		1.003	82.630	225	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
RE1	418400.700	426643.031	418400.700	426643.031	Required	
S1	418418.072	426653.683	418418.072	426653.683	Required	
S2	418426.900	426646.749	418426.900	426646.749	Required	
S4	418460.296	426644.005	418460.296	426644.005	Required	
RE2	418407.909	426631.657	418407.909	426631.657	Required	
RE3	418415.557	426619.183	418415.557	426619.183	Required	
S5	418433.073	426629.726	418433.073	426629.726	Required	
S6	418431.140	426632.908	418431.140	426632.908	Required	

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Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S3	418436.319	426631.388	418436.319	426631.388	Required	
EX SW CEN02	418417.949	426615.360			No Entry	

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	150	RE1	85.950	85.298	0.502	Open Manhole	150
1.001	o	150	S1	85.220	83.600	1.470	Open Manhole	600
1.002	o	150	S2	84.950	82.975	1.825	Open Manhole	1200
2.000	o	150	S4	85.510	84.160	1.200	Open Manhole	1200
3.000	o	150	RE2	85.900	85.298	0.452	Open Manhole	150
3.001	o	150	RE3	85.200	84.485	0.565	Open Manhole	150
3.002	o	150	S5	84.850	83.350	1.350	Open Manhole	600
3.003	o	150	S6	84.850	83.100	1.600	Open Manhole	600
1.003	o	225	S3	84.800	82.940	1.635	Open Manhole	1800

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	20.377	12.0	S1	85.220	83.600	1.470	Open Manhole	600
1.001	11.226	18.0	S2	84.950	82.975	1.825	Open Manhole	1200
1.002	18.019	514.8	S3	84.800	82.940	1.710	Open Manhole	1800
2.000	27.094	22.2	S3	84.800	82.940	1.710	Open Manhole	1800
3.000	14.632	18.0	RE3	85.200	84.485	0.565	Open Manhole	150
3.001	20.444	18.0	S5	84.850	83.350	1.350	Open Manhole	600
3.002	3.724	14.9	S6	84.850	83.100	1.600	Open Manhole	600
3.003	5.398	33.7	S3	84.800	82.940	1.710	Open Manhole	1800
1.003	24.380	78.6	EX SW CEN02	84.610	82.630	1.755	Open Manhole	1200

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.046	0.046	0.046
1.001	-	-	100	0.000	0.000	0.000
1.002	-	-	100	0.093	0.093	0.093
2.000	-	-	100	0.016	0.016	0.016
3.000	-	-	100	0.036	0.036	0.036
3.001	-	-	100	0.022	0.022	0.022
3.002	-	-	100	0.000	0.000	0.000
3.003	-	-	100	0.000	0.000	0.000
1.003	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.213	0.213	0.213

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.003	EX SW CEN02	84.610	82.630	82.630	1200	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m ³ /ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	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	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	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)	19.000	Storm Duration (mins)	30
Ratio R	0.349		

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Storage Structures for Storm

Cellular Storage Manhole: S2, DS/PN: 1.002

Invert Level (m) 82.975 Safety Factor 2.0
 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
 Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	72.0	0.0	0.801	0.0	0.0
0.800	72.0	0.0	1.975	0.0	0.0

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

PN	US/MH Name	Surcharged		Flooded		Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
		Depth (m)	Volume (m ³)	Flow / Cap.	Overflow (l/s)				
2.000	S4	-0.099	0.000	0.25			8.9	OK	
3.000	RE2	-0.073	0.000	0.52			20.1	OK	
3.001	RE3	0.021	0.000	0.81			32.2	SURCHARGED	
3.002	S5	0.479	0.000	0.99			30.8	SURCHARGED	
3.003	S6	0.498	0.000	1.22			30.6	SURCHARGED	
1.003	S3	0.400	0.000	0.42			22.5	SURCHARGED	