

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)	30	PIMP (%)	100
M5-60 (mm)	19.000	Add Flow / Climate Change (%)	0
Ratio R	0.304	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.	1.000	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

- Indicates pipe length does not match coordinates

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
S1.000	20.000#	0.080	250.0	0.066	5.00	0.0	0.600	o	600	Pipe/Conduit	
S1.001	27.100#	0.110	246.4	0.033	0.00	0.0	0.600	o	900	Pipe/Conduit	
S1.002	29.000#	0.100	290.0	0.167	0.00	0.0	0.600	o	1500	Pipe/Conduit	
S1.003	13.200#	0.045	293.3	0.020	0.00	0.0	0.600	o	1500	Pipe/Conduit	
S1.004	6.500#	0.040	162.5	0.000	0.00	0.0	0.600	o	300	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)
S1.000	50.00	5.22	73.000	0.066	0.0	0.0	0.0	1.54	434.2	11.9
S1.001	50.00	5.44	72.620	0.099	0.0	0.0	0.0	1.99	1267.1	17.9
S1.002	50.00	5.64	71.910	0.266	0.0	0.0	0.0	2.51	4442.3	48.0
S1.003	50.00	5.72	71.810	0.286	0.0	0.0	0.0	2.50	4416.8	51.6
S1.004	50.00	5.81	71.765	0.286	0.0	0.0	0.0	1.23	87.0	51.6

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)	Backdrop (mm)
SS100	75.000	2.000	Open Manhole	1800	S1.000	73.000	600				
SS101	75.000	2.380	Open Manhole	2100	S1.001	72.620	900	S1.000	72.920	600	
SS102	75.000	3.090	Open Manhole	2700	S1.002	71.910	1500	S1.001	72.510	900	
SS103	75.000	3.190	Open Manhole	2700	S1.003	71.810	1500	S1.002	71.810	1500	
SS104 HB	75.000	3.235	Open Manhole	3000	S1.004	71.765	300	S1.003	71.765	1500	
SComb 1	75.000	3.275	Open Manhole	0		OUTFALL		S1.004	71.725	300	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SS100	187.246	18.457	187.246	18.457	Required	
SS101	186.914	81.875	186.914	81.875	Required	
SS102	272.578	81.543	272.578	81.543	Required	
SS103	272.578	-6.113	272.578	-6.113	Required	
SS104 HB	272.910	-39.980	272.910	-39.980	Required	
SComb 1	284.199	-49.941			No Entry	

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PIPELINE SCHEDULES for Storm

Upstream Manhole

- Indicates pipe length does not match coordinates

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	600	SS100	75.000	73.000	1.400	Open Manhole	1800
S1.001	o	900	SS101	75.000	72.620	1.480	Open Manhole	2100
S1.002	o	1500	SS102	75.000	71.910	1.590	Open Manhole	2700
S1.003	o	1500	SS103	75.000	71.810	1.690	Open Manhole	2700
S1.004	o	300	SS104 HB	75.000	71.765	2.935	Open Manhole	3000

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)
S1.000	20.000#	250.0	SS101	75.000	72.920	1.480	Open Manhole	2100
S1.001	27.100#	246.4	SS102	75.000	72.510	1.590	Open Manhole	2700
S1.002	29.000#	290.0	SS103	75.000	71.810	1.690	Open Manhole	2700
S1.003	13.200#	293.3	SS104 HB	75.000	71.765	1.735	Open Manhole	3000
S1.004	6.500#	162.5	SComb 1	75.000	71.725	2.975	Open Manhole	0

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Setting Out Information - Site Coordinates (Storm)

- Indicates pipe length does not match coordinates

PN	USMH Name	Dia/Len (mm)	Width (mm)	US Easting (m)	US Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Layout (North)
S1.000	SS100	1800		187.246 #	18.457 #	187.246	18.457	
S1.001	SS101	2100		186.914 #	81.875 #	186.914	81.875	
S1.002	SS102	2700		272.578 #	81.543 #	272.578	81.543	
S1.003	SS103	2700		272.578 #	-6.113 #	272.578	-6.113	
S1.004	SS104 HB	3000		272.910 #	-39.980 #	272.910	-39.980	

- Indicates pipe length does not match coordinates

PN	DSMH Name	Dia/Len (mm)	Width (mm)	DS Easting (m)	DS Northing (m)	Layout (North)
S1.004	SComb 1	0		284.199 #	-49.941 #	

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.066	0.066	0.066
1.001	-	-	100	0.033	0.033	0.033
1.002	-	-	100	0.167	0.167	0.167
1.003	-	-	100	0.020	0.020	0.020
1.004	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.286	0.286	0.286

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)
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S1.004	SComb 1	75.000	71.725	0.000	0	0
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Simulation Criteria for Storm

Volumetric Runoff Coeff	1.000	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 Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	1	Number of Storage Structures	1	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	30	Cv (Summer)	1.000
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Storm Duration (mins)	30
Ratio R	0.304		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: SS104 HB, DS/PN: S1.004, Volume (m³): 41.2

Unit Reference	MD-SHE-0083-5000-3000-5000
Design Head (m)	3.000
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	83
Invert Level (m)	71.765
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	3.000	5.0	Kick-Flo®	0.741	2.6
Flush-Flo™	0.360	3.3	Mean Flow over Head Range	-	3.7

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)	Depth (m)	Flow (l/s)
0.100	2.5	0.800	2.7	2.000	4.1	4.000	5.7	7.000	7.4
0.200	3.1	1.000	3.0	2.200	4.3	4.500	6.0	7.500	7.7
0.300	3.3	1.200	3.3	2.400	4.5	5.000	6.4	8.000	7.9
0.400	3.3	1.400	3.5	2.600	4.7	5.500	6.6	8.500	8.2
0.500	3.2	1.600	3.7	3.000	5.0	6.000	6.9	9.000	8.4
0.600	3.1	1.800	3.9	3.500	5.4	6.500	7.2	9.500	8.6

Storage Structures for Storm

Tank or Pond Manhole: SS104 HB, DS/PN: S1.004

Invert Level (m) 73.100

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	80.0	0.600	80.0	0.601	0.0

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

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 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 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 19.000 Cv (Summer) 1.000
 Region England and Wales Ratio R 0.305 Cv (Winter) 1.000

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
 Return Period(s) (years) 1, 2, 30, 100
 Climate Change (%) 0, 0, 0, 45

									Water	Surcharged
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Level (m)	Depth (m)
S1.000	SS100	15 Summer	1	+0%	100/120 Summer				73.069	-0.531
S1.001	SS101	15 Summer	1	+0%	100/120 Summer				72.688	-0.832
S1.002	SS102	180 Summer	1	+0%	100/60 Summer				72.436	-0.974
S1.003	SS103	180 Summer	1	+0%	100/60 Summer				72.435	-0.875
S1.004	SS104 HB	180 Summer	1	+0%	1/15 Summer				72.434	0.369

		Flooded		Pipe		Level	
PN	US/MH Name	Volume (m³)	Flow / Cap.	Flow (l/s)	Status	Exceeded	
S1.000	SS100	0.000	0.03	10.0	OK		
S1.001	SS101	0.000	0.02	14.3	OK		
S1.002	SS102	0.000	0.01	14.9	OK		
S1.003	SS103	0.000	0.00	8.0	OK		
S1.004	SS104 HB	0.000	0.05	3.3	SURCHARGED		

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

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 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 1
Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model
FSR M5-60 (mm) 19.000
Cv (Summer) 1.000

Region England and Wales
Ratio R 0.305
Cv (Winter) 1.000

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

Return Period(s) (years) 1, 2, 30, 100

Climate Change (%) 0, 0, 0, 45

										Water Surcharged
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Level (m)	Depth (m)
S1.000	SS100	15 Summer	2	+0%	100/120 Summer				73.077	-0.523
S1.001	SS101	15 Summer	2	+0%	100/120 Summer				72.707	-0.813
S1.002	SS102	240 Winter	2	+0%	100/60 Summer				72.619	-0.791
S1.003	SS103	240 Winter	2	+0%	100/60 Summer				72.619	-0.691
S1.004	SS104 HB	240 Winter	2	+0%	1/15 Summer				72.619	0.554

		Flooded		Pipe		Level	
PN	US/MH Name	Volume (m³)	Flow / Cap. (l/s)	Flow (l/s)	Status	Exceeded	
S1.000	SS100	0.000	0.04	13.0	OK		
S1.001	SS101	0.000	0.02	18.5	OK		
S1.002	SS102	0.000	0.00	10.6	OK		
S1.003	SS103	0.000	0.00	6.1	OK		
S1.004	SS104 HB	0.000	0.05	3.3	SURCHARGED		

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

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 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 1

Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 19.000

Cv (Summer) 1.000

Region England and Wales

Ratio R 0.305

Cv (Winter) 1.000

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

Return Period(s) (years) 1, 2, 30, 100

Climate Change (%) 0, 0, 0, 45

										Water Surcharged
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Level (m)	Depth (m)
S1.000	SS100	15 Summer	30	+0%	100/120 Summer				73.109	-0.491
S1.001	SS101	180 Winter	30	+0%	100/120 Summer				73.089	-0.431
S1.002	SS102	180 Winter	30	+0%	100/60 Summer				73.089	-0.321
S1.003	SS103	180 Winter	30	+0%	100/60 Summer				73.089	-0.221
S1.004	SS104 HB	180 Winter	30	+0%	1/15 Summer				73.089	1.024

		Flooded		Pipe		Level	
PN	US/MH Name	Volume (m³)	Flow / Overflow Cap. (l/s)	Pipe Flow (l/s)	Status	Exceeded	
S1.000	SS100	0.000	0.07	24.5	OK		
S1.001	SS101	0.000	0.01	9.4	OK		
S1.002	SS102	0.000	0.01	22.5	OK		
S1.003	SS103	0.000	0.00	10.0	OK		
S1.004	SS104 HB	0.000	0.06	3.4	SURCHARGED		

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

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 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 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 19.000 Cv (Summer) 1.000
 Region England and Wales Ratio R 0.305 Cv (Winter) 1.000

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
 Return Period(s) (years) 1, 2, 30, 100
 Climate Change (%) 0, 0, 0, 45

									Water	Surcharged
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Level (m)	Depth (m)
S1.000	SS100	360 Winter	100	+45%	100/120 Summer				74.351	0.751
S1.001	SS101	360 Winter	100	+45%	100/120 Summer				74.351	0.831
S1.002	SS102	360 Winter	100	+45%	100/60 Summer				74.351	0.941
S1.003	SS103	360 Winter	100	+45%	100/60 Summer				74.351	1.041
S1.004	SS104 HB	360 Winter	100	+45%	1/15 Summer				74.351	2.286

		Flooded		Pipe		Level	
PN	US/MH Name	Volume (m³)	Flow / Overflow Cap. (l/s)	Pipe Flow (l/s)	Status	Exceeded	
S1.000	SS100	0.000	0.02	6.9	SURCHARGED		
S1.001	SS101	0.000	0.01	8.6	SURCHARGED		
S1.002	SS102	0.000	0.01	22.8	SURCHARGED		
S1.003	SS103	0.000	0.01	20.1	SURCHARGED		
S1.004	SS104 HB	0.000	0.08	4.7	SURCHARGED		