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	PIMP (%)	100
M5-60 (mm)	18.500	Add Flow / Climate Change (%)	0
Ratio R	0.331	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

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
S1.000	32.000	0.800	40.0	0.046	5.00	0.0	0.600	o	300	Pipe/Conduit	
S1.001	17.918	0.600	29.9	0.030	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.002	32.000	0.800	40.0	0.040	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.003	48.999	3.650	13.4	0.016	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)
S1.000	45.30	5.21	62.350	0.046	0.0	0.0	0.0	2.49	176.2	5.6
S1.001	44.93	5.32	61.550	0.076	0.0	0.0	0.0	2.89	204.1	9.2
S1.002	44.19	5.53	60.950	0.116	0.0	0.0	0.0	2.49	176.2	13.9
S1.003	43.43	5.76	60.150	0.132	0.0	0.0	0.0	3.59	142.8	15.5

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Manhole Schedules for Storm

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	63.450	1.100	Open Manhole	1200	S1.000	62.350	300				
S2	62.650	1.100	Open Manhole	1200	S1.001	61.550	300	S1.000	61.550	300	
S3	62.050	1.100	Open Manhole	1200	S1.002	60.950	300	S1.001	60.950	300	
S4	61.250	1.100	Open Manhole	1200	S1.003	60.150	225	S1.002	60.150	300	
S5	57.500	1.000	Open Manhole	0		OUTFALL		S1.003	56.500	225	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S1	385923.535	400817.939	385923.535	400817.939	Required	
S2	385905.674	400791.387	385905.674	400791.387	Required	
S3	385889.261	400798.575	385889.261	400798.575	Required	
S4	385871.400	400772.023	385871.400	400772.023	Required	
S5	385912.056	400744.673			No Entry	

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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)
S1.000	o	300	S1	63.450	62.350	0.800	Open Manhole	1200
S1.001	o	300	S2	62.650	61.550	0.800	Open Manhole	1200
S1.002	o	300	S3	62.050	60.950	0.800	Open Manhole	1200
S1.003	o	225	S4	61.250	60.150	0.875	Open Manhole	1200

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	32.000	40.0	S2	62.650	61.550	0.800	Open Manhole	1200
S1.001	17.918	29.9	S3	62.050	60.950	0.800	Open Manhole	1200
S1.002	32.000	40.0	S4	61.250	60.150	0.800	Open Manhole	1200
S1.003	48.999	13.4	S5	57.500	56.500	0.775	Open Manhole	0

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)
S1.003	S5	57.500	56.500	0.000	0	0

Simulation Criteria for Storm

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	3
Number of Online Controls	2	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)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.500	Storm Duration (mins)	30
Ratio R	0.331		

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Online Controls for Storm

Orifice Manhole: S2, DS/PN: S1.001, Volume (m³): 3.4

Diameter (m) 0.020 Discharge Coefficient 0.600 Invert Level (m) 61.550

Orifice Manhole: S4, DS/PN: S1.003, Volume (m³): 3.4

Diameter (m) 0.030 Discharge Coefficient 0.600 Invert Level (m) 60.150

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Storage Structures for Storm

Complex Manhole: S1, DS/PN: S1.000

Infiltration Blanket

Infiltration Coefficient Base (m/hr)	0.00000	Diameter/Width (m)	34.5
Safety Factor	2.0	Length (m)	19.3
Porosity	0.30	Cap Volume Depth (m)	0.300
Invert Level (m)	62.350		

Filter Drain

Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.300
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.000
Safety Factor	2.0	Number of Pipes	1
Porosity	0.30	Slope (1:X)	40.0
Invert Level (m)	62.350	Cap Volume Depth (m)	1.000
Trench Width (m)	0.6	Cap Infiltration Depth (m)	0.000
Trench Length (m)	32.0		

Filter Drain Manhole: S2, DS/PN: S1.001

Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.300
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.000
Safety Factor	2.0	Number of Pipes	1
Porosity	0.30	Slope (1:X)	30.0
Invert Level (m)	61.550	Cap Volume Depth (m)	1.000
Trench Width (m)	0.6	Cap Infiltration Depth (m)	0.000
Trench Length (m)	18.0		

Complex Manhole: S3, DS/PN: S1.002

Infiltration Blanket

Infiltration Coefficient Base (m/hr)	0.00000	Diameter/Width (m)	34.5
Safety Factor	2.0	Length (m)	19.3
Porosity	0.30	Cap Volume Depth (m)	0.300
Invert Level (m)	60.950		

Filter Drain

Infiltration Coefficient Base (m/hr)	0.00000	Trench Length (m)	32.0
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Diameter (m)	0.300
Safety Factor	2.0	Pipe Depth above Invert (m)	0.000
Porosity	0.30	Number of Pipes	1
Invert Level (m)	60.950	Slope (1:X)	40.0
Trench Width (m)	0.6	Cap Volume Depth (m)	1.000

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Filter Drain

Cap Infiltration Depth (m) 0.000

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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 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 3
Number of Online Controls 2 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 0.326
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 18.500 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep Fine Inertia Status OFF
DTS Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320
Return Period(s) (years) 100
Climate Change (%) 45

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	480 Winter	100	+45%					62.534
S1.001	S2	360 Winter	100	+45%	100/15 Summer				62.534
S1.002	S3	240 Winter	100	+45%					61.074
S1.003	S4	480 Winter	100	+45%	100/15 Summer				61.125

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.116	0.000	0.01		448	1.0	OK	
S1.001	S2	0.684	0.000	0.00			0.8	FLOOD RISK	
S1.002	S3	-0.176	0.000	0.01		244	2.0	OK	
S1.003	S4	0.750	0.000	0.01			1.8	FLOOD RISK	

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