STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Surface Network 6

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	0.350	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 Surface Network 6

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.071	4-8	0.024

Total Area Contributing (ha) = 0.095

Total Pipe Volume (m³) = 4.410

Network Design Table for Surface Network 6

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	10.522	0.139	75.7	0.015	5.00	0.0	0.600	o	225	Pipe/Conduit	
1.001	19.760	0.262	75.4	0.015	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	31.515	0.374	84.2	0.021	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	21.828	0.146	150.0	0.017	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.004	18.836	0.126	149.5	0.014	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.005	8.455	0.056	151.0	0.013	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)
1.000	50.00	5.12	115.830	0.015	0.0	0.0	0.0	1.50	59.8	2.0
1.001	50.00	5.34	115.691	0.030	0.0	0.0	0.0	1.51	59.9	4.1
1.002	50.00	5.70	115.429	0.051	0.0	0.0	0.0	1.43	56.7	6.9
1.003	50.00	6.04	115.055	0.068	0.0	0.0	0.0	1.07	42.4	9.2
1.004	50.00	6.34	114.909	0.082	0.0	0.0	0.0	1.07	42.4	11.1
1.005	50.00	6.47	114.783	0.095	0.0	0.0	0.0	1.06	42.2	12.9

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Free Flowing Outfall Details for Surface Network 6

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.005	Outfall	115.155	114.727	0.000	900	675

Simulation Criteria for Surface Network 6

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	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	0.350		

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Online Controls for Surface Network 6

Hydro-Brake® Optimum Manhole: S6-Ph1c (FC), DS/PN: 1.005, Volume (m³): 2.5

Unit Reference	MD-SHE-0020-2000-1000-2000
Design Head (m)	1.000
Design Flow (l/s)	0.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	20
Invert Level (m)	114.783
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	0.2
Flush-Flo™	0.084	0.1
Kick-Flo®	0.175	0.1
Mean Flow over Head Range	-	0.1

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	0.1	1.200	0.2	3.000	0.3	7.000	0.5
0.200	0.1	1.400	0.2	3.500	0.3	7.500	0.5
0.300	0.1	1.600	0.2	4.000	0.4	8.000	0.5
0.400	0.1	1.800	0.3	4.500	0.4	8.500	0.5
0.500	0.1	2.000	0.3	5.000	0.4	9.000	0.5
0.600	0.2	2.200	0.3	5.500	0.4	9.500	0.5
0.800	0.2	2.400	0.3	6.000	0.4		
1.000	0.2	2.600	0.3	6.500	0.4		

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Storage Structures for Surface Network 6

Tank or Pond Manhole: S6-Ph1c (FC), DS/PN: 1.005

Invert Level (m) 114.850

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	104.0	1.000	104.0	1.001	0.0

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 6

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	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	0.350
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	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, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	100
Climate Change (%)	40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.000	S1-Ph1c	15 Winter	100	+40%				
1.001	S2-Ph1c	15 Winter	100	+40%				
1.002	S3-Ph1c	2880 Winter	100	+40%				
1.003	S4-Ph1c	2880 Winter	100	+40%	100/15 Summer			
1.004	S5-Ph1c	2880 Winter	100	+40%	100/15 Summer			
1.005	S6-Ph1c (FC)	2880 Winter	100	+40%	100/15 Summer			

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.000	S1-Ph1c	115.892	-0.163	0.000	0.17			8.4	OK
1.001	S2-Ph1c	115.779	-0.137	0.000	0.32			17.3	OK
1.002	S3-Ph1c	115.652	-0.002	0.000	0.02			0.9	OK
1.003	S4-Ph1c	115.652	0.372	0.000	0.03			1.1	SURCHARGED
1.004	S5-Ph1c	115.651	0.517	0.000	0.04			1.3	FLOOD RISK
1.005	S6-Ph1c (FC)	115.651	0.643	0.000	0.01			0.2	SURCHARGED

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 6

PN	US/MH Name	Level Exceeded
1.000	S1-Ph1c	
1.001	S2-Ph1c	
1.002	S3-Ph1c	
1.003	S4-Ph1c	
1.004	S5-Ph1c	
1.005	S6-Ph1c (FC)	

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