

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for externals surface

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	9.498	0.095	100.0	0.010	5.00	0.0	0.600	o	150	Pipe/Conduit	
S1.001	5.048	0.050	101.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.002	5.984	0.060	99.7	0.006	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.003	23.623	0.205	115.0	0.004	0.00	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)
S1.000	50.00	5.16	48.700	0.010	0.0	0.0	0.0	1.00	17.8	1.4
S1.001	50.00	5.24	48.605	0.010	0.0	0.0	0.0	1.00	17.7	1.4
S1.002	50.00	5.34	48.555	0.016	0.0	0.0	0.0	1.01	17.8	2.2
S1.003	50.00	5.76	48.120	0.020	0.0	0.0	0.0	0.94	16.5	2.8

Manhole Schedules for externals surface

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)
S8a	49.420	0.720	Open Manhole	450	S1.000	48.700	150				
S8b	49.300	0.695	Open Manhole	450	S1.001	48.605	150	S1.000	48.605	150	
Sjunction	49.160	0.605	Junction		S1.002	48.555	150	S1.001	48.555	150	
S9	49.200	1.080	Open Manhole	1500	S1.003	48.120	150	S1.002	48.495	150	375
S	49.200	1.285	Open Manhole	150		OUTFALL		S1.003	47.915	150	

PIPELINE SCHEDULES for externals surface

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	150	S8a	49.420	48.700	0.570	Open Manhole	450
S1.001	o	150	S8b	49.300	48.605	0.545	Open Manhole	450
S1.002	o	150	Sjunction	49.160	48.555	0.455	Junction	
S1.003	o	150	S9	49.200	48.120	0.930	Open Manhole	1500

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	9.498	100.0	S8b	49.300	48.605	0.545	Open Manhole	450
S1.001	5.048	101.0	Sjunction	49.160	48.555	0.455	Junction	
S1.002	5.984	99.7	S9	49.200	48.495	0.555	Open Manhole	1500
S1.003	23.623	115.0	S	49.200	47.915	1.135	Open Manhole	150

Area Summary for externals surface

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.010	0.010	0.010
1.001	-	-	100	0.000	0.000	0.000
1.002	User	-	100	0.006	0.006	0.006
1.003	User	-	100	0.004	0.004	0.004
	User	-	100	0.000	0.000	0.004
				Total	Total	Total
				0.020	0.020	0.020

Free Flowing Outfall Details for externals surface

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,I (mm)	W (mm)
S1.003	S	49.200	47.915	47.870	150	0

Online Controls for externals surface

Hydro-Brake® Optimum Manhole: S9, DS/PN: S1.003, Volume (m³): 2.0

Unit Reference	MD-SHE-0067-2000-1000-2000	Sump Available	Yes
Design Head (m)	1.000	Diameter (mm)	67
Design Flow (l/s)	2.0	Invert Level (m)	48.120
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	100
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	2.0	Kick-Flo®	0.599	1.6
Flush-Flo™	0.296	1.9	Mean Flow over Head Range	-	1.7

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)	Depth (m)	Flow (l/s)
0.100	1.6	0.600	1.6	1.600	2.5	2.600	3.1	5.000	4.2	7.500	5.1
0.200	1.9	0.800	1.8	1.800	2.6	3.000	3.3	5.500	4.4	8.000	5.2
0.300	1.9	1.000	2.0	2.000	2.7	3.500	3.5	6.000	4.6	8.500	5.4
0.400	1.9	1.200	2.2	2.200	2.9	4.000	3.8	6.500	4.7	9.000	5.5
0.500	1.8	1.400	2.3	2.400	3.0	4.500	4.0	7.000	4.9	9.500	5.7

Curtins Consulting		Page 6																								
Merchant Exchange 17-19 Whitworth Street West Manchester M1 5WG	Swan House Manchester																									
Date 17/05/2022 12:25	Designed by CG																									
File surface 4ls and foul network 30.03.22.MDX	Checked by																									
Micro Drainage	Network 2018.1.1																									
<u>Storage Structures for externals surface</u> <u>Porous Car Park Manhole: Sjunction, DS/PN: S1.002</u> <table><tr><td>Infiltration Coefficient Base (m/hr)</td><td>0.00000</td><td>Porosity</td><td>0.30</td><td>Slope (1:X)</td><td>40.0</td></tr><tr><td>Membrane Percolation (mm/hr)</td><td>1000</td><td>Invert Level (m)</td><td>48.710</td><td>Depression Storage (mm)</td><td>5</td></tr><tr><td>Max Percolation (l/s)</td><td>38.9</td><td>Width (m)</td><td>14.0</td><td>Evaporation (mm/day)</td><td>3</td></tr><tr><td>Safety Factor</td><td>2.0</td><td>Length (m)</td><td>10.0</td><td>Cap Volume Depth (m)</td><td>0.350</td></tr></table>			Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.30	Slope (1:X)	40.0	Membrane Percolation (mm/hr)	1000	Invert Level (m)	48.710	Depression Storage (mm)	5	Max Percolation (l/s)	38.9	Width (m)	14.0	Evaporation (mm/day)	3	Safety Factor	2.0	Length (m)	10.0	Cap Volume Depth (m)	0.350
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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for externals surface

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 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) 18.000 Cv (Summer) 0.740
Region England and Wales Ratio R 0.361 Cv (Winter) 0.850

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep 2.5 Second Increment (Extended) Inertia Status ON
DTS 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) 1, 30, 100
Climate Change (%) 0, 0, 40

								Water Surcharged Flooded						Pipe
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Level (m)	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Flow (l/s)
S1.000	S8a	15 Winter	1	+0%	100/30 Winter				48.728	-0.122	0.000	0.08		1.2
S1.001	S8b	15 Winter	1	+0%	100/15 Summer				48.635	-0.120	0.000	0.09		1.2
S1.002	Sjunction	15 Winter	1	+0%	100/15 Summer				48.583	-0.122	0.000	0.08		1.2
S1.003	S9	15 Winter	1	+0%	30/15 Summer				48.205	-0.065	0.000	0.09		1.5

		US/MH	Level
PN	Name	Status	Exceeded
S1.000	S8a	OK	
S1.001	S8b	OK	
S1.002	Sjunction	OK*	
S1.003	S9	OK	

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

Simulation Criteria
Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 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) 18.000 Cv (Summer) 0.740
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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, 30, 100
Climate Change (%) 0, 0, 40

US/MH		Return Climate		First (X)	First (Y)	First (Z)	Overflow	Water	Surcharged	Flooded	Pipe		
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	Level	Depth	Volume	Flow /	Overflow
									(m)	(m)	(m³)	Cap.	(1/s)
S1.000	S8a	15 Winter	30	+0%	100/30 Winter				48.745	-0.105	0.000	0.19	3.0
S1.001	S8b	15 Winter	30	+0%	100/15 Summer				48.652	-0.103	0.000	0.21	3.0
S1.002	Sjuncttion	30 Winter	30	+0%	100/15 Summer				48.613	-0.092	0.000	0.22	3.4
S1.003	S9	30 Winter	30	+0%	30/15 Summer				48.610	0.340	0.000	0.12	1.9

US/MH		Level	
PN	Name	Status	Exceeded
S1.000	S8a	OK	
S1.001	S8b	OK	
S1.002	Sjuncttion	OK*	
S1.003	S9	SURCHARGED	

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

Simulation Criteria
Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 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) 18.000 Cv (Summer) 0.740
Region England and Wales Ratio R 0.361 Cv (Winter) 0.850
Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep 2.5 Second Increment (Extended) Inertia Status ON
DTS 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) 1, 30, 100
Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water			Flooded		Pipe Flow
									Level (m)	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	
S1.000	S8a	60 Winter	100	+40%	100/30 Winter				48.854	0.004	0.000	0.18		2.9
S1.001	S8b	60 Winter	100	+40%	100/15 Summer				48.850	0.095	0.000	0.19		2.6
S1.002	Sjunction	60 Winter	100	+40%	100/15 Summer				48.848	0.143	0.000	0.27		4.1
S1.003	S9	60 Winter	100	+40%	30/15 Summer				48.846	0.576	0.000	0.12		1.9

PN	US/MH Name	Status	Level Exceeded
S1.000	S8a	SURCHARGED	
S1.001	S8b	SURCHARGED	
S1.002	Sjunction	SURCHARGED*	
S1.003	S9	SURCHARGED	