STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for PARCEL A_SW

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	0.283	Minimum Backdrop Height (m)	0.600
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	3.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.000
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 PARCEL A_SW

« - 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	26.567	0.066	400.0	0.189	5.00	0.0	0.600	o	1350	Pipe/Conduit	
2.000	22.832	0.057	400.6	0.119	5.00	0.0	0.600	o	750	Pipe/Conduit	
1.001	12.940	0.033	392.1	0.051	0.00	0.0	0.600	o	1350	Pipe/Conduit	
1.002	25.643	0.064	400.7	0.027	0.00	0.0	0.600	o	1350	Pipe/Conduit	
1.003	7.074	0.018	393.0	0.017	0.00	0.0	0.600	o	1350	Pipe/Conduit	
1.004	26.163	0.065	400.0	0.051	0.00	0.0	0.600	o	1350	Pipe/Conduit	
1.005	11.645	0.029	400.0	0.011	0.00	0.0	0.600	o	1350	Pipe/Conduit	
1.006	17.732	0.044	400.0	0.000	0.00	0.0	0.600	o	1350	Pipe/Conduit	
1.007	11.060	0.028	395.0	0.155	0.00	0.0	0.600	o	1350	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	5.22	54.480	0.189	0.0	0.0	0.0	2.00	2869.3	25.6
2.000	50.00	5.27	54.981	0.119	0.0	0.0	0.0	1.39	615.0	16.1
1.001	50.00	5.38	54.414	0.359	0.0	0.0	0.0	2.02	2898.2	48.6
1.002	50.00	5.59	54.317	0.386	0.0	0.0	0.0	2.00	2866.9	52.3
1.003	50.00	5.65	54.253	0.403	0.0	0.0	0.0	2.02	2894.9	54.6
1.004	50.00	5.87	54.235	0.454	0.0	0.0	0.0	2.00	2869.3	61.5
1.005	50.00	5.97	54.170	0.465	0.0	0.0	0.0	2.00	2869.3	63.0
1.006	50.00	6.11	54.140	0.465	0.0	0.0	0.0	2.00	2869.3	63.0
1.007	50.00	6.20	54.096	0.620	0.0	0.0	0.0	2.02	2887.6	84.0

Network Design Table for PARCEL A_SW

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
1.008	25.610	0.064	400.0	0.105	0.00	0.0	0.600	o	1350	Pipe/Conduit	
1.009	5.734	0.034	167.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.010	5.257	0.031	167.0	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)
1.008	50.00	6.42	54.068	0.725	0.0	0.0	0.0	2.00	2869.3	98.2
1.009	50.00	6.51	54.004	0.725	0.0	0.0	0.0	1.01	40.1«	98.2
1.010	50.00	6.60	53.970	0.725	0.0	0.0	0.0	1.01	40.1«	98.2

Manhole Schedules for PARCEL A SW

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)
S11	57.059	2.579	Open Manhole	3000	1.000	54.480	1350			
S27	57.026	2.045	Open Manhole	2100	2.000	54.981	750			
S12	57.340	2.926	Open Manhole	3000	1.001	54.414	1350	1.000	54.414	1350
								2.000	54.924	750
S13	57.489	3.172	Open Manhole	3000	1.002	54.317	1350	1.001	54.381	1350
S14	57.474	3.221	Open Manhole	3000	1.003	54.253	1350	1.002	54.253	1350
S15	57.421	3.186	Open Manhole	3000	1.004	54.235	1350	1.003	54.235	1350
S16	57.742	3.572	Open Manhole	3000	1.005	54.170	1350	1.004	54.170	1350
S17	58.061	3.921	Open Manhole	3000	1.006	54.140	1350	1.005	54.140	1350
S23	57.812	3.716	Open Manhole	3000	1.007	54.096	1350	1.006	54.096	1350
S24	57.874	3.806	Open Manhole	3000	1.008	54.068	1350	1.007	54.068	1350
S25 HYDROBRAKE	57.902	3.898	Open Manhole	3000	1.009	54.004	225	1.008	54.004	1350
S26	57.595	3.625	Open Manhole	1350	1.010	53.970	225	1.009	53.970	225
S27 PUMP STATION	57.664	3.725	Open Manhole	225		OUTFALL		1.010	53.939	225

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S11	372623.956	437526.638	372623.956	437526.638	Required	
S27	372651.713	437503.195	372651.713	437503.195	Required	
S12	372629.033	437500.561	372629.033	437500.561	Required	
S13	372629.704	437487.639	372629.704	437487.639	Required	
S14	372623.127	437462.854	372623.127	437462.854	Required	
S15	372624.957	437456.021	372624.957	437456.021	Required	
S16	372636.437	437432.512	372636.437	437432.512	Required	

Manhole Schedules for PARCEL A SW

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S17	372645.264	437424.916	372645.264	437424.916	Required	
S23	372662.491	437420.711	372662.491	437420.711	Required	
S24	372663.210	437409.675	372663.210	437409.675	Required	
S25 HYDROBRAKE	372665.390	437384.157	372665.390	437384.157	Required	
S26	372664.208	437378.547	372664.208	437378.547	Required	
S27 PUMP STATION	372662.762	437373.493			No Entry	

PIPELINE SCHEDULES for PARCEL A_SW

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	1350	S11	57.059	54.480	1.229	Open Manhole	3000
2.000	o	750	S27	57.026	54.981	1.295	Open Manhole	2100
1.001	o	1350	S12	57.340	54.414	1.576	Open Manhole	3000
1.002	o	1350	S13	57.489	54.317	1.822	Open Manhole	3000
1.003	o	1350	S14	57.474	54.253	1.871	Open Manhole	3000
1.004	o	1350	S15	57.421	54.235	1.836	Open Manhole	3000
1.005	o	1350	S16	57.742	54.170	2.222	Open Manhole	3000
1.006	o	1350	S17	58.061	54.140	2.571	Open Manhole	3000
1.007	o	1350	S23	57.812	54.096	2.366	Open Manhole	3000
1.008	o	1350	S24	57.874	54.068	2.456	Open Manhole	3000
1.009	o	225	S25 HYDROBRAKE	57.902	54.004	3.673	Open Manhole	3000
1.010	o	225	S26	57.595	53.970	3.400	Open Manhole	1350

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	26.567	400.0	S12	57.340	54.414	1.576	Open Manhole	3000
2.000	22.832	400.6	S12	57.340	54.924	1.666	Open Manhole	3000
1.001	12.940	392.1	S13	57.489	54.381	1.758	Open Manhole	3000
1.002	25.643	400.7	S14	57.474	54.253	1.871	Open Manhole	3000
1.003	7.074	393.0	S15	57.421	54.235	1.836	Open Manhole	3000
1.004	26.163	400.0	S16	57.742	54.170	2.222	Open Manhole	3000
1.005	11.645	400.0	S17	58.061	54.140	2.571	Open Manhole	3000
1.006	17.732	400.0	S23	57.812	54.096	2.366	Open Manhole	3000
1.007	11.060	395.0	S24	57.874	54.068	2.456	Open Manhole	3000
1.008	25.610	400.0	S25 HYDROBRAKE	57.902	54.004	2.548	Open Manhole	3000
1.009	5.734	167.0	S26	57.595	53.970	3.400	Open Manhole	1350
1.010	5.257	167.0	S27 PUMP STATION	57.664	53.939	3.500	Open Manhole	225

Surcharged Outfall Details for PARCEL A_SW

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.010	S27 PUMP STATION	57.664	53.939	53.000	225	0

Datum (m) 0.000 Offset (mins) 0

Surcharged Outfall Details for PARCEL A_SW

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
5	1.000	15	1.000	25	1.000	35	1.000	45	1.000	55	1.000
10	1.000	20	1.000	30	1.000	40	1.000	50	1.000	60	1.000

Simulation Criteria for PARCEL A_SW

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	4.000
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	0
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)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Storm Duration (mins)	30
Ratio R	0.283		

Online Controls for PARCEL A_SW

Hydro-Brake® Optimum Manhole: S25 HYDROBRAKE, DS/PN: 1.009, Volume (m³): 59.9

Unit Reference	MD-SHE-0119-9400-2600-9400
Design Head (m)	2.600
Design Flow (l/s)	9.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	119
Invert Level (m)	54.004
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.600	9.4
Flush-Flo™	0.523	7.8
Kick-Flo®	1.065	6.2
Mean Flow over Head Range	-	7.4

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	4.2	1.200	6.5	3.000	10.1	7.000	15.0
0.200	6.7	1.400	7.0	3.500	10.8	7.500	15.6
0.300	7.4	1.600	7.5	4.000	11.5	8.000	16.0
0.400	7.7	1.800	7.9	4.500	12.2	8.500	16.5
0.500	7.8	2.000	8.3	5.000	12.8	9.000	17.0
0.600	7.7	2.200	8.7	5.500	13.4	9.500	17.4
0.800	7.5	2.400	9.1	6.000	14.0		
1.000	6.7	2.600	9.4	6.500	14.5		

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

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	4.000
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	0
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 0.283
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
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia 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)	2, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	S11	180 minute 2 year Winter I+0%	57.059	54.685	-1.145	0.000
2.000	S27	15 minute 2 year Winter I+0%	57.026	55.078	-0.653	0.000
1.001	S12	180 minute 2 year Winter I+0%	57.340	54.685	-1.079	0.000
1.002	S13	180 minute 2 year Winter I+0%	57.489	54.685	-0.982	0.000
1.003	S14	180 minute 2 year Winter I+0%	57.474	54.685	-0.918	0.000
1.004	S15	180 minute 2 year Winter I+0%	57.421	54.685	-0.900	0.000
1.005	S16	180 minute 2 year Winter I+0%	57.742	54.684	-0.835	0.000
1.006	S17	180 minute 2 year Winter I+0%	58.061	54.684	-0.806	0.000
1.007	S23	180 minute 2 year Winter I+0%	57.812	54.684	-0.762	0.000
1.008	S24	180 minute 2 year Winter I+0%	57.874	54.684	-0.735	0.000
1.009	S25 HYDROBRAKE	180 minute 2 year Winter I+0%	57.902	54.683	0.454	0.000
1.010	S26	30 minute 2 year Winter I+0%	57.595	54.048	-0.147	0.000

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

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	S11	0.00		8.1	OK
2.000	S27	0.04		17.9	OK
1.001	S12	0.01		14.7	OK
1.002	S13	0.01		14.7	OK
1.003	S14	0.01		12.8	OK
1.004	S15	0.01		13.4	OK
1.005	S16	0.01		10.3	OK
1.006	S17	0.01		8.1	OK
1.007	S23	0.01		11.0	OK
1.008	S24	0.01		12.8	OK
1.009	S25 HYDROBRAKE	0.26		7.8	SURCHARGED
1.010	S26	0.26		7.8	OK

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

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	4.000
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	0
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 0.283
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
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia 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)	2, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	S11	240 minute 30 year Winter I+0%	57.059	55.131	-0.699	0.000
2.000	S27	240 minute 30 year Winter I+0%	57.026	55.131	-0.600	0.000
1.001	S12	240 minute 30 year Winter I+0%	57.340	55.131	-0.633	0.000
1.002	S13	240 minute 30 year Winter I+0%	57.489	55.131	-0.536	0.000
1.003	S14	240 minute 30 year Winter I+0%	57.474	55.130	-0.473	0.000
1.004	S15	240 minute 30 year Winter I+0%	57.421	55.130	-0.455	0.000
1.005	S16	240 minute 30 year Winter I+0%	57.742	55.130	-0.390	0.000
1.006	S17	240 minute 30 year Winter I+0%	58.061	55.130	-0.361	0.000
1.007	S23	240 minute 30 year Winter I+0%	57.812	55.129	-0.317	0.000
1.008	S24	240 minute 30 year Winter I+0%	57.874	55.129	-0.289	0.000
1.009	S25 HYDROBRAKE	240 minute 30 year Winter I+0%	57.902	55.127	0.898	0.000
1.010	S26	960 minute 30 year Winter I+0%	57.595	54.048	-0.147	0.000

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

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	S11	0.01		11.2	OK
2.000	S27	0.02		8.2	OK
1.001	S12	0.01		17.9	OK
1.002	S13	0.01		16.9	OK
1.003	S14	0.01		12.3	OK
1.004	S15	0.01		13.5	OK
1.005	S16	0.01		9.3	OK
1.006	S17	0.00		7.4	OK
1.007	S23	0.01		10.5	OK
1.008	S24	0.01		14.3	OK
1.009	S25 HYDROBRAKE	0.26		7.8	SURCHARGED
1.010	S26	0.26		7.8	OK

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

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	4.000
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	0
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 0.283
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
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia 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)	2, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	S11	360 minute 100 year Winter I+40%	57.059	56.791	0.961	0.000
2.000	S27	360 minute 100 year Winter I+40%	57.026	56.791	1.060	0.000
1.001	S12	360 minute 100 year Winter I+40%	57.340	56.791	1.027	0.000
1.002	S13	360 minute 100 year Winter I+40%	57.489	56.791	1.124	0.000
1.003	S14	360 minute 100 year Winter I+40%	57.474	56.791	1.188	0.000
1.004	S15	360 minute 100 year Winter I+40%	57.421	56.791	1.206	0.000
1.005	S16	360 minute 100 year Winter I+40%	57.742	56.791	1.271	0.000
1.006	S17	360 minute 100 year Winter I+40%	58.061	56.791	1.300	0.000
1.007	S23	360 minute 100 year Winter I+40%	57.812	56.791	1.345	0.000
1.008	S24	360 minute 100 year Winter I+40%	57.874	56.791	1.373	0.000
1.009	S25 HYDROBRAKE	360 minute 100 year Winter I+40%	57.902	56.791	2.562	0.000
1.010	S26	360 minute 100 year Winter I+40%	57.595	54.058	-0.137	0.000

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

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	S11	0.01		15.4	FLOOD RISK
2.000	S27	0.02		9.9	FLOOD RISK
1.001	S12	0.02		19.9	SURCHARGED
1.002	S13	0.01		18.0	SURCHARGED
1.003	S14	0.01		11.9	SURCHARGED
1.004	S15	0.01		13.4	SURCHARGED
1.005	S16	0.01		7.6	SURCHARGED
1.006	S17	0.00		6.8	SURCHARGED
1.007	S23	0.01		10.8	SURCHARGED
1.008	S24	0.01		17.2	SURCHARGED
1.009	S25 HYDROBRAKE	0.32		9.6	SURCHARGED
1.010	S26	0.32		9.6	OK