STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	1
FEH Rainfall Version	1999
Site Location	GB 529200 120700 TQ 29200 20700
C (1km)	-0.027
D1 (1km)	0.383
D2 (1km)	0.289
D3 (1km)	0.420
E (1km)	0.316
F (1km)	2.478
Maximum Rainfall (mm/hr)	550
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	1.000
PIMP (%)	100
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	1.00
Min Slope for Optimisation (1:X)	300

Designed with Level Soffits

Network Design Table for Storm

« - 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
S3.000	4.002	0.725	5.5	0.055	5.00	0.0	0.600	o	100	Pipe/Conduit	
S4.000	5.282	0.728	7.3	0.044	5.00	0.0	0.600	o	100	Pipe/Conduit	
S3.001	54.707	0.180	303.9	0.000	0.00	0.0	0.600	o	750	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)
S3.000	55.08	5.02	23.175	0.055	0.0	0.0	0.0	3.31	26.0	10.9
S4.000	55.01	5.03	23.178	0.044	0.0	0.0	0.0	2.89	22.7	8.7
S3.001	51.48	5.60	21.800	0.099	0.0	0.0	0.0	1.60	706.8	18.4

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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
S5.000	3.595	0.205	17.5	0.046	5.00	0.0	0.600	o	100	Pipe/Conduit	
S6.000	5.525	0.205	27.0	0.042	5.00	0.0	0.600	o	100	Pipe/Conduit	
S3.002	36.412	0.120	303.4	0.000	0.00	0.0	0.600	o	750	Pipe/Conduit	
S7.000	2.997	0.087	34.4	0.049	5.00	0.0	0.600	o	100	Pipe/Conduit	
S8.000	6.057	0.081	74.8	0.044	5.00	0.0	0.600	o	100	Pipe/Conduit	
S3.003	36.517	0.131	278.8	0.000	0.00	0.0	0.600	o	750	Pipe/Conduit	
S9.000	4.054	0.264	15.4	0.040	5.00	0.0	0.600	o	100	Pipe/Conduit	
S10.000	5.441	0.264	20.6	0.036	5.00	0.0	0.600	o	100	Pipe/Conduit	
S3.004	7.197	0.032	224.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.005	13.171	0.091	144.7	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.006	42.402	0.141	300.7	0.000	0.00	0.0	0.600	o	1050	Pipe/Conduit	
S11.000	5.430	1.190	4.6	0.036	5.00	0.0	0.600	o	100	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)
S5.000	54.99	5.03	22.475	0.046	0.0	0.0	0.0	1.85	14.6	9.1
S6.000	54.80	5.06	22.475	0.042	0.0	0.0	0.0	1.49	11.7	8.3
S3.002	49.44	5.98	21.620	0.187	0.0	0.0	0.0	1.60	707.4	33.4
S7.000	54.96	5.04	22.237	0.049	0.0	0.0	0.0	1.32	10.4	9.7
S8.000	54.45	5.11	22.231	0.044	0.0	0.0	0.0	0.89	7.0«	8.7
S3.003	47.67	6.34	21.500	0.280	0.0	0.0	0.0	1.67	738.3	48.2
S9.000	54.98	5.03	22.283	0.040	0.0	0.0	0.0	1.98	15.6	7.9
S10.000	54.85	5.05	22.283	0.036	0.0	0.0	0.0	1.71	13.4	7.1
S3.004	47.04	6.48	20.708	0.356	0.0	0.0	0.0	0.87	34.5«	60.5
S3.005	46.16	6.68	20.676	0.356	0.0	0.0	0.0	1.08	43.1«	60.5
S3.006	44.70	7.04	20.583	0.356	0.0	0.0	0.0	1.98	1716.2	60.5
S11.000	55.04	5.02	22.744	0.036	0.0	0.0	0.0	3.65	28.6	7.2

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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
S12.000	3.741	1.190	3.1	0.041	5.00	0.0	0.600	o	100	Pipe/Conduit	
S3.007	41.626	0.139	299.5	0.000	0.00	0.0	0.600	o	1200	Pipe/Conduit	
S13.000	4.118	1.530	2.7	0.032	5.00	0.0	0.600	o	100	Pipe/Conduit	
S14.000	5.778	1.525	3.8	0.028	5.00	0.0	0.600	o	100	Pipe/Conduit	
S3.008	49.164	0.164	300.0	0.000	0.00	0.0	0.600	o	1200	Pipe/Conduit	
S15.000	3.912	1.017	3.8	0.038	5.00	0.0	0.600	o	100	Pipe/Conduit	
S16.000	5.429	1.008	5.4	0.035	5.00	0.0	0.600	o	100	Pipe/Conduit	
S3.009	42.544	0.142	299.6	0.000	0.00	0.0	0.600	o	1200	Pipe/Conduit	
S17.000	5.499	0.619	8.9	0.035	5.00	0.0	0.600	o	100	Pipe/Conduit	
S18.000	5.346	0.520	10.3	0.036	5.00	0.0	0.600	o	100	Pipe/Conduit	
S3.010	33.954	0.113	300.5	0.000	0.00	0.0	0.600	o	1200	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)
S12.000	55.12	5.01	22.744	0.041	0.0	0.0	0.0	4.39	34.5	8.2
S3.007	43.49	7.36	20.442	0.433	0.0	0.0	0.0	2.16	2439.2	68.0
S13.000	55.11	5.01	22.934	0.032	0.0	0.0	0.0	4.75	37.3	6.4
S14.000	55.05	5.02	22.929	0.028	0.0	0.0	0.0	4.00	31.4	5.6
S3.008	42.16	7.74	20.303	0.493	0.0	0.0	0.0	2.15	2437.0	75.0
S15.000	55.10	5.02	22.269	0.038	0.0	0.0	0.0	3.97	31.2	7.6
S16.000	55.03	5.03	22.260	0.035	0.0	0.0	0.0	3.35	26.3	7.0
S3.009	41.09	8.07	20.139	0.566	0.0	0.0	0.0	2.16	2438.6	84.0
S17.000	54.97	5.04	21.741	0.035	0.0	0.0	0.0	2.61	20.5	6.9
S18.000	54.96	5.04	21.642	0.036	0.0	0.0	0.0	2.42	19.0	7.1
S3.010	40.28	8.33	19.997	0.637	0.0	0.0	0.0	2.15	2435.1	92.7

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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
S19.000	4.012	0.196	20.5	0.037	5.00	0.0	0.600	o	100	Pipe/Conduit	
S20.000	5.465	0.201	27.2	0.027	5.00	0.0	0.600	o	100	Pipe/Conduit	
S3.011	23.643	0.079	299.3	0.000	0.00	0.0	0.600	o	1200	Pipe/Conduit	
S21.000	5.966	0.060	100.0	0.026	5.00	0.0	0.600	o	100	Pipe/Conduit	
S22.000	4.351	0.044	100.0	0.030	5.00	0.0	0.600	o	100	Pipe/Conduit	
S3.012	7.470	0.050	149.4	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)
S19.000	54.95	5.04	21.160	0.037	0.0	0.0	0.0	1.71	13.5	7.3
S20.000	54.80	5.06	21.165	0.027	0.0	0.0	0.0	1.49	11.7	5.3
S3.011	39.75	8.52	19.884	0.701	0.0	0.0	0.0	2.16	2440.0	100.6
S21.000	54.35	5.13	20.468	0.026	0.0	0.0	0.0	0.77	6.0	5.1
S22.000	54.58	5.09	20.470	0.030	0.0	0.0	0.0	0.77	6.0	5.9
S3.012	39.42	8.63	19.805	0.757	0.0	0.0	0.0	1.07	42.4«	107.7

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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)	Back (m
STP04-319	24.700	1.525	Open Manhole	1200	S3.000	23.175	100				
STP04-320	24.700	1.522	Open Manhole	1200	S4.000	23.178	100				
SMH04-312	24.873	3.073	Open Manhole	1800	S3.001	21.800	750	S3.000	22.450	100	
								S4.000	22.450	100	
STP04-317	24.006	1.531	Open Manhole	1200	S5.000	22.475	100				
STP04-318	24.006	1.531	Open Manhole	1200	S6.000	22.475	100				
SMH04-311	24.016	2.396	Open Manhole	1800	S3.002	21.620	750	S3.001	21.620	750	
								S5.000	22.270	100	
								S6.000	22.270	100	
STP04-315	23.757	1.520	Open Manhole	1200	S7.000	22.237	100				
STP04-316	23.757	1.526	Open Manhole	1200	S8.000	22.231	100				
SMH04-310	23.800	2.300	Open Manhole	1800	S3.003	21.500	750	S3.002	21.500	750	
								S7.000	22.150	100	
								S8.000	22.150	100	
STP04-313	23.803	1.520	Open Manhole	1200	S9.000	22.283	100				
STP04-314	23.803	1.520	Open Manhole	1200	S10.000	22.283	100				
SMH04-309	24.070	3.362	Open Manhole	1800	S3.004	20.708	225	S3.003	21.369	750	
								S9.000	22.019	100	
								S10.000	22.019	100	
SMH04-308	24.141	3.465	Open Manhole	1200	S3.005	20.676	225	S3.004	20.676	225	
SMH04-307	24.279	3.696	Open Manhole	2100	S3.006	20.583	1050	S3.005	20.585	225	
STP04-312	24.265	1.521	Open Manhole	1200	S11.000	22.744	100				
STP04-311	24.265	1.521	Open Manhole	1200	S12.000	22.744	100				
SMH04-306	24.726	4.284	Open Manhole	2100	S3.007	20.442	1200	S3.006	20.442	1050	
								S11.000	21.554	100	
								S12.000	21.554	100	
STP04-309	24.450	1.516	Open Manhole	1200	S13.000	22.934	100				
STP04-310	24.450	1.521	Open Manhole	1200	S14.000	22.929	100				
SMH04-305	24.604	4.301	Open Manhole	2100	S3.008	20.303	1200	S3.007	20.303	1200	
								S13.000	21.404	100	
								S14.000	21.404	100	
STP04-307	23.802	1.533	Open Manhole	1200	S15.000	22.269	100				
STP04-308	23.802	1.542	Open Manhole	1200	S16.000	22.260	100				
SMH04-304	23.784	3.645	Open Manhole	2100	S3.009	20.139	1200	S3.008	20.139	1200	
								S15.000	21.252	100	
								S16.000	21.252	100	
STP04-305	23.264	1.523	Open Manhole	1200	S17.000	21.741	100				
STP04-306	23.160	1.518	Open Manhole	1200	S18.000	21.642	100				

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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)	Back (m
SMH04-303	23.197	3.200	Open Manhole	2100	S3.010	19.997	1200	S3.009	19.997	1200	
								S17.000	21.122	100	
								S18.000	21.122	100	
STP04-303	22.696	1.536	Open Manhole	1200	S19.000	21.160	100				
STP04-304	22.696	1.531	Open Manhole	1200	S20.000	21.165	100				
SMH04-302	22.729	2.845	Open Manhole	2100	S3.011	19.884	1200	S3.010	19.884	1200	
								S19.000	20.964	100	
								S20.000	20.964	100	
STP04-302	22.010	1.542	Open Manhole	1200	S21.000	20.468	100				
STP04-301	22.010	1.540	Open Manhole	1200	S22.000	20.470	100				
SMH04-301	22.236	2.431	Open Manhole	2100	S3.012	19.805	225	S3.011	19.805	1200	
								S21.000	20.408	100	
								S22.000	20.426	100	
S	22.050	2.295	Open Manhole	0		OUTFALL		S3.012	19.755	225	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
STP04-319	530026.899	120767.636	530026.899	120767.636	Required	
STP04-320	530031.568	120759.612	530031.568	120759.612	Required	
SMH04-312	530028.913	120764.178	530028.913	120764.178	Required	
STP04-317	529978.312	120743.902	529978.312	120743.902	Required	
STP04-318	529981.524	120735.366	529981.524	120735.366	Required	
SMH04-311	529979.578	120740.537	529979.578	120740.537	Required	
STP04-315	529944.057	120732.644	529944.057	120732.644	Required	

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Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
STP04-316	529946.312	120723.875	529946.312	120723.875	Required	
SMH04-310	529944.803	120729.741	529944.803	120729.741	Required	
STP04-313	529908.640	120725.093	529908.640	120725.093	Required	
STP04-314	529911.219	120715.998	529911.219	120715.998	Required	
SMH04-309	529909.323	120721.098	529909.323	120721.098	Required	
SMH04-308	529902.131	120720.840	529902.142	120720.598	Required	
SMH04-307	529888.982	120720.069	529889.007	120719.865	Required	
STP04-312	529848.298	120706.137	529848.298	120706.137	Required	
STP04-311	529846.874	120715.196	529846.874	120715.196	Required	
SMH04-306	529847.455	120711.501	529847.455	120711.501	Required	
STP04-309	529806.385	120709.161	529806.385	120709.161	Required	
STP04-310	529808.064	120699.531	529808.064	120699.531	Required	
SMH04-305	529806.333	120705.043	529806.333	120705.043	Required	
STP04-307	529757.170	120701.264	529757.170	120701.264	Required	
STP04-308	529758.606	120692.034	529758.606	120692.034	Required	

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Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SMH04-304	529757.767	120697.397	529757.767	120697.397	Required	
STP04-305	529718.923	120695.292	529718.923	120695.292	Required	
STP04-306	529716.749	120685.562	529716.749	120685.562	Required	
SMH04-303	529715.736	120690.811	529715.736	120690.811	Required	
STP04-303	529681.515	120689.470	529681.515	120689.470	Required	
STP04-304	529682.986	120680.109	529682.986	120680.109	Required	
SMH04-302	529682.198	120685.517	529682.198	120685.517	Required	
STP04-302	529662.068	120676.854	529662.068	120676.854	Required	
STP04-301	529660.430	120685.919	529660.430	120685.919	Required	
SMH04-301	529658.837	120681.870	529658.837	120681.870	Required	
S	529651.458	120680.711			No Entry	

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
3.000	-	-	100	0.055	0.055	0.055
4.000	-	-	100	0.044	0.044	0.044
3.001	-	-	100	0.000	0.000	0.000
5.000	-	-	100	0.046	0.046	0.046
6.000	-	-	100	0.042	0.042	0.042
3.002	-	-	100	0.000	0.000	0.000
7.000	-	-	100	0.049	0.049	0.049
8.000	-	-	100	0.044	0.044	0.044
3.003	-	-	100	0.000	0.000	0.000
9.000	-	-	100	0.040	0.040	0.040
10.000	-	-	100	0.036	0.036	0.036
3.004	-	-	100	0.000	0.000	0.000
3.005	-	-	100	0.000	0.000	0.000
3.006	-	-	100	0.000	0.000	0.000
11.000	-	-	100	0.036	0.036	0.036
12.000	-	-	100	0.041	0.041	0.041
3.007	-	-	100	0.000	0.000	0.000
13.000	-	-	100	0.032	0.032	0.032
14.000	-	-	100	0.028	0.028	0.028
3.008	-	-	100	0.000	0.000	0.000
15.000	-	-	100	0.038	0.038	0.038
16.000	-	-	100	0.035	0.035	0.035
3.009	-	-	100	0.000	0.000	0.000
17.000	-	-	100	0.035	0.035	0.035
18.000	-	-	100	0.036	0.036	0.036
3.010	-	-	100	0.000	0.000	0.000
19.000	-	-	100	0.037	0.037	0.037
20.000	-	-	100	0.027	0.027	0.027
3.011	-	-	100	0.000	0.000	0.000
21.000	-	-	100	0.026	0.026	0.026
22.000	-	-	100	0.030	0.030	0.030
3.012	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.757	0.757	0.757

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)
S3.012	S	22.050	19.755	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 * 10m³/ha Storage	5.000
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)	2500
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	16

Number of Input Hydrographs	0	Number of Storage Structures	20
Number of Online Controls	4	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 529200 120700 TQ 29200 20700
C (1km)	-0.027
D1 (1km)	0.383
D2 (1km)	0.289
D3 (1km)	0.420
E (1km)	0.316
F (1km)	2.478
Summer Storms	No
Winter Storms	Yes
Cv (Summer)	1.000
Cv (Winter)	1.000
Storm Duration (mins)	960

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: SMH04-309, DS/PN: S3.004, Volume (m³): 23.9

Unit Reference	MD-SHE-0100-4500-1000-4500
Design Head (m)	1.000
Design Flow (l/s)	4.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	100
Invert Level (m)	20.708
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.000	4.5
Flush-Flo™	0.292	4.5
Kick-Flo®	0.630	3.6
Mean Flow over Head Range	-	3.9

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	3.3	1.200	4.9	3.000	7.5	7.000	11.2
0.200	4.4	1.400	5.3	3.500	8.1	7.500	11.6
0.300	4.5	1.600	5.6	4.000	8.6	8.000	12.0
0.400	4.4	1.800	5.9	4.500	9.1	8.500	12.3
0.500	4.2	2.000	6.2	5.000	9.6	9.000	12.7
0.600	3.8	2.200	6.5	5.500	10.0	9.500	13.0
0.800	4.1	2.400	6.8	6.000	10.4		
1.000	4.5	2.600	7.0	6.500	10.8		

Hydro-Brake® Optimum Manhole: SMH04-306, DS/PN: S3.007, Volume (m³): 49.8

Unit Reference	MD-SHE-0100-4500-1000-4500
Design Head (m)	1.000
Design Flow (l/s)	4.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	100
Invert Level (m)	20.442
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

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Hydro-Brake® Optimum Manhole: SMH04-306, DS/PN: S3.007, Volume (m³): 49.8

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	4.5
Flush-Flo™	0.292	4.5
Kick-Flo®	0.630	3.6
Mean Flow over Head Range	-	3.9

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	3.3	1.200	4.9	3.000	7.5	7.000	11.2
0.200	4.4	1.400	5.3	3.500	8.1	7.500	11.6
0.300	4.5	1.600	5.6	4.000	8.6	8.000	12.0
0.400	4.4	1.800	5.9	4.500	9.1	8.500	12.3
0.500	4.2	2.000	6.2	5.000	9.6	9.000	12.7
0.600	3.8	2.200	6.5	5.500	10.0	9.500	13.0
0.800	4.1	2.400	6.8	6.000	10.4		
1.000	4.5	2.600	7.0	6.500	10.8		

Hydro-Brake® Optimum Manhole: SMH04-304, DS/PN: S3.009, Volume (m³): 65.9

Unit Reference	MD-SHE-0087-4000-1500-4000
Design Head (m)	1.500
Design Flow (l/s)	4.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	87
Invert Level (m)	20.139
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	4.0
Flush-Flo™	0.384	3.7
Kick-Flo®	0.780	3.0
Mean Flow over Head Range	-	3.3

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	2.7	0.300	3.6	0.500	3.6	0.800	3.0
0.200	3.4	0.400	3.7	0.600	3.5	1.000	3.3

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Hydro-Brake® Optimum Manhole: SMH04-304, DS/PN: S3.009, Volume (m³): 65.9

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
1.200	3.6	2.400	5.0	5.000	7.0	8.000	8.8
1.400	3.9	2.600	5.2	5.500	7.3	8.500	9.0
1.600	4.1	3.000	5.5	6.000	7.7	9.000	9.3
1.800	4.4	3.500	5.9	6.500	8.0	9.500	9.5
2.000	4.6	4.000	6.3	7.000	8.2		
2.200	4.8	4.500	6.7	7.500	8.5		

Hydro-Brake® Optimum Manhole: SMH04-301, DS/PN: S3.012, Volume (m³): 32.8

Unit Reference	MD-SHE-0097-5600-2000-5600
Design Head (m)	2.000
Design Flow (l/s)	5.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	97
Invert Level (m)	19.805
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	5.6
Flush-Flo™	0.425	4.8
Kick-Flo®	0.868	3.8
Mean Flow over Head Range	-	4.5

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	3.2	1.200	4.4	3.000	6.8	7.000	10.1
0.200	4.3	1.400	4.7	3.500	7.3	7.500	10.4
0.300	4.7	1.600	5.0	4.000	7.7	8.000	10.8
0.400	4.8	1.800	5.3	4.500	8.2	8.500	11.1
0.500	4.7	2.000	5.6	5.000	8.6	9.000	11.4
0.600	4.6	2.200	5.8	5.500	9.0	9.500	11.7
0.800	4.2	2.400	6.1	6.000	9.4		
1.000	4.1	2.600	6.3	6.500	9.7		

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Storage Structures for Storm

Bio-Retention Area Manhole: STP04-319, DS/PN: S3.000

Invert Level (m) 23.175 Infiltration Coefficient Side (m/hr) 0.00000
Porosity 0.30 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000

Depth (m)	Area (m²)	Perimeter (m)	Depth (m)	Area (m²)	Perimeter (m)
0.000	150.0	114.000	1.000	150.0	114.000

Bio-Retention Area Manhole: STP04-320, DS/PN: S4.000

Invert Level (m) 23.178 Infiltration Coefficient Side (m/hr) 0.00000
Porosity 0.30 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000

Depth (m)	Area (m²)	Perimeter (m)	Depth (m)	Area (m²)	Perimeter (m)
0.000	117.0	94.000	1.000	117.0	94.000

Bio-Retention Area Manhole: STP04-317, DS/PN: S5.000

Invert Level (m) 22.475 Infiltration Coefficient Side (m/hr) 0.00000
Porosity 0.30 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000

Depth (m)	Area (m²)	Perimeter (m)	Depth (m)	Area (m²)	Perimeter (m)
0.000	85.0	70.000	1.000	85.0	70.000

Bio-Retention Area Manhole: STP04-318, DS/PN: S6.000

Invert Level (m) 22.475 Infiltration Coefficient Side (m/hr) 0.00000
Porosity 0.30 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000

Depth (m)	Area (m²)	Perimeter (m)	Depth (m)	Area (m²)	Perimeter (m)
0.000	87.0	70.000	1.000	87.0	70.000

Bio-Retention Area Manhole: STP04-315, DS/PN: S7.000

Invert Level (m) 22.237 Infiltration Coefficient Side (m/hr) 0.00000
Porosity 0.30 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000

Depth (m)	Area (m²)	Perimeter (m)	Depth (m)	Area (m²)	Perimeter (m)
0.000	59.0	51.000	1.000	59.0	51.000

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Bio-Retention Area Manhole: STP04-316, DS/PN: S8.000

Invert Level (m) 22.231 Infiltration Coefficient Side (m/hr) 0.00000
Porosity 0.30 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000

Depth (m)	Area (m²)	Perimeter (m)	Depth (m)	Area (m²)	Perimeter (m)
0.000	62.0	53.000	1.000	62.0	53.000

Bio-Retention Area Manhole: STP04-313, DS/PN: S9.000

Invert Level (m) 22.283 Infiltration Coefficient Side (m/hr) 0.00000
Porosity 0.30 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000

Depth (m)	Area (m²)	Perimeter (m)	Depth (m)	Area (m²)	Perimeter (m)
0.000	104.0	91.000	1.000	104.0	91.000

Bio-Retention Area Manhole: STP04-314, DS/PN: S10.000

Invert Level (m) 22.283 Infiltration Coefficient Side (m/hr) 0.00000
Porosity 0.30 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000

Depth (m)	Area (m²)	Perimeter (m)	Depth (m)	Area (m²)	Perimeter (m)
0.000	107.0	92.000	1.000	107.0	92.000

Bio-Retention Area Manhole: STP04-312, DS/PN: S11.000

Invert Level (m) 22.744 Infiltration Coefficient Side (m/hr) 0.00000
Porosity 0.30 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000

Depth (m)	Area (m²)	Perimeter (m)	Depth (m)	Area (m²)	Perimeter (m)
0.000	94.0	83.000	1.000	94.0	83.000

Bio-Retention Area Manhole: STP04-311, DS/PN: S12.000

Invert Level (m) 22.744 Infiltration Coefficient Side (m/hr) 0.00000
Porosity 0.30 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000

Depth (m)	Area (m²)	Perimeter (m)	Depth (m)	Area (m²)	Perimeter (m)
0.000	94.0	83.000	1.000	94.0	83.000

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Bio-Retention Area Manhole: STP04-309, DS/PN: S13.000

Invert Level (m) 22.934 Infiltration Coefficient Side (m/hr) 0.00000
Porosity 0.30 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000

Depth (m)	Area (m²)	Perimeter (m)	Depth (m)	Area (m²)	Perimeter (m)
0.000	73.0	59.000	1.000	73.0	59.000

Bio-Retention Area Manhole: STP04-310, DS/PN: S14.000

Invert Level (m) 22.929 Infiltration Coefficient Side (m/hr) 0.00000
Porosity 0.30 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000

Depth (m)	Area (m²)	Perimeter (m)	Depth (m)	Area (m²)	Perimeter (m)
0.000	73.0	59.000	1.000	73.0	59.000

Bio-Retention Area Manhole: STP04-307, DS/PN: S15.000

Invert Level (m) 22.269 Infiltration Coefficient Side (m/hr) 0.00000
Porosity 0.30 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000

Depth (m)	Area (m²)	Perimeter (m)	Depth (m)	Area (m²)	Perimeter (m)
0.000	65.0	53.000	1.000	65.0	53.000

Bio-Retention Area Manhole: STP04-308, DS/PN: S16.000

Invert Level (m) 22.260 Infiltration Coefficient Side (m/hr) 0.00000
Porosity 0.30 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000

Depth (m)	Area (m²)	Perimeter (m)	Depth (m)	Area (m²)	Perimeter (m)
0.000	74.0	59.000	1.000	74.0	59.000

Bio-Retention Area Manhole: STP04-305, DS/PN: S17.000

Invert Level (m) 21.741 Infiltration Coefficient Side (m/hr) 0.00000
Porosity 0.30 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000

Depth (m)	Area (m²)	Perimeter (m)	Depth (m)	Area (m²)	Perimeter (m)
0.000	86.0	69.000	1.000	86.0	69.000

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Bio-Retention Area Manhole: STP04-306, DS/PN: S18.000

Invert Level (m) 21.642 Infiltration Coefficient Side (m/hr) 0.00000
Porosity 0.30 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000

Depth (m)	Area (m²)	Perimeter (m)	Depth (m)	Area (m²)	Perimeter (m)
0.000	78.0	64.000	1.000	78.0	64.000

Bio-Retention Area Manhole: STP04-303, DS/PN: S19.000

Invert Level (m) 21.160 Infiltration Coefficient Side (m/hr) 0.00000
Porosity 0.30 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000

Depth (m)	Area (m²)	Perimeter (m)	Depth (m)	Area (m²)	Perimeter (m)
0.000	70.0	57.000	1.000	70.0	57.000

Bio-Retention Area Manhole: STP04-304, DS/PN: S20.000

Invert Level (m) 21.165 Infiltration Coefficient Side (m/hr) 0.00000
Porosity 0.30 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000

Depth (m)	Area (m²)	Perimeter (m)	Depth (m)	Area (m²)	Perimeter (m)
0.000	70.0	56.000	1.000	70.0	56.000

Bio-Retention Area Manhole: STP04-302, DS/PN: S21.000

Invert Level (m) 20.468 Infiltration Coefficient Side (m/hr) 0.00000
Porosity 0.30 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000

Depth (m)	Area (m²)	Perimeter (m)	Depth (m)	Area (m²)	Perimeter (m)
0.000	82.0	65.000	1.000	82.0	65.000

Bio-Retention Area Manhole: STP04-301, DS/PN: S22.000

Invert Level (m) 20.470 Infiltration Coefficient Side (m/hr) 0.00000
Porosity 0.30 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000

Depth (m)	Area (m²)	Perimeter (m)	Depth (m)	Area (m²)	Perimeter (m)
0.000	82.0	65.000	1.000	82.0	65.000

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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 5.000
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 20
Number of Online Controls 4 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	1999
Site Location	GB 529200 120700 TQ 29200 20700
C (1km)	-0.027
D1 (1km)	0.383
D2 (1km)	0.289
D3 (1km)	0.420
E (1km)	0.316
F (1km)	2.478
Cv (Summer)	1.000
Cv (Winter)	1.000

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, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S3.000	STP04-319	720 Winter	100	+40%	100/15 Summer			
S4.000	STP04-320	720 Winter	100	+40%	100/15 Summer			
S3.001	SMH04-312	720 Winter	100	+40%	30/60 Summer			
S5.000	STP04-317	720 Winter	100	+40%	30/15 Summer			
S6.000	STP04-318	720 Winter	100	+40%	30/15 Summer			
S3.002	SMH04-311	720 Winter	100	+40%	30/15 Summer			
S7.000	STP04-315	720 Winter	100	+40%	30/15 Summer			
S8.000	STP04-316	720 Winter	100	+40%	30/15 Summer			
S3.003	SMH04-310	720 Winter	100	+40%	30/15 Summer			

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

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
S3.000	STP04-319	23.582	0.307	0.000	0.20		372	4.3	SURCHARGED
S4.000	STP04-320	23.582	0.304	0.000	0.17		372	3.5	SURCHARGED
S3.001	SMH04-312	23.582	1.032	0.000	0.01			7.5	SURCHARGED
S5.000	STP04-317	23.581	1.006	0.000	0.22			2.7	SURCHARGED
S6.000	STP04-318	23.582	1.007	0.000	0.24			2.5	SURCHARGED
S3.002	SMH04-311	23.582	1.212	0.000	0.02			9.3	SURCHARGED
S7.000	STP04-315	23.581	1.244	0.000	0.29			2.4	FLOOD RISK
S8.000	STP04-316	23.582	1.251	0.000	0.34			2.1	FLOOD RISK
S3.003	SMH04-310	23.582	1.332	0.000	0.02			10.3	FLOOD RISK

PN	US/MH Name	Level Exceeded
S3.000	STP04-319	
S4.000	STP04-320	
S3.001	SMH04-312	
S5.000	STP04-317	
S6.000	STP04-318	
S3.002	SMH04-311	
S7.000	STP04-315	
S8.000	STP04-316	
S3.003	SMH04-310	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S9.000	STP04-313	720 Winter	100	+40%	30/15 Summer			
S10.000	STP04-314	720 Winter	100	+40%	30/15 Summer			
S3.004	SMH04-309	720 Winter	100	+40%	1/15 Summer			
S3.005	SMH04-308	720 Winter	100	+40%	1/180 Summer			
S3.006	SMH04-307	720 Winter	100	+40%	30/360 Summer			
S11.000	STP04-312	720 Winter	100	+40%	100/15 Summer			
S12.000	STP04-311	720 Winter	100	+40%	100/15 Summer			
S3.007	SMH04-306	720 Winter	100	+40%	30/360 Summer			
S13.000	STP04-309	720 Winter	100	+40%	100/15 Summer			
S14.000	STP04-310	720 Winter	100	+40%	100/360 Summer			
S3.008	SMH04-305	720 Winter	100	+40%	30/360 Summer			
S15.000	STP04-307	720 Winter	100	+40%	100/15 Summer			
S16.000	STP04-308	720 Winter	100	+40%	100/15 Summer			
S3.009	SMH04-304	720 Winter	100	+40%	30/360 Summer			
S17.000	STP04-305	15 Summer	100	+40%	100/15 Summer			
S18.000	STP04-306	15 Summer	100	+40%	100/15 Summer			
S3.010	SMH04-303	5760 Summer	100	+40%	100/120 Summer			
S19.000	STP04-303	960 Winter	100	+40%	30/15 Summer			
S20.000	STP04-304	960 Winter	100	+40%	100/15 Summer			
S3.011	SMH04-302	2880 Summer	100	+40%	100/120 Summer			
S21.000	STP04-302	960 Winter	100	+40%	30/15 Summer			
S22.000	STP04-301	960 Winter	100	+40%	30/15 Summer			
S3.012	SMH04-301	2880 Summer	100	+40%	1/15 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
S9.000	STP04-313	23.581	1.198	0.000	0.16			2.1	FLOOD RISK
S10.000	STP04-314	23.581	1.198	0.000	0.16			1.9	FLOOD RISK
S3.004	SMH04-309	23.582	2.649	0.000	0.17			4.8	SURCHARGED
S3.005	SMH04-308	23.485	2.584	0.000	0.12			4.6	SURCHARGED
S3.006	SMH04-307	23.480	1.847	0.000	0.00			4.3	SURCHARGED
S11.000	STP04-312	23.481	0.637	0.000	0.11		684	2.8	SURCHARGED
S12.000	STP04-311	23.481	0.637	0.000	0.11		684	3.2	SURCHARGED
S3.007	SMH04-306	23.480	1.838	0.000	0.00			4.9	SURCHARGED
S13.000	STP04-309	23.322	0.288	0.000	0.08		396	2.5	SURCHARGED
S14.000	STP04-310	23.322	0.293	0.000	0.08		396	2.2	SURCHARGED
S3.008	SMH04-305	23.321	1.818	0.000	0.00			8.3	SURCHARGED
S15.000	STP04-307	23.322	0.953	0.000	0.11			3.0	SURCHARGED
S16.000	STP04-308	23.322	0.962	0.000	0.12			2.8	SURCHARGED
S3.009	SMH04-304	23.321	1.982	0.000	0.00			4.1	SURCHARGED
S17.000	STP04-305	21.991	0.150	0.000	1.12		7	20.2	SURCHARGED
S18.000	STP04-306	21.936	0.194	0.000	1.17		7	19.7	SURCHARGED
S3.010	SMH04-303	21.917	0.720	0.000	0.00			6.7	SURCHARGED
S19.000	STP04-303	21.722	0.462	0.000	0.20		528	2.3	SURCHARGED
S20.000	STP04-304	21.723	0.458	0.000	0.16		512	1.7	SURCHARGED
S3.011	SMH04-302	21.886	0.802	0.000	0.00			5.7	SURCHARGED

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

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
S21.000	STP04-302	21.723	1.155	0.000	0.16			0.9	FLOOD RISK
S22.000	STP04-301	21.722	1.152	0.000	0.21			1.1	FLOOD RISK
S3.012	SMH04-301	21.890	1.860	0.000	0.17			5.3	SURCHARGED

PN	US/MH Name	Level Exceeded
S9.000	STP04-313	
S10.000	STP04-314	
S3.004	SMH04-309	
S3.005	SMH04-308	
S3.006	SMH04-307	
S11.000	STP04-312	
S12.000	STP04-311	
S3.007	SMH04-306	
S13.000	STP04-309	
S14.000	STP04-310	
S3.008	SMH04-305	
S15.000	STP04-307	
S16.000	STP04-308	
S3.009	SMH04-304	
S17.000	STP04-305	
S18.000	STP04-306	
S3.010	SMH04-303	
S19.000	STP04-303	
S20.000	STP04-304	
S3.011	SMH04-302	
S21.000	STP04-302	
S22.000	STP04-301	
S3.012	SMH04-301	

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