



400 LONGWATER AVENUE

Technical Submittal – Surface water calculations
1620001295-RAM-XX-XX-TS-C-00004
Revision: C01

22nd July 2019

Project no. 1620001295

Ramboll

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Micro Drainage Network 2018.1		

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)	2	PIMP (%)	100
M5-60 (mm)	18.500	Add Flow / Climate Change (%)	0
Ratio R	0.400	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)	250

Designed with Level Soffits

Time Area Diagram for Storm at outfall S (pipe S1.007)

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.168	4-8	0.807	8-12	0.205	12-16	0.019

Total Area Contributing (ha) = 1.198

Total Pipe Volume (m³) = 20.329

Time Area Diagram at outfall S (pipe S16.002)

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.250	4-8	0.584	8-12	0.124	12-16	0.033

Total Area Contributing (ha) = 0.991

Total Pipe Volume (m³) = 12.768

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length	Fall	Slope	I.Area	T.E.	Base	k	HYD	DIA	Section	Type	Auto
(m)	(m)	(1:X)	(ha)	(mins)	Flow	(l/s)	(mm)	SECT	(mm)			Design

Network Results Table

PN	Rain	T.C.	US/IL	Σ I.Area	Σ Base	Foul	Add Flow	Vel	Cap	Flow
(mm/hr)	(mins)	(m)	(ha)	Flow	(l/s)	(l/s)	(l/s)	(m/s)	(l/s)	(l/s)

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<u>Network Design Table for Storm</u>											
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	22.771	0.285	80.0	0.049	5.00	0.0	0.600	o	150	Pipe/Conduit	
S2.000	24.225	0.303	80.0	0.045	5.00	0.0	0.600	o	150	Pipe/Conduit	
S1.001	42.853	0.433	99.0	0.013	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.000	19.826	0.249	79.6	0.042	5.00	0.0	0.600	o	150	Pipe/Conduit	
S3.001	11.090	0.148	74.9	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S4.000	21.392	0.265	80.7	0.046	5.00	0.0	0.600	o	150	Pipe/Conduit	
S4.001	5.231	0.084	62.3	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S5.000	21.556	0.269	80.0	0.037	5.00	0.0	0.600	o	150	Pipe/Conduit	
S6.000	23.616	0.295	80.0	0.052	5.00	0.0	0.600	o	150	Pipe/Conduit	
S1.002	33.294	0.148	225.0	0.050	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.003	3.998	0.040	100.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S7.000	29.159	0.292	100.0	0.048	5.00	0.0	0.600	o	150	Pipe/Conduit	
S7.001	20.932	0.209	100.0	0.025	0.00	0.0	0.600	o	150	Pipe/Conduit	
<u>Network Results Table</u>											
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	50.00	5.34	39.000	0.049	0.0	0.0	0.0	1.12	19.9	6.7	
S2.000	50.00	5.36	39.000	0.045	0.0	0.0	0.0	1.12	19.9	6.1	
S1.001	50.00	5.90	38.697	0.108	0.0	0.0	0.0	1.31	52.3	14.6	
S3.000	50.00	5.29	39.250	0.042	0.0	0.0	0.0	1.13	19.9	5.7	
S3.001	50.00	5.45	39.001	0.042	0.0	0.0	0.0	1.16	20.6	5.7	
S4.000	50.00	5.32	39.250	0.046	0.0	0.0	0.0	1.12	19.8	6.3	
S4.001	50.00	5.39	38.985	0.046	0.0	0.0	0.0	1.28	22.6	6.3	
S5.000	50.00	5.32	39.250	0.037	0.0	0.0	0.0	1.12	19.9	5.0	
S6.000	50.00	5.35	39.250	0.052	0.0	0.0	0.0	1.12	19.9	7.1	
S1.002	50.00	6.74	38.200	0.335	0.0	0.0	0.0	0.67	11.8«	45.4	
S1.003	50.00	6.80	38.052	0.335	0.0	0.0	0.0	1.01	17.8«	45.4	
S7.000	50.00	5.48	39.000	0.048	0.0	0.0	0.0	1.00	17.8	6.5	
S7.001	50.00	5.83	38.708	0.074	0.0	0.0	0.0	1.00	17.8	10.0	
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Micro Drainage

Network 2018.1

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
S8.000	26.894	0.269	100.0	0.081	5.00	0.0	0.600	o	150	Pipe/Conduit	
S7.002	25.729	0.257	100.1	0.019	0.00	0.0	0.600	o	150	Pipe/Conduit	
S9.000	27.472	0.275	100.0	0.052	5.00	0.0	0.600	o	150	Pipe/Conduit	
S7.003	13.935	0.230	60.6	0.016	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.004	38.699	0.126	305.9	0.054	0.00	0.0	0.600	o	300	Pipe/Conduit	
S10.000	12.455	0.156	80.0	0.027	5.00	0.0	0.600	o	150	Pipe/Conduit	
S11.000	12.804	0.160	80.0	0.225	10.00	0.0	0.600	o	150	Pipe/Conduit	
S11.001	23.148	0.290	79.8	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S11.002	6.910	0.085	81.3	0.032	0.00	0.0	0.600	o	150	Pipe/Conduit	
S12.000	20.344	0.203	100.2	0.032	5.00	0.0	0.600	o	150	Pipe/Conduit	
S13.000	18.495	0.253	73.1	0.054	5.00	0.0	0.600	o	150	Pipe/Conduit	
S12.001	18.742	0.188	99.7	0.006	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)
S8.000	50.00	5.45	39.000	0.081	0.0	0.0	0.0	1.00	17.8	11.0
S7.002	50.00	6.26	38.424	0.174	0.0	0.0	0.0	1.00	17.7«	23.6
S9.000	50.00	5.46	39.000	0.052	0.0	0.0	0.0	1.00	17.8	7.0
S7.003	50.00	6.44	38.092	0.242	0.0	0.0	0.0	1.29	22.9«	32.8
S1.004	50.00	7.52	37.862	0.631	0.0	0.0	0.0	0.89	63.2«	85.5
S10.000	50.00	5.18	38.800	0.027	0.0	0.0	0.0	1.12	19.9	3.6
S11.000	45.97	10.19	39.100	0.225	0.0	0.0	0.0	1.12	19.9«	28.0
S11.001	45.14	10.53	38.790	0.225	0.0	0.0	0.0	1.13	19.9«	28.0
S11.002	44.90	10.64	38.425	0.258	0.0	0.0	0.0	1.12	19.7«	31.3
S12.000	50.00	5.34	39.250	0.032	0.0	0.0	0.0	1.00	17.7	4.4
S13.000	50.00	5.26	39.250	0.054	0.0	0.0	0.0	1.18	20.8	7.3
S12.001	50.00	5.58	38.922	0.093	0.0	0.0	0.0	1.31	52.1	12.6

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<u>Network Design Table for Storm</u>											
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
S14.000	16.804	0.391	43.0	0.064	5.00	0.0	0.600	o	150	Pipe/Conduit	
S12.002	26.778	0.268	99.9	0.009	0.00	0.0	0.600	o	300	Pipe/Conduit	
S12.003	19.192	0.114	168.4	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S15.000	12.945	0.300	43.2	0.082	5.00	0.0	0.600	o	150	Pipe/Conduit	
S1.005	23.314	0.078	298.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.006	66.550	0.296	224.8	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.007	15.906	0.071	224.0	0.035	0.00	0.0	0.600	o	150	Pipe/Conduit	
S16.000	4.982	0.042	118.6	0.000	10.00	0.0	0.600	o	150	Pipe/Conduit	
S16.001	23.072	1.376	16.8	0.077	0.00	0.0	0.600	o	150	Pipe/Conduit	
S17.000	11.121	0.139	80.0	0.060	5.00	0.0	0.600	o	150	Pipe/Conduit	
S18.000	40.590	0.677	60.0	0.093	5.00	0.0	0.600	o	225	Pipe/Conduit	
S18.001	14.252	0.178	80.1	0.031	0.00	0.0	0.600	o	300	Pipe/Conduit	
S19.000	20.604	0.227	90.6	0.068	5.00	0.0	0.600	o	150	Pipe/Conduit	
S20.000	10.246	0.102	100.0	0.225	10.00	0.0	0.600	o	300	Pipe/Conduit	
<u>Network Results Table</u>											
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)	
S14.000	50.00	5.18	39.250	0.064	0.0	0.0	0.0	1.54	27.2	8.7	
S12.002	50.00	5.86	38.659	0.166	0.0	0.0	0.0	1.57	111.2	22.5	
S12.003	50.00	6.12	38.391	0.166	0.0	0.0	0.0	1.21	85.5	22.5	
S15.000	50.00	5.14	38.850	0.082	0.0	0.0	0.0	1.54	27.1	11.0	
S1.005	43.76	11.15	37.730	1.163	0.0	0.0	0.0	0.75	29.9«	137.9	
S1.006	41.19	12.43	37.652	1.163	0.0	0.0	0.0	0.87	34.5«	137.9	
S1.007	40.47	12.83	37.356	1.198	0.0	0.0	0.0	0.67	11.8«	137.9	
S16.000	46.21	10.09	38.330	0.000	0.0	0.0	0.0	0.92	16.3	0.0	
S16.001	45.83	10.25	38.288	0.077	0.0	0.0	0.0	2.47	43.7	9.6	
S17.000	50.00	5.16	38.900	0.060	0.0	0.0	0.0	1.12	19.9	8.1	
S18.000	50.00	5.40	39.250	0.093	0.0	0.0	0.0	1.69	67.3	12.6	
S18.001	50.00	5.53	38.498	0.124	0.0	0.0	0.0	1.76	124.3	16.8	
S19.000	50.00	5.33	39.000	0.068	0.0	0.0	0.0	1.06	18.7	9.2	
S20.000	46.17	10.11	38.800	0.225	0.0	0.0	0.0	1.57	111.1	28.1	
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<u>Network Design Table for Storm</u>											
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
S19.001	36.096	0.361	100.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S21.000	23.822	0.238	100.1	0.078	5.00	0.0	0.600	o	150	Pipe/Conduit	
S22.000	22.208	0.238	93.2	0.062	5.00	0.0	0.600	o	150	Pipe/Conduit	
S21.001	8.608	0.057	151.0	0.107	0.00	0.0	0.600	o	150	Pipe/Conduit	
S21.002	8.608	0.057	151.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S19.002	16.502	0.073	227.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S17.001	28.334	0.094	300.0	0.057	0.00	0.0	0.600	o	300	Pipe/Conduit	
S17.002	68.526	0.228	300.6	0.093	0.00	0.0	0.600	o	150	Pipe/Conduit	
S17.003	11.629	0.116	100.0	0.039	0.00	0.0	0.600	o	150	Pipe/Conduit	
S16.002	2.793	0.200	14.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
<u>Network Results Table</u>											
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)	
S19.001	45.24	10.49	38.623	0.293	0.0	0.0	0.0	1.57	111.1	35.9	
S21.000	50.00	5.40	39.000	0.078	0.0	0.0	0.0	1.00	17.7	10.6	
S22.000	50.00	5.36	39.000	0.062	0.0	0.0	0.0	1.04	18.4	8.4	
S21.001	50.00	5.57	38.687	0.248	0.0	0.0	0.0	0.82	14.4«	33.6	
S21.002	50.00	5.75	38.629	0.248	0.0	0.0	0.0	0.82	14.4«	33.6	
S19.002	44.63	10.76	38.262	0.541	0.0	0.0	0.0	1.04	73.5	65.4	
S17.001	43.49	11.28	37.350	0.781	0.0	0.0	0.0	0.90	63.8«	92.0	
S17.002	39.70	13.27	37.256	0.874	0.0	0.0	0.0	0.57	10.2«	94.0	
S17.003	39.37	13.46	37.028	0.913	0.0	0.0	0.0	1.00	17.8«	97.4	
S16.002	39.35	13.47	36.837	0.991	0.0	0.0	0.0	3.52	140.0	105.6	
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Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m ³ /ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	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	14
Number of Online Controls	9	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)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.500	Storm Duration (mins)	30
Ratio R	0.400		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: SSWMH10, DS/PN: S1.003, Volume (m³): 2.8

Unit Reference	MD-SHE-0076-2200-0600-2200
Design Head (m)	0.600
Design Flow (l/s)	2.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	76
Invert Level (m)	38.052
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.600	2.2
Flush-Flo™	0.179	2.2
Kick-Flo®	0.401	1.8
Mean Flow over Head Range	-	1.9

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	2.1	1.200	3.0	3.000	4.6	7.000	6.9
0.200	2.2	1.400	3.2	3.500	5.0	7.500	7.1
0.300	2.1	1.600	3.4	4.000	5.3	8.000	7.4
0.400	1.8	1.800	3.6	4.500	5.6	8.500	7.6
0.500	2.0	2.000	3.8	5.000	5.9	9.000	7.8
0.600	2.2	2.200	4.0	5.500	6.1	9.500	8.0
0.800	2.5	2.400	4.2	6.000	6.4		
1.000	2.8	2.600	4.3	6.500	6.6		

Orifice Manhole: SSWMH12, DS/PN: S7.001, Volume (m³): 1.8

Diameter (m) 0.039 Discharge Coefficient 0.600 Invert Level (m) 38.708

Orifice Manhole: SSWMH14, DS/PN: S7.002, Volume (m³): 2.4

Diameter (m) 0.052 Discharge Coefficient 0.600 Invert Level (m) 38.424

Orifice Manhole: SSWMH16, DS/PN: S7.003, Volume (m³): 2.8

Diameter (m) 0.058 Discharge Coefficient 0.600 Invert Level (m) 38.167

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Non Return Valve Manhole: SSWMH26, DS/PN: S12.003, Volume (m³): 3.7

Hydro-Brake® Optimum Manhole: SSWMH29, DS/PN: S1.007, Volume (m³): 5.6

Unit Reference MD-SHE-0080-3500-1600-3500
Design Head (m) 1.600
Design Flow (l/s) 3.5
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 80
Invert Level (m) 37.356
Minimum Outlet Pipe Diameter (mm) 100
Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.600	3.5
Flush-Flo™	0.351	3.0
Kick-Flo®	0.715	2.4
Mean Flow over Head Range	-	2.8

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	2.3	1.200	3.1	3.000	4.7	7.000	7.0
0.200	2.9	1.400	3.3	3.500	5.0	7.500	7.2
0.300	3.0	1.600	3.5	4.000	5.4	8.000	7.4
0.400	3.0	1.800	3.7	4.500	5.7	8.500	7.6
0.500	2.9	2.000	3.9	5.000	5.9	9.000	7.8
0.600	2.8	2.200	4.0	5.500	6.2	9.500	8.1
0.800	2.5	2.400	4.2	6.000	6.5		
1.000	2.8	2.600	4.4	6.500	6.7		

Orifice Manhole: SSWMH30, DS/PN: S16.001, Volume (m³): 0.7

Diameter (m) 0.016 Discharge Coefficient 0.600 Invert Level (m) 38.288

Orifice Manhole: SSWMH43, DS/PN: S21.002, Volume (m³): 1.7

Diameter (m) 0.036 Discharge Coefficient 0.600 Invert Level (m) 38.629

Hydro-Brake® Optimum Manhole: SSWMH41, DS/PN: S17.003, Volume (m³): 4.8

Unit Reference MD-SHE-0060-2000-1550-2000
Design Head (m) 1.550
Design Flow (l/s) 2.0

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<u>Hydro-Brake® Optimum Manhole: SSWMH41, DS/PN: S17.003, Volume (m³): 4.8</u>																																																																										
Flush-Flo™Calculated ObjectiveMinimise upstream storage ApplicationSurface Sump AvailableYes Diameter (mm)60 Invert Level (m)37.028 Minimum Outlet Pipe Diameter (mm)75 Suggested Manhole Diameter (mm)1200																																																																										
<table><tr><td>Control Points</td><td>Head (m)</td><td>Flow (l/s)</td></tr><tr><td>Design Point (Calculated)</td><td>1.550</td><td>2.0</td></tr><tr><td>Flush-Flo™</td><td>0.268</td><td>1.5</td></tr><tr><td>Kick-Flo®</td><td>0.541</td><td>1.2</td></tr><tr><td>Mean Flow over Head Range</td><td>-</td><td>1.5</td></tr></table>			Control Points	Head (m)	Flow (l/s)	Design Point (Calculated)	1.550	2.0	Flush-Flo™	0.268	1.5	Kick-Flo®	0.541	1.2	Mean Flow over Head Range	-	1.5																																																									
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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																																																																										
<table><tr><td>Depth (m)</td><td>Flow (l/s)</td><td>Depth (m)</td><td>Flow (l/s)</td><td>Depth (m)</td><td>Flow (l/s)</td><td>Depth (m)</td><td>Flow (l/s)</td></tr><tr><td>0.100</td><td>1.3</td><td>1.200</td><td>1.8</td><td>3.000</td><td>2.7</td><td>7.000</td><td>4.0</td></tr><tr><td>0.200</td><td>1.5</td><td>1.400</td><td>1.9</td><td>3.500</td><td>2.9</td><td>7.500</td><td>4.1</td></tr><tr><td>0.300</td><td>1.5</td><td>1.600</td><td>2.0</td><td>4.000</td><td>3.1</td><td>8.000</td><td>4.3</td></tr><tr><td>0.400</td><td>1.5</td><td>1.800</td><td>2.1</td><td>4.500</td><td>3.3</td><td>8.500</td><td>4.4</td></tr><tr><td>0.500</td><td>1.4</td><td>2.000</td><td>2.2</td><td>5.000</td><td>3.4</td><td>9.000</td><td>4.5</td></tr><tr><td>0.600</td><td>1.3</td><td>2.200</td><td>2.3</td><td>5.500</td><td>3.6</td><td>9.500</td><td>4.6</td></tr><tr><td>0.800</td><td>1.5</td><td>2.400</td><td>2.4</td><td>6.000</td><td>3.7</td><td></td><td></td></tr><tr><td>1.000</td><td>1.6</td><td>2.600</td><td>2.5</td><td>6.500</td><td>3.9</td><td></td><td></td></tr></table>			Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	0.100	1.3	1.200	1.8	3.000	2.7	7.000	4.0	0.200	1.5	1.400	1.9	3.500	2.9	7.500	4.1	0.300	1.5	1.600	2.0	4.000	3.1	8.000	4.3	0.400	1.5	1.800	2.1	4.500	3.3	8.500	4.4	0.500	1.4	2.000	2.2	5.000	3.4	9.000	4.5	0.600	1.3	2.200	2.3	5.500	3.6	9.500	4.6	0.800	1.5	2.400	2.4	6.000	3.7			1.000	1.6	2.600	2.5	6.500	3.9		
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)																																																																			
0.100	1.3	1.200	1.8	3.000	2.7	7.000	4.0																																																																			
0.200	1.5	1.400	1.9	3.500	2.9	7.500	4.1																																																																			
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0.400	1.5	1.800	2.1	4.500	3.3	8.500	4.4																																																																			
0.500	1.4	2.000	2.2	5.000	3.4	9.000	4.5																																																																			
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Storage Structures for Storm

Cellular Storage Manhole: STank 1, DS/PN: S1.002

Invert Level (m) 38.200 Safety Factor 2.0
 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
 Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	240.0	235.0	0.801	0.0	339.0
0.800	240.0	339.0			

Porous Car Park Manhole: SSWMH11, DS/PN: S7.000

Infiltration Coefficient Base (m/hr) 0.00000 Width (m) 15.7
 Membrane Percolation (mm/hr) 1000 Length (m) 30.8
 Max Percolation (l/s) 134.3 Slope (1:X) 80.0
 Safety Factor 2.0 Depression Storage (mm) 5
 Porosity 0.30 Evaporation (mm/day) 3
 Invert Level (m) 39.115 Cap Volume Depth (m) 0.220

Porous Car Park Manhole: SSWMH13, DS/PN: S8.000

Infiltration Coefficient Base (m/hr) 0.00000 Width (m) 26.5
 Membrane Percolation (mm/hr) 1000 Length (m) 30.8
 Max Percolation (l/s) 226.7 Slope (1:X) 80.0
 Safety Factor 2.0 Depression Storage (mm) 5
 Porosity 0.30 Evaporation (mm/day) 3
 Invert Level (m) 39.115 Cap Volume Depth (m) 0.220

Porous Car Park Manhole: SSWMH15, DS/PN: S9.000

Infiltration Coefficient Base (m/hr) 0.00000 Width (m) 15.6
 Membrane Percolation (mm/hr) 1000 Length (m) 31.0
 Max Percolation (l/s) 134.3 Slope (1:X) 79.9
 Safety Factor 2.0 Depression Storage (mm) 5
 Porosity 0.30 Evaporation (mm/day) 3
 Invert Level (m) 39.115 Cap Volume Depth (m) 0.220

Swale Manhole: SSWMH17, DS/PN: S1.004

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr) 0.00000 Length (m) 65.6
 Infiltration Coefficient Side (m/hr) 0.00000 Side Slope (1:X) 4.0
 Safety Factor 2.0 Slope (1:X) 0.0
 Porosity 1.00 Cap Volume Depth (m) 0.560
 Invert Level (m) 38.300 Cap Infiltration Depth (m) 0.300
 Base Width (m) 2.9 Include Swale Volume Yes

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Cellular Storage Manhole: STank 2, DS/PN: S1.005

Invert Level (m) 37.730 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	250.0	264.0	0.801	0.0	344.0
0.800	250.0	344.0			

Swale Manhole: SSWMH29, DS/PN: S1.007

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr) 0.00000 Length (m) 57.0
Infiltration Coefficient Side (m/hr) 0.00000 Side Slope (1:X) 4.0
Safety Factor 2.0 Slope (1:X) 0.0
Porosity 1.00 Cap Volume Depth (m) 0.560
Invert Level (m) 38.300 Cap Infiltration Depth (m) 0.300
Base Width (m) 2.9 Include Swale Volume Yes

Cellular Storage Manhole: SPermavoid, DS/PN: S16.000

Invert Level (m) 38.330 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	788.8	788.8	0.301	0.0	831.8
0.300	788.8	831.8			

Porous Car Park Manhole: SSWMH34, DS/PN: S19.000

Infiltration Coefficient Base (m/hr) 0.00000 Width (m) 15.0
Membrane Percolation (mm/hr) 1000 Length (m) 45.0
Max Percolation (l/s) 187.5 Slope (1:X) 80.0
Safety Factor 2.0 Depression Storage (mm) 5
Porosity 0.30 Evaporation (mm/day) 3
Invert Level (m) 39.500 Cap Volume Depth (m) 0.220

Porous Car Park Manhole: SSWMH36, DS/PN: S21.000

Infiltration Coefficient Base (m/hr) 0.00000 Width (m) 20.0
Membrane Percolation (mm/hr) 1000 Length (m) 42.0
Max Percolation (l/s) 233.3 Slope (1:X) 80.0
Safety Factor 2.0 Depression Storage (mm) 5
Porosity 0.30 Evaporation (mm/day) 3
Invert Level (m) 39.500 Cap Volume Depth (m) 0.220

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Porous Car Park Manhole: SSWMH37, DS/PN: S22.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	15.5
Membrane Percolation (mm/hr)	1000	Length (m)	42.0
Max Percolation (l/s)	180.8	Slope (1:X)	80.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	39.500	Cap Volume Depth (m)	0.220

Porous Car Park Manhole: SSWMH38, DS/PN: S21.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	25.6
Membrane Percolation (mm/hr)	1000	Length (m)	42.0
Max Percolation (l/s)	298.7	Slope (1:X)	80.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	39.500	Cap Volume Depth (m)	0.220

Cellular Storage Manhole: STank 3, DS/PN: S17.001

Invert Level (m)	37.350	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	270.0	270.0	0.801	0.0	392.4
0.800	270.0	392.4			

Swale Manhole: SSWMH40, DS/PN: S17.002

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	130.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	4.0
Safety Factor	2.0	Slope (1:X)	0.0
Porosity	1.00	Cap Volume Depth (m)	0.560
Invert Level (m)	38.300	Cap Infiltration Depth (m)	0.300
Base Width (m)	2.9	Include Swale Volume	Yes

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

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	SSWMH1	39.105	-0.045	0.000	0.81		15.2	OK	
S2.000	SSWMH2	39.098	-0.052	0.000	0.74		13.9	OK	
S1.001	SSWMH3	38.834	-0.088	0.000	0.67		33.4	OK	
S3.000	SSWMH4	39.344	-0.056	0.000	0.70		13.1	OK	
S3.001	SSWMH5	39.096	-0.055	0.000	0.70		13.0	OK	
S4.000	SSWMH6	39.351	-0.049	0.000	0.77		14.4	OK	
S4.001	SSWMH7	39.088	-0.047	0.000	0.79		14.4	OK	
S5.000	SSWMH8	39.337	-0.063	0.000	0.62		11.6	OK	
S6.000	SSWMH9	39.359	-0.041	0.000	0.86		16.1	OK	
S1.002	STank 1	38.403	0.053	0.000	0.68		8.0	SURCHARGED*	
S1.003	SSWMH10	38.394	0.192	0.000	0.17		2.2	SURCHARGED	
S7.000	SSWMH11	39.291	0.141	0.000	0.06		1.1	SURCHARGED	
S7.001	SSWMH12	39.324	0.466	0.000	0.10		1.8	SURCHARGED	
S8.000	SSWMH13	39.265	0.115	0.000	0.49		8.3	SURCHARGED	
S7.002	SSWMH14	39.349	0.775	0.000	0.26		4.4	SURCHARGED	
S9.000	SSWMH15	39.225	0.075	0.000	0.83		14.2	SURCHARGED	
S7.003	SSWMH16	39.211	0.969	0.000	0.33		7.0	SURCHARGED	
S1.004	SSWMH17	38.147	-0.015	0.000	0.43		25.0	OK	
S10.000	SSWMH18	38.872	-0.078	0.000	0.46		8.4	OK	
S11.000	SCP 1	39.250	0.000	0.000	1.79		35.5	SURCHARGED*	

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

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S17.000	SSWMH31	39.051	0.001	0.000	1.01		18.0	SURCHARGED	
S18.000	SSWMH32	39.357	-0.118	0.000	0.45		28.6	OK	
S18.001	SSWMH33	38.627	-0.171	0.000	0.37		38.6	OK	
S19.000	SSWMH34	39.212	0.062	0.000	1.12		19.7	SURCHARGED	
S20.000	SCP2	38.968	-0.132	0.000	0.60		48.5	OK	
S19.001	SSWMH35	38.801	-0.121	0.000	0.66		67.6	OK	
S21.000	SSWMH36	39.638	0.488	0.000	0.22		3.7	SURCHARGED	
S22.000	SSWMH37	39.637	0.487	0.000	0.14		2.4	SURCHARGED	
S21.001	SSWMH38	39.632	0.795	0.000	0.91		11.4	SURCHARGED	
S21.002	SSWMH43	39.623	0.844	0.000	0.21		2.7	SURCHARGED*	
S19.002	SSWMH39	38.566	0.004	0.000	1.12		70.1	SURCHARGED	
S17.001	STank 3	37.708	0.058	0.000	0.07		4.2	SURCHARGED*	
S17.002	SSWMH40	37.764	0.358	0.000	0.59		5.9	SURCHARGED	
S17.003	SSWMH41	38.301	1.123	0.000	0.11		1.8	SURCHARGED	
S16.002	SSWMH42	36.864	-0.198	0.000	0.03		2.1	OK	