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129 Cumberland Road Bristol BS1 6UY	B05581, Cribbs Causeway CTL Food Store SW Network 1	
Date 13/05/2021 File B05581-SW Network 1-Rev...	Designed by darren.henson Checked by	
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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for SW-NETWORK.SWS

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	20.000	Add Flow / Climate Change (%)	0
Ratio R	0.350	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	0.000
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)	0.75
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for SW-NETWORK.SWS




Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.384	4-8	0.292

Total Area Contributing (ha) = 0.676

Total Pipe Volume (m³) = 25.594


Network Design Table for SW-NETWORK.SWS

« - 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
S1.000	22.792	0.152	149.9	0.085	5.00	0.0	0.600	o	225	Pipe/Conduit	
S2.000	41.300	0.375	110.1	0.096	5.00	0.0	0.600	o	300	Pipe/Conduit	
S2.001	59.026	0.375	157.4	0.258	0.00	0.0	0.600	o	375	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)
S1.000	50.00	5.36	37.800	0.085	0.0	0.0	0.0	1.07	42.4	11.5
S2.000	50.00	5.46	38.325	0.096	0.0	0.0	0.0	1.50	105.9	13.0
S2.001	50.00	6.14	37.875	0.354	0.0	0.0	0.0	1.44	159.2	47.9


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Network Design Table for SW-NETWORK.SWS

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
S1.001	5.875	0.049	119.9	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.002	5.626	0.375	15.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
S3.000	75.460	0.755	99.9	0.237	5.00	0.0	0.600	o	300	Pipe/Conduit	
S3.001	57.910	0.500	115.8	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S3.002	58.188	0.346	168.2	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.003	11.019	0.110	100.2	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)
S1.001	50.00	6.20	37.498	0.439	0.0	0.0	0.0	1.65	182.6	59.4
S1.002	50.00	6.22	37.349	0.439	0.0	0.0	0.0	4.70	518.9	59.4
S3.000	50.00	5.80	38.575	0.237	0.0	0.0	0.0	1.57	111.2	32.1
S3.001	50.00	6.46	37.820	0.237	0.0	0.0	0.0	1.46	103.2	32.1
S3.002	50.00	7.26	37.320	0.237	0.0	0.0	0.0	1.21	85.5	32.1
S1.003	50.00	7.40	36.974	0.676	0.0	0.0	0.0	1.31	51.9«	91.5

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PIPELINE SCHEDULES for SW-NETWORK.SWS

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	225	S2	38.960	37.800	0.935	Open Manhole	1200
S2.000	o	300	S6	39.080	38.325	0.455	Open Manhole	1200
S2.001	o	375	S7	38.820	37.875	0.570	Open Manhole	1350
S1.001	o	375	S3	38.960	37.498	1.087	Open Manhole	1350
S1.002	o	375	S4	38.800	37.349	1.076	Open Manhole	1350
S3.000	o	300	S8	39.250	38.575	0.375	Open Manhole	1200
S3.001	o	300	S9	39.250	37.820	1.130	Open Manhole	1200
S3.002	o	300	S10	38.900	37.320	1.280	Open Manhole	1200
S1.003	o	225	S5	38.800	36.974	1.601	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)
S1.000	22.792	149.9	S3	38.960	37.648	1.087	Open Manhole	1350
S2.000	41.300	110.1	S7	38.820	37.950	0.570	Open Manhole	1350
S2.001	59.026	157.4	S3	38.960	37.500	1.085	Open Manhole	1350
S1.001	5.875	119.9	S4	38.800	37.449	0.976	Open Manhole	1350
S1.002	5.626	15.0	S5	38.800	36.974	1.451	Open Manhole	1350
S3.000	75.460	99.9	S9	39.250	37.820	1.130	Open Manhole	1200
S3.001	57.910	115.8	S10	38.900	37.320	1.280	Open Manhole	1200
S3.002	58.188	168.2	S5	38.800	36.974	1.526	Open Manhole	1350
S1.003	11.019	100.2	S102	38.620	36.864	1.531	Open Manhole	0

Area Summary for SW-NETWORK.SWS

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.085	0.085	0.085
2.000	-	-	100	0.096	0.096	0.096
2.001	-	-	100	0.258	0.258	0.258
1.001	-	-	100	0.000	0.000	0.000
1.002	-	-	100	0.000	0.000	0.000
3.000	-	-	100	0.237	0.237	0.237
3.001	-	-	100	0.000	0.000	0.000
3.002	-	-	100	0.000	0.000	0.000
1.003	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.676	0.676	0.676


Surcharged Outfall Details for SW-NETWORK.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.003	S102	38.620	36.864	36.547	0	0
		Datum (m)	37.089	Offset (mins)	0	

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
1	0.583	11	0.583	21	0.583	31	0.583	41	0.583	51	0.583
2	0.583	12	0.583	22	0.583	32	0.583	42	0.583	52	0.583
3	0.583	13	0.583	23	0.583	33	0.583	43	0.583	53	0.583
4	0.583	14	0.583	24	0.583	34	0.583	44	0.583	54	0.583
5	0.583	15	0.583	25	0.583	35	0.583	45	0.583	55	0.583
6	0.583	16	0.583	26	0.583	36	0.583	46	0.583	56	0.583
7	0.583	17	0.583	27	0.583	37	0.583	47	0.583	57	0.583
8	0.583	18	0.583	28	0.583	38	0.583	48	0.583	58	0.583
9	0.583	19	0.583	29	0.583	39	0.583	49	0.583	59	0.583
10	0.583	20	0.583	30	0.583	40	0.583	50	0.583	60	0.583

Simulation Criteria for SW-NETWORK.SWS


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		1	
Number of Online Controls		1	
Number of Time/Area Diagrams		0	
Number of Offline Controls		0	
Number of Real Time Controls		0	

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Simulation Criteria for SW-NETWORK.SWS

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)	20.000	Storm Duration (mins)	30
Ratio R	0.350		

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Online Controls for SW-NETWORK.SWS


Hydro-Brake® Optimum Manhole: S5, DS/PN: S1.003, Volume (m³): 7.1

Unit Reference	MD-SHE-0096-4000-0920-4000
Design Head (m)	0.920
Design Flow (l/s)	4.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	96
Invert Level (m)	36.974
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.920	4.0
Flush-Flo™	0.274	4.0
Kick-Flo®	0.590	3.3
Mean Flow over Head Range	-	3.5

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	3.1	1.200	4.5	3.000	6.9	7.000	10.3
0.200	3.9	1.400	4.8	3.500	7.4	7.500	10.7
0.300	4.0	1.600	5.2	4.000	7.9	8.000	11.0
0.400	3.9	1.800	5.5	4.500	8.4	8.500	11.3
0.500	3.7	2.000	5.7	5.000	8.8	9.000	11.7
0.600	3.3	2.200	6.0	5.500	9.2	9.500	11.9
0.800	3.7	2.400	6.2	6.000	9.6		
1.000	4.1	2.600	6.5	6.500	10.0		


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Storage Structures for SW-NETWORK.SWS

Cellular Storage Manhole: S5, DS/PN: S1.003

Invert Level (m) 37.050 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	900.0	900.0	0.900	0.0	1000.0
0.800	900.0	1000.0			

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for SW-NETWORK.SWS

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 Coefficient 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) 20.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia 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


PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S2	15 Winter	1	+0%	100/15 Summer				37.883
S2.000	S6	15 Winter	1	+0%	100/15 Summer				38.397
S2.001	S7	15 Winter	1	+0%	100/15 Summer				38.010
S1.001	S3	15 Winter	1	+0%	30/15 Summer				37.682
S1.002	S4	15 Winter	1	+0%					37.467
S3.000	S8	15 Winter	1	+0%	100/15 Summer				38.687
S3.001	S9	15 Winter	1	+0%	100/15 Summer				37.934
S3.002	S10	15 Winter	1	+0%	100/15 Summer				37.445
S1.003	S5	960 Winter	1	+0%	30/30 Winter				37.188

PN	US/MH Name	Depth (m)	Surcharged Volume (m ³)	Flooded Flow / Cap. (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Pipe Level Exceeded
S1.000	S2	-0.142	0.000	0.29		11.1	OK	
S2.000	S6	-0.228	0.000	0.13		12.6	OK	

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
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PN	US/MH Name	Surcharged Flooded		Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
		Depth (m)	Volume (m ³)						
S2.001	S7	-0.240	0.000	0.27			40.7	OK	
S1.001	S3	-0.191	0.000	0.48			51.4	OK	
S1.002	S4	-0.257	0.000	0.22			51.7	OK	
S3.000	S8	-0.188	0.000	0.29			30.5	OK	
S3.001	S9	-0.186	0.000	0.30			29.8	OK	
S3.002	S10	-0.175	0.000	0.36			29.0	OK	
S1.003	S5	-0.011	0.000	0.07		743	2.9	OK	

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for SW-NETWORK.SWS

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 Coefficient 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) 20.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia 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


PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S2	15 Winter	30	+0%	100/15 Summer				37.998
S2.000	S6	15 Winter	30	+0%	100/15 Summer				38.442
S2.001	S7	15 Winter	30	+0%	100/15 Summer				38.136
S1.001	S3	15 Winter	30	+0%	30/15 Summer				37.929
S1.002	S4	15 Winter	30	+0%					37.553
S3.000	S8	15 Winter	30	+0%	100/15 Summer				38.766
S3.001	S9	15 Winter	30	+0%	100/15 Summer				38.017
S3.002	S10	15 Winter	30	+0%	100/15 Summer				37.541
S1.003	S5	960 Winter	30	+0%	30/30 Winter				37.341

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m ³)	Flow / Overflow Cap. (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Pipe Level Exceeded
S1.000	S2	-0.027	0.000	0.69		26.6	OK	
S2.000	S6	-0.183	0.000	0.31		30.8	OK	

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
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PN	US/MH Name	Surcharged Flooded		Flow / Overflow		Half Drain	Pipe	Status	Level Exceeded
		Depth (m)	Volume (m ³)	Cap.	(l/s)	Time (mins)	Flow (l/s)		
S2.001	S7	-0.114	0.000	0.76			113.7	OK	
S1.001	S3	0.056	0.000	1.27			135.6	SURCHARGED	
S1.002	S4	-0.171	0.000	0.57			136.4	OK	
S3.000	S8	-0.109	0.000	0.70			74.9	OK	
S3.001	S9	-0.103	0.000	0.75			73.2	OK	
S3.002	S10	-0.079	0.000	0.87			71.0	OK	
S1.003	S5	0.142	0.000	0.09		742	3.9	SURCHARGED	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SW-NETWORK.SWS

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m ³ /ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coefficient	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)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia 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) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S2	15 Winter	100	+40%	100/15	Summer			38.364
S2.000	S6	15 Winter	100	+40%	100/15	Summer			38.822
S2.001	S7	15 Winter	100	+40%	100/15	Summer			38.721
S1.001	S3	15 Winter	100	+40%	30/15	Summer			38.144
S1.002	S4	15 Winter	100	+40%					37.637
S3.000	S8	15 Winter	100	+40%	100/15	Summer			39.209
S3.001	S9	15 Winter	100	+40%	100/15	Summer			38.397
S3.002	S10	15 Winter	100	+40%	100/15	Summer			37.825
S1.003	S5	960 Winter	100	+40%	30/30	Winter			37.635

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Date 13/05/2021 File B05581-SW Network 1-Rev...	Designed by darren.henson Checked by	
XP Solutions	Network 2020.1	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SW-NETWORK.SWS

PN	US/MH Name	Surcharged		Flow / Overflow Cap. (l/s)	Half Drain Time (mins)	Pipe		Level Exceeded
		Depth (m)	Volume (m ³)			Flow (l/s)	Status	
S1.000	S2	0.339	0.000	1.18		45.9	SURCHARGED	
S2.000	S6	0.197	0.000	0.54		52.8	FLOOD RISK	
S2.001	S7	0.471	0.000	1.21		179.7	FLOOD RISK	
S1.001	S3	0.271	0.000	2.11		226.5	SURCHARGED	
S1.002	S4	-0.087	0.000	0.95		226.8	OK	
S3.000	S8	0.334	0.000	1.09		116.8	FLOOD RISK	
S3.001	S9	0.277	0.000	1.08		106.2	SURCHARGED	
S3.002	S10	0.205	0.000	1.27		102.8	SURCHARGED	
S1.003	S5	0.436	0.000	0.09		4.0	SURCHARGED	