


Shaun Tonge Engineering		Page 0
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Date 01/01/0001 File storm.MDX	Designed by shaun Checked by	
CADS		Network 2020.1.3

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for STORM.SWS

Pipe Sizes STORM Manhole Sizes STORM










FSR Rainfall Model - England and Wales

Return Period (years)	1	PIMP (%)	100
M5-60 (mm)	19.000	Add Flow / Climate Change (%)	0
Ratio R	0.308	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	0	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.	0.850	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits


Network Design Table for STORM.SWS

- Indicates pipe length does not match coordinates



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	5.793	0.155	37.4	0.035	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	26.433	0.990	26.7	0.024	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	35.074	2.578	13.6	0.130	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.000	29.100#	1.810	16.1	0.088	5.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	15.588	0.920	16.9	0.097	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.004	20.750#	0.046	451.1	0.000	0.00	0.0	0.600	[]	-1	Pipe/Conduit	
1.005	3.140#	0.009	348.9	0.119	0.00	0.0	0.600	o	525	Pipe/Conduit	
1.006	5.820	0.062	93.9	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.007	30.139	0.750	40.2	0.000	0.00	0.0	0.600	o	150	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	0.00	5.06	177.793	0.035	0.0	0.0	0.0	1.65	29.2	0.0
1.001	0.00	5.28	177.638	0.059	0.0	0.0	0.0	1.96	34.6	0.0
1.002	0.00	5.45	176.573	0.189	0.0	0.0	0.0	3.57	141.8	0.0
2.000	0.00	5.15	175.805	0.088	0.0	0.0	0.0	3.28	130.4	0.0
1.003	0.00	5.53	173.995	0.374	0.0	0.0	0.0	3.19	127.0	0.0
1.004	0.00	5.64	171.300	0.374	0.0	0.0	0.0	3.25	61180.3	0.0
1.005	0.00	5.68	171.254	0.493	0.0	0.0	0.0	1.19	258.3	0.0
1.006	0.00	5.77	171.195	0.493	0.0	0.0	0.0	1.04	18.3	0.0
1.007	0.00	6.09	171.133	0.493	0.0	0.0	0.0	1.59	28.1	0.0

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Network Design Table for STORM.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
1.008	9.633	0.963	10.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.009	25.616	2.562	10.0	0.000	0.00	0.0	0.600	o	150	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	0.00	6.14	170.383	0.493	0.0	0.0	0.0	3.20	56.6	0.0
1.009	0.00	6.27	169.420	0.493	0.0	0.0	0.0	3.21	56.6	0.0

Simulation Criteria for STORM.SWS

Volumetric Runoff Coeff	0.850	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m ³ /ha Storage	0.000
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	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)	1	Cv (Summer)	0.850
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Storm Duration (mins)	30
Ratio R	0.308		

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Online Controls for STORM.SWS


Hydro-Brake® Optimum Manhole: 7, DS/PN: 1.006, Volume (m³): 7.0

Unit Reference	MD-SHE-0075-3500-2100-3500
Design Head (m)	2.100
Design Flow (l/s)	3.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	75
Invert Level (m)	171.195
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.100	3.5
Flush-Flo™	0.332	2.6
Kick-Flo®	0.674	2.1
Mean Flow over Head Range	-	2.7

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)
0.100	2.1	1.200	2.7	3.000	4.1	7.000	6.1
0.200	2.5	1.400	2.9	3.500	4.4	7.500	6.3
0.300	2.6	1.600	3.1	4.000	4.7	8.000	6.5
0.400	2.6	1.800	3.3	4.500	5.0	8.500	6.7
0.500	2.5	2.000	3.4	5.000	5.2	9.000	6.9
0.600	2.3	2.200	3.6	5.500	5.5	9.500	7.1
0.800	2.2	2.400	3.7	6.000	5.7		
1.000	2.5	2.600	3.9	6.500	5.9		

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

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 0.000
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 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 0.308
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 ON
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, 2160
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.000	1	15 Winter	1	+0%	100/15 Summer			
1.001	2	15 Winter	1	+0%	100/15 Summer			
1.002	3	15 Winter	1	+0%	100/15 Summer			
2.000	12	15 Winter	1	+0%	100/15 Summer			
1.003	4	15 Winter	1	+0%	30/15 Summer			
1.004	5	240 Winter	1	+0%	100/480 Winter			
1.005	6	240 Winter	1	+0%	30/15 Winter			
1.006	7	480 Winter	1	+0%	1/15 Summer			
1.007	8	720 Summer	1	+0%				
1.008	9	1440 Winter	1	+0%				
1.009	c1	720 Summer	1	+0%				

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m ³)	Flow / Overflow Cap. (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.000	1	177.835	-0.108	0.000	0.17		4.2	OK

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

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m ³)	Flow / Overflow Cap. (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.001	2	177.684	-0.104	0.000	0.20		6.6	OK
1.002	3	176.631	-0.167	0.000	0.15		19.9	OK
2.000	12	175.850	-0.180	0.000	0.09		10.6	OK
1.003	4	174.089	-0.131	0.000	0.36		40.2	OK
1.004	5	171.730	-1.570	0.000	0.00		11.2	OK
1.005	6	171.730	-0.049	0.000	0.03		5.6	OK
1.006	7	171.739	0.394	0.000	0.17		2.6	SURCHARGED
1.007	8	171.164	-0.119	0.000	0.10		2.6	OK
1.008	9	170.405	-0.128	0.000	0.05		2.6	OK
1.009	c1	169.441	-0.129	0.000	0.05		2.6	OK

PN	US/MH Name	Level Exceeded
1.000		1
1.001		2
1.002		3
2.000		12
1.003		4
1.004		5
1.005		6
1.006		7
1.007		8
1.008		9
1.009	c1	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for STORM.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	0.000
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	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	0.308
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	ON
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, 2160
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 45


PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	30	+0%	100/15 Summer				177.862
1.001	2	15 Winter	30	+0%	100/15 Summer				177.717
1.002	3	15 Winter	30	+0%	100/15 Summer				176.678
2.000	12	15 Winter	30	+0%	100/15 Summer				175.876
1.003	4	15 Winter	30	+0%	30/15 Summer				174.261
1.004	5	480 Winter	30	+0%	100/480 Winter				172.315
1.005	6	480 Winter	30	+0%	30/15 Winter				172.315
1.006	7	360 Winter	30	+0%	1/15 Summer				172.320
1.007	8	480 Winter	30	+0%					171.164
1.008	9	480 Winter	30	+0%					170.405
1.009	c1	480 Winter	30	+0%					169.441

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	Level Exceeded
1.000	1	-0.081	0.000	0.43		10.3	OK	

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m ³)	Flow / Cap. (l/s)	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.001	2	-0.071	0.000	0.54			17.8	OK	
1.002	3	-0.120	0.000	0.44			59.0	OK	
2.000	12	-0.154	0.000	0.21			26.1	OK	
1.003	4	0.041	0.000	1.01			113.0	SURCHARGED	
1.004	5	-0.985	0.000	0.00			15.2	OK	
1.005	6	0.536	0.000	0.03			5.5	SURCHARGED	
1.006	7	0.975	0.000	0.17			2.6	SURCHARGED	
1.007	8	-0.119	0.000	0.10			2.6	OK	
1.008	9	-0.128	0.000	0.05			2.6	OK	
1.009	c1	-0.129	0.000	0.05			2.6	OK	

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

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 0.000
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 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 0.308
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 ON
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, 2160
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	100	+45%	100/15 Summer				178.036
1.001	2	15 Winter	100	+45%	100/15 Summer				177.956
1.002	3	15 Winter	100	+45%	100/15 Summer				177.267
2.000	12	15 Winter	100	+45%	100/15 Summer				176.199
1.003	4	15 Winter	100	+45%	30/15 Summer				175.933
1.004	5	720 Winter	100	+45%	100/480 Winter				173.363
1.005	6	720 Winter	100	+45%	30/15 Winter				173.363
1.006	7	720 Winter	100	+45%	1/15 Summer				173.376
1.007	8	720 Winter	100	+45%					171.169
1.008	9	720 Winter	100	+45%					170.409
1.009	c1	720 Winter	100	+45%					169.445

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	Level Exceeded
1.000	1	0.093	0.000	0.74		17.9	SURCHARGED	

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

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)						
1.001	2	0.168	0.000	0.91			30.1	SURCHARGED	
1.002	3	0.469	0.000	0.73			97.0	SURCHARGED	
2.000	12	0.169	0.000	0.38			46.2	SURCHARGED	
1.003	4	1.713	0.000	1.69			189.2	SURCHARGED	
1.004	5	0.063	0.000	0.00			21.0	SURCHARGED	
1.005	6	1.584	0.000	0.03			5.6	SURCHARGED	
1.006	7	2.031	0.000	0.23			3.5	SURCHARGED	
1.007	8	-0.114	0.000	0.13			3.5	OK	
1.008	9	-0.124	0.000	0.07			3.5	OK	
1.009	c1	-0.125	0.000	0.07			3.5	OK	