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Date 13/03/2020	Designed by LW	
File 7387 SW07.MDX	Checked by AJ	
Micro Drainage	Network 2018.1.1	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for 7387 N1 SW02.SWS

Pipe Sizes 7387 N1 SW01 Manhole Sizes 7387 N1 SW01

FSR Rainfall Model - England and Wales			
Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	18.000	Add Flow / Climate Change (%)	0
Ratio R	0.304	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.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for 7387 N1 SW02.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
1.000	17.703	0.044	402.3	0.089	5.00	12.0	0.600	o	750	Pipe/Conduit	
1.001	20.451	0.051	401.0	0.030	0.00	0.0	0.600	o	750	Pipe/Conduit	
1.002	6.926	0.017	407.4	0.000	0.00	0.0	0.600	o	750	Pipe/Conduit	
1.003	21.809	0.056	389.4	0.003	0.00	0.0	0.600	o	900	Pipe/Conduit	
2.000	14.235	0.036	395.4	0.137	5.00	0.0	0.600	o	900	Pipe/Conduit	
1.004	13.289	0.033	402.7	0.000	0.00	0.0	0.600	o	900	Pipe/Conduit	
1.005	13.010	0.033	394.2	0.019	0.00	0.0	0.600	o	900	Pipe/Conduit	
1.006	11.494	0.029	400.0	0.104	0.00	0.0	0.600	o	900	Pipe/Conduit	
1.007	11.237	0.112	100.3	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.008	8.924	0.925	9.6	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.009	9.459	0.100	94.6	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)
1.000	0.00	5.21	82.550	0.089	12.0	0.0	0.0	1.39	613.6	12.0
1.001	0.00	5.46	82.506	0.119	12.0	0.0	0.0	1.39	614.6	12.0
1.002	0.00	5.54	82.455	0.119	12.0	0.0	0.0	1.38	609.7	12.0
1.003	0.00	5.77	82.288	0.122	12.0	0.0	0.0	1.58	1006.2	12.0
2.000	0.00	5.15	82.268	0.137	0.0	0.0	0.0	1.57	998.5	0.0
1.004	0.00	5.91	82.232	0.259	12.0	0.0	0.0	1.56	989.3	12.0
1.005	0.00	6.05	82.199	0.278	12.0	0.0	0.0	1.57	1000.0	12.0
1.006	0.00	6.17	82.166	0.382	12.0	0.0	0.0	1.56	992.7	12.0
1.007	0.00	6.32	82.137	0.382	12.0	0.0	0.0	1.31	51.9	12.0
1.008	0.00	6.35	82.025	0.382	12.0	0.0	0.0	4.24	168.5	12.0
1.009	0.00	6.47	79.600	0.382	12.0	0.0	0.0	1.34	53.5	12.0

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Manhole Schedules for 7387 N1 SW02.SWS

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)	Backdrop (mm)
1	85.233	2.683	Open Manhole	1800	1.000	82.550	750				
2	85.585	3.079	Open Manhole	1800	1.001	82.506	750	1.000	82.506	750	
3	85.544	3.089	Open Manhole	1800	1.002	82.455	750	1.001	82.455	750	
4	85.580	3.292	Open Manhole	1800	1.003	82.288	900	1.002	82.438	750	
5	86.293	4.025	Open Manhole	1800	2.000	82.268	900				
6	86.022	3.790	Open Manhole	1800	1.004	82.232	900	1.003	82.232	900	
								2.000	82.232	900	
7	85.799	3.600	Open Manhole	1800	1.005	82.199	900	1.004	82.199	900	
8	85.750	3.584	Open Manhole	1800	1.006	82.166	900	1.005	82.166	900	
9	85.600	3.463	Open Manhole	2400	1.007	82.137	225	1.006	82.137	900	
10	85.600	3.575	Open Manhole	1200	1.008	82.025	225	1.007	82.025	225	
11	84.590	4.990	Open Manhole	1200	1.009	79.600	225	1.008	81.100	225	1500
11	80.000	0.500	Open Manhole	1200		OUTFALL		1.009	79.500	225	

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PIPELINE SCHEDULES for 7387 N1 SW02.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)
1.000	o	750	1	85.233	82.550	1.933	Open Manhole	1800
1.001	o	750	2	85.585	82.506	2.329	Open Manhole	1800
1.002	o	750	3	85.544	82.455	2.339	Open Manhole	1800
1.003	o	900	4	85.580	82.288	2.392	Open Manhole	1800
2.000	o	900	5	86.293	82.268	3.125	Open Manhole	1800
1.004	o	900	6	86.022	82.232	2.890	Open Manhole	1800
1.005	o	900	7	85.799	82.199	2.700	Open Manhole	1800
1.006	o	900	8	85.750	82.166	2.684	Open Manhole	1800
1.007	o	225	9	85.600	82.137	3.238	Open Manhole	2400
1.008	o	225	10	85.600	82.025	3.350	Open Manhole	1200
1.009	o	225	11	84.590	79.600	4.765	Open Manhole	1200

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	17.703	402.3	2	85.585	82.506	2.329	Open Manhole	1800
1.001	20.451	401.0	3	85.544	82.455	2.339	Open Manhole	1800
1.002	6.926	407.4	4	85.580	82.438	2.392	Open Manhole	1800
1.003	21.809	389.4	6	86.022	82.232	2.890	Open Manhole	1800
2.000	14.235	395.4	6	86.022	82.232	2.890	Open Manhole	1800
1.004	13.289	402.7	7	85.799	82.199	2.700	Open Manhole	1800
1.005	13.010	394.2	8	85.750	82.166	2.684	Open Manhole	1800
1.006	11.494	400.0	9	85.600	82.137	2.563	Open Manhole	2400
1.007	11.237	100.3	10	85.600	82.025	3.350	Open Manhole	1200
1.008	8.924	9.6	11	84.590	81.100	3.265	Open Manhole	1200
1.009	9.459	94.6	11	80.000	79.500	0.275	Open Manhole	1200

Free Flowing Outfall Details for 7387 N1 SW02.SWS

Outfall Pipe	Outfall Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
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1.009	11		80.000	79.500	0.000	1200	0
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Simulation Criteria for 7387 N1 SW02.SWS

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/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 Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

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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)	18.000	Storm Duration (mins)	30
Ratio R	0.304		

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Online Controls for 7387 N1 SW02.SWS

Hydro-Brake® Optimum Manhole: 9, DS/PN: 1.007, Volume (m³): 21.6

Unit Reference	MD-SHE-0163-1700-2500-1700
Design Head (m)	2.500
Design Flow (l/s)	17.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	163
Invert Level (m)	82.137
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1800

Control Points			Head (m)	Flow (l/s)	Control Points			Head (m)	Flow (l/s)
Design Point (Calculated)			2.500	17.0	Kick-Flo®			1.451	13.1
Flush-Flo™			0.702	16.7	Mean Flow over Head Range			-	14.7

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)	Depth (m)	Flow (l/s)
0.100	5.8	0.800	16.7	2.000	15.3	4.000	21.3	7.000	27.8
0.200	13.2	1.000	16.3	2.200	16.0	4.500	22.5	7.500	28.8
0.300	14.9	1.200	15.5	2.400	16.7	5.000	23.7	8.000	29.7
0.400	15.8	1.400	13.8	2.600	17.3	5.500	24.8	8.500	30.5
0.500	16.4	1.600	13.7	3.000	18.5	6.000	25.8	9.000	31.4
0.600	16.7	1.800	14.5	3.500	19.9	6.500	26.8	9.500	32.2

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Storage Structures for 7387 N1 SW02.SWS

Cellular Storage Manhole: 5, DS/PN: 2.000

Invert Level (m) 83.950 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)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	100.0	100.0	0.800	100.0	132.0	0.801	0.0	132.0

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 7387 N1 SW02.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 Offline Controls 0 Number of Time/Area Diagrams 0
 Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.312 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) 1, 30, 100
 Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level	Surcharged Depth	Flooded Volume
									(m)	(m)	(m ³)
1.000	1	120 Winter	1	+0%	30/120 Winter				82.712	-0.588	0.000
1.001	2	120 Winter	1	+0%	30/120 Winter				82.706	-0.550	0.000
1.002	3	120 Winter	1	+0%	30/120 Winter				82.704	-0.501	0.000
1.003	4	120 Winter	1	+0%	30/120 Winter				82.703	-0.485	0.000
2.000	5	120 Winter	1	+0%	30/120 Winter				82.699	-0.469	0.000
1.004	6	120 Winter	1	+0%	30/60 Winter				82.699	-0.433	0.000
1.005	7	120 Winter	1	+0%	30/60 Winter				82.696	-0.403	0.000
1.006	8	120 Winter	1	+0%	30/60 Winter				82.692	-0.374	0.000
1.007	9	120 Winter	1	+0%	1/15 Summer				82.688	0.326	0.000
1.008	10	120 Winter	1	+0%					82.077	-0.173	0.000
1.009	11	120 Winter	1	+0%					79.695	-0.130	0.000

PN	US/MH Name	Pipe Flow / Overflow		Status	Level Exceeded
		Cap.	(l/s)		
1.000	1	0.04	15.8	OK	
1.001	2	0.04	16.7	OK	
1.002	3	0.05	16.5	OK	
1.003	4	0.02	16.0	OK	
2.000	5	0.01	5.4	OK	
1.004	6	0.03	16.8	OK	
1.005	7	0.03	15.6	OK	
1.006	8	0.04	17.9	OK	
1.007	9	0.38	16.6	SURCHARGED	
1.008	10	0.12	16.6	OK	
1.009	11	0.38	16.6	OK	

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 7387 N1 SW02.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 Offline Controls 0 Number of Time/Area Diagrams 0
 Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.312 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) 1, 30, 100
 Climate Change (%) 0, 0, 40

										Water Surcharged
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) SurchARGE	First (Y) Flood	First (Z) Overflow	Overflow Act.	Level (m)	Depth (m)
1.000	1	240 Winter	30	+0%	30/120 Winter				83.856	0.556
1.001	2	240 Winter	30	+0%	30/120 Winter				83.855	0.599
1.002	3	240 Winter	30	+0%	30/120 Winter				83.853	0.648
1.003	4	240 Winter	30	+0%	30/120 Winter				83.853	0.665
2.000	5	240 Winter	30	+0%	30/120 Winter				83.852	0.684
1.004	6	240 Winter	30	+0%	30/60 Winter				83.852	0.720
1.005	7	240 Winter	30	+0%	30/60 Winter				83.851	0.752
1.006	8	240 Winter	30	+0%	30/60 Winter				83.850	0.784
1.007	9	240 Winter	30	+0%	1/15 Summer				83.849	1.487
1.008	10	1440 Summer	30	+0%					82.077	-0.173
1.009	11	600 Summer	30	+0%					79.696	-0.129

Flooded				Pipe			
PN	US/MH Name	Volume (m³)	Flow / Cap.	Overflow (l/s)	Flow (l/s)	Status	Level Exceeded
1.000	1	0.000	0.04		17.0	SURCHARGED	
1.001	2	0.000	0.04		16.4	SURCHARGED	
1.002	3	0.000	0.05		15.5	SURCHARGED	
1.003	4	0.000	0.02		14.8	SURCHARGED	
2.000	5	0.000	0.02		8.1	SURCHARGED	
1.004	6	0.000	0.04		19.2	SURCHARGED	
1.005	7	0.000	0.04		17.9	SURCHARGED	
1.006	8	0.000	0.04		19.5	SURCHARGED	
1.007	9	0.000	0.38		16.7	SURCHARGED	
1.008	10	0.000	0.12		16.7	OK	
1.009	11	0.000	0.38		16.7	OK	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 7387 N1 SW02.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 Offline Controls 0 Number of Time/Area Diagrams 0
 Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.312 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) 1, 30, 100
 Climate Change (%) 0, 0, 40

									Water	Surcharged	Flooded	
	US/MH			Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level	Depth	Volume
PN	Name	Storm	Period	Change		Surcharge	Flood	Overflow	Act.	(m)	(m)	(m³)
1.000	1	360 Winter	100	+40%	30/120	Winter				84.811	1.511	0.000
1.001	2	360 Winter	100	+40%	30/120	Winter				84.809	1.553	0.000
1.002	3	360 Winter	100	+40%	30/120	Winter				84.805	1.600	0.000
1.003	4	360 Winter	100	+40%	30/120	Winter				84.803	1.615	0.000
2.000	5	360 Winter	100	+40%	30/120	Winter				84.804	1.636	0.000
1.004	6	360 Winter	100	+40%	30/60	Winter				84.802	1.670	0.000
1.005	7	360 Winter	100	+40%	30/60	Winter				84.805	1.706	0.000
1.006	8	360 Winter	100	+40%	30/60	Winter				84.813	1.747	0.000
1.007	9	360 Winter	100	+40%	1/15	Summer				84.814	2.452	0.000
1.008	10	360 Winter	100	+40%						82.078	-0.172	0.000
1.009	11	360 Winter	100	+40%						79.698	-0.127	0.000

		Pipe		Level	
PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Flow (l/s)	Status
1.000	1	0.06		24.8	SURCHARGED
1.001	2	0.07		28.6	SURCHARGED
1.002	3	0.10		30.1	SURCHARGED
1.003	4	0.04		30.0	SURCHARGED
2.000	5	0.06		31.0	SURCHARGED
1.004	6	0.10		51.7	SURCHARGED
1.005	7	0.08		41.4	SURCHARGED
1.006	8	0.07		34.5	SURCHARGED
1.007	9	0.40		17.4	SURCHARGED
1.008	10	0.13		17.4	OK
1.009	11	0.39		17.4	OK