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Metro House Northgate Chichester PO19 1BE	1-3 Castle Crescent Reading	
Date 09/03/2018 File D1368 NETWORK 1.MDX	Designed by SPB Checked by MJA	
XP Solutions Network 2016.1		

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	Add Flow / Climate Change (%)	0
M5-60 (mm)	18.700	Minimum Backdrop Height (m)	0.500
Ratio R	0.400	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	0	Min Design Depth for Optimisation (m)	1.350
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	1.000		

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.110	4-8	0.042

Total Area Contributing (ha) = 0.152

Total Pipe Volume (m³) = 5.199

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
1.000	35.713	0.280	127.5	0.012	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	23.526	0.190	123.8	0.012	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	11.688	0.100	116.9	0.012	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.003	11.543	0.100	115.4	0.012	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.004	32.067	0.110	291.5	0.012	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.000	5.000	0.085	58.8	0.068	5.00	0.0	0.600	o	300	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	5.67	58.600	0.012	0.0	0.0	0.0	0.89	15.7	0.0
1.001	0.00	6.10	58.320	0.024	0.0	0.0	0.0	0.90	15.9	0.0
1.002	0.00	6.31	58.130	0.036	0.0	0.0	0.0	0.93	16.4	0.0
1.003	0.00	6.52	58.030	0.048	0.0	0.0	0.0	0.93	16.5	0.0
1.004	0.00	7.10	57.780	0.060	0.0	0.0	0.0	0.92	64.7	0.0
2.000	0.00	5.04	57.440	0.068	0.0	0.0	0.0	2.05	145.2	0.0

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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
1.005	10.312	0.050	206.2	0.012	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.006	9.877	0.100	98.8	0.012	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)
1.005	0.00	7.26	57.355	0.140	0.0	0.0	0.0	1.09	77.1	0.0
1.006	0.00	7.39	57.305	0.152	0.0	0.0	0.0	1.32	52.3	0.0

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
1	59.100	0.500	Open Manhole	150	1.000	58.600	150				
2	59.000	0.680	Open Manhole	480	1.001	58.320	150	1.000	58.320	150	
3	59.050	0.920	Open Manhole	480	1.002	58.130	150	1.001	58.130	150	
4	59.100	1.070	Open Manhole	480	1.003	58.030	150	1.002	58.030	150	
5	59.070	1.290	Open Manhole	1050	1.004	57.780	300	1.003	57.930	150	
6	59.170	1.730	Open Manhole	1200	2.000	57.440	300				
6	59.170	1.815	Open Manhole	1050	1.005	57.355	300	1.004	57.670	300	315
								2.000	57.355	300	
7	59.420	2.115	Open Manhole	1200	1.006	57.305	225	1.005	57.305	300	
	59.460	2.255	Open Manhole	0		OUTFALL		1.006	57.205	225	

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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd	Diam	MH	C.Level	I.Level	D.Depth	MH	MH DIAM., L*W
	Sect	(mm)	Name	(m)	(m)	(m)	Connection	(mm)
1.000	o	150	1	59.100	58.600	0.350	Open Manhole	150
1.001	o	150	2	59.000	58.320	0.530	Open Manhole	480
1.002	o	150	3	59.050	58.130	0.770	Open Manhole	480
1.003	o	150	4	59.100	58.030	0.920	Open Manhole	480
1.004	o	300	5	59.070	57.780	0.990	Open Manhole	1050
2.000	o	300	6	59.170	57.440	1.430	Open Manhole	1200
1.005	o	300	6	59.170	57.355	1.515	Open Manhole	1050
1.006	o	225	7	59.420	57.305	1.890	Open Manhole	1200

Downstream Manhole

PN	Length	Slope	MH	C.Level	I.Level	D.Depth	MH	MH DIAM., L*W
	(m)	(1:X)	Name	(m)	(m)	(m)	Connection	(mm)
1.000	35.713	127.5	2	59.000	58.320	0.530	Open Manhole	480
1.001	23.526	123.8	3	59.050	58.130	0.770	Open Manhole	480
1.002	11.688	116.9	4	59.100	58.030	0.920	Open Manhole	480
1.003	11.543	115.4	5	59.070	57.930	0.990	Open Manhole	1050
1.004	32.067	291.5	6	59.170	57.670	1.200	Open Manhole	1050
2.000	5.000	58.8	6	59.170	57.355	1.515	Open Manhole	1050
1.005	10.312	206.2	7	59.420	57.305	1.815	Open Manhole	1200
1.006	9.877	98.8		59.460	57.205	2.030	Open Manhole	0

Free Flowing Outfall Details for Storm

Outfall	Outfall	C. Level	I. Level	Min	D,L	W
Pipe Number	Name	(m)	(m)	I. Level (m)	(mm)	(mm)

1.006		59.460	57.205	57.060	0	0
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Simulation Criteria for Storm

Volumetric Runoff Coeff	1.000	Additional Flow - % of Total Flow	10.000
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 Online Controls	1	Number of Storage Structures	1

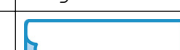
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Simulation Criteria for Storm

Number of Time/Area Diagrams 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	1.000
Region	England and Wales	Cv (Winter)	1.000
M5-60 (mm)	18.700	Storm Duration (mins)	30
Ratio R	0.400		

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Online Controls for Storm

Hydro-Brake Optimum® Manhole: 6, DS/PN: 1.005, Volume (m³): 4.0

Unit Reference	MD-SHE-0207-2500-1815-2500
Design Head (m)	1.815
Design Flow (l/s)	25.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	207
Invert Level (m)	57.355
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.815	25.0
Flush-Flo™	0.536	25.0
Kick-Flo®	1.160	20.2
Mean Flow over Head Range	-	21.7

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	7.1	1.200	20.5	3.000	31.8	7.000	47.9
0.200	19.9	1.400	22.1	3.500	34.3	7.500	49.5
0.300	23.6	1.600	23.5	4.000	36.5	8.000	51.1
0.400	24.6	1.800	24.9	4.500	38.7	8.500	52.6
0.500	25.0	2.000	26.2	5.000	40.7	9.000	54.1
0.600	24.9	2.200	27.4	5.500	42.6	9.500	55.5
0.800	24.3	2.400	28.6	6.000	44.4		
1.000	22.9	2.600	29.7	6.500	46.2		

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Storage Structures for Storm

Porous Car Park Manhole: 6, DS/PN: 1.005

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	68.0
Max Percolation (l/s)	188.9	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	57.155	Membrane Depth (mm)	0