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ACO Business Park Hitchin Road Bedfordshire SG17 5TE	Canterbury	
Date 01/09/2019 File Canterbury 01-09-19.MDX	Designed by Dave Dunn Checked by	
Micro Drainage	Network 2019.1	

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)	26.250	Add Flow / Climate Change (%)	0
Ratio R	0.377	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	150	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.	0.840	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm




Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.440	4-8	0.481	8-12	0.019

Total Area Contributing (ha) = 0.940

Total Pipe Volume (m³) = 20.288


Network Design Table for Storm

< - 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
1.000	70.807	0.283	250.2	0.120	6.00	0.0	0.600	o	225	Pipe/Conduit	
2.000	14.426	0.146	98.8	0.050	6.00	0.0	0.600	o	150	Pipe/Conduit	
3.000	23.142	0.204	113.4	0.050	6.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL E (m)	I.Area (ha)	E Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	75.15	7.44	4.283	0.120	0.0	0.0	0.0	0.82	32.7	27.4
2.000	81.40	6.24	4.221	0.050	0.0	0.0	0.0	1.01	17.9	12.3
3.000	80.43	6.41	4.279	0.050	0.0	0.0	0.0	0.94	16.7	12.2


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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
4.000	14.709	0.148	99.4	0.050	6.00	0.0	0.600	o	150	Pipe/Conduit		
5.000	21.333	0.142	150.2	0.037	6.00	0.0	0.600	o	150	Pipe/Conduit		
1.001	51.239	0.205	249.9	0.013	0.00	0.0	0.600	o	300	Pipe/Conduit		
6.000	10.301	0.069	149.3	0.048	6.00	0.0	0.600	o	150	Pipe/Conduit		
7.000	10.028	0.067	149.7	0.078	6.00	0.0	0.600	o	150	Pipe/Conduit		
8.000	20.000	0.010	2000.0	0.050	6.00	0.0	0.600	Q35	-3	Pipe/Conduit		
1.002	1.281	0.020	64.1	0.004	0.00	0.0	0.600	o	300	Pipe/Conduit		
9.000	49.942	0.200	249.7	0.063	6.00	0.0	0.600	o	225	Pipe/Conduit		
10.000	42.500	0.021	2023.8	0.040	6.00	0.0	0.600	Q22	-2	Pipe/Conduit		
9.001	2.390	0.020	119.5	0.057	0.00	0.0	0.600	o	300	Pipe/Conduit		
11.000	17.505	0.117	149.6	0.200	6.00	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)
4.000	81.37	6.24	4.223	0.050	0.0	0.0	0.0	1.01	17.8	12.3
5.000	80.29	6.43	4.217	0.037	0.0	0.0	0.0	0.82	14.4	9.0
1.001	71.31	8.30	3.925	0.320	0.0	0.0	0.0	0.99	70.0	69.2
6.000	81.56	6.21	3.989	0.048	0.0	0.0	0.0	0.82	14.5	11.9
7.000	81.59	6.20	4.042	0.078	0.0	0.0	0.0	0.82	14.5<	19.3
8.000	77.90	6.88	4.750	0.050	0.0	0.0	0.0	0.38	36.3	11.8
1.002	71.26	8.31	3.720	0.500	0.0	0.0	0.0	1.97	139.1	108.1
9.000	77.23	7.01	3.995	0.063	0.0	0.0	0.0	0.82	32.7	14.8
10.000	70.46	8.50	4.875	0.040	0.0	0.0	0.0	0.28	11.3	8.5
9.001	70.35	8.53	3.720	0.160	0.0	0.0	0.0	1.44	101.6	34.1
11.000	81.46	6.23	3.912	0.200	0.0	0.0	0.0	1.28	90.7	49.4

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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
12.000	32.500	0.016	2031.3	0.080	6.00	0.0	0.600	Q35	-3	Pipe/Conduit	
11.001	1.097	0.020	54.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.003	10.950	0.044	250.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.004	15.797	0.158	100.0	0.000	0.00	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)
12.000	75.11	7.44	4.750	0.080	0.0	0.0	0.0	0.38	36.0	18.2
11.001	75.07	7.45	3.795	0.280	0.0	0.0	0.0	2.13	150.4	63.8
1.003	69.61	8.72	3.700	0.940	0.0	0.0	0.0	0.99	70.0«	198.5
1.004	68.96	8.88	3.656	0.940	0.0	0.0	0.0	1.57	111.1«	198.5

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)	Pipe Out Diameter (mm)	PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	5.300	1.017	Open Manhole	1200	1.000	4.283	225				
2	5.300	1.079	Open Manhole	1200	2.000	4.221	150				
3	5.300	1.021	Open Manhole	1200	3.000	4.279	150				
4	5.300	1.077	Open Manhole	1200	4.000	4.223	150				
5	5.300	1.083	Open Manhole	1200	5.000	4.217	150				
6	5.300	1.375	Open Manhole	1200	1.001	3.925	300	1.000	4.000	225	
								2.000	4.075	150	
								3.000	4.075	150	
								4.000	4.075	150	
								5.000	4.075	150	
7	5.300	1.311	Open Manhole	1200	6.000	3.989	150				
8	5.300	1.258	Open Manhole	1200	7.000	4.042	150				
9	5.300	0.550	Junction		8.000	4.750	-3				
9	5.300	1.580	Open Manhole	10000	1.002	3.720	300	1.001	3.720	300	
								6.000	3.920	150	50
								7.000	3.975	150	105
								8.000	4.740	-3	1070
10	5.300	1.305	Open Manhole	1200	9.000	3.995	225				
12	5.300	0.425	Junction		10.000	4.875	-2				
11	5.300	1.580	Open Manhole	10000	9.001	3.720	300	9.000	3.795	225	
								10.000	4.854	-2	1059
12	5.300	1.388	Open Manhole	1200	11.000	3.912	300				
15	5.300	0.550	Junction		12.000	4.750	-3				
13	5.350	1.555	Open Manhole	10000	11.001	3.795	300	11.000	3.795	300	
								12.000	4.734	-3	989
14	5.500	1.800	Open Manhole	1200	1.003	3.700	300	1.002	3.700	300	
								9.001	3.700	300	
								11.001	3.775	300	75
15	5.600	1.944	Open Manhole	1500	1.004	3.656	300	1.003	3.656	300	
	5.500	2.002	Open Manhole	0		OUTFALL		1.004	3.498	300	

No coordinates have been specified, layout information cannot be produced.

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PIPELINE SCHEDULES for Storm

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	225	1	5.300	4.283	0.792	Open Manhole	1200
2.000	o	150	2	5.300	4.221	0.929	Open Manhole	1200
3.000	o	150	3	5.300	4.279	0.871	Open Manhole	1200
4.000	o	150	4	5.300	4.223	0.927	Open Manhole	1200
5.000	o	150	5	5.300	4.217	0.933	Open Manhole	1200
1.001	o	300	6	5.300	3.925	1.075	Open Manhole	1200
6.000	o	150	7	5.300	3.989	1.161	Open Manhole	1200
7.000	o	150	8	5.300	4.042	1.108	Open Manhole	1200
8.000	Q35	-3	9	5.300	4.750	0.200	Junction	
1.002	o	300	9	5.300	3.720	1.280	Open Manhole	10000
9.000	o	225	10	5.300	3.995	1.080	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	70.807	250.2	6	5.300	4.000	1.075	Open Manhole	1200
2.000	14.426	98.8	6	5.300	4.075	1.075	Open Manhole	1200
3.000	23.142	113.4	6	5.300	4.075	1.075	Open Manhole	1200
4.000	14.709	99.4	6	5.300	4.075	1.075	Open Manhole	1200
5.000	21.333	150.2	6	5.300	4.075	1.075	Open Manhole	1200
1.001	51.239	249.9	9	5.300	3.720	1.280	Open Manhole	10000
6.000	10.301	149.3	9	5.300	3.920	1.230	Open Manhole	10000
7.000	10.028	149.7	9	5.300	3.975	1.175	Open Manhole	10000
8.000	20.000	2000.0	9	5.300	4.740	0.210	Open Manhole	10000
1.002	1.281	64.1	14	5.500	3.700	1.500	Open Manhole	1200
9.000	49.942	249.7	11	5.300	3.795	1.280	Open Manhole	10000

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PIPELINE SCHEDULES for Storm

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)
10.000	Q22	-2	12	5.300	4.875	0.200	Junction	
9.001	o	300	11	5.300	3.720	1.280	Open Manhole	10000
11.000	o	300	12	5.300	3.912	1.088	Open Manhole	1200
12.000	Q35	-3	15	5.300	4.750	0.200	Junction	
11.001	o	300	13	5.350	3.795	1.255	Open Manhole	10000
1.003	o	300	14	5.500	3.700	1.500	Open Manhole	1200
1.004	o	300	15	5.600	3.656	1.644	Open Manhole	1500

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)
10.000	42.500	2023.8	11	5.300	4.854	0.221	Open Manhole	10000
9.001	2.390	119.5	14	5.500	3.700	1.500	Open Manhole	1200
11.000	17.505	149.6	13	5.350	3.795	1.255	Open Manhole	10000
12.000	32.500	2031.3	13	5.350	4.734	0.266	Open Manhole	10000
11.001	1.097	54.9	14	5.500	3.775	1.425	Open Manhole	1200
1.003	10.950	250.0	15	5.600	3.656	1.644	Open Manhole	1500
1.004	15.797	100.0		5.500	3.498	1.702	Open Manhole	0

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.004		5.500	3.498	0.000	0	0


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Simulation Criteria for Storm

Volumetric Runoff Coeff	0.840	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	7
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)	2	Cv (Summer)	0.840
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.900	Storm Duration (mins)	30
Ratio R	0.377		


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Online Controls for Storm

ACO Q-Brake Manhole: 15, DS/PN: 1.004, Volume (m³): 4.1

Design Head (m) 0.914 Diameter (mm) 87
Design Flow (l/s) 3.8 Invert Level (m) 3.656

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.6	1.200	4.3	3.000	6.8	7.000	10.4
0.200	3.6	1.400	4.7	3.500	7.4	7.500	10.8
0.300	3.8	1.600	5.0	4.000	7.9	8.000	11.1
0.400	3.5	1.800	5.3	4.500	8.3	8.500	11.5
0.500	2.8	2.000	5.6	5.000	8.8	9.000	11.8
0.600	3.0	2.200	5.8	5.500	9.2	9.500	12.1
0.800	3.5	2.400	6.1	6.000	9.6		
1.000	3.9	2.600	6.3	6.500	10.0		

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Storage Structures for Storm

Porous Car Park Manhole: 2, DS/PN: 2.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	14.8
Max Percolation (l/s)	41.1	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	4.221	Membrane Depth (mm)	600

Porous Car Park Manhole: 3, DS/PN: 3.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	14.8
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	41.1	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	4.279	Membrane Depth (mm)	600

Porous Car Park Manhole: 4, DS/PN: 4.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	7.6
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	21.1	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	4.223	Membrane Depth (mm)	600

Porous Car Park Manhole: 7, DS/PN: 6.000


Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	17.5
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	48.6	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	3.989	Membrane Depth (mm)	600

Porous Car Park Manhole: 8, DS/PN: 7.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	17.5
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	48.6	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	4.042	Membrane Depth (mm)	600

Porous Car Park Manhole: 12, DS/PN: 11.000

Infiltration Coefficient Base (m/hr)	0.00000	Max Percolation (l/s)	331.9
Membrane Percolation (mm/hr)	1000	Safety Factor	2.0

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Porous Car Park Manhole: 12, DS/PN: 11.000

Porosity 0.30 Slope (1:X) 0.0
 Invert Level (m) 3.912 Depression Storage (mm) 5
 Width (m) 50.0 Evaporation (mm/day) 3
 Length (m) 23.9 Membrane Depth (mm) 600

Cellular Storage Manhole: 14, DS/PN: 1.003

Invert Level (m) 3.700 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	615.0	0.0	0.915	0.0	0.0
0.914	615.0	0.0			