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1st Floor Block C Holland Park Newcastle Upon Tyne NE2 4LD	Jarrow	
Date May 15 File SW 09.03.15.mdx	Designed by AM Checked by	
Micro Drainage	Network 2015.1	

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)	18.600	Minimum Backdrop Height (m)	0.000
Ratio R	0.350	Maximum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	100	Min Design Depth for Optimisation (m)	1.200
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.	0.750		

Designed with Level Soffits







Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.118	4-8	0.051

Total Area Contributing (ha) = 0.169


Total Pipe Volume (m³) = 5.077

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)	Auto Design
1.000	42.500	0.531	80.0	0.043	5.00	0.0	0.600	o	150	
1.001	10.000	0.125	80.0	0.018	0.00	0.0	0.600	o	225	
1.002	16.000	0.200	80.0	0.008	0.00	0.0	0.600	o	225	
1.003	19.200	0.240	80.0	0.008	0.00	0.0	0.600	o	225	
1.004	23.000	0.288	79.9	0.026	0.00	0.0	0.600	o	225	
1.005	10.000	0.125	80.0	0.004	0.00	0.0	0.600	o	225	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E 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	58.07	5.63	15.440	0.043	0.0	0.0	0.0	1.12	19.9	6.8
1.001	57.58	5.74	14.834	0.061	0.0	0.0	0.0	1.46	58.2	9.5
1.002	56.81	5.93	14.709	0.069	0.0	0.0	0.0	1.46	58.2	10.6
1.003	55.92	6.14	14.509	0.077	0.0	0.0	0.0	1.46	58.2	11.7
1.004	54.90	6.41	14.269	0.103	0.0	0.0	0.0	1.46	58.2	15.3
1.005	54.46	6.52	13.981	0.107	0.0	0.0	0.0	1.46	58.2	15.8


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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)	Auto Design
2.000	22.000	0.275	80.0	0.015	5.00	0.0	0.600	o	150	
2.001	7.700	0.096	80.2	0.002	0.00	0.0	0.600	o	150	
3.000	8.800	0.110	80.0	0.045	5.00	0.0	0.600	o	150	
1.006	6.000	0.075	80.0	0.000	0.00	0.0	0.600	o	225	
1.007	2.700	0.034	80.0	0.000	0.00	0.0	0.600	o	225	
1.008	4.800	0.060	80.0	0.000	0.00	0.0	0.600	o	225	


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)
2.000	59.44	5.33	15.440	0.015	0.0	0.0	0.0	1.12	19.9	2.4
2.001	58.92	5.44	15.165	0.017	0.0	0.0	0.0	1.12	19.9	2.7
3.000	60.36	5.13	15.150	0.045	0.0	0.0	0.0	1.12	19.9	7.4
1.006	54.21	6.59	13.856	0.169	0.0	0.0	0.0	1.46	58.2	24.8
1.007	54.10	6.62	13.781	0.169	0.0	0.0	0.0	1.46	58.2	24.8
1.008	53.89	6.67	13.747	0.169	0.0	0.0	0.0	1.46	58.2	24.8

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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)	Pipe Out Diameter (mm)	PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	16.190	0.750	Open Manhole	150	1.000	15.440	150				
2	16.050	1.216	Open Manhole	475	1.001	14.834	225	1.000	14.909	150	
3	16.050	1.341	Open Manhole	475	1.002	14.709	225	1.001	14.709	225	
4	16.050	1.541	Open Manhole	475	1.003	14.509	225	1.002	14.509	225	
5	16.050	1.781	Open Manhole	475	1.004	14.269	225	1.003	14.269	225	
6	16.050	2.069	Open Manhole	475	1.005	13.981	225	1.004	13.981	225	
7	16.190	0.750	Open Manhole	150	2.000	15.440	150				
8	16.170	1.005	Open Manhole	475	2.001	15.165	150	2.000	15.165	150	
9	15.900	0.750	Open Manhole	450	3.000	15.150	150				
9	16.050	2.194	Open Manhole	1200	1.006	13.856	225	1.005	13.856	225	
								2.001	15.069	150	1138
								3.000	15.040	150	1109
11	16.000	2.219	Open Manhole	1200	1.007	13.781	225	1.006	13.781	225	
12	16.000	2.253	Open Manhole	1200	1.008	13.747	225	1.007	13.747	225	
	16.000	2.313	Open Manhole	0		OUTFALL		1.008	13.687	225	

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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	150	1	16.190	15.440	0.600	Open Manhole	150
1.001	o	225	2	16.050	14.834	0.991	Open Manhole	475
1.002	o	225	3	16.050	14.709	1.116	Open Manhole	475
1.003	o	225	4	16.050	14.509	1.316	Open Manhole	475
1.004	o	225	5	16.050	14.269	1.556	Open Manhole	475
1.005	o	225	6	16.050	13.981	1.844	Open Manhole	475
2.000	o	150	7	16.190	15.440	0.600	Open Manhole	150
2.001	o	150	8	16.170	15.165	0.855	Open Manhole	475
3.000	o	150	9	15.900	15.150	0.600	Open Manhole	450
1.006	o	225	9	16.050	13.856	1.969	Open Manhole	1200
1.007	o	225	11	16.000	13.781	1.994	Open Manhole	1200
1.008	o	225	12	16.000	13.747	2.028	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	42.500	80.0	2	16.050	14.909	0.991	Open Manhole	475
1.001	10.000	80.0	3	16.050	14.709	1.116	Open Manhole	475
1.002	16.000	80.0	4	16.050	14.509	1.316	Open Manhole	475
1.003	19.200	80.0	5	16.050	14.269	1.556	Open Manhole	475
1.004	23.000	79.9	6	16.050	13.981	1.844	Open Manhole	475
1.005	10.000	80.0	9	16.050	13.856	1.969	Open Manhole	1200
2.000	22.000	80.0	8	16.170	15.165	0.855	Open Manhole	475
2.001	7.700	80.2	9	16.050	15.069	0.831	Open Manhole	1200
3.000	8.800	80.0	9	16.050	15.040	0.860	Open Manhole	1200
1.006	6.000	80.0	11	16.000	13.781	1.994	Open Manhole	1200
1.007	2.700	80.0	12	16.000	13.747	2.028	Open Manhole	1200
1.008	4.800	80.0		16.000	13.687	2.088	Open Manhole	0


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Storage Structures for Storm

Tank or Pond Manhole: 11, DS/PN: 1.007

Invert Level (m) 13.781

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	35.0	1.000	35.0	1.001	0.0

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

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) 18.600 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 OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 30


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	1	+0%	100/15	Summer			15.494
1.001	2 15	Winter	1	+0%	100/15	Winter			14.892
1.002	3 15	Winter	1	+0%	100/15	Winter			14.768
1.003	4 15	Winter	1	+0%	100/15	Summer			14.571
1.004	5 15	Winter	1	+0%	100/15	Summer			14.340
1.005	6 15	Winter	1	+0%	30/15	Summer			14.057
2.000	7 15	Winter	1	+0%	100/120	Winter			15.472
2.001	8 15	Winter	1	+0%	100/60	Winter			15.200
3.000	9 15	Winter	1	+0%	100/15	Summer			15.208
1.006	9 60	Winter	1	+0%	30/15	Summer			14.014
1.007	11 60	Winter	1	+0%	1/60	Winter			14.011
1.008	12 60	Winter	1	+0%	1/15	Winter			14.021

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m ³)	Pipe Flow / Cap. (l/s)	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.096	0.000	0.28		5.3	OK	

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

PN	US/MH Name	Surcharged Flooded		Pipe		Status	Level Exceeded
		Depth (m)	Volume (m ³)	Flow / Overflow Cap. (l/s)	Flow (l/s)		
1.001	2	-0.167	0.000	0.15	7.2	OK	
1.002	3	-0.166	0.000	0.16	8.0	OK	
1.003	4	-0.163	0.000	0.17	8.8	OK	
1.004	5	-0.154	0.000	0.21	11.5	OK	
1.005	6	-0.149	0.000	0.24	11.8	OK	
2.000	7	-0.118	0.000	0.10	1.8	OK	
2.001	8	-0.115	0.000	0.12	2.0	OK	
3.000	9	-0.092	0.000	0.32	5.5	OK	
1.006	9	-0.067	0.000	0.29	11.2	OK	
1.007	11	0.005	0.000	0.14	4.3	SURCHARGED	
1.008	12	0.048	0.000	0.11	3.8	SURCHARGED	

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

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) 18.600 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 OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 30


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			15.531
1.001	2 15	Winter	30	+0%	100/15	Winter			14.931
1.002	3 15	Winter	30	+0%	100/15	Winter			14.809
1.003	4 15	Winter	30	+0%	100/15	Summer			14.615
1.004	5 60	Winter	30	+0%	100/15	Summer			14.454
1.005	6 60	Winter	30	+0%	30/15	Summer			14.445
2.000	7 15	Winter	30	+0%	100/120	Winter			15.490
2.001	8 15	Winter	30	+0%	100/60	Winter			15.222
3.000	9 15	Winter	30	+0%	100/15	Summer			15.251
1.006	9 60	Winter	30	+0%	30/15	Summer			14.440
1.007	11 60	Winter	30	+0%	1/60	Winter			14.435
1.008	12 60	Winter	30	+0%	1/15	Winter			14.441

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m ³)	Pipe Flow / Cap. (l/s)	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.059	0.000	0.66		12.7	OK	

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

PN	US/MH Name	Surcharged		Flooded		Pipe Flow (l/s)	Status	Level Exceeded
		Depth (m)	Volume (m ³)	Flow / Cap.	Overflow (l/s)			
1.001	2	-0.128	0.000	0.37		18.1	OK	
1.002	3	-0.125	0.000	0.40		20.5	OK	
1.003	4	-0.119	0.000	0.44		22.9	OK	
1.004	5	-0.040	0.000	0.32		16.8	OK	
1.005	6	0.239	0.000	0.33		15.8	SURCHARGED	
2.000	7	-0.100	0.000	0.24		4.5	OK	
2.001	8	-0.093	0.000	0.30		5.1	OK	
3.000	9	-0.049	0.000	0.78		13.6	OK	
1.006	9	0.359	0.000	0.65		25.2	SURCHARGED	
1.007	11	0.429	0.000	0.27		8.0	SURCHARGED	
1.008	12	0.469	0.000	0.18		6.2	SURCHARGED	

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

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
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Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 30

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	+30%	100/15 Summer				15.679
1.001	2	120 Winter	100	+30%	100/15 Winter				15.640
1.002	3	120 Winter	100	+30%	100/15 Winter				15.635
1.003	4	120 Winter	100	+30%	100/15 Summer				15.627
1.004	5	120 Winter	100	+30%	100/15 Summer				15.618
1.005	6	120 Winter	100	+30%	30/15 Summer				15.604
2.000	7	120 Winter	100	+30%	100/120 Winter				15.603
2.001	8	120 Winter	100	+30%	100/60 Winter				15.598
3.000	9	120 Winter	100	+30%	100/15 Summer				15.604
1.006	9	120 Winter	100	+30%	30/15 Summer				15.596
1.007	11	120 Winter	100	+30%	1/60 Winter				15.587
1.008	12	120 Winter	100	+30%	1/15 Winter				15.582

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m ³)	Flow / Cap. (l/s)	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.089	0.000	1.07		20.6	SURCHARGED	

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

PN	US/MH Name	Surcharged Flooded		Flow / Overflow		Pipe	Status	Level Exceeded
		Depth (m)	Volume (m ³)	Cap.	(l/s)	Flow (l/s)		
1.001	2	0.581	0.000	0.22		10.8	SURCHARGED	
1.002	3	0.701	0.000	0.24		12.2	SURCHARGED	
1.003	4	0.893	0.000	0.25		13.0	SURCHARGED	
1.004	5	1.124	0.000	0.30		16.1	SURCHARGED	
1.005	6	1.398	0.000	0.35		16.7	SURCHARGED	
2.000	7	0.013	0.000	0.14		2.7	SURCHARGED	
2.001	8	0.283	0.000	0.18		3.0	SURCHARGED	
3.000	9	0.304	0.000	0.46		8.0	FLOOD RISK	
1.006	9	1.515	0.000	0.70		27.0	SURCHARGED	
1.007	11	1.581	0.000	0.36		10.9	SURCHARGED	
1.008	12	1.610	0.000	0.29		10.1	SURCHARGED	