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Turing House 5 Archway Manchester M15 5RL	Woone Lane Mearley Croft Clitheroe	
Date 23/07/2021 File AM MODEL.MDX	Designed by A Morris Checked by C Munro	
XP Solutions	Network 2018.1	

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)	30	PIMP (%)	100
M5-60 (mm)	19.000	Add Flow / Climate Change (%)	0
Ratio R	0.275	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	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.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Inverts

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.071	4-8	0.019

Total Area Contributing (ha) = 0.090

Total Pipe Volume (m³) = 4.957

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	9.869	0.025	394.8	0.037	5.00	0.0	0.600	o	300	Pipe/Conduit	
1.001	9.869	0.025	394.8	0.013	0.00	0.0	0.600	o	375	Pipe/Conduit	
2.000	11.208	0.028	400.3	0.017	5.00	0.0	0.600	o	450	Pipe/Conduit	
2.001	3.325	0.008	415.6	0.023	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.002	2.497	0.006	416.2	0.000	0.00	0.0	0.600	o	450	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	50.00	5.21	72.300	0.037	0.0	0.0	0.0	0.79	55.5	5.0
1.001	50.00	5.39	72.275	0.050	0.0	0.0	0.0	0.91	100.0	6.8
2.000	50.00	5.18	72.300	0.017	0.0	0.0	0.0	1.01	160.6	2.3
2.001	50.00	5.24	72.271	0.040	0.0	0.0	0.0	0.99	157.6	5.4
1.002	50.00	5.43	72.250	0.090	0.0	0.0	0.0	0.99	157.5	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
1.003	26.056	3.139	8.3	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)
1.003	50.00	5.56	72.244	0.090	0.0	0.0	0.0	3.52	62.2	12.2

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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)
6	75.300	3.000	Open Manhole	1200	1.000	72.300	300				
7	76.050	3.775	Open Manhole	1350	1.001	72.275	375	1.000	72.275	300	
8	75.800	3.500	Open Manhole	1350	2.000	72.300	450				
9	76.465	4.194	Open Manhole	1350	2.001	72.271	450	2.000	72.272	450	1
10	76.545	4.295	Open Manhole	1350	1.002	72.250	450	1.001	72.250	375	
								2.001	72.263	450	13
11	76.366	4.122	Open Manhole	1500	1.003	72.244	150	1.002	72.244	450	
	70.200	1.095	Open Manhole	150		OUTFALL		1.003	69.105	150	

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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	300	6	75.300	72.300	2.700	Open Manhole	1200
1.001	o	375	7	76.050	72.275	3.400	Open Manhole	1350
2.000	o	450	8	75.800	72.300	3.050	Open Manhole	1350
2.001	o	450	9	76.465	72.271	3.744	Open Manhole	1350
1.002	o	450	10	76.545	72.250	3.845	Open Manhole	1350
1.003	o	150	11	76.366	72.244	3.972	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)
1.000	9.869	394.8	7	76.050	72.275	3.475	Open Manhole	1350
1.001	9.869	394.8	10	76.545	72.250	3.920	Open Manhole	1350
2.000	11.208	400.3	9	76.465	72.272	3.743	Open Manhole	1350
2.001	3.325	415.6	10	76.545	72.263	3.832	Open Manhole	1350
1.002	2.497	416.2	11	76.366	72.244	3.672	Open Manhole	1500
1.003	26.056	8.3		70.200	69.105	0.945	Open Manhole	150

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.037	0.037	0.037
1.001	-	-	100	0.013	0.013	0.013
2.000	-	-	100	0.017	0.017	0.017
2.001	-	-	100	0.023	0.023	0.023
1.002	-	-	100	0.000	0.000	0.000
1.003	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.090	0.090	0.090

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)
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1.003		70.200	69.105	69.600	150	0
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Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	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	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)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Storm Duration (mins)	30
Ratio R	0.275		

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Online Controls for Storm

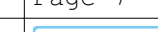
Hydro-Brake® Optimum Manhole: 11, DS/PN: 1.003, Volume (m³): 7.5

Unit Reference	MD-SHE-0083-5000-3000-5000
Design Head (m)	3.000
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	83
Invert Level (m)	72.244
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	3.000	5.0
Flush-Flo™	0.360	3.3
Kick-Flo®	0.741	2.6
Mean Flow over Head Range	-	3.7

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	2.5	1.200	3.3	3.000	5.0	7.000	7.4
0.200	3.1	1.400	3.5	3.500	5.4	7.500	7.7
0.300	3.3	1.600	3.7	4.000	5.7	8.000	7.9
0.400	3.3	1.800	3.9	4.500	6.0	8.500	8.2
0.500	3.2	2.000	4.1	5.000	6.4	9.000	8.4
0.600	3.1	2.200	4.3	5.500	6.6	9.500	8.6
0.800	2.7	2.400	4.5	6.000	6.9		
1.000	3.0	2.600	4.7	6.500	7.2		

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

Simulation Criteria

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

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH		Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water
	Name	Storm							Level (m)
1.000	6	15 Winter	1	+0%	30/15 Summer				72.468
1.001	7	15 Winter	1	+0%	30/15 Summer				72.467
2.000	8	15 Winter	1	+0%	30/15 Summer				72.467
2.001	9	60 Summer	1	+0%	30/15 Summer				72.469
1.002	10	30 Winter	1	+0%	30/15 Summer				72.485
1.003	11	30 Winter	1	+0%	1/15 Summer				72.485

PN	Surcharged		Flooded		Pipe		Status	Level Exceeded
	US/MH Name	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Flow (l/s)		
1.000	6	-0.132	0.000	0.11		4.1	OK	
1.001	7	-0.183	0.000	0.06		4.0	OK	
2.000	8	-0.283	0.000	0.01		1.4	OK	
2.001	9	-0.252	0.000	0.02		2.1	OK	
1.002	10	-0.215	0.000	0.03		3.8	OK	

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

		Surcharged	Flooded		Pipe		
PN	US/MH Name	Depth (m)	Volume (m³)	Flow / Overflow Cap. (l/s)	Flow (l/s)	Status	Level Exceeded
1.003	11	0.091	0.000	0.05	3.2	SURCHARGED	

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5 Archway
Manchester M15 5RL

Woone Lane
Mearley Croft
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Micro
Drainage

30 year Return Period Summary of Critical Results by Maximum Outflow (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 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 0.280

Region England and Wales Cv (Summer) 0.750

M5-60 (mm)

19.700 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm)

300.0

Analysis Timestep 2.5 Second Increment (Extended)

DTS Status

ON

DVD Status

OFF

Inertia Status

OFF

Profile(s)

Summer and Winter

Duration(s) (mins)

15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080

Return Period(s) (years)

1, 30, 100

Climate Change (%)

0, 0, 40

US/MH

PN

Name

Storm

Return Period

Climate Change

First (X) Surge

First (Y) Flood

First (Z) Overflow

Overflow Act.

Water Level (m)

1.000

6

15 Winter

30

+0%

30/15 Summer

72.975

1.001

7

15 Winter

30

+0%

30/15 Summer

72.974

2.000

8

15 Winter

30

+0%

30/15 Summer

72.974

2.001

9

15 Summer

30

+0%

30/15 Summer

72.826

1.002

10

15 Winter

30

+0%

30/15 Summer

72.973

1.003

11

480 Summer

30

+0%

1/15 Summer

72.606

Surcharged Flooded

Pipe

US/MH

PN

Name

Depth (m)

Volume (m³)

Flow / Cap.

Overflow (l/s)

Pipe Flow (l/s)

Status

Level Exceeded

1.000

6

0.375

0.000

0.24

9.2

SURCHARGED

1.001

7

0.324

0.000

0.15

9.6

SURCHARGED

2.000

8

0.224

0.000

0.03

3.1

SURCHARGED

2.001

9

0.105

0.000

0.03

3.9

SURCHARGED

1.002

10

0.273

0.000

0.05

6.4

SURCHARGED

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

		Surcharged	Flooded		Pipe		
PN	US/MH Name	Depth (m)	Volume (m³)	Flow / Overflow Cap. (l/s)	Flow (l/s)	Status	Level Exceeded
1.003	11	0.212	0.000	0.06	3.3	SURCHARGED	

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

		Surcharged	Flooded		Pipe		
PN	US/MH Name	Depth (m)	Volume (m³)	Flow / Overflow Cap. (l/s)	Flow (l/s)	Status	Level Exceeded
1.003	11	2.823	0.000	0.08	5.0	SURCHARGED	