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8 Westleigh House Denby Dale Huddersfield	Baytree Lane	
Date 15/03/2024 10:39 File 1332 SW DRAINAGE.MDX	Designed by Sarah Griggs Checked by	
Micro Drainage	Network 2020.1.3	

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)	18.900	Add Flow / Climate Change (%)	0
Ratio R	0.298	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)	0.600
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 Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.031	4-8	0.007

Total Area Contributing (ha) = 0.038

Total Pipe Volume (m³) = 1.348

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	26.700	0.650	41.1	0.010	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	11.900	0.500	23.8	0.018	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	23.000	1.150	20.0	0.010	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	1.960	0.600	3.3	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.003	12.740	0.450	28.3	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)
1.000	50.00	5.28	104.650	0.010	0.0	0.0	0.0	1.57	27.8	1.4
1.001	50.00	5.38	104.000	0.028	0.0	0.0	0.0	2.07	36.6	3.8
2.000	50.00	5.17	104.650	0.010	0.0	0.0	0.0	2.26	40.0	1.4
1.002	50.00	5.38	103.500	0.038	0.0	0.0	0.0	5.62	99.3	5.1
1.003	50.00	5.50	102.900	0.038	0.0	0.0	0.0	1.90	33.6	5.1

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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)
RE	105.100	0.450	Open Manhole	150	1.000	104.650	150				
S1	105.000	1.000	Open Manhole	460	1.001	104.000	150	1.000	104.000	150	
RE	105.100	0.450	Open Manhole	150	2.000	104.650	150				
S2	104.700	1.200	Open Manhole	1050	1.002	103.500	150	1.001	103.500	150	
								2.000	103.500	150	
C1	104.100	1.200	Open Manhole	460	1.003	102.900	150	1.002	102.900	150	
	103.790	1.340	Open Manhole	1200		OUTFALL		1.003	102.450	150	

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	150	RE	105.100	104.650	0.300	Open Manhole	150
1.001	o	150	S1	105.000	104.000	0.850	Open Manhole	460
2.000	o	150	RE	105.100	104.650	0.300	Open Manhole	150
1.002	o	150	S2	104.700	103.500	1.050	Open Manhole	1050
1.003	o	150	C1	104.100	102.900	1.050	Open Manhole	460

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	26.700	41.1	S1	105.000	104.000	0.850	Open Manhole	460
1.001	11.900	23.8	S2	104.700	103.500	1.050	Open Manhole	1050
2.000	23.000	20.0	S2	104.700	103.500	1.050	Open Manhole	1050
1.002	1.960	3.3	C1	104.100	102.900	1.050	Open Manhole	460
1.003	12.740	28.3		103.790	102.450	1.190	Open Manhole	1200

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 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	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.900	Storm Duration (mins)	30
Ratio R	0.298		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: S2, DS/PN: 1.002, Volume (m³): 1.6

Unit Reference	MD-SHE-0100-4500-1000-4500
Design Head (m)	1.000
Design Flow (l/s)	4.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	100
Invert Level (m)	103.500
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	4.5
Flush-Flo™	0.292	4.5
Kick-Flo®	0.630	3.6
Mean Flow over Head Range	-	3.9

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	3.3	1.200	4.9	3.000	7.5	7.000	11.2
0.200	4.4	1.400	5.3	3.500	8.1	7.500	11.6
0.300	4.5	1.600	5.6	4.000	8.6	8.000	12.0
0.400	4.4	1.800	5.9	4.500	9.1	8.500	12.3
0.500	4.2	2.000	6.2	5.000	9.6	9.000	12.7
0.600	3.8	2.200	6.5	5.500	10.0	9.500	13.0
0.800	4.1	2.400	6.8	6.000	10.4		
1.000	4.5	2.600	7.0	6.500	10.8		

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Storage Structures for Storm

Porous Car Park Manhole: S1, DS/PN: 1.001

Infiltration Coefficient Base (m/hr)	0.00540	Width (m)	12.0
Membrane Percolation (mm/hr)	1000	Length (m)	10.5
Max Percolation (l/s)	35.0	Slope (1:X)	26.3
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	104.100	Cap Volume Depth (m)	0.500

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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 0.298

Region England and Wales Cv (Summer) 0.750

M5-60 (mm) 18.900 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0

DVD Status ON

Analysis Timestep Fine

Inertia Status OFF

DTS 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, 40, 45

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	RE	15 Winter	1	+0%					104.670
1.001	S1	15 Winter	1	+0%	30/15 Summer				104.029
2.000	RE	15 Winter	1	+0%					104.667
1.002	S2	30 Winter	1	+0%	30/15 Summer				103.604
1.003	C1	30 Winter	1	+0%	1/15 Summer				103.463

Surcharged Flooded

Half Drain Pipe

US/MH Depth Volume Flow / Overflow Time Flow Level

PN Name (m) (m³) Cap. (l/s) (mins) (l/s) Status Exceeded

1.000 RE -0.130 0.000 0.04

1.001 S1 -0.121 0.000 0.07

2.000 RE -0.133 0.000 0.03

1.002 S2 -0.046 0.000 0.07

1.003 C1 0.413 0.000 0.11

1.2 OK

5 2.3 OK

1.2 OK

3.4 OK

3.4 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 0.298

Region England and Wales

Cv (Summer) 0.750

M5-60 (mm) 18.900

Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0

DVD Status ON

Analysis Timestep Fine

Inertia Status OFF

DTS 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, 40, 45

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	RE	15 Winter	30	+40%					104.689
1.001	S1	30 Winter	30	+40%	30/15	Summer			104.338
2.000	RE	15 Winter	30	+40%					104.683
1.002	S2	30 Winter	30	+40%	30/15	Summer			104.328
1.003	C1	180 Summer	30	+40%	1/15	Summer			103.467

Surcharged Flooded

US/MH Name

Depth (m)

Volume (m³)

Flow / Cap.

Overflow (l/s)

Half Drain Time (mins)

Pipe Flow (l/s)

Status

Level Exceeded

1.000	RE	-0.111	0.000	0.15		4.0	OK	
1.001	S1	0.188	0.000	0.20	13	6.8	SURCHARGED	
2.000	RE	-0.117	0.000	0.11		4.1	OK	
1.002	S2	0.678	0.000	0.09		4.4	SURCHARGED	
1.003	C1	0.417	0.000	0.15		4.4	SURCHARGED	

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

Simulation Criteria

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

Rainfall Model	FSR	Ratio R	0.298
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	18.900	Cv (Winter)	0.840

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, 40, 45

PN	US/MH Name	Surcharged	Flooded	Flow / Cap.	Overflow (l/s)	Half Drain	Pipe	Status	Level Exceeded
		Depth (m)	Volume (m³)			Time (mins)	Flow (l/s)		
1.000	RE	-0.104	0.000	0.20			5.4	OK	
1.001	S1	0.278	0.000	0.22		17	7.3	SURCHARGED	
2.000	RE	-0.112	0.000	0.14			5.5	OK	
1.002	S2	0.769	0.000	0.09			4.4	FLOOD RISK	
1.003	C1	0.418	0.000	0.15			4.5	SURCHARGED	