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8 Westleigh House Denby Dale Huddersfield	Greenhill Road Middleton	
Date 09/10/2024 11:33 File 1326 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)	19.000	Add Flow / Climate Change (%)	0
Ratio R	0.297	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 Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.271	4-8	0.046

Total Area Contributing (ha) = 0.317

Total Pipe Volume (m³) = 64.964

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	31.067	0.080	388.3	0.043	5.00	0.0	0.600	o	900	Pipe/Conduit	
1.001	9.037	0.030	301.2	0.012	0.00	0.0	0.600	o	900	Pipe/Conduit	
1.002	27.407	0.070	391.5	0.030	0.00	0.0	0.600	o	900	Pipe/Conduit	
1.003	20.367	0.060	339.5	0.094	0.00	0.0	0.600	o	900	Pipe/Conduit	
1.004	13.385	0.040	334.6	0.084	0.00	0.0	0.600	o	900	Pipe/Conduit	
1.005	3.927	0.050	78.5	0.054	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.006	9.740	0.130	74.9	0.000	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)
1.000	50.00	5.33	100.630	0.043	0.0	0.0	0.0	1.58	1007.6	5.8
1.001	50.00	5.41	100.550	0.055	0.0	0.0	0.0	1.80	1145.1	7.4
1.002	50.00	5.70	100.520	0.085	0.0	0.0	0.0	1.58	1003.5	11.5
1.003	50.00	5.90	100.450	0.179	0.0	0.0	0.0	1.69	1078.3	24.2
1.004	50.00	6.03	100.390	0.263	0.0	0.0	0.0	1.71	1086.1	35.6
1.005	50.00	6.08	100.350	0.317	0.0	0.0	0.0	1.48	58.7	42.9
1.006	50.00	6.18	100.300	0.317	0.0	0.0	0.0	1.51	60.1	42.9

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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)
S1	104.000	3.370	Open Manhole	3000	1.000	100.630	900				
S2	104.250	3.700	Open Manhole	3000	1.001	100.550	900	1.000	100.550	900	
S3	104.150	3.630	Open Manhole	3000	1.002	100.520	900	1.001	100.520	900	
S4	103.500	3.050	Open Manhole	3000	1.003	100.450	900	1.002	100.450	900	
S5	102.950	2.560	Open Manhole	3000	1.004	100.390	900	1.003	100.390	900	
S6	102.550	2.200	Open Manhole	3000	1.005	100.350	225	1.004	100.350	900	
C1	102.450	2.150	Open Manhole	1200	1.006	100.300	225	1.005	100.300	225	
	101.300	1.130	Open Manhole	1200		OUTFALL		1.006	100.170	225	

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	900	S1	104.000	100.630	2.470	Open Manhole	3000
1.001	o	900	S2	104.250	100.550	2.800	Open Manhole	3000
1.002	o	900	S3	104.150	100.520	2.730	Open Manhole	3000
1.003	o	900	S4	103.500	100.450	2.150	Open Manhole	3000
1.004	o	900	S5	102.950	100.390	1.660	Open Manhole	3000
1.005	o	225	S6	102.550	100.350	1.975	Open Manhole	3000
1.006	o	225	C1	102.450	100.300	1.925	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	31.067	388.3	S2	104.250	100.550	2.800	Open Manhole	3000
1.001	9.037	301.2	S3	104.150	100.520	2.730	Open Manhole	3000
1.002	27.407	391.5	S4	103.500	100.450	2.150	Open Manhole	3000
1.003	20.367	339.5	S5	102.950	100.390	1.660	Open Manhole	3000
1.004	13.385	334.6	S6	102.550	100.350	1.300	Open Manhole	3000
1.005	3.927	78.5	C1	102.450	100.300	1.925	Open Manhole	1200
1.006	9.740	74.9		101.300	100.170	0.905	Open Manhole	1200

Surcharged 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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1.006 101.300 100.170 0.000 1200 0

Datum (m) 100.170 Offset (mins) 0

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
10	1.000	130	1.000	250	1.000	370	1.000	490	1.000	610	1.000
20	1.000	140	1.000	260	1.000	380	1.000	500	1.000	620	1.000
30	1.000	150	1.000	270	1.000	390	1.000	510	1.000	630	1.000
40	1.000	160	1.000	280	1.000	400	1.000	520	1.000	640	1.000
50	1.000	170	1.000	290	1.000	410	1.000	530	1.000	650	1.000
60	1.000	180	1.000	300	1.000	420	1.000	540	1.000	660	1.000
70	1.000	190	1.000	310	1.000	430	1.000	550	1.000	670	1.000
80	1.000	200	1.000	320	1.000	440	1.000	560	1.000	680	1.000
90	1.000	210	1.000	330	1.000	450	1.000	570	1.000	690	1.000
100	1.000	220	1.000	340	1.000	460	1.000	580	1.000	700	1.000
110	1.000	230	1.000	350	1.000	470	1.000	590	1.000	710	1.000
120	1.000	240	1.000	360	1.000	480	1.000	600	1.000	720	1.000

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Surcharged Outfall Details for Storm

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
730	1.000	850	1.000	970	1.000	1090	1.000	1210	1.000	1330	1.000
740	1.000	860	1.000	980	1.000	1100	1.000	1220	1.000	1340	1.000
750	1.000	870	1.000	990	1.000	1110	1.000	1230	1.000	1350	1.000
760	1.000	880	1.000	1000	1.000	1120	1.000	1240	1.000	1360	1.000
770	1.000	890	1.000	1010	1.000	1130	1.000	1250	1.000	1370	1.000
780	1.000	900	1.000	1020	1.000	1140	1.000	1260	1.000	1380	1.000
790	1.000	910	1.000	1030	1.000	1150	1.000	1270	1.000	1390	1.000
800	1.000	920	1.000	1040	1.000	1160	1.000	1280	1.000	1400	1.000
810	1.000	930	1.000	1050	1.000	1170	1.000	1290	1.000	1410	1.000
820	1.000	940	1.000	1060	1.000	1180	1.000	1300	1.000	1420	1.000
830	1.000	950	1.000	1070	1.000	1190	1.000	1310	1.000	1430	1.000
840	1.000	960	1.000	1080	1.000	1200	1.000	1320	1.000	1440	1.000

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)	19.000	Storm Duration (mins)	30
Ratio R	0.297		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: S6, DS/PN: 1.005, Volume (m³): 22.2

Unit Reference	MD-SHE-0100-5600-1800-5600
Design Head (m)	1.800
Design Flow (l/s)	5.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	100
Invert Level (m)	100.350
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.800	5.6
Flush-Flo™	0.434	5.1
Kick-Flo®	0.890	4.0
Mean Flow over Head Range	-	4.6

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	4.6	3.000	7.1	7.000	10.6
0.200	4.6	1.400	5.0	3.500	7.6	7.500	11.0
0.300	4.9	1.600	5.3	4.000	8.1	8.000	11.3
0.400	5.1	1.800	5.6	4.500	8.6	8.500	11.6
0.500	5.0	2.000	5.9	5.000	9.0	9.000	12.0
0.600	5.0	2.200	6.1	5.500	9.5	9.500	12.3
0.800	4.5	2.400	6.4	6.000	9.9		
1.000	4.3	2.600	6.6	6.500	10.2		

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Storage Structures for Storm

Cellular Storage Manhole: S6, DS/PN: 1.005

Invert Level (m) 101.520 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	79.0	79.0	0.801	0.0	107.6
0.800	79.0	107.6			

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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 0.297

Region England and Wales Cv (Summer) 0.750

M5-60 (mm) 19.000

Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0

DVD Status ON

Analysis Timestep Fine

Inertia Status OFF

DTS Status OFF

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	S1	1440 Winter	1	+0%	30/120 Summer				101.223
1.001	S2	1440 Winter	1	+0%	30/60 Winter				101.223
1.002	S3	1440 Winter	1	+0%	30/60 Winter				101.223
1.003	S4	1440 Winter	1	+0%	30/60 Summer				101.223
1.004	S5	1440 Winter	1	+0%	30/60 Summer				101.223
1.005	S6	1440 Winter	1	+0%	1/15 Summer				101.223
1.006	C1	1440 Winter	1	+0%	1/15 Summer				101.172

PN	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	S1	-0.307	0.000	0.00			0.4	OK	
1.001	S2	-0.227	0.000	0.00			1.6	OK	
1.002	S3	-0.197	0.000	0.00			2.1	OK	
1.003	S4	-0.127	0.000	0.00			3.3	OK	
1.004	S5	-0.067	0.000	0.01			4.3	OK	
1.005	S6	0.648	0.000	0.16		672	5.1	SURCHARGED	
1.006	C1	0.647	0.000	0.10			5.1	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 0.297

Region England and Wales Cv (Summer) 0.750

M5-60 (mm) 19.000

Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0

DVD Status ON

Analysis Timestep Fine

Inertia Status OFF

DTS Status OFF

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) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S1	600 Winter	30	+40%	30/120 Summer				101.896
1.001	S2	600 Winter	30	+40%	30/60 Winter				101.896
1.002	S3	600 Winter	30	+40%	30/60 Winter				101.896
1.003	S4	600 Winter	30	+40%	30/60 Summer				101.896
1.004	S5	600 Winter	30	+40%	30/60 Summer				101.896
1.005	S6	600 Winter	30	+40%	1/15 Summer				101.896
1.006	C1	960 Winter	30	+40%	1/15 Summer				101.177

PN	US/MH Name	Depth (m)	Surcharged Volume (m³)	Flooded Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S1	0.366	0.000	0.00			1.6	SURCHARGED	
1.001	S2	0.446	0.000	0.00			2.1	SURCHARGED	
1.002	S3	0.476	0.000	0.00			2.8	SURCHARGED	
1.003	S4	0.546	0.000	0.01			6.0	SURCHARGED	
1.004	S5	0.606	0.000	0.02			9.4	SURCHARGED	
1.005	S6	1.321	0.000	0.16		220	5.1	SURCHARGED	
1.006	C1	0.652	0.000	0.11			5.3	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

Number of Offline Controls 0

Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR

Ratio R 0.297

Region England and Wales Cv (Summer) 0.750

M5-60 (mm) 19.000

Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0

DVD Status ON

Analysis Timestep Fine

Inertia Status OFF

DTS Status OFF

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	S1	600 Winter	100	+45%	30/120 Summer				102.497
1.001	S2	600 Winter	100	+45%	30/60 Winter				102.497
1.002	S3	600 Winter	100	+45%	30/60 Winter				102.497
1.003	S4	600 Winter	100	+45%	30/60 Summer				102.497
1.004	S5	600 Winter	100	+45%	30/60 Summer				102.497
1.005	S6	600 Winter	100	+45%	1/15 Summer				102.497
1.006	C1	240 Summer	100	+45%	1/15 Summer				101.177

PN	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	S1	0.967	0.000	0.00			1.9	SURCHARGED	
1.001	S2	1.047	0.000	0.00			2.0	SURCHARGED	
1.002	S3	1.077	0.000	0.00			2.7	SURCHARGED	
1.003	S4	1.147	0.000	0.01			7.9	SURCHARGED	
1.004	S5	1.207	0.000	0.02			12.3	SURCHARGED	
1.005	S6	1.922	0.000	0.16		360	5.1	FLOOD RISK	
1.006	C1	0.652	0.000	0.10			5.1	SURCHARGED	

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