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St Andrew's House 23 Kingfield Road Sheffield S11 9AS		
Date 10/11/2023 16:19 File 48518 - SW CALCULATIONS...	Designed by DBurrows Checked by	
Innovyze	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)	100	PIMP (%)	100
M5-60 (mm)	19.000	Add Flow / Climate Change (%)	40
Ratio R	0.351	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

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	10.957	0.100	109.6	0.010	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	11.146	0.150	74.3	0.008	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	9.844	0.100	98.4	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.003	7.473	0.200	37.4	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	9.535	0.100	95.4	0.003	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.004	13.937	0.139	100.3	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)	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	50.00	5.19	230.100	0.010	0.0	0.0	0.5	0.96	17.0	1.9
1.001	50.00	5.35	230.000	0.018	0.0	0.0	1.0	1.17	20.6	3.4
1.002	50.00	5.51	229.850	0.018	0.0	0.0	1.0	1.01	17.9	3.4
1.003	50.00	5.59	228.500	0.018	0.0	0.0	1.0	1.65	29.2	3.4
2.000	50.00	5.15	228.400	0.003	0.0	0.0	0.2	1.03	18.2	0.6
1.004	50.00	5.82	228.300	0.021	0.0	0.0	1.1	1.00	17.7	4.0

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall C. Name	Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.004		229.000	228.161	0.000	0	0

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: 4, DS/PN: 1.003, Volume (m³): 2.6

Unit Reference	MD-SHE-0040-1000-2000-1000
Design Head (m)	2.000
Design Flow (l/s)	1.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	40
Invert Level (m)	228.500
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

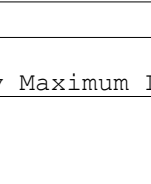
Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	1.0
Flush-Flo™	0.173	0.6
Kick-Flo®	0.355	0.5
Mean Flow over Head Range	-	0.7

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	0.5	1.200	0.8	3.000	1.2	7.000	1.8
0.200	0.6	1.400	0.9	3.500	1.3	7.500	1.8
0.300	0.5	1.600	0.9	4.000	1.4	8.000	1.9
0.400	0.5	1.800	1.0	4.500	1.4	8.500	1.9
0.500	0.5	2.000	1.0	5.000	1.5	9.000	2.0
0.600	0.6	2.200	1.0	5.500	1.6	9.500	2.0
0.800	0.7	2.400	1.1	6.000	1.6		
1.000	0.7	2.600	1.1	6.500	1.7		

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<u>Storage Structures for Storm</u> <u>Porous Car Park Manhole: 4, DS/PN: 1.003</u> <table> <tr> <td>Infiltration Coefficient Base (m/hr)</td> <td>0.00000</td> <td>Width (m)</td> <td>3.0</td> </tr> <tr> <td>Membrane Percolation (mm/hr)</td> <td>1000</td> <td>Length (m)</td> <td>10.0</td> </tr> <tr> <td>Max Percolation (l/s)</td> <td>8.3</td> <td>Slope (1:X)</td> <td>0.0</td> </tr> <tr> <td>Safety Factor</td> <td>2.0</td> <td>Depression Storage (mm)</td> <td>5</td> </tr> <tr> <td>Porosity</td> <td>0.30</td> <td>Evaporation (mm/day)</td> <td>3</td> </tr> <tr> <td>Invert Level (m)</td> <td>229.450</td> <td>Cap Volume Depth (m)</td> <td>0.200</td> </tr> </table>			Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	3.0	Membrane Percolation (mm/hr)	1000	Length (m)	10.0	Max Percolation (l/s)	8.3	Slope (1:X)	0.0	Safety Factor	2.0	Depression Storage (mm)	5	Porosity	0.30	Evaporation (mm/day)	3	Invert Level (m)	229.450	Cap Volume Depth (m)	0.200
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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 0.351
Region England and Wales Cv (Summer)	0.750	
M5-60 (mm)	19.000 Cv (Winter)	0.840

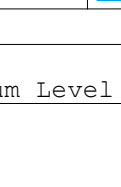
Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia Status	ON

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, 40

	US/MH	Event	US/CL	Water Level	Surcharged Depth	Flooded Volume	Flow / Cap.
PN	Name		(m)	(m)	(m)	(m³)	
1.000	1 15 minute	1 year Winter I+0%	230.550	230.129	-0.121	0.000	0.08
1.001	2 15 minute	1 year Winter I+0%	231.050	230.034	-0.116	0.000	0.11
1.002	3 15 minute	1 year Winter I+0%	230.700	229.886	-0.114	0.000	0.13
1.003	4 30 minute	1 year Winter I+0%	230.670	229.096	0.446	0.000	0.02
2.000	3 15 minute	1 year Winter I+0%	228.870	228.416	-0.134	0.000	0.02
1.004	6 15 minute	1 year Winter I+0%	229.500	228.323	-0.127	0.000	0.06

	US/MH	Maximum Overflow	Pipe Velocity	Flow	Status
PN	Name	(l/s)	(m/s)	(l/s)	
1.000	1		0.5	1.2	OK
1.001	2		0.7	2.1	OK
1.002	3		0.6	2.1	OK
1.003	4		0.7	0.6	SURCHARGED
2.000	3		0.4	0.4	OK
1.004	6		0.5	0.9	OK

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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	0.351
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
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia Status	ON

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, 40

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
1.000	1	15 minute 30 year Winter I+0%	230.550	230.146	-0.104	0.000	0.20
1.001	2	15 minute 30 year Winter I+0%	231.050	230.057	-0.093	0.000	0.30
1.002	3	15 minute 30 year Winter I+0%	230.700	229.912	-0.088	0.000	0.35
1.003	4	60 minute 30 year Winter I+0%	230.670	229.583	0.933	0.000	0.03
2.000	3	15 minute 30 year Winter I+0%	228.870	228.423	-0.127	0.000	0.06
1.004	6	15 minute 30 year Winter I+0%	229.500	228.331	-0.119	0.000	0.10

PN	US/MH Name	Maximum Overflow (l/s)	Pipe Velocity (m/s)	Pipe Flow (l/s)	Status
1.000	1	0.7	3.1		OK
1.001	2	0.9	5.7		OK
1.002	3	0.8	5.6		OK
1.003	4	0.7	0.8		SURCHARGED
2.000	3	0.5	0.9		OK
1.004	6	0.6	1.6		OK

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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 0.351

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

Analysis Timestep 2.5 Second Increment (Extended)

DTS Status ON

DVD Status ON

Inertia Status ON

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, 40

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
1.000	1	60 minute 100 year Winter I+40%	230.550	230.312	0.062	0.000	0.20
1.001	2	60 minute 100 year Winter I+40%	231.050	230.310	0.160	0.000	0.30
1.002	3	60 minute 100 year Winter I+40%	230.700	230.306	0.306	0.000	0.35
1.003	4	60 minute 100 year Winter I+40%	230.670	230.303	1.653	0.000	0.04
2.000	3	15 minute 100 year Winter I+40%	228.870	228.432	-0.118	0.000	0.10
1.004	6	15 minute 100 year Winter I+40%	229.500	228.339	-0.111	0.000	0.15

Maximum Pipe

US/MH Overflow Velocity

Pipe Flow

PN

Name

(l/s)

(m/s)

(l/s)

Status

1.000

1

0.7

3.1

FLOOD RISK

1.001

2

0.9

5.6

SURCHARGED

1.002

3

0.8

5.6

SURCHARGED

1.003

4

0.8

1.0

SURCHARGED

2.000

3

0.6

1.7

OK

1.004

6

0.7

2.4

OK

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