STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	100	Maximum Time of Concentration (mins)	30
		Foul Sewage (l/s/ha)	0.000
FEH Rainfall Version	1999	Volumetric Runoff Coeff.	0.750
Site Location	GB 526100 184450 TQ 26100 84450	PIMP (%)	100
C (1km)	-0.025	Add Flow / Climate Change (%)	10
D1 (1km)	0.330	Minimum Backdrop Height (m)	1.500
D2 (1km)	0.277	Maximum Backdrop Height (m)	1.500
D3 (1km)	0.234	Min Design Depth for Optimisation (m)	1.200
E (1km)	0.332	Min Vel for Auto Design only (m/s)	1.00
F (1km)	2.519	Min Slope for Optimisation (1:X)	500
Maximum Rainfall (mm/hr)	50		

Designed with Level Soffits

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)
S1.003	S	49.320	45.455	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Manhole Headloss Coeff (Global)	0.500	Inlet Coeffiecient	0.800
Areal Reduction Factor	1.000	Foul Sewage per hectare (l/s)	0.000	Flow per Person per Day (l/per/day)	0.000
Hot Start (mins)	0	Additional Flow - % of Total Flow	0.000	Run Time (mins)	60
Hot Start Level (mm)	0	MADD Factor * 10m³/ha Storage	2.000	Output Interval (mins)	1

Number of Input Hydrographs 0	Number of Offline Controls 0	Number of Time/Area Diagrams 0
Number of Online Controls 1	Number of Storage Structures 1	Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	E (1km)	0.332
Return Period (years)	100	F (1km)	2.519
FEH Rainfall Version	1999	Summer Storms	Yes
Site Location	GB 526100 184450 TQ 26100 84450	Winter Storms	No
C (1km)	-0.025	Cv (Summer)	0.750
D1 (1km)	0.330	Cv (Winter)	0.840
D2 (1km)	0.277	Storm Duration (mins)	30
D3 (1km)	0.234		

Online Controls for Storm

Hydro-Brake® Optimum Manhole: S6, DS/PN: S1.003, Volume (m³): 15.9

Unit Reference	MD-SHE-0071-3300-2400-3300	Sump Available	Yes
Design Head (m)	2.400	Diameter (mm)	71
Design Flow (l/s)	3.3	Invert Level (m)	45.497
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	100
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.400	3.3	Kick-Flo®	0.630	1.8
Flush-Flo™	0.307	2.2	Mean Flow over Head Range	-	2.4

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)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.8	0.600	1.9	1.600	2.7	2.600	3.4	5.000	4.6	7.500	5.6
0.200	2.2	0.800	2.0	1.800	2.9	3.000	3.7	5.500	4.9	8.000	5.8
0.300	2.2	1.000	2.2	2.000	3.0	3.500	3.9	6.000	5.1	8.500	6.0
0.400	2.2	1.200	2.4	2.200	3.2	4.000	4.2	6.500	5.2	9.000	6.1
0.500	2.1	1.400	2.6	2.400	3.3	4.500	4.4	7.000	5.4	9.500	6.3

Storage Structures for Storm

Tank or Pond Manhole: S6, DS/PN: S1.003

Invert Level (m) 45.497

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	239.0	2.400	239.0	2.401	0.0

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

Simulation Criteria

Areal Reduction Factor	1.000	Manhole Headloss Coeff (Global)	0.500	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Foul Sewage per hectare (l/s)	0.000	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Additional Flow - % of Total Flow	0.000	Flow per Person per Day (l/per/day)	0.000

Number of Input Hydrographs 0	Number of Offline Controls 0	Number of Time/Area Diagrams 0
Number of Online Controls 1	Number of Storage Structures 1	Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.234
FEH Rainfall Version	1999	E (1km)	0.332
Site Location	GB 526100 184450 TQ 26100 84450	F (1km)	2.519
C (1km)	-0.025	Cv (Summer)	0.750
D1 (1km)	0.330	Cv (Winter)	0.840
D2 (1km)	0.277		

Margin for Flood Risk Warning (mm)	300.0	DVD Status	ON
Analysis Timestep 2.5 Second Increment (Extended)		Inertia Status	ON
DTS 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)	2, 30, 100
Climate Change (%)	0, 0, 40

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

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status

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

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
S1.000	S1	15 minute 2 year Winter I+0%	49.500	48.100	-0.350	0.000	0.11		21.8	OK
S1.001	S2	15 minute 2 year Winter I+0%	49.500	47.944	-0.313	0.000	0.20		40.1	OK
S1.002	S3	15 minute 2 year Winter I+0%	49.500	47.810	-0.276	0.000	0.31		57.7	OK
S2.000	S4	15 minute 2 year Winter I+0%	49.200	47.797	-0.353	0.000	0.10		21.3	OK
S2.001	S5	15 minute 2 year Winter I+0%	49.200	47.448	-0.316	0.000	0.19		39.4	OK
S1.003	S6	720 minute 2 year Winter I+0%	49.500	45.952	0.230	0.000	0.07		2.2	SURCHARGED

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

Simulation Criteria

Areal Reduction Factor	1.000	Manhole Headloss Coeff (Global)	0.500	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Foul Sewage per hectare (l/s)	0.000	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Additional Flow - % of Total Flow	0.000	Flow per Person per Day (l/per/day)	0.000

Number of Input Hydrographs 0	Number of Offline Controls 0	Number of Time/Area Diagrams 0
Number of Online Controls 1	Number of Storage Structures 1	Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.234
FEH Rainfall Version	1999	E (1km)	0.332
Site Location	GB 526100 184450 TQ 26100 84450	F (1km)	2.519
C (1km)	-0.025	Cv (Summer)	0.750
D1 (1km)	0.330	Cv (Winter)	0.840
D2 (1km)	0.277		

Margin for Flood Risk Warning (mm)	300.0	DVD Status	ON
Analysis Timestep 2.5 Second Increment (Extended)		Inertia Status	ON
DTS 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)	2, 30, 100
Climate Change (%)	0, 0, 40

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

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status

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

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
S1.000	S1	15 minute 30 year Winter I+0%	49.500	48.168	-0.282	0.000	0.29		58.4	OK
S1.001	S2	15 minute 30 year Winter I+0%	49.500	48.070	-0.187	0.000	0.59		117.0	OK
S1.002	S3	15 minute 30 year Winter I+0%	49.500	47.985	-0.101	0.000	0.95		174.8	OK
S2.000	S4	15 minute 30 year Winter I+0%	49.200	47.862	-0.288	0.000	0.27		57.3	OK
S2.001	S5	15 minute 30 year Winter I+0%	49.200	47.559	-0.205	0.000	0.57		116.2	OK
S1.003	S6	720 minute 30 year Winter I+0%	49.500	46.666	0.944	0.000	0.08		2.4	SURCHARGED

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

Simulation Criteria

Areal Reduction Factor	1.000	Manhole Headloss Coeff (Global)	0.500	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Foul Sewage per hectare (l/s)	0.000	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Additional Flow - % of Total Flow	0.000	Flow per Person per Day (l/per/day)	0.000

Number of Input Hydrographs 0	Number of Offline Controls 0	Number of Time/Area Diagrams 0
Number of Online Controls 1	Number of Storage Structures 1	Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.234
FEH Rainfall Version	1999	E (1km)	0.332
Site Location	GB 526100 184450 TQ 26100 84450	F (1km)	2.519
C (1km)	-0.025	Cv (Summer)	0.750
D1 (1km)	0.330	Cv (Winter)	0.840
D2 (1km)	0.277		

Margin for Flood Risk Warning (mm)	300.0	DVD Status	ON
Analysis Timestep 2.5 Second Increment (Extended)		Inertia Status	ON
DTS 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)	2, 30, 100
Climate Change (%)	0, 0, 40

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

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status

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

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
S1.000	S1	15 minute 100 year Winter I+40%	49.500	48.838	0.388	0.000	0.63		127.1	SURCHARGED
S1.001	S2	15 minute 100 year Winter I+40%	49.500	48.720	0.463	0.000	1.26		251.4	SURCHARGED
S1.002	S3	15 minute 100 year Winter I+40%	49.500	48.431	0.345	0.000	2.04		376.9	SURCHARGED
S2.000	S4	15 minute 100 year Winter I+40%	49.200	47.956	-0.194	0.000	0.58		125.1	OK
S2.001	S5	720 minute 100 year Winter I+40%	49.200	47.880	0.116	0.000	0.08		16.4	SURCHARGED
S1.003	S6	720 minute 100 year Winter I+40%	49.500	47.880	2.158	0.000	0.11		3.3	SURCHARGED