STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes SW NETWORK 3 Manhole Sizes SW NETWORK 3

FEH Rainfall Model	
Return Period (years)	2
FEH Rainfall Version	2013
Site Location	GB 577291 164528 TQ 77291 64528
Data Type	Point
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
PIMP (%)	100
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	1.00
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	30.000	0.200	150.0	0.025	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	39.000	0.260	150.0	0.036	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	12.000	0.080	150.0	0.007	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.003	7.350	0.049	150.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.004	5.000	0.033	151.5	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	5.61	94.300	0.025	0.0	0.0	0.0	0.82	14.5	3.4
1.001	50.00	6.41	94.100	0.061	0.0	0.0	0.0	0.82	14.5	8.3
1.002	50.00	6.65	93.840	0.068	0.0	0.0	0.0	0.82	14.5	9.2
1.003	50.00	6.80	93.760	0.068	0.0	0.0	0.0	0.82	14.5	9.2
1.004	50.00	6.90	93.711	0.068	0.0	0.0	0.0	0.81	14.4	9.2

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	95.000	0.700	Sealed Manhole	1200	1.000	94.300	150				
2	96.100	2.000	Open Manhole	1200	1.001	94.100	150	1.000	94.100	150	
3	98.000	4.160	Open Manhole	1200	1.002	93.840	150	1.001	93.840	150	
4	97.000	3.240	Open Manhole	1200	1.003	93.760	150	1.002	93.760	150	
5	97.000	3.289	Open Manhole	1200	1.004	93.711	150	1.003	93.711	150	
SA4	98.000	4.322	Open Manhole	1200		OUTFALL		1.004	93.678	150	

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	1	95.000	94.300	0.550	Sealed Manhole	1200
1.001	o	150	2	96.100	94.100	1.850	Open Manhole	1200
1.002	o	150	3	98.000	93.840	4.010	Open Manhole	1200
1.003	o	150	4	97.000	93.760	3.090	Open Manhole	1200
1.004	o	150	5	97.000	93.711	3.139	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	30.000	150.0	2	96.100	94.100	1.850	Open Manhole	1200
1.001	39.000	150.0	3	98.000	93.840	4.010	Open Manhole	1200
1.002	12.000	150.0	4	97.000	93.760	3.090	Open Manhole	1200
1.003	7.350	150.0	5	97.000	93.711	3.139	Open Manhole	1200
1.004	5.000	151.5	SA4	98.000	93.678	4.172	Open Manhole	1200

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)
1.004	SA4	98.000	93.678	93.678	1200	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	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 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
Return Period (years)	2

Synthetic Rainfall Details

FEH Rainfall Version	2013
Site Location	GB 577291 164528 TQ 77291 64528
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Storm Duration (mins)	30

Online Controls for Storm

Weir Manhole: 5, DS/PN: 1.004, Volume (m³): 3.8

Discharge Coef 0.544 Width (m) 0.300 Invert Level (m) 97.000

Storage Structures for Storm

Cellular Storage Manhole: 5, DS/PN: 1.004

Invert Level (m) 93.711 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.17000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.17000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	25.0	25.0	1.201	0.0	49.0
1.200	25.0	49.0			

2 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 Coeffiecient	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 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
FEH Rainfall Version	2013
Site Location	GB 577291 164528 TQ 77291 64528
Data Type	Point
Cv (Summer)	0.750
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)	2, 30, 100
Climate Change (%)	0, 0, 40

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	1	15 Winter	2	+0%	30/15 Summer				94.355
1.001	2	15 Winter	2	+0%	30/15 Summer				94.186
1.002	3	240 Winter	2	+0%	30/15 Summer				93.974
1.003	4	240 Winter	2	+0%	2/30 Winter				93.971
1.004	5	240 Winter	2	+0%	2/15 Winter				93.969

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.095	0.000	0.28		3.9	OK	

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.001	2	-0.064	0.000	0.60		8.4	OK	
1.002	3	-0.016	0.000	0.18		2.4	OK	
1.003	4	0.061	0.000	0.18		2.2	SURCHARGED	
1.004	5	0.108	0.000	0.00		0.0	SURCHARGED	

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 Coeffiecient	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 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
FEH Rainfall Version	2013
Site Location	GB 577291 164528 TQ 77291 64528
Data Type	Point
Cv (Summer)	0.750
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)	2, 30, 100
Climate Change (%)	0, 0, 40

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	1	15 Winter	30	+0%	30/15 Summer				94.544
1.001	2	15 Winter	30	+0%	30/15 Summer				94.491
1.002	3	120 Winter	30	+0%	30/15 Summer				94.307
1.003	4	120 Winter	30	+0%	2/30 Winter				94.303
1.004	5	120 Winter	30	+0%	2/15 Winter				94.301

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.094	0.000	0.55		7.6	SURCHARGED*	

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.001	2	0.241	0.000	1.20		16.9	SURCHARGED	
1.002	3	0.317	0.000	0.52		6.8	SURCHARGED	
1.003	4	0.393	0.000	0.53		6.6	SURCHARGED	
1.004	5	0.440	0.000	0.00		0.0	SURCHARGED	

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 Coeffiecient	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 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
FEH Rainfall Version	2013
Site Location	GB 577291 164528 TQ 77291 64528
Data Type	Point
Cv (Summer)	0.750
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)	2, 30, 100
Climate Change (%)	0, 0, 40

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	1	15 Winter	100	+40%	30/15 Summer				95.000
1.001	2	15 Winter	100	+40%	30/15 Summer				95.353
1.002	3	480 Winter	100	+40%	30/15 Summer				95.144
1.003	4	480 Winter	100	+40%	2/30 Winter				95.139
1.004	5	480 Winter	100	+40%	2/15 Winter				95.136

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.550	0.000	0.84		11.6	FLOOD RISK*	

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.001	2	1.103	0.000	1.77		24.8	SURCHARGED	
1.002	3	1.154	0.000	0.35		4.6	SURCHARGED	
1.003	4	1.229	0.000	0.36		4.5	SURCHARGED	
1.004	5	1.275	0.000	0.00		0.0	SURCHARGED	