STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for 10721 SWNET.SWS

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	30
FEH Rainfall Version	2013
Site Location	GB 522045 105170 TQ 22045 05170
Data Type	Point
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	1.000
PIMP (%)	100
Add Flow / Climate Change (%)	40
Minimum Backdrop Height (m)	0.450
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	0.600
Min Vel for Auto Design only (m/s)	1.00
Min Slope for Optimisation (1:X)	300

Designed with Level Soffits

Time Area Diagram for 10721 SWNET.SWS

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.328	4-8	0.175

Total Area Contributing (ha) = 0.503

Total Pipe Volume (m³) = 13.292

Network Design Table for 10721 SWNET.SWS

« - Indicates pipe capacity < flow

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	35.885	0.214	167.7	0.110	5.00	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	5.59	2.775	0.110	0.0	0.0	7.9	1.01	40.0	27.8

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Network Design Table for 10721 SWNET.SWS

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
1.001	19.270	0.115	167.6	0.022	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.000	31.054	0.311	99.9	0.014	5.00	0.0	0.600	o	150	Pipe/Conduit	
2.001	18.628	0.468	39.8	0.015	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	13.832	0.086	161.3	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
3.000	34.475	0.345	99.9	0.029	5.00	0.0	0.600	o	225	Pipe/Conduit	
3.001	26.670	0.158	168.8	0.031	0.00	0.0	0.600	o	225	Pipe/Conduit	
4.000	13.425	0.134	100.2	0.011	5.00	0.0	0.600	o	150	Pipe/Conduit	
4.001	7.715	0.432	17.9	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
5.000	21.427	0.366	58.5	0.019	5.00	0.0	0.600	o	150	Pipe/Conduit	
4.002	42.094	0.624	67.5	0.112	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	33.512	0.112	299.2	0.084	0.00	0.0	0.600	o	375	Pipe/Conduit	
6.000	29.275	0.293	99.9	0.033	5.00	0.0	0.600	o	150	Pipe/Conduit	
6.001	9.002	0.090	100.0	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)
1.001	50.00	5.91	2.561	0.132	0.0	0.0	9.5	1.01	40.0	33.4
2.000	50.00	5.51	3.300	0.014	0.0	0.0	1.0	1.01	17.8	3.5
2.001	50.00	5.71	2.989	0.029	0.0	0.0	2.1	1.60	28.3	7.3
1.002	50.00	6.14	2.446	0.161	0.0	0.0	11.6	1.03	40.8	40.7
3.000	50.00	5.44	2.400	0.029	0.0	0.0	2.1	1.31	52.0	7.3
3.001	50.00	5.88	2.055	0.060	0.0	0.0	4.3	1.00	39.9	15.2
4.000	50.00	5.22	3.050	0.011	0.0	0.0	0.8	1.00	17.7	2.8
4.001	50.00	5.28	2.916	0.011	0.0	0.0	0.8	2.39	42.3	2.8
5.000	50.00	5.27	2.850	0.019	0.0	0.0	1.4	1.32	23.3	4.8
4.002	50.00	5.72	2.409	0.142	0.0	0.0	10.3	1.59	63.4	35.9
1.003	50.00	6.67	1.635	0.447	0.0	0.0	32.3	1.04	115.1	113.0
6.000	50.00	5.49	3.100	0.033	0.0	0.0	2.4	1.01	17.8	8.3
6.001	50.00	5.63	2.807	0.033	0.0	0.0	2.4	1.00	17.8	8.3

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Network Design Table for 10721 SWNET.SWS

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
7.000	46.912	1.124	41.7	0.023	5.00	0.0	0.600	o	100	Pipe/Conduit	
1.004	3.844	0.038	101.2	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)
7.000	50.00	5.65	2.850	0.023	0.0	0.0	1.7	1.20	9.4	5.8
1.004	50.00	6.74	1.523	0.503	0.0	0.0	36.3	1.00	17.7«	127.1

Simulation Criteria for 10721 SWNET.SWS

Volumetric Runoff Coeff	1.000	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)	2880
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	24

Number of Input Hydrographs	0	Number of Storage Structures	2
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	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 522045 105170 TQ 22045 05170
Data Type	Point
Summer Storms	No
Winter Storms	Yes
Cv (Summer)	1.000
Cv (Winter)	1.000
Storm Duration (mins)	1440

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Online Controls for 10721 SWNET.SWS

Hydro-Brake® Optimum Manhole: 16, DS/PN: 1.004, Volume (m³): 7.0

Unit Reference	MD-SHE-0058-2000-1900-2000
Design Head (m)	1.900
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	58
Invert Level (m)	1.523
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.900	2.0	Kick-Flo®	0.514	1.1
Flush-Flo™	0.251	1.4	Mean Flow over Head Range	-	1.5

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	1.2	1.200	1.6	3.000	2.5	7.000	3.7
0.200	1.3	1.400	1.7	3.500	2.6	7.500	3.8
0.300	1.4	1.600	1.8	4.000	2.8	8.000	3.9
0.400	1.3	1.800	1.9	4.500	3.0	8.500	4.0
0.500	1.1	2.000	2.0	5.000	3.1	9.000	4.1
0.600	1.2	2.200	2.1	5.500	3.3	9.500	4.2
0.800	1.3	2.400	2.2	6.000	3.4		
1.000	1.5	2.600	2.3	6.500	3.5		

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Storage Structures for 10721 SWNET.SWS

Porous Car Park Manhole: IC1, DS/PN: 1.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	20.0
Membrane Percolation (mm/hr)	1000	Length (m)	58.0
Max Percolation (l/s)	322.2	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	3.000	Cap Volume Depth (m)	0.370

Cellular Storage Manhole: 12, DS/PN: 1.003

Invert Level (m)	1.748	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	345.5	0.0	0.801	261.5	0.0
0.400	345.5	0.0	1.200	261.5	0.0
0.401	319.5	0.0	1.201	0.0	0.0
0.800	319.5	0.0			

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Summary of Critical Results by Maximum Level (Rank 1) for 10721 SWNET.SWS

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 Storage Structures	2
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	FEH
FEH Rainfall Version	2013
Site Location	GB 522045 105170 TQ 22045 05170
Data Type	Point
Cv (Summer)	1.000
Cv (Winter)	1.000

Margin for Flood Risk Warning (mm)	300.0	DVD Status	ON
Analysis Timestep	Fine	Inertia Status	ON
DTS Status	ON		

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, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.000	IC1	30 Summer	100	+0%	30/15 Summer			
1.001	IC2	960 Winter	100	+0%	30/15 Summer			
2.000	IC3	15 Summer	100	+0%				
2.001	IC4	15 Summer	100	+0%				
1.002	5	960 Winter	100	+0%	30/15 Summer			
3.000	IC6	960 Winter	100	+0%	100/180 Summer			
3.001	IC7	960 Winter	100	+0%	30/120 Summer			
4.000	IC8	15 Summer	100	+0%	100/15 Summer			
4.001	IC9	15 Summer	100	+0%	100/15 Summer			
5.000	IC10	15 Summer	100	+0%	100/15 Summer			
4.002	IC11	15 Summer	100	+0%	30/15 Summer			
1.003	12	960 Winter	100	+0%	2/120 Summer			
6.000	IC13	15 Summer	100	+0%	100/15 Summer			
6.001	IC14	1440 Winter	100	+0%	30/120 Summer			
7.000	AC15	15 Summer	100	+0%	30/15 Summer	100/15 Summer		
1.004	16	960 Winter	100	+0%	2/15 Summer	2/5760 Summer		

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Summary of Critical Results by Maximum Level (Rank 1) for 10721 SWNET.SWS

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	IC1	3.027	0.027	0.000	0.95		35.9	SURCHARGED	
1.001	IC2	3.064	0.278	0.000	0.14		5.2	SURCHARGED	
2.000	IC3	3.376	-0.074	0.000	0.50		8.5	OK	
2.001	IC4	3.084	-0.055	0.000	0.71		18.7	OK	
1.002	5	3.065	0.394	0.000	0.18		6.3	SURCHARGED	
3.000	IC6	3.050	0.425	0.000	0.02		1.1	SURCHARGED	
3.001	IC7	3.093	0.813	0.000	0.06		2.1	SURCHARGED	
4.000	IC8	3.291	0.091	0.000	0.45		7.2	FLOOD RISK	
4.001	IC9	3.268	0.202	0.000	0.31		11.5	FLOOD RISK	
5.000	IC10	3.325	0.325	0.000	0.60		13.1	FLOOD RISK	
4.002	IC11	3.253	0.619	0.000	1.39		83.9	SURCHARGED	
1.003	12	3.110	1.100	0.000	0.02		2.1	SURCHARGED	
6.000	IC13	3.384	0.134	0.000	1.13		19.3	SURCHARGED	
6.001	IC14	3.383	0.426	0.000	0.06		0.9	FLOOD RISK	
7.000	AC15	3.550	0.600	0.227	1.16		10.8	FLOOD	3
1.004	16	3.402	1.729	0.212	0.15		1.8	FLOOD	

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