

Woods Hardwick		Page 1
15-17 Goldington Road Bedford MK40 3NH		
Date 21/07/2015 09:06 File Permeable paving...	Designed by c.brackley Checked by	
Micro Drainage	Network W.12.6	

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)	1	Add Flow / Climate Change (%)	0
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio R	0.400	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	5	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.00	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500
PIMP (%)	100		

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)
1.000	5.000	0.050	100.0	0.051	4.00	0.0	0.600	o	150
1.001	21.000	0.600	35.0	0.000	0.00	0.0	0.600	o	150
1.002	4.500	0.050	90.0	0.118	0.00	0.0	0.600	o	150
1.003	33.000	0.200	165.0	0.000	0.00	0.0	0.600	o	150
1.004	10.800	0.150	72.0	0.017	0.00	0.0	0.600	o	150
1.005	12.300	0.200	61.5	0.000	0.00	0.0	0.600	o	150

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	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	5.00	4.08	9.650	0.051	0.0	0.0	0.0	1.00	17.8	0.7
1.001	5.00	4.29	9.600	0.051	0.0	0.0	0.0	1.71	30.2	0.7
1.002	5.00	4.36	9.000	0.169	0.0	0.0	0.0	1.06	18.7	2.3
1.003	5.00	5.06	8.950	0.169	0.0	0.0	0.0	0.78	13.8	2.3
1.004	5.00	5.22	8.750	0.186	0.0	0.0	0.0	1.19	21.0	2.5
1.005	5.00	5.38	8.600	0.186	0.0	0.0	0.0	1.28	22.7	2.5

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)
1.005		9.320	8.400	0.000	1200	0

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<u>Simulation Criteria for Storm</u> 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 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 Offline Controls 0 Number of Time/Area Diagrams 0 Number of Online Controls 1 Number of Storage Structures 3 Number of Real Time Controls 0 <u>Synthetic Rainfall Details</u> <table> <tr> <td>Rainfall Model</td> <td>FSR</td> <td>Profile Type</td> <td>Summer</td> </tr> <tr> <td>Return Period (years)</td> <td>1</td> <td>Cv (Summer)</td> <td>0.750</td> </tr> <tr> <td>Region</td> <td>England and Wales</td> <td>Cv (Winter)</td> <td>0.840</td> </tr> <tr> <td>M5-60 (mm)</td> <td>20.000</td> <td>Storm Duration (mins)</td> <td>30</td> </tr> <tr> <td>Ratio R</td> <td>0.400</td> <td></td> <td></td> </tr> </table>			Rainfall Model	FSR	Profile Type	Summer	Return Period (years)	1	Cv (Summer)	0.750	Region	England and Wales	Cv (Winter)	0.840	M5-60 (mm)	20.000	Storm Duration (mins)	30	Ratio R	0.400		
Rainfall Model	FSR	Profile Type	Summer																			
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Storage Structures for Storm

Porous Car Park Manhole: 2, DS/PN: 1.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	13.9	Slope (1:X)	100.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	9.600	Cap Volume Depth (m)	0.400

Porous Car Park Manhole: 4, DS/PN: 1.003

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	20.9
Membrane Percolation (mm/hr)	1000	Length (m)	20.9
Max Percolation (l/s)	121.3	Slope (1:X)	100.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	9.200	Cap Volume Depth (m)	0.450

Porous Car Park Manhole: 6, DS/PN: 1.005

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	7.0
Membrane Percolation (mm/hr)	1000	Length (m)	7.0
Max Percolation (l/s)	13.6	Slope (1:X)	100.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	9.000	Cap Volume Depth (m)	0.450

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

Margin for Flood Risk Warning (mm) 450.0 DVD Status ON
 Analysis Timestep Fine Inertia Status OFF
 DTS 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, 30

PN	Storm	Return Period	Climate Change	First X Surchage	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	15 Winter	1	0%	30/15 Summer	100/15 Summer			4
1.001	15 Winter	1	0%	30/15 Summer				
1.002	15 Winter	1	0%	1/15 Summer	100/15 Summer			4
1.003	60 Winter	1	0%	1/15 Summer				
1.004	60 Winter	1	0%	1/15 Summer				
1.005	60 Winter	1	0%	1/15 Summer	100/60 Winter			7

PN	US/MH Name	Water		Flooded		Pipe		Status
		Level (m)	Surch'd Depth (m)	Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	
1.000	1	9.729	-0.071	0.000	0.54	0.0	7.6	FLOOD RISK
1.001	2	9.652	-0.098	0.000	0.26	0.0	7.5	OK
1.002	3	9.343	0.193	0.000	1.32	0.0	18.6	SURCHARGED
1.003	4	9.313	0.213	0.000	0.57	0.0	7.5	SURCHARGED
1.004	5	9.298	0.398	0.000	0.44	0.0	8.2	SURCHARGED
1.005	6	9.289	0.539	0.000	0.13	0.0	2.6	FLOOD RISK

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

Margin for Flood Risk Warning (mm) 450.0 DVD Status ON
 Analysis Timestep Fine Inertia Status OFF
 DTS 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, 30

PN	Storm	Return Period	Climate Change	First X Surchage	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	15 Winter	30	0%	30/15 Summer	100/15 Summer			4
1.001	15 Winter	30	0%	30/15 Summer				
1.002	15 Winter	30	0%	1/15 Summer	100/15 Summer			4
1.003	120 Winter	30	0%	1/15 Summer				
1.004	120 Winter	30	0%	1/15 Summer				
1.005	120 Winter	30	0%	1/15 Summer	100/60 Winter			7

PN	US/MH Name	Water		Flooded		Pipe		Status
		Level (m)	Surch'd Depth (m)	Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	
1.000	1	9.867	0.067	0.000	1.25	0.0	17.5	FLOOD RISK
1.001	2	9.828	0.078	0.000	0.55	0.0	15.7	FLOOD RISK
1.002	3	9.783	0.633	0.000	2.94	0.0	41.2	FLOOD RISK
1.003	4	9.515	0.415	0.000	0.42	0.0	5.6	FLOOD RISK
1.004	5	9.497	0.597	0.000	0.33	0.0	6.2	FLOOD RISK
1.005	6	9.487	0.737	0.000	0.14	0.0	2.9	FLOOD RISK

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

Margin for Flood Risk Warning (mm) 450.0 DVD Status ON
 Analysis Timestep Fine Inertia Status OFF
 DTS 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, 30

PN	Storm	Return Period	Climate Change	First X Surchage	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	15 Winter	100	+30%	30/15 Summer	100/15 Summer			4
1.001	30 Winter	100	+30%	30/15 Summer				
1.002	15 Winter	100	+30%	1/15 Summer	100/15 Summer			4
1.003	120 Winter	100	+30%	1/15 Summer				
1.004	120 Winter	100	+30%	1/15 Summer				
1.005	240 Winter	100	+30%	1/15 Summer	100/60 Winter			7

PN	US/MH Name	Water	Surch'd Depth (m)	Flooded	Pipe		Status	
		Level (m)		Volume (m³)	Flow / Cap.	O'flow (l/s)		Pipe Flow (l/s)
1.000	1	10.102	0.302	1.894	1.59	0.0	22.1	FLOOD
1.001	2	10.079	0.329	0.000	0.63	0.0	17.8	FLOOD RISK
1.002	3	10.003	0.853	2.866	3.59	0.0	50.3	FLOOD
1.003	4	9.743	0.643	0.000	0.55	0.0	7.3	FLOOD RISK
1.004	5	9.684	0.784	0.000	0.42	0.0	8.0	FLOOD RISK
1.005	6	9.662	0.912	11.903	0.16	0.0	3.2	FLOOD