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Ground Floor, 24 High Street Whittlesford Cambs, CB22 4LT	Station Road, Cuffley Southern SWS	
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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)	2	PIMP (%)	100
M5-60 (mm)	20.200	Add Flow / Climate Change (%)	0
Ratio R	0.433	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

Time Area Diagram for Storm





Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.056	4-8	0.013

Total Area Contributing (ha) = 0.069

Total Pipe Volume (m³) = 0.570

Network Design Table for Storm

< - 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	9.150	0.305	30.0	0.010	5.00	0.0	0.600	o	100	Pipe/Conduit	
1.001	20.600	0.824	25.0	0.010	0.00	0.0	0.600	o	100	Pipe/Conduit	
1.002	6.000	0.040	150.0	0.009	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	1.000	0.010	100.0	0.030	5.00	0.0	0.600	o	100	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	5.11	58.365	0.010	0.0	0.0	0.0	1.41	11.1	1.4
1.001	50.00	5.33	58.060	0.020	0.0	0.0	0.0	1.55	12.2	2.7
1.002	50.00	5.45	57.236	0.029	0.0	0.0	0.0	0.82	14.5	3.9
2.000	50.00	5.02	58.295	0.030	0.0	0.0	0.0	0.77	6.0	4.1

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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
2.001	18.938	0.829	22.8	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
2.002	7.790	0.260	30.0	0.010	0.00	0.0	0.600	o	100	Pipe/Conduit	
1.003	1.630	0.020	81.5	0.000	0.00	0.0	0.600	o	100	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)
2.001	50.00	5.22	58.285	0.030	0.0	0.0	0.0	1.62	12.7	4.1
2.002	50.00	5.31	57.456	0.040	0.0	0.0	0.0	1.41	11.1	5.4
1.003	50.00	5.48	57.196	0.069	0.0	0.0	0.0	0.85	6.7<	9.3


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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	Pipe Out		Pipes In			Backdrop (mm)
					PN	Invert Level (m)	Diameter (mm)	PN	Invert Level (m)	
SIC2	59.000	0.635	Open Manhole	1200	1.000	58.365	100			
SIC3	59.000	0.940	Open Manhole	1200	1.001	58.060	100	1.000	58.060	100
SIC4	58.300	1.064	Open Manhole	1200	1.002	57.236	150	1.001	57.236	100
SIC 1	59.000	0.705	Open Manhole	1200	2.000	58.295	100			
SIC5	59.000	0.715	Open Manhole	1200	2.001	58.285	100	2.000	58.285	100
SIC6	58.500	1.044	Open Manhole	1200	2.002	57.456	100	2.001	57.456	100
6	58.150	0.954	Open Manhole	1200	1.003	57.196	100	1.002	57.196	150
	58.100	0.924	Open Manhole	0		OUTFALL		2.002	57.196	100
								1.003	57.176	100

No coordinates have been specified, layout information cannot be produced.

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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	100	SIC2	59.000	58.365	0.535	Open Manhole	1200
1.001	o	100	SIC3	59.000	58.060	0.840	Open Manhole	1200
1.002	o	150	SIC4	58.300	57.236	0.914	Open Manhole	1200
2.000	o	100	SIC 1	59.000	58.295	0.605	Open Manhole	1200
2.001	o	100	SIC5	59.000	58.285	0.615	Open Manhole	1200
2.002	o	100	SIC6	58.500	57.456	0.944	Open Manhole	1200
1.003	o	100	6	58.150	57.196	0.854	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	9.150	30.0	SIC3	59.000	58.060	0.840	Open Manhole	1200
1.001	20.600	25.0	SIC4	58.300	57.236	0.964	Open Manhole	1200
1.002	6.000	150.0	6	58.150	57.196	0.804	Open Manhole	1200
2.000	1.000	100.0	SIC5	59.000	58.285	0.615	Open Manhole	1200
2.001	18.938	22.8	SIC6	58.500	57.456	0.944	Open Manhole	1200
2.002	7.790	30.0	6	58.150	57.196	0.854	Open Manhole	1200
1.003	1.630	81.5		58.100	57.176	0.824	Open Manhole	0

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)
1.003		58.100	57.176	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m ³ /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 Storage Structures	2
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

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Simulation Criteria for Storm

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.200	Storm Duration (mins)	30
Ratio R	0.433		

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Online Controls for Storm

Orifice Manhole: SIC5, DS/PN: 2.001, Volume (m³): 0.8

Diameter (m) 0.028 Discharge Coefficient 0.600 Invert Level (m) 58.285

Orifice Manhole: 6, DS/PN: 1.003, Volume (m³): 1.2

Diameter (m) 0.037 Discharge Coefficient 0.600 Invert Level (m) 57.196

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Storage Structures for Storm


Cellular Storage Manhole: SIC4, DS/PN: 1.002

Invert Level (m) 57.236 Safety Factor 2.0
 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
 Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	18.0	18.0	0.900	0.0	32.4
0.800	18.0	31.6			

Porous Car Park Manhole: SIC 1, DS/PN: 2.000

Infiltration Coefficient Base (m/hr) 0.00000 Width (m) 5.0
 Membrane Percolation (mm/hr) 1000 Length (m) 55.0
 Max Percolation (l/s) 76.4 Slope (1:X) 0.0
 Safety Factor 2.0 Depression Storage (mm) 5
 Porosity 0.30 Evaporation (mm/day) 3
 Invert Level (m) 58.295 Membrane Depth (mm) 0

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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 2
Number of Online Controls 2 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 0.441
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 21.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 200.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
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) 1, 30, 100
Climate Change (%) 0, 0, 40


PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	SIC2	15 Winter	1	+0%					58.391
1.001	SIC3	15 Winter	1	+0%	100/15 Summer				58.093
1.002	SIC4	60 Winter	1	+0%	30/15 Summer				57.353
2.000	SIC 1	480 Winter	1	+0%	100/30 Summer				58.323
2.001	SIC5	360 Winter	1	+0%	30/180 Winter				58.324
2.002	SIC6	15 Winter	1	+0%	30/30 Winter				57.480
1.003	6	60 Winter	1	+0%	1/15 Summer				57.352

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m ³)	Flow / Overflow Cap. (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	SIC2	-0.074	0.000	0.15		1.5	OK	
1.001	SIC3	-0.067	0.000	0.24		2.8	OK	
1.002	SIC4	-0.033	0.000	0.08	40	1.0	OK	
2.000	SIC 1	-0.072	0.000	0.06	216	0.2	OK	
2.001	SIC5	-0.061	0.000	0.02		0.2	OK	
2.002	SIC6	-0.076	0.000	0.13		1.3	OK	

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

PN	US/MH Name	Surcharged		Flooded Volume (m ³)	Flow / Overflow Cap. (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
		Depth (m)	Flow						
1.003	6	0.056	0.000	0.000	0.27		1.1	SURCHARGED	

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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 2
Number of Online Controls 2 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 0.441
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 21.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 200.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
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) 1, 30, 100
Climate Change (%) 0, 0, 40


PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	SIC2	15 Winter	30	+0%					58.407
1.001	SIC3	15 Winter	30	+0%	100/15 Summer				58.119
1.002	SIC4	60 Winter	30	+0%	30/15 Summer				57.587
2.000	SIC 1	180 Winter	30	+0%	100/30 Summer				58.374
2.001	SIC5	480 Winter	30	+0%	30/180 Winter				58.405
2.002	SIC6	120 Winter	30	+0%	30/30 Winter				57.591
1.003	6	180 Winter	30	+0%	1/15 Summer				57.680

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m ³)	Flow / Cap. (l/s)	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	SIC2	-0.058	0.000	0.36			3.7	OK	
1.001	SIC3	-0.041	0.000	0.65			7.6	OK	
1.002	SIC4	0.201	0.000	0.09		66	1.1	SURCHARGED	
2.000	SIC 1	-0.021	0.000	0.14		171	0.5	OK	
2.001	SIC5	0.020	0.000	0.04			0.5	SURCHARGED	
2.002	SIC6	0.035	0.000	0.14			1.4	SURCHARGED	

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

PN	US/MH Name	Surcharged Flooded		Flow / Overflow		Half Drain	Pipe	Status	Level Exceeded
		Depth (m)	Volume (m ³)	Cap.	(l/s)	Time (mins)	Flow (l/s)		
1.003	6	0.384	0.000	0.42			1.6	SURCHARGED	

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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 2
Number of Online Controls 2 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 0.441
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 21.000 Cv (Winter) 0.840


Margin for Flood Risk Warning (mm) 200.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
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) 1, 30, 100
Climate Change (%) 0, 0, 40

WARNING: Half Drain Time has not been calculated as the structure is too full.

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	SIC2	15 Winter	100	+40%					58.454
1.001	SIC3	15 Winter	100	+40%	100/15 Summer				58.357
1.002	SIC4	60 Winter	100	+40%	30/15 Summer				57.947
2.000	SIC 1	180 Winter	100	+40%	100/30 Summer				58.460
2.001	SIC5	180 Winter	100	+40%	30/180 Winter				58.472
2.002	SIC6	120 Winter	100	+40%	30/30 Winter				57.961
1.003	6	480 Summer	100	+40%	1/15 Summer				58.117

PN	US/MH Name	Depth (m)	Surcharged Volume (m ³)	Flooded Flow / Cap. (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	SIC2	-0.011	0.000	0.65		6.7	OK	
1.001	SIC3	0.197	0.000	0.97		11.4	SURCHARGED	
1.002	SIC4	0.561	0.000	0.13		1.6	SURCHARGED	

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

PN	US/MH Name	Surcharged Flooded		Flow / Overflow		Half Drain	Pipe	Status	Level Exceeded
		Depth (m)	Volume (m ³)	Cap.	(l/s)	Time (mins)	Flow (l/s)		
2.000	SIC 1	0.065	0.000	0.19			0.7	SURCHARGED	
2.001	SIC5	0.087	0.000	0.05			0.7	SURCHARGED	
2.002	SIC6	0.405	0.000	0.20			2.0	SURCHARGED	
1.003	6	0.821	0.000	0.51			2.0	FLOOD RISK	