

Appendix C

Simulation Settings

Rainfall Methodology	FSR	Drain Down Time (mins)	240
FSR Region	England and Wales	Additional Storage (m ³ /ha)	20.0
M5-60 (mm)	17.000	Check Discharge Rate(s)	✓
Ratio-R	0.400	1 year (l/s)	0.1
Summer CV	0.750	2 year (l/s)	0.1
Winter CV	0.840	30 year (l/s)	0.1
Analysis Speed	Normal	100 year (l/s)	0.2
Skip Steady State	x	Check Discharge Volume	x

Storm Durations

15 | 30 | 60 | 120 | 180 | 240 | 360 | 480 | 600 | 720 | 960 | 1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
2	0	0	0
30	0	0	0
100	0	0	0
100	40	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	1.70
Greenfield Method	IH124	Growth Factor 100 year	2.08
Positively Drained Area (ha)	0.011	Betterment (%)	0
SAAR (mm)	909	QBar	0.1
Soil Index	4	Q 1 year (l/s)	0.1
SPR	0.47	Q 2 year (l/s)	0.1
Region	10	Q 30 year (l/s)	0.1
Growth Factor 1 year	0.87	Q 100 year (l/s)	0.2
Growth Factor 2 year	0.93		

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Skip Steady State	x	Check Discharge Volume	x

Storm Durations

15 | 30 | 60 | 120 | 180 | 240 | 360 | 480 | 600 | 720 | 960 | 1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
2	0	0	0
30	0	0	0
100	0	0	0
100	40	0	0

Pre-development Discharge Rate

Site Makeup	Brownfield	Betterment (%)	0
Brownfield Method	MRM	Q 1 year (l/s)	0.8
Contributing Area (ha)	0.007	Q 2 year (l/s)	1.0
PIMP (%)	100	Q 30 year (l/s)	1.9
CV	0.750	Q 100 year (l/s)	2.4
Time of Concentration (mins)	6.00		

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	2	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Inverts
M5-60 (mm)	17.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	6.00	Enforce best practice design rules	✓

Circular Link Type

Shape	Circular	Auto Increment (mm)	75
Barrels	1	Follow Ground	x

Available Diameters (mm)

100 | 150

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
Development	0.003	6.00	52.800	450	-0.002	-0.070	0.500
Manhole			52.800	450	5.131	-0.100	0.600
Outfall			52.800	450	10.112	-0.070	0.685
Permeable Surface	0.001	6.00	52.800		3.127	3.120	0.450

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	Development	Manhole	10.000	0.600	52.300	52.200	0.100	100.0	100	6.22	50.0
1.001	Manhole	Outfall	5.000	0.600	52.200	52.115	0.085	58.8	100	6.30	50.0
2.000	Permeable Surface	Manhole	5.000	0.600	52.350	52.300	0.050	100.0	100	6.11	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.769	6.0	0.4	0.400	0.500	0.003	0.0	18	0.432
1.001	1.006	7.9	0.5	0.500	0.585	0.004	0.0	18	0.567
2.000	0.769	6.0	0.1	0.350	0.400	0.001	0.0	11	0.309

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	10.000	100.0	100	Circular	52.800	52.300	0.400	52.800	52.200	0.500
1.001	5.000	58.8	100	Circular	52.800	52.200	0.500	52.800	52.115	0.585
2.000	5.000	100.0	100	Circular	52.800	52.350	0.350	52.800	52.300	0.400

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	Development	450	Manhole	Adoptable	Manhole	450	Manhole	Adoptable
1.001	Manhole	450	Manhole	Adoptable	Outfall	450	Manhole	Adoptable
2.000	Permeable Surface		Junction		Manhole	450	Manhole	Adoptable

Node Manhole Online Orifice Control

Flap Valve	x	Invert Level (m)	52.200	Diameter (m)	0.035
Downstream Link	1.001	Design Depth (m)	0.600	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Design Flow (l/s)	2.0		

Node Permeable Surface Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	52.350	Slope (1:X)	400.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	0.350
Safety Factor	2.0	Width (m)	2.050	Inf Depth (m)	
Porosity	0.30	Length (m)	8.570		

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
1 year 15 minute summer	92.521	26.180	2 year 15 minute winter	84.042	33.888
1 year 15 minute winter	64.927	26.180	2 year 30 minute summer	77.518	21.935
1 year 30 minute summer	60.022	16.984	2 year 30 minute winter	54.399	21.935
1 year 30 minute winter	42.121	16.984	2 year 60 minute summer	51.720	13.668
1 year 60 minute summer	40.398	10.676	2 year 60 minute winter	34.361	13.668
1 year 60 minute winter	26.839	10.676	2 year 120 minute summer	31.549	8.338
1 year 120 minute summer	24.980	6.602	2 year 120 minute winter	20.961	8.338
1 year 120 minute winter	16.596	6.602	2 year 180 minute summer	24.133	6.210
1 year 180 minute summer	19.271	4.959	2 year 180 minute winter	15.687	6.210
1 year 180 minute winter	12.527	4.959	2 year 240 minute summer	19.039	5.032
1 year 240 minute summer	15.301	4.043	2 year 240 minute winter	12.649	5.032
1 year 240 minute winter	10.165	4.043	2 year 360 minute summer	14.516	3.735
1 year 360 minute summer	11.775	3.030	2 year 360 minute winter	9.436	3.735
1 year 360 minute winter	7.654	3.030	2 year 480 minute summer	11.436	3.022
1 year 480 minute summer	9.342	2.469	2 year 480 minute winter	7.598	3.022
1 year 480 minute winter	6.207	2.469	2 year 600 minute summer	9.363	2.561
1 year 600 minute summer	7.682	2.101	2 year 600 minute winter	6.398	2.561
1 year 600 minute winter	5.249	2.101	2 year 720 minute summer	8.339	2.235
1 year 720 minute summer	6.859	1.838	2 year 720 minute winter	5.605	2.235
1 year 720 minute winter	4.609	1.838	2 year 960 minute summer	6.846	1.803
1 year 960 minute summer	5.653	1.489	2 year 960 minute winter	4.535	1.803
1 year 960 minute winter	3.745	1.489	2 year 1440 minute summer	4.967	1.331
1 year 1440 minute summer	4.127	1.106	2 year 1440 minute winter	3.338	1.331
1 year 1440 minute winter	2.773	1.106	30 year 15 minute summer	226.195	64.005
2 year 15 minute summer	119.760	33.888	30 year 15 minute winter	158.733	64.005

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
30 year 30 minute summer	147.452	41.724	100 year 360 minute winter	22.923	9.075
30 year 30 minute winter	103.475	41.724	100 year 480 minute summer	27.350	7.228
30 year 60 minute summer	98.615	26.061	100 year 480 minute winter	18.171	7.228
30 year 60 minute winter	65.517	26.061	100 year 600 minute summer	22.137	6.055
30 year 120 minute summer	59.946	15.842	100 year 600 minute winter	15.126	6.055
30 year 120 minute winter	39.827	15.842	100 year 720 minute summer	19.562	5.243
30 year 180 minute summer	45.598	11.734	100 year 720 minute winter	13.147	5.243
30 year 180 minute winter	29.640	11.734	100 year 960 minute summer	15.851	4.174
30 year 240 minute summer	35.759	9.450	100 year 960 minute winter	10.500	4.174
30 year 240 minute winter	23.758	9.450	100 year 1440 minute summer	11.278	3.023
30 year 360 minute summer	26.939	6.932	100 year 1440 minute winter	7.579	3.023
30 year 360 minute winter	17.511	6.932	100 year +40% CC 15 minute summer	408.473	115.584
30 year 480 minute summer	20.981	5.545	100 year +40% CC 15 minute winter	286.647	115.584
30 year 480 minute winter	13.940	5.545	100 year +40% CC 30 minute summer	268.775	76.054
30 year 600 minute summer	17.039	4.661	100 year +40% CC 30 minute winter	188.614	76.054
30 year 600 minute winter	11.642	4.661	100 year +40% CC 60 minute summer	180.954	47.821
30 year 720 minute summer	15.093	4.045	100 year +40% CC 60 minute winter	120.222	47.821
30 year 720 minute winter	10.143	4.045	100 year +40% CC 120 minute summer	110.370	29.168
30 year 960 minute summer	12.278	3.233	100 year +40% CC 120 minute winter	73.327	29.168
30 year 960 minute winter	8.133	3.233	100 year +40% CC 180 minute summer	83.953	21.604
30 year 1440 minute summer	8.788	2.355	100 year +40% CC 180 minute winter	54.572	21.604
30 year 1440 minute winter	5.906	2.355	100 year +40% CC 240 minute summer	65.765	17.380
100 year 15 minute summer	291.766	82.560	100 year +40% CC 240 minute winter	43.693	17.380
100 year 15 minute winter	204.748	82.560	100 year +40% CC 360 minute summer	49.370	12.705
100 year 30 minute summer	191.982	54.324	100 year +40% CC 360 minute winter	32.092	12.705
100 year 30 minute winter	134.724	54.324	100 year +40% CC 480 minute summer	38.291	10.119
100 year 60 minute summer	129.253	34.158	100 year +40% CC 480 minute winter	25.439	10.119
100 year 60 minute winter	85.873	34.158	100 year +40% CC 600 minute summer	30.992	8.477
100 year 120 minute summer	78.836	20.834	100 year +40% CC 600 minute winter	21.176	8.477
100 year 120 minute winter	52.377	20.834	100 year +40% CC 720 minute summer	27.387	7.340
100 year 180 minute summer	59.966	15.431	100 year +40% CC 720 minute winter	18.406	7.340
100 year 180 minute winter	38.980	15.431	100 year +40% CC 960 minute summer	22.191	5.844
100 year 240 minute summer	46.975	12.414	100 year +40% CC 960 minute winter	14.700	5.844
100 year 240 minute winter	31.209	12.414	100 year +40% CC 1440 minute summer	15.789	4.232
100 year 360 minute summer	35.264	9.075	100 year +40% CC 1440 minute winter	10.611	4.232

Results for 1 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	Development	12	52.315	0.015	0.3	0.0042	0.0000	OK
15 minute winter	Manhole	13	52.236	0.036	0.4	0.0058	0.0000	OK
15 minute summer	Outfall	1	52.115	0.000	0.3	0.0000	0.0000	OK
30 minute winter	Permeable Surface	22	52.359	0.009	0.1	0.0111	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	Development	1.000	Manhole	0.3	0.376	0.050	0.0155	
15 minute winter	Manhole	Orifice	Outfall	0.4				0.2
30 minute winter	Permeable Surface	2.000	Manhole	0.1	0.287	0.016	0.0017	

Results for 2 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	Development	12	52.317	0.017	0.4	0.0049	0.0000	OK
15 minute winter	Manhole	13	52.246	0.046	0.5	0.0073	0.0000	OK
15 minute summer	Outfall	1	52.115	0.000	0.4	0.0000	0.0000	OK
60 minute winter	Permeable Surface	40	52.359	0.009	0.1	0.0112	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	Development	1.000	Manhole	0.4	0.376	0.066	0.0212	
15 minute winter	Manhole	Orifice	Outfall	0.4				0.3
60 minute winter	Permeable Surface	2.000	Manhole	0.1	0.288	0.017	0.0017	

Results for 30 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	Development	11	52.325	0.025	0.8	0.0069	0.0000	OK
15 minute winter	Manhole	14	52.305	0.105	1.0	0.0167	0.0000	SURCHARGED
15 minute summer	Outfall	1	52.115	0.000	0.7	0.0000	0.0000	OK
15 minute winter	Permeable Surface	12	52.364	0.014	0.3	0.0251	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	Development	1.000	Manhole	0.8	0.376	0.132	0.0454	
15 minute winter	Manhole	Orifice	Outfall	0.8				0.5
15 minute winter	Permeable Surface	2.000	Manhole	0.2	0.375	0.040	0.0032	

Results for 100 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	Development	14	52.338	0.038	1.0	0.0105	0.0000	OK
15 minute winter	Manhole	14	52.337	0.137	1.3	0.0218	0.0000	SURCHARGED
15 minute summer	Outfall	1	52.115	0.000	0.9	0.0000	0.0000	OK
15 minute winter	Permeable Surface	13	52.365	0.015	0.3	0.0296	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	Development	1.000	Manhole	1.0	0.420	0.165	0.0527	
15 minute winter	Manhole	Orifice	Outfall	0.9				0.7
15 minute winter	Permeable Surface	2.000	Manhole	0.3	0.389	0.049	0.0084	

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	Development	14	52.377	0.077	1.4	0.0215	0.0000	OK
15 minute winter	Manhole	14	52.377	0.177	1.6	0.0281	0.0000	SURCHARGED
15 minute summer	Outfall	1	52.115	0.000	1.0	0.0000	0.0000	OK
15 minute winter	Permeable Surface	14	52.376	0.026	0.6	0.0811	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	Development	1.000	Manhole	1.2	0.417	0.205	0.0715	
15 minute winter	Manhole	Orifice	Outfall	1.0				1.0
15 minute winter	Permeable Surface	2.000	Manhole	0.6	0.404	0.097	0.0201	