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Table C-1: Catchment area calculations (all areas in hectares)

Catchment	Total Area	Impermeable (non-adoptable area – roofs, driveways)	Impermeable (adoptable areas – roads, pavements, communal parking)	Increase for urban creep (10% of non-adoptable areas)	SuDS Footprint	Total impermeable area	Remaining permeable area	30% estimate of permeable area to drain to network	Total positively drained area
	A	B	C	D = B*0.1	E	F = C+D+E	G = A-F	H = G*0.3	I = F + H
Eastern	2.80	0.48	0.50	0.05	0.09	1.11	1.70	0.51	1.62
Central	2.65	0.56	0.54	0.06	0.10	1.26	1.39	0.42	1.68
Southern	1.8	0.08	0.29	0.01	0.00	0.39	1.42	1.42*	1.80
Western	1.0	0.19	0.20	0.02		0.41	0.59	0.18	0.59
Western SuDS Basin (not within Western Catchment)					0.12	0.12			0.12
Total									5.80

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.00		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)	Invert Level (m)
Western Porous Paving	0.340	5.00	50.000	1200	-17.867	83.820	1.425	48.575
Western Additional Impermeable surfaces	0.100	5.00	50.000	1200	11.938	82.847	1.350	48.650
Western Basin	0.118		49.000		-1.687	56.691	1.500	47.500
Eastern Porous Paving	0.760	5.00	50.000	1200	72.036	82.847	1.500	48.500
Eastern Additional Impermeable surfaces	0.260	5.00	50.000	1200	104.152	82.968	1.425	48.575
Eastern Basin	0.090		49.000		91.500	60.241	1.500	47.500
Central Porous Paving	0.630	5.00	50.000	1200	24.978	30.414	1.575	48.425
Central Additional Impermeable surfaces	0.530	5.00	50.000	1350	64.637	30.789	1.575	48.425
Central Basin	0.100		49.000		44.564	6.038	1.500	47.500
Southern Impermeable surfaces	0.390	5.00	50.000	1350	24.641	73.524	1.500	48.500

Links

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
Western Porous Paving	Western Basin	31.588	0.600	48.575	47.500	1.075	29.4	225	5.22	5
Western Additional Impermeable surfaces	Western Basin	29.492	0.600	48.650	47.500	1.150	25.6	225	5.19	5
Eastern Porous Paving	Eastern Basin	29.831	0.600	48.500	47.500	1.000	29.8	300	5.17	5
Eastern Additional Impermeable surfaces	Eastern Basin	26.011	0.600	48.575	47.500	1.075	24.2	300	5.14	5
Central Porous Paving	Central Basin	31.270	0.600	48.425	47.500	0.925	33.8	300	5.19	5
Central Additional Impermeable surfaces	Central Basin	31.867	0.600	48.425	47.500	0.925	34.5	375	5.17	5
Southern Impermeable surfaces	Western Basin	31.249	0.600	48.500	47.500	1.000	31.2	375	5.16	5

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)
3.000	2.422	96.3	61.4	1.200	1.275	0.340	0.0	131	2.562
5.000	2.594	103.1	18.1	1.125	1.275	0.100	0.0	64	1.967
6.000	2.889	204.2	137.3	1.200	1.200	0.760	0.0	181	3.092
7.000	3.209	226.8	47.0	1.125	1.200	0.260	0.0	92	2.550
2.000	2.713	191.8	113.8	1.275	1.200	0.630	0.0	167	2.825
1.000	3.095	341.9	95.8	1.200	1.125	0.530	0.0	135	2.670
4.000	3.251	359.0	70.5	1.125	1.125	0.390	0.0	112	2.544

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)
3.000	31.588	29.4	225	Circular	50.000	48.575	1.200	49.000	47.500	1.275
5.000	29.492	25.6	225	Circular	50.000	48.650	1.125	49.000	47.500	1.275
6.000	29.831	29.8	300	Circular	50.000	48.500	1.200	49.000	47.500	1.200
7.000	26.011	24.2	300	Circular	50.000	48.575	1.125	49.000	47.500	1.200
2.000	31.270	33.8	300	Circular	50.000	48.425	1.275	49.000	47.500	1.200
1.000	31.867	34.5	375	Circular	50.000	48.425	1.200	49.000	47.500	1.125
4.000	31.249	31.2	375	Circular	50.000	48.500	1.125	49.000	47.500	1.125

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Node Type
3.000	Western Porous Paving	1200	Manhole	Adoptable	Western Basin	Junction
5.000	Western Additional Impermeable surfaces	1200	Manhole	Adoptable	Western Basin	Junction
6.000	Eastern Porous Paving	1200	Manhole	Adoptable	Eastern Basin	Junction
7.000	Eastern Additional Impermeable surfaces	1200	Manhole	Adoptable	Eastern Basin	Junction
2.000	Central Porous Paving	1200	Manhole	Adoptable	Central Basin	Junction
1.000	Central Additional Impermeable surfaces	1350	Manhole	Adoptable	Central Basin	Junction
4.000	Southern Impermeable surfaces	1350	Manhole	Adoptable	Western Basin	Junction

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)	
Western Porous Paving	-17.867	83.820	50.000	1.425	1200		0	3.000	48.575	225
Western Additional Impermeable surfaces	11.938	82.847	50.000	1.350	1200		0	5.000	48.650	225
Western Basin	-1.687	56.691	49.000	1.500			1 2 3	5.000	47.500	225
Eastern Porous Paving	72.036	82.847	50.000	1.500	1200		0	6.000	48.500	300
Eastern Additional Impermeable surfaces	104.152	82.968	50.000	1.425	1200		0	7.000	48.575	300
Eastern Basin	91.500	60.241	49.000	1.500			1 2	7.000	47.500	300
Central Porous Paving	24.978	30.414	50.000	1.575	1200		0	2.000	48.425	300

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)	
Central Additional Impermeable surfaces	64.637	30.789	50.000	1.575	1350		0	1.000	48.425	375
Central Basin	44.564	6.038	49.000	1.500			1	2.000	47.500	300
Southern Impermeable surfaces	24.641	73.524	50.000	1.500	1350		0	4.000	48.500	375

Simulation Settings

Rainfall Methodology	FEH-22	Skip Steady State	x	2 year (l/s)	31.5
Rainfall Events	Singular	Drain Down Time (mins)	2160	30 year (l/s)	77.6
Summer CV	1.000	Additional Storage (m³/ha)	20.0	100 year (l/s)	100.2
Winter CV	1.000	Starting Level (m)		Check Discharge Volume	x
Analysis Speed	Normal	Check Discharge Rate(s)	✓		

Storm Durations

15	60	180	360	600	960	2160
30	120	240	480	720	1440	2880

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
30	40	0	0
100	45	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Betterment (%)	0
Greenfield Method	ReFH2	Q 2 year (l/s)	31.5
Region	England, Wales, NI	Q 30 year (l/s)	77.6
Include Baseflow	x	Q 100 year (l/s)	100.2
Positively Drained Area (ha)	5.800		

Node Western Basin Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	47.500	Product Number	CTL-SHE-0152-1150-1200-1150
Design Depth (m)	1.200	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	11.5	Min Node Diameter (mm)	1500

Node Western Porous Paving Online Orifice Control

Flap Valve	x	Invert Level (m)	48.575	Discharge Coefficient	0.600
Replaces Downstream Link	x	Diameter (m)	0.055		

Node Eastern Basin Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	47.500	Product Number	CTL-SHE-0134-8700-1200-8700
Design Depth (m)	1.200	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	8.7	Min Node Diameter (mm)	1200

Node Eastern Porous Paving Online Orifice Control

Flap Valve	x	Invert Level (m)	48.500	Discharge Coefficient	0.600
Replaces Downstream Link	x	Diameter (m)	0.075		

Node Central Porous Paving Online Orifice Control

Flap Valve	x	Invert Level (m)	48.425	Discharge Coefficient	0.600
Replaces Downstream Link	x	Diameter (m)	0.070		

Node Central Basin Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	47.500	Product Number	CTL-SHE-0134-8700-1200-8700
Design Depth (m)	1.200	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	8.7	Min Node Diameter (mm)	1200

Node Western Porous Paving Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	49.300	Slope (1:X)	150.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	328	Depth (m)	0.450
Safety Factor	2.0	Width (m)	150.000	Inf Depth (m)	
Porosity	0.35	Length (m)	10.000		

Node Western Basin Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	47.500
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	1410

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	562.0	562.0	1.500	1179.3	1198.3

Node Eastern Porous Paving Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	49.300	Slope (1:X)	150.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	400	Depth (m)	0.450
Safety Factor	2.0	Width (m)	350.000	Inf Depth (m)	
Porosity	0.35	Length (m)	10.000		

Node Eastern Basin Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	47.500
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	1380



Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	360.9	360.9	1.500	878.1	894.0

Node Central Porous Paving Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	49.300	Slope (1:X)	150.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	364	Depth (m)	0.450
Safety Factor	2.0	Width (m)	300.000	Inf Depth (m)	
Porosity	0.35	Length (m)	10.000		

Node Central Basin Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	47.500
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	1680

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	443.3	443.3	1.500	1004.2	1021.5

Results for 2 year Critical Storm Duration. Lowest mass balance: 99.83%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute summer	Western Porous Paving	124	49.389	0.814	24.7	34.2065	0.0000	SURCHARGED
15 minute summer	Western Additional Impermeable surfaces	10	48.720	0.070	18.3	0.1832	0.0000	OK
480 minute summer	Western Basin	424	47.827	0.327	34.1	206.6152	0.0000	OK
180 minute summer	Eastern Porous Paving	128	49.393	0.893	55.2	82.6970	0.0000	SURCHARGED
15 minute summer	Eastern Additional Impermeable surfaces	10	48.681	0.106	47.8	0.5052	0.0000	OK
480 minute winter	Eastern Basin	472	47.940	0.440	21.4	192.9200	0.0000	OK
180 minute summer	Central Porous Paving	128	49.387	0.962	45.7	65.1305	0.0000	SURCHARGED
15 minute summer	Central Additional Impermeable surfaces	10	48.580	0.155	97.4	1.2647	0.0000	OK
480 minute summer	Central Basin	448	47.948	0.448	35.7	237.0189	0.0000	OK
15 minute summer	Southern Impermeable surfaces	10	48.630	0.130	71.8	0.8632	0.0000	OK

Link Event stream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Disch Vol (
minute summer	Western Porous Paving	3.000	Western Basin	5.6	1.590	0.058	0.6941	
minute summer	Western Additional Impermeable surfaces	5.000	Western Basin	18.4	2.630	0.179	0.2943	
minute summer	Western Basin	Hydro-Brake®		11.5				4
minute summer	Eastern Porous Paving	6.000	Eastern Basin	10.8	1.884	0.053	1.1534	
minute summer	Eastern Additional Impermeable surfaces	7.000	Eastern Basin	47.9	3.708	0.211	0.4726	
minute winter	Eastern Basin	Hydro-Brake®		8.7				3
minute summer	Central Porous Paving	2.000	Central Basin	9.8	1.707	0.051	1.2068	
minute summer	Central Additional Impermeable surfaces	1.000	Central Basin	97.3	4.028	0.285	0.8766	
minute summer	Central Basin	Hydro-Brake®		8.7				4
minute summer	Southern Impermeable surfaces	4.000	Western Basin	71.8	3.954	0.200	0.6489	

Results for 30 year +40% CC Critical Storm Duration. Lowest mass balance: 99.97%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute winter	Western Porous Paving	176	49.630	1.055	51.0	161.8231	0.0000	SURCHARGED
15 minute summer	Western Additional Impermeable surfaces	9	48.783	0.133	65.3	0.3472	0.0000	OK
960 minute summer	Western Basin	960	48.595	1.095	60.1	863.5172	0.0000	OK
180 minute winter	Eastern Porous Paving	176	49.632	1.132	113.9	378.4672	0.0000	SURCHARGED
15 minute summer	Eastern Additional Impermeable surfaces	10	48.789	0.214	169.9	1.0220	0.0000	OK
2160 minute summer	Eastern Basin	1920	48.710	1.210	27.6	690.8881	0.0000	OK
180 minute winter	Central Porous Paving	176	49.615	1.190	94.4	305.9615	0.0000	SURCHARGED
15 minute summer	Central Additional Impermeable surfaces	10	48.785	0.360	346.0	2.9395	0.0000	OK
1440 minute winter	Central Basin	1470	48.729	1.229	32.8	829.0781	0.0000	OK
15 minute summer	Southern Impermeable surfaces	10	48.758	0.258	255.3	1.7097	0.0000	OK
Link Event stream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Disc Vol
minute winter	Western Porous Paving	3.000	Western Basin	6.4	1.734	0.066	0.7008	
minute summer	Western Additional Impermeable surfaces	5.000	Western Basin	65.5	3.077	0.635	0.8580	
minute summer	Western Basin	Hydro-Brake®		11.5				14
minute winter	Eastern Porous Paving	6.000	Eastern Basin	12.2	2.061	0.060	1.1634	
minute summer	Eastern Additional Impermeable surfaces	7.000	Eastern Basin	169.8	4.453	0.748	1.1601	
minute summer	Eastern Basin	Hydro-Brake®		8.7				11
minute winter	Central Porous Paving	2.000	Central Basin	10.9	1.852	0.057	1.2155	
minute summer	Central Additional Impermeable surfaces	1.000	Central Basin	344.5	4.657	1.008	2.7688	
minute winter	Central Basin	Hydro-Brake®		8.8				14
minute summer	Southern Impermeable surfaces	4.000	Western Basin	254.9	4.709	0.710	1.9659	

Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 99.83%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
240 minute winter	Western Porous Paving	232	49.744	1.169	53.2	222.6577	0.0000	FLOOD RISK
1440 minute summer	Western Additional Impermeable surfaces	1380	48.948	0.298	8.7	0.7792	0.0000	SURCHARGED
1440 minute summer	Western Basin	1380	48.948	1.448	67.7	1247.6730	0.0000	OK
240 minute winter	Eastern Porous Paving	236	49.748	1.248	118.9	521.9065	0.0000	FLOOD RISK
2880 minute summer	Eastern Additional Impermeable surfaces	2700	48.971	0.396	16.4	1.8946	0.0000	SURCHARGED
2880 minute summer	Eastern Basin	2700	48.971	1.471	31.1	905.9628	0.0000	OK
240 minute winter	Central Porous Paving	236	49.724	1.299	98.6	422.3672	0.0000	FLOOD RISK
15 minute summer	Central Additional Impermeable surfaces	11	49.542	1.117	450.8	9.1133	0.0000	SURCHARGED
2160 minute summer	Central Basin	1980	49.000	1.500	44.2	1087.6250	9.6500	FLOOD
1440 minute summer	Southern Impermeable surfaces	1380	48.948	0.448	47.0	2.9739	0.0000	SURCHARGED

Link Event	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Disc Vol
stream Depth)								
minute winter	Western Porous Paving	3.000	Western Basin	6.7	1.709	0.070	0.7036	
minute summer	Western Additional Impermeable surfaces	5.000	Western Basin	8.7	0.542	0.084	1.1729	
minute summer	Western Basin	Hydro-Brake®		12.6				2
minute winter	Eastern Porous Paving	6.000	Eastern Basin	12.9	2.037	0.063	1.5733	
minute summer	Eastern Additional Impermeable surfaces	7.000	Eastern Basin	16.4	0.438	0.072	1.8317	
minute summer	Eastern Basin	Hydro-Brake®		9.6				2
minute winter	Central Porous Paving	2.000	Central Basin	11.4	1.833	0.059	1.9899	
minute summer	Central Additional Impermeable surfaces	1.000	Central Basin	429.6	4.574	1.257	3.3987	
minute summer	Central Basin	Hydro-Brake®		9.7				2
minute summer	Southern Impermeable surfaces	4.000	Western Basin	47.0	1.164	0.131	3.4467	

