

PHG Consulting Engineers		Page 1
107 Cowbridge Road East Cardiff Wales, CF11 9AG	Haydn Terrace Planning Calculations - Storm Rev A	
Date 30/10/2025 File 2308-MD-PS-A-Surface Wa...	Designed by MP Checked by SJD	
Innovyze	Network 2020.1	

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)	20.000	Add Flow / Climate Change (%)	0
Ratio R	0.200	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)	1.500
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)	Time (mins)	Area (ha)
0-4	0.394	4-8	0.212	8-12	0.028

Total Area Contributing (ha) = 0.635

Total Pipe Volume (m³) = 15.850

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
S1.000	35.773	0.214	167.0	0.059	8.00	0.0	0.600	o	225	Pipe/Conduit	
S2.000	6.020	0.102	59.0	0.021	8.00	0.0	0.600	o	225	Pipe/Conduit	
S1.001	7.645	0.046	167.0	0.110	0.00	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)
S1.000	40.48	8.59	313.976	0.059	0.0	0.0	0.0	1.01	40.1	6.4
S2.000	41.50	8.06	314.655	0.021	0.0	0.0	0.0	1.71	67.8	2.3
S1.001	40.25	8.72	313.762	0.189	0.0	0.0	0.0	1.01	40.1	20.6

PHG Consulting Engineers		Page 2
107 Cowbridge Road East Cardiff Wales, CF11 9AG	Haydn Terrace Planning Calculations - Storm Rev A	
Date 30/10/2025 File 2308-MD-PS-A-Surface Wa...	Designed by MP Checked by SJD	
Innovyze	Network 2020.1	

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
S1.002	15.408	3.141	4.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.003	7.251	0.043	167.7	0.140	0.00	0.0	0.600	o	300	Pipe/Conduit	
S3.000	16.571	0.099	167.4	0.009	8.00	0.0	0.600	o	225	Pipe/Conduit	
S3.001	7.503	1.037	7.2	0.076	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.002	37.450	2.517	14.9	0.021	0.00	0.0	0.600	o	225	Pipe/Conduit	
S4.000	41.181	0.247	167.0	0.043	8.00	0.0	0.600	o	300	Pipe/Conduit	
S1.004	21.934	0.728	30.1	0.028	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.005	9.035	0.054	167.0	0.059	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.006	19.436	0.072	269.9	0.070	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.007	17.889	0.066	269.9	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.008	18.397	0.123	149.6	0.000	0.00	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)
S1.002	40.17	8.76	313.716	0.189	0.0	0.0	0.0	5.95	236.5	20.6
S1.003	39.99	8.86	310.575	0.330	0.0	0.0	0.0	1.21	85.6	35.7
S3.000	41.08	8.27	314.200	0.009	0.0	0.0	0.0	1.01	40.1	1.0
S3.001	41.03	8.30	314.101	0.085	0.0	0.0	0.0	4.90	194.7	9.4
S3.002	40.68	8.48	313.064	0.106	0.0	0.0	0.0	3.41	135.6	11.6
S4.000	40.53	8.57	309.850	0.043	0.0	0.0	0.0	1.21	85.8	4.7
S1.004	39.76	8.99	309.603	0.506	0.0	0.0	0.0	2.88	203.3	54.5
S1.005	39.57	9.09	308.875	0.565	0.0	0.0	0.0	1.40	154.5	60.5
S1.006	39.06	9.39	308.821	0.635	0.0	0.0	0.0	1.10	121.3	67.2
S1.007	38.61	9.66	308.749	0.635	0.0	0.0	0.0	1.10	121.3	67.2
S1.008	38.15	9.95	308.638	0.635	0.0	0.0	0.0	1.07	42.4	67.2

PHG Consulting Engineers		Page 3
107 Cowbridge Road East Cardiff Wales, CF11 9AG	Haydn Terrace Planning Calculations - Storm Rev A	
Date 30/10/2025 File 2308-MD-PS-A-Surface Wa...	Designed by MP Checked by SJD	
Innovyze	Network 2020.1	

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.059	0.059	0.059
2.000	User	-	100	0.021	0.021	0.021
1.001	User	-	100	0.033	0.033	0.033
	User	-	100	0.028	0.028	0.061
	User	-	100	0.025	0.025	0.086
	User	-	100	0.025	0.025	0.110
1.002	-	-	100	0.000	0.000	0.000
1.003	User	-	100	0.140	0.140	0.140
3.000	User	-	100	0.009	0.009	0.009
3.001	User	-	100	0.076	0.076	0.076
3.002	User	-	100	0.021	0.021	0.021
4.000	User	-	100	0.043	0.043	0.043
1.004	User	-	100	0.028	0.028	0.028
1.005	User	-	100	0.059	0.059	0.059
1.006	User	-	100	0.070	0.070	0.070
1.007	-	-	100	0.000	0.000	0.000
1.008	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.635	0.635	0.635

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)
---------------------	--------------	--------------	--------------	------------------	----------	--------

S1.008	S	309.000	308.515	308.055	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 * 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 Storage Structures	1
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	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	30
Ratio R	0.200		

PHG Consulting Engineers		Page 4
107 Cowbridge Road East Cardiff Wales, CF11 9AG	Haydn Terrace Planning Calculations - Storm Rev A	
Date 30/10/2025 File 2308-MD-PS-A-Surface Wa...	Designed by MP Checked by SJD	
Innovyze	Network 2020.1	

Online Controls for Storm

Hydro-Brake® Optimum Manhole: S14(HB), DS/PN: S1.008, Volume (m³): 4.6

Unit Reference	MD-SHE-0178-1650-1311-1650
Design Head (m)	1.311
Design Flow (l/s)	16.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	178
Invert Level (m)	308.638
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.311	16.5
Flush-Flo™	0.393	16.5
Kick-Flo®	0.867	13.6
Mean Flow over Head Range	-	14.2

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	6.3	1.200	15.8	3.000	24.5	7.000	36.8
0.200	15.3	1.400	17.0	3.500	26.4	7.500	38.1
0.300	16.3	1.600	18.1	4.000	28.1	8.000	39.3
0.400	16.5	1.800	19.2	4.500	29.7	8.500	40.4
0.500	16.3	2.000	20.2	5.000	31.3	9.000	41.6
0.600	16.0	2.200	21.1	5.500	32.8	9.500	42.7
0.800	14.7	2.400	22.0	6.000	34.2		
1.000	14.5	2.600	22.9	6.500	35.5		

PHG Consulting Engineers		Page 5
107 Cowbridge Road East Cardiff Wales, CF11 9AG	Haydn Terrace Planning Calculations - Storm Rev A	
Date 30/10/2025 File 2308-MD-PS-A-Surface Wa...	Designed by MP Checked by SJD	
Innovyze	Network 2020.1	

Storage Structures for Storm

Cellular Storage Manhole: S13, DS/PN: S1.007

Invert Level (m) 308.749 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	355.0	355.0	1.201	0.0	464.2
1.200	355.0	464.2			

PHG Consulting Engineers		Page 7
107 Cowbridge Road East Cardiff Wales, CF11 9AG	Haydn Terrace Planning Calculations - Storm Rev A	
Date 30/10/2025 File 2308-MD-PS-A-Surface Wa...	Designed by MP Checked by SJD	
Innovyze	Network 2020.1	

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

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m ³)	Flow / Cap. (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S1.000	S1	314.031	-0.170	0.000	0.13		5.1	OK
S2.000	S2	314.684	-0.196	0.000	0.04		1.8	OK
S1.001	S3	313.882	-0.105	0.000	0.55		16.7	OK
S1.002	S4	313.758	-0.183	0.000	0.08		16.6	OK
S1.003	S5	310.722	-0.153	0.000	0.48		29.4	OK
S3.000	S6	314.222	-0.203	0.000	0.02		0.7	OK
S3.001	S7	314.135	-0.191	0.000	0.05		7.8	OK
S3.002	S8	313.105	-0.184	0.000	0.08		9.8	OK
S4.000	S9	309.891	-0.259	0.000	0.05		3.7	OK
S1.004	S10	309.706	-0.198	0.000	0.25		45.2	OK
S1.005	S11	309.056	-0.194	0.000	0.47		50.4	OK
S1.006	S12 (CELLS)	309.023	-0.173	0.000	0.56		56.7	OK
S1.007	S13	308.890	-0.234	0.000	0.16	53	16.0	OK
S1.008	S14 (HB)	308.874	0.011	0.000	0.41		15.8	SURCHARGED

PN	US/MH Name	Level Exceeded
S1.000	S1	
S2.000	S2	
S1.001	S3	
S1.002	S4	
S1.003	S5	
S3.000	S6	
S3.001	S7	
S3.002	S8	
S4.000	S9	
S1.004	S10	
S1.005	S11	
S1.006	S12 (CELLS)	
S1.007	S13	
S1.008	S14 (HB)	

PHG Consulting Engineers		Page 9
107 Cowbridge Road East Cardiff Wales, CF11 9AG	Haydn Terrace Planning Calculations - Storm Rev A	
Date 30/10/2025 File 2308-MD-PS-A-Surface Wa...	Designed by MP Checked by SJD	
Innovyze	Network 2020.1	

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

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m ³)	Flow / Cap. (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S1.000	S1	314.076	-0.125	0.000	0.33		12.6	OK
S2.000	S2	314.702	-0.178	0.000	0.10		4.4	OK
S1.001	S3	314.043	0.056	0.000	1.53		46.0	SURCHARGED
S1.002	S4	313.788	-0.153	0.000	0.22		46.3	OK
S1.003	S5	310.939	0.064	0.000	1.36		83.7	SURCHARGED
S3.000	S6	314.233	-0.192	0.000	0.05		1.8	OK
S3.001	S7	314.162	-0.164	0.000	0.17		23.7	OK
S3.002	S8	313.137	-0.152	0.000	0.23		29.7	OK
S4.000	S9	309.917	-0.233	0.000	0.11		9.1	OK
S1.004	S10	309.807	-0.096	0.000	0.72		129.0	OK
S1.005	S11	309.431	0.181	0.000	1.34		144.1	SURCHARGED
S1.006	S12 (CELLS)	309.293	0.097	0.000	1.59		161.1	SURCHARGED
S1.007	S13	309.167	0.043	0.000	0.20	116	20.1	SURCHARGED
S1.008	S14 (HB)	309.182	0.319	0.000	0.43		16.5	SURCHARGED

PN	US/MH Name	Level Exceeded
S1.000	S1	
S2.000	S2	
S1.001	S3	
S1.002	S4	
S1.003	S5	
S3.000	S6	
S3.001	S7	
S3.002	S8	
S4.000	S9	
S1.004	S10	
S1.005	S11	
S1.006	S12 (CELLS)	
S1.007	S13	
S1.008	S14 (HB)	

PHG Consulting Engineers		Page 11
107 Cowbridge Road East Cardiff Wales, CF11 9AG	Haydn Terrace Planning Calculations - Storm Rev A	
Date 30/10/2025 File 2308-MD-PS-A-Surface Wa...	Designed by MP Checked by SJD	
Innovyze	Network 2020.1	

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

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m ³)	Flow / Overflow Cap. (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S1.000	S1	314.354	0.153	0.000	0.65		24.4	SURCHARGED
S2.000	S2	314.719	-0.161	0.000	0.18		8.1	OK
S1.001	S3	314.290	0.303	0.000	2.69		81.0	SURCHARGED
S1.002	S4	313.815	-0.126	0.000	0.39		81.6	OK
S1.003	S5	311.342	0.467	0.000	2.38		146.3	SURCHARGED
S3.000	S6	314.246	-0.179	0.000	0.09		3.4	OK
S3.001	S7	314.185	-0.141	0.000	0.30		42.8	OK
S3.002	S8	313.165	-0.124	0.000	0.42		53.5	OK
S4.000	S9	311.048	0.898	0.000	0.37		29.5	SURCHARGED
S1.004	S10	311.027	1.123	0.000	1.18		211.6	SURCHARGED
S1.005	S11	309.987	0.737	0.000	2.20		235.9	SURCHARGED
S1.006	S12 (CELLS)	309.805	0.609	0.000	0.90		90.8	SURCHARGED
S1.007	S13	309.744	0.620	0.000	0.29	206	28.6	SURCHARGED
S1.008	S14 (HB)	310.141	1.278	0.000	0.43		16.5	SURCHARGED

PN	US/MH Name	Level Exceeded
S1.000	S1	
S2.000	S2	
S1.001	S3	
S1.002	S4	
S1.003	S5	
S3.000	S6	
S3.001	S7	
S3.002	S8	
S4.000	S9	
S1.004	S10	
S1.005	S11	
S1.006	S12 (CELLS)	
S1.007	S13	
S1.008	S14 (HB)	