

BSP Consulting		Page 1
12 Oxford Street Nottingham NG1 5BG	Proposed Care Home Bognor Regis SW Drainage Strategy	
Date 13/10/2021	Designed by TKH	
File	Checked by TG	
Innovyze	Network 2019.1	

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)	19.000	Add Flow / Climate Change (%)	0
Ratio R	0.346	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	0.235	4-8	0.093

Total Area Contributing (ha) = 0.328

Total Pipe Volume (m³) = 6.485

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	56.400	0.400	141.0	0.037	5.00	0.0	0.600	o	225	Pipe/Conduit	
1.001	42.000	0.300	140.0	0.076	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	4.300	0.150	28.7	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.000	28.700	0.600	47.8	0.071	5.00	0.0	0.600	o	150	Pipe/Conduit	
2.001	22.500	0.175	128.6	0.017	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.002	5.300	0.050	106.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.003	5.000	0.050	100.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
3.000	1.700	0.150	11.3	0.017	5.00	0.0	0.600	o	150	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)
1.000	50.00	5.86	2.200	0.037	0.0	0.0	0.0	1.10	43.7	5.0
1.001	50.00	6.49	1.800	0.113	0.0	0.0	0.0	1.10	43.9	15.3
1.002	50.00	6.52	1.500	0.113	0.0	0.0	0.0	2.45	97.5	15.3
2.000	50.00	5.33	2.300	0.071	0.0	0.0	0.0	1.46	25.8	9.6
2.001	50.00	5.65	1.625	0.088	0.0	0.0	0.0	1.15	45.8	11.9
2.002	50.00	5.72	1.450	0.088	0.0	0.0	0.0	1.27	50.5	11.9
2.003	50.00	5.79	1.400	0.088	0.0	0.0	0.0	1.31	52.0	11.9
3.000	50.00	5.01	1.650	0.017	0.0	0.0	0.0	3.01	53.2	2.3

BSP Consulting		Page 2
12 Oxford Street Nottingham NG1 5BG	Proposed Care Home Bognor Regis SW Drainage Strategy	
Date 13/10/2021	Designed by TKH	
File	Checked by TG	
Innovyze	Network 2019.1	

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
1.003	13.200	0.300	44.0	0.087	0.00	0.0	0.600	o	150	Pipe/Conduit	
4.000	6.900	0.100	69.0	0.023	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.004	11.600	0.100	116.0	0.000	0.00	0.0	0.600	o	150	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)
1.003	50.00	6.66	1.350	0.305	0.0	0.0	0.0	1.52	26.9«	41.3
4.000	50.00	5.09	1.150	0.023	0.0	0.0	0.0	1.21	21.4	3.1
1.004	50.00	6.87	1.050	0.328	0.0	0.0	0.0	0.93	16.5«	44.4

BSP Consulting		Page 3
12 Oxford Street Nottingham NG1 5BG	Proposed Care Home Bognor Regis SW Drainage Strategy	
Date 13/10/2021	Designed by TKH	
File	Checked by TG	
Innovyze	Network 2019.1	

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	225	1	3.050	2.200	0.625	Open Manhole	1200
1.001	o	225	2	3.050	1.800	1.025	Open Manhole	1200
1.002	o	225	3	3.050	1.500	1.325	Open Manhole	1200
2.000	o	150	4	3.050	2.300	0.600	Open Manhole	1200
2.001	o	225	5	2.450	1.625	0.600	Open Manhole	1200
2.002	o	225	6	3.050	1.450	1.375	Open Manhole	1200
2.003	o	225	7	3.100	1.400	1.475	Open Manhole	1200
3.000	o	150	8	3.050	1.650	1.250	Open Manhole	1200
1.003	o	150	9	2.200	1.350	0.700	Open Manhole	1200
4.000	o	150	10	2.000	1.150	0.700	Open Manhole	1200
1.004	o	150	10	2.300	1.050	1.100	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	56.400	141.0	2	3.050	1.800	1.025	Open Manhole	1200
1.001	42.000	140.0	3	3.050	1.500	1.325	Open Manhole	1200
1.002	4.300	28.7	9	2.200	1.350	0.625	Open Manhole	1200
2.000	28.700	47.8	5	2.450	1.700	0.600	Open Manhole	1200
2.001	22.500	128.6	6	3.050	1.450	1.375	Open Manhole	1200
2.002	5.300	106.0	7	3.100	1.400	1.475	Open Manhole	1200
2.003	5.000	100.0	9	2.200	1.350	0.625	Open Manhole	1200
3.000	1.700	11.3	9	2.200	1.500	0.550	Open Manhole	1200
1.003	13.200	44.0	10	2.300	1.050	1.100	Open Manhole	1200
4.000	6.900	69.0	10	2.300	1.050	1.100	Open Manhole	1200
1.004	11.600	116.0		1.700	0.950	0.600	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)
1.004		1.700	0.950	0.950	0	0

BSP Consulting		Page 4
12 Oxford Street Nottingham NG1 5BG	Proposed Care Home Bognor Regis SW Drainage Strategy	
Date 13/10/2021	Designed by TKH	
File	Checked by TG	
Innovyze	Network 2019.1	

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 Offline Controls	0
Number of Online Controls	1	Number of Storage Structures	1
		Number of Time/Area Diagrams	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)	19.000	Storm Duration (mins)	30
Ratio R	0.346		

BSP Consulting		Page 5
12 Oxford Street Nottingham NG1 5BG	Proposed Care Home Bognor Regis SW Drainage Strategy	
Date 13/10/2021	Designed by TKH	
File	Checked by TG	
Innovyze	Network 2019.1	

Online Controls for Storm

Hydro-Brake® Optimum Manhole: 10, DS/PN: 1.004, Volume (m³): 1.7

Unit Reference MD-SCU-0051-2100-0550-2100
Design Head (m) 0.550
Design Flow (l/s) 2.1
Flush-Flo™ Calculated
Objective Linear discharge profile
Application Surface
Sump Available Yes
Diameter (mm) 51
Invert Level (m) 1.050
Minimum Outlet Pipe Diameter (mm) 75
Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.550	2.1	Kick-Flo®	0.076	0.9
Flush-Flo™	0.076	0.9	Mean Flow over Head Range	-	1.4

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)	Depth (m)	Flow (l/s)
0.100	1.0	0.800	2.5	2.000	3.8	4.000	5.3	7.000	6.9
0.200	1.3	1.000	2.8	2.200	4.0	4.500	5.6	7.500	7.2
0.300	1.6	1.200	3.0	2.400	4.2	5.000	5.9	8.000	7.4
0.400	1.8	1.400	3.2	2.600	4.3	5.500	6.1	8.500	7.6
0.500	2.0	1.600	3.4	3.000	4.6	6.000	6.4	9.000	7.8
0.600	2.2	1.800	3.6	3.500	5.0	6.500	6.7	9.500	8.1

BSP Consulting		Page 6
12 Oxford Street Nottingham NG1 5BG	Proposed Care Home Bognor Regis SW Drainage Strategy	
Date 13/10/2021	Designed by TKH	
File	Checked by TG	
Innovyze	Network 2019.1	

Storage Structures for Storm

Complex Manhole: 9, DS/PN: 1.003

Cellular Storage

Invert Level (m) 1.350 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)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	687.5	0.0	0.400	687.5	0.0	0.401	0.0	0.0

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	14.4
Membrane Percolation (mm/hr)	1000	Length (m)	22.8
Max Percolation (l/s)	91.2	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	1.350	Cap Volume Depth (m)	0.320

BSP Consulting		Page 7
12 Oxford Street Nottingham NG1 5BG	Proposed Care Home Bognor Regis SW Drainage Strategy	
Date 13/10/2021	Designed by TKH	
File	Checked by TG	
Innovyze	Network 2019.1	

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 Offline Controls 0 Number of Time/Area Diagrams 0
 Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 19.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.346 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
 Analysis Timestep 2.5 Second Increment (Extended)
 DTS Status ON
 DVD Status ON
 Inertia 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, 40

									Water	Surcharged	Flooded	
PN	US/MH		Storm	Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level	Depth	Volume
	Name			Period	Change	Surcharge	Flood	Overflow	Act.	(m)	(m)	(m³)
1.000	1	15	Winter	1	+0%					2.250	-0.175	0.000
1.001	2	15	Winter	1	+0%	100/15	Summer			1.884	-0.141	0.000
1.002	3	15	Winter	1	+0%					1.572	-0.153	0.000
2.000	4	15	Winter	1	+0%	100/15	Summer			2.363	-0.087	0.000
2.001	5	15	Winter	1	+0%	100/15	Summer			1.702	-0.148	0.000
2.002	6	15	Winter	1	+0%	100/15	Summer			1.540	-0.135	0.000
2.003	7	15	Winter	1	+0%	100/15	Summer			1.490	-0.135	0.000
3.000	8	15	Winter	1	+0%					1.680	-0.120	0.000
1.003	9	480	Winter	1	+0%	100/60	Summer			1.401	-0.099	0.000
4.000	10	480	Winter	1	+0%	1/30	Summer			1.397	0.097	0.000
1.004	10	360	Winter	1	+0%	1/15	Summer			1.397	0.197	0.000

		Pipe		Level	
PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Flow (l/s)	Status
1.000	1	0.11		4.5	OK
1.001	2	0.29		12.2	OK
1.002	3	0.22		12.2	OK
2.000	4	0.36		8.8	OK
2.001	5	0.26		10.7	OK
2.002	6	0.34		10.6	OK
2.003	7	0.33		10.6	OK
3.000	8	0.09		2.1	OK
1.003	9	0.08		1.9	OK
4.000	10	0.03		0.5	SURCHARGED
1.004	10	0.11		1.7	SURCHARGED

BSP Consulting		Page 8
12 Oxford Street Nottingham NG1 5BG	Proposed Care Home Bognor Regis SW Drainage Strategy	
Date 13/10/2021	Designed by TKH	
File	Checked by TG	
Innovyze	Network 2019.1	

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 Offline Controls 0 Number of Time/Area Diagrams 0
 Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 19.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.346 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
 Analysis Timestep 2.5 Second Increment (Extended)
 DTS Status ON
 DVD Status ON
 Inertia 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, 40

									Water	Surcharged	Flooded	
PN	US/MH			Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level	Depth	Volume
	Name	Storm		Period	Change	Surcharge	Flood	Overflow	Act.	(m)	(m)	(m³)
1.000	1	15 Winter		30	+0%					2.280	-0.145	0.000
1.001	2	15 Winter		30	+0%	100/15 Summer				1.960	-0.065	0.000
1.002	3	15 Winter		30	+0%					1.629	-0.096	0.000
2.000	4	15 Winter		30	+0%	100/15 Summer				2.411	-0.039	0.000
2.001	5	15 Winter		30	+0%	100/15 Summer				1.758	-0.092	0.000
2.002	6	15 Winter		30	+0%	100/15 Summer				1.609	-0.066	0.000
2.003	7	15 Winter		30	+0%	100/15 Summer				1.560	-0.065	0.000
3.000	8	15 Winter		30	+0%					1.697	-0.103	0.000
1.003	9	480 Winter		30	+0%	100/60 Summer				1.488	-0.012	0.000
4.000	10	15 Winter		30	+0%	1/30 Summer				1.538	0.238	0.000
1.004	10	15 Winter		30	+0%	1/15 Summer				1.519	0.319	0.000

		Pipe				Level	
PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Exceeded	
1.000	1	0.26		11.0	OK		
1.001	2	0.82		34.2	OK		
1.002	3	0.63		34.2	OK		
2.000	4	0.87		21.5	OK		
2.001	5	0.64		26.8	OK		
2.002	6	0.85		26.8	OK		
2.003	7	0.84		26.5	OK		
3.000	8	0.22		5.2	OK		
1.003	9	0.10		2.4	OK		
4.000	10	0.33		6.0	SURCHARGED		
1.004	10	0.13		1.9	SURCHARGED		

BSP Consulting		Page 9
12 Oxford Street Nottingham NG1 5BG	Proposed Care Home Bognor Regis SW Drainage Strategy	
Date 13/10/2021	Designed by TKH	
File	Checked by TG	
Innovyze	Network 2019.1	

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 Offline Controls 0 Number of Time/Area Diagrams 0
 Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 19.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.346 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
 Analysis Timestep 2.5 Second Increment (Extended)
 DTS Status ON
 DVD Status ON
 Inertia 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, 40

PN	US/MH		Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level	Surcharged Depth	Flooded Volume
	Name	Storm							(m)	(m)	(m ³)
1.000	1	15 Winter	100	+40%					2.342	-0.083	0.000
1.001	2	15 Winter	100	+40%	100/15 Summer				2.260	0.235	0.000
1.002	3	15 Winter	100	+40%					1.689	-0.036	0.000
2.000	4	15 Winter	100	+40%	100/15 Summer				2.945	0.495	0.000
2.001	5	15 Winter	100	+40%	100/15 Summer				1.884	0.034	0.000
2.002	6	15 Winter	100	+40%	100/15 Summer				1.721	0.046	0.000
2.003	7	15 Winter	100	+40%	100/15 Summer				1.643	0.018	0.000
3.000	8	15 Winter	100	+40%					1.715	-0.085	0.000
1.003	9	960 Winter	100	+40%	100/60 Summer				1.630	0.130	0.000
4.000	10	15 Winter	100	+40%	1/30 Summer				1.628	0.328	0.000
1.004	10	960 Winter	100	+40%	1/15 Summer				1.636	0.436	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe	Status	Level Exceeded
				Flow (l/s)		
1.000	1	0.46		19.3	OK	
1.001	2	1.32		55.2	SURCHARGED	
1.002	3	1.00		54.5	OK	
2.000	4	1.33		32.7	FLOOD RISK	
2.001	5	0.95		39.6	SURCHARGED	
2.002	6	1.25		39.5	SURCHARGED	
2.003	7	1.25		39.4	SURCHARGED	
3.000	8	0.39		9.5	OK	
1.003	9	0.11		2.7	SURCHARGED	
4.000	10	0.70		12.8	SURCHARGED	
1.004	10	0.14		2.1	SURCHARGED	