


William Saunders		Page 1
Sheppard Lockton House Cafferata Way Newark, NG24 2TN	Site off Fenside Road Boston 30yr and 100_40 FEH	
Date 05/03/2020 16:12 File 20.03.04 original_with ...	Designed by PAE Checked by	
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)	18.800	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	0.500
Maximum Rainfall (mm/hr)	100	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	60	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


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	22.932	0.050	458.6	0.089	5.00	0.0	0.600	o	450	Pipe/Conduit	
2.000	44.951	0.090	499.5	0.056	5.00	0.0	0.600	o	900	Pipe/Conduit	
1.001	48.075	0.167	287.9	0.085	0.00	0.0	0.600	o	900	Pipe/Conduit	
3.000	27.361	0.055	497.5	0.052	5.00	0.0	0.600	o	450	Pipe/Conduit	
3.001	17.105	0.311	55.0	0.031	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.002	20.420	0.070	291.7	0.026	0.00	0.0	0.600	o	900	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	63.87	5.41	1.310	0.089	0.0	0.0	0.0	0.94	149.9	15.4
2.000	63.19	5.54	1.350	0.056	0.0	0.0	0.0	1.40	887.6	9.5
1.001	61.09	5.97	1.260	0.229	0.0	0.0	0.0	1.84	1171.6	38.0
3.000	63.36	5.50	1.909	0.052	0.0	0.0	0.0	0.90	143.9	9.0
3.001	62.84	5.61	1.854	0.083	0.0	0.0	0.0	2.75	436.7	14.2
1.002	60.23	6.16	1.093	0.339	0.0	0.0	0.0	1.83	1163.8	55.3

William Saunders										Page 2		
Sheppard Lockton House Cafferata Way Newark, NG24 2TN					Site off Fenside Road Boston 30yr and 100_40 FEH							
Date 05/03/2020 16:12 File 20.03.04 original_with ...					Designed by PAE Checked by							
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
4.000	7.509	0.012	625.8	0.000	5.00	0.0	0.600	o	600	Pipe/Conduit		
1.003	22.790	0.084	271.3	0.000	0.00	0.0	0.600	o	900	Pipe/Conduit		
5.000	28.006	0.056	500.1	0.042	5.00	0.0	0.600	o	900	Pipe/Conduit		
5.001	8.663	0.017	509.6	0.018	0.00	0.0	0.600	o	900	Pipe/Conduit		
1.004	10.758	0.039	275.8	0.043	0.00	0.0	0.600	o	900	Pipe/Conduit		
6.000	18.878	0.076	248.4	0.037	5.00	0.0	0.600	o	300	Pipe/Conduit		
6.001	9.078	0.036	252.2	0.008	0.00	0.0	0.600	o	300	Pipe/Conduit		
1.005	10.088	0.020	504.4	0.000	0.00	0.0	0.600	o	900	Pipe/Conduit		
1.006	38.872	0.078	498.4	0.068	0.00	0.0	0.600	o	900	Pipe/Conduit		
7.000	42.500	0.085	500.0	0.081	5.00	0.0	0.600	o	900	Pipe/Conduit		
1.007	20.116	0.040	502.9	0.028	0.00	0.0	0.600	o	900	Pipe/Conduit		
1.008	24.119	0.050	482.4	0.053	0.00	0.0	0.600	o	900	Pipe/Conduit		
1.009	25.287	0.050	505.7	0.031	0.00	0.0	0.600	oo	900	Double Pipe		
1.010	30.834	0.062	497.3	0.064	0.00	0.0	0.600	oo	900	Double Pipe		
1.011	14.835	0.100	148.4	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)		
4.000	65.33	5.13	1.035	0.000	0.0	0.0	0.0	0.97	273.2	0.0		
1.003	59.35	6.36	1.023	0.339	0.0	0.0	0.0	1.90	1207.1	55.3		
5.000	64.23	5.33	1.012	0.042	0.0	0.0	0.0	1.39	887.0	7.2		
5.001	63.69	5.44	0.956	0.060	0.0	0.0	0.0	1.38	878.6	10.3		
1.004	58.93	6.45	0.939	0.441	0.0	0.0	0.0	1.88	1197.0	70.4		
6.000	64.33	5.32	1.212	0.037	0.0	0.0	0.0	0.99	70.2	6.4		
6.001	63.53	5.47	1.136	0.044	0.0	0.0	0.0	0.99	69.7	7.6		
1.005	58.42	6.57	0.900	0.486	0.0	0.0	0.0	1.39	883.2	76.9		
1.006	56.54	7.04	0.880	0.554	0.0	0.0	0.0	1.40	888.5	84.8		
7.000	63.34	5.51	0.887	0.081	0.0	0.0	0.0	1.39	887.1	13.9		
1.007	55.62	7.28	0.802	0.662	0.0	0.0	0.0	1.39	884.5	99.7		
1.008	54.58	7.56	0.762	0.716	0.0	0.0	0.0	1.42	903.3	105.8		
1.009	53.51	7.87	0.712	0.747	0.0	0.0	0.0	1.39	1763.9	108.3		
1.010	52.29	8.23	0.662	0.811	0.0	0.0	0.0	1.40	1778.9	114.9		
1.011	51.33	8.53	0.600	0.811	0.0	0.0	0.0	0.82	14.5	114.9		
©1982-2019 Innovyze												

William Saunders		Page 4
Sheppard Lockton House Cafferata Way Newark, NG24 2TN	Site off Fenside Road Boston 30yr and 100_40 FEH	
Date 05/03/2020 16:12 File 20.03.04 original_with ...	Designed by PAE Checked by	
Innovyze	Network 2019.1	

Online Controls for Storm


Hydro-Brake® Optimum Manhole: 21, DS/PN: 1.011, Volume (m³): 52.4

Unit Reference MD-SHE-0088-4700-2100-4700
Design Head (m) 2.100
Design Flow (l/s) 4.7
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 88
Invert Level (m) 0.600
Minimum Outlet Pipe Diameter (mm) 100
Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.100	4.7
Flush-Flo™	0.384	3.7
Kick-Flo®	0.783	3.0
Mean Flow over Head Range	-	3.7

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	2.7	1.200	3.6	3.000	5.5	7.000	8.3
0.200	3.5	1.400	3.9	3.500	6.0	7.500	8.5
0.300	3.7	1.600	4.1	4.000	6.4	8.000	8.8
0.400	3.7	1.800	4.4	4.500	6.7	8.500	9.1
0.500	3.7	2.000	4.6	5.000	7.1	9.000	9.3
0.600	3.6	2.200	4.8	5.500	7.4	9.500	9.6
0.800	3.0	2.400	5.0	6.000	7.7		
1.000	3.3	2.600	5.2	6.500	8.0		


William Saunders		Page 5
Sheppard Lockton House Cafferata Way Newark, NG24 2TN	Site off Fenside Road Boston 30yr and 100_40 FEH	
Date 05/03/2020 16:12 File 20.03.04 original_with ...	Designed by PAE Checked by	
Innovyze	Network 2019.1	

Storage Structures for Storm

Tank or Pond Manhole: 7, DS/PN: 4.000

Invert Level (m) 2.050

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	723.0	0.700	0.0	1.400	0.0	2.100	0.0
0.100	761.0	0.701	0.0	1.500	0.0	2.200	0.0
0.200	800.0	0.900	0.0	1.600	0.0	2.300	0.0
0.300	839.0	1.000	0.0	1.700	0.0	2.400	0.0
0.400	879.0	1.100	0.0	1.800	0.0	2.500	0.0
0.500	919.0	1.200	0.0	1.900	0.0		
0.600	960.0	1.300	0.0	2.000	0.0		

William Saunders		Page 6
Sheppard Lockton House Cafferata Way Newark, NG24 2TN	Site off Fenside Road Boston 30yr and 100_40 FEH	
Date 05/03/2020 16:12 File 20.03.04 original_with ...	Designed by PAE Checked by	
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	0.000
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	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	FEH
FEH Rainfall Version	1999
Site Location	GB 532100 343050 TF 32100 43050
C (1km)	-0.023
D1 (1km)	0.326
D2 (1km)	0.293
D3 (1km)	0.234
E (1km)	0.314
F (1km)	2.485
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	450.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	30, 100
Climate Change (%)	0, 40


PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.000	1	480 Winter	30	+0%	30/240 Winter	100/180 Winter		
2.000	2	480 Winter	30	+0%	100/60 Summer			
1.001	3	480 Winter	30	+0%	100/60 Summer			
3.000	4	60 Summer	30	+0%	100/60 Winter			
3.001	5	480 Winter	30	+0%	100/60 Summer			
1.002	6	480 Winter	30	+0%	30/480 Winter			
4.000	7	480 Winter	30	+0%	30/120 Winter	100/60 Summer		
1.003	8	480 Winter	30	+0%	30/360 Winter			
5.000	9	480 Winter	30	+0%	30/360 Winter			

©1982-2019 Innovyze

William Saunders		Page 7
Sheppard Lockton House Cafferata Way Newark, NG24 2TN	Site off Fenside Road Boston 30yr and 100_40 FEH	
Date 05/03/2020 16:12 File 20.03.04 original_with ...	Designed by PAE Checked by	
Innovyze	Network 2019.1	

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


PN	US/MH Name	Water		Surcharged		Flooded		Pipe		Status	Level Exceeded
		Level (m)	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Flow (l/s)				
1.000	1	1.988	0.228	0.000	0.04		4.3	SURCHARGED			13
2.000	2	1.987	-0.263	0.000	0.01		5.6	OK			
1.001	3	1.988	-0.172	0.000	0.10		97.8	OK			
3.000	4	2.009	-0.350	0.000	0.10		12.8	OK			
3.001	5	1.953	-0.351	0.000	0.02		5.7	OK			
1.002	6	1.997	0.004	0.000	0.25		198.3	SURCHARGED			
4.000	7	2.011	0.376	0.000	0.03		5.1	FLOOD RISK			28
1.003	8	2.011	0.088	0.000	0.25		209.8	SURCHARGED			
5.000	9	2.044	0.132	0.000	0.01		7.4	SURCHARGED			

William Saunders		Page 8
Sheppard Lockton House Cafferata Way Newark, NG24 2TN	Site off Fenside Road Boston 30yr and 100_40 FEH	
Date 05/03/2020 16:12 File 20.03.04 original_with ...	Designed by PAE Checked by	
Innovyze	Network 2019.1	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
5.001	10	480 Winter	30	+0%	30/360 Winter			
1.004	11	480 Winter	30	+0%	30/360 Winter			
6.000	12	480 Winter	30	+0%	30/60 Winter			
6.001	13	480 Winter	30	+0%	30/60 Summer			
1.005	14	480 Winter	30	+0%	30/240 Winter			
1.006	15	480 Winter	30	+0%	30/240 Winter			
7.000	16	480 Winter	30	+0%	30/240 Winter			
1.007	17	480 Winter	30	+0%	30/180 Winter			
1.008	18	480 Winter	30	+0%	30/120 Winter			
1.009	19	480 Winter	30	+0%	30/120 Winter	100/60 Summer		
1.010	20	480 Winter	30	+0%	30/60 Winter			
1.011	21	480 Winter	30	+0%	30/60 Summer	100/60 Summer		

PN	US/MH Name	Water			Flooded		Pipe		Level Exceeded
		Level (m)	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Flow (l/s)	Status	
5.001	10	2.044	0.188	0.000	0.13		53.6	SURCHARGED	
1.004	11	2.045	0.206	0.000	0.41		270.1	SURCHARGED	
6.000	12	2.072	0.560	0.000	0.07		4.3	SURCHARGED	
6.001	13	2.072	0.636	0.000	0.15		8.3	SURCHARGED	
1.005	14	2.075	0.275	0.000	0.75		272.7	SURCHARGED	
1.006	15	2.104	0.324	0.000	0.32		222.5	SURCHARGED	
7.000	16	2.151	0.364	0.000	0.02		11.0	SURCHARGED	
1.007	17	2.151	0.449	0.000	0.34		178.3	SURCHARGED	
1.008	18	2.182	0.520	0.000	0.23		146.5	SURCHARGED	
1.009	19	2.209	0.597	0.000	0.08		96.1	SURCHARGED	23
1.010	20	2.216	0.654	0.000	0.04		47.5	SURCHARGED	
1.011	21	2.218	1.468	0.000	0.31		4.1	SURCHARGED	21

William Saunders		Page 9
Sheppard Lockton House Cafferata Way Newark, NG24 2TN	Site off Fenside Road Boston 30yr and 100_40 FEH	
Date 05/03/2020 16:12 File 20.03.04 original_with ...	Designed by PAE Checked by	
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	0.000
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	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	FEH
FEH Rainfall Version	1999
Site Location	GB 532100 343050 TF 32100 43050
C (1km)	-0.023
D1 (1km)	0.326
D2 (1km)	0.293
D3 (1km)	0.234
E (1km)	0.314
F (1km)	2.485
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	450.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	30, 100
Climate Change (%)	0, 40


PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.000	1	720 Winter	100	+40%	30/240 Winter	100/180 Winter		
2.000	2	720 Winter	100	+40%	100/60 Summer			
1.001	3	720 Winter	100	+40%	100/60 Summer			
3.000	4	720 Winter	100	+40%	100/60 Winter			
3.001	5	720 Winter	100	+40%	100/60 Summer			
1.002	6	720 Winter	100	+40%	30/480 Winter			
4.000	7	720 Winter	100	+40%	30/120 Winter	100/60 Summer		
1.003	8	720 Winter	100	+40%	30/360 Winter			
5.000	9	600 Winter	100	+40%	30/360 Winter			

©1982-2019 Innovyze

William Saunders		Page 10
Sheppard Lockton House Cafferata Way Newark, NG24 2TN	Site off Fenside Road Boston 30yr and 100_40 FEH	
Date 05/03/2020 16:12 File 20.03.04 original_with ...	Designed by PAE Checked by	
Innovyze	Network 2019.1	

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

PN	US/MH Name	Water		Surcharged		Flooded		Pipe		Status	Level Exceeded
		Level (m)	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Flow (l/s)				
1.000	1	2.481	0.721	7.630	0.71		87.6		FLOOD		13
2.000	2	2.590	0.340	0.000	0.02		13.4		SURCHARGED		
1.001	3	2.590	0.430	0.000	0.18		168.6		SURCHARGED		
3.000	4	2.606	0.247	0.000	0.09		11.5		SURCHARGED		
3.001	5	2.603	0.299	0.000	0.27		84.2		SURCHARGED		
1.002	6	2.602	0.609	0.000	0.41		320.2		SURCHARGED		
4.000	7	2.477	0.842	346.206	1.45		263.1		FLOOD		28
1.003	8	2.618	0.695	0.000	0.67		560.9		FLOOD RISK		
5.000	9	2.723	0.811	0.000	0.03		20.9		FLOOD RISK		

William Saunders		Page 11
Sheppard Lockton House Cafferata Way Newark, NG24 2TN	Site off Fenside Road Boston 30yr and 100_40 FEH	
Date 05/03/2020 16:12 File 20.03.04 original_with ...	Designed by PAE Checked by	
Innovyze	Network 2019.1	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
5.001	10	600 Winter	100	+40%	30/360 Winter			
1.004	11	720 Winter	100	+40%	30/360 Winter			
6.000	12	720 Winter	100	+40%	30/60 Winter			
6.001	13	720 Winter	100	+40%	30/60 Summer			
1.005	14	600 Winter	100	+40%	30/240 Winter			
1.006	15	600 Winter	100	+40%	30/240 Winter			
7.000	16	600 Winter	100	+40%	30/240 Winter			
1.007	17	600 Winter	100	+40%	30/180 Winter			
1.008	18	720 Winter	100	+40%	30/120 Winter			
1.009	19	720 Winter	100	+40%	30/120 Winter	100/60 Summer		
1.010	20	600 Winter	100	+40%	30/60 Winter			
1.011	21	720 Winter	100	+40%	30/60 Summer	100/60 Summer		

PN	US/MH Name	Water			Flooded		Pipe		Level Exceeded
		Level (m)	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Flow (l/s)	Status	
5.001	10	2.723	0.867	0.000	0.14		57.1	FLOOD RISK	
1.004	11	2.727	0.888	0.000	0.91		597.0	FLOOD RISK	
6.000	12	2.783	1.271	0.000	0.20		12.2	FLOOD RISK	
6.001	13	2.788	1.352	0.000	0.41		21.9	FLOOD RISK	
1.005	14	2.802	1.002	0.000	1.66		603.3	FLOOD RISK	
1.006	15	2.866	1.086	0.000	0.72		497.7	FLOOD RISK	
7.000	16	2.932	1.145	0.000	0.04		31.1	FLOOD RISK	
1.007	17	2.932	1.230	0.000	0.78		413.1	FLOOD RISK	
1.008	18	2.943	1.281	0.000	0.56		355.8	FLOOD RISK	
1.009	19	2.956	1.344	21.185	0.19		237.3	FLOOD	23
1.010	20	3.007	1.445	0.000	0.09		118.0	FLOOD RISK	
1.011	21	3.002	2.252	1.649	0.37		4.9	FLOOD	21