

William Saunders		Page 1
Sheppard Lockton House Cafferata Way Newark NG24 2TN		
Date 21/05/2019 13:02 File Weston Highway Drainage - IDB o...	Designed by PaulE Checked by	
Micro Drainage	Network 2018.1	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	2
FEH Rainfall Version	1999
Site Location GB 528900 324900 TF 28900 24900	
C (1km)	-0.023
D1 (1km)	0.319
D2 (1km)	0.274
D3 (1km)	0.232
E (1km)	0.316
F (1km)	2.482
Maximum Rainfall (mm/hr)	100
Maximum Time of Concentration (mins)	100
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
PIMP (%)	100
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	1.00
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

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
1.000	7.600	0.015	506.7	0.050	4.00	0.0	0.600	o	450	Pipe/Conduit	
1.001	85.195	0.170	501.1	0.008	0.00	0.0	0.600	oo	525	Double Pipe	
2.000	18.550	0.037	501.4	0.049	4.00	0.0	0.600	o	525	Pipe/Conduit	
1.002	17.338	0.035	495.4	0.000	0.00	0.0	0.600	oo	525	Double Pipe	

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	95.99	4.14	1.812	0.050	0.0	0.0	0.0	0.90	142.6	12.9
1.001	78.07	5.57	1.797	0.058	0.0	0.0	0.0	0.99	430.2	12.9
2.000	93.33	4.31	1.664	0.049	0.0	0.0	0.0	0.99	215.1	12.3
1.002	75.36	5.86	1.627	0.107	0.0	0.0	0.0	1.00	432.8	21.8

William Saunders		Page 2
Sheppard Lockton House Cafferata Way Newark NG24 2TN		
Date 21/05/2019 13:02 File Weston Highway Drainage - IDB o...	Designed by PaulE Checked by	
Micro Drainage	Network 2018.1	

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	10.742	0.043	249.8	0.009	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)
1.003	73.47	6.08	1.592	0.115	0.0	0.0	0.0	0.82	32.7	23.0

William Saunders		Page 3
Sheppard Lockton House Cafferata Way Newark NG24 2TN		
Date 21/05/2019 13:02	Designed by PaulE	
File Weston Highway Drainage - IDB o...	Checked by	
Micro Drainage		Network 2018.1

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
1	2.912	1.100	Open Manhole	1350	1.000	1.812	450				
2	3.000	1.203	Open Manhole	1950	1.001	1.797	525	1.000	1.797	450	
3	2.775	1.111	Open Manhole	1500	2.000	1.664	525				
3	2.912	1.285	Open Manhole	1950	1.002	1.627	525	1.001	1.627	525	
								2.000	1.627	525	
4	3.087	1.495	Open Manhole	1950	1.003	1.592	225	1.002	1.592	525	
	3.000	1.451	Open Manhole	0		OUTFALL		1.003	1.549	225	

William Saunders		Page 4
Sheppard Lockton House Cafferata Way Newark NG24 2TN		
Date 21/05/2019 13:02	Designed by PaulE	
File Weston Highway Drainage - IDB o...	Checked by	
Micro Drainage		Network 2018.1

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	450	1	2.912	1.812	0.650	Open Manhole	1350
1.001	oo	525	2	3.000	1.797	0.678	Open Manhole	1950
2.000	o	525	3	2.775	1.664	0.586	Open Manhole	1500
1.002	oo	525	3	2.912	1.627	0.760	Open Manhole	1950
1.003	o	225	4	3.087	1.592	1.270	Open Manhole	1950

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	7.600	506.7	2	3.000	1.797	0.753	Open Manhole	1950
1.001	85.195	501.1	3	2.912	1.627	0.760	Open Manhole	1950
2.000	18.550	501.4	3	2.912	1.627	0.760	Open Manhole	1950
1.002	17.338	495.4	4	3.087	1.592	0.970	Open Manhole	1950
1.003	10.742	249.8		3.000	1.549	1.226	Open Manhole	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	0.000
Hot Start (mins)	0	Inlet Coeffiecient	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 0
 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
Return Period (years)	2
FEH Rainfall Version	1999
Site Location	GB 528900 324900 TF 28900 24900
C (1km)	-0.023
D1 (1km)	0.319
D2 (1km)	0.274
D3 (1km)	0.232
E (1km)	0.316
F (1km)	2.482
Summer Storms	Yes

William Saunders		Page 5
Sheppard Lockton House Cafferata Way Newark NG24 2TN		
Date 21/05/2019 13:02 File Weston Highway Drainage - IDB o...	Designed by PaulE Checked by	
Micro Drainage	Network 2018.1	
<u>Synthetic Rainfall Details</u> Winter Storms No Cv (Summer) 0.750 Cv (Winter) 0.840 Storm Duration (mins) 30		
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William Saunders		Page 6
Sheppard Lockton House Cafferata Way Newark NG24 2TN		
Date 21/05/2019 13:02	Designed by PaulE	
File Weston Highway Drainage - IDB o...	Checked by	
Micro Drainage		Network 2018.1

Online Controls for Storm

Hydro-Brake® Optimum Manhole: 4, DS/PN: 1.003, Volume (m³): 11.1

Unit Reference	MD-SHE-0095-4000-1000-4000
Design Head (m)	1.000
Design Flow (l/s)	4.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	95
Invert Level (m)	1.592
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	4.0
Flush-Flo™	0.294	4.0
Kick-Flo®	0.629	3.2
Mean Flow over Head Range	-	3.5

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	3.0	1.200	4.3	3.000	6.7	7.000	10.0
0.200	3.9	1.400	4.7	3.500	7.2	7.500	10.3
0.300	4.0	1.600	5.0	4.000	7.6	8.000	10.6
0.400	3.9	1.800	5.3	4.500	8.1	8.500	10.9
0.500	3.8	2.000	5.5	5.000	8.5	9.000	11.2
0.600	3.4	2.200	5.8	5.500	8.9	9.500	11.5
0.800	3.6	2.400	6.0	6.000	9.3		
1.000	4.0	2.600	6.2	6.500	9.6		

William Saunders		Page 7
Sheppard Lockton House Cafferata Way Newark NG24 2TN		
Date 21/05/2019 13:02 File Weston Highway Drainage - IDB o...	Designed by PaulE Checked by	
Micro Drainage	Network 2018.1	

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 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 0
 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 528900 324900 TF 28900 24900
 C (1km) -0.023
 D1 (1km) 0.319
 D2 (1km) 0.274
 D3 (1km) 0.232
 E (1km) 0.316
 F (1km) 2.482
 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) 1, 30, 100
 Climate Change (%) 0, 0, 40

US/MH		Return Climate		First (X)	First (Y)	First (Z)	Overflow	Water
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Level
							Act.	(m)
1.000	1 60 Summer		1	+0%	100/60 Winter			1.874
1.001	2 60 Summer		1	+0%	100/60 Winter			1.838
2.000	3 60 Winter		1	+0%	100/60 Winter			1.755
1.002	3 60 Winter		1	+0%	100/60 Summer			1.754
1.003	4 60 Winter		1	+0%	30/60 Summer			1.753

William Saunders		Page 8
Sheppard Lockton House Cafferata Way Newark NG24 2TN		
Date 21/05/2019 13:02 File Weston Highway Drainage - IDB o...	Designed by PaulE Checked by	
Micro Drainage	Network 2018.1	

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

PN	US/MH Name	Surcharged		Flooded		Pipe		Level Exceeded
		Depth (m)	Volume (m ³)	Flow / Cap.	Overflow (l/s)	Flow (l/s)	Status	
1.000	1	-0.388	0.000	0.05		4.3	OK	
1.001	2	-0.484	0.000	0.01		4.7	OK	
2.000	3	-0.434	0.000	0.02		3.2	OK	
1.002	3	-0.398	0.000	0.02		4.8	OK	
1.003	4	-0.064	0.000	0.13		3.7	OK	

William Saunders		Page 9
Sheppard Lockton House Cafferata Way Newark NG24 2TN		
Date 21/05/2019 13:02 File Weston Highway Drainage - IDB o...	Designed by PaulE Checked by	
Micro Drainage	Network 2018.1	

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 0
 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 528900 324900 TF 28900 24900
 C (1km) -0.023
 D1 (1km) 0.319
 D2 (1km) 0.274
 D3 (1km) 0.232
 E (1km) 0.316
 F (1km) 2.482
 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) 1, 30, 100
 Climate Change (%) 0, 0, 40

US/MH		Return Climate		First (X)	First (Y)	First (Z)	Overflow	Water
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Level
							Act.	(m)
1.000	1 60 Winter		30	+0%	100/60 Winter			1.931
1.001	2 60 Winter		30	+0%	100/60 Winter			1.931
2.000	3 60 Winter		30	+0%	100/60 Winter			1.931
1.002	3 60 Winter		30	+0%	100/60 Summer			1.931
1.003	4 60 Winter		30	+0%	30/60 Summer			1.931

William Saunders		Page 10
Sheppard Lockton House Cafferata Way Newark NG24 2TN		
Date 21/05/2019 13:02 File Weston Highway Drainage - IDB o...	Designed by PaulE Checked by	
Micro Drainage	Network 2018.1	

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

PN	US/MH Name	Surcharged		Flooded		Pipe Flow (l/s)	Status	Level Exceeded
		Depth (m)	Volume (m ³)	Flow / Cap.	Overflow (l/s)			
1.000	1	-0.331	0.000	0.11		10.0	OK	
1.001	2	-0.391	0.000	0.03		11.2	OK	
2.000	3	-0.258	0.000	0.07		9.4	OK	
1.002	3	-0.221	0.000	0.02		6.3	OK	
1.003	4	0.114	0.000	0.14		4.0	SURCHARGED	

William Saunders		Page 11
Sheppard Lockton House Cafferata Way Newark NG24 2TN		
Date 21/05/2019 13:02 File Weston Highway Drainage - IDB o...	Designed by PaulE Checked by	
Micro Drainage	Network 2018.1	

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 0
 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
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 D1 (1km) 0.319
 D2 (1km) 0.274
 D3 (1km) 0.232
 E (1km) 0.316
 F (1km) 2.482
 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) 1, 30, 100
 Climate Change (%) 0, 0, 40

US/MH		Return Climate		First (X)	First (Y)	First (Z)	Overflow	Water
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Level
							Act.	(m)
1.000	1 60 Winter		100	+40%	100/60 Winter			2.488
1.001	2 60 Winter		100	+40%	100/60 Winter			2.488
2.000	3 60 Winter		100	+40%	100/60 Winter			2.488
1.002	3 60 Winter		100	+40%	100/60 Summer			2.488
1.003	4 60 Winter		100	+40%	30/60 Summer			2.487

William Saunders		Page 12
Sheppard Lockton House Cafferata Way Newark NG24 2TN		
Date 21/05/2019 13:02 File Weston Highway Drainage - IDB o...	Designed by PaulE Checked by	
Micro Drainage	Network 2018.1	

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

PN	US/MH Name	Surcharged		Flooded		Pipe Flow (l/s)	Status	Level Exceeded
		Depth (m)	Volume (m ³)	Flow / Cap.	Overflow (l/s)			
1.000	1	0.226	0.000	0.21		20.2	FLOOD RISK	
1.001	2	0.166	0.000	0.05		21.6	SURCHARGED	
2.000	3	0.299	0.000	0.14		19.4	FLOOD RISK	
1.002	3	0.336	0.000	0.03		7.1	FLOOD RISK	
1.003	4	0.670	0.000	0.14		4.0	SURCHARGED	