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Sheppard Lockton House	11974	
Cafferata Way	Hilljet Quadring	
Newark, NG24 2TN	FEH with crates	
Date 31/10/2019	Designed by PAE	
File 19.10.31 750 5ls feh wi...	Checked by	
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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	0.400	Minimum Backdrop Height (m)	0.000
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

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	24.701	0.050	494.0	0.074	5.00	0.0	0.600	o	750	Pipe/Conduit	
S1.001	23.046	0.050	460.9	0.055	0.00	0.0	0.600	o	750	Pipe/Conduit	
S2.000	32.000	0.065	492.3	0.039	5.00	0.0	0.600	o	750	Pipe/Conduit	
S1.002	32.117	0.065	494.1	0.025	0.00	0.0	0.600	o	750	Pipe/Conduit	
S3.000	6.000	0.025	240.0	0.000	5.00	0.0	0.600	o	450	Pipe/Conduit	
S1.003	3.818	0.050	76.4	0.037	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	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	64.95	5.33	2.340	0.074	0.0	0.0	0.0	1.25	553.2	13.0
S1.001	63.42	5.62	2.290	0.129	0.0	0.0	0.0	1.30	572.9	22.2
S2.000	64.44	5.43	2.305	0.039	0.0	0.0	0.0	1.25	554.2	6.8
S1.002	61.36	6.05	2.240	0.193	0.0	0.0	0.0	1.25	553.2	32.1
S3.000	66.32	5.08	2.500	0.000	0.0	0.0	0.0	1.31	208.0	0.0
S1.003	61.16	6.09	2.175	0.229	0.0	0.0	0.0	1.50	59.6	38.0

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: SS5, DS/PN: S1.003, Volume (m³): 18.1

Unit Reference	MD-SHE-0103-5000-1156-5000
Design Head (m)	1.156
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	103
Invert Level (m)	2.175
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.156	5.0	Kick-Flo®	0.721	4.0
Flush-Flo™	0.341	5.0	Mean Flow over Head Range	-	4.4

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)
0.100	3.5	1.200	5.1	3.000	7.8	7.000	11.7
0.200	4.8	1.400	5.5	3.500	8.4	7.500	12.1
0.300	5.0	1.600	5.8	4.000	8.9	8.000	12.4
0.400	5.0	1.800	6.1	4.500	9.5	8.500	12.8
0.500	4.9	2.000	6.5	5.000	9.9	9.000	13.2
0.600	4.6	2.200	6.8	5.500	10.4	9.500	13.5
0.800	4.2	2.400	7.0	6.000	10.8		
1.000	4.7	2.600	7.3	6.500	11.3		

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Storage Structures for Storm

Cellular Storage Manhole: SS40, DS/PN: S3.000

Invert Level (m) 2.525 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	165.0	165.0	0.401	0.0	195.4
0.400	165.0	195.4			

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2 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 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 FEH
 FEH Rainfall Version 1999
 Site Location GB 522850 333500 TF 22850 33500
 C (1km) -0.020
 D1 (1km) 0.291
 D2 (1km) 0.308
 D3 (1km) 0.210
 E (1km) 0.304
 F (1km) 2.524
 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) 2, 30, 100
 Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	SS1	60 Winter	2	+0%	100/120 Winter				2.545
S1.001	SS2	60 Winter	2	+0%	100/60 Winter				2.545
S2.000	SS3	60 Winter	2	+0%	100/60 Winter				2.545
S1.002	SS4	60 Winter	2	+0%	100/60 Winter				2.545
S3.000	SS40	60 Winter	2	+0%	100/60 Winter				2.527

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2 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	
S1.000	SS1	-0.545	0.000	0.01		6.0	OK	
S1.001	SS2	-0.495	0.000	0.02		8.3	OK	
S2.000	SS3	-0.510	0.000	0.01		2.8	OK	
S1.002	SS4	-0.445	0.000	0.02		7.1	OK	
S3.000	SS40	-0.423	0.000	0.01		1.1	OK	

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2 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.	Water Level (m)
S1.003	SS5	60 Winter	2	+0%	2/60 Summer				2.545

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m ³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.003	SS5	0.145	0.000	0.16		5.0	SURCHARGED	

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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 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 FEH
 FEH Rainfall Version 1999
 Site Location GB 522850 333500 TF 22850 33500
 C (1km) -0.020
 D1 (1km) 0.291
 D2 (1km) 0.308
 D3 (1km) 0.210
 E (1km) 0.304
 F (1km) 2.524
 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) 2, 30, 100
 Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	SS1	60 Winter	30	+0%	100/120 Winter				2.733
S1.001	SS2	60 Winter	30	+0%	100/60 Winter				2.731
S2.000	SS3	60 Winter	30	+0%	100/60 Winter				2.730
S1.002	SS4	60 Winter	30	+0%	100/60 Winter				2.730
S3.000	SS40	60 Winter	30	+0%	100/60 Winter				2.673

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30 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	
S1.000	SS1	-0.357	0.000	0.03		13.8	OK	
S1.001	SS2	-0.309	0.000	0.04		18.8	OK	
S2.000	SS3	-0.325	0.000	0.02		6.8	OK	
S1.002	SS4	-0.260	0.000	0.06		23.9	OK	
S3.000	SS40	-0.277	0.000	0.03		3.2	OK	

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
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PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.003	SS5	60 Winter	30	+0%	2/60 Summer				2.726

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m ³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.003	SS5	0.326	0.000	0.16		5.0	SURCHARGED	

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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 Offline Controls 0 Number of Time/Area Diagrams 0
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 Cv (Summer) 0.750
 Cv (Winter) 0.840

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 DVD Status OFF
 Inertia Status OFF

Profile(s) Summer and Winter
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 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
 Return Period(s) (years) 2, 30, 100
 Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	SS1	120 Winter	100	+40%	100/120 Winter				3.332
S1.001	SS2	120 Winter	100	+40%	100/60 Winter				3.332
S2.000	SS3	120 Winter	100	+40%	100/60 Winter				3.332
S1.002	SS4	120 Winter	100	+40%	100/60 Winter				3.332
S3.000	SS40	120 Winter	100	+40%	100/60 Winter				3.332

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100 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	
S1.000	SS1	0.242	0.000	0.04		17.2	SURCHARGED	
S1.001	SS2	0.292	0.000	0.07		27.7	SURCHARGED	
S2.000	SS3	0.277	0.000	0.02		8.8	SURCHARGED	
S1.002	SS4	0.342	0.000	0.09		37.5	SURCHARGED	
S3.000	SS40	0.382	0.000	0.02		2.9	FLOOD RISK	

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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.	Water Level (m)
S1.003	SS5	120 Winter	100	+40%	2/60 Summer				3.332

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m ³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.003	SS5	0.932	0.000	0.16		5.0	FLOOD RISK	