


Pell Frischmann		Page 1
5 Manchester Square London W1U 3PD		
Date 12/12/2022 15:43 File 104878 Phase 2A (GF).MDX	Designed by MFox Checked by	
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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm


Pipe Sizes STANDARD Manhole Sizes STANDARD

	FEH Rainfall Model		
Return Period (years)	100	Maximum Time of Concentration (mins)	30
		Foul Sewage (l/s/ha)	0.000
FEH Rainfall Version	1999	Volumetric Runoff Coeff.	0.750
Site Location	GB 526100 184450 TQ 26100 84450	PIMP (%)	100
C (1km)	-0.025	Add Flow / Climate Change (%)	10
D1 (1km)	0.330	Minimum Backdrop Height (m)	1.500
D2 (1km)	0.277	Maximum Backdrop Height (m)	1.500
D3 (1km)	0.234	Min Design Depth for Optimisation (m)	1.200
E (1km)	0.332	Min Vel for Auto Design only (m/s)	1.00
F (1km)	2.519	Min Slope for Optimisation (1:X)	500
Maximum Rainfall (mm/hr)	50		

Designed with Level Soffits

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)
S1.005	S	49.500	46.300	0.000	0	0

Pell Frischmann		Page 2
5 Manchester Square London W1U 3PD		
Date 12/12/2022 15:43 File 104878 Phase 2A (GF).MDX	Designed by MFox Checked by	
Innovyze	Network 2020.1.3	


Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Manhole Headloss Coeff (Global)	0.500	Inlet Coeffiecient	0.800
Areal Reduction Factor	1.000	Foul Sewage per hectare (l/s)	0.000	Flow per Person per Day (l/per/day)	0.000
Hot Start (mins)	0	Additional Flow - % of Total Flow	0.000	Run Time (mins)	60
Hot Start Level (mm)	0	MADD Factor * 10m ³ /ha Storage	2.000	Output Interval (mins)	1

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	E (1km)	0.332
Return Period (years)	100	F (1km)	2.519
FEH Rainfall Version	1999	Summer Storms	Yes
Site Location	GB 526100 184450 TQ 26100 84450	Winter Storms	No
C (1km)	-0.025	Cv (Summer)	0.750
D1 (1km)	0.330	Cv (Winter)	0.840
D2 (1km)	0.277	Storm Duration (mins)	30
D3 (1km)	0.234		

Pell Frischmann		Page 3
5 Manchester Square London W1U 3PD		
Date 12/12/2022 15:43 File 104878 Phase 2A (GF).MDX	Designed by MFox Checked by	
Innovyze	Network 2020.1.3	

Online Controls for Storm


Hydro-Brake® Optimum Manhole: S6, DS/PN: S1.005, Volume (m³): 41.1

Unit Reference	MD-SHE-0093-5100-2000-5100	Sump Available	Yes
Design Head (m)	2.000	Diameter (mm)	93
Design Flow (l/s)	5.1	Invert Level (m)	46.333
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	150
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	5.1	Kick-Flo®	0.825	3.4
Flush-Flo™	0.405	4.2	Mean Flow over Head Range	-	4.0

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)	Depth (m)	Flow (l/s)
0.100	2.9	0.600	4.1	1.600	4.6	2.600	5.8	5.000	7.8	7.500	9.5
0.200	3.9	0.800	3.5	1.800	4.9	3.000	6.2	5.500	8.2	8.000	9.8
0.300	4.2	1.000	3.7	2.000	5.1	3.500	6.6	6.000	8.6	8.500	10.1
0.400	4.2	1.200	4.0	2.200	5.3	4.000	7.1	6.500	8.9	9.000	10.4
0.500	4.2	1.400	4.3	2.400	5.6	4.500	7.5	7.000	9.2	9.500	10.6


Pell Frischmann		Page 4
5 Manchester Square London W1U 3PD		
Date 12/12/2022 15:43 File 104878 Phase 2A (GF).MDX	Designed by MFox Checked by	
Innovyze	Network 2020.1.3	

Storage Structures for Storm

Tank or Pond Manhole: S6, DS/PN: S1.005

Invert Level (m) 46.333

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	427.5	2.000	427.5	2.001	0.0

Pell Frischmann		Page 5
5 Manchester Square London W1U 3PD		
Date 12/12/2022 15:43 File 104878 Phase 2A (GF).MDX	Designed by MFox Checked by	
Innovyze	Network 2020.1.3	

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

Simulation Criteria

Areal Reduction Factor	1.000	Manhole Headloss Coeff (Global)	0.500	MADD Factor * 10m ³ /ha Storage	2.000
Hot Start (mins)	0	Foul Sewage per hectare (l/s)	0.000	Inlet Coefficient	0.800
Hot Start Level (mm)	0	Additional Flow - % of Total Flow	0.000	Flow per Person per Day (l/per/day)	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	D3 (1km)	0.234
FEH Rainfall Version	1999	E (1km)	0.332
Site Location	GB 526100 184450 TQ 26100 84450	F (1km)	2.519
C (1km)		-0.025 Cv (Summer)	0.750
D1 (1km)		0.330 Cv (Winter)	0.840
D2 (1km)		0.277	

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 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

Pell Frischmann		Page 6
5 Manchester Square London W1U 3PD		
Date 12/12/2022 15:43 File 104878 Phase 2A (GF).MDX	Designed by MFox Checked by	
Innovyze	Network 2020.1.3	

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

US/MH	US/CL	Water Level	Surcharged Depth	Flooded Volume	Flow / Overflow Cap.	Pipe Flow	Status
PN Name	Event	(m)	(m)	(m ³)	(1/s)	(1/s)	

5 Manchester Square
 London
 W1U 3PD



Date 12/12/2022 15:43
 File 104878 Phase 2A (GF).MDX


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Network 2020.1.3

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

PN	US/MH Name	Event	US/CL (m)	Water	Surcharged	Flooded	Flow / Cap.	Overflow	Pipe	Status
				Level (m)	Depth (m)	Volume (m ³)		Flow (1/s)	Flow (1/s)	
S1.000	S1	15 minute 2 year Winter I+0%	50.000	48.449	-0.301	0.000	0.23		42.4	OK
S1.001	S2	15 minute 2 year Winter I+0%	50.000	48.350	-0.296	0.000	0.25		42.8	OK
S1.002	S3	15 minute 2 year Winter I+0%	49.000	48.237	-0.340	0.000	0.27		78.2	OK
S1.003	S4	15 minute 2 year Winter I+0%	49.600	47.988	-0.412	0.000	0.21		77.5	OK
S1.004	S5	15 minute 2 year Winter I+0%	49.800	47.841	-0.428	0.000	0.18		77.3	OK
S2.000	S6	15 minute 2 year Winter I+0%	49.500	48.136	-0.314	0.000	0.20		42.8	OK
S3.000	S7	15 minute 2 year Winter I+0%	49.800	48.428	-0.322	0.000	0.18		43.2	OK
S1.005	S6	600 minute 2 year Winter I+0%	49.500	46.711	0.153	0.000	0.15		4.2	SURCHARGED

Pell Frischmann		Page 8
5 Manchester Square London W1U 3PD		
Date 12/12/2022 15:43 File 104878 Phase 2A (GF).MDX	Designed by MFox Checked by	
Innovyze	Network 2020.1.3	

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

Simulation Criteria

Areal Reduction Factor	1.000	Manhole Headloss Coeff (Global)	0.500	MADD Factor * 10m ³ /ha Storage	2.000
Hot Start (mins)	0	Foul Sewage per hectare (l/s)	0.000	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Additional Flow - % of Total Flow	0.000	Flow per Person per Day (l/per/day)	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	D3 (1km)	0.234
FEH Rainfall Version	1999	E (1km)	0.332
Site Location	GB 526100 184450 TQ 26100 84450	F (1km)	2.519
C (1km)		-0.025 Cv (Summer)	0.750
D1 (1km)		0.330 Cv (Winter)	0.840
D2 (1km)		0.277	

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 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

Pell Frischmann		Page 9
5 Manchester Square London W1U 3PD		
Date 12/12/2022 15:43 File 104878 Phase 2A (GF).MDX	Designed by MFox Checked by	
Innovyze	Network 2020.1.3	

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

US/MH	US/CL	Water Level	Surcharged Depth	Flooded Volume	Flow / Overflow Cap.	Pipe Flow	Status
PN Name	Event	(m)	(m)	(m ³)	(1/s)	(1/s)	

5 Manchester Square
 London
 W1U 3PD



Date 12/12/2022 15:43
 File 104878 Phase 2A (GF).MDX


Designed by MFox
 Checked by

Innovyze

Network 2020.1.3

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

PN	US/MH Name	Event	US/CL (m)	Water	Surcharged	Flooded	Flow / Cap.	Overflow (l/s)	Pipe	Status
				Level (m)	Depth (m)	Volume (m ³)			Flow (l/s)	
S1.000	S1	15 minute 30 year Winter I+0%	50.000	48.563	-0.187	0.000	0.63		114.0	OK
S1.001	S2	15 minute 30 year Winter I+0%	50.000	48.471	-0.175	0.000	0.68		114.7	OK
S1.002	S3	15 minute 30 year Winter I+0%	49.000	48.411	-0.166	0.000	0.78		228.4	OK
S1.003	S4	15 minute 30 year Winter I+0%	49.600	48.144	-0.256	0.000	0.62		226.9	OK
S1.004	S5	15 minute 30 year Winter I+0%	49.800	47.982	-0.287	0.000	0.53		227.4	OK
S2.000	S6	15 minute 30 year Winter I+0%	49.500	48.235	-0.215	0.000	0.53		114.5	OK
S3.000	S7	15 minute 30 year Winter I+0%	49.800	48.520	-0.230	0.000	0.48		116.1	OK
S1.005	S6	720 minute 30 year Winter I+0%	49.500	47.326	0.768	0.000	0.15		4.2	SURCHARGED

Pell Frischmann		Page 11
5 Manchester Square London W1U 3PD		
Date 12/12/2022 15:43 File 104878 Phase 2A (GF).MDX	Designed by MFox Checked by	
Innovyze	Network 2020.1.3	

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

Simulation Criteria

Areal Reduction Factor	1.000	Manhole Headloss Coeff (Global)	0.500	MADD Factor * 10m ³ /ha Storage	2.000
Hot Start (mins)	0	Foul Sewage per hectare (l/s)	0.000	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Additional Flow - % of Total Flow	0.000	Flow per Person per Day (l/per/day)	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	D3 (1km)	0.234
FEH Rainfall Version	1999	E (1km)	0.332
Site Location	GB 526100 184450 TQ 26100 84450	F (1km)	2.519
C (1km)	-0.025	Cv (Summer)	0.750
D1 (1km)	0.330	Cv (Winter)	0.840
D2 (1km)	0.277		

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 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

Pell Frischmann		Page 12
5 Manchester Square London W1U 3PD		
Date 12/12/2022 15:43 File 104878 Phase 2A (GF).MDX	Designed by MFox Checked by	
Innovyze	Network 2020.1.3	

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

PN	US/MH Name	Event	US/CL (m)	Water		Surcharged		Flooded		Pipe Flow (1/s)	Status
				Level (m)	Depth (m)	Volume (m ³)	Flow / Cap.	Overflow (1/s)			

5 Manchester Square
 London
 W1U 3PD



Date 12/12/2022 15:43
 File 104878 Phase 2A (GF).MDX

Designed by MFox
 Checked by

Innovyze

Network 2020.1.3

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

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m ³)	Flow / Cap.	Overflow (l/s)	Pipe	Status
									Flow (l/s)	
S1.000	S1	15 minute 100 year Winter I+40%	50.000	49.373	0.623	0.000	1.35	244.5	244.5	SURCHARGED
S1.001	S2	15 minute 100 year Winter I+40%	50.000	49.179	0.533	0.000	1.45	244.9	244.9	SURCHARGED
S1.002	S3	15 minute 100 year Winter I+40%	49.000	48.989	0.411	0.000	1.64	481.8	481.8	FLOOD RISK
S1.003	S4	15 minute 100 year Winter I+40%	49.600	48.518	0.118	0.000	1.30	473.4	473.4	SURCHARGED
S1.004	S5	720 minute 100 year Winter I+40%	49.800	48.414	0.145	0.000	0.07	31.7	31.7	SURCHARGED
S2.000	S6	15 minute 100 year Winter I+40%	49.500	48.527	0.077	0.000	1.16	251.9	251.9	SURCHARGED
S3.000	S7	15 minute 100 year Winter I+40%	49.800	48.778	0.028	0.000	1.01	244.6	244.6	SURCHARGED
S1.005	S6	720 minute 100 year Winter I+40%	49.500	48.414	1.856	0.000	0.18	5.2	5.2	SURCHARGED