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3 Worsley Court High Street Worsley Manchester	30480 Pioneer House Wythenshawe Proposed SW	
Date 30/03/2023 File 30580 Proposed SW 230331...	Designed by SAP Checked by	
Micro Drainage	Network 2020.1.3	

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
M5-60 (mm)	18.000
Ratio R	0.384
Maximum Rainfall (mm/hr)	100
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
PIMP (%)	100
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.000
Maximum Backdrop Height (m)	0.000
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	20.960	0.104	201.5	0.052	5.00	0.0	0.600	o	300	Pipe/Conduit	
1.001	30.113	0.150	200.8	0.029	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.000	12.330	0.773	16.0	0.068	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	4.440	0.022	201.8	0.019	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.000	10.700	0.054	198.1	0.037	5.00	0.0	0.600	o	300	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	60.33	5.32	30.411	0.052	0.0	0.0	0.0	1.10	78.0	8.5
1.001	58.22	5.77	30.307	0.081	0.0	0.0	0.0	1.11	78.2	12.8
2.000	61.50	5.08	31.080	0.068	0.0	0.0	0.0	2.53	44.8	11.3
1.002	57.92	5.84	30.157	0.168	0.0	0.0	0.0	1.10	78.0	26.4
3.000	61.10	5.16	30.189	0.037	0.0	0.0	0.0	1.11	78.7	6.1

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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	1.750	0.265	6.6	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E 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	57.90	5.84	30.135	0.205	0.0	0.0	0.0	5.12	203.8	32.1

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 2.000
 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 2
 Number of Online Controls 2 Number of Time/Area Diagrams 0
 Number of Offline Controls 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)	18.000	Storm Duration (mins)	30
Ratio R	0.384		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: 4, DS/PN: 1.002, Volume (m³): 5.0

Unit Reference	MD-SHE-0092-4000-1200-4000
Design Head (m)	1.200
Design Flow (l/s)	4.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	92
Invert Level (m)	30.157
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	4.0
Flush-Flo™	0.359	4.0
Kick-Flo®	0.743	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	2.9	1.200	4.0	3.000	6.1	7.000	9.1
0.200	3.8	1.400	4.3	3.500	6.6	7.500	9.4
0.300	4.0	1.600	4.6	4.000	7.0	8.000	9.7
0.400	4.0	1.800	4.8	4.500	7.4	8.500	10.0
0.500	3.9	2.000	5.1	5.000	7.8	9.000	10.3
0.600	3.8	2.200	5.3	5.500	8.2	9.500	10.6
0.800	3.3	2.400	5.5	6.000	8.5		
1.000	3.7	2.600	5.7	6.500	8.8		

Hydro-Brake® Optimum Manhole: 6, DS/PN: 1.003, Volume (m³): 3.8

Unit Reference	MD-SHE-0152-1100-1000-1100
Design Head (m)	1.000
Design Flow (l/s)	11.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	152
Invert Level (m)	30.135
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

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Hydro-Brake® Optimum Manhole: 6, DS/PN: 1.003, Volume (m³): 3.8

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	11.0
Flush-Flo™	0.309	11.0
Kick-Flo®	0.683	9.2
Mean Flow over Head Range	-	9.4

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	5.5	1.200	12.0	3.000	18.5	7.000	27.8
0.200	10.6	1.400	12.9	3.500	19.9	7.500	28.8
0.300	11.0	1.600	13.7	4.000	21.3	8.000	29.7
0.400	10.9	1.800	14.5	4.500	22.5	8.500	30.6
0.500	10.6	2.000	15.3	5.000	23.7	9.000	31.4
0.600	10.1	2.200	16.0	5.500	24.8	9.500	32.2
0.800	9.9	2.400	16.7	6.000	25.8		
1.000	11.0	2.600	17.3	6.500	26.8		

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Storage Structures for Storm

Cellular Storage Manhole: 2, DS/PN: 1.001

Invert Level (m) 30.400
 Infiltration Coefficient Base (m/hr) 0.00000
 Infiltration Coefficient Side (m/hr) 0.00000
 Safety Factor 2.0
 Porosity 0.95

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	36.0	0.0	0.801	0.0	0.0
0.800	36.0	0.0			

Cellular Storage Manhole: 3, DS/PN: 2.000

Invert Level (m) 31.080
 Infiltration Coefficient Base (m/hr) 0.00000
 Infiltration Coefficient Side (m/hr) 0.00000
 Safety Factor 2.0
 Porosity 0.30

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	248.0	0.0	0.451	0.0	0.0
0.450	248.0	0.0			

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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 Storage Structures 2
Number of Online Controls 2 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.384
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 18.000 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, 180, 240, 360, 480, 600,
720, 960, 1440
Return Period(s) (years) 1, 2, 30, 100
Climate Change (%) 0, 0, 0, 45

									Water
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Level (m)
1.000	1	60 Winter	1	+0%	30/15 Winter				30.488
1.001	2	30 Winter	1	+0%	30/15 Summer				30.487
2.000	3	30 Winter	1	+0%	100/30 Summer				31.112
1.002	4	30 Winter	1	+0%	1/15 Winter				30.485
3.000	5	15 Winter	1	+0%	100/15 Summer				30.266
1.003	6	15 Winter	1	+0%	30/15 Summer				30.258

Surcharged Flooded					Half Drain	Pipe			
PN	US/MH Name	Depth (m)	Volume (m ³)	Flow / Cap.	Overflow (l/s)	Time (mins)	Flow (l/s)	Status	Level Exceeded
1.000	1	-0.223	0.000	0.05			3.3	OK	
1.001	2	-0.120	0.000	0.08		16	5.5	OK	
2.000	3	-0.118	0.000	0.10		17	4.2	OK	
1.002	4	0.028	0.000	0.08			3.9	SURCHARGED	
3.000	5	-0.223	0.000	0.07			4.4	OK	
1.003	6	-0.102	0.000	0.10			7.4	OK	

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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 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 Storage Structures 2
Number of Online Controls 2 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.384
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 18.000 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, 180, 240, 360, 480, 600,
720, 960, 1440
Return Period(s) (years) 1, 2, 30, 100
Climate Change (%) 0, 0, 0, 45

									Water
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Level (m)
1.000	1	60 Winter	2	+0%	30/15 Winter				30.556
1.001	2	60 Winter	2	+0%	30/15 Summer				30.555
2.000	3	15 Winter	2	+0%	100/30 Summer				31.118
1.002	4	60 Winter	2	+0%	1/15 Winter				30.553
3.000	5	15 Winter	2	+0%	100/15 Summer				30.282
1.003	6	15 Winter	2	+0%	30/15 Summer				30.275

Surcharged Flooded					Half Drain	Pipe			
PN	US/MH Name	Depth (m)	Volume (m ³)	Flow / Overflow Cap.	Time (mins)	Flow (l/s)	Status	Level Exceeded	
1.000	1	-0.155	0.000	0.06		4.2	OK		
1.001	2	-0.052	0.000	0.06	28	3.9	OK		
2.000	3	-0.112	0.000	0.15	12	5.9	OK		
1.002	4	0.096	0.000	0.08		4.0	SURCHARGED		
3.000	5	-0.207	0.000	0.09		5.7	OK		
1.003	6	-0.085	0.000	0.12		8.6	OK		

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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

Hot Start (mins) 0

Hot Start Level (mm) 0

Manhole Headloss Coeff (Global) 0.500

Foul Sewage per hectare (l/s) 0.000

Additional Flow - % of Total Flow 0.000

MADD Factor * 10m³/ha Storage 2.000

Inlet Coeffiecient 0.800

Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0

Number of Online Controls 2

Number of Offline Controls 0

Synthetic Rainfall Details

Rainfall Model FSR

Region England and Wales Cv (Summer) 0.750

M5-60 (mm) 18.000 Cv (Winter) 0.840

Ratio R 0.384

18.000 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, 180, 240, 360, 480, 600, 720, 960, 1440

Return Period(s) (years) 1, 2, 30, 100

Climate Change (%) 0, 0, 0, 45

									Water
PN	US/MH		Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level
	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	(m)
1.000	1	120 Winter	100	+45%	30/15 Winter				31.467
1.001	2	120 Winter	100	+45%	30/15 Summer				31.465
2.000	3	120 Winter	100	+45%	100/30 Summer				31.467
1.002	4	120 Winter	100	+45%	1/15 Winter				31.462
3.000	5	30 Winter	100	+45%	100/15 Summer				31.165
1.003	6	30 Winter	100	+45%	30/15 Summer				31.157

								Level
PN	US/MH	Depth	Volume	Flow /	Overflow	Time	Pipe	Exceeded
	Name	(m)	(m³)	Cap.	(l/s)	(mins)	Flow	
1.000	1	0.756	0.000	0.13			9.2	SURCHARGED
1.001	2	0.858	0.000	0.18			13.1	SURCHARGED
2.000	3	0.237	0.000	0.29		71	11.8	FLOOD RISK
1.002	4	1.005	0.000	0.08			4.0	FLOOD RISK
3.000	5	0.676	0.000	0.21			12.7	SURCHARGED
1.003	6	0.797	0.000	0.15			11.1	SURCHARGED

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