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Old Hall Chambers 31 Old Hall Street Liverpool L3 9SY		
Date 05/10/2020 14:47 File SW Network.MDX	Designed by WinDes Checked by	
Micro Drainage	Network 2020.1	

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)	30	PIMP (%)	100
M5-60 (mm)	18.000	Add Flow / Climate Change (%)	0
Ratio R	0.357	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	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
1.000	10.000	0.067	149.3	0.151	5.00	0.0	0.600	o	300	Pipe/Conduit	
1.001	10.000	0.067	150.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	7.000	0.047	150.0	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)	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	50.00	5.13	43.517	0.151	0.0	0.0	0.0	1.28	90.8	20.4
1.001	50.00	5.29	43.450	0.151	0.0	0.0	0.0	1.07	42.4	20.4
1.002	50.00	5.40	43.383	0.151	0.0	0.0	0.0	1.07	42.4	20.4

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)
1.002		46.776	43.337	41.900	1200	0

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: 2, DS/PN: 1.001, Volume (m³): 2.4

Unit Reference	MD-SHE-0098-5000-1500-5000
Design Head (m)	1.500
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	98
Invert Level (m)	43.450
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)	1.500	5.0	Kick-Flo®	0.878	3.9
Flush-Flo™	0.431	4.9	Mean Flow over Head Range	-	4.3

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)
0.100	3.2	0.800	4.3	2.000	5.7	4.000	7.9	7.000	10.3
0.200	4.4	1.000	4.1	2.200	6.0	4.500	8.4	7.500	10.7
0.300	4.8	1.200	4.5	2.400	6.2	5.000	8.8	8.000	11.0
0.400	4.9	1.400	4.8	2.600	6.5	5.500	9.2	8.500	11.3
0.500	4.9	1.600	5.1	3.000	6.9	6.000	9.6	9.000	11.6
0.600	4.8	1.800	5.4	3.500	7.4	6.500	10.0	9.500	11.9

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Storage Structures for Storm

Tank or Pond Manhole: 2, DS/PN: 1.001

Invert Level (m) 43.500

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	39.0	1.200	39.0	1.201	0.0

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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 * 10m ³ /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 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	FSR M5-60 (mm)	18.000	Cv (Summer)	0.750	
Region	England and Wales	Ratio R	0.358	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	150.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

	Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60,	120, 180, 240, 360
Return Period(s) (years)		1, 29, 30, 99, 100
Climate Change (%)		0, 0, 40, 0, 40

									Water	Surcharged	Flooded
PN	US/MH		Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level	Depth	Volume
	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	(m)	(m)	(m³)
1.000	1	60 Winter	30	+40%	29/15 Summer				44.300	0.483	0.000
1.001	2	60 Winter	30	+40%	29/15 Summer				44.296	0.621	0.000
1.002	3	15 Summer	30	+40%					43.443	-0.165	0.000

PN	US/MH	Flow /	Half Drain	Pipe	Status	Level Exceeded
	Name	Cap.	Time (mins)	Flow (l/s)		
1.000	1	0.47		30.7	SURCHARGED	
1.001	2	0.14		4.9	SURCHARGED	
1.002	3	0.16		4.9	OK	

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99 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 * 10m ³ /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 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	FSR M5-60 (mm)	18.000	Cv (Summer)	0.750	
Region	England and Wales	Ratio R	0.358	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	150.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

	Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60,	120, 180, 240, 360
Return Period(s) (years)		1, 29, 30, 99, 100
Climate Change (%)		0, 0, 40, 0, 40

										Water	Surcharged	Flooded
	US/MH			Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level	Depth	Volume
PN	Name	Storm	Period	Change		Surcharge	Flood	Overflow	Act.	(m)	(m)	(m³)
1.000	1	60 Winter	99	+0%	29/15	Summer				44.224	0.407	0.000
1.001	2	60 Winter	99	+0%	29/15	Summer				44.221	0.546	0.000
1.002	3	30 Summer	99	+0%						43.443	-0.165	0.000

PN	US/MH	Flow /	Half Drain	Pipe	Status	Level Exceeded
	Name	Cap.	Time (mins)	Flow (l/s)		
1.000	1	0.44		28.8	SURCHARGED	
1.001	2	0.14		4.9	SURCHARGED	
1.002	3	0.16		4.9	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 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 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 FSR M5-60 (mm) 18.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.358 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 150.0 DVD Status OFF
 Analysis Timestep Fine Inertia Status OFF
 DTS Status ON

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360
 Return Period(s) (years) 1, 29, 30, 99, 100
 Climate Change (%) 0, 0, 40, 0, 40

	US/MH		Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Water	Surcharged
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	Level	Depth
									(m)	(m)
1.000	1	120 Winter	100	+40%	29/15 Summer				44.681	0.864
1.001	2	120 Winter	100	+40%	29/15 Summer				44.678	1.003
1.002	3	30 Summer	100	+40%					43.443	-0.165

	US/MH	Flooded		Half Drain	Pipe		Level
PN	Name	Volume	Flow /	Time	Flow	Status	Exceeded
		(m³)	Cap. (l/s)	(mins)	(l/s)		
1.000	1	0.000	0.39		25.6	SURCHARGED	
1.001	2	0.000	0.14		4.9	SURCHARGED	
1.002	3	0.000	0.16		4.9	OK	