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Morgan House, Mount View Standard Way Northallerton DL6 2YD	Parkmount Road Manchester	
Date 19/07/2023	Designed by ZS	
File Storm Network Calculati...	Checked by BD	
Innovyze	Network 2020.1	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm (South) - 1in100 +45CC

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	PIMP (%)	100
M5-60 (mm)	18.400	Add Flow / Climate Change (%)	0
Ratio R	0.344	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 (South) - 1in100 +45CC

« - Indicates pipe capacity < flow

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
S3.000	32.546	0.165	197.2	0.050	5.00	0.0	0.600	o	875	Pipe/Conduit	
S4.000	11.498	0.115	100.0	0.052	5.00	0.0	0.600	o	875	Pipe/Conduit	
S3.001	33.264	0.083	400.8	0.020	0.00	0.0	0.600	o	875	Pipe/Conduit	
S3.002	12.034	0.030	401.1	0.044	0.00	0.0	0.600	o	875	Pipe/Conduit	
S3.003	25.125	0.251	100.1	0.062	0.00	0.0	0.600	o	150	Pipe/Conduit	
S3.004	9.877	0.099	99.8	0.000	0.00	0.0	0.600	o	150	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)
S3.000	50.00	5.25	77.440	0.050	0.0	0.0	0.0	2.19	1316.3	6.8
S4.000	50.00	5.06	77.390	0.052	0.0	0.0	0.0	3.08	1851.9	7.0
S3.001	50.00	5.61	77.275	0.122	0.0	0.0	0.0	1.53	921.1	16.5
S3.002	50.00	5.74	77.192	0.166	0.0	0.0	0.0	1.53	920.7	22.5
S3.003	50.00	6.16	77.162	0.228	0.0	0.0	0.0	1.00	17.7«	30.9
S3.004	50.00	6.32	76.911	0.228	0.0	0.0	0.0	1.01	17.8«	30.9

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Manhole Schedules for Storm (South) - lin100 +45CC

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)	Dia
S5	81.435	3.995	Open Manhole	1800	S3.000	77.440	875			
S6	80.962	3.572	Open Manhole	1800	S4.000	77.390	875			
S7	81.217	3.942	Open Manhole	1800	S3.001	77.275	875	S3.000	77.275	
S8	80.497	3.305	Open Manhole	1800	S3.002	77.192	875	S4.000	77.275	
S9 - HB	79.991	2.829	Open Manhole	1800	S3.003	77.162	150	S3.001	77.192	
S10- Combined	79.664	2.753	Open Manhole	1500	S3.004	76.911	150	S3.002	77.162	
SExisting Combined MH	79.300	2.488	Open Manhole	1500		OUTFALL		S3.003	76.911	
								S3.004	76.812	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S5	386030.846	402132.187	386030.846	402132.187	Required	
S6	386023.393	402098.887	386023.393	402098.887	Required	
S7	386034.847	402099.888	386034.847	402099.888	Required	
S8	386036.880	402066.686	386036.880	402066.686	Required	
S9 - HB	386035.463	402054.736	386035.463	402054.736	Required	
S10- Combined	386010.478	402057.389	386010.478	402057.389	Required	
SExisting Combined MH	386000.796	402057.309			No Entry	

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PIPELINE SCHEDULES for Storm (South) - 1in100 +45CC

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)
S3.000	o	875		S5 81.435	77.440	3.120	Open Manhole	1800
S4.000	o	875		S6 80.962	77.390	2.697	Open Manhole	1800
S3.001	o	875		S7 81.217	77.275	3.067	Open Manhole	1800
S3.002	o	875		S8 80.497	77.192	2.430	Open Manhole	1800
S3.003	o	150	S9 - HB	79.991	77.162	2.679	Open Manhole	1800
S3.004	o	150	S10- Combined	79.664	76.911	2.603	Open Manhole	1500

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)
S3.000	32.546	197.2		S7 81.217	77.275	3.067	Open Manhole	1800
S4.000	11.498	100.0		S7 81.217	77.275	3.067	Open Manhole	1800
S3.001	33.264	400.8		S8 80.497	77.192	2.430	Open Manhole	1800
S3.002	12.034	401.1	S9 - HB	79.991	77.162	1.954	Open Manhole	1800
S3.003	25.125	100.1	S10- Combined	79.664	76.911	2.603	Open Manhole	1500
S3.004	9.877	99.8	SExisting Combined MH	79.300	76.812	2.338	Open Manhole	1500

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Setting Out Information - True Coordinates (Storm (South) - 1in100 +45CC)								
PN	USMH Name	Dia/Len (mm)	Width (mm)	US Easting (m)	US Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Layout (North)
S3.000	S5	1800		386030.846	402132.187	386030.846	402132.187	
S4.000	S6	1800		386023.393	402098.887	386023.393	402098.887	
S3.001	S7	1800		386034.847	402099.888	386034.847	402099.888	
S3.002	S8	1800		386036.880	402066.686	386036.880	402066.686	
S3.003	S9 - HB	1800		386035.463	402054.736	386035.463	402054.736	
S3.004	S10- Combined	1500		386010.478	402057.389	386010.478	402057.389	
PN	DSMH Name	Dia/Len (mm)	Width (mm)	DS Easting (m)	DS Northing (m)	Layout (North)		
S3.004	SExisting Combined MH	1500		386000.796	402057.309			
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Area Summary for Storm (South) - lin100 +45CC

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
3.000	-	-	100	0.050	0.050	0.050
4.000	-	-	100	0.052	0.052	0.052
3.001	-	-	100	0.020	0.020	0.020
3.002	-	-	100	0.044	0.044	0.044
3.003	-	-	100	0.062	0.062	0.062
3.004	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.228	0.228	0.228

Free Flowing Outfall Details for Storm (South) - lin100 +45CC

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
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S3.004 SExisting Combined MH 79.300 76.812 0.000 1500 0

Simulation Criteria for Storm (South) - lin100 +45CC

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m ³ /ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	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 1
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	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.300	Storm Duration (mins)	30
Ratio R	0.344		

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Online Controls for Storm (South) - 1in100 +45CC

Hydro-Brake® Optimum Manhole: S9 - HB, DS/PN: S3.003, Volume (m³): 13.4

Unit Reference	MD-SHE-0076-3500-2000-3500
Design Head (m)	2.000
Design Flow (l/s)	3.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	76
Invert Level (m)	77.162
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	3.5
Flush-Flo™	0.331	2.7
Kick-Flo®	0.679	2.1
Mean Flow over Head Range	-	2.7

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	2.1	1.200	2.8	3.000	4.2	7.000	6.3
0.200	2.5	1.400	3.0	3.500	4.5	7.500	6.5
0.300	2.7	1.600	3.2	4.000	4.8	8.000	6.7
0.400	2.6	1.800	3.3	4.500	5.1	8.500	6.9
0.500	2.6	2.000	3.5	5.000	5.4	9.000	7.1
0.600	2.4	2.200	3.7	5.500	5.6	9.500	7.3
0.800	2.3	2.400	3.8	6.000	5.8		
1.000	2.5	2.600	4.0	6.500	6.1		

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<u>Storage Structures for Storm (South) - 1in100 +45CC</u> <u>Cellular Storage Manhole: S9 - HB, DS/PN: S3.003</u> Invert Level (m) 78.400 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>90.0</td><td>0.0</td><td>1.001</td><td>0.0</td><td>0.0</td></tr><tr><td>1.000</td><td>90.0</td><td>0.0</td><td></td><td></td><td></td></tr></table>			Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	90.0	0.0	1.001	0.0	0.0	1.000	90.0	0.0			
Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)															
0.000	90.0	0.0	1.001	0.0	0.0															
1.000	90.0	0.0																		
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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm (South) - lin100 +45CC

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 1

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 FSR

Ratio R 0.344

Region England and Wales Cv (Summer) 1.000

M5-60 (mm) 18.300

Cv (Winter) 1.000

Margin for Flood Risk Warning (mm) 300.0

DVD Status OFF

Analysis Timestep Fine

Inertia Status OFF

DTS Status ON

Profile(s) Summer and Winter

Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440

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

Climate Change (%) 0, 0, 45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) SurchARGE	First (Y) Flood	First (Z) Overflow	Overflow Act.
S3.000	S5	120 Winter	1	+0%	30/120 Winter			
S4.000	S6	120 Winter	1	+0%	30/120 Winter			
S3.001	S7	120 Winter	1	+0%	30/120 Summer			
S3.002	S8	120 Winter	1	+0%	30/60 Summer			
S3.003	S9 - HB	120 Winter	1	+0%	1/15 Summer			
S3.004	S10-	Combined 360 Summer	1	+0%				

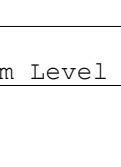
PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Half Drain Time (mins)	Pipe Flow (l/s)
S3.000	S5	77.625	-0.690	0.000	0.00		2.3
S4.000	S6	77.625	-0.640	0.000	0.00		2.3
S3.001	S7	77.625	-0.525	0.000	0.00		2.6
S3.002	S8	77.627	-0.440	0.000	0.01		2.5
S3.003	S9 - HB	77.628	0.316	0.000	0.16	88	2.6
S3.004	S10-	Combined 76.952	-0.109	0.000	0.17		2.6

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm (South) - 1in100 +45CC

PN	US/MH Name	Status	Level Exceeded
S3.000		S5	OK
S4.000		S6	OK
S3.001		S7	OK
S3.002		S8	OK
S3.003	S9 - HB	SURCHARGED	
S3.004	S10- Combined		OK

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm (South) - lin100 +45CC

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 Storage Structures	1
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	FSR	Ratio R	0.344
Region England and Wales Cv (Summer)	1.000		
M5-60 (mm)	18.300	Cv (Winter)	1.000

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s) Summer and Winter

Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S3.000	S5	360 Summer	30	+0%	30/120 Winter			
S4.000	S6	480 Summer	30	+0%	30/120 Winter			
S3.001	S7	480 Summer	30	+0%	30/120 Summer			
S3.002	S8	360 Summer	30	+0%	30/60 Summer			
S3.003	S9 - HB	480 Summer	30	+0%	1/15 Summer			
S3.004	S10- Combined	240 Winter	30	+0%				

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m ³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
S3.000	S5	78.396	0.081	0.000	0.00			3.6
S4.000	S6	78.396	0.131	0.000	0.00			3.0
S3.001	S7	78.400	0.250	0.000	0.01			6.9
S3.002	S8	78.400	0.333	0.000	0.02			8.7
S3.003	S9 - HB	78.403	1.091	0.000	0.16		344	2.6
S3.004	S10- Combined	76.953	-0.108	0.000	0.17			2.8

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm (South) - lin100 +45CC

PN	US/MH Name	Status	Level Exceeded
S3.000		S5 SURCHARGED	
S4.000		S6 SURCHARGED	
S3.001		S7 SURCHARGED	
S3.002		S8 SURCHARGED	
S3.003	S9 - HB	SURCHARGED	
S3.004	S10- Combined	OK	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm (South) - lin100 +45CC

PN	US/MH Name	Status	Level Exceeded
S3.000		S5 SURCHARGED	
S4.000		S6 SURCHARGED	
S3.001		S7 SURCHARGED	
S3.002		S8 SURCHARGED	
S3.003	S9 - HB	SURCHARGED	
S3.004	S10- Combined	OK	