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Studio 313 Scott House The Custard Factory, Gibb St... Birmingham, B9 4AA	BOLEYN ROAD REDNAL BIRMINGHAM	
Date 01/01/0001 File Storm 01.02.23 riaz.MDX	Designed by ZH Checked by	
Innovyze	Network 2019.1	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for STORM 27.01.23.SWS

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales			
Return Period (years)	1	PIMP (%)	100
M5-60 (mm)	20.000	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	0	Maximum Backdrop Height (m)	0.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.700
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	0.75
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for STORM 27.01.23.SWS

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.707	4-8	0.371

Total Area Contributing (ha) = 1.078

Total Pipe Volume (m³) = 206.284

Network Design Table for STORM 27.01.23.SWS

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	14.412	0.030	480.4	0.049	4.00	0.0	0.600	o	450	Pipe/Conduit	
1.001	13.000	0.025	520.0	0.049	0.00	0.0	0.600	o	975	Pipe/Conduit	
1.002	10.495	0.021	499.8	0.049	0.00	0.0	0.600	o	975	Pipe/Conduit	
1.003	16.795	0.034	494.0	0.049	0.00	0.0	0.600	o	975	Pipe/Conduit	
2.000	20.163	1.080	18.7	0.049	4.00	0.0	0.600	o	225	Pipe/Conduit	
2.001	16.515	0.874	18.9	0.049	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)	E Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	0.00	4.26	203.971	0.049	0.0	0.0	0.0	0.92	146.5	0.0
1.001	0.00	4.41	203.416	0.098	0.0	0.0	0.0	1.44	1072.7	0.0
1.002	0.00	4.53	203.391	0.147	0.0	0.0	0.0	1.47	1094.4	0.0
1.003	0.00	4.72	203.370	0.196	0.0	0.0	0.0	1.47	1100.8	0.0
2.000	0.00	4.11	207.280	0.049	0.0	0.0	0.0	3.04	121.0	0.0
2.001	0.00	4.20	206.200	0.098	0.0	0.0	0.0	3.02	120.2	0.0

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Manhole Schedules for STORM 27.01.23.SWS

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
S1	209.250	5.279	Open Manhole	1350	1.000	203.971	450				
S2	208.974	5.558	Open Manhole	2100	1.001	203.416	975	1.000	203.941	450	
S3	208.758	5.367	Open Manhole	2100	1.002	203.391	975	1.001	203.391	975	
S4	208.587	5.217	Open Manhole	2100	1.003	203.370	975	1.002	203.370	975	
S11	209.000	1.720	Open Manhole	1200	2.000	207.280	225				
S12	208.853	2.653	Open Manhole	1200	2.001	206.200	225	2.000	206.200	225	
S13	208.629	3.303	Open Manhole	1200	2.002	205.326	225	2.001	205.326	225	
S5	208.255	4.919	Open Manhole	2400	1.004	203.336	975	1.003	203.336	975	
								2.002	204.086	225	
S6	207.523	4.276	Open Manhole	2100	1.005	203.247	975	1.004	203.247	975	
S14	208.858	1.651	Open Manhole	1200	3.000	207.207	225				
S15	208.588	2.580	Open Manhole	1200	3.001	206.008	225	3.000	206.008	225	
S16	208.315	2.653	Open Manhole	1200	3.002	205.662	225	3.001	205.662	225	
S17	208.226	2.880	Open Manhole	1200	3.003	205.346	225	3.002	205.346	225	
S18	208.031	3.539	Open Manhole	1500	3.004	204.492	600	3.003	204.867	225	
S19	207.827	3.373	Open Manhole	1500	3.005	204.454	600	3.004	204.454	600	
S20	207.532	3.134	Open Manhole	1500	3.006	204.398	600	3.005	204.398	600	
S7	207.324	4.098	Open Manhole	2400	1.006	203.751	1200	1.005	203.226	975	
								3.006	204.330	600	
S21	208.364	1.364	Open Manhole	1200	4.000	207.000	225				
S22	208.163	1.238	Open Manhole	1200	4.001	206.925	225	4.000	206.925	225	
S23	207.304	1.336	Open Manhole	1200	4.002	205.968	225	4.001	205.968	225	
S24	206.885	1.760	Open Manhole	1200	4.003	205.125	225	4.002	205.125	225	
S25	206.589	2.889	Open Manhole	2100	4.004	203.700	1200	4.003	204.675	225	
FCC	206.073	2.439	Open Manhole	3000	1.007	203.634	225	1.006	203.634	1200	
								4.004	203.634	1200	
10	203.500	2.190	Open Manhole	0		OUTFALL		1.007	201.310	225	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S1	398675.613	278733.910	398675.613	278733.910	Required	
S2	398667.243	278722.178	398667.243	278722.178	Required	



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BOLEYN ROAD
REDNAL
BIRMINGHAM



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Manhole Schedules for STORM 27.01.23.SWS

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S3	398665.300	278709.324	398665.300	278709.324	Required	
S4	398660.517	278699.982	398660.517	278699.982	Required	
S11	398619.879	278745.673	398619.879	278745.673	Required	
S12	398623.669	278725.869	398623.669	278725.869	Required	
S13	398629.968	278710.603	398629.968	278710.603	Required	
S5	398647.439	278689.445	398647.439	278689.445	Required	
S6	398623.522	278652.714	398623.522	278652.714	Required	
S14	398607.187	278751.077	398607.187	278751.077	Required	
S15	398583.273	278740.241	398583.273	278740.241	Required	
S16	398563.992	278728.060	398563.992	278728.060	Required	
S17	398563.843	278719.242	398563.843	278719.242	Required	
S18	398570.270	278700.933	398570.270	278700.933	Required	
S19	398579.163	278683.969	398579.163	278683.969	Required	
S20	398597.023	278662.447	398597.023	278662.447	Required	
S7	398614.405	278647.034	398614.405	278647.034	Required	

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MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S21	398530.064	278689.153	398530.064	278689.153	Required	
S22	398535.445	278677.271	398535.445	278677.271	Required	
S23	398539.870	278643.022	398539.870	278643.022	Required	
S24	398545.673	278628.099	398545.673	278628.099	Required	
S25	398552.549	278617.413	398552.549	278617.413	Required	
FCC	398580.354	278599.435	398580.354	278599.435	Required	
10	398604.967	278599.435			No Entry	

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PIPELINE SCHEDULES for STORM 27.01.23.SWS

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)
1.000	o	450	S1	209.250	203.971	4.829	Open Manhole	1350
1.001	o	975	S2	208.974	203.416	4.583	Open Manhole	2100
1.002	o	975	S3	208.758	203.391	4.392	Open Manhole	2100
1.003	o	975	S4	208.587	203.370	4.242	Open Manhole	2100
2.000	o	225	S11	209.000	207.280	1.495	Open Manhole	1200
2.001	o	225	S12	208.853	206.200	2.428	Open Manhole	1200
2.002	o	225	S13	208.629	205.326	3.078	Open Manhole	1200
1.004	o	975	S5	208.255	203.336	3.944	Open Manhole	2400
1.005	o	975	S6	207.523	203.247	3.301	Open Manhole	2100
3.000	o	225	S14	208.858	207.207	1.426	Open Manhole	1200
3.001	o	225	S15	208.588	206.008	2.355	Open Manhole	1200
3.002	o	225	S16	208.315	205.662	2.428	Open Manhole	1200
3.003	o	225	S17	208.226	205.346	2.655	Open Manhole	1200
3.004	o	600	S18	208.031	204.492	2.939	Open Manhole	1500
3.005	o	600	S19	207.827	204.454	2.773	Open Manhole	1500
3.006	o	600	S20	207.532	204.398	2.534	Open Manhole	1500
1.006	o	1200	S7	207.324	203.751	2.373	Open Manhole	2400

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)
1.000	14.412	480.4	S2	208.974	203.941	4.583	Open Manhole	2100
1.001	13.000	520.0	S3	208.758	203.391	4.392	Open Manhole	2100
1.002	10.495	499.8	S4	208.587	203.370	4.242	Open Manhole	2100
1.003	16.795	494.0	S5	208.255	203.336	3.944	Open Manhole	2400
2.000	20.163	18.7	S12	208.853	206.200	2.428	Open Manhole	1200
2.001	16.515	18.9	S13	208.629	205.326	3.078	Open Manhole	1200
2.002	27.439	22.1	S5	208.255	204.086	3.944	Open Manhole	2400
1.004	43.832	492.5	S6	207.523	203.247	3.301	Open Manhole	2100
1.005	10.742	511.5	S7	207.324	203.226	3.123	Open Manhole	2400
3.000	26.254	21.9	S15	208.588	206.008	2.355	Open Manhole	1200
3.001	22.806	65.9	S16	208.315	205.662	2.428	Open Manhole	1200
3.002	8.820	27.9	S17	208.226	205.346	2.655	Open Manhole	1200
3.003	19.404	40.5	S18	208.031	204.867	2.939	Open Manhole	1500
3.004	19.154	504.1	S19	207.827	204.454	2.773	Open Manhole	1500
3.005	27.968	499.4	S20	207.532	204.398	2.534	Open Manhole	1500
3.006	23.231	341.6	S7	207.324	204.330	2.394	Open Manhole	2400
1.006	58.525	500.2	FCC	206.073	203.634	1.239	Open Manhole	3000

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Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type Summer
Return Period (years)	1	Cv (Summer) 0.750
Region England and Wales		Cv (Winter) 0.840
M5-60 (mm)	20.000	Storm Duration (mins) 30
Ratio R	0.400	

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Online Controls for STORM 27.01.23.SWS

Hydro-Brake® Optimum Manhole: FCC, DS/PN: 1.007, Volume (m³): 114.9

Unit Reference	MD-SHE-0147-1160-1600-1160
Design Head (m)	1.600
Design Flow (l/s)	11.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	147
Invert Level (m)	203.634
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.600	11.6
Flush-Flo™	0.468	11.6
Kick-Flo®	0.991	9.3
Mean Flow over Head Range	-	10.1

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	5.3	1.200	10.1	3.000	15.6	7.000	23.4
0.200	10.3	1.400	10.9	3.500	16.8	7.500	24.2
0.300	11.2	1.600	11.6	4.000	17.9	8.000	25.0
0.400	11.5	1.800	12.3	4.500	19.0	8.500	25.7
0.500	11.6	2.000	12.9	5.000	19.9	9.000	26.4
0.600	11.5	2.200	13.5	5.500	20.9	9.500	27.1
0.800	10.9	2.400	14.0	6.000	21.8		
1.000	9.3	2.600	14.6	6.500	22.6		

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Storage Structures for STORM 27.01.23.SWS

Tank or Pond Manhole: S2, DS/PN: 1.001

Invert Level (m) 203.960

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	370.0	0.700	370.0	1.400	0.0	2.100	0.0
0.100	370.0	0.800	370.0	1.500	0.0	2.200	0.0
0.200	370.0	0.900	370.0	1.600	0.0	2.300	0.0
0.300	370.0	1.000	370.0	1.700	0.0	2.400	0.0
0.400	370.0	1.001	0.0	1.800	0.0	2.500	0.0
0.500	370.0	1.200	0.0	1.900	0.0		
0.600	370.0	1.300	0.0	2.000	0.0		

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500 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for STORM 27.01.23.SWS

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 Coeffiecient 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 0.400

Region England and Wales Cv (Summer) 0.750

M5-60 (mm)

20.000 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, 240, 360, 480, 960, 1440

Return Period(s) (years)

500

Climate Change (%)

0

PN

US/MH Name

Storm

Return Period

Climate Change

First (X) Surge

First (Y) Flood

First (Z) Overflow

Overflow Act.

Water Level (m)

1.000

S1

240 Winter

500

+0%

500/30 Summer

204.980

1.001

S2

240 Winter

500

+0%

500/30 Summer

204.980

1.002

S3

240 Winter

500

+0%

500/15 Winter

204.980

1.003

S4

240 Winter

500

+0%

500/15 Summer

204.980

2.000

S11

15 Winter

500

+0%

207.364

2.001

S12

15 Winter

500

+0%

206.328

2.002

S13

15 Summer

500

+0%

205.501

1.004

S5

240 Winter

500

+0%

500/15 Summer

204.980

1.005

S6

240 Winter

500

+0%

500/15 Summer

204.981

3.000

S14

15 Winter

500

+0%

207.294

3.001

S15

15 Winter

500

+0%

500/15 Summer

206.915

3.002

S16

15 Winter

500

+0%

500/15 Summer

206.587

3.003

S17

15 Winter

500

+0%

500/15 Summer

206.218

3.004

S18

240 Winter

500

+0%

204.990

3.005

S19

240 Winter

500

+0%

204.989

3.006

S20

240 Winter

500

+0%

204.988

1.006

S7

240 Winter

500

+0%

500/240 Winter

204.981

4.000

S21

15 Summer

500

+0%

207.176

4.001

S22

15 Summer

500

+0%

207.079

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500 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for STORM 27.01.23.SWS

PN	US/MH Name	Surcharged Flooded		Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
		Depth (m)	Volume (m³)					
1.000	S1	0.559	0.000	0.06		5.7	SURCHARGED	
1.001	S2	0.589	0.000	0.08		35.5	SURCHARGED	
1.002	S3	0.614	0.000	0.08		33.5	SURCHARGED	
1.003	S4	0.635	0.000	0.05		29.3	SURCHARGED	
2.000	S11	-0.141	0.000	0.30		33.0	OK	
2.001	S12	-0.097	0.000	0.62		65.9	OK	
2.002	S13	-0.050	0.000	0.96		99.0	OK	
1.004	S5	0.669	0.000	0.02		18.9	SURCHARGED	
1.005	S6	0.759	0.000	0.04		17.8	SURCHARGED	
3.000	S14	-0.138	0.000	0.32		33.0	OK	
3.001	S15	0.682	0.000	0.98		57.5	SURCHARGED	
3.002	S16	0.700	0.000	1.08		85.2	SURCHARGED	
3.003	S17	0.647	0.000	1.53		113.0	SURCHARGED	
3.004	S18	-0.102	0.000	0.15		29.6	OK	
3.005	S19	-0.065	0.000	0.14		35.4	OK	
3.006	S20	-0.010	0.000	0.14		41.3	OK	
1.006	S7	0.030	0.000	0.01		17.3	SURCHARGED	
4.000	S21	-0.049	0.000	0.97		33.0	OK	
4.001	S22	-0.071	0.000	0.80		65.8	OK	

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500 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for STORM 27.01.23.SWS

US/MH		Return Climate		First (X)		First (Y)	First (Z)	Overflow	Water
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	Level (m)
4.002	S23	15 Winter	500	+0%	500/15 Summer				206.463
4.003	S24	15 Winter	500	+0%	500/15 Summer				205.820
4.004	S25	240 Winter	500	+0%	500/240 Winter				204.981
1.007	FCC	240 Winter	500	+0%	500/15 Summer				204.981

US/MH		Surcharged Flooded		Pipe		Level	
PN	Name	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Flow (l/s)	Status Exceeded
4.002	S23	0.270	0.000	0.87		92.5	SURCHARGED
4.003	S24	0.470	0.000	1.43		121.1	SURCHARGED
4.004	S25	0.081	0.000	0.02		28.8	SURCHARGED
1.007	FCC	1.122	0.000	0.08		11.6	SURCHARGED