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Title	SPAR Store 210 Winsover Road Spalding
Project No	20-16277
Date	Nov 2020
Engineer	RAS
Checker	LM
Revision	C3
Sheet No	1

Surface Water Drainage Design Calculations
Critical Results

Client:	Blakemore Retail Ltd.
Architect:	ADM Surveyors Ltd.
Project:	210 Winsover Road, Spalding
Project No:	20-16277
Document No:	0-010
Revision:	C3
Date:	April 2022
Engineer:	Rebecca Shimmings

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)	19.000	Add Flow / Climate Change (%)	0
Ratio R	0.400	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	20.900	0.250	83.6	0.051	4.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	9.867	0.200	49.3	0.006	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	2.000	0.050	40.0	0.057	4.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	1.620	0.030	54.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.003	18.850	0.170	110.9	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)
1.000	50.00	4.32	2.050	0.051	0.0	0.0	0.0	1.10	19.4	6.9
1.001	50.00	4.43	1.800	0.057	0.0	0.0	0.0	1.44	25.4	7.7
2.000	50.00	4.02	1.650	0.057	0.0	0.0	0.0	1.60	28.2	7.7
1.002	50.00	4.45	0.950	0.114	0.0	0.0	0.0	1.37	24.2	15.4
1.003	50.00	4.78	0.920	0.114	0.0	0.0	0.0	0.95	16.9	15.4

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Bac
RE1	3.150	1.100	Open Manhole	450	1.000	2.050	150				
S2	3.150	1.350	Open Manhole	450	1.001	1.800	150	1.000	1.800	150	
S3	3.000	1.350	Open Manhole	450	2.000	1.650	150				
S4-Attenuation	3.000	2.050	Open Manhole	100	1.002	0.950	150	1.001	1.600	150	
								2.000	1.600	150	
S5-Control	3.150	2.230	Open Manhole	600 x 450	1.003	0.920	150	1.002	0.920	150	
EX. Outfall	3.000	2.250	Open Manhole	0		OUTFALL		1.003	0.750	150	

No coordinates have been specified, layout information cannot be produced.

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PIPELINE SCHEDULES for Storm

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	150	RE1	3.150	2.050	0.950	Open Manhole	450
1.001	o	150	S2	3.150	1.800	1.200	Open Manhole	450
2.000	o	150	S3	3.000	1.650	1.200	Open Manhole	450
1.002	o	150	S4-Attenuation	3.000	0.950	1.900	Open Manhole	100
1.003	o	150	S5-Control	3.150	0.920	2.080	Open Manhole	600 x 450

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	20.900	83.6	S2	3.150	1.800	1.200	Open Manhole	450
1.001	9.867	49.3	S4-Attenuation	3.000	1.600	1.250	Open Manhole	100
2.000	2.000	40.0	S4-Attenuation	3.000	1.600	1.250	Open Manhole	100
1.002	1.620	54.0	S5-Control	3.150	0.920	2.080	Open Manhole	600 x 450
1.003	18.850	110.9	EX. Outfall	3.000	0.750	2.100	Open Manhole	0

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)
1.003	EX. Outfall	3.000	0.750	0.000	0	0

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	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)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Storm Duration (mins)	30
Ratio R	0.400		

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Online Controls for Storm

Pump Manhole: S5-Control, DS/PN: 1.003, Volume (m³): 0.6

Invert Level (m) 0.920

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.0000	1.200	5.0000	3.000	5.0000	7.000	5.0000
0.200	5.0000	1.400	5.0000	3.500	5.0000	7.500	5.0000
0.300	5.0000	1.600	5.0000	4.000	5.0000	8.000	5.0000
0.400	5.0000	1.800	5.0000	4.500	5.0000	8.500	5.0000
0.500	5.0000	2.000	5.0000	5.000	5.0000	9.000	5.0000
0.600	5.0000	2.200	5.0000	5.500	5.0000	9.500	5.0000
0.800	5.0000	2.400	5.0000	6.000	5.0000		
1.000	5.0000	2.600	5.0000	6.500	5.0000		

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Storage Structures for Storm

Cellular Storage Manhole: S4-Attenuation, DS/PN: 1.002

Invert Level (m) 0.950 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	38.0	38.0	0.900	0.0	59.6
0.800	38.0	59.6			

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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 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)	19.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia 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)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
1.000	RE1	15 Winter	1	+0%	100/15 Summer		
1.001	S2	15 Winter	1	+0%	100/15 Summer		
2.000	S3	15 Summer	1	+0%	30/15 Summer	100/60 Winter	
1.002	S4-Attenuation	30 Winter	1	+0%	30/15 Summer	100/60 Winter	
1.003	S5-Control	30 Winter	1	+0%	1/15 Winter		

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
1.000	RE1		2.115	-0.085	0.000	0.39			7.2
1.001	S2		1.861	-0.089	0.000	0.35			7.9
2.000	S3		1.732	-0.068	0.000	0.58			8.1
1.002	S4-Attenuation		1.078	-0.022	0.000	0.48		14	5.2
1.003	S5-Control		1.099	0.029	0.000	0.32			5.0

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

PN	US/MH Name	Status	Level Exceeded
1.000	RE1	OK	
1.001	S2	OK	
2.000	S3	OK	1
1.002	S4-Attenuation	OK	2
1.003	S5-Control	SURCHARGED	

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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 * 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)	19.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia 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)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
1.000	RE1	15 Winter	30	+0%	100/15 Summer		
1.001	S2	15 Winter	30	+0%	100/15 Summer		
2.000	S3	15 Summer	30	+0%	30/15 Summer	100/60 Winter	
1.002	S4-Attenuation	30 Winter	30	+0%	30/15 Summer	100/60 Winter	
1.003	S5-Control	60 Winter	30	+0%	1/15 Winter		

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
1.000	RE1		2.167	-0.033	0.000	0.96			17.6
1.001	S2		1.909	-0.041	0.000	0.87			19.7
2.000	S3		1.843	0.043	0.000	1.41			19.8
1.002	S4-Attenuation		1.380	0.280	0.000	0.53		30	5.7
1.003	S5-Control		1.422	0.352	0.000	0.32			5.0

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

PN	US/MH Name	Status	Level Exceeded
1.000	RE1	OK	
1.001	S2	OK	
2.000	S3	SURCHARGED	1
1.002	S4-Attenuation	SURCHARGED	2
1.003	S5-Control	SURCHARGED	

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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 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)	19.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia 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)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
1.000	RE1	60 Winter	100	+40%	100/15 Summer		
1.001	S2	60 Winter	100	+40%	100/15 Summer		
2.000	S3	60 Winter	100	+40%	30/15 Summer	100/60 Winter	
1.002	S4-Attenuation	60 Winter	100	+40%	30/15 Summer	100/60 Winter	
1.003	S5-Control	60 Winter	100	+40%	1/15 Winter		

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
1.000	RE1		3.040	0.840	0.000	0.86			15.8
1.001	S2		3.018	1.068	0.000	0.78			17.7
2.000	S3		3.002	1.202	1.783	1.26			17.7
1.002	S4-Attenuation		3.000	1.900	0.135	0.68		84	7.4
1.003	S5-Control		3.082	2.012	0.000	0.32			5.0

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

PN	US/MH Name	Status	Level Exceeded
1.000	RE1	FLOOD RISK	
1.001	S2	FLOOD RISK	
2.000	S3	FLOOD	1
1.002	S4-Attenuation	FLOOD	2
1.003	S5-Control	FLOOD RISK	

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