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Morgan House, Mount View Standard Way Northallerton, DL6 2YD	Princedom North SW Drainage	
Date 29/06/2023	Designed by BID	
File PV2309-APP-92-XX-CA-C-1000 SW	Checked by ZS	
Innovyze	Network 2020.1.3	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm North

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	PIMP (%)	100
M5-60 (mm)	18.300	Add Flow / Climate Change (%)	0
Ratio R	0.348	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

Time Area Diagram for Storm North

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.078	4-8	0.031

Total Area Contributing (ha) = 0.109

Total Pipe Volume (m³) = 4.415

Network Design Table for Storm North

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
S2.000	33.462	0.364	91.9	0.037	4.00	0.0	0.600	o	150	Pipe/Conduit	
S2.001	56.034	0.374	149.8	0.019	0.00	0.0	0.600	o	225	Pipe/Conduit	
S2.002	17.974	0.144	124.8	0.018	0.00	0.0	0.600	o	225	Pipe/Conduit	
S2.003	15.219	0.126	120.8	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S2.004	3.188	0.039	81.7	0.035	0.00	0.0	0.600	o	225	Pipe/Conduit	
S2.005	8.468	0.085	100.0	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)
S2.000	50.00	4.53	76.350	0.037	0.0	0.0	0.0	1.05	18.5	5.0
S2.001	50.00	5.41	75.911	0.056	0.0	0.0	0.0	1.07	42.4	7.6
S2.002	50.00	5.66	75.537	0.074	0.0	0.0	0.0	1.17	46.5	10.0
S2.003	50.00	5.88	75.393	0.074	0.0	0.0	0.0	1.19	47.3	10.0
S2.004	50.00	5.91	75.267	0.109	0.0	0.0	0.0	1.45	57.6	14.8
S2.005	50.00	6.05	75.228	0.109	0.0	0.0	0.0	1.00	17.8	14.8

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Manhole Schedules for Storm North

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)
S6	77.260	0.910	Open Manhole	450	S2.000	76.350	150				
S7	77.600	1.689	Open Manhole	600	S2.001	75.911	225	S2.000	75.986	150	
S8	77.620	2.083	Open Manhole	600	S2.002	75.537	225	S2.001	75.537	225	
S9 - CP MH	77.450	2.057	Open Manhole	600	S2.003	75.393	225	S2.002	75.393	225	
S10- HB	77.250	1.983	Open Manhole	1500	S2.004	75.267	225	S2.003	75.267	225	
S11	77.250	2.022	Open Manhole	450	S2.005	75.228	150	S2.004	75.228	225	
SS12 - New MH	77.120	1.977	Open Manhole	1200		OUTFALL		S2.005	75.143	150	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S6	386406.918	401717.822	386406.918	401717.822	Required	
S7	386439.817	401723.933	386439.817	401723.933	Required	
S8	386450.051	401668.841	386450.051	401668.841	Required	
S9 - CP MH	386432.400	401665.449	386432.400	401665.449	Required	
S10- HB	386417.454	401662.577	386417.454	401662.577	Required	
S11	386417.835	401659.512	386417.835	401659.512	Required	
SS12 - New MH	386419.291	401651.170			No Entry	

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PIPELINE SCHEDULES for Storm North

Upstream Manhole

PN	Hyd	Diam	MH	C.Level	I.Level	D.Depth	MH	MH DIAM., L*W
	Sect	(mm)	Name	(m)	(m)	(m)	Connection	(mm)
S2.000	o	150	S6	77.260	76.350	0.760	Open Manhole	450
S2.001	o	225	S7	77.600	75.911	1.464	Open Manhole	600
S2.002	o	225	S8	77.620	75.537	1.858	Open Manhole	600
S2.003	o	225	S9 - CP MH	77.450	75.393	1.832	Open Manhole	600
S2.004	o	225	S10- HB	77.250	75.267	1.758	Open Manhole	1500
S2.005	o	150	S11	77.250	75.228	1.872	Open Manhole	450

Downstream Manhole

PN	Length	Slope	MH	C.Level	I.Level	D.Depth	MH	MH DIAM., L*W
	(m)	(1:X)	Name	(m)	(m)	(m)	Connection	(mm)
S2.000	33.462	91.9	S7	77.600	75.986	1.464	Open Manhole	600
S2.001	56.034	149.8	S8	77.620	75.537	1.858	Open Manhole	600
S2.002	17.974	124.8	S9 - CP MH	77.450	75.393	1.832	Open Manhole	600
S2.003	15.219	120.8	S10- HB	77.250	75.267	1.758	Open Manhole	1500
S2.004	3.188	81.7	S11	77.250	75.228	1.797	Open Manhole	450
S2.005	8.468	100.0	SS12 - New MH	77.120	75.143	1.827	Open Manhole	1200

Setting Out Information - True Coordinates (Storm North)

PN	USMH Name	Dia/Len (mm)	Width (mm)	US Easting (m)	US Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Layout (North)
S2.000	S6	450		386406.918	401717.822	386406.918	401717.822	
S2.001	S7	600		386439.817	401723.933	386439.817	401723.933	
S2.002	S8	600		386450.051	401668.841	386450.051	401668.841	
S2.003	S9 - CP MH	600		386432.400	401665.449	386432.400	401665.449	
S2.004	S10- HB	1500		386417.454	401662.577	386417.454	401662.577	
S2.005	S11	450		386417.835	401659.512	386417.835	401659.512	

PN	DSMH Name	Dia/Len (mm)	Width (mm)	DS Easting (m)	DS Northing (m)	Layout (North)
S2.005	SS12 - New MH	1200		386419.291	401651.170	

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Area Summary for Storm North

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
2.000	-	-	100	0.037	0.037	0.037
2.001	-	-	100	0.019	0.019	0.019
2.002	-	-	100	0.018	0.018	0.018
2.003	-	-	100	0.000	0.000	0.000
2.004	-	-	100	0.035	0.035	0.035
2.005	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.109	0.109	0.109

Free Flowing Outfall Details for Storm North

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
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S2.005	SS12 - New MH	77.120	75.143	0.000	1200	0
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Simulation Criteria for Storm North

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	0.000
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 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	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	0.348		

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Online Controls for Storm North

Hydro-Brake® Optimum Manhole: S10- HB, DS/PN: S2.004, Volume (m³): 4.1

Unit Reference	MD-SHE-0075-3000-1500-3000
Design Head (m)	1.500
Design Flow (l/s)	3.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	75
Invert Level (m)	75.267
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	3.0	Kick-Flo®	0.671	2.1
Flush-Flo™	0.329	2.6	Mean Flow over Head Range	-	2.4

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)	Depth (m)	Flow (l/s)
0.100	2.1	0.800	2.2	2.000	3.4	4.000	4.7	7.000	6.1
0.200	2.5	1.000	2.5	2.200	3.6	4.500	5.0	7.500	6.3
0.300	2.6	1.200	2.7	2.400	3.7	5.000	5.2	8.000	6.5
0.400	2.6	1.400	2.9	2.600	3.9	5.500	5.5	8.500	6.7
0.500	2.5	1.600	3.1	3.000	4.1	6.000	5.7	9.000	6.9
0.600	2.3	1.800	3.3	3.500	4.4	6.500	5.9	9.500	7.1

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Storage Structures for Storm North

Cellular Storage Manhole: S10- HB, DS/PN: S2.004

Invert Level (m) 75.393 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)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	48.0	48.0	1.200	48.0	86.4	1.210	0.0	86.4

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

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
 Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 0.000
 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) 18.300 Cv (Summer) 1.000
 Region England and Wales Ratio R 0.350 Cv (Winter) 1.000

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

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

									Water	Surcharged
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Level (m)	Depth (m)
S2.000	S6	15 Summer	1	+0%	100/15 Summer				76.412	-0.088
S2.001	S7	15 Summer	1	+0%	100/15 Summer				75.982	-0.154
S2.002	S8	15 Summer	1	+0%	30/30 Summer				75.614	-0.148
S2.003	S9 - CP MH	60 Summer	1	+0%	30/15 Summer				75.511	-0.107
S2.004	S10- HB	60 Summer	1	+0%	1/30 Summer				75.508	0.016
S2.005	S11	60 Summer	1	+0%					75.268	-0.110

		Flooded		Half Drain		Pipe			
PN	US/MH Name	Volume (m ³)	Flow / Overflow Cap. (l/s)	Time (mins)	Flow (l/s)	Status	Level Exceeded		
S2.000	S6	0.000	0.36		6.4	OK			
S2.001	S7	0.000	0.21		8.5	OK			
S2.002	S8	0.000	0.26		10.7	OK			
S2.003	S9 - CP MH	0.000	0.18		7.6	OK			
S2.004	S10- HB	0.000	0.08	36	2.5	SURCHARGED			
S2.005	S11	0.000	0.16		2.5	OK			

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

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
 Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 0.000
 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) 18.300 Cv (Summer) 1.000
 Region England and Wales Ratio R 0.350 Cv (Winter) 1.000

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

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.	Water	Surcharged
									Level (m)	Depth (m)
S2.000	S6	15 Summer	30	+0%	100/15 Summer				76.459	-0.041
S2.001	S7	15 Summer	30	+0%	100/15 Summer				76.034	-0.102
S2.002	S8	60 Winter	30	+0%	30/30 Summer				75.818	0.056
S2.003	S9 - CP MH	60 Winter	30	+0%	30/15 Summer				75.813	0.195
S2.004	S10- HB	60 Winter	30	+0%	1/30 Summer				75.810	0.318
S2.005	S11	60 Summer	30	+0%					75.269	-0.109

PN	US/MH Name	Flooded Volume (m ³)	Flow / Cap.	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S2.000	S6	0.000	0.87		15.5	OK	
S2.001	S7	0.000	0.54		22.1	OK	
S2.002	S8	0.000	0.32		13.4	SURCHARGED	
S2.003	S9 - CP MH	0.000	0.30		12.4	SURCHARGED	
S2.004	S10- HB	0.000	0.09	80	2.6	SURCHARGED	
S2.005	S11	0.000	0.17		2.6	OK	

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

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
 Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 0.000
 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) 18.300 Cv (Summer) 1.000
 Region England and Wales Ratio R 0.350 Cv (Winter) 1.000

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

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.	Water	Surcharged
									Level (m)	Depth (m)
S2.000	S6	15 Summer	100	+45%	100/15 Summer				77.208	0.708
S2.001	S7	120 Winter	100	+45%	100/15 Summer				76.470	0.334
S2.002	S8	120 Winter	100	+45%	30/30 Summer				76.464	0.702
S2.003	S9 - CP MH	120 Winter	100	+45%	30/15 Summer				76.460	0.842
S2.004	S10- HB	120 Winter	100	+45%	1/30 Summer				76.455	0.963
S2.005	S11	120 Winter	100	+45%					75.270	-0.108

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level
								Exceeded
S2.000	S6	0.000	1.58			28.2	FLOOD RISK	
S2.001	S7	0.000	0.31			12.6	SURCHARGED	
S2.002	S8	0.000	0.36			14.8	SURCHARGED	
S2.003	S9 - CP MH	0.000	0.35			14.7	SURCHARGED	
S2.004	S10- HB	0.000	0.09		200	2.7	SURCHARGED	
S2.005	S11	0.000	0.17			2.7	OK	