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Modulus House Salterns Lane Fareham PO16 0QS	90 Rose Green Road Bognor Regis	
Date 25.01.2018	Designed by JPS	
File E-E1644 SW MODEL.MDX	Checked by APT	
XP Solutions		Network 2015.2

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)	1	Add Flow / Climate Change (%)	0
M5-60 (mm)	19.000	Minimum Backdrop Height (m)	0.200
Ratio R	0.350	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

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)	Auto Design
S1.000	19.963	0.780	25.6	0.093	4.00	0.0	0.600	o	150	
S1.001	22.503	0.230	97.8	0.007	0.00	0.0	0.600	o	150	
S1.002	7.432	0.080	92.9	0.000	0.00	0.0	0.600	o	150	
S1.003	11.123	0.290	38.4	0.005	0.00	0.0	0.600	o	150	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL Σ (m)	I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	4.17	5.380	0.093	0.0	0.0	0.0	2.00	35.3	12.7
S1.001	50.00	4.54	4.600	0.100	0.0	0.0	0.0	1.02	18.0	13.6
S1.002	50.00	4.65	4.370	0.100	0.0	0.0	0.0	1.04	18.4	13.6
S1.003	49.61	4.77	4.290	0.105	0.0	0.0	0.0	1.63	28.8	14.1

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.014	0.014	0.014
	User	-	100	0.010	0.010	0.024
	User	-	100	0.010	0.010	0.035
	User	-	100	0.010	0.010	0.045
	User	-	100	0.048	0.048	0.093
1.001	User	-	100	0.007	0.007	0.007
1.002	-	-	100	0.000	0.000	0.000
1.003	User	-	100	0.005	0.005	0.005
				Total	Total	Total
				0.105	0.105	0.105

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Online Controls for Storm

Hydro-Brake Optimum® Manhole: S4, DS/PN: S1.003, Volume (m³): 2.4

Unit Reference MD-SHE-0099-5000-1400-5000
Design Head (m) 1.400
Design Flow (l/s) 5.0
Flush-Flo™ Calculated
Objective Minimise upstream storage
Diameter (mm) 99
Invert Level (m) 4.290
Minimum Outlet Pipe Diameter (mm) 150
Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.400	5.0
Flush-Flo™	0.413	5.0
Kick-Flo®	0.852	4.0
Mean Flow over Head Range	-	4.4

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)
0.100	3.3	1.200	4.6	3.000	7.1	7.000	10.6
0.200	4.6	1.400	5.0	3.500	7.7	7.500	11.0
0.300	4.9	1.600	5.3	4.000	8.2	8.000	11.3
0.400	5.0	1.800	5.6	4.500	8.6	8.500	11.7
0.500	4.9	2.000	5.9	5.000	9.1	9.000	12.0
0.600	4.8	2.200	6.2	5.500	9.5	9.500	12.3
0.800	4.3	2.400	6.4	6.000	9.9		
1.000	4.3	2.600	6.7	6.500	10.3		

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Storage Structures for Storm

Cellular Storage Manhole: S2, DS/PN: S1.001

Invert Level (m) 4.600 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	42.5	0.0	5.200	0.0	0.0
0.400	42.5	0.0	5.600	0.0	0.0
0.800	42.5	0.0	6.000	0.0	0.0
1.200	0.0	0.0	6.400	0.0	0.0
1.600	0.0	0.0	6.800	0.0	0.0
2.000	0.0	0.0	7.200	0.0	0.0
2.400	0.0	0.0	7.600	0.0	0.0
2.800	0.0	0.0	8.000	0.0	0.0
3.200	0.0	0.0	8.400	0.0	0.0
3.600	0.0	0.0	8.800	0.0	0.0
4.000	0.0	0.0	9.200	0.0	0.0
4.400	0.0	0.0	9.600	0.0	0.0
4.800	0.0	0.0	10.000	0.0	0.0

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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 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 0.350
 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 ON
 Inertia Status ON

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600,
 720, 960, 1440
 Return Period(s) (years) 1, 30, 100
 Climate Change (%) 0, 0, 30

US/MH		Return Climate		First (X)	First (Y)	First (Z)	Overflow	Water
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Level
							Act.	(m)
S1.000	S1	15 Winter	100	+30%	100/15 Summer			6.233
S1.001	S2	60 Winter	100	+30%	30/15 Summer			5.303
S1.002	S3	60 Winter	100	+30%	1/15 Summer			5.289
S1.003	S4	60 Winter	100	+30%	1/15 Summer			5.281

US/MH		Surcharged	Flooded	Pipe		Level	
PN	Name	Depth (m)	Volume (m ³)	Flow / Cap.	Overflow (l/s)	Flow (l/s)	Status
							Exceeded
S1.000	S1	0.703	0.000	1.30		43.2	FLOOD RISK
S1.001	S2	0.553	0.000	0.45		7.6	SURCHARGED
S1.002	S3	0.769	0.000	0.36		5.7	SURCHARGED
S1.003	S4	0.841	0.000	0.19		4.9	SURCHARGED