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Dewey House 55 High Street Ringwood BH24 1AE	10456 Maitland Park Grafton Terrace Surface Water Drainage	
Date 28/04/2020 11:26 File GRAFTON SW DESIGN.MDX	Designed by MH Checked by MPD	
Elstree Computing Ltd		Network 2020.1

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)	10	PIMP (%)	100
M5-60 (mm)	21.000	Add Flow / Climate Change (%)	40
Ratio R	0.440	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	300	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	0.900
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)	300

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.071	4-8	0.026

Total Area Contributing (ha) = 0.097


Total Pipe Volume (m³) = 7.705

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
1.000	14.000	0.140	100.0	0.020	4.00	0.0	0.600	o	150	Pipe/Conduit
1.001	16.300	0.097	168.0	0.031	0.00	0.0	0.600	o	300	Pipe/Conduit
1.002	12.900	0.077	167.5	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit
1.003	14.000	0.083	168.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit
1.004	24.150	0.165	146.4	0.013	0.00	0.0	0.600	o	300	Pipe/Conduit
1.005	28.150	0.213	132.2	0.033	0.00	0.0	0.600	o	300	Pipe/Conduit
1.006	10.000	0.041	243.9	0.000	0.00	0.0	0.600	o	300	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	123.21	4.23	46.550	0.020	0.0	0.0	2.7	1.00	17.8	9.3
1.001	120.74	4.46	46.335	0.051	0.0	0.0	6.7	1.21	85.5	23.3
1.002	118.86	4.63	46.238	0.051	0.0	0.0	6.7	1.21	85.7	23.3
1.003	116.89	4.83	46.161	0.051	0.0	0.0	6.7	1.21	85.5	23.3
1.004	113.89	5.14	46.078	0.064	0.0	0.0	7.9	1.30	91.7	27.6
1.005	110.76	5.48	45.913	0.097	0.0	0.0	11.6	1.37	96.6	40.7
1.006	109.32	5.65	45.110	0.097	0.0	0.0	11.6	1.00	70.8	40.7

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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)
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1.006		47.060	45.069	45.000	0	0
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Simulation Criteria for Storm

Volumetric Runoff Coeff	0.840	Foul Sewage per hectare (l/s)	0.000
Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	40.000
Hot Start (mins)	0	MADD Factor * 10m ³ /ha Storage	2.000
Hot Start Level (mm)	0	Run Time (mins)	60
Manhole Headloss Coeff (Global)	0.500	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0		

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Winter
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	21.000	Storm Duration (mins)	30
Ratio R	0.439		

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Online Controls for Storm

Orifice Manhole: 6, DS/PN: 1.005, Volume (m³): 3.9

Diameter (m) 0.150 Discharge Coefficient 0.600 Invert Level (m) 45.913


Hydro-Brake® Optimum Manhole: 7, DS/PN: 1.006, Volume (m³): 4.1

Unit Reference	MD-SHE-0140-1100-1800-1100
Design Head (m)	1.800
Design Flow (l/s)	11.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	140
Invert Level (m)	45.110
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.800	11.0
Flush-Flo™	0.533	11.0
Kick-Flo®	1.103	8.7
Mean Flow over Head Range	-	9.6

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	5.1	1.200	9.1	3.000	14.0	7.000	21.0
0.200	9.4	1.400	9.8	3.500	15.1	7.500	21.7
0.300	10.4	1.600	10.4	4.000	16.1	8.000	22.4
0.400	10.8	1.800	11.0	4.500	17.0	8.500	23.1
0.500	11.0	2.000	11.6	5.000	17.9	9.000	23.7
0.600	11.0	2.200	12.1	5.500	18.7	9.500	24.3
0.800	10.6	2.400	12.6	6.000	19.5		
1.000	9.7	2.600	13.1	6.500	20.3		


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Storage Structures for Storm

Cellular Storage Manhole: 1, DS/PN: 1.000

Invert Level (m) 46.550 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	15.0	0.0	0.601	0.0	0.0
0.600	15.0	0.0			

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Summary of Results for 30 minute 100 year Winter (Storm)

Margin for Flood Risk Warning (mm) 300.0
 Analysis Timestep 2.5 Second Increment (Extended)
 DTS Status ON
 DVD Status ON
 Inertia Status ON

PN	US/MH Name	Water	Surcharged	Flooded	Half Drain Pipe		Status
		Level (m)	Depth (m)	Volume (m ³)	Flow / Cap.	Overflow (l/s)	
1.000	1	47.107	0.407	0.000	0.53		8.6 SURCHARGED
1.001	2	47.100	0.465	0.000	0.32		22.9 SURCHARGED
1.002	3	47.095	0.557	0.000	0.27		18.9 SURCHARGED
1.003	4	47.092	0.631	0.000	0.21		15.0 SURCHARGED
1.004	5	47.089	0.712	0.000	0.19		15.4 SURCHARGED
1.005	6	47.084	0.871	0.000	0.27		23.4 SURCHARGED
1.006	7	47.007	1.597	0.000	0.20		11.0 FLOOD RISK