



BELL MUNRO CONSULTING LTD.

**Proposed Development at
Osbourne's Yard**

**Drainage Calculations
June 2021**

	Initials	Signature	Date
Prepared by:	R.C		06/21
Checked by:	S.J.B		06/21
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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)	100	PIMP (%)	100
M5-60 (mm)	18.000	Add Flow / Climate Change (%)	0
Ratio R	0.361	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	22.376	0.373	60.0	0.024	4.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	37.605	0.627	60.0	0.039	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	18.651	0.186	100.0	0.015	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	20.402	0.255	80.0	0.054	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.000	33.316	0.416	80.1	0.028	4.00	0.0	0.600	o	150	Pipe/Conduit	
2.001	2.479	0.031	80.0	0.055	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.004	32.987	0.110	300.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.005	2.694	0.034	80.0	0.000	0.00	0.0	0.600	o	225	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	4.29	57.300	0.024	0.0	0.0	0.0	1.30	23.0	3.2
1.001	50.00	4.77	56.927	0.063	0.0	0.0	0.0	1.30	23.0	8.5
1.002	50.00	5.01	56.225	0.078	0.0	0.0	0.0	1.31	52.0	10.5
1.003	50.00	5.24	56.039	0.131	0.0	0.0	0.0	1.46	58.2	17.8
2.000	50.00	4.49	57.250	0.028	0.0	0.0	0.0	1.12	19.9	3.8
2.001	50.00	4.53	56.834	0.084	0.0	0.0	0.0	1.12	19.9	11.3
1.004	50.00	5.97	55.784	0.215	0.0	0.0	0.0	0.75	29.8	29.1
1.005	50.00	6.00	55.674	0.215	0.0	0.0	0.0	1.46	58.2	29.1

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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	0.024	0.024	0.024
1.001	User	-	100	0.039	0.039	0.039
1.002	User	-	100	0.015	0.015	0.015
1.003	User	-	100	0.054	0.054	0.054
2.000	User	-	100	0.028	0.028	0.028
2.001	User	-	100	0.055	0.055	0.055
1.004	-	-	100	0.000	0.000	0.000
1.005	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.215	0.215	0.215

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: SW08, DS/PN: 1.005, Volume (m³): 4.8

Unit Reference	MD-SHE-0183-1660-1000-1660
Design Head (m)	1.000
Design Flow (l/s)	16.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	183
Invert Level (m)	55.674
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	16.6
Flush-Flo™	0.328	16.6
Kick-Flo®	0.709	14.1
Mean Flow over Head Range	-	14.1

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	6.4	1.200	18.1	3.000	28.0	7.000	42.2
0.200	15.9	1.400	19.5	3.500	30.2	7.500	43.6
0.300	16.6	1.600	20.8	4.000	32.2	8.000	45.0
0.400	16.5	1.800	22.0	4.500	34.1	8.500	46.4
0.500	16.2	2.000	23.1	5.000	35.9	9.000	47.7
0.600	15.6	2.200	24.2	5.500	37.6	9.500	48.9
0.800	14.9	2.400	25.2	6.000	39.2		
1.000	16.6	2.600	26.2	6.500	40.7		

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Storage Structures for Storm Cellular Storage Manhole: SW07, DS/PN: 1.004 Invert Level (m) 55.784 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><thead><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr></thead><tbody><tr><td>0.000</td><td>68.0</td><td>68.0</td><td>0.801</td><td>0.0</td><td>101.6</td></tr><tr><td>0.800</td><td>68.0</td><td>101.6</td><td></td><td></td><td></td></tr></tbody></table>			Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	68.0	68.0	0.801	0.0	101.6	0.800	68.0	101.6			
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Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Flooded		Pipe		Status	Level Exceeded
		Depth (m)	Volume (m ³)	Flow / Overflow Cap.	Flow (l/s)		
2.000	SW05	0.260	0.000	0.76	14.6	FLOOD RISK	
2.001	SW06	0.453	0.000	3.88	42.8	FLOOD RISK	
1.004	SW07	0.496	0.000	0.68	19.1	SURCHARGED	
1.005	SW08	0.574	0.000	0.55	16.5	SURCHARGED	