



BELL MUNRO CONSULTING LTD.

**Proposed Development at
Osbourne's Yard**

**Drainage Calculations
Rev. A
September 2021**

	Initials	Signature	Date
Prepared by:	R.C		09/21
Checked by:	S.J.B		09/21
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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	4.691	0.255	18.4	0.054	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.000	48.517	0.485	100.0	0.028	4.00	0.0	0.600	o	150	Pipe/Conduit	
2.001	2.650	0.031	85.5	0.055	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.004	48.699	0.110	442.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.005	2.694	0.034	80.0	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)	I.Area (ha)	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	5.03	56.039	0.131	0.0	0.0	0.0	3.07	121.9	17.8
2.000	50.00	4.80	57.100	0.028	0.0	0.0	0.0	1.00	17.8	3.8
2.001	50.00	4.85	56.615	0.084	0.0	0.0	0.0	1.09	19.2	11.3
1.004	50.00	6.13	55.709	0.215	0.0	0.0	0.0	0.74	52.4	29.1
1.005	50.00	6.15	55.599	0.215	0.0	0.0	0.0	1.76	124.4	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): 7.1

Unit Reference	MD-SHE-0132-8000-1000-8000
Design Head (m)	1.000
Design Flow (l/s)	8.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	132
Invert Level (m)	55.599
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	8.0
Flush-Flo™	0.302	8.0
Kick-Flo®	0.664	6.6
Mean Flow over Head Range	-	6.9

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	4.7	1.200	8.7	3.000	13.4	7.000	20.1
0.200	7.8	1.400	9.4	3.500	14.5	7.500	20.8
0.300	8.0	1.600	10.0	4.000	15.4	8.000	21.5
0.400	7.9	1.800	10.5	4.500	16.3	8.500	22.1
0.500	7.7	2.000	11.1	5.000	17.1	9.000	22.7
0.600	7.2	2.200	11.6	5.500	17.9	9.500	23.3
0.800	7.2	2.400	12.1	6.000	18.7		
1.000	8.0	2.600	12.6	6.500	19.4		

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Date 27/09/2021 08:30	Designed by BMC 7																			
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Storage Structures for Storm Cellular Storage Manhole: SW07, DS/PN: 1.004 Invert Level (m) 55.709 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>136.0</td><td>68.0</td><td>0.801</td><td>0.0</td><td>101.6</td></tr><tr><td>0.800</td><td>136.0</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	136.0	68.0	0.801	0.0	101.6	0.800	136.0	101.6			
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0.000	136.0	68.0	0.801	0.0	101.6															
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Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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

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, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	100
Climate Change (%)	40

									Water
	US/MH		Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	(m)
1.000	SW01	15 Winter	100	+40%	100/15 Summer				57.662
1.001	SW02	15 Winter	100	+40%	100/15 Summer				57.565
1.002	SW03	15 Winter	100	+40%					56.377
1.003	SW04	120 Winter	100	+40%					56.241
2.000	SW05	15 Winter	100	+40%	100/15 Summer				57.540
2.001	SW06	15 Winter	100	+40%	100/15 Summer				57.210
1.004	SW07	120 Winter	100	+40%	100/15 Winter				56.237
1.005	SW08	180 Winter	100	+40%	100/15 Summer				56.273

PN	US/MH	Surcharged	Flooded	Flow / Cap.	Overflow (1/s)	Pipe	Status	Level
	Name	Depth (m)	Volume (m³)			Flow (1/s)		Exceeded
1.000	SW01	0.212	0.000	0.53		11.6	FLOOD	RISK
1.001	SW02	0.488	0.000	1.32		29.2	FLOOD	RISK
1.002	SW03	-0.073	0.000	0.78		36.4		OK
1.003	SW04	-0.023	0.000	0.34		24.2		OK

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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	0.290	0.000	0.82	14.2	FLOOD RISK	
2.001	SW06	0.445	0.000	3.87	42.7	SURCHARGED	
1.004	SW07	0.229	0.000	0.24	11.9	SURCHARGED	
1.005	SW08	0.374	0.000	0.13	8.0	SURCHARGED	