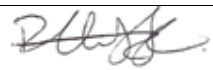




BELL MUNRO CONSULTING LTD.

**Proposed Development at
Osbourne's Yard,**

**Drainage Calculations
Rev. B
March 2022**

	Initials	Signature	Date
Prepared by:	R.C		03/22
Checked by:	S.J.B		03/22
Approved by:	S.J.B		03/22

Bell Munro Consulting Ltd.
Consulting Civil and Structural Engineers
Turing House
5 Archway
Manchester
M15 5RL
Tel: 0161 209 8032
Fax: 0161 209 8033
E-Mail: consulting@bellmunro.co.uk
Ref: J7119

Bell Munro Consulting Ltd										Page 1			
Turing House 5 Archway Manchester M15 5RL													
Date 11/03/2022 09:45										Designed by RichardCliffe			
File J7119 NETWORK 27 09 21.MDX										Checked by			
XP Solutions						Network 2020.1.3							
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)	E I.Area (ha)	E 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			
©1982-2020 Innovyze													

Bell Munro Consulting Ltd		Page 3																																																																																													
Turing House 5 Archway Manchester M15 5RL																																																																																															
Date 11/03/2022 09:45	Designed by RichardCliffe																																																																																														
File J7119 NETWORK 27 09 21.MDX	Checked by																																																																																														
XP Solutions		Network 2020.1.3																																																																																													
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 ObjectiveMinimise upstream storage ApplicationSurface Sump AvailableYes Diameter (mm)132 Invert Level (m)55.599 Minimum Outlet Pipe Diameter (mm)150 Suggested Manhole Diameter (mm)1200 <table><tr><th>Control Points</th><th>Head (m)</th><th>Flow (l/s)</th><th>Control Points</th><th>Head (m)</th><th>Flow (l/s)</th></tr><tr><td>Design Point (Calculated)</td><td>1.000</td><td>8.0</td><td>Kick-Flo®</td><td>0.664</td><td>6.6</td></tr><tr><td>Flush-Flo™</td><td>0.302</td><td>8.0</td><td>Mean Flow over Head Range</td><td>-</td><td>6.9</td></tr></table> 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 <table><tr><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th></tr><tr><td>0.100</td><td>4.7</td><td>1.200</td><td>8.7</td><td>3.000</td><td>13.4</td><td>7.000</td><td>20.1</td></tr><tr><td>0.200</td><td>7.8</td><td>1.400</td><td>9.4</td><td>3.500</td><td>14.5</td><td>7.500</td><td>20.8</td></tr><tr><td>0.300</td><td>8.0</td><td>1.600</td><td>10.0</td><td>4.000</td><td>15.4</td><td>8.000</td><td>21.5</td></tr><tr><td>0.400</td><td>7.9</td><td>1.800</td><td>10.5</td><td>4.500</td><td>16.3</td><td>8.500</td><td>22.1</td></tr><tr><td>0.500</td><td>7.7</td><td>2.000</td><td>11.1</td><td>5.000</td><td>17.1</td><td>9.000</td><td>22.7</td></tr><tr><td>0.600</td><td>7.2</td><td>2.200</td><td>11.6</td><td>5.500</td><td>17.9</td><td>9.500</td><td>23.3</td></tr><tr><td>0.800</td><td>7.2</td><td>2.400</td><td>12.1</td><td>6.000</td><td>18.7</td><td></td><td></td></tr><tr><td>1.000</td><td>8.0</td><td>2.600</td><td>12.6</td><td>6.500</td><td>19.4</td><td></td><td></td></tr></table> <tr><td colspan="3">©1982-2020 Innovyze</td></tr>			Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)	Design Point (Calculated)	1.000	8.0	Kick-Flo®	0.664	6.6	Flush-Flo™	0.302	8.0	Mean Flow over Head Range	-	6.9	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			©1982-2020 Innovyze		
Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)																																																																																										
Design Point (Calculated)	1.000	8.0	Kick-Flo®	0.664	6.6																																																																																										
Flush-Flo™	0.302	8.0	Mean Flow over Head Range	-	6.9																																																																																										
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																																																																																										
©1982-2020 Innovyze																																																																																															

Bell Munro Consulting Ltd		Page 4
Turing House 5 Archway Manchester M15 5RL		
Date 11/03/2022 09:45	Designed by RichardCliffe	
File J7119 NETWORK 27 09 21.MDX	Checked by	
XP Solutions		Network 2020.1.3

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

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	136.0	68.0	0.801	0.0	101.6
0.800	136.0	101.6			

©1982-2020 Innovyze

Bell Munro Consulting Ltd							Page 1																																																																																																															
Turing House 5 Archway Manchester M15 5RL																																																																																																																						
Date 11/03/2022 09:50																																																																																																																						
File J7119 NETWORK 27 09 21.MDX																																																																																																																						
Designed by RichardCliffe					Checked by																																																																																																																	
XP Solutions					Network 2020.1.3																																																																																																																	
<u>Summary of Critical Results by Maximum Level (Rank 1) for Storm</u>																																																																																																																						
<u>Simulation Criteria</u>																																																																																																																						
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 Coeffiecient 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																																																																																																																						
<u>Synthetic Rainfall Details</u>																																																																																																																						
Rainfall Model FSR Ratio R 0.361																																																																																																																						
Region England and Wales Cv (Summer) 0.750																																																																																																																						
M5-60 (mm) 18.000 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, 2160, 2880, 4320, 5760, 7200, 8640, 10080																																																																																																																						
Return Period(s) (years) 30																																																																																																																						
Climate Change (%) 0																																																																																																																						
<table><tr><th></th><th>US/MH</th><th></th><th>Return</th><th>Climate</th><th>First (X)</th><th>First (Y)</th><th>First (Z)</th><th>Overflow</th><th>Water</th></tr><tr><th>PN</th><th>Name</th><th>Storm</th><th>Period</th><th>Change</th><th>Surcharge</th><th>Flood</th><th>Overflow</th><th>Act.</th><th>Level</th></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>(m)</td></tr><tr><td>1.000</td><td>SW01</td><td>15 Winter</td><td>30</td><td>+0%</td><td></td><td></td><td></td><td></td><td>57.361</td></tr><tr><td>1.001</td><td>SW02</td><td>15 Winter</td><td>30</td><td>+0%</td><td></td><td></td><td></td><td></td><td>57.038</td></tr><tr><td>1.002</td><td>SW03</td><td>15 Winter</td><td>30</td><td>+0%</td><td></td><td></td><td></td><td></td><td>56.341</td></tr><tr><td>1.003</td><td>SW04</td><td>15 Winter</td><td>30</td><td>+0%</td><td></td><td></td><td></td><td></td><td>56.162</td></tr><tr><td>2.000</td><td>SW05</td><td>15 Winter</td><td>30</td><td>+0%</td><td></td><td></td><td></td><td></td><td>57.177</td></tr><tr><td>2.001</td><td>SW06</td><td>15 Winter</td><td>30</td><td>+0%</td><td>30/15 Summer</td><td></td><td></td><td></td><td>56.899</td></tr><tr><td>1.004</td><td>SW07</td><td>60 Winter</td><td>30</td><td>+0%</td><td></td><td></td><td></td><td></td><td>55.935</td></tr><tr><td>1.005</td><td>SW08</td><td>60 Winter</td><td>30</td><td>+0%</td><td>30/30 Winter</td><td></td><td></td><td></td><td>55.924</td></tr></table>										US/MH		Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Water	PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	Level										(m)	1.000	SW01	15 Winter	30	+0%					57.361	1.001	SW02	15 Winter	30	+0%					57.038	1.002	SW03	15 Winter	30	+0%					56.341	1.003	SW04	15 Winter	30	+0%					56.162	2.000	SW05	15 Winter	30	+0%					57.177	2.001	SW06	15 Winter	30	+0%	30/15 Summer				56.899	1.004	SW07	60 Winter	30	+0%					55.935	1.005	SW08	60 Winter	30	+0%	30/30 Winter				55.924
	US/MH		Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Water																																																																																																													
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	Level																																																																																																													
									(m)																																																																																																													
1.000	SW01	15 Winter	30	+0%					57.361																																																																																																													
1.001	SW02	15 Winter	30	+0%					57.038																																																																																																													
1.002	SW03	15 Winter	30	+0%					56.341																																																																																																													
1.003	SW04	15 Winter	30	+0%					56.162																																																																																																													
2.000	SW05	15 Winter	30	+0%					57.177																																																																																																													
2.001	SW06	15 Winter	30	+0%	30/15 Summer				56.899																																																																																																													
1.004	SW07	60 Winter	30	+0%					55.935																																																																																																													
1.005	SW08	60 Winter	30	+0%	30/30 Winter				55.924																																																																																																													
©1982-2020 Innovyze																																																																																																																						

Bell Munro Consulting Ltd							Page 1		
Turing House 5 Archway Manchester M15 5RL									
Date 11/03/2022 09:46								Designed by RichardCliffe	
File J7119 NETWORK 27 09 21.MDX								Checked by	
XP Solutions					Network 2020.1.3				
<u>Summary of Critical Results by Maximum Level (Rank 1) for Storm</u>									
<u>Simulation Criteria</u>									
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 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									
<u>Synthetic Rainfall Details</u>									
Rainfall Model FSR Ratio R 0.361									
Region England and Wales Cv (Summer) 0.750									
M5-60 (mm) 18.000 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, 2160, 2880, 4320, 5760, 7200, 8640, 10080									
Return Period(s) (years) 100									
Climate Change (%) 40									

