

Paul Waite Associates			Page 1																																																																																																																																																																																																																																																																																																																																																																																																																							
Summit House Riparian Way Keighley BD20 7BW			22228-PWA-00-XX-CA-C-3001 P01 SURFACE WATER CALCULATIONS GENESIS BUSINESS PARK																																																																																																																																																																																																																																																																																																																																																																																																																							
Date 11/08/2023 File 22228-PWA-00-XX-CA-C-30...			Designed by IB Checked by LS																																																																																																																																																																																																																																																																																																																																																																																																																							
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Summary of Results for 100 year Return Period (+30%) Half Drain Time : 336 minutes. <table><thead><tr><th>Storm Event</th><th>Max Level (m)</th><th>Max Depth (m)</th><th>Max Infiltration (l/s)</th><th>Max Control (l/s)</th><th>Max Outflow (l/s)</th><th>Max Volume (m³)</th><th>Status</th></tr></thead><tbody><tr><td>15 min Summer</td><td>8.042</td><td>0.442</td><td>0.0</td><td>5.0</td><td>5.0</td><td>75.6</td><td>O K</td></tr><tr><td>30 min Summer</td><td>8.199</td><td>0.599</td><td>0.0</td><td>5.0</td><td>5.0</td><td>102.4</td><td>O K</td></tr><tr><td>60 min Summer</td><td>8.363</td><td>0.763</td><td>0.0</td><td>5.0</td><td>5.0</td><td>130.5</td><td>O K</td></tr><tr><td>120 min Summer</td><td>8.515</td><td>0.915</td><td>0.0</td><td>5.0</td><td>5.0</td><td>156.4</td><td>O K</td></tr><tr><td>180 min Summer</td><td>8.572</td><td>0.972</td><td>0.0</td><td>5.0</td><td>5.0</td><td>166.2</td><td>O K</td></tr><tr><td>240 min Summer</td><td>8.595</td><td>0.995</td><td>0.0</td><td>5.0</td><td>5.0</td><td>170.1</td><td>O K</td></tr><tr><td>360 min Summer</td><td>8.600</td><td>1.000</td><td>0.0</td><td>5.0</td><td>5.0</td><td>171.0</td><td>O K</td></tr><tr><td>480 min Summer</td><td>8.590</td><td>0.990</td><td>0.0</td><td>5.0</td><td>5.0</td><td>169.4</td><td>O K</td></tr><tr><td>600 min Summer</td><td>8.574</td><td>0.974</td><td>0.0</td><td>5.0</td><td>5.0</td><td>166.6</td><td>O K</td></tr><tr><td>720 min Summer</td><td>8.555</td><td>0.955</td><td>0.0</td><td>5.0</td><td>5.0</td><td>163.3</td><td>O K</td></tr><tr><td>960 min Summer</td><td>8.510</td><td>0.910</td><td>0.0</td><td>5.0</td><td>5.0</td><td>155.6</td><td>O K</td></tr><tr><td>1440 min Summer</td><td>8.397</td><td>0.797</td><td>0.0</td><td>5.0</td><td>5.0</td><td>136.2</td><td>O K</td></tr><tr><td>2160 min Summer</td><td>8.234</td><td>0.634</td><td>0.0</td><td>5.0</td><td>5.0</td><td>108.4</td><td>O K</td></tr><tr><td>2880 min Summer</td><td>8.099</td><td>0.499</td><td>0.0</td><td>5.0</td><td>5.0</td><td>85.3</td><td>O K</td></tr><tr><td>4320 min Summer</td><td>7.914</td><td>0.314</td><td>0.0</td><td>4.9</td><td>4.9</td><td>53.7</td><td>O K</td></tr><tr><td>5760 min Summer</td><td>7.812</td><td>0.212</td><td>0.0</td><td>4.6</td><td>4.6</td><td>36.3</td><td>O K</td></tr><tr><td>7200 min Summer</td><td>7.755</td><td>0.155</td><td>0.0</td><td>4.3</td><td>4.3</td><td>26.6</td><td>O K</td></tr><tr><td>8640 min Summer</td><td>7.725</td><td>0.125</td><td>0.0</td><td>4.0</td><td>4.0</td><td>21.4</td><td>O K</td></tr><tr><td>10080 min Summer</td><td>7.711</td><td>0.111</td><td>0.0</td><td>3.6</td><td>3.6</td><td>18.9</td><td>O K</td></tr><tr><td>15 min Winter</td><td>8.097</td><td>0.497</td><td>0.0</td><td>5.0</td><td>5.0</td><td>85.0</td><td>O K</td></tr><tr><td>30 min Winter</td><td>8.275</td><td>0.675</td><td>0.0</td><td>5.0</td><td>5.0</td><td>115.4</td><td>O K</td></tr><tr><td>60 min Winter</td><td>8.466</td><td>0.866</td><td>0.0</td><td>5.0</td><td>5.0</td><td>148.0</td><td>O K</td></tr><tr><td>120 min Winter</td><td>8.639</td><td>1.039</td><td>0.0</td><td>5.0</td><td>5.0</td><td>177.7</td><td>O K</td></tr><tr><td>180 min Winter</td><td>8.709</td><td>1.109</td><td>0.0</td><td>5.0</td><td>5.0</td><td>189.6</td><td>O K</td></tr><tr><td>240 min Winter</td><td>8.742</td><td>1.142</td><td>0.0</td><td>5.0</td><td>5.0</td><td>195.2</td><td>O K</td></tr><tr><td>360 min Winter</td><td>8.758</td><td>1.158</td><td>0.0</td><td>5.0</td><td>5.0</td><td>198.0</td><td>O K</td></tr><tr><td>480 min Winter</td><td>8.741</td><td>1.141</td><td>0.0</td><td>5.0</td><td>5.0</td><td>195.1</td><td>O K</td></tr><tr><td>600 min Winter</td><td>8.720</td><td>1.120</td><td>0.0</td><td>5.0</td><td>5.0</td><td>191.5</td><td>O K</td></tr><tr><td>720 min Winter</td><td>8.694</td><td>1.094</td><td>0.0</td><td>5.0</td><td>5.0</td><td>187.0</td><td>O K</td></tr><tr><td>960 min Winter</td><td>8.629</td><td>1.029</td><td>0.0</td><td>5.0</td><td>5.0</td><td>176.0</td><td>O K</td></tr></tbody></table> <table><thead><tr><th>Storm Event</th><th>Rain (mm/hr)</th><th>Flooded Volume (m³)</th><th>Discharge Volume (m³)</th><th>Time-Peak (mins)</th></tr></thead><tbody><tr><td>15 min Summer</td><td>116.002</td><td>0.0</td><td>78.5</td><td>18</td></tr><tr><td>30 min Summer</td><td>79.998</td><td>0.0</td><td>108.4</td><td>33</td></tr><tr><td>60 min Summer</td><td>52.662</td><td>0.0</td><td>143.4</td><td>62</td></tr><tr><td>120 min Summer</td><td>33.322</td><td>0.0</td><td>181.6</td><td>122</td></tr><tr><td>180 min Summer</td><td>24.998</td><td>0.0</td><td>204.4</td><td>182</td></tr><tr><td>240 min Summer</td><td>20.313</td><td>0.0</td><td>221.4</td><td>240</td></tr><tr><td>360 min Summer</td><td>15.144</td><td>0.0</td><td>247.6</td><td>324</td></tr><tr><td>480 min Summer</td><td>12.271</td><td>0.0</td><td>267.6</td><td>384</td></tr><tr><td>600 min Summer</td><td>10.413</td><td>0.0</td><td>283.8</td><td>450</td></tr><tr><td>720 min Summer</td><td>9.099</td><td>0.0</td><td>297.6</td><td>518</td></tr><tr><td>960 min Summer</td><td>7.345</td><td>0.0</td><td>320.3</td><td>656</td></tr><tr><td>1440 min Summer</td><td>5.419</td><td>0.0</td><td>354.4</td><td>924</td></tr><tr><td>2160 min Summer</td><td>3.986</td><td>0.0</td><td>391.6</td><td>1300</td></tr><tr><td>2880 min Summer</td><td>3.200</td><td>0.0</td><td>419.1</td><td>1668</td></tr><tr><td>4320 min Summer</td><td>2.349</td><td>0.0</td><td>461.2</td><td>2340</td></tr><tr><td>5760 min Summer</td><td>1.888</td><td>0.0</td><td>494.7</td><td>3048</td></tr><tr><td>7200 min Summer</td><td>1.594</td><td>0.0</td><td>522.2</td><td>3744</td></tr><tr><td>8640 min Summer</td><td>1.389</td><td>0.0</td><td>545.9</td><td>4408</td></tr><tr><td>10080 min Summer</td><td>1.237</td><td>0.0</td><td>566.8</td><td>5136</td></tr><tr><td>15 min 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(l/s)	Max Control (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status	15 min Summer	8.042	0.442	0.0	5.0	5.0	75.6	O K	30 min Summer	8.199	0.599	0.0	5.0	5.0	102.4	O K	60 min Summer	8.363	0.763	0.0	5.0	5.0	130.5	O K	120 min Summer	8.515	0.915	0.0	5.0	5.0	156.4	O K	180 min Summer	8.572	0.972	0.0	5.0	5.0	166.2	O K	240 min Summer	8.595	0.995	0.0	5.0	5.0	170.1	O K	360 min Summer	8.600	1.000	0.0	5.0	5.0	171.0	O K	480 min Summer	8.590	0.990	0.0	5.0	5.0	169.4	O K	600 min Summer	8.574	0.974	0.0	5.0	5.0	166.6	O K	720 min Summer	8.555	0.955	0.0	5.0	5.0	163.3	O K	960 min Summer	8.510	0.910	0.0	5.0	5.0	155.6	O K	1440 min Summer	8.397	0.797	0.0	5.0	5.0	136.2	O K	2160 min Summer	8.234	0.634	0.0	5.0	5.0	108.4	O K	2880 min Summer	8.099	0.499	0.0	5.0	5.0	85.3	O K	4320 min Summer	7.914	0.314	0.0	4.9	4.9	53.7	O K	5760 min Summer	7.812	0.212	0.0	4.6	4.6	36.3	O K	7200 min Summer	7.755	0.155	0.0	4.3	4.3	26.6	O K	8640 min Summer	7.725	0.125	0.0	4.0	4.0	21.4	O K	10080 min Summer	7.711	0.111	0.0	3.6	3.6	18.9	O K	15 min Winter	8.097	0.497	0.0	5.0	5.0	85.0	O K	30 min Winter	8.275	0.675	0.0	5.0	5.0	115.4	O K	60 min Winter	8.466	0.866	0.0	5.0	5.0	148.0	O K	120 min Winter	8.639	1.039	0.0	5.0	5.0	177.7	O K	180 min Winter	8.709	1.109	0.0	5.0	5.0	189.6	O K	240 min Winter	8.742	1.142	0.0	5.0	5.0	195.2	O K	360 min Winter	8.758	1.158	0.0	5.0	5.0	198.0	O K	480 min Winter	8.741	1.141	0.0	5.0	5.0	195.1	O K	600 min Winter	8.720	1.120	0.0	5.0	5.0	191.5	O K	720 min Winter	8.694	1.094	0.0	5.0	5.0	187.0	O K	960 min Winter	8.629	1.029	0.0	5.0	5.0	176.0	O K	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	15 min Summer	116.002	0.0	78.5	18	30 min Summer	79.998	0.0	108.4	33	60 min Summer	52.662	0.0	143.4	62	120 min Summer	33.322	0.0	181.6	122	180 min Summer	24.998	0.0	204.4	182	240 min Summer	20.313	0.0	221.4	240	360 min Summer	15.144	0.0	247.6	324	480 min Summer	12.271	0.0	267.6	384	600 min Summer	10.413	0.0	283.8	450	720 min Summer	9.099	0.0	297.6	518	960 min Summer	7.345	0.0	320.3	656	1440 min Summer	5.419	0.0	354.4	924	2160 min Summer	3.986	0.0	391.6	1300	2880 min Summer	3.200	0.0	419.1	1668	4320 min Summer	2.349	0.0	461.2	2340	5760 min Summer	1.888	0.0	494.7	3048	7200 min Summer	1.594	0.0	522.2	3744	8640 min Summer	1.389	0.0	545.9	4408	10080 min Summer	1.237	0.0	566.8	5136	15 min Winter	116.002	0.0	88.0	18	30 min Winter	79.998	0.0	121.5	33	60 min Winter	52.662	0.0	160.7	62	120 min Winter	33.322	0.0	203.4	120	180 min Winter	24.998	0.0	228.9	178	240 min Winter	20.313	0.0	248.0	234	360 min Winter	15.144	0.0	277.4	342	480 min Winter	12.271	0.0	299.7	438	600 min Winter	10.413	0.0	317.9	472	720 min Winter	9.099	0.0	333.3	550	960 min Winter	7.345	0.0	358.8	710
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status																																																																																																																																																																																																																																																																																																																																																																																																																			
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30 min Summer	79.998	0.0	108.4	33																																																																																																																																																																																																																																																																																																																																																																																																																						
60 min Summer	52.662	0.0	143.4	62																																																																																																																																																																																																																																																																																																																																																																																																																						
120 min Summer	33.322	0.0	181.6	122																																																																																																																																																																																																																																																																																																																																																																																																																						
180 min Summer	24.998	0.0	204.4	182																																																																																																																																																																																																																																																																																																																																																																																																																						
240 min Summer	20.313	0.0	221.4	240																																																																																																																																																																																																																																																																																																																																																																																																																						
360 min Summer	15.144	0.0	247.6	324																																																																																																																																																																																																																																																																																																																																																																																																																						
480 min Summer	12.271	0.0	267.6	384																																																																																																																																																																																																																																																																																																																																																																																																																						
600 min Summer	10.413	0.0	283.8	450																																																																																																																																																																																																																																																																																																																																																																																																																						
720 min Summer	9.099	0.0	297.6	518																																																																																																																																																																																																																																																																																																																																																																																																																						
960 min Summer	7.345	0.0	320.3	656																																																																																																																																																																																																																																																																																																																																																																																																																						
1440 min Summer	5.419	0.0	354.4	924																																																																																																																																																																																																																																																																																																																																																																																																																						
2160 min Summer	3.986	0.0	391.6	1300																																																																																																																																																																																																																																																																																																																																																																																																																						
2880 min Summer	3.200	0.0	419.1	1668																																																																																																																																																																																																																																																																																																																																																																																																																						
4320 min Summer	2.349	0.0	461.2	2340																																																																																																																																																																																																																																																																																																																																																																																																																						
5760 min Summer	1.888	0.0	494.7	3048																																																																																																																																																																																																																																																																																																																																																																																																																						
7200 min Summer	1.594	0.0	522.2	3744																																																																																																																																																																																																																																																																																																																																																																																																																						
8640 min Summer	1.389	0.0	545.9	4408																																																																																																																																																																																																																																																																																																																																																																																																																						
10080 min Summer	1.237	0.0	566.8	5136																																																																																																																																																																																																																																																																																																																																																																																																																						
15 min Winter	116.002	0.0	88.0	18																																																																																																																																																																																																																																																																																																																																																																																																																						
30 min Winter	79.998	0.0	121.5	33																																																																																																																																																																																																																																																																																																																																																																																																																						
60 min Winter	52.662	0.0	160.7	62																																																																																																																																																																																																																																																																																																																																																																																																																						
120 min Winter	33.322	0.0	203.4	120																																																																																																																																																																																																																																																																																																																																																																																																																						
180 min Winter	24.998	0.0	228.9	178																																																																																																																																																																																																																																																																																																																																																																																																																						
240 min Winter	20.313	0.0	248.0	234																																																																																																																																																																																																																																																																																																																																																																																																																						
360 min Winter	15.144	0.0	277.4	342																																																																																																																																																																																																																																																																																																																																																																																																																						
480 min Winter	12.271	0.0	299.7	438																																																																																																																																																																																																																																																																																																																																																																																																																						
600 min Winter	10.413	0.0	317.9	472																																																																																																																																																																																																																																																																																																																																																																																																																						
720 min Winter	9.099	0.0	333.3	550																																																																																																																																																																																																																																																																																																																																																																																																																						
960 min Winter	7.345	0.0	358.8	710																																																																																																																																																																																																																																																																																																																																																																																																																						
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Innovyze	Source Control 2020.1.3	

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
1440 min Winter	8.472	0.872	0.0	5.0	5.0	149.0	O K
2160 min Winter	8.200	0.600	0.0	5.0	5.0	102.5	O K
2880 min Winter	8.007	0.407	0.0	5.0	5.0	69.6	O K
4320 min Winter	7.801	0.201	0.0	4.6	4.6	34.4	O K
5760 min Winter	7.724	0.124	0.0	4.0	4.0	21.2	O K
7200 min Winter	7.704	0.104	0.0	3.4	3.4	17.7	O K
8640 min Winter	7.691	0.091	0.0	3.0	3.0	15.6	O K
10080 min Winter	7.683	0.083	0.0	2.7	2.7	14.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
1440 min Winter	5.419	0.0	396.9	1022
2160 min Winter	3.986	0.0	438.6	1384
2880 min Winter	3.200	0.0	469.4	1728
4320 min Winter	2.349	0.0	516.6	2376
5760 min Winter	1.888	0.0	554.1	2992
7200 min Winter	1.594	0.0	584.9	3672
8640 min Winter	1.389	0.0	611.4	4400
10080 min Winter	1.237	0.0	634.9	5136

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Summit House Riparian Way Keighley BD20 7BW	22228-PWA-00-XX-CA-C-3001 P01 SURFACE WATER CALCULATIONS GENESIS BUSINESS PARK	
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Innovyze Source Control 2020.1.3		

Rainfall Details

Rainfall Model	FSR	Ratio R	0.300	Cv (Winter)	0.840
Return Period (years)	100	Summer Storms	Yes	Shortest Storm (mins)	15
Region	England and Wales	Winter Storms	Yes	Longest Storm (mins)	10080
M5-60 (mm)	20.000	Cv (Summer)	0.750	Climate Change %	+30

Time Area Diagram

Total Area (ha) 0.364

Time (mins)	Area (ha)
From: 0	To: 4 0.364

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Model Details

Storage is Online Cover Level (m) 10.000

Cellular Storage Structure

Invert Level (m) 7.600 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)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	180.0	0.0	1.199	180.0	0.0	1.200	0.0	0.0

Hydro-Brake® Optimum Outflow Control

Unit Reference MD-SHE-0100-5000-1400-5000 Sump Available Yes
Design Head (m) 1.400 Diameter (mm) 100
Design Flow (l/s) 5.0 Invert Level (m) 7.600
Flush-Flo™ Calculated Minimum Outlet Pipe Diameter (mm) 150
Objective Minimise upstream storage Suggested Manhole Diameter (mm) 1200
Application Surface

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.400	5.0	Kick-Flo®	0.855	4.0
Flush-Flo™	0.416	5.0	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)	Depth (m)	Flow (l/s)
0.100	3.3	0.800	4.3	2.000	5.9	4.000	8.2	7.000	10.7
0.200	4.6	1.000	4.3	2.200	6.2	4.500	8.6	7.500	11.0
0.300	4.9	1.200	4.7	2.400	6.4	5.000	9.1	8.000	11.4
0.400	5.0	1.400	5.0	2.600	6.7	5.500	9.5	8.500	11.7
0.500	5.0	1.600	5.3	3.000	7.1	6.000	9.9	9.000	12.0
0.600	4.9	1.800	5.6	3.500	7.7	6.500	10.3	9.500	12.3