History.

Revision	Date	Reason
p0	Nov 2017	Planning.

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Background.

To calculate proposed drainage characteristics and SW attenuation design in order to design the detailed site drainage.

Predevelopment Land Usage.

Pre-development site area (brownfield area)	0Ha.	(0 sqm)
Pre-development site area (greenfield area)	0.595 Ha.	(5950 sqm)
Total Site	**0.595 Ha.**	**(5950 sqm)**

Proposed Development Land Usage.

Rural area (s.landscaping etc)	0.065 Ha	(0650 sqm)
Roofs, driveways, pavement & access Rd	0.530 Ha	(5300 sqm)
Total Proposed Site	**0.595 Ha.**	**(5950 sqm)**

Pre-development Rainfall Runoff.

The site comprises both impermeable and permeable areas and thus run-off estimates can be considered as both greenfield and brownfield & calculated as follows:

Proposed Allowable Run-off.

Full site allowance was previously agreed between DWLLP Consulting Engineers and United Utilities.

Total site allowance	31.16 l/s

Total site area (all units)	2.8 Ha.
Unit D area	0.595 Ha.
Unit D allowance (as a ratio of site area), 0.595 / 2.8 x 31.16 =	**6.62 l/s**

Total Pre-development Run-off.

Site Partition	Individual Site Area (Ha)	Total Site Area (Ha)	Total Site Allowable Discharge (l/s)	Individual Site Allowable Discharge (l/s)
UNITS E & F	0.655	2.8	31.16	**7.29**
UNIT G	0.40	2.8	31.16	**4.45 (5l/s)**
UNIT A	0.482	2.8	31.16	**5.36**
UNIT D	0.595	2.8	31.16	**6.62**
UNIT C	0.668	2.8	31.16	**7.43**

Proposed SW Flood Attenuation System

The site is to be served by channel/slot drains and aco kerbs to the car parks, and siphonic drainage to the roof area.

To evaluate SUDS, different rainfall events were sized to give the critical volume required to retain the largest flood event volume. The system will utilise modular surface water storage crates to give the required volume for the 1:100yr+cc flood event, controlled by a Hydro-Break Optimum vortex flow control unit that will limit surface water to not greater than 6.62 l/s at a control head of 1.075m.

Flood Storage Attenuation & Discharges.

100 Year +CC Return Period.

The following indicates the flow control and storage on site before discharge in to the UU mains sewer.

Storage required	293m3 of attenuation storage
Storage provided	approx 297m3 (23m x 12m x 1.075m)
Refer to TJBA calculation spreadshhet in appendix.	All calculation are run with a 30% allowance for climate change.
Critical storm	480 Winter
Max water level	137.79m aOD = 1.06m depth.
Control	Hydro-Brake vortex control unit ngt 6.6l/s @ max 1.075m head
Max control discharge	6.6 l/s
Allowable discharge	= 6.62 l/s **OK**.

Refer to appendix for storm water attenuation & vortex discharge calculations.

Appendix.

Source Control SW Attenuation, 1:100+CC yr Rainfall Event.

T J Booth Associates		Page 1
104 Yorkshire St Rochdale Lancashire OL16 1JY	Condale Construction Unit D Tower Business Park	Micro Drainage
Date 12/09/17 File calc-tjba-CCL-tower bus pk, darwen...	Designed By DS Checked By	
Micro Drainage	Source Control W.10.4	

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

Storm Duration (mins)	Maximum Control (l/s)	Maximum Overflow (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Overflow Volume (m³)	Maximum Volume (m³)	Status
15 Summer	6.6	0.0	6.6	137.1077	0.3777	0.0	104.2	O K
30 Summer	6.6	0.0	6.6	137.2532	0.5232	0.0	144.4	O K
60 Summer	6.6	0.0	6.6	137.4198	0.6898	0.0	190.4	O K
120 Summer	6.6	0.0	6.6	137.5473	0.8173	0.0	225.6	O K
180 Summer	6.6	0.0	6.6	137.6188	0.8888	0.0	245.3	O K
240 Summer	6.6	0.0	6.6	137.6448	0.9148	0.0	252.4	O K
360 Summer	6.6	0.0	6.6	137.6423	0.9123	0.0	251.8	O K
480 Summer	6.6	0.0	6.6	137.6543	0.9243	0.0	255.1	O K
600 Summer	6.6	0.0	6.6	137.6453	0.9153	0.0	252.6	O K
720 Summer	6.6	0.0	6.6	137.6323	0.9023	0.0	249.0	O K
960 Summer	6.6	0.0	6.6	137.5998	0.8698	0.0	240.1	O K
1440 Summer	6.6	0.0	6.6	137.5228	0.7928	0.0	218.8	O K
2160 Summer	6.6	0.0	6.6	137.3938	0.6638	0.0	183.2	O K
2880 Summer	6.6	0.0	6.6	137.2677	0.5377	0.0	148.4	O K
4320 Summer	6.6	0.0	6.6	137.0822	0.3522	0.0	97.3	O K
5760 Summer	6.5	0.0	6.5	136.9737	0.2437	0.0	67.3	O K
7200 Summer	6.2	0.0	6.2	136.9193	0.1892	0.0	52.3	O K
8640 Summer	5.5	0.0	5.5	136.8893	0.1593	0.0	43.9	O K
10080 Summer	5.0	0.0	5.0	136.8672	0.1373	0.0	37.8	O K
15 Winter	6.6	0.0	6.6	137.1702	0.4402	0.0	121.5	O K
30 Winter	6.6	0.0	6.6	137.3337	0.6038	0.0	166.7	O K
60 Winter	6.6	0.0	6.6	137.5103	0.7803	0.0	215.3	O K
120 Winter	6.6	0.0	6.6	137.6733	0.9433	0.0	260.4	O K
180 Winter	6.6	0.0	6.6	137.7423	1.0123	0.0	279.3	O K
240 Winter	6.6	0.0	6.6	137.7763	1.0463	0.0	288.8	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	89.23	18
30 Summer	61.54	33
60 Summer	40.51	66
120 Summer	25.63	122
180 Summer	19.23	184
240 Summer	15.63	242
360 Summer	11.65	330
480 Summer	9.44	392
600 Summer	8.01	454
720 Summer	7.00	522
960 Summer	5.65	660
1440 Summer	4.17	940
2160 Summer	3.07	1340
2880 Summer	2.46	1704
4320 Summer	1.81	2388
5760 Summer	1.45	3064
7200 Summer	1.23	3752
8640 Summer	1.07	4424
10080 Summer	0.95	5152
15 Winter	89.23	22
30 Winter	61.54	37
60 Winter	40.51	66
120 Winter	25.63	122
180 Winter	19.23	180
240 Winter	15.63	236

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104 Yorkshire St Rochdale Lancashire OL16 1JY	Condale Construction Unit D Tower Business Park	Micro Drainage
Date 12/09/17 File calc-tjba-CCL-tower bus pk, darwen...	Designed By DS Checked By	
Micro Drainage	Source Control W.10.4	

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

Storm Duration (mins)	Maximum Control (l/s)	Maximum Overflow (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Overflow Volume (m³)	Maximum Volume (m³)	Status
360 Winter	6.6	0.0	6.6	137.7853	1.0553	0.0	291.3	O K
480 Winter	6.6	0.0	6.6	137.7918	1.0618	0.0	293.0	O K
600 Winter	6.6	0.0	6.6	137.7788	1.0488	0.0	289.4	O K
720 Winter	6.6	0.0	6.6	137.7608	1.0308	0.0	284.5	O K
960 Winter	6.6	0.0	6.6	137.7138	0.9838	0.0	271.5	O K
1440 Winter	6.6	0.0	6.6	137.6003	0.8703	0.0	240.2	O K
2160 Winter	6.6	0.0	6.6	137.3972	0.6673	0.0	184.1	O K
2880 Winter	6.6	0.0	6.6	137.2007	0.4707	0.0	129.9	O K
4320 Winter	6.5	0.0	6.5	136.9672	0.2372	0.0	65.5	O K
5760 Winter	5.7	0.0	5.7	136.8962	0.1663	0.0	45.9	O K
7200 Winter	4.8	0.0	4.8	136.8593	0.1293	0.0	35.7	O K
8640 Winter	4.3	0.0	4.3	136.8337	0.1038	0.0	28.7	O K
10080 Winter	3.9	0.0	3.9	136.8217	0.0918	0.0	25.3	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
360 Winter	11.65	344
480 Winter	9.44	442
600 Winter	8.01	478
720 Winter	7.00	554
960 Winter	5.65	712
1440 Winter	4.17	1018
2160 Winter	3.07	1448
2880 Winter	2.46	1792
4320 Winter	1.81	2416
5760 Winter	1.45	3064
7200 Winter	1.23	3760
8640 Winter	1.07	4488
10080 Winter	0.95	5144

Rainfall Details

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

Pipe Network

Volume in Pipe Network (m^3)	6	Dia of Outfall Pipe (m)	0.200
Slope of Outfall Pipe (1:x)	200.0	Roughness of Outfall Pipe	0.600

Time / Area Diagram

Total Area (ha) = 0.530

Time from:	(mins) to:	Area (ha)
0	4	0.530

Tank/Pond Details

Invert Level (m) 136.730 Ground Level (m) 138.600

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.00	276.0	0.60	276.0	1.20	276.0	1.80	276.0	2.40	276.0
0.10	276.0	0.70	276.0	1.30	276.0	1.90	276.0	2.50	276.0
0.20	276.0	0.80	276.0	1.40	276.0	2.00	276.0		
0.30	276.0	0.90	276.0	1.50	276.0	2.10	276.0		
0.40	276.0	1.00	276.0	1.60	276.0	2.20	276.0		
0.50	276.0	1.10	276.0	1.70	276.0	2.30	276.0		

Depth / Flow Outflow Control

Invert Level of Control 136.730

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)
0.10	4.2	0.80	5.7	2.00	6.9	4.00	6.9	7.00	6.9
0.20	6.4	1.00	6.4	2.20	6.9	4.50	6.9	7.50	6.9
0.30	6.6	1.20	6.9	2.40	6.9	5.00	6.9	8.00	6.9
0.40	6.5	1.40	6.9	2.60	6.9	5.50	6.9	8.50	6.9
0.50	6.4	1.60	6.9	3.00	6.9	6.00	6.9	9.00	6.9
0.60	6.0	1.80	6.9	3.50	6.9	6.50	6.9	9.50	6.9

Pipe Overflow Control

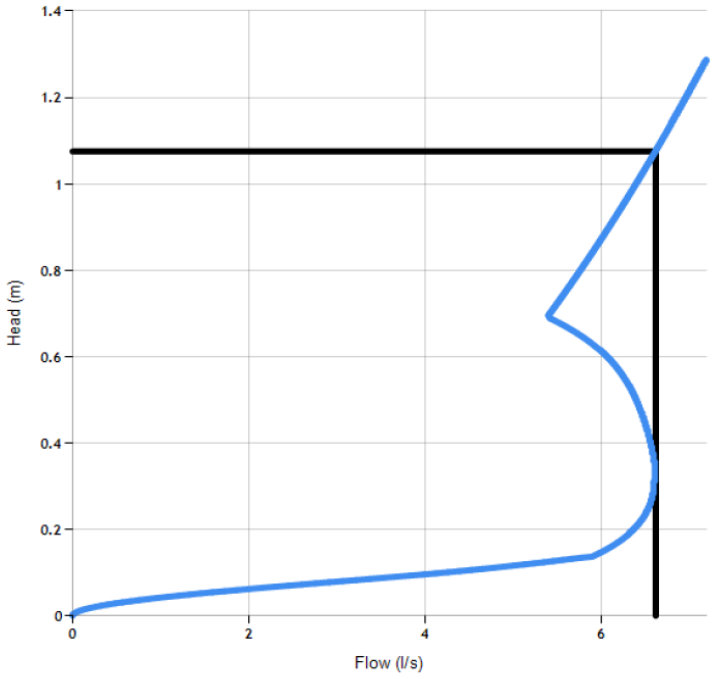
Pipe Diameter (m)	0.150	Entry Loss Coef	0.500
Slope (1:x)	60.0	Coef of Contraction	0.600
Length (m)	6.000	Invert Level (m)	137.810
Roughness (mm)	0.600		

Hydro-brake Technical Details.

Technical Specification		
Control Point	Head (m)	Flow (l/s)
Primary Design	1.075	6.618
Flush-Flo™	0.318	6.610
Kick-Flo®	0.691	5.389
Mean Flow		5.741

BBA APPROVAL INSPECTION TESTING CERTIFICATION
CERTIFICATE No 08/4596

WRc APPROVED
PT/329/0412



Head (m)	Flow (l/s)
0.000	0.000
0.037	0.792
0.074	2.715
0.111	4.788
0.148	6.013
0.185	6.293
0.222	6.466
0.259	6.562
0.297	6.604
0.334	6.608
0.371	6.585
0.408	6.546
0.445	6.494
0.482	6.429
0.519	6.348
0.556	6.241
0.593	6.095
0.630	5.894
0.667	5.619
0.704	5.438
0.741	5.569
0.778	5.696
0.816	5.820
0.853	5.941
0.890	6.060
0.927	6.176
0.964	6.290
1.001	6.401
1.038	6.511
1.075	6.618

DESIGN ADVICE !

The head/flow characteristics of this SHE-0119-6620-1075-6620 Hydro-Brake Optimum® Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.

The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.

Hydro International®

DATE	31/10/2017 14:26:46
SITE	Tower Business Park
DESIGNER	Daniel Slattery
REF	Unit D

SHE-0119-6620-1075-6620
Hydro-Brake Optimum®