

**PROPOSED CONSTRUCTION OF THE FENLAND CARAVAN CENTRE AT
CARRINGTONS DROVE SOUTH, CROWLAND PE6 0BZ**

SURFACE WATER PLAN

Revision B 23rd February 2015 Rainfall volumes amended

**Revision C 28th July 2015 Areas of surfacing with direct outfall
amended**

The construction of a new Caravan Display and Repair Centre is proposed at Carrington Drove, Crowland. This report details how the surface water will be attenuated and the flow into the IDB drain will be reduced to Greenfield rates.

Two of the four existing buildings are to be retained and used as part of the new development. At the present time these buildings have no rainwater gutters and roof water falls into a small grip behind the poultry houses. These grips drain through a 100mm pipe into the dyke on the south western boundary of the development. This design assumes that when refurbished the buildings will be fitted with rainwater gutters and downpipes and the rainwater will discharge into the surface water system.

Initially in revision B the total area of roofing and surfacing which has a positive drainage system discharging from the site was as follows:-

Area of Roofing.....	4216 s.m.
Area of concrete and tarmac surfacing.....	8424 s.m.
Total impervious area	12,640 s.m.

Crowland Caravans (CC) have decided now to amend the areas of surfacing, and to construct the tarmac areas from porous tarmac, and increase the area of gravel around the site. A plan showing the areas of concrete, porous tarmac and gravel is shown at the end of this report as Appendix 1.

The latest plans show an area of new concrete roadways of 2,887 s.m. At the present time CC plan to slope the concrete areas onto gravel and porous concrete areas where the water will then soakaway. This will work in most areas but there may be some overland flow into the adjoining dykes. Therefore the design will allow for 50% of the flow from the concrete surfaces.

Therefore the design area will now be taken as:-

Area of Roofing.....	4,216 s.m.
50% of area of concrete surfacing.....	1,444 s.m.
Total impervious area	5,660 s.m.

Design of Storage Dykes for Discharge at Greenfield rates

North Level will not charge a development fee if the rate of discharge is reduced to 5 litres/second. This will be achieved by providing storage dykes and allowing these to discharge very slowly into the Board's drain. The impervious area draining to the storage dykes is 0.566 ha, as shown above. The flow into the IDB drain will be limited to 5 litres/second by the use of a Hydrobrake flow limiter.

The volumes of discharge have been calculated using the following table:

Duration	M5_60min	Z1	M5-D	Z2	M100-D	Intensity mm/hour	Areal Factor	Areal Intensity mm/hour	Area (ha)	Volume cum/hr	Vol + 30% climate Change cum/hr	Total Volume cu m climate
15	24	0.64	15.36	1.98	30.41	121.65	0.94	114.35	0.566	647.233	841.40	210.4
30	24	0.81	19.44	1.97	38.30	76.59	0.95	72.76	0.566	411.844	535.40	267.7
60	24	1	24	1.93	46.32	46.32	0.96	44.47	0.566	251.684	327.19	327.2
120	24	1.2	28.8	1.89	54.43	27.22	0.97	26.40	0.566	149.421	194.25	388.5
240	24	1.42	34.08	1.86	63.39	15.85	0.97	15.37	0.566	87.004	113.11	452.4
360	24	1.57	37.68	1.83	68.95	11.49	0.98	11.26	0.566	63.746	82.87	497.2
600	24	1.74	41.76	1.81	75.59	7.56	0.98	7.41	0.566	41.926	54.50	545.0
1440	24	2.16	51.84	1.81	93.83	3.91	0.98	3.83	0.566	21.686	28.19	676.6
2520	24	2.4	57.6	1.81	104.26	2.48	0.98	2.43	0.566	13.769	17.90	751.8
2880	24	2.5	60	1.81	108.60	2.26	0.98	2.22	0.566	12.550	16.31	783.1

From this the volume of storage required can be tabulated, using an average outflow into the IDB drain of 4.5litres/second.

Duration minutes	Total Volume cu m	Maximum Outflow cumecs	Outflow in storm duration	Total Volume in Storage Lagoon	Equivalent Rainfall mm	Time to Empty hours
15	210.4	0.00450	4.05	206.3	16.6	13.0
30	267.7	0.00450	8.10	259.6	21.2	16.5
60	327.2	0.00450	16.20	311.0	25.9	20.2
120	388.5	0.00450	32.40	356.1	30.7	24.0
240	452.4	0.00450	64.80	387.6	35.8	27.9
360	497.2	0.00450	97.20	400.0	39.3	30.7
600	545.0	0.00450	162.00	383.0	43.1	33.6
1440	676.6	0.00450	388.80	287.8	53.5	41.8
2520	751.8	0.00450	680.40	71.4	59.5	46.4
2880	783.1	0.00450	777.60	5.5	62.0	48.3

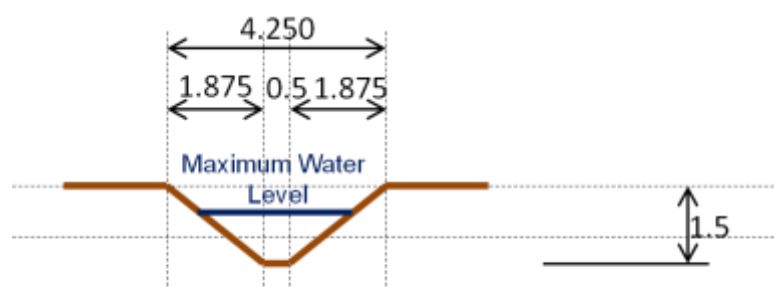
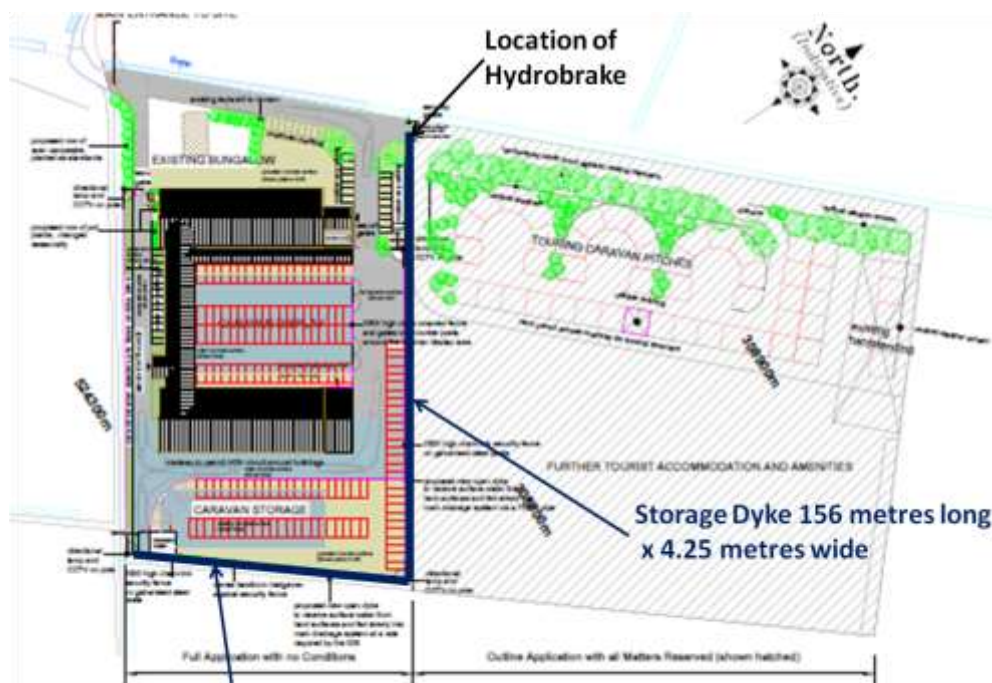
It can be seen that the volume of storage required is approximately 400.0 cum and the storage lagoon would take nearly 2 days to completely empty.

The storage dykes that are proposed will be a 105 metre long dyke on the south east side and a 156 metre length between the development phases. Both dykes will have a base width of 0.5 metres, depth of 1.5 metres and 1:1.25 side slopes. This will make the top width of the storage dykes 4.25 metres.

The design allows for a maximum of 1.0 metre depth of water. However at a depth of 1.25m the dyke can accommodate a higher volume. Cross sections of the proposed dykes are shown below:

Length	Depth	Average water width	Total Volume
261	1.0	3.0	456.8
261	1.25	3.625	672.9

Therefore it can be seen the required storage volume is provided when the water depth is just below 1.0 metres.



Section Through Storage Dykes

Details of a suitable flow limiter have been supplied by Hydrobrake and in Appendix 2 the design flows and a calculation of the hourly outflow with 6 hour rainfall is shown.

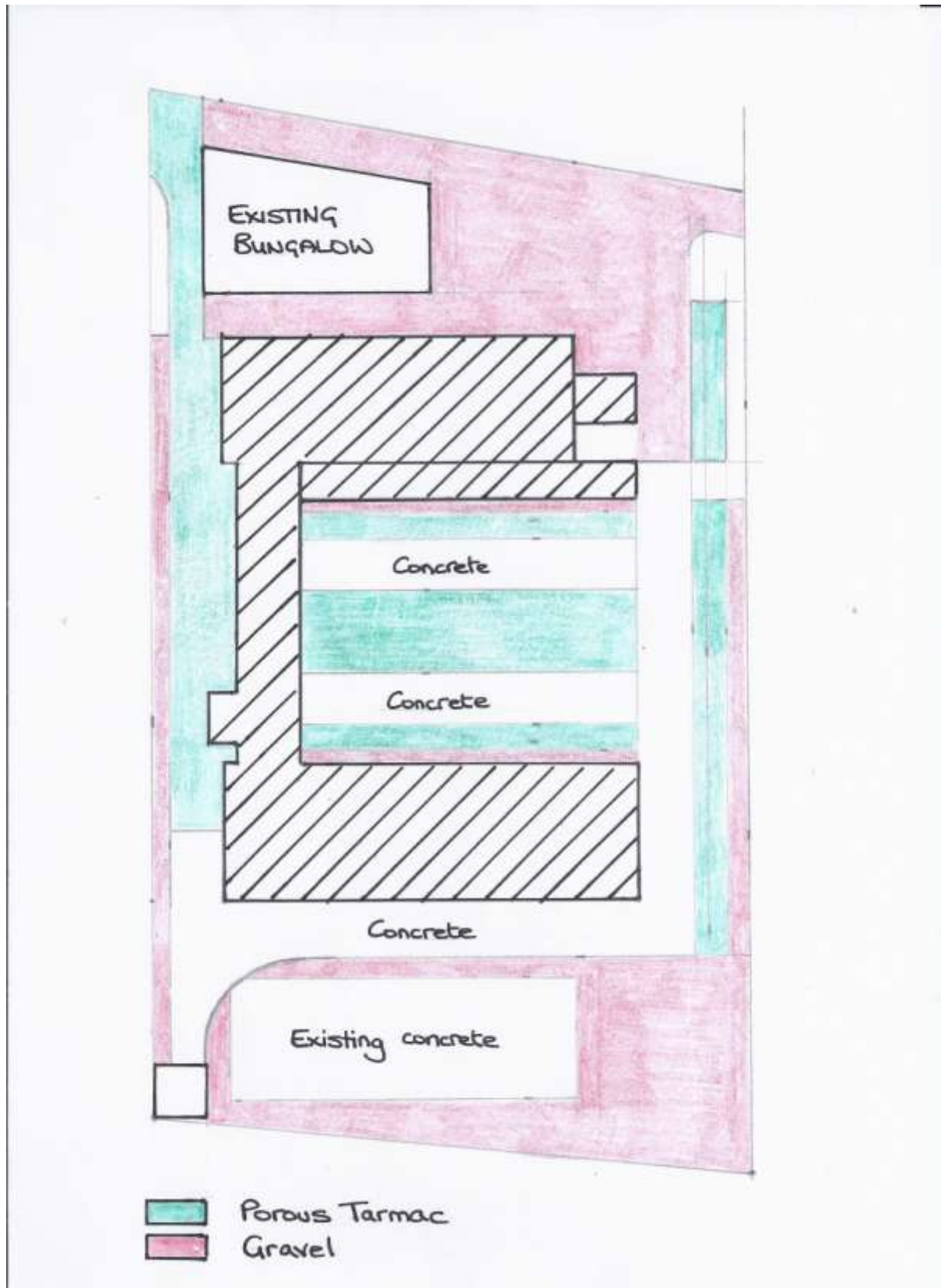
Stuart Hemmings B Sc C Eng MICE MIWEM

26th January 2015

Revision C 28th July 2015.

APPENDIX 1

DETAILS OF PROPOSED AREAS OF SURFACING

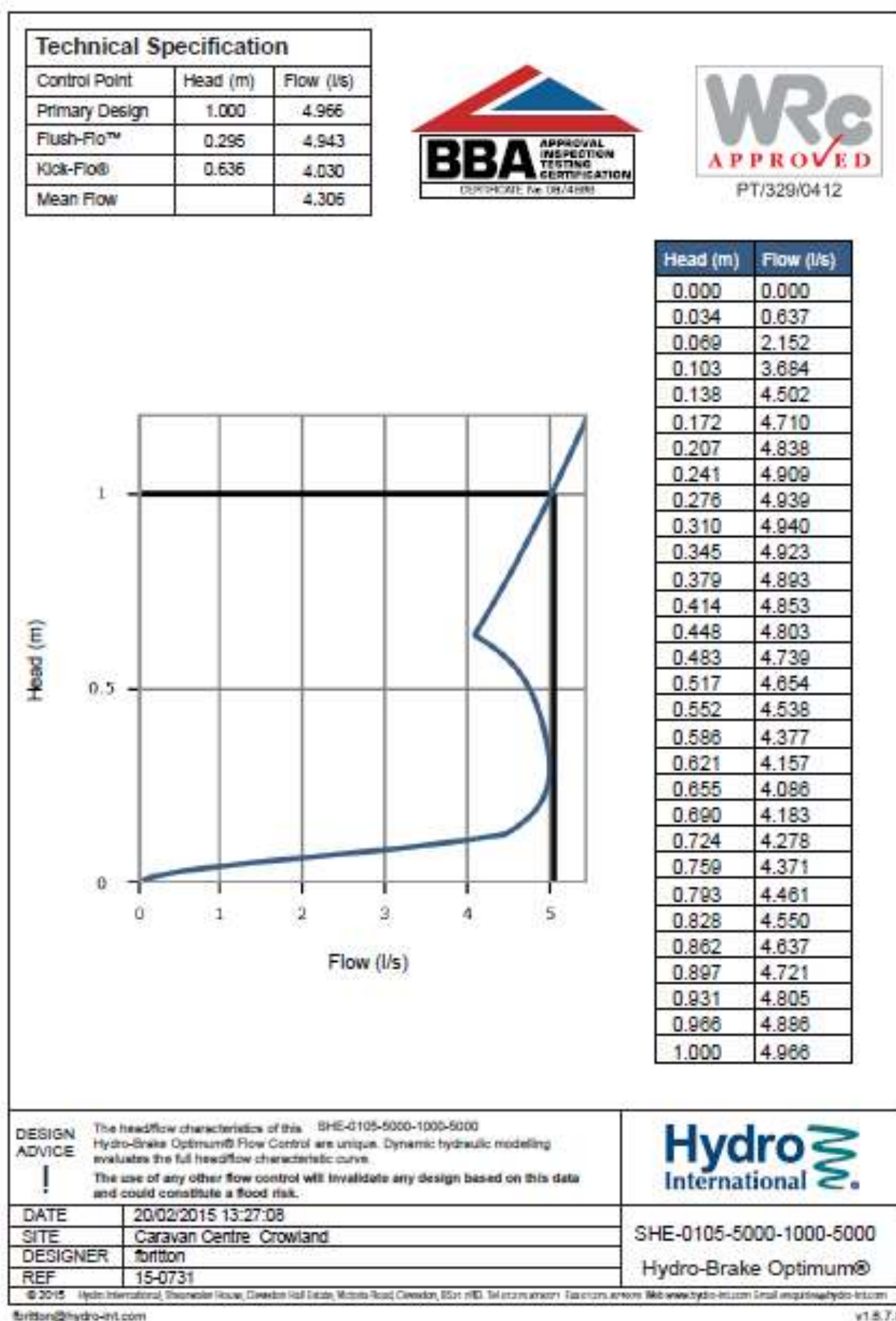


APPENDIX 2

Calculation of Inflow and Discharge from Attenuation Dykes with 6 hour Rainfall

Time (hrs)	Volume	Cumulative Volume	Calcalaton for h				Discharge	Vol in 15 mins	
						h metres	Q cumecs		
0.25	20.72	20	43130.25	207.6782	77.17824	0.118	0.004	3.60	
0.5	20.72	37.12	65467.5	255.8662	125.3662	0.192	0.0048	4.32	
0.75	20.72	53.51	86865.15	294.7289	164.2289	0.252	0.00492	4.43	
1	20.72	69.80	108121.9	328.8189	198.3189	0.304	0.00494	4.45	
1.25	20.72	86.07	129355.1	359.6597	229.1597	0.351	0.00492	4.43	
1.5	20.72	102.36	150611.8	388.0873	257.5873	0.395	0.00487	4.38	
1.75	20.72	118.70	171927.2	414.6411	284.1411	0.435	0.00481	4.33	
2	20.72	135.08	193313.1	439.6739	309.1739	0.474	0.00474	4.27	
2.25	20.72	151.53	214781.3	463.445	332.945	0.510	0.00465	4.19	
2.5	20.72	168.07	236355.1	486.1636	355.6636	0.545	0.00454	4.09	
2.75	20.72	184.70	258058.1	507.9942	377.4942	0.579	0.00438	3.94	
3	20.72	201.47	279949	529.1021	398.6021	0.611	0.00417	3.75	
3.25	20.72	218.43	302086.6	549.6241	419.1241	0.642	0.00409	3.68	
3.5	20.72	235.47	324318.2	569.4894	438.9894	0.673	0.00413	3.72	
3.75	20.72	252.47	346502.7	588.6448	458.1448	0.702	0.00423	3.81	
4	20.72	269.38	368569.8	607.0995	476.5995	0.730	0.00428	3.85	
4.25	20.72	286.24	390578.2	624.9626	494.4626	0.758	0.00437	3.93	
4.5	20.72	303.03	412480.9	642.2468	511.7468	0.784	0.00445	4.01	
4.75	20.72	319.74	434289.6	659.0066	528.5066	0.810	0.0045	4.05	
5	20.72	336.41	456039.6	675.3071	544.8071	0.835	0.00455	4.10	
5.25	20.72	353.03	477730.9	691.1808	560.6808	0.859	0.00464	4.18	
5.5	20.72	369.57	499316.5	706.6233	576.1233	0.883	0.0047	4.23	
5.75	20.72	386.05	520831.6	721.6866	591.1866	0.906	0.00472	4.25	
6	20.72	402.52	542323.2	736.426	605.926	0.929	0.00481	4.33	
	497.20							98.29	
								4.55	litres/sec

Characteristics of Hydrobrake Flow Limiter

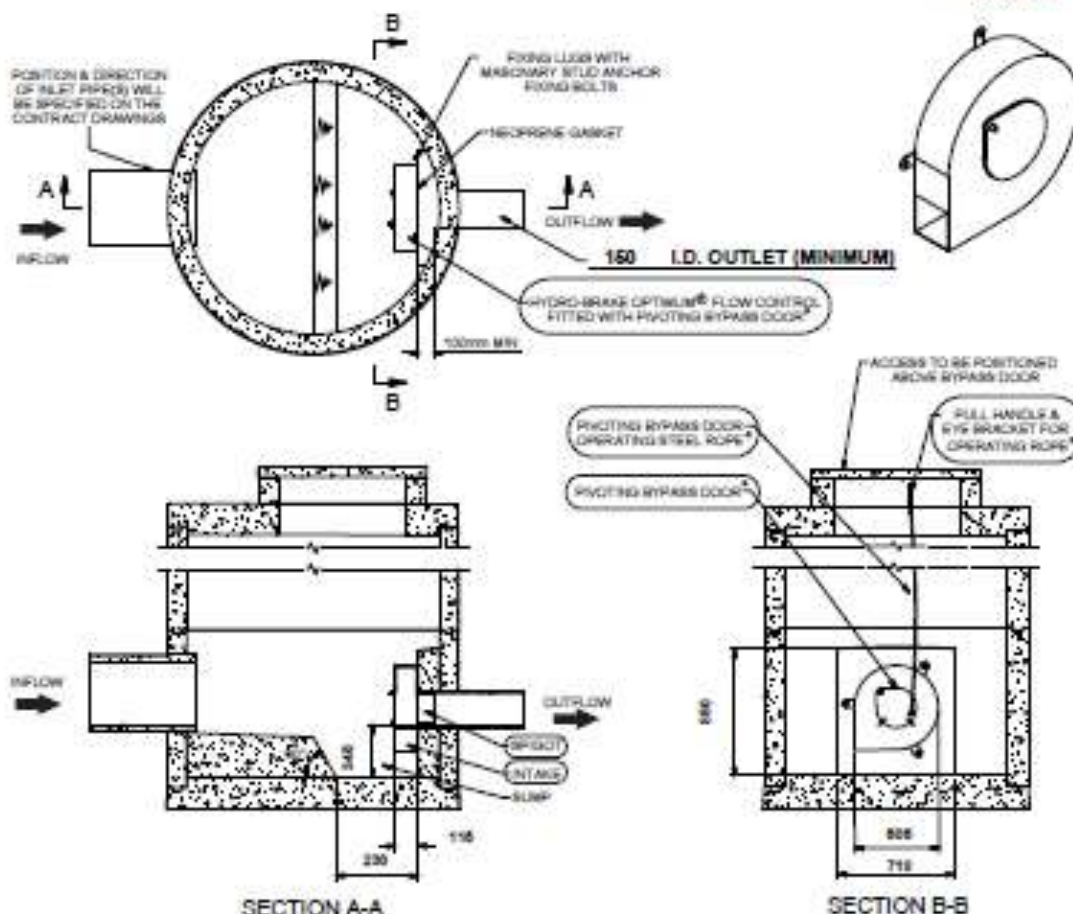


Details of Flow Limiter

Control Point	Head (m)	Flow (l/s)
Primary Design	1.000	4.966
Flush-Flo™	0.295	4.943
Kick-Flo®	0.636	4.030
Mean Flow		4.306

Hydro-Strike Optimum® Flow Control including

- 3 mm grade 304L stainless steel
- Integral stainless steel pivoting bypass door allowing clear line of sight through to outlet, on stainless steel operating rope
- Bead blasted finish to maximise corrosion resistance
- Stainless steel flange
- Neoprene gasket to seal outlet



IMPORTANT:  LIMIT OF HYDRO INTERNATIONAL SUPPLY
THE DEVICE WILL BE HANDLED TO SUIT SITE CONDITIONS
FOR SITE SPECIFIC DETAILS AND MINIMUM CHAMBER SIZE REFER TO HYDRO INTERNATIONAL
ALL CIVIL AND INSTALLATION WORK BY OTHERS
* WHERE SUPPLIED
HYDRO-BRAKE® FLOW CONTROL & HYDRO-BRAKE OPTIMUM FLOW CONTROL ARE REGISTERED
CONTROLS DESIGNED AND MANUFACTURED EXCLUSIVELY BY HYDRO INTERNATIONAL

THIS DESIGN LAYOUT IS FOR ILLUSTRATIVE PURPOSES ONLY. NOT TO SCALE.

DESIGN ADVICE	The headflow characteristics of this SHE-0105-5000-1000-5000 Hydro-Brake Optimum® Flow Control are unique. Dynamic hydraulic modelling evaluates the full headflow characteristic curve. The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.	 SHE-0105-5000-1000-5000 Hydro-Brake Optimum®
DATE	20/02/2015 13:27:08	
SITE	Caravan Centre Crowland	
DESIGNER	firton	
REF	15-0731	