

Calculated by:	Daniel Lytton
Site name:	Land at The Inglenook
Site location:	PO21 3QB

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	50.78132° N
Longitude:	0.73839° W
Reference:	2662645326
Date:	Jul 15 2021 13:15

Runoff estimation approach

IH124

Site characteristics

Total site area (ha):	0.52
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Methodology

Q _{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	3	3
HOST class:	N/A	N/A
SPR/SPRHOST:	0.37	0.37

Hydrological characteristics

	Default	Edited
SAAR (mm):	694	694
Hydrological region:	7	7
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Growth curve factor 200 years:	3.74	3.74

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Q _{BAR} (l/s):	1.48	1.48
1 in 1 year (l/s):	1.26	1.26
1 in 30 years (l/s):	3.4	3.4
1 in 100 year (l/s):	4.72	4.72
1 in 200 years (l/s):	5.53	5.53

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

Our Ref: YEX1885

7th May 2021

For the attention of Mr M. Bish,

Ref: Inglenook Hotel, PO21 3QB

We thank you for your request to undertake groundwater monitoring at the above mentioned site and take pleasure in enclosing the results of this work. The investigation was undertaken between the 8th March 2021 and 5th May 2021, in accordance with your instruction to proceed. This letter describes the work undertaken, presents the data obtained and discusses the results of the tests.

Geology

An examination of the available British Geological Survey data of the area for the site indicates that the superficial deposits underlying the study site comprise of Storm Beach deposits (gravel) and the bedrock deposits are recorded as the London Clay Formation (clay, silt and sand).

Fieldworks

The programme of this investigation included the measurement of the groundwater level from the two (2no.) boreholes installed onsite on the 25th January 2021, as illustrated by the site plans in Appendix A.

Groundwater results

Water level readings were taken between 8th March 2021 and 5th May 2021 from the installed boreholes (WS01, WS02, WS03 and WS04) on site, the readings are displayed in the table below:

Table 1: Groundwater Monitoring Test Results

Exploratory Hole	08.03.2021 1 Standing Level (mbgl)	24.03.2021 1 Standing Level (mbgl)	06.04.2021 1 Standing Level (mbgl)	20.04.2021 1 Standing Level (mbgl)	05.05.2021 1 Standing Level (mbgl)
WS01	1.00	1.15	1.33	1.33	1.43
WS02	1.28	1.32	1.46	1.40	2/58
WS03	1.70	1.11	1.54	1.54	1.59
WS04	0.96	1.06	1.38	1.38	1.49

It should be noted that groundwater levels are dependent upon seasonal variations and can change after periods of prolonged rainfall or drought.

For and on behalf of

YourEnvironment

Yours Faithfully,

Mathew Griffiths



Geo-Environmental Consultant

Enc.

Appendix A: Site Investigation Plan

Appendix B: Borehole Logs



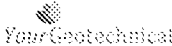
Appendix A:

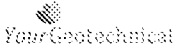
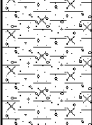
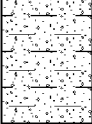
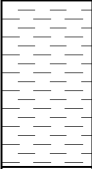


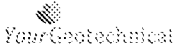


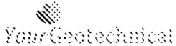
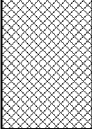
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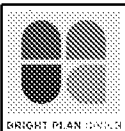


				Borehole Log				Borehole No. WS01 Sheet 1 of 1	
Project Name: Inglenook Hotel				Project No. YEX1885		Co-ords:		Hole Type WLS	
Location: 255, Pagham Road, Nyetimber, Bognor Regis PO21 3QB				Level:				Scale 1:50	
Client: CGS Civils Ltd				Dates: 25/01/2021				Logged By JvM	
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.15			Very soft black slightly sandy CLAY. Sand is fine and medium. (TOPSOIL)	
					0.60			Firm dark brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular and sub-angular fine and medium of flint. Frequent rootlets. (POSSIBLE REWORKED GROUND)	
					0.90			Soft orangish brown mottled greyish brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular and sub-angular fine and medium of flint.	1
					1.80			Soft orangish brown mottled grey sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular to sub-rounded fine to coarse of flint.	
					1.95			Band of brown gravelly SAND. Sand is fine to coarse. Gravel is angular to sub-rounded fine and medium of flint.	2
					2.40			Brown slightly clayey gravelly SAND. Sand is fine to coarse. Gravel is angular to rounded fine to coarse of flint. Low cobble content of sub-rounded flint.	
					2.90			Soft orangish brown mottled grey sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular to sub-rounded fine to coarse of flint.	3
					3.60			Brown slightly gravelly SAND. Sand is fine to coarse. Gravel is angular to sub-rounded fine to coarse of flint.	
					4.00			Very soft brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is sub-angular and sub-rounded fine and medium of flint.	
								Very soft dark grey CLAY.	4
							End of Borehole at 4.00m		
									5
									6
									7
									8
									9
									10
Remarks No groundwater encountered									

				Borehole Log				Borehole No. WS02 Sheet 1 of 1	
Project Name: Inglenook Hotel				Project No. YEX1885		Co-ords:		Hole Type WLS	
Location: 255, Pagham Road, Nyetimber, Bognor Regis PO21 3QB				Level:				Scale 1:50	
Client: CGS Civils Ltd				Dates: 25/01/2021				Logged By JvM	
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.10			Very Soft black slightly sandy CLAY. Sand is fine and medium. (TOPSOIL)	1
					0.80			Soft greyish brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular and sub-angular fine to coarse of flint. Frequent rootlets (POSSIBLE REWORKED GROUND)	
					1.65			Soft orangish brown mottled greyish brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular to sub-rounded fine and medium of flint.	
					1.80			Soft grey mottled brown slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is angular to sub-rounded fine to coarse of flint.	
					2.90			Brown slightly clayey gravelly SAND. Sand is fine to coarse. Gravel is angular to rounded fine to coarse of flint. Rare shelly fragments.	
				4.00			Very soft reddish brown CLAY.	3	
							End of Borehole at 4.00m	4	
								5	
								6	
								7	
								8	
								9	
								10	
Remarks No groundwater encountered									

				Borehole Log				Borehole No. WS03 Sheet 1 of 1	
Project Name: Inglenook Hotel				Project No. YEX1885		Co-ords:		Hole Type WLS	
Location: 255, Pagham Road, Nyetimber, Bognor Regis PO21 3QB				Level:				Scale 1:50	
Client: CGS Civils Ltd				Dates: 25/01/2021				Logged By JvM	
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.10			Grass over very soft dark grey slightly sandy CLAY. Sand is fine and medium. (TOPSOIL)	
					0.60			Soft greyish brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular and sub-angular fine to coarse of flint. Frequent rootlets. (POSSIBLE REWORKED GROUND)	
					1.15			Firm orangish brown mottled greyish brown slightly sandy CLAY. Sand is fine to coarse.	1
								Firm orangish brown mottled grey sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular to sub-rounded fine to coarse of flint. Low cobble content of sub-rounded flint. Rare shelly fragments.	2
					2.60			Band of light brown gravelly SAND. Sand is fine to coarse. Gravel is angular to sub-rounded fine and medium of flint.	
								Brown gravelly SAND. Sand is fine to coarse. Gravel is angular to sub-rounded fine to coarse of flint.	3
					3.45			Soft brown CLAY.	
					3.65			Firm dark grey CLAY.	
					4.00			End of Borehole at 4.00m	4
									5
									6
									7
									8
									9
									10
Remarks No groundwater encountered									

				Borehole Log				Borehole No. WS04 Sheet 1 of 1	
Project Name: Inglenook Hotel				Project No. YEX1885		Co-ords:		Hole Type WLS	
Location: 255, Pagham Road, Nyetimber, Bognor Regis PO21 3QB						Level:		Scale 1:50	
Client: CGS Civils Ltd						Dates: 25/01/2021		Logged By JvM	
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.10		 Grass over very soft dark grey slightly sandy CLAY. (TOPSOIL)		
					1.15		 Soft brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular and sub-angular fine and medium of flint. Frequent rootlets. (POSSIBLE REWORKED GROUND)		1
					1.70		 Stiff light brown mottled orangish brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular to sub-rounded fine to coarse of flint.		
					2.00		 Firm brown sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular to sub-rounded fine to coarse of flint.		2
End of Borehole at 2.00m									
									3
									4
									5
									6
									7
									8
									9
									10
Remarks No groundwater encountered									



Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	2	Maximum Rainfall (mm/hr)	250.0
Additional Flow (%)	10	Minimum Velocity (m/s)	0.75
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	17.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	0.600
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Width (mm)	Depth (m)
5	0.086	5.00	6.100	1200		0.818
4			6.120	1200	900	0.869
3			6.075	1200	900	1.311
2			5.750	1200	900	1.063
1			5.680	1200	900	1.135

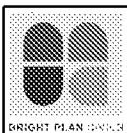
Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.003	42.699	300.0	225	5.750	4.687	0.838	5.680	4.545	0.910
1.002	22.985	300.0	225	6.075	4.764	1.086	5.750	4.687	0.838
1.001	73.369	178.0	150	6.120	5.251	0.719	6.075	4.839	1.086
1.000	5.499	178.0	150	6.100	5.282	0.668	6.120	5.251	0.719

Link	US Node	DS Node
1.003	2	1
1.002	3	2
1.001	4	3
1.000	5	4

Manhole Schedule

Node	CL (m)	Depth (m)	Dia (mm)	Width (mm)	Connections	Link	IL (m)	Dia (mm)
5	6.100	0.818	1200					
						0	1.000	5.282
4	6.120	0.869	1200	900		1	1.000	5.251
						0	1.001	5.251
3	6.075	1.311	1200	900		1	1.001	4.839
						0	1.002	4.764



Manhole Schedule

Node	CL (m)	Depth (m)	Dia (mm)	Width (mm)	Connections	Link	IL (m)	Dia (mm)
2	5.750	1.063	1200	900		1	1.002	4.687 225
1	5.680	1.135	1200	900		1	1.003	4.545 225

Node 5 Time-Area Diagram

Overrides Design Area x Depression Storage Depth (mm) 5
 Overrides Design Additional Inflow x Evapo-transpiration (mm/day) 3
 Depression Storage Area (m²) 858
 Applies to All storms

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-2	0.020	4-6	0.020	8-10	0.020	12-14	0.020	16-18	0.020	20-22	0.020
2-4	0.020	6-8	0.020	10-12	0.020	14-16	0.020	18-20	0.020	22-24	0.010

Node 4 Online Hydro-Brake® Control

Flap Valve x Objective (HE) Minimise upstream storage
 Replaces Downstream Link ✓ Sump Available ✓
 Invert Level (m) 5.251 Product Number CTL-SHE-0077-2500-0865-2500
 Design Depth (m) 0.865 Min Outlet Diameter (m) 0.100
 Design Flow (l/s) 2.5 Min Node Diameter (mm) 1200

Node 5 Online Orifice Control

Flap Valve x Invert Level (m) 5.282 Discharge Coefficient 0.600
 Replaces Downstream Link x Diameter (m) 0.225

Node 5 Carpark Storage Structure

Base Inf Coefficient (m/hr) 0.00000 Invert Level (m) 5.282 Slope (1:X) 5000.0
 Side Inf Coefficient (m/hr) 0.00000 Time to half empty (mins) Depth (m) 0.625
 Safety Factor 2.0 Width (m) 10.460 Inf Depth (m)
 Porosity 0.32 Length (m) 82.000

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
1 year 15 minute summer	92.521	26.180
1 year 15 minute winter	64.927	26.180
1 year 30 minute summer	60.022	16.984
1 year 30 minute winter	42.121	16.984
1 year 60 minute summer	40.398	10.676
1 year 60 minute winter	26.839	10.676
1 year 120 minute summer	24.980	6.602



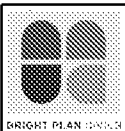
Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
1 year 120 minute winter	16.596	6.602
1 year 180 minute summer	19.271	4.959
1 year 180 minute winter	12.527	4.959
1 year 240 minute summer	15.301	4.043
1 year 240 minute winter	10.165	4.043
1 year 360 minute summer	11.775	3.030
1 year 360 minute winter	7.654	3.030
1 year 480 minute summer	9.342	2.469
1 year 480 minute winter	6.207	2.469
1 year 600 minute summer	7.682	2.101
1 year 600 minute winter	5.249	2.101
1 year 720 minute summer	6.859	1.838
1 year 720 minute winter	4.609	1.838
1 year 960 minute summer	5.653	1.489
1 year 960 minute winter	3.745	1.489
1 year 1440 minute summer	4.127	1.106
1 year 1440 minute winter	2.773	1.106
30 year 15 minute summer	226.195	64.005
30 year 15 minute winter	158.733	64.005
30 year 30 minute summer	147.452	41.724
30 year 30 minute winter	103.475	41.724
30 year 60 minute summer	98.615	26.061
30 year 60 minute winter	65.517	26.061
30 year 120 minute summer	59.946	15.842
30 year 120 minute winter	39.827	15.842
30 year 180 minute summer	45.598	11.734
30 year 180 minute winter	29.640	11.734
30 year 240 minute summer	35.759	9.450
30 year 240 minute winter	23.758	9.450
30 year 360 minute summer	26.939	6.932
30 year 360 minute winter	17.511	6.932
30 year 480 minute summer	20.981	5.545
30 year 480 minute winter	13.940	5.545
30 year 600 minute summer	17.039	4.661
30 year 600 minute winter	11.642	4.661
30 year 720 minute summer	15.093	4.045
30 year 720 minute winter	10.143	4.045
30 year 960 minute summer	12.278	3.233
30 year 960 minute winter	8.133	3.233
30 year 1440 minute summer	8.788	2.355
30 year 1440 minute winter	5.906	2.355
100 year +40% CC 15 minute summer	408.473	115.584
100 year +40% CC 15 minute winter	286.647	115.584
100 year +40% CC 30 minute summer	268.775	76.054
100 year +40% CC 30 minute winter	188.614	76.054
100 year +40% CC 60 minute summer	180.954	47.821
100 year +40% CC 60 minute winter	120.222	47.821
100 year +40% CC 120 minute summer	110.370	29.168
100 year +40% CC 120 minute winter	73.327	29.168
100 year +40% CC 180 minute summer	83.953	21.604
100 year +40% CC 180 minute winter	54.572	21.604
100 year +40% CC 240 minute summer	65.765	17.380



Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year +40% CC 240 minute winter	43.693	17.380
100 year +40% CC 360 minute summer	49.370	12.705
100 year +40% CC 360 minute winter	32.092	12.705
100 year +40% CC 480 minute summer	38.291	10.119
100 year +40% CC 480 minute winter	25.439	10.119
100 year +40% CC 600 minute summer	30.992	8.477
100 year +40% CC 600 minute winter	21.176	8.477
100 year +40% CC 720 minute summer	27.387	7.340
100 year +40% CC 720 minute winter	18.406	7.340
100 year +40% CC 960 minute summer	22.191	5.844
100 year +40% CC 960 minute winter	14.700	5.844
100 year +40% CC 1440 minute summer	15.789	4.232
100 year +40% CC 1440 minute winter	10.611	4.232
100 year +40% CC +10% A 15 minute summer	408.473	115.584
100 year +40% CC +10% A 15 minute winter	286.647	115.584
100 year +40% CC +10% A 30 minute summer	268.775	76.054
100 year +40% CC +10% A 30 minute winter	188.614	76.054
100 year +40% CC +10% A 60 minute summer	180.954	47.821
100 year +40% CC +10% A 60 minute winter	120.222	47.821
100 year +40% CC +10% A 120 minute summer	110.370	29.168
100 year +40% CC +10% A 120 minute winter	73.327	29.168
100 year +40% CC +10% A 180 minute summer	83.953	21.604
100 year +40% CC +10% A 180 minute winter	54.572	21.604
100 year +40% CC +10% A 240 minute summer	65.765	17.380
100 year +40% CC +10% A 240 minute winter	43.693	17.380
100 year +40% CC +10% A 360 minute summer	49.370	12.705
100 year +40% CC +10% A 360 minute winter	32.092	12.705
100 year +40% CC +10% A 480 minute summer	38.291	10.119
100 year +40% CC +10% A 480 minute winter	25.439	10.119
100 year +40% CC +10% A 600 minute summer	30.992	8.477
100 year +40% CC +10% A 600 minute winter	21.176	8.477
100 year +40% CC +10% A 720 minute summer	27.387	7.340
100 year +40% CC +10% A 720 minute winter	18.406	7.340
100 year +40% CC +10% A 960 minute summer	22.191	5.844
100 year +40% CC +10% A 960 minute winter	14.700	5.844
100 year +40% CC +10% A 1440 minute summer	15.789	4.232
100 year +40% CC +10% A 1440 minute winter	10.611	4.232



Results for 1 year Critical Storm Duration. Lowest mass balance: 99.37%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
240 minute winter	5	184	5.372	0.090	7.2	22.7551	0.0000	OK
240 minute winter	4	184	5.369	0.118	2.3	0.1275	0.0000	OK
240 minute winter	3	184	4.806	0.042	2.3	0.0454	0.0000	OK
240 minute winter	2	184	4.730	0.043	2.3	0.0464	0.0000	OK
240 minute winter	1	184	4.583	0.038	2.3	0.0000	0.0000	OK

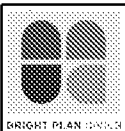
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)	Discharge Vol (m ³)
240 minute winter	5	1.000	4	2.3	0.290	0.171	0.0705	
240 minute winter	4	Hydro-Brake®	3	2.3				
240 minute winter	3	1.002	2	2.3	0.436	0.076	0.1193	
240 minute winter	2	1.003	1	2.3	0.468	0.076	0.2071	35.2



Results for 30 year Critical Storm Duration. Lowest mass balance: 99.37%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
240 minute winter	5	232	5.543	0.261	17.0	70.4768	0.0000	SURCHARGED
240 minute winter	4	232	5.539	0.288	2.7	0.3109	0.0000	SURCHARGED
240 minute winter	3	160	4.808	0.044	2.5	0.0478	0.0000	OK
120 minute winter	2	100	4.732	0.045	2.5	0.0486	0.0000	OK
120 minute winter	1	100	4.585	0.040	2.5	0.0000	0.0000	OK

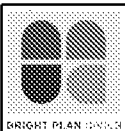
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)	Discharge Vol (m ³)
240 minute winter	5	1.000	4	2.7	0.288	0.202	0.0968	
240 minute winter	4	Hydro-Brake®	3	2.5				
240 minute winter	3	1.002	2	2.5	0.449	0.084	0.1280	
120 minute winter	2	1.003	1	2.5	0.480	0.084	0.2226	46.3



Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.37%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
360 minute winter	5	360	5.851	0.569	23.1	156.9048	0.0000	FLOOD RISK
360 minute winter	4	360	5.848	0.597	2.6	0.6446	0.0000	FLOOD RISK
60 minute winter	3	40	4.808	0.044	2.5	0.0478	0.0000	OK
15 minute winter	2	74	4.732	0.045	2.5	0.0486	0.0000	OK
15 minute winter	1	75	4.585	0.040	2.5	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
360 minute winter	5	1.000	4	2.6	0.281	0.193	0.0968	
360 minute winter	4	Hydro-Brake®	3	2.5				
60 minute winter	3	1.002	2	2.5	0.450	0.084	0.1280	
15 minute winter	2	1.003	1	2.5	0.480	0.084	0.2226	36.2



Results for 100 year +40% CC +10% A Critical Storm Duration. Lowest mass balance: 99.37%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
480 minute winter	5	456	6.100	0.818	20.5	175.2721	0.5783	FLOOD
480 minute winter	4	456	6.096	0.845	2.6	0.9122	0.0000	FLOOD RISK
60 minute winter	3	39	4.808	0.044	2.5	0.0478	0.0000	OK
15 minute summer	2	64	4.732	0.045	2.5	0.0486	0.0000	OK
15 minute summer	1	64	4.585	0.040	2.5	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)	Discharge Vol (m ³)
480 minute winter	5	1.000	4	2.6	0.283	0.198	0.0968	
480 minute winter	4	Hydro-Brake®	3	2.5				
60 minute winter	3	1.002	2	2.5	0.450	0.084	0.1280	
15 minute summer	2	1.003	1	2.5	0.480	0.084	0.2226	36.1

Hydro-Brake® Flow Control

Reduce Storage Needs!

Product Summary

The Hydro-Brake® Vortex Flow Control is a versatile, self-activating device with a unique geometry designed to harness the energy of vortex flow.

The Hydro-Brake® is used to maximize savings on new construction projects by minimizing stormwater detention volumes. Also an economical retrofit solution, the Hydro-Brake® can be installed in over-discharging ponds and catch basins to restrict the outflow without requiring the construction of additional detention volumes.

With large openings that guard against blockages and an installation base upwards of 25,000 units, the Hydro-Brake® is a trusted and proven solution used to reduce the rate of stormwater runoff.

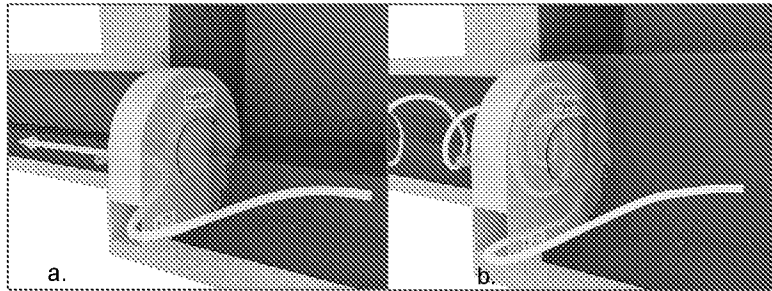


Fig.1 The Hydro-Brake® operates like (a) a large orifice under low flow conditions, and (b) a small orifice under higher flow / higher head conditions when a vortex air core forms within the device and throttles the flow.

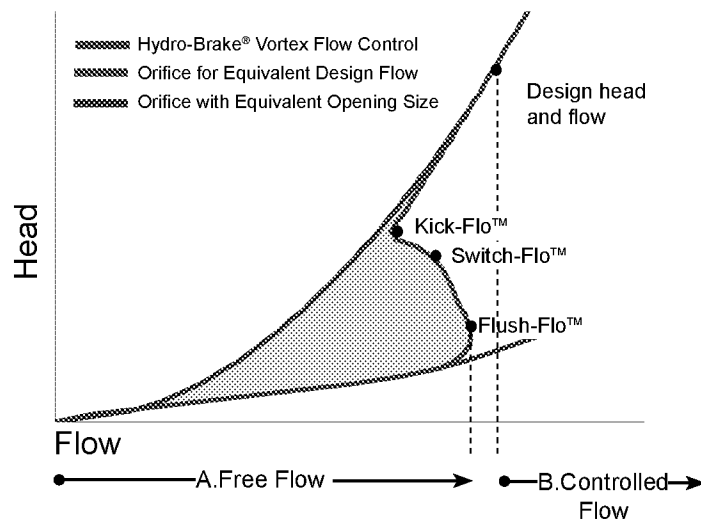
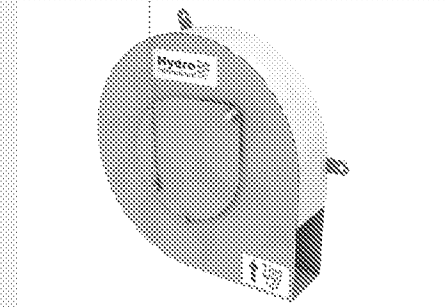


Fig.2 The characteristic of the Hydro-Brake® vs. an equivalent orifice.

The Hydro-Brake® Vortex Flow Control optimizes flow control to allow for higher discharge rates at lower heads than conventional flow control options. The head/discharge curves shown below illustrate the behavior of a Hydro-Brake® Vortex Flow Control compared to an orifice (Fig.2).

How it Works

Reduce Storage Volumes by 40%



The Hydro-Brake® operates on simple fluid hydraulics. Flow enters the volute tangentially through the inlet. Under low flow conditions, the Hydro-Brake® acts as a large orifice and water passes directly from the inlet to the outlet (Fig.1a).

As flow increases and reaches the Flush-Flo™ point, high peripheral velocities initiate the throttling action. As head increases, the valve approaches the Switch-Flo™ and Kick-Flo™ points and an air-filled core starts to form in the volute. As head continues to increase, the air core fully stabilizes and the valve discharge is throttled to that of a smaller orifice (Fig.1b).

Benefits

- » Reduced stormwater storage volumes by up to 40%
- » Up to 50% savings in project storage costs
- » Self-activating with no moving parts or power requirements
- » Available in wall-mounted or floor-mounted geometries
- » Area of opening is 3-6 times larger than the equivalent orifice
- » Virtually maintenance free
- » Proven performance with over 25,000 installations worldwide



Stormwater Solutions

→ hydro-int.com/hydro-brake

Sizing & Design

Three series of Hydro-Brake® Vortex Flow Controls are available to suit various applications and design constraints. Refer to the Hydro-Brake® Design Chart for typical sizing guidelines (Table 1).

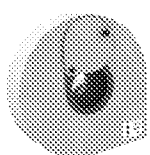
Table 1. Hydro-Brake® Vortex Flow Control design chart.

Series	S Series	V Series	C Series
Typical Geometry			
Models	SH STH SXH SMH SMXH	SV SXV SMV	C CX CH
Typical Applications	- Flow control at the inlet of the storm drain system - Outlet flow control for stormwater detention systems	- Erosion control & energy dissipation - Roof runoff control for "Blue Roof" detention schemes	- Outlet flow control for flood dams and levees - Outlet flow control for stormwater detention systems
Typical Mount Style	Wall Mount	Downspout/Roof Mount Floor Mount Pipe Mount	Floor Mount
Typical Diameter Range*	2 - 16 in (5 - 41 cm)	2 - 16 in (5 - 41 cm)	3 - 20 in (7.5 - 51 cm)
Typical Flow Range**	0.05 - 5.6 cfs (1 - 157 L/s)	0.05 - 6.0 cfs (1 - 174 L/s)	0.18 - 14.3 cfs (5.3 - 405 L/s)

*Listed diameter ranges are typical guidelines only. Hydro-Brake® Vortex Flow Controls can be manufactured to any specified diameter up to 6'.

Optional Design Accessories

Pivoting Bypass Door



For maintenance access to the outlet pipe.

Curved Backplate



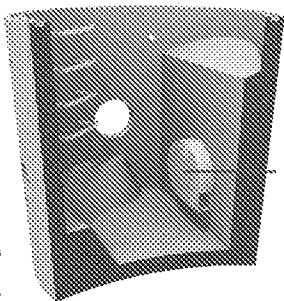
To allow for flush-mounting to the wall of a round manhole.

Vortex Suppressor Pipe

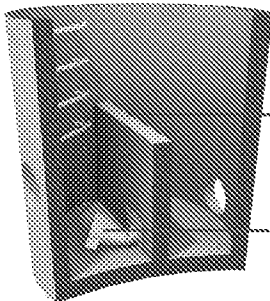


To eliminate air core for emergency bypass.

Typical Chamber Configurations

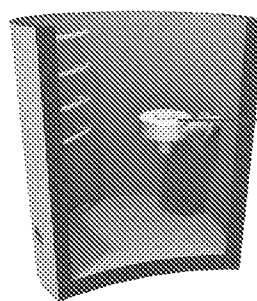


Wall Mounted
SXH Model for
Catch Basin
Inlet Control



Large Storm
Bypass Weir

Floor Mounted
CH Model for
Small Storm
Flow Control



Pipe Mounted
SXV Model for
Energy & Velocity
Dissipation



from
**Southern
Water**

Mr Dan Lytton
Bright Plan Civils
2 West Barn
Norton Lane
Norton
Chichester
West Sussex
PO20 3NH

Your ref

Our ref
DSA000002353

Date
20 July 2021



Dear Mr Lytton,

Application to Connect to the Public Sewerage System - Section 106 Water Industry Act 1991.
Location: Land at The Inglenook, Pagham Road, Bognor Regis, West Sussex, PO21 3QB.

We refer to your application to connect to the public foul and surface water sewers at the above location. We are pleased to advise that your proposal, as shown on your drawing D1966-103.1 dated 28/05/2021 and drawing D1966.103.2 dated 28/05/2021, is approved subject to:

This review is for the purpose of approval to permit communication to be made to the public sewer, under Section 106 of the Water Industry Act 1991. **It is to the means and mode of construction only.**

We reserve the right to immediately disconnect any development under S109 of the WIA 1991 where it has been shown actual connections do not reflect those applied for in the s106 application.

S106 approval does not confirm that public sewer network capacity is available for the proposed development. The availability of capacity may be assessed through the Pre-Planning Enquiry process.

This letter should not be considered as approval by Southern Water to the discharge of any relevant Planning Conditions relating to drainage. This is a separate matter which will be reviewed under a consultation from the Planning Authority.

If connection is to be made through land under the ownership of other Parties, then you are advised to obtain the Landowners consent before carrying out any works.

In approving this application, it is assumed that you have obtained any necessary Building Regulations Approval and/or Highway Authority Road Opening License.

Southern Water, Southern House, Yeoman Road, Worthing, West Sussex BN13 3NX
southernwater.co.uk

Southern Water Services Ltd, Registered Office: Southern House, Yeoman Road, Worthing BN13 3NX Registered in England No. 2366670

This approval is given based on the information provided in support of this application and the assumption of the final discharge point being to the public foul and surface water sewers. If this is different, then this approval becomes invalid.

If as noted above, there is any change in the approved connection point, then you must provide us with revised drawings and details and obtain our approval for the changes prior to the connection being made.

Connections to new manholes and the arrangement of pipe junctions within any new manholes should be in accordance with the new Design and Construction Guidance manual ("the Code") and Southern Water's guidance documentation.

water.org.uk/sewerage-sector-guidance-approved-documents/

We refer you to Southern Water Health and Safety Advisory that can be viewed in the Developer and Builders section of the Southern Water website as the link below:

southernwater.co.uk/developing-building/health-and-safety

This approval is given on the basis that you will review this Advisory and take the necessary actions concerning Health and Safety.

Please contact Mick Vince our Assistant Adoption Manager for this area ([REDACTED]) living at least two full working days' notice, for a mutually convenient date and time for the inspection of the works to be arranged.

Yours sincerely,

[REDACTED]

Ashley Marshman
Head of Business Channels
Business Channels

SuDS Drainage Maintenance Schedule

D1966 - LAND AT THE INGLENOOK

1.1 Surface Water Maintenance

- 1.1.1 The proposed surface water drainage scheme will capture runoff via traditional rainwater pipe and gully drainage, as well as via permeable block paving within driveway areas. This will discharge into the surface water sewer at a controlled rate.
- 1.1.2 Maintenance plays an important part in the long-term performance of a surface water drainage system and will be required to ensure that it remains fully operational.
- 1.1.3 The responsibility for the maintenance of the surface water drainage system will lie with a management company appointed by the Developer who will be made aware of specific maintenance tasks to ensure that the surface water drainage system remains operational throughout its lifetime (it is recommended that this document is made available to them).

1.2 Permeable Paving / Diffuser Units

- 1.2.1 The areas of permeable paving are designed to allow infiltration of surface water run-off through the joints in the block paving surface course and into the subbase below. The water is then collected and discharged into the positive drainage system.
- 1.2.2 As part of the permeable paving system, diffuser units are used to discharge surface water run-off from roof areas into the sub-base, as well as forming links between areas of permeable paving. These diffuser units are small heavy-duty cellular units which allow more efficient discharge of surface water into the sub-base base of the permeable paved areas.
- 1.2.3 The areas of permeable paving will require additional maintenance measures to ensure they operate as designed. Failure in carrying out this maintenance, could increase the risk of flooding. The additional measures are as follow:
- Periodic surface sweeping to reduce silt and debris accumulation. The permeable surfaces should be swept at least every 8 to 12 weeks with additional sweeps in the autumn to clear fallen leaves
 - Removal / management of weed growth, as required. Typically, once or twice a year for regularly used areas
 - Periodic silt removal from permeable surfaces as described by the manufacturer. If any areas are showing signs of ponding, they shall be dealt with by raking out the joints and redressing. The entire surface shall be monitored and when there are signs of excessive siltation resulting in poor drainage over the whole area, the blocks shall be taken up and a replacement of bedding layer and geotextile shall be undertaken

- Redressing of joints on the block paving as required
- Catchpits upstream of diffuser units, should be emptied and inspected on the same regime as all catchpits specified previously set out in this document

1.3 Flow Control Chambers (HydroBrake or equivalent)

- 1.3.1 The HydroBrake flow control system is a proposed manufacturing option for use for the flow control units at the development. The system is self-activating, relying on upstream hydraulic head to generate an air-filled vortex within the centre of the casing. Once the vortex is initiated water drains down through a small opening in the back of the device at the designed restricted flow rate.
- 1.3.2 The flow control device has an emergency (i.e. blockage) release, in the form of a door situated in the front of the unit itself, this can be operated from the surface by a release cable situated just under the manhole cover which closes under its own weight and does not require any mechanism to operate. This will allow the system to drain down freely, until the blockage can be cleared.
- 1.3.3 The HydroBrake flow control chamber will require additional maintenance measures to ensure it operates as designed. The additional measures are as follows:
- The sump within the flow control chamber should be monitored for build-up of silts and should be emptied, as a minimum, on the same regime as specified for catchpits previously within this document
 - The drain down door located on the centre of the unit will require inspection and opening annually, to ensure it is operating as intended

1.4 Remedial/Repair Actions

- 1.4.1 Significant storm events may cause considerable damage to SuDS and their associated components. As such, it may be necessary to inspect and carry out essential recovery works to return the feature to full working order. Resetting of uneven blocks by lifting block area, removing bedding material and relaying to match original design are all actions which may need to be undertaken.

1.5 Maintenance Regime

- 1.5.1 The drainage system has been designed to minimise maintenance requirements; however a number of key tasks will need to be undertaken so that the system remains in optimal condition. These operations are summarised in Table 1 below, along with the required frequency of works.
- 1.5.2 It is also recommended that the level of silt in the system is recorded at each maintenance visit to help establish a more informed regime.
- 1.5.3 In addition to the intervals above, the condition of the surface water drainage system should be assessed following significant rainfall events to ensure that silt has not washed through and been deposited in a way that could affect the operation of the system.

Drainage System feature	Proposed maintenance / remedial works	Required frequency of works
Permeable Paving	Surface sweeping to reduce silt and debris accumulation.	Every 8 to 12 weeks
	Removal / management of weed growth	At least once a year
	Silt removal from permeable surfaces, possibly involving raking out of joints, redressing, removal and remedial works.	As required / to be specified by manufacturer
Diffuser units & catch pits, gully sumps and drains	Inspection and additional cleansing as required.	Annual
	Desilting	Year 1, Year 3, then every 5 years
Pipework	Jetting to clear blockages	As required
Flow Control Unit	As specified by manufacturer	As specified by manufacturer
	Inspection and additional cleansing as required.	Annual

Table 1. Proposed Maintenance Regime

1.6 Accidental Spillages

- 1.6.1 It is not envisaged that any materials are to be stored onsite once the development has been completed which could cause major spills and potential pollution issues within the drainage system. If this situation alters in the future consultation with a specialist will be required in order to confirm if any upgrades to the existing system are necessary.
- 1.6.2 Minor spillages of fuels and oils from motor vehicles will be dealt with by the permeable pavement, by capturing and bio-degrading the hydrocarbons.

1.7 Construction Phasing

- 1.7.1 It is recommended that the construction of the permeable pavement within the access road, Hydro-brake and sewer connection are completed prior to the commencement of construction of the buildings and hardstanding areas. This will ensure that flows are captured and treated during and after construction. The proposed drainage system will need a complete maintenance check at the completion of the development construction and any required remedial tasks undertaken.
- 1.7.2 By constructing these drainage components first, runoff from the construction site and the hardstanding areas will travel overland to the permeable pavement. This will ensure that run-off from the site receives a level of treatment required by the SuDS manual.

1.8 Future Alterations to the Development

- 1.8.1 Any future alterations to the permeable paving should be confirmed by a specialist. Where possible any future services are to avoid being located through areas of permeable paving. If new services are required to run through areas of permeable paving, services should be installed below the depth of permeable paving with the permeable system reinstalled above.

1.9 Responsibility and Adoption

- 1.9.1 The Developer will be responsible for the management and maintenance of the proposed drainage system, and will be responsible for their maintenance and repair until such time that adoption of any elements of the drainage system is agreed with the relevant authority.
- 1.9.2 The Developer is responsible for management and maintenance and this includes the entirety of the incurred costs of this ongoing work, until such time that adoption of any elements of the drainage system is agreed with the relevant authority. Should the Developer wish to recuperate costs associated with these works, they will need to agree the basis for this with individual property inhabitants.