FNH432 – Former Chailey Industrial Estate, Pump Lane, Hayes

2010/APP/2018/4231 Condition 7 Summary Report

Sustainable Water Management

FNH432/C7/01

Issue 1: 12th February 2020

1.0 Introduction

1.1 Infrastructure Design Ltd (IDL) has been appointed by Fairview New Homes (Developments) Ltd to prepare a Foul, Surface Water & SuDS design for their proposed residential development site.

1.2 A Drainage Strategy was prepared in support of the planning application (Ref: FNH432/DS/01, dated 26th November 2018), following a meeting with the LLFA on 2nd October 2018.

1.3 This planning drainage strategy report accompanied a the Flood Risk Assessment prepared by Hydrock (ref: 08639-HYD-XX-XX-RP-D-5001) and the completed *Hillingdon Technical Assessment ProForma*.

1.4 The scheme obtain planning consent on 4th October 2019.

1.5 This summary report supplies the information required to satisfy Condition 7 of the Planning Consent.

2.0 Condition 7 Requirements

Prior to commencement (excluding demolition and site clearance) a scheme for the provision of sustainable water management shall be submitted to, and approved in writing by the Local Planning Authority. The scheme shall follow the strategy set out in the submitted letter dated 21st September from GTA Civils. The scheme shall clearly demonstrate how it, manages water and demonstrate ways of controlling the surface water on site by providing information on:
a) Suds features
i. incorporating sustainable urban drainage (SuDs) in accordance with the hierarchy set out in Policy 5.15 of the London Plan. Where the proposal does not utilise the most sustainable solution, justification must be provided,
ii. calculations showing storm period and intensity and volume of storage required to control surface water and size of features to control that volume to Greenfield run off rates at a variety of return periods including 1 in 1 year, 1 in 30, 1 in 100, and 1 in 100 plus Climate change. This rate should be presented per hectare as well as the total for the whole site.
iii. where it is intended to have above ground storage, overland flooding should be mapped, both designed and exceedance routes above the 100, plus climate change, including flow paths depths and velocities identified as well as any hazards, (safe access and egress must be demonstrated).
iv. Where infiltration techniques (soakaway) a site investigation must be provided to establish the level of groundwater on the site, and to demonstrate the suitability of infiltration techniques proposed on the site. (This should be undertaken at the appropriate time of year as groundwater levels fluctuate).

b) Minimise water use
i. incorporate water saving measures and equipment.
ii. provide details of how rain and or grey water will be recycled and reused in the development.
c) Long Term Management and Maintenance of the drainage system
i. Provide a management and maintenance plan
ii Include details of Inspection regimes, performance specification, (remediation and timescales for the resolving of issues where a PMC).
iii Where overland flooding is proposed, the plan should include the appropriate actions to define those areas and actions required to ensure the safety of the users of the site should that be required.
iv. Clear plans showing all of the drainage network above and below ground. The responsibility of different parties such as the landowner.
Thereafter the development shall be implemented and retained/maintained in accordance with these details for as long as the development remains in existence.
REASON
To ensure that surface water run off is controlled to ensure the development does not increase the risk of flooding contrary to: Policy EM6 Flood Risk Management in Hillingdon Local Plan: Part 1- Strategic Policies (Nov 2012), Policy 5.12 Flood Risk Management of the London Plan (March 2016) and To be handled as close to its
source as possible in compliance with Policy 5.13 Sustainable Drainage of the London Plan (March 2016), and Conserve water supplies in accordance with Policy 5.15 Water use and supplies of the London Plan (March 2016). National Planning Policy Framework (July 2018), and the Planning Practice Guidance (Flood Risk and Coastal Change March 2014)

2.1 The wording of the condition is incorrect within the first paragraph, as it refers to letter date 21st September from GTA Civils. The strategy report submitted, is that provided by Infrastructure Design Limited, dated 26th November 2018.

2.2 Item b (i) is dealt with outside of the scope of this report, as it relates to the use of fittings provided to reduce water usage. Information in the regard is provided separately by the Developer.

3.0 Condition 7 Response (SuDS Features)

3.1 i. incorporating sustainable urban drainage (SuDs) in accordance with the hierarchy set out in Policy 5.15 of the London Plan. Where the proposal does not utilise the most sustainable solution, justification must be provided,

We feel that that the clause referred to in this paragraph should read 5.13 (rather than 5.15) as it relates to the SuDS Hierarchy

The London Plan Policy 5.13 (SUSTAINABLE DRAINAGE)

A Development should utilise sustainable urban drainage systems (SUDS) unless there are practical reasons for not doing so, and should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible in line with the following drainage hierarchy:

1 Store rainwater for later use
Consideration has been given to the incorporation of Rainwater Harvesting, however, given the limited fall across the site, RWHT installations are not possible as they include a step in invert across the tank which cannot be accommodated.

2 Use infiltration techniques, such as porous surfaces in non-clay areas
The underlying geology is unsuitable for infiltration techniques.

3 Attenuate rainwater in ponds or open water features for gradual release

Given the desires of the LPA and viability of the site, density on this development is such that insufficient communal space is available for this larger form of above-ground SuDS feature. Blue Roofs however have been incorporated at podium level which will serve to deal with some surface water at source.

4 Attenuate rainwater by storing in tanks or sealed water features for gradual release
Cellular attenuation crates are proposed, along with a series of staged gravity flow control devices to ultimately limit discharge rates to greenfield runoff rates. Lined permeable paving is proposed extensively in the construction of roads and external parking areas.

5 Discharge rainwater direct to a watercourse
There are no watercourses within the immediate vicinity of the site.

6 Discharge rainwater to a surface water sewer/drain
Adoptable SW sewers exist in Pump Lane and agreement has been reached with Thames Water to connect.

7 Discharge rainwater to the combined sewer.
Not required.

3.2 *ii. calculations showing storm period and intensity and volume of storage required to control surface water and size of features to control that volume to Greenfield run off rates at a variety of return periods including 1 in 1 year, 1 in 30, 1 in 100, and 1 in 100 plus Climate change. This rate should be presented per hectare as well as the total for the whole site.*

Calculations are included in Appendix B

3.3 *iii. where it is intended to have above ground storage, overland flooding should be mapped, both designed and exceedance routes above the 100, plus climate change, including flow paths depths and velocities identified as well as any hazards, (safe access and egress must be demonstrated).*

We can confirm that there will be no above-ground storage.

3.4 *iv. Where infiltration techniques (soakaway) a site investigation must be provided to establish the level of groundwater on the site, and to demonstrate the suitability of infiltration techniques proposed on the site. (This should be undertaken at the appropriate time of year as groundwater levels fluctuate).*

Infiltration techniques are not proposed on this development

4.0 Condition 7 Response (Minimising Water Use)

4.1 *i. incorporate water saving measures and equipment.*

Information in the regard is provided separately by the Developer.

4.2 *ii. provide details of how rain and or grey water will be recycled and reused in the development.*

As noted above under The London Plan Heirarchy, rainwater, and indeed grey water cannot be collected for reuse given the step in inverts across the tanks which would be provided to store the water. This is due to the fall across the site and the minimum self-cleansing gradients of the surface water drains required to serve the development.

5.0 Condition 7 Response (Long Term Management and Maintenance of the drainage system)

5.1 i. Provide a management and maintenance plan

Refer to Management & Maintenance Plan included as Appendix C.

5.2 *ii Include details of Inspection regimes, performance specification, (remediation and timescales for the resolving of issues where a PMC).*

Refer to Management & Maintenance Plan included as Appendix C.

5.3 iii Where overland flooding is proposed, the plan should include the appropriate actions to define those areas and actions required to ensure the safety of the users of the site should that be required. iv. Clear plans showing all of the drainage network above and below ground. The responsibility of different parties such as the landowner.

No overland flooding is proposed

6.0 Enclosures

6.1 Appendix A includes the Drainage Layout

6.2 Appendix B includes the surface water calculations for each SuDs feature.

6.3 Appendix C includes the Management & Maintenance Requirements.

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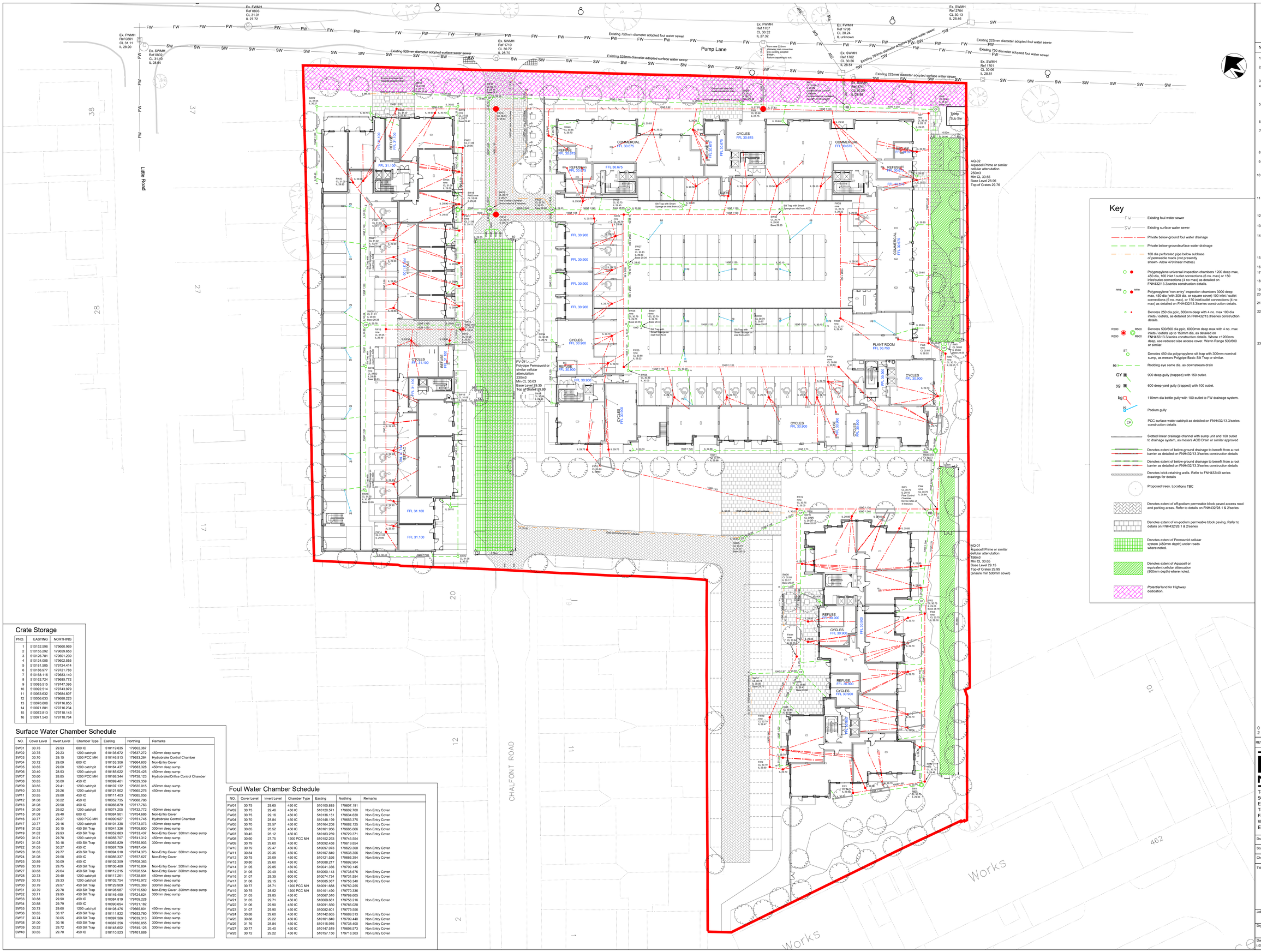
Appendix A – Drainage Layout



Crate Storage

PNO.	EASTING	NORTHING
1	510152.596	179660.969
2	510155.292	179659.653
3	510126.781	179601.239
4	510124.085	179602.555
5	510181.585	179724.414
6	510186.977	179721.783
7	510168.116	179683.140
8	510162.724	179685.772
9	510085.515	179747.395
10	510092.514	179743.979
11	510063.632	179684.807
12	510056.633	179688.223
13	510070.608	179716.855
14	510071.881	179716.234
15	510072.813	179718.143
16	510071.540	179718.764

Surface Water Chamber Schedule

NO.	Cover Level	Invert Level	Chamber Type	Easting	Northing	Remarks
SW01	30.75	29.93	600 IC	510119.635	179602.367	
SW02	30.75	29.23	1200 catchpit	510136.672	179637.272	450mm deep sump
SW03	30.70	29.15	1200 PCC MH	510146.513	179653.264	Hydrobrake Control Chamber
SW04	30.72	29.09	600 IC	510153.306	179664.603	Non-Entry Cover
SW05	30.65	29.00	1200 catchpit	510164.437	179683.328	450mm deep sump
SW06	30.40	28.93	1200 catchpit	510185.022	179729.425	450mm deep sump
SW07	30.60	28.85	1200 PCC MH	510168.344	179738.123	Hydrobrake/Orifice Control Chamber
SW08	30.85	30.00	450 IC	510099.461	179629.359	
SW09	30.85	29.41	1200 catchpit	510107.132	179635.015	450mm deep sump
SW10	30.75	29.26	1200 catchpit	510121.902	179665.276	450mm deep sump
SW11	30.85	29.88	450 IC	510111.403	179685.056	
SW12	31.08	30.22	450 IC	510052.735	179688.786	
SW13	31.08	29.98	450 IC	510066.879	179717.763	
SW14	31.09	29.52	1200 catchpit	510074.205	179732.772	450mm deep sump
SW15	31.08	29.40	600 IC	510084.901	179754.686	Non-Entry Cover
SW16	30.77	29.27	1200 PCC MH	510090.927	179751.745	Hydrobrake Control Chamber
SW17	30.77	29.16	1200 catchpit	510101.338	179773.073	450mm deep sump
SW18	31.02	30.15	450 Silt Trap	510041.326	179709.800	300mm deep sump
SW19	31.02	29.93	450 Silt Trap	510052.863	179733.437	Non-Entry Cover. 300mm deep sump
SW20	31.01	29.78	1200 catchpit	510056.707	179741.312	450mm deep sump
SW21	31.02	30.18	450 Silt Trap	510063.829	179755.903	300mm deep sump
SW22	31.05	30.27	450 IC	510067.709	179767.454	
SW23	31.05	29.77	450 Silt Trap	510094.510	179774.373	Non-Entry Cover. 300mm deep sump
SW24	31.08	29.58	450 IC	510086.337	179757.627	Non-Entry Cover
SW25	30.89	30.09	450 IC	510102.359	179708.363	
SW26	30.79	29.75	450 Silt Trap	510106.480	179716.804	Non-Entry Cover. 300mm deep sump
SW27	30.83	29.64	450 Silt Trap	510112.215	179728.554	Non-Entry Cover. 300mm deep sump
SW28	30.73	29.40	1200 catchpit	510117.261	179738.891	450mm deep sump
SW29	30.75	29.33	1200 catchpit	510102.754	179745.972	450mm deep sump
SW30	30.79	29.97	450 Silt Trap	510129.909	179705.369	300mm deep sump
SW31	30.79	29.78	450 Silt Trap	510108.987	179715.580	Non-Entry Cover. 300mm deep sump
SW32	30.71	29.95	450 Silt Trap	510146.490	179724.624	300mm deep sump
SW33	30.88	29.90	450 IC	510084.819	179709.228	
SW34	30.88	29.78	450 IC	510090.654	179721.182	
SW35	30.73	29.60	1200 catchpit	510108.475	179665.801	450mm deep sump
SW36	30.85	30.17	450 Silt Trap	510111.822	179652.760	300mm deep sump
SW37	30.74	30.05	450 Silt Trap	510097.586	179639.313	300mm deep sump
SW38	31.00	30.16	450 Silt Trap	510087.256	179780.855	300mm deep sump
SW39	30.52	29.72	450 Silt Trap	510148.652	179749.125	300mm deep sump
SW40	30.65	29.70	450 IC	510110.523	179761.889	

Foul Water Chamber Schedule

NO.	Cover Level	Invert Level	Chamber Type	Easting	Northing	Remarks
FW01	30.75	29.65	450 IC	510105.885	179607.191	
FW02	30.75	29.46	450 IC	510120.571	179602.700	Non Entry Cover
FW03	30.75	29.16	450 IC	510136.151	179634.620	Non Entry Cover
FW04	30.70	28.84	450 IC	510148.199	179653.375	Non Entry Cover
FW05	30.70	28.57	450 IC	510164.208	179682.125	Non Entry Cover
FW06	30.65	28.52	450 IC	510181.956	179685.666	Non Entry Cover
FW07	30.45	28.12	450 IC	510183.289	179729.371	Non Entry Cover
FW08	30.60	27.75	1200 PCC MH	510152.263	179745.554	
FW09	30.79	29.60	450 IC	510092.458	179619.854	
FW10	30.79	29.47	450 IC	510097.073	179629.308	Non Entry Cover
FW11	30.84	29.35	450 IC	510107.840	179638.356	Non Entry Cover
FW12	30.75	29.09	450 IC	510121.526	179666.394	Non Entry Cover
FW13	30.80	29.60	450 IC	510088.217	179692.904	
FW14	31.05	29.85	450 IC	510041.336	179700.145	
FW15	31.05	29.49	450 IC	510060.143	179738.676	Non Entry Cover
FW16	31.07	29.35	600 IC	510074.734	179731.554	Non Entry Cover
FW17	31.06	29.15	450 IC	510085.367	179753.340	Non Entry Cover
FW18	30.77	28.71	1200 PCC MH	510091.688	179750.255	
FW19	30.75	28.52	1200 PCC MH	510101.490	179770.336	
FW20	31.05	29.85	450 IC	510067.510	179769.605	
FW21	31.05	29.71	450 IC	510069.681	179758.216	Non Entry Cover
FW22	31.06	29.90	450 IC	510091.560	179766.028	
FW23	31.07	29.90	450 IC	510082.601	179779.556	
FW24	30.88	29.60	450 IC	510142.665	179689.513	Non Entry Cover
FW25	30.88	29.22	450 IC	510101.840	179709.440	Non Entry Cover
FW26	31.76	28.84	450 IC	510115.976	179738.400	Non Entry Cover
FW27	30.77	29.40	450 IC	510147.519	179698.573	Non Entry Cover
FW28	30.72	29.22	450 IC	510157.150	179718.303	Non Entry Cover

Key

- Existing foul water sewer
- Existing surface water sewer
- Private below-ground foul water drainage
- Private below-groundsurface water drainage
- 100 dia perforated pipe below subbase of permeable roads (not presently shown- Allow 470 linear metres)
- Polypropylene universal inspection chambers 1200 deep max, 450 dia. 100 inlet / outlet connections (8 no. max) or 150 inlet/outlet connections (4 no max) as detailed on FNH432/13.3/series construction details.
- rme — Polypropylene 'non-entry' inspection chambers 3000 deep max, 450 dia (with 300 dia. or square cover) 100 inlet / outlet connections (8 no. max), or 150 inlet/outlet connections (4 no max) as detailed on FNH432/13.3/series construction details.
- Denotes 250 dia pipic, 600mm deep with 4 no. max 100 dia inlets / outlets, as detailed on FNH432/13.3/series construction details.
- R500 R600 — Denotes 500/600 dia pipic, 6000mm deep max with 4 no. max inlets / outlets up to 150mm dia, as detailed on FNH432/13.3/series construction details. Where >1200mm deep, use reduced size access cover. Wavin Range 500/600 or similar.
- ST — Denotes 450 dia polypropylene silt trap with 300mm nominal sump, as messrs Polypipe Basic Silt Trap or similar.
- re — Rodding eye same dia. as downstream drain
- GY — 900 deep gully (trapped) with 150 outlet.
- yg — 600 deep yard gully (trapped) with 100 outlet.
- bg — 110mm dia bottle gully with 100 outlet to FW drainage system.
- pg — Podium gully
- CP — PCC surface water catchpit as detailed on FNH432/13.3/series construction details
- Slotted linear drainage channel with sump unit and 100 outlet to drainage system, as messrs ACO Drain or similar approved
- Denotes extent of below-ground drainage to benefit from a root barrier as detailed on FNH432/13.3/series construction details
- Denotes extent of below-ground drainage to benefit from a root barrier as detailed on FNH432/13.3/series construction details
- Denotes brick retaining walls. Refer to FNH432/40 series drawings for details
- Proposed trees. Locations TBC
- Denotes extent of off-podium permeable block paved access road and parking areas. Refer to details on FNH432/28.1 & 2/series
- Denotes extent of on-podium permeable block paving. Refer to details on FNH432/28.1 & 2/series
- Denotes extent of Permavoid cellular system (450mm depth) under roads where noted.
- Denotes extent of Aquacell or equivalent cellular attenuation (800mm depth) where noted.
- *Potential* land for Highway dedication.

ConDoc Issue

NOTES

1. This drawing is to be read in conjunction with the private and drainage construction details.
2. All private drainage works to be carried out in accordance with the provisions laid down in BS EN 752 & The Building Regulations, Part H.
3. Levels shown in buildings are Finished Floor Level.
4. Drainage under adopted roads to be either:-
   a) Vitrified Clayware to BSEN295.
   b) Concrete to BS 5911, Class M. Laterals to be formed of either vitrified clay or "Extra Strength", concrete "Class M".
5. Before commencing any Sewer or drainage works, the Developer's Groundworker must satisfy themselves, the developer and the Local Authority of actual levels and conditions of existing sewers.
6. Buried concrete to satisfy the requirements of BRE Special Digest 1 as predetermined by the site's Geotechnical Report
7. All abandoned, buried obstructions encountered during the construction of Highway & Drainage Works are to be broken out to bed level of drains and sewers, and to the formation of carparks and drives etc., and to sufficient depth to allow for laying service company's mains and services.
8. Depth and Location of existing services to be traced prior to any excavation.
9. All private drainage to be laid to levels shown using flexibly jointed pipes, either uPVC to BS 4660 and BS 5481 or vitrified clayware to BS EN 295.
10. Generally pipes to have granular Bed & Surround in accordance with manufacturers recommendations, ensuring adequate protection with respect to depth and location. Where bedding material is placed at depths susceptible to ground water ingress, it is to be wrapped in a geotextile (Terram 700 or better).
11. Private precast concrete manholes and catchpits to be constructed using conc. box sections or circular rings to BS 5911-200, with 150mm conc. surround, size and construction to comply with Table 12 of Approved Document, Part H.
12. Rodding eyes, etc are to be laid to manufacturers minimum cover and depth to allow adequate fall from adjoining unit.
13. Access panels are to be provided to all rainwater pipes, a max. 600 above finished ground level.
14. All manholes / inspection chambers in block paved areas, to have recessed covers. These are to be orientated such as to minimise cut blocks.
15. All pipework to be 100mmØ (150Ø from road gullies) unless otherwise stated.
16. All levels in metres (m) unless specified otherwise.
17. All drain runs from Svp's, stub stacks or FW gullies to be laid at 1:40 gradient unless otherwise stated.
18. Svp's, stub stacks & RWP's are shown indicative only. Refer to FNH432/12 series drawings for accurate locations
19. House/Flat drainage to be laid prior to erection of scaffold.
20. All cover and invert levels shown are in metres. All pipe diameters are in millimetres U.N.O.
21. All chambers located in trafficked areas to have concrete surround as detailed on FNH432/13 series construction details
22. IMPORTANT NOTE:
    At depths where groundwater ingress is encountered, consider the use of a sump / pump arrangement. Additional reference should be made to the Interpretative Geotechnical Report for supplementary measures in such instances
    Where excavations are >1m deep, consider the use of full perimeter trench support.
23. IMPORTANT NOTE:
    The new sewer connections are be successfully made prior to commencing any upstream drainage works.

REV	AMENDMENTS	BY	DATE
0	ConDoc Issue	IDL	29.11.19
2	Prelim Issue	IDL	28.10.19

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Drawn :	IDL	Date :	Aug 2019
Scale :	1:250@A0	Section :	Infra
Checked :	DC	Approved :	PT

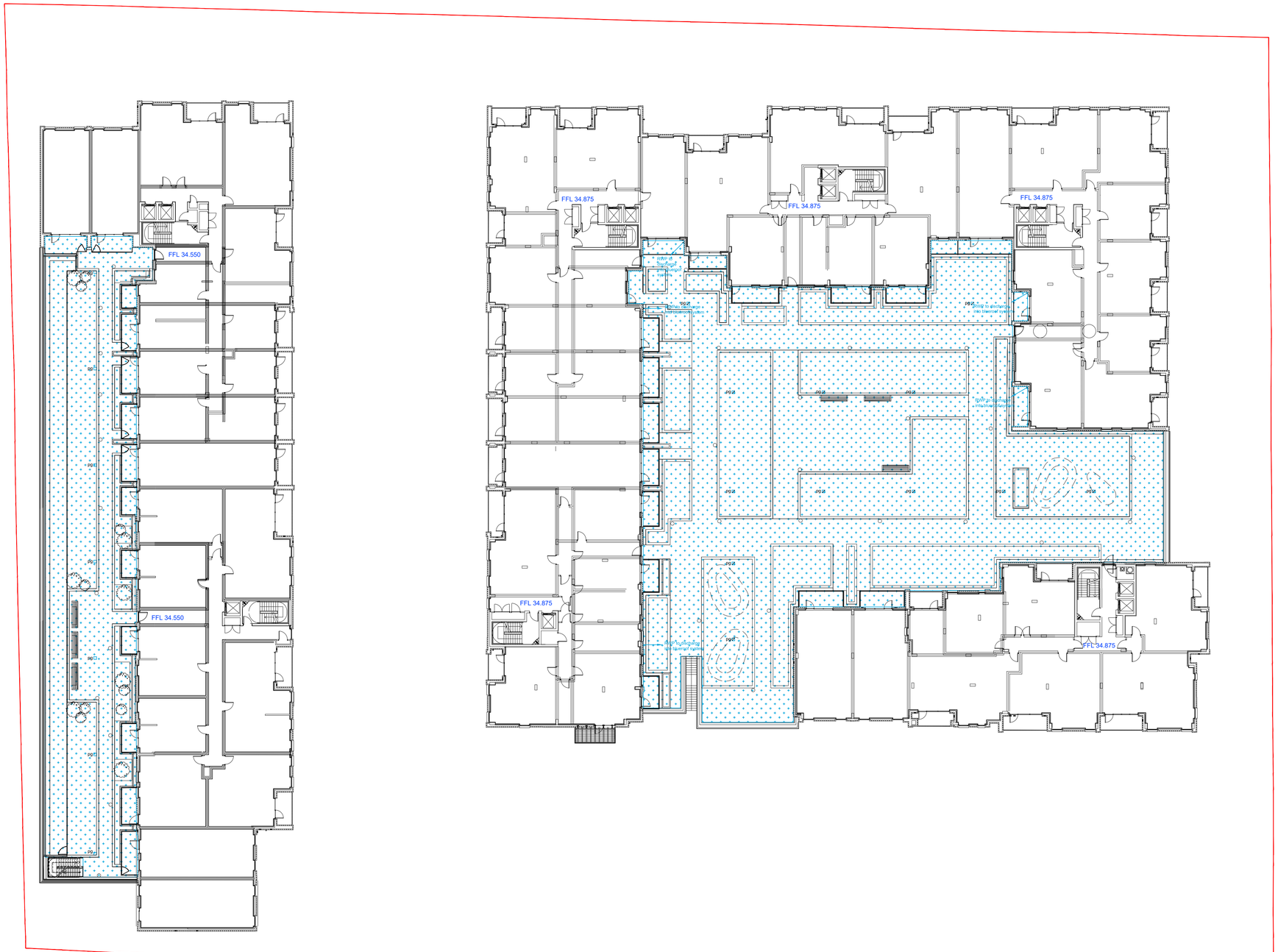
Title :

Drainage Layout (Site Level)

Job : Chailey Industrial Estate Pump Lane, Hayes

Drg. No : FNH432/13.3/1 — Rev : 0

Dwg file name: I:\Drawings\906 Chailey Ind Est\07 Drainage\13-3-1.dwg



ConDoc Issue

NOTES

Denotes extent of blue roof system

pg Podium Gully Outlet. Refer to detail on FNH432/35.101

REV	AMENDMENTS		DATE
0	ConDoc Issue	IDL	29.11.19
2	Prelim Issue	IDL	28.10.19

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Drawn :	IDL	Date :	Aug 2019
Scale :	1:250 @ A1	Section :	Infra
Checked :	DC	Approved :	PT

Title :

Drainage
Layout
(Podium Level)

Job :
Chailey Ind Est, Pump Lane, Hayes

Drg. No : FNH432/13.3/2

Rev : 0

Dwg file name:
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Appendix B – Surface Water Drainage Calculations

Cascade Summary of Results for BlueRoof-01.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	Hydrobrake-02.SRCX	(None)

Half Drain Time : 589 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	34.610	0.010	0.0	0.1	0.1	10.7	O K
30 min Summer	34.615	0.015	0.0	0.2	0.2	15.4	O K
60 min Summer	34.620	0.020	0.0	0.2	0.2	20.7	O K
120 min Summer	34.625	0.025	0.0	0.4	0.4	26.6	O K
180 min Summer	34.629	0.029	0.0	0.5	0.5	30.0	O K
240 min Summer	34.631	0.031	0.0	0.6	0.6	32.3	O K
360 min Summer	34.633	0.033	0.0	0.6	0.6	34.5	O K
480 min Summer	34.634	0.034	0.0	0.7	0.7	35.4	O K
600 min Summer	34.634	0.034	0.0	0.7	0.7	36.2	O K
720 min Summer	34.635	0.035	0.0	0.7	0.7	36.8	O K
960 min Summer	34.636	0.036	0.0	0.8	0.8	37.6	O K
1440 min Summer	34.637	0.037	0.0	0.8	0.8	38.4	O K
2160 min Summer	34.636	0.036	0.0	0.8	0.8	38.3	O K
2880 min Summer	34.636	0.036	0.0	0.8	0.8	37.6	O K
4320 min Summer	34.634	0.034	0.0	0.7	0.7	35.8	O K
5760 min Summer	34.632	0.032	0.0	0.6	0.6	34.0	O K
7200 min Summer	34.631	0.031	0.0	0.6	0.6	32.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	31.332	0.0	3.9	86
30 min Summer	20.391	0.0	7.3	88
60 min Summer	12.872	0.0	15.0	102
120 min Summer	7.960	0.0	20.8	138
180 min Summer	5.980	0.0	24.7	184
240 min Summer	4.876	0.0	27.7	242
360 min Summer	3.634	0.0	31.9	360
480 min Summer	2.942	0.0	35.1	418
600 min Summer	2.497	0.0	37.6	476
720 min Summer	2.184	0.0	39.6	536
960 min Summer	1.768	0.0	42.9	664
1440 min Summer	1.313	0.0	47.2	928
2160 min Summer	0.975	0.0	59.0	1332
2880 min Summer	0.789	0.0	62.6	1728
4320 min Summer	0.586	0.0	66.4	2500
5760 min Summer	0.474	0.0	75.7	3280
7200 min Summer	0.403	0.0	78.3	4032

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Cascade Summary of Results for BlueRoof-01.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	34.629	0.029	0.0	0.5	0.5	31.0	O K
10080 min Summer	34.628	0.028	0.0	0.5	0.5	29.8	O K
15 min Winter	34.612	0.012	0.0	0.1	0.1	12.6	O K
30 min Winter	34.617	0.017	0.0	0.2	0.2	17.9	O K
60 min Winter	34.623	0.023	0.0	0.3	0.3	23.8	O K
120 min Winter	34.629	0.029	0.0	0.5	0.5	30.3	O K
180 min Winter	34.632	0.032	0.0	0.6	0.6	34.1	O K
240 min Winter	34.635	0.035	0.0	0.7	0.7	36.5	O K
360 min Winter	34.637	0.037	0.0	0.8	0.8	38.9	O K
480 min Winter	34.638	0.038	0.0	0.8	0.8	39.8	O K
600 min Winter	34.639	0.039	0.0	0.9	0.9	40.6	O K
720 min Winter	34.639	0.039	0.0	0.9	0.9	41.1	O K
960 min Winter	34.640	0.040	0.0	0.9	0.9	41.6	O K
1440 min Winter	34.639	0.039	0.0	0.9	0.9	41.5	O K
2160 min Winter	34.638	0.038	0.0	0.9	0.9	40.2	O K
2880 min Winter	34.637	0.037	0.0	0.8	0.8	38.6	O K
4320 min Winter	34.634	0.034	0.0	0.7	0.7	35.8	O K
5760 min Winter	34.632	0.032	0.0	0.6	0.6	33.3	O K
7200 min Winter	34.630	0.030	0.0	0.5	0.5	31.2	O K
8640 min Winter	34.628	0.028	0.0	0.5	0.5	29.4	O K
10080 min Winter	34.627	0.027	0.0	0.4	0.4	27.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	0.352	0.0	80.3	4760
10080 min Summer	0.315	0.0	81.4	5504
15 min Winter	31.332	0.0	5.1	84
30 min Winter	20.391	0.0	9.3	87
60 min Winter	12.872	0.0	18.0	100
120 min Winter	7.960	0.0	24.7	136
180 min Winter	5.980	0.0	29.1	182
240 min Winter	4.876	0.0	32.5	238
360 min Winter	3.634	0.0	37.3	346
480 min Winter	2.942	0.0	40.9	432
600 min Winter	2.497	0.0	43.8	474
720 min Winter	2.184	0.0	46.2	548
960 min Winter	1.768	0.0	50.0	694
1440 min Winter	1.313	0.0	55.0	984
2160 min Winter	0.975	0.0	68.1	1404
2880 min Winter	0.789	0.0	72.4	1812
4320 min Winter	0.586	0.0	77.2	2592
5760 min Winter	0.474	0.0	87.8	3392
7200 min Winter	0.403	0.0	90.8	4112
8640 min Winter	0.352	0.0	92.8	4920
10080 min Winter	0.315	0.0	94.0	5648

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Cascade Rainfall Details for BlueRoof-01.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.100	Shortest Storm (mins)	15
Ratio R	0.407	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Green Roof

Area (m³)	1107	Evaporation (mm/day)	3
Depression Storage (mm)	5	Decay Coefficient	0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.020116	32	36	0.004061	64	68	0.000820	96	100	0.000166
4	8	0.016470	36	40	0.003325	68	72	0.000671	100	104	0.000136
8	12	0.013484	40	44	0.002722	72	76	0.000550	104	108	0.000111
12	16	0.011040	44	48	0.002229	76	80	0.000450	108	112	0.000091
16	20	0.009039	48	52	0.001825	80	84	0.000368	112	116	0.000074
20	24	0.007400	52	56	0.001494	84	88	0.000302	116	120	0.000061
24	28	0.006059	56	60	0.001223	88	92	0.000247			
28	32	0.004961	60	64	0.001002	92	96	0.000202			

Time Area Diagram

Total Area (ha) 0.176

Time From:	(mins) To:	Area (ha)
0	4	0.176

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Cascade Model Details for BlueRoof-01.SRCX

Storage is Online Cover Level (m) 35.000

Cellular Storage Structure

Invert Level (m) 34.600 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	1107.0	1107.0	1.300	0.0	1127.0
0.100	1107.0	1120.3	1.400	0.0	1127.0
0.200	0.0	1127.0	1.500	0.0	1127.0
0.300	0.0	1127.0	1.600	0.0	1127.0
0.400	0.0	1127.0	1.700	0.0	1127.0
0.500	0.0	1127.0	1.800	0.0	1127.0
0.600	0.0	1127.0	1.900	0.0	1127.0
0.700	0.0	1127.0	2.000	0.0	1127.0
0.800	0.0	1127.0	2.100	0.0	1127.0
0.900	0.0	1127.0	2.200	0.0	1127.0
1.000	0.0	1127.0	2.300	0.0	1127.0
1.100	0.0	1127.0	2.400	0.0	1127.0
1.200	0.0	1127.0	2.500	0.0	1127.0

Pipe Outflow Control

Diameter (m) 0.150 Entry Loss Coefficient 0.500
Slope (1:X) 1.0 Coefficient of Contraction 0.600
Length (m) 3.000 Upstream Invert Level (m) 34.600
Roughness k (mm) 0.600

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Cascade Summary of Results for BlueRoof-02.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	Hydrobrake-02.SRCX	(None)

Half Drain Time : 573 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	34.607	0.007	0.0	0.0	0.0	4.2	O K
30 min Summer	34.610	0.010	0.0	0.1	0.1	6.4	O K
60 min Summer	34.614	0.014	0.0	0.1	0.1	8.8	O K
120 min Summer	34.619	0.019	0.0	0.2	0.2	11.4	O K
180 min Summer	34.621	0.021	0.0	0.2	0.2	13.0	O K
240 min Summer	34.623	0.023	0.0	0.3	0.3	14.0	O K
360 min Summer	34.625	0.025	0.0	0.3	0.3	15.0	O K
480 min Summer	34.625	0.025	0.0	0.3	0.3	15.4	O K
600 min Summer	34.626	0.026	0.0	0.3	0.3	15.7	O K
720 min Summer	34.626	0.026	0.0	0.3	0.3	16.0	O K
960 min Summer	34.627	0.027	0.0	0.3	0.3	16.4	O K
1440 min Summer	34.627	0.027	0.0	0.4	0.4	16.7	O K
2160 min Summer	34.627	0.027	0.0	0.4	0.4	16.6	O K
2880 min Summer	34.627	0.027	0.0	0.3	0.3	16.3	O K
4320 min Summer	34.625	0.025	0.0	0.3	0.3	15.4	O K
5760 min Summer	34.624	0.024	0.0	0.3	0.3	14.6	O K
7200 min Summer	34.623	0.023	0.0	0.2	0.2	13.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	31.332	0.0	1.5	92
30 min Summer	20.391	0.0	3.1	94
60 min Summer	12.872	0.0	6.4	108
120 min Summer	7.960	0.0	9.1	144
180 min Summer	5.980	0.0	10.9	188
240 min Summer	4.876	0.0	12.2	242
360 min Summer	3.634	0.0	14.2	360
480 min Summer	2.942	0.0	15.6	416
600 min Summer	2.497	0.0	16.7	474
720 min Summer	2.184	0.0	17.6	534
960 min Summer	1.768	0.0	19.1	664
1440 min Summer	1.313	0.0	20.9	932
2160 min Summer	0.975	0.0	25.9	1332
2880 min Summer	0.789	0.0	27.4	1728
4320 min Summer	0.586	0.0	28.8	2504
5760 min Summer	0.474	0.0	32.5	3232
7200 min Summer	0.403	0.0	33.4	4032

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Cascade Summary of Results for BlueRoof-02.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	34.622	0.022	0.0	0.2	0.2	13.4	O K
10080 min Summer	34.621	0.021	0.0	0.2	0.2	12.8	O K
15 min Winter	34.608	0.008	0.0	0.0	0.0	5.1	O K
30 min Winter	34.612	0.012	0.0	0.1	0.1	7.5	O K
60 min Winter	34.617	0.017	0.0	0.1	0.1	10.2	O K
120 min Winter	34.622	0.022	0.0	0.2	0.2	13.1	O K
180 min Winter	34.624	0.024	0.0	0.3	0.3	14.8	O K
240 min Winter	34.626	0.026	0.0	0.3	0.3	15.9	O K
360 min Winter	34.628	0.028	0.0	0.4	0.4	17.0	O K
480 min Winter	34.629	0.029	0.0	0.4	0.4	17.4	O K
600 min Winter	34.629	0.029	0.0	0.4	0.4	17.7	O K
720 min Winter	34.630	0.030	0.0	0.4	0.4	18.0	O K
960 min Winter	34.630	0.030	0.0	0.4	0.4	18.2	O K
1440 min Winter	34.630	0.030	0.0	0.4	0.4	18.1	O K
2160 min Winter	34.629	0.029	0.0	0.4	0.4	17.5	O K
2880 min Winter	34.628	0.028	0.0	0.4	0.4	16.7	O K
4320 min Winter	34.625	0.025	0.0	0.3	0.3	15.4	O K
5760 min Winter	34.624	0.024	0.0	0.3	0.3	14.3	O K
7200 min Winter	34.622	0.022	0.0	0.2	0.2	13.4	O K
8640 min Winter	34.621	0.021	0.0	0.2	0.2	12.7	O K
10080 min Winter	34.620	0.020	0.0	0.2	0.2	12.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	0.352	0.0	34.0	4760
10080 min Summer	0.315	0.0	34.4	5480
15 min Winter	31.332	0.0	2.1	88
30 min Winter	20.391	0.0	4.0	92
60 min Winter	12.872	0.0	7.8	106
120 min Winter	7.960	0.0	10.9	140
180 min Winter	5.980	0.0	12.9	184
240 min Winter	4.876	0.0	14.4	238
360 min Winter	3.634	0.0	16.6	348
480 min Winter	2.942	0.0	18.3	420
600 min Winter	2.497	0.0	19.6	476
720 min Winter	2.184	0.0	20.6	548
960 min Winter	1.768	0.0	22.3	694
1440 min Winter	1.313	0.0	24.5	986
2160 min Winter	0.975	0.0	30.1	1404
2880 min Winter	0.789	0.0	31.9	1796
4320 min Winter	0.586	0.0	33.8	2596
5760 min Winter	0.474	0.0	38.0	3344
7200 min Winter	0.403	0.0	39.1	4112
8640 min Winter	0.352	0.0	39.7	4928
10080 min Winter	0.315	0.0	40.0	5656

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Cascade Rainfall Details for BlueRoof-02.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.100	Shortest Storm (mins)	15
Ratio R	0.407	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Green Roof

Area (m³)	639	Evaporation (mm/day)	3
Depression Storage (mm)	5	Decay Coefficient	0.050

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.011612	32	36	0.002344	64	68	0.000473	96	100	0.000096
4	8	0.009507	36	40	0.001919	68	72	0.000388	100	104	0.000078
8	12	0.007784	40	44	0.001571	72	76	0.000317	104	108	0.000064
12	16	0.006373	44	48	0.001287	76	80	0.000260	108	112	0.000052
16	20	0.005218	48	52	0.001053	80	84	0.000213	112	116	0.000043
20	24	0.004272	52	56	0.000862	84	88	0.000174	116	120	0.000035
24	28	0.003497	56	60	0.000706	88	92	0.000143			
28	32	0.002863	60	64	0.000578	92	96	0.000117			

Time Area Diagram

Total Area (ha) 0.067

Time (mins) From:	To:	Area (ha)
0	4	0.067

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Cascade Model Details for BlueRoof-02.SRCX

Storage is Online Cover Level (m) 35.000

Cellular Storage Structure

Invert Level (m) 34.600 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	639.0	639.0	1.300	0.0	654.2
0.100	639.0	649.1	1.400	0.0	654.2
0.200	0.0	654.2	1.500	0.0	654.2
0.300	0.0	654.2	1.600	0.0	654.2
0.400	0.0	654.2	1.700	0.0	654.2
0.500	0.0	654.2	1.800	0.0	654.2
0.600	0.0	654.2	1.900	0.0	654.2
0.700	0.0	654.2	2.000	0.0	654.2
0.800	0.0	654.2	2.100	0.0	654.2
0.900	0.0	654.2	2.200	0.0	654.2
1.000	0.0	654.2	2.300	0.0	654.2
1.100	0.0	654.2	2.400	0.0	654.2
1.200	0.0	654.2	2.500	0.0	654.2

Pipe Outflow Control

Diameter (m) 0.100 Entry Loss Coefficient 0.500
Slope (1:X) 1.0 Coefficient of Contraction 0.600
Length (m) 3.000 Upstream Invert Level (m) 34.600
Roughness k (mm) 0.600

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Cascade Summary of Results for Hydrobrake-01.srcx

Upstream Structures	Outflow To	Overflow To
Porous-CP-to-HB01.SRCX	Hydrobrake-03.SRCX	(None)

Half Drain Time : 35 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	29.595	0.045	0.0	4.0	4.0	8.3	O K
30 min Summer	29.608	0.058	0.0	4.0	4.0	10.8	O K
60 min Summer	29.616	0.066	0.0	4.0	4.0	12.2	O K
120 min Summer	29.618	0.068	0.0	4.0	4.0	12.5	O K
180 min Summer	29.615	0.065	0.0	4.0	4.0	12.0	O K
240 min Summer	29.609	0.059	0.0	4.0	4.0	11.0	O K
360 min Summer	29.594	0.044	0.0	4.0	4.0	8.2	O K
480 min Summer	29.580	0.030	0.0	4.0	4.0	5.6	O K
600 min Summer	29.569	0.019	0.0	4.0	4.0	3.5	O K
720 min Summer	29.560	0.010	0.0	4.0	4.0	1.9	O K
960 min Summer	29.551	0.001	0.0	4.0	4.0	0.2	O K
1440 min Summer	29.550	0.000	0.0	3.1	3.1	0.0	O K
2160 min Summer	29.550	0.000	0.0	2.3	2.3	0.0	O K
2880 min Summer	29.550	0.000	0.0	1.9	1.9	0.0	O K
4320 min Summer	29.550	0.000	0.0	1.4	1.4	0.0	O K
5760 min Summer	29.550	0.000	0.0	1.1	1.1	0.0	O K
7200 min Summer	29.550	0.000	0.0	0.9	0.9	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	31.332	0.0	13.3	18
30 min Summer	20.391	0.0	18.5	32
60 min Summer	12.872	0.0	24.3	52
120 min Summer	7.960	0.0	30.7	86
180 min Summer	5.980	0.0	35.1	120
240 min Summer	4.876	0.0	38.4	152
360 min Summer	3.634	0.0	43.4	216
480 min Summer	2.942	0.0	47.1	276
600 min Summer	2.497	0.0	49.9	334
720 min Summer	2.184	0.0	52.5	390
960 min Summer	1.768	0.0	56.6	494
1440 min Summer	1.313	0.0	62.9	0
2160 min Summer	0.975	0.0	69.8	0
2880 min Summer	0.789	0.0	74.8	0
4320 min Summer	0.586	0.0	82.0	0
5760 min Summer	0.474	0.0	87.2	0
7200 min Summer	0.403	0.0	91.3	0

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Cascade Summary of Results for Hydrobrake-01.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	29.550	0.000	0.0	0.8	0.8	0.0	O K
10080 min Summer	29.550	0.000	0.0	0.7	0.7	0.0	O K
15 min Winter	29.604	0.054	0.0	4.0	4.0	10.1	O K
30 min Winter	29.621	0.071	0.0	4.0	4.0	13.2	O K
60 min Winter	29.630	0.080	0.0	4.0	4.0	14.9	O K
120 min Winter	29.628	0.078	0.0	4.0	4.0	14.5	O K
180 min Winter	29.621	0.071	0.0	4.0	4.0	13.1	O K
240 min Winter	29.611	0.061	0.0	4.0	4.0	11.2	O K
360 min Winter	29.586	0.036	0.0	4.0	4.0	6.7	O K
480 min Winter	29.566	0.016	0.0	4.0	4.0	2.9	O K
600 min Winter	29.553	0.003	0.0	4.0	4.0	0.5	O K
720 min Winter	29.550	0.000	0.0	3.7	3.7	0.0	O K
960 min Winter	29.550	0.000	0.0	3.0	3.0	0.0	O K
1440 min Winter	29.550	0.000	0.0	2.2	2.2	0.0	O K
2160 min Winter	29.550	0.000	0.0	1.7	1.7	0.0	O K
2880 min Winter	29.550	0.000	0.0	1.3	1.3	0.0	O K
4320 min Winter	29.550	0.000	0.0	1.0	1.0	0.0	O K
5760 min Winter	29.550	0.000	0.0	0.8	0.8	0.0	O K
7200 min Winter	29.550	0.000	0.0	0.7	0.7	0.0	O K
8640 min Winter	29.550	0.000	0.0	0.6	0.6	0.0	O K
10080 min Winter	29.550	0.000	0.0	0.5	0.5	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	0.352	0.0	94.5	0
10080 min Summer	0.315	0.0	97.1	0
15 min Winter	31.332	0.0	15.5	19
30 min Winter	20.391	0.0	21.1	32
60 min Winter	12.872	0.0	27.6	58
120 min Winter	7.960	0.0	34.8	92
180 min Winter	5.980	0.0	39.8	128
240 min Winter	4.876	0.0	43.4	164
360 min Winter	3.634	0.0	48.9	228
480 min Winter	2.942	0.0	53.0	284
600 min Winter	2.497	0.0	56.5	326
720 min Winter	2.184	0.0	59.3	0
960 min Winter	1.768	0.0	64.0	0
1440 min Winter	1.313	0.0	71.2	0
2160 min Winter	0.975	0.0	79.0	0
2880 min Winter	0.789	0.0	84.7	0
4320 min Winter	0.586	0.0	93.1	0
5760 min Winter	0.474	0.0	99.3	0
7200 min Winter	0.403	0.0	104.1	0
8640 min Winter	0.352	0.0	108.1	0
10080 min Winter	0.315	0.0	111.4	0

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Cascade Rainfall Details for Hydrobrake-01.srcx

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.100	Shortest Storm (mins)	15
Ratio R	0.407	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.167

Time (mins) From:	To:	Area (ha)
0	4	0.167

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Cascade Model Details for Hydrobrake-01.srcx

Storage is Online Cover Level (m) 30.650

Cellular Storage Structure

Invert Level (m) 29.550 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	195.0	195.0	1.300	0.0	242.5
0.100	195.0	200.6	1.400	0.0	242.5
0.200	195.0	206.2	1.500	0.0	242.5
0.300	195.0	211.8	1.600	0.0	242.5
0.400	195.0	217.3	1.700	0.0	242.5
0.500	195.0	222.9	1.800	0.0	242.5
0.600	195.0	228.5	1.900	0.0	242.5
0.700	195.0	234.1	2.000	0.0	242.5
0.800	195.0	239.7	2.100	0.0	242.5
0.900	0.0	242.5	2.200	0.0	242.5
1.000	0.0	242.5	2.300	0.0	242.5
1.100	0.0	242.5	2.400	0.0	242.5
1.200	0.0	242.5	2.500	0.0	242.5

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0095-4000-1000-4000
Design Head (m)	1.000
Design Flow (l/s)	4.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	95
Invert Level (m)	29.310
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	4.0
Flush-Flo™	0.294	4.0
Kick-Flo®	0.629	3.2
Mean Flow over Head Range	-	3.5

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

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Hydro-Brake® Optimum Outflow Control

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.0	1.200	4.3	3.000	6.7	7.000	10.0
0.200	3.9	1.400	4.7	3.500	7.2	7.500	10.3
0.300	4.0	1.600	5.0	4.000	7.6	8.000	10.6
0.400	3.9	1.800	5.3	4.500	8.1	8.500	10.9
0.500	3.8	2.000	5.5	5.000	8.5	9.000	11.2
0.600	3.4	2.200	5.8	5.500	8.9	9.500	11.5
0.800	3.6	2.400	6.0	6.000	9.3		
1.000	4.0	2.600	6.2	6.500	9.6		

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Cascade Summary of Results for Hydrobrake-02.SRCX

Upstream Structures	Outflow To	Overflow To
BlueRoof-01.SRCX BlueRoof-02.SRCX Porous-CP-to-HB02.SRCX	Hydrobrake-03.SRCX	(None)

Half Drain Time : 27 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	29.374	0.024	0.0	5.2	5.2	11.6	O K
30 min Summer	29.378	0.028	0.0	5.5	5.5	13.7	O K
60 min Summer	29.381	0.031	0.0	5.7	5.7	14.9	O K
120 min Summer	29.381	0.031	0.0	5.7	5.7	14.9	O K
180 min Summer	29.379	0.029	0.0	5.6	5.6	14.2	O K
240 min Summer	29.377	0.027	0.0	5.4	5.4	13.1	O K
360 min Summer	29.372	0.022	0.0	5.0	5.0	10.6	O K
480 min Summer	29.368	0.018	0.0	4.7	4.7	8.5	O K
600 min Summer	29.364	0.014	0.0	4.5	4.5	6.8	O K
720 min Summer	29.361	0.011	0.0	4.3	4.3	5.4	O K
960 min Summer	29.357	0.007	0.0	3.9	3.9	3.3	O K
1440 min Summer	29.352	0.002	0.0	3.6	3.6	0.7	O K
2160 min Summer	29.350	0.000	0.0	3.1	3.1	0.0	O K
2880 min Summer	29.350	0.000	0.0	2.7	2.7	0.0	O K
4320 min Summer	29.350	0.000	0.0	2.2	2.2	0.0	O K
5760 min Summer	29.350	0.000	0.0	1.9	1.9	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	31.332	0.0	21.1	16
30 min Summer	20.391	0.0	31.8	28
60 min Summer	12.872	0.0	49.3	44
120 min Summer	7.960	0.0	64.9	80
180 min Summer	5.980	0.0	75.4	114
240 min Summer	4.876	0.0	83.5	146
360 min Summer	3.634	0.0	95.0	212
480 min Summer	2.942	0.0	103.2	276
600 min Summer	2.497	0.0	110.1	338
720 min Summer	2.184	0.0	115.9	400
960 min Summer	1.768	0.0	125.3	522
1440 min Summer	1.313	0.0	138.8	752
2160 min Summer	0.975	0.0	163.4	0
2880 min Summer	0.789	0.0	174.2	0
4320 min Summer	0.586	0.0	187.9	0
5760 min Summer	0.474	0.0	207.0	0

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Cascade Summary of Results for Hydrobrake-02.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
7200 min Summer	29.350	0.000	0.0	1.7	1.7	0.0	O K
8640 min Summer	29.350	0.000	0.0	1.5	1.5	0.0	O K
10080 min Summer	29.350	0.000	0.0	1.4	1.4	0.0	O K
15 min Winter	29.378	0.028	0.0	5.5	5.5	13.7	O K
30 min Winter	29.384	0.034	0.0	5.9	5.9	16.4	O K
60 min Winter	29.386	0.036	0.0	6.0	6.0	17.4	O K
120 min Winter	29.384	0.034	0.0	5.9	5.9	16.7	O K
180 min Winter	29.381	0.031	0.0	5.7	5.7	15.2	O K
240 min Winter	29.378	0.028	0.0	5.5	5.5	13.4	O K
360 min Winter	29.371	0.021	0.0	5.0	5.0	10.1	O K
480 min Winter	29.365	0.015	0.0	4.6	4.6	7.4	O K
600 min Winter	29.361	0.011	0.0	4.2	4.2	5.3	O K
720 min Winter	29.357	0.007	0.0	4.0	4.0	3.6	O K
960 min Winter	29.353	0.003	0.0	3.6	3.6	1.2	O K
1440 min Winter	29.350	0.000	0.0	3.1	3.1	0.0	O K
2160 min Winter	29.350	0.000	0.0	2.6	2.6	0.0	O K
2880 min Winter	29.350	0.000	0.0	2.3	2.3	0.0	O K
4320 min Winter	29.350	0.000	0.0	1.9	1.9	0.0	O K
5760 min Winter	29.350	0.000	0.0	1.6	1.6	0.0	O K
7200 min Winter	29.350	0.000	0.0	1.4	1.4	0.0	O K
8640 min Winter	29.350	0.000	0.0	1.3	1.3	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
7200 min Summer	0.403	0.0	215.5	0
8640 min Summer	0.352	0.0	222.1	0
10080 min Summer	0.315	0.0	226.9	0
15 min Winter	31.332	0.0	25.2	16
30 min Winter	20.391	0.0	37.3	30
60 min Winter	12.872	0.0	57.0	48
120 min Winter	7.960	0.0	74.7	86
180 min Winter	5.980	0.0	86.6	122
240 min Winter	4.876	0.0	95.8	158
360 min Winter	3.634	0.0	108.9	228
480 min Winter	2.942	0.0	118.5	296
600 min Winter	2.497	0.0	126.4	362
720 min Winter	2.184	0.0	133.1	432
960 min Winter	1.768	0.0	144.0	550
1440 min Winter	1.313	0.0	159.3	0
2160 min Winter	0.975	0.0	186.8	0
2880 min Winter	0.789	0.0	199.5	0
4320 min Winter	0.586	0.0	216.0	0
5760 min Winter	0.474	0.0	238.0	0
7200 min Winter	0.403	0.0	247.8	0
8640 min Winter	0.352	0.0	255.2	0

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Cascade Summary of Results for Hydrobrake-02.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Winter	29.350	0.000	0.0	1.2	1.2	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Winter	0.315	0.0	260.7	0

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Cascade Rainfall Details for Hydrobrake-02.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.100	Shortest Storm (mins)	15
Ratio R	0.407	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.199

Time (mins) From:	To:	Area (ha)
0	4	0.199

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Cascade Model Details for Hydrobrake-02.SRCX

Storage is Online Cover Level (m) 30.630

Cellular Storage Structure

Invert Level (m) 29.350 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	510.0	510.0	1.300	0.0	559.7
0.100	510.0	519.0	1.400	0.0	559.7
0.200	510.0	528.1	1.500	0.0	559.7
0.300	510.0	537.1	1.600	0.0	559.7
0.400	510.0	546.1	1.700	0.0	559.7
0.500	510.0	555.2	1.800	0.0	559.7
0.600	0.0	559.7	1.900	0.0	559.7
0.700	0.0	559.7	2.000	0.0	559.7
0.800	0.0	559.7	2.100	0.0	559.7
0.900	0.0	559.7	2.200	0.0	559.7
1.000	0.0	559.7	2.300	0.0	559.7
1.100	0.0	559.7	2.400	0.0	559.7
1.200	0.0	559.7	2.500	0.0	559.7

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0136-8000-0680-8000
Design Head (m)	0.680
Design Flow (l/s)	8.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	136
Invert Level (m)	29.270
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.680	8.0
Flush-Flo™	0.231	8.0
Kick-Flo®	0.492	6.9
Mean Flow over Head Range	-	6.7

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

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Hydro-Brake® Optimum Outflow Control

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.9	1.200	10.4	3.000	16.1	7.000	24.1
0.200	7.9	1.400	11.2	3.500	17.4	7.500	25.0
0.300	7.9	1.600	12.0	4.000	18.5	8.000	25.8
0.400	7.6	1.800	12.6	4.500	19.6	8.500	26.6
0.500	6.9	2.000	13.3	5.000	20.6	9.000	27.4
0.600	7.5	2.200	13.9	5.500	21.6	9.500	28.1
0.800	8.6	2.400	14.5	6.000	22.5		
1.000	9.6	2.600	15.1	6.500	23.4		

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Cascade Summary of Results for Hydrobrake-03.SRCX

Upstream Structures	Outflow To	Overflow To
Hydrobrake-01.srcx	(None)	(None)
Porous-CP-to-HB01.SRCX		
Hydrobrake-02.SRCX		
BlueRoof-01.SRCX		
BlueRoof-02.SRCX		
Porous-CP-to-HB02.SRCX		

Half Drain Time : 76 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	29.015	0.065	0.0	6.0	6.0	19.4	O K
30 min Summer	29.039	0.089	0.0	6.0	6.0	26.4	O K
60 min Summer	29.062	0.112	0.0	6.0	6.0	33.2	O K
120 min Summer	29.083	0.133	0.0	6.0	6.0	39.4	O K
180 min Summer	29.096	0.146	0.0	6.0	6.0	43.2	O K
240 min Summer	29.102	0.152	0.0	6.0	6.0	45.1	O K
360 min Summer	29.100	0.150	0.0	6.0	6.0	44.3	O K
480 min Summer	29.092	0.142	0.0	6.0	6.0	42.1	O K
600 min Summer	29.082	0.132	0.0	6.0	6.0	39.3	O K
720 min Summer	29.073	0.123	0.0	6.0	6.0	36.3	O K
960 min Summer	29.052	0.102	0.0	6.0	6.0	30.4	O K
1440 min Summer	29.017	0.067	0.0	6.0	6.0	19.9	O K
2160 min Summer	28.982	0.032	0.0	5.8	5.8	9.5	O K
2880 min Summer	28.967	0.017	0.0	5.1	5.1	4.9	O K
4320 min Summer	28.951	0.001	0.0	4.3	4.3	0.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	31.332	0.0	45.3	57
30 min Summer	20.391	0.0	64.4	81
60 min Summer	12.872	0.0	91.6	112
120 min Summer	7.960	0.0	118.1	158
180 min Summer	5.980	0.0	135.6	198
240 min Summer	4.876	0.0	149.2	232
360 min Summer	3.634	0.0	169.0	284
480 min Summer	2.942	0.0	183.2	338
600 min Summer	2.497	0.0	194.9	402
720 min Summer	2.184	0.0	205.1	464
960 min Summer	1.768	0.0	221.7	592
1440 min Summer	1.313	0.0	246.1	810
2160 min Summer	0.975	0.0	282.6	1148
2880 min Summer	0.789	0.0	302.3	1504
4320 min Summer	0.586	0.0	329.3	2204

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Cascade Summary of Results for Hydrobrake-03.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
5760 min Summer	28.950	0.000	0.0	3.7	3.7	0.0	O K
7200 min Summer	28.950	0.000	0.0	3.2	3.2	0.0	O K
8640 min Summer	28.950	0.000	0.0	2.9	2.9	0.0	O K
10080 min Summer	28.950	0.000	0.0	2.6	2.6	0.0	O K
15 min Winter	29.026	0.076	0.0	6.0	6.0	22.4	O K
30 min Winter	29.053	0.103	0.0	6.0	6.0	30.6	O K
60 min Winter	29.082	0.132	0.0	6.0	6.0	39.1	O K
120 min Winter	29.108	0.158	0.0	6.0	6.0	46.8	O K
180 min Winter	29.123	0.173	0.0	6.0	6.0	51.3	O K
240 min Winter	29.132	0.182	0.0	6.0	6.0	54.0	O K
360 min Winter	29.125	0.175	0.0	6.0	6.0	51.9	O K
480 min Winter	29.111	0.161	0.0	6.0	6.0	47.9	O K
600 min Winter	29.096	0.146	0.0	6.0	6.0	43.2	O K
720 min Winter	29.078	0.128	0.0	6.0	6.0	38.0	O K
960 min Winter	29.045	0.095	0.0	6.0	6.0	28.2	O K
1440 min Winter	28.993	0.043	0.0	5.9	5.9	12.7	O K
2160 min Winter	28.965	0.015	0.0	5.0	5.0	4.4	O K
2880 min Winter	28.951	0.001	0.0	4.4	4.4	0.4	O K
4320 min Winter	28.950	0.000	0.0	3.5	3.5	0.0	O K
5760 min Winter	28.950	0.000	0.0	2.9	2.9	0.0	O K
7200 min Winter	28.950	0.000	0.0	2.5	2.5	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
5760 min Summer	0.474	0.0	358.5	0
7200 min Summer	0.403	0.0	374.9	0
8640 min Summer	0.352	0.0	388.1	0
10080 min Summer	0.315	0.0	398.5	0
15 min Winter	31.332	0.0	52.9	66
30 min Winter	20.391	0.0	74.3	91
60 min Winter	12.872	0.0	104.6	124
120 min Winter	7.960	0.0	134.5	170
180 min Winter	5.980	0.0	154.8	210
240 min Winter	4.876	0.0	169.9	246
360 min Winter	3.634	0.0	192.1	300
480 min Winter	2.942	0.0	208.3	366
600 min Winter	2.497	0.0	222.0	436
720 min Winter	2.184	0.0	233.4	504
960 min Winter	1.768	0.0	252.6	632
1440 min Winter	1.313	0.0	280.1	850
2160 min Winter	0.975	0.0	321.1	1208
2880 min Winter	0.789	0.0	344.0	1556
4320 min Winter	0.586	0.0	375.7	0
5760 min Winter	0.474	0.0	409.2	0
7200 min Winter	0.403	0.0	428.3	0

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Cascade Summary of Results for Hydrobrake-03.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Winter	28.950	0.000	0.0	2.2	2.2	0.0	O K
10080 min Winter	28.950	0.000	0.0	2.0	2.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Winter	0.352	0.0	443.4	0
10080 min Winter	0.315	0.0	455.6	0

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Cascade Rainfall Details for Hydrobrake-03.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.100	Shortest Storm (mins)	15
Ratio R	0.407	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.188

Time (mins) From:	To:	Area (ha)
0	4	0.188

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Cascade Model Details for Hydrobrake-03.SRCX

Storage is Online Cover Level (m) 30.550

Cellular Storage Structure

Invert Level (m) 28.950 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	312.0	312.0	1.300	0.0	372.1
0.100	312.0	319.1	1.400	0.0	372.1
0.200	312.0	326.1	1.500	0.0	372.1
0.300	312.0	333.2	1.600	0.0	372.1
0.400	312.0	340.3	1.700	0.0	372.1
0.500	312.0	347.3	1.800	0.0	372.1
0.600	312.0	354.4	1.900	0.0	372.1
0.700	312.0	361.5	2.000	0.0	372.1
0.800	312.0	368.5	2.100	0.0	372.1
0.900	0.0	372.1	2.200	0.0	372.1
1.000	0.0	372.1	2.300	0.0	372.1
1.100	0.0	372.1	2.400	0.0	372.1
1.200	0.0	372.1	2.500	0.0	372.1

Complex Outflow Control

Hydro-Brake® Optimum

Unit Reference	MD-SHE-0121-6000-0600-6000
Design Head (m)	0.600
Design Flow (l/s)	6.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	121
Invert Level (m)	28.850
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.600	6.0
Flush-Flo™	0.202	6.0
Kick-Flo®	0.435	5.2
Mean Flow over Head Range	-	5.0

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

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Hydro-Brake® Optimum

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.3	1.200	8.3	3.000	12.8	7.000	19.2
0.200	6.0	1.400	8.9	3.500	13.8	7.500	19.9
0.300	5.9	1.600	9.5	4.000	14.7	8.000	20.5
0.400	5.5	1.800	10.0	4.500	15.5	8.500	21.1
0.500	5.5	2.000	10.6	5.000	16.3	9.000	21.8
0.600	6.0	2.200	11.0	5.500	17.1	9.500	22.4
0.800	6.9	2.400	11.5	6.000	17.8		
1.000	7.6	2.600	12.0	6.500	18.5		

Orifice

Diameter (m) 0.125 Discharge Coefficient 0.600 Invert Level (m) 29.450

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Cascade Summary of Results for Porous-CP-to-HB01.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	Hydrobrake-01.srcx	(None)

Half Drain Time : 7 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	30.103	0.123	0.0	5.8	5.8	2.0	O K
30 min Summer	30.118	0.138	0.0	6.9	6.9	2.6	O K
60 min Summer	30.120	0.140	0.0	7.1	7.1	2.7	O K
120 min Summer	30.108	0.128	0.0	6.1	6.1	2.2	O K
180 min Summer	30.096	0.116	0.0	5.2	5.2	1.8	O K
240 min Summer	30.087	0.107	0.0	4.5	4.5	1.6	O K
360 min Summer	30.078	0.098	0.0	3.5	3.5	1.3	O K
480 min Summer	30.071	0.091	0.0	2.8	2.8	1.1	O K
600 min Summer	30.066	0.086	0.0	2.4	2.4	1.0	O K
720 min Summer	30.061	0.081	0.0	2.1	2.1	0.9	O K
960 min Summer	30.055	0.075	0.0	1.7	1.7	0.8	O K
1440 min Summer	30.048	0.068	0.0	1.3	1.3	0.6	O K
2160 min Summer	30.040	0.060	0.0	1.0	1.0	0.5	O K
2880 min Summer	30.036	0.056	0.0	0.8	0.8	0.4	O K
4320 min Summer	30.031	0.051	0.0	0.6	0.6	0.4	O K
5760 min Summer	30.028	0.048	0.0	0.5	0.5	0.3	O K
7200 min Summer	30.025	0.045	0.0	0.4	0.4	0.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	31.332	0.0	3.7	13
30 min Summer	20.391	0.0	5.9	21
60 min Summer	12.872	0.0	8.3	36
120 min Summer	7.960	0.0	11.0	66
180 min Summer	5.980	0.0	12.8	96
240 min Summer	4.876	0.0	14.1	126
360 min Summer	3.634	0.0	16.1	186
480 min Summer	2.942	0.0	17.5	246
600 min Summer	2.497	0.0	18.7	308
720 min Summer	2.184	0.0	19.6	368
960 min Summer	1.768	0.0	21.2	490
1440 min Summer	1.313	0.0	23.5	734
2160 min Summer	0.975	0.0	25.8	1100
2880 min Summer	0.789	0.0	27.3	1432
4320 min Summer	0.586	0.0	29.2	2168
5760 min Summer	0.474	0.0	30.2	2856
7200 min Summer	0.403	0.0	30.7	3560

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Cascade Summary of Results for Porous-CP-to-HB01.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	30.024	0.044	0.0	0.3	0.3	0.3	O K
10080 min Summer	30.022	0.042	0.0	0.3	0.3	0.2	O K
15 min Winter	30.116	0.136	0.0	6.7	6.7	2.5	O K
30 min Winter	30.126	0.146	0.0	7.7	7.7	2.9	O K
60 min Winter	30.119	0.139	0.0	7.0	7.0	2.6	O K
120 min Winter	30.097	0.117	0.0	5.3	5.3	1.9	O K
180 min Winter	30.085	0.105	0.0	4.2	4.2	1.5	O K
240 min Winter	30.077	0.097	0.0	3.4	3.4	1.3	O K
360 min Winter	30.069	0.089	0.0	2.6	2.6	1.1	O K
480 min Winter	30.061	0.081	0.0	2.1	2.1	0.9	O K
600 min Winter	30.056	0.076	0.0	1.8	1.8	0.8	O K
720 min Winter	30.052	0.072	0.0	1.6	1.6	0.7	O K
960 min Winter	30.047	0.067	0.0	1.3	1.3	0.6	O K
1440 min Winter	30.040	0.060	0.0	0.9	0.9	0.5	O K
2160 min Winter	30.034	0.054	0.0	0.7	0.7	0.4	O K
2880 min Winter	30.031	0.051	0.0	0.6	0.6	0.3	O K
4320 min Winter	30.026	0.046	0.0	0.4	0.4	0.3	O K
5760 min Winter	30.023	0.043	0.0	0.3	0.3	0.3	O K
7200 min Winter	30.021	0.041	0.0	0.3	0.3	0.2	O K
8640 min Winter	30.019	0.039	0.0	0.2	0.2	0.2	O K
10080 min Winter	30.018	0.038	0.0	0.2	0.2	0.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	0.352	0.0	30.9	4256
10080 min Summer	0.315	0.0	30.8	5032
15 min Winter	31.332	0.0	4.6	13
30 min Winter	20.391	0.0	7.0	22
60 min Winter	12.872	0.0	9.7	38
120 min Winter	7.960	0.0	12.8	68
180 min Winter	5.980	0.0	14.8	96
240 min Winter	4.876	0.0	16.3	126
360 min Winter	3.634	0.0	18.5	188
480 min Winter	2.942	0.0	20.1	246
600 min Winter	2.497	0.0	21.4	308
720 min Winter	2.184	0.0	22.5	368
960 min Winter	1.768	0.0	24.3	492
1440 min Winter	1.313	0.0	27.0	720
2160 min Winter	0.975	0.0	29.7	1100
2880 min Winter	0.789	0.0	31.6	1456
4320 min Winter	0.586	0.0	34.0	2204
5760 min Winter	0.474	0.0	35.4	2928
7200 min Winter	0.403	0.0	36.3	3672
8640 min Winter	0.352	0.0	36.9	4392
10080 min Winter	0.315	0.0	37.1	5056

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Cascade Rainfall Details for Porous-CP-to-HB01.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.100	Shortest Storm (mins)	15
Ratio R	0.407	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.123

Time (mins) From:	To:	Area (ha)
0	4	0.123

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Cascade Model Details for Porous-CP-to-HB01.SRCX

Storage is Online Cover Level (m) 30.590

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	6.0
Membrane Percolation (mm/hr)	1000	Length (m)	115.0
Max Percolation (l/s)	191.7	Slope (1:X)	150.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	29.980	Membrane Depth (m)	0

Pipe Outflow Control

Diameter (m)	0.150	Entry Loss Coefficient	0.500
Slope (1:X)	80.0	Coefficient of Contraction	0.600
Length (m)	10.000	Upstream Invert Level (m)	30.000
Roughness k (mm)	0.600		

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Cascade Summary of Results for Porous-CP-to-HB02.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	Hydrobrake-02.SRCX	(None)

Half Drain Time : 0 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	30.020	0.000	0.0	18.2	18.2	0.0	O K
30 min Summer	30.020	0.000	0.0	15.8	15.8	0.0	O K
60 min Summer	30.020	0.000	0.0	11.4	11.4	0.0	O K
120 min Summer	30.020	0.000	0.0	7.6	7.6	0.0	O K
180 min Summer	30.020	0.000	0.0	5.8	5.8	0.0	O K
240 min Summer	30.020	0.000	0.0	4.8	4.8	0.0	O K
360 min Summer	30.020	0.000	0.0	3.6	3.6	0.0	O K
480 min Summer	30.020	0.000	0.0	2.9	2.9	0.0	O K
600 min Summer	30.020	0.000	0.0	2.4	2.4	0.0	O K
720 min Summer	30.020	0.000	0.0	2.1	2.1	0.0	O K
960 min Summer	30.020	0.000	0.0	1.7	1.7	0.0	O K
1440 min Summer	30.020	0.000	0.0	1.3	1.3	0.0	O K
2160 min Summer	30.020	0.000	0.0	0.9	0.9	0.0	O K
2880 min Summer	30.020	0.000	0.0	0.8	0.8	0.0	O K
4320 min Summer	30.020	0.000	0.0	0.6	0.6	0.0	O K
5760 min Summer	30.020	0.000	0.0	0.4	0.4	0.0	O K
7200 min Summer	30.020	0.000	0.0	0.4	0.4	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	31.332	0.0	4.0	0
30 min Summer	20.391	0.0	6.2	0
60 min Summer	12.872	0.0	8.6	0
120 min Summer	7.960	0.0	11.2	0
180 min Summer	5.980	0.0	13.0	0
240 min Summer	4.876	0.0	14.3	0
360 min Summer	3.634	0.0	16.3	0
480 min Summer	2.942	0.0	17.7	0
600 min Summer	2.497	0.0	18.8	0
720 min Summer	2.184	0.0	19.8	0
960 min Summer	1.768	0.0	21.4	0
1440 min Summer	1.313	0.0	23.7	0
2160 min Summer	0.975	0.0	26.1	0
2880 min Summer	0.789	0.0	27.7	0
4320 min Summer	0.586	0.0	29.7	0
5760 min Summer	0.474	0.0	30.9	0
7200 min Summer	0.403	0.0	31.7	0

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Cascade Summary of Results for Porous-CP-to-HB02.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	30.020	0.000	0.0	0.3	0.3	0.0	O K
10080 min Summer	30.020	0.000	0.0	0.3	0.3	0.0	O K
15 min Winter	30.020	0.000	0.0	18.2	18.2	0.0	O K
30 min Winter	30.020	0.000	0.0	13.7	13.7	0.0	O K
60 min Winter	30.020	0.000	0.0	9.0	9.0	0.0	O K
120 min Winter	30.020	0.000	0.0	5.6	5.6	0.0	O K
180 min Winter	30.020	0.000	0.0	4.2	4.2	0.0	O K
240 min Winter	30.020	0.000	0.0	3.5	3.5	0.0	O K
360 min Winter	30.020	0.000	0.0	2.6	2.6	0.0	O K
480 min Winter	30.020	0.000	0.0	2.1	2.1	0.0	O K
600 min Winter	30.020	0.000	0.0	1.8	1.8	0.0	O K
720 min Winter	30.020	0.000	0.0	1.5	1.5	0.0	O K
960 min Winter	30.020	0.000	0.0	1.2	1.2	0.0	O K
1440 min Winter	30.020	0.000	0.0	0.9	0.9	0.0	O K
2160 min Winter	30.020	0.000	0.0	0.7	0.7	0.0	O K
2880 min Winter	30.020	0.000	0.0	0.5	0.5	0.0	O K
4320 min Winter	30.020	0.000	0.0	0.4	0.4	0.0	O K
5760 min Winter	30.020	0.000	0.0	0.3	0.3	0.0	O K
7200 min Winter	30.020	0.000	0.0	0.3	0.3	0.0	O K
8640 min Winter	30.020	0.000	0.0	0.2	0.2	0.0	O K
10080 min Winter	30.020	0.000	0.0	0.2	0.2	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	0.352	0.0	32.0	0
10080 min Summer	0.315	0.0	32.1	0
15 min Winter	31.332	0.0	4.9	0
30 min Winter	20.391	0.0	7.3	0
60 min Winter	12.872	0.0	10.0	0
120 min Winter	7.960	0.0	13.0	0
180 min Winter	5.980	0.0	15.0	0
240 min Winter	4.876	0.0	16.5	0
360 min Winter	3.634	0.0	18.7	0
480 min Winter	2.942	0.0	20.3	0
600 min Winter	2.497	0.0	21.6	0
720 min Winter	2.184	0.0	22.7	0
960 min Winter	1.768	0.0	24.5	0
1440 min Winter	1.313	0.0	27.2	0
2160 min Winter	0.975	0.0	29.9	0
2880 min Winter	0.789	0.0	31.8	0
4320 min Winter	0.586	0.0	34.4	0
5760 min Winter	0.474	0.0	36.0	0
7200 min Winter	0.403	0.0	37.1	0
8640 min Winter	0.352	0.0	37.8	0
10080 min Winter	0.315	0.0	38.3	0

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Cascade Rainfall Details for Porous-CP-to-HB02.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.100	Shortest Storm (mins)	15
Ratio R	0.407	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.121

Time (mins) From:	To:	Area (ha)
0	4	0.121

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Cascade Model Details for Porous-CP-to-HB02.SRCX

Storage is Online Cover Level (m) 30.630

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	8.0
Membrane Percolation (mm/hr)	1000	Length (m)	76.3
Max Percolation (l/s)	169.6	Slope (1:X)	40.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	30.020	Membrane Depth (m)	0

Pipe Outflow Control

Diameter (m)	0.150	Entry Loss Coefficient	0.500
Slope (1:X)	80.0	Coefficient of Contraction	0.600
Length (m)	10.000	Upstream Invert Level (m)	28.850
Roughness k (mm)	0.600		

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Cascade Summary of Results for BlueRoof-01.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	Hydrobrake-02.SRCX	(None)

Half Drain Time : 317 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	34.632	0.032	0.0	0.6	0.6	33.2	O K
30 min Summer	34.642	0.042	0.0	1.0	1.0	44.0	O K
60 min Summer	34.652	0.052	0.0	1.6	1.6	55.0	O K
120 min Summer	34.663	0.063	0.0	2.2	2.2	65.7	O K
180 min Summer	34.667	0.067	0.0	2.5	2.5	70.1	O K
240 min Summer	34.668	0.068	0.0	2.5	2.5	71.5	O K
360 min Summer	34.669	0.069	0.0	2.6	2.6	73.1	O K
480 min Summer	34.670	0.070	0.0	2.7	2.7	74.0	O K
600 min Summer	34.671	0.071	0.0	2.8	2.8	74.4	O K
720 min Summer	34.671	0.071	0.0	2.8	2.8	74.4	O K
960 min Summer	34.670	0.070	0.0	2.7	2.7	73.9	O K
1440 min Summer	34.668	0.068	0.0	2.6	2.6	71.7	O K
2160 min Summer	34.664	0.064	0.0	2.3	2.3	67.7	O K
2880 min Summer	34.661	0.061	0.0	2.1	2.1	64.0	O K
4320 min Summer	34.655	0.055	0.0	1.8	1.8	58.1	O K
5760 min Summer	34.651	0.051	0.0	1.5	1.5	53.8	O K
7200 min Summer	34.648	0.048	0.0	1.3	1.3	50.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	76.886	0.0	22.8	69
30 min Summer	49.908	0.0	33.4	72
60 min Summer	30.968	0.0	52.0	86
120 min Summer	18.650	0.0	65.2	124
180 min Summer	13.718	0.0	73.1	182
240 min Summer	10.984	0.0	78.8	226
360 min Summer	8.013	0.0	87.1	282
480 min Summer	6.403	0.0	93.3	344
600 min Summer	5.378	0.0	98.2	408
720 min Summer	4.662	0.0	102.2	476
960 min Summer	3.719	0.0	108.5	608
1440 min Summer	2.701	0.0	116.7	874
2160 min Summer	1.960	0.0	134.7	1256
2880 min Summer	1.560	0.0	141.4	1640
4320 min Summer	1.130	0.0	149.1	2376
5760 min Summer	0.898	0.0	162.7	3112
7200 min Summer	0.751	0.0	167.1	3864

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Cascade Summary of Results for BlueRoof-01.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	34.645	0.045	0.0	1.2	1.2	47.5	O K
10080 min Summer	34.643	0.043	0.0	1.1	1.1	45.0	O K
15 min Winter	34.636	0.036	0.0	0.8	0.8	37.5	O K
30 min Winter	34.647	0.047	0.0	1.3	1.3	49.6	O K
60 min Winter	34.659	0.059	0.0	2.0	2.0	61.8	O K
120 min Winter	34.670	0.070	0.0	2.7	2.7	73.7	O K
180 min Winter	34.674	0.074	0.0	3.1	3.1	78.3	O K
240 min Winter	34.676	0.076	0.0	3.3	3.3	79.6	O K
360 min Winter	34.677	0.077	0.0	3.4	3.4	80.7	O K
480 min Winter	34.677	0.077	0.0	3.4	3.4	81.0	O K
600 min Winter	34.677	0.077	0.0	3.4	3.4	80.6	O K
720 min Winter	34.676	0.076	0.0	3.3	3.3	79.9	O K
960 min Winter	34.674	0.074	0.0	3.1	3.1	78.0	O K
1440 min Winter	34.670	0.070	0.0	2.7	2.7	73.7	O K
2160 min Winter	34.664	0.064	0.0	2.3	2.3	67.4	O K
2880 min Winter	34.659	0.059	0.0	2.0	2.0	62.4	O K
4320 min Winter	34.652	0.052	0.0	1.6	1.6	55.1	O K
5760 min Winter	34.648	0.048	0.0	1.3	1.3	50.2	O K
7200 min Winter	34.644	0.044	0.0	1.1	1.1	46.3	O K
8640 min Winter	34.641	0.041	0.0	1.0	1.0	43.0	O K
10080 min Winter	34.638	0.038	0.0	0.9	0.9	40.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	0.649	0.0	169.9	4584
10080 min Summer	0.574	0.0	170.9	5344
15 min Winter	76.886	0.0	27.0	66
30 min Winter	49.908	0.0	39.2	70
60 min Winter	30.968	0.0	59.9	84
120 min Winter	18.650	0.0	74.7	122
180 min Winter	13.718	0.0	83.6	176
240 min Winter	10.984	0.0	90.0	224
360 min Winter	8.013	0.0	99.4	282
480 min Winter	6.403	0.0	106.4	354
600 min Winter	5.378	0.0	112.0	428
720 min Winter	4.662	0.0	116.5	500
960 min Winter	3.719	0.0	123.7	638
1440 min Winter	2.701	0.0	133.2	918
2160 min Winter	1.960	0.0	152.9	1316
2880 min Winter	1.560	0.0	160.8	1700
4320 min Winter	1.130	0.0	170.1	2464
5760 min Winter	0.898	0.0	185.2	3200
7200 min Winter	0.751	0.0	190.7	3968
8640 min Winter	0.649	0.0	194.5	4680
10080 min Winter	0.574	0.0	196.3	5448

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Cascade Rainfall Details for BlueRoof-01.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.100	Shortest Storm (mins)	15
Ratio R	0.407	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Green Roof

Area (m³)	1107	Evaporation (mm/day)	3
Depression Storage (mm)	5	Decay Coefficient	0.050

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.020116	32	36	0.004061	64	68	0.000820	96	100	0.000166
4	8	0.016470	36	40	0.003325	68	72	0.000671	100	104	0.000136
8	12	0.013484	40	44	0.002722	72	76	0.000550	104	108	0.000111
12	16	0.011040	44	48	0.002229	76	80	0.000450	108	112	0.000091
16	20	0.009039	48	52	0.001825	80	84	0.000368	112	116	0.000074
20	24	0.007400	52	56	0.001494	84	88	0.000302	116	120	0.000061
24	28	0.006059	56	60	0.001223	88	92	0.000247			
28	32	0.004961	60	64	0.001002	92	96	0.000202			

Time Area Diagram

Total Area (ha) 0.176

Time (mins) From:	To:	Area (ha)
0	4	0.176

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Cascade Model Details for BlueRoof-01.SRCX

Storage is Online Cover Level (m) 35.000

Cellular Storage Structure

Invert Level (m) 34.600 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	1107.0	1107.0	1.300	0.0	1127.0
0.100	1107.0	1120.3	1.400	0.0	1127.0
0.200	0.0	1127.0	1.500	0.0	1127.0
0.300	0.0	1127.0	1.600	0.0	1127.0
0.400	0.0	1127.0	1.700	0.0	1127.0
0.500	0.0	1127.0	1.800	0.0	1127.0
0.600	0.0	1127.0	1.900	0.0	1127.0
0.700	0.0	1127.0	2.000	0.0	1127.0
0.800	0.0	1127.0	2.100	0.0	1127.0
0.900	0.0	1127.0	2.200	0.0	1127.0
1.000	0.0	1127.0	2.300	0.0	1127.0
1.100	0.0	1127.0	2.400	0.0	1127.0
1.200	0.0	1127.0	2.500	0.0	1127.0

Pipe Outflow Control

Diameter (m) 0.150 Entry Loss Coefficient 0.500
Slope (1:X) 1.0 Coefficient of Contraction 0.600
Length (m) 3.000 Upstream Invert Level (m) 34.600
Roughness k (mm) 0.600

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Cascade Summary of Results for BlueRoof-02.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	Hydrobrake-02.SRCX	(None)

Half Drain Time : 293 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	34.624	0.024	0.0	0.3	0.3	14.4	O K
30 min Summer	34.632	0.032	0.0	0.5	0.5	19.3	O K
60 min Summer	34.640	0.040	0.0	0.7	0.7	24.3	O K
120 min Summer	34.648	0.048	0.0	1.0	1.0	29.1	O K
180 min Summer	34.651	0.051	0.0	1.2	1.2	31.0	O K
240 min Summer	34.652	0.052	0.0	1.3	1.3	31.5	O K
360 min Summer	34.653	0.053	0.0	1.3	1.3	32.2	O K
480 min Summer	34.654	0.054	0.0	1.4	1.4	32.5	O K
600 min Summer	34.654	0.054	0.0	1.4	1.4	32.7	O K
720 min Summer	34.654	0.054	0.0	1.4	1.4	32.7	O K
960 min Summer	34.653	0.053	0.0	1.3	1.3	32.4	O K
1440 min Summer	34.652	0.052	0.0	1.3	1.3	31.4	O K
2160 min Summer	34.649	0.049	0.0	1.1	1.1	29.7	O K
2880 min Summer	34.646	0.046	0.0	1.0	1.0	28.2	O K
4320 min Summer	34.642	0.042	0.0	0.8	0.8	25.4	O K
5760 min Summer	34.639	0.039	0.0	0.7	0.7	23.4	O K
7200 min Summer	34.636	0.036	0.0	0.6	0.6	21.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	76.886	0.0	10.1	73
30 min Summer	49.908	0.0	15.0	76
60 min Summer	30.968	0.0	23.4	90
120 min Summer	18.650	0.0	29.4	126
180 min Summer	13.718	0.0	33.1	180
240 min Summer	10.984	0.0	35.7	218
360 min Summer	8.013	0.0	39.4	276
480 min Summer	6.403	0.0	42.2	338
600 min Summer	5.378	0.0	44.4	404
720 min Summer	4.662	0.0	46.2	470
960 min Summer	3.719	0.0	49.1	604
1440 min Summer	2.701	0.0	52.7	866
2160 min Summer	1.960	0.0	60.5	1252
2880 min Summer	1.560	0.0	63.4	1640
4320 min Summer	1.130	0.0	66.6	2380
5760 min Summer	0.898	0.0	72.2	3112
7200 min Summer	0.751	0.0	73.8	3832

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Cascade Summary of Results for BlueRoof-02.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	34.634	0.034	0.0	0.5	0.5	20.6	O K
10080 min Summer	34.632	0.032	0.0	0.5	0.5	19.5	O K
15 min Winter	34.627	0.027	0.0	0.4	0.4	16.4	O K
30 min Winter	34.636	0.036	0.0	0.6	0.6	21.8	O K
60 min Winter	34.645	0.045	0.0	0.9	0.9	27.3	O K
120 min Winter	34.654	0.054	0.0	1.4	1.4	32.5	O K
180 min Winter	34.657	0.057	0.0	1.5	1.5	34.5	O K
240 min Winter	34.658	0.058	0.0	1.6	1.6	35.1	O K
360 min Winter	34.659	0.059	0.0	1.7	1.7	35.6	O K
480 min Winter	34.659	0.059	0.0	1.7	1.7	35.6	O K
600 min Winter	34.658	0.058	0.0	1.6	1.6	35.4	O K
720 min Winter	34.658	0.058	0.0	1.6	1.6	35.0	O K
960 min Winter	34.656	0.056	0.0	1.5	1.5	34.0	O K
1440 min Winter	34.653	0.053	0.0	1.3	1.3	32.0	O K
2160 min Winter	34.649	0.049	0.0	1.1	1.1	29.5	O K
2880 min Winter	34.645	0.045	0.0	0.9	0.9	27.4	O K
4320 min Winter	34.639	0.039	0.0	0.7	0.7	24.0	O K
5760 min Winter	34.636	0.036	0.0	0.6	0.6	21.6	O K
7200 min Winter	34.633	0.033	0.0	0.5	0.5	20.0	O K
8640 min Winter	34.631	0.031	0.0	0.4	0.4	18.7	O K
10080 min Winter	34.629	0.029	0.0	0.4	0.4	17.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	0.649	0.0	74.7	4584
10080 min Summer	0.574	0.0	74.9	5336
15 min Winter	76.886	0.0	12.1	70
30 min Winter	49.908	0.0	17.7	74
60 min Winter	30.968	0.0	27.0	88
120 min Winter	18.650	0.0	33.8	124
180 min Winter	13.718	0.0	37.9	176
240 min Winter	10.984	0.0	40.8	222
360 min Winter	8.013	0.0	45.0	280
480 min Winter	6.403	0.0	48.2	352
600 min Winter	5.378	0.0	50.7	424
720 min Winter	4.662	0.0	52.8	494
960 min Winter	3.719	0.0	56.0	634
1440 min Winter	2.701	0.0	60.3	906
2160 min Winter	1.960	0.0	68.8	1300
2880 min Winter	1.560	0.0	72.3	1700
4320 min Winter	1.130	0.0	76.2	2460
5760 min Winter	0.898	0.0	82.5	3176
7200 min Winter	0.751	0.0	84.7	3960
8640 min Winter	0.649	0.0	86.0	4680
10080 min Winter	0.574	0.0	86.6	5448

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Cascade Rainfall Details for BlueRoof-02.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.100	Shortest Storm (mins)	15
Ratio R	0.407	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Green Roof

Area (m³)	639	Evaporation (mm/day)	3
Depression Storage (mm)	5	Decay Coefficient	0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.011612	32	36	0.002344	64	68	0.000473	96	100	0.000096
4	8	0.009507	36	40	0.001919	68	72	0.000388	100	104	0.000078
8	12	0.007784	40	44	0.001571	72	76	0.000317	104	108	0.000064
12	16	0.006373	44	48	0.001287	76	80	0.000260	108	112	0.000052
16	20	0.005218	48	52	0.001053	80	84	0.000213	112	116	0.000043
20	24	0.004272	52	56	0.000862	84	88	0.000174	116	120	0.000035
24	28	0.003497	56	60	0.000706	88	92	0.000143			
28	32	0.002863	60	64	0.000578	92	96	0.000117			

Time Area Diagram

Total Area (ha) 0.067

Time From:	(mins) To:	Area (ha)
0	4	0.067

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Cascade Model Details for BlueRoof-02.SRCX

Storage is Online Cover Level (m) 35.000

Cellular Storage Structure

Invert Level (m) 34.600 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	639.0	639.0	1.300	0.0	654.2
0.100	639.0	649.1	1.400	0.0	654.2
0.200	0.0	654.2	1.500	0.0	654.2
0.300	0.0	654.2	1.600	0.0	654.2
0.400	0.0	654.2	1.700	0.0	654.2
0.500	0.0	654.2	1.800	0.0	654.2
0.600	0.0	654.2	1.900	0.0	654.2
0.700	0.0	654.2	2.000	0.0	654.2
0.800	0.0	654.2	2.100	0.0	654.2
0.900	0.0	654.2	2.200	0.0	654.2
1.000	0.0	654.2	2.300	0.0	654.2
1.100	0.0	654.2	2.400	0.0	654.2
1.200	0.0	654.2	2.500	0.0	654.2

Pipe Outflow Control

Diameter (m) 0.100 Entry Loss Coefficient 0.500
Slope (1:X) 1.0 Coefficient of Contraction 0.600
Length (m) 3.000 Upstream Invert Level (m) 34.600
Roughness k (mm) 0.600

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Cascade Summary of Results for Hydrobrake-01.srcx

Upstream Structures	Outflow To	Overflow To
Porous-CP-to-HB01.SRCX	Hydrobrake-03.SRCX	(None)

Half Drain Time : 138 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	29.717	0.167	0.0	4.0	4.0	31.0	O K
30 min Summer	29.770	0.220	0.0	4.0	4.0	40.8	O K
60 min Summer	29.812	0.262	0.0	4.0	4.0	48.4	O K
120 min Summer	29.827	0.277	0.0	4.0	4.0	51.3	O K
180 min Summer	29.821	0.271	0.0	4.0	4.0	50.2	O K
240 min Summer	29.810	0.260	0.0	4.0	4.0	48.2	O K
360 min Summer	29.787	0.237	0.0	4.0	4.0	43.9	O K
480 min Summer	29.764	0.214	0.0	4.0	4.0	39.6	O K
600 min Summer	29.741	0.191	0.0	4.0	4.0	35.4	O K
720 min Summer	29.719	0.169	0.0	4.0	4.0	31.3	O K
960 min Summer	29.679	0.129	0.0	4.0	4.0	23.8	O K
1440 min Summer	29.615	0.065	0.0	4.0	4.0	12.0	O K
2160 min Summer	29.562	0.012	0.0	4.0	4.0	2.2	O K
2880 min Summer	29.550	0.000	0.0	3.7	3.7	0.0	O K
4320 min Summer	29.550	0.000	0.0	2.7	2.7	0.0	O K
5760 min Summer	29.550	0.000	0.0	2.1	2.1	0.0	O K
7200 min Summer	29.550	0.000	0.0	1.8	1.8	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	76.886	0.0	38.2	26
30 min Summer	49.908	0.0	50.7	38
60 min Summer	30.968	0.0	63.7	62
120 min Summer	18.650	0.0	77.4	120
180 min Summer	13.718	0.0	85.5	150
240 min Summer	10.984	0.0	91.7	180
360 min Summer	8.013	0.0	100.5	248
480 min Summer	6.403	0.0	107.3	314
600 min Summer	5.378	0.0	112.4	380
720 min Summer	4.662	0.0	117.0	446
960 min Summer	3.719	0.0	124.4	570
1440 min Summer	2.701	0.0	135.3	808
2160 min Summer	1.960	0.0	146.8	1128
2880 min Summer	1.560	0.0	155.2	0
4320 min Summer	1.130	0.0	167.2	0
5760 min Summer	0.898	0.0	175.7	0
7200 min Summer	0.751	0.0	182.2	0

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Cascade Summary of Results for Hydrobrake-01.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	29.550	0.000	0.0	1.5	1.5	0.0	O K
10080 min Summer	29.550	0.000	0.0	1.3	1.3	0.0	O K
15 min Winter	29.743	0.193	0.0	4.0	4.0	35.7	O K
30 min Winter	29.805	0.255	0.0	4.0	4.0	47.2	O K
60 min Winter	29.856	0.306	0.0	4.0	4.0	56.7	O K
120 min Winter	29.879	0.329	0.0	4.0	4.0	61.0	O K
180 min Winter	29.874	0.324	0.0	4.0	4.0	60.1	O K
240 min Winter	29.859	0.309	0.0	4.0	4.0	57.2	O K
360 min Winter	29.825	0.275	0.0	4.0	4.0	50.9	O K
480 min Winter	29.789	0.239	0.0	4.0	4.0	44.2	O K
600 min Winter	29.753	0.203	0.0	4.0	4.0	37.6	O K
720 min Winter	29.718	0.168	0.0	4.0	4.0	31.2	O K
960 min Winter	29.657	0.107	0.0	4.0	4.0	19.9	O K
1440 min Winter	29.572	0.022	0.0	4.0	4.0	4.1	O K
2160 min Winter	29.550	0.000	0.0	3.3	3.3	0.0	O K
2880 min Winter	29.550	0.000	0.0	2.7	2.7	0.0	O K
4320 min Winter	29.550	0.000	0.0	1.9	1.9	0.0	O K
5760 min Winter	29.550	0.000	0.0	1.5	1.5	0.0	O K
7200 min Winter	29.550	0.000	0.0	1.3	1.3	0.0	O K
8640 min Winter	29.550	0.000	0.0	1.1	1.1	0.0	O K
10080 min Winter	29.550	0.000	0.0	1.0	1.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	0.649	0.0	187.4	0
10080 min Summer	0.574	0.0	191.7	0
15 min Winter	76.886	0.0	43.1	27
30 min Winter	49.908	0.0	57.2	39
60 min Winter	30.968	0.0	71.8	62
120 min Winter	18.650	0.0	86.9	118
180 min Winter	13.718	0.0	96.1	172
240 min Winter	10.984	0.0	102.9	196
360 min Winter	8.013	0.0	113.0	270
480 min Winter	6.403	0.0	120.7	342
600 min Winter	5.378	0.0	126.7	412
720 min Winter	4.662	0.0	131.5	478
960 min Winter	3.719	0.0	139.9	604
1440 min Winter	2.701	0.0	152.2	810
2160 min Winter	1.960	0.0	165.3	0
2880 min Winter	1.560	0.0	174.8	0
4320 min Winter	1.130	0.0	188.5	0
5760 min Winter	0.898	0.0	198.3	0
7200 min Winter	0.751	0.0	205.9	0
8640 min Winter	0.649	0.0	212.0	0
10080 min Winter	0.574	0.0	217.1	0

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Cascade Rainfall Details for Hydrobrake-01.srcx

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.100	Shortest Storm (mins)	15
Ratio R	0.407	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.167

Time (mins) From:	To:	Area (ha)
0	4	0.167

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Cascade Model Details for Hydrobrake-01.srcx

Storage is Online Cover Level (m) 30.650

Cellular Storage Structure

Invert Level (m) 29.550 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	195.0	195.0	1.300	0.0	242.5
0.100	195.0	200.6	1.400	0.0	242.5
0.200	195.0	206.2	1.500	0.0	242.5
0.300	195.0	211.8	1.600	0.0	242.5
0.400	195.0	217.3	1.700	0.0	242.5
0.500	195.0	222.9	1.800	0.0	242.5
0.600	195.0	228.5	1.900	0.0	242.5
0.700	195.0	234.1	2.000	0.0	242.5
0.800	195.0	239.7	2.100	0.0	242.5
0.900	0.0	242.5	2.200	0.0	242.5
1.000	0.0	242.5	2.300	0.0	242.5
1.100	0.0	242.5	2.400	0.0	242.5
1.200	0.0	242.5	2.500	0.0	242.5

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0095-4000-1000-4000
Design Head (m)	1.000
Design Flow (l/s)	4.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	95
Invert Level (m)	29.310
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	4.0
Flush-Flo™	0.294	4.0
Kick-Flo®	0.629	3.2
Mean Flow over Head Range	-	3.5

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

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Hydro-Brake® Optimum Outflow Control

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.0	1.200	4.3	3.000	6.7	7.000	10.0
0.200	3.9	1.400	4.7	3.500	7.2	7.500	10.3
0.300	4.0	1.600	5.0	4.000	7.6	8.000	10.6
0.400	3.9	1.800	5.3	4.500	8.1	8.500	10.9
0.500	3.8	2.000	5.5	5.000	8.5	9.000	11.2
0.600	3.4	2.200	5.8	5.500	8.9	9.500	11.5
0.800	3.6	2.400	6.0	6.000	9.3		
1.000	4.0	2.600	6.2	6.500	9.6		

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Cascade Summary of Results for Hydrobrake-02.SRCX

Upstream Structures	Outflow To	Overflow To
BlueRoof-01.SRCX BlueRoof-02.SRCX Porous-CP-to-HB02.SRCX	Hydrobrake-03.SRCX	(None)

Half Drain Time : 69 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	29.427	0.077	0.0	7.8	7.8	37.2	O K
30 min Summer	29.445	0.095	0.0	7.9	7.9	46.2	O K
60 min Summer	29.457	0.107	0.0	7.9	7.9	51.9	O K
120 min Summer	29.460	0.110	0.0	7.9	7.9	53.1	O K
180 min Summer	29.458	0.108	0.0	7.9	7.9	52.2	O K
240 min Summer	29.454	0.104	0.0	7.9	7.9	50.3	O K
360 min Summer	29.446	0.096	0.0	7.9	7.9	46.6	O K
480 min Summer	29.439	0.089	0.0	7.8	7.8	43.3	O K
600 min Summer	29.433	0.083	0.0	7.8	7.8	40.3	O K
720 min Summer	29.428	0.078	0.0	7.8	7.8	37.6	O K
960 min Summer	29.418	0.068	0.0	7.7	7.7	32.8	O K
1440 min Summer	29.405	0.055	0.0	7.1	7.1	26.6	O K
2160 min Summer	29.391	0.041	0.0	6.3	6.3	19.8	O K
2880 min Summer	29.381	0.031	0.0	5.7	5.7	14.9	O K
4320 min Summer	29.367	0.017	0.0	4.7	4.7	8.5	O K
5760 min Summer	29.358	0.008	0.0	4.0	4.0	4.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	76.886	0.0	75.7	17
30 min Summer	49.908	0.0	105.0	32
60 min Summer	30.968	0.0	146.5	60
120 min Summer	18.650	0.0	180.8	104
180 min Summer	13.718	0.0	201.5	138
240 min Summer	10.984	0.0	216.3	174
360 min Summer	8.013	0.0	238.2	246
480 min Summer	6.403	0.0	254.6	316
600 min Summer	5.378	0.0	267.6	386
720 min Summer	4.662	0.0	278.4	454
960 min Summer	3.719	0.0	295.8	586
1440 min Summer	2.701	0.0	319.9	850
2160 min Summer	1.960	0.0	358.4	1232
2880 min Summer	1.560	0.0	377.5	1588
4320 min Summer	1.130	0.0	402.2	2336
5760 min Summer	0.898	0.0	431.1	3056

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Cascade Summary of Results for Hydrobrake-02.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
7200 min Summer	29.352	0.002	0.0	3.6	3.6	0.8	O K
8640 min Summer	29.350	0.000	0.0	3.3	3.3	0.0	O K
10080 min Summer	29.350	0.000	0.0	3.0	3.0	0.0	O K
15 min Winter	29.438	0.088	0.0	7.8	7.8	42.7	O K
30 min Winter	29.460	0.110	0.0	7.9	7.9	53.5	O K
60 min Winter	29.477	0.127	0.0	8.0	8.0	61.3	O K
120 min Winter	29.483	0.133	0.0	8.0	8.0	64.5	O K
180 min Winter	29.482	0.132	0.0	8.0	8.0	64.0	O K
240 min Winter	29.478	0.128	0.0	8.0	8.0	62.0	O K
360 min Winter	29.467	0.117	0.0	7.9	7.9	56.9	O K
480 min Winter	29.458	0.108	0.0	7.9	7.9	52.5	O K
600 min Winter	29.449	0.099	0.0	7.9	7.9	48.1	O K
720 min Winter	29.441	0.091	0.0	7.9	7.9	43.9	O K
960 min Winter	29.425	0.075	0.0	7.8	7.8	36.3	O K
1440 min Winter	29.405	0.055	0.0	7.1	7.1	26.8	O K
2160 min Winter	29.387	0.037	0.0	6.1	6.1	18.0	O K
2880 min Winter	29.375	0.025	0.0	5.3	5.3	12.2	O K
4320 min Winter	29.360	0.010	0.0	4.2	4.2	4.8	O K
5760 min Winter	29.350	0.000	0.0	3.5	3.5	0.0	O K
7200 min Winter	29.350	0.000	0.0	3.0	3.0	0.0	O K
8640 min Winter	29.350	0.000	0.0	2.6	2.6	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
7200 min Summer	0.751	0.0	445.1	3752
8640 min Summer	0.649	0.0	455.0	0
10080 min Summer	0.574	0.0	461.3	0
15 min Winter	76.886	0.0	87.5	17
30 min Winter	49.908	0.0	120.6	31
60 min Winter	30.968	0.0	166.9	60
120 min Winter	18.650	0.0	205.3	118
180 min Winter	13.718	0.0	228.6	174
240 min Winter	10.984	0.0	245.2	228
360 min Winter	8.013	0.0	270.0	288
480 min Winter	6.403	0.0	288.4	364
600 min Winter	5.378	0.0	303.2	440
720 min Winter	4.662	0.0	315.6	512
960 min Winter	3.719	0.0	335.2	646
1440 min Winter	2.701	0.0	362.6	908
2160 min Winter	1.960	0.0	405.4	1296
2880 min Winter	1.560	0.0	427.3	1672
4320 min Winter	1.130	0.0	456.1	2420
5760 min Winter	0.898	0.0	489.1	3120
7200 min Winter	0.751	0.0	505.6	0
8640 min Winter	0.649	0.0	517.9	0

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Cascade Summary of Results for Hydrobrake-02.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Winter	29.350	0.000	0.0	2.3	2.3	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Winter	0.574	0.0	526.4	0

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Cascade Rainfall Details for Hydrobrake-02.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.100	Shortest Storm (mins)	15
Ratio R	0.407	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.199

Time (mins) From:	To:	Area (ha)
0	4	0.199

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Cascade Model Details for Hydrobrake-02.SRCX

Storage is Online Cover Level (m) 30.630

Cellular Storage Structure

Invert Level (m) 29.350 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	510.0	510.0	1.300	0.0	559.7
0.100	510.0	519.0	1.400	0.0	559.7
0.200	510.0	528.1	1.500	0.0	559.7
0.300	510.0	537.1	1.600	0.0	559.7
0.400	510.0	546.1	1.700	0.0	559.7
0.500	510.0	555.2	1.800	0.0	559.7
0.600	0.0	559.7	1.900	0.0	559.7
0.700	0.0	559.7	2.000	0.0	559.7
0.800	0.0	559.7	2.100	0.0	559.7
0.900	0.0	559.7	2.200	0.0	559.7
1.000	0.0	559.7	2.300	0.0	559.7
1.100	0.0	559.7	2.400	0.0	559.7
1.200	0.0	559.7	2.500	0.0	559.7

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0136-8000-0680-8000
Design Head (m)	0.680
Design Flow (l/s)	8.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	136
Invert Level (m)	29.270
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.680	8.0
Flush-Flo™	0.231	8.0
Kick-Flo®	0.492	6.9
Mean Flow over Head Range	-	6.7

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

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Hydro-Brake® Optimum Outflow Control

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.9	1.200	10.4	3.000	16.1	7.000	24.1
0.200	7.9	1.400	11.2	3.500	17.4	7.500	25.0
0.300	7.9	1.600	12.0	4.000	18.5	8.000	25.8
0.400	7.6	1.800	12.6	4.500	19.6	8.500	26.6
0.500	6.9	2.000	13.3	5.000	20.6	9.000	27.4
0.600	7.5	2.200	13.9	5.500	21.6	9.500	28.1
0.800	8.6	2.400	14.5	6.000	22.5		
1.000	9.6	2.600	15.1	6.500	23.4		

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Cascade Summary of Results for Hydrobrake-03.SRCX

Upstream Structures	Outflow To	Overflow To
Hydrobrake-01.srcx Porous-CP-to-HB01.SRCX Hydrobrake-02.SRCX BlueRoof-01.SRCX BlueRoof-02.SRCX Porous-CP-to-HB02.SRCX	(None)	(None)

Half Drain Time : 178 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	29.150	0.200	0.0	6.0	6.0	59.4	O K
30 min Summer	29.234	0.284	0.0	6.0	6.0	84.3	O K
60 min Summer	29.338	0.388	0.0	6.0	6.0	114.9	O K
120 min Summer	29.426	0.476	0.0	6.0	6.0	141.1	O K
180 min Summer	29.469	0.519	0.0	6.3	6.3	154.0	O K
240 min Summer	29.492	0.542	0.0	7.1	7.1	160.5	O K
360 min Summer	29.512	0.562	0.0	8.3	8.3	166.6	O K
480 min Summer	29.521	0.571	0.0	9.0	9.0	169.1	O K
600 min Summer	29.527	0.577	0.0	9.5	9.5	171.1	O K
720 min Summer	29.526	0.576	0.0	9.4	9.4	170.7	O K
960 min Summer	29.511	0.561	0.0	8.2	8.2	166.4	O K
1440 min Summer	29.477	0.527	0.0	6.5	6.5	156.2	O K
2160 min Summer	29.414	0.464	0.0	6.0	6.0	137.5	O K
2880 min Summer	29.342	0.392	0.0	6.0	6.0	116.1	O K
4320 min Summer	29.168	0.218	0.0	6.0	6.0	64.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	76.886	0.0	140.7	146
30 min Summer	49.908	0.0	190.8	201
60 min Summer	30.968	0.0	253.7	270
120 min Summer	18.650	0.0	310.8	342
180 min Summer	13.718	0.0	344.9	390
240 min Summer	10.984	0.0	370.0	430
360 min Summer	8.013	0.0	406.5	498
480 min Summer	6.403	0.0	433.9	560
600 min Summer	5.378	0.0	455.8	620
720 min Summer	4.662	0.0	474.3	670
960 min Summer	3.719	0.0	504.1	760
1440 min Summer	2.701	0.0	546.3	1070
2160 min Summer	1.960	0.0	604.6	1492
2880 min Summer	1.560	0.0	638.1	1892
4320 min Summer	1.130	0.0	684.1	2592

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Cascade Summary of Results for Hydrobrake-03.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
5760 min Summer	29.055	0.105	0.0	6.0	6.0	31.0	O K
7200 min Summer	28.997	0.047	0.0	5.9	5.9	13.9	O K
8640 min Summer	28.975	0.025	0.0	5.5	5.5	7.5	O K
10080 min Summer	28.964	0.014	0.0	5.0	5.0	4.1	O K
15 min Winter	29.183	0.233	0.0	6.0	6.0	69.1	O K
30 min Winter	29.287	0.337	0.0	6.0	6.0	99.9	O K
60 min Winter	29.401	0.451	0.0	6.0	6.0	133.5	O K
120 min Winter	29.492	0.542	0.0	7.1	7.1	160.7	O K
180 min Winter	29.515	0.565	0.0	8.5	8.5	167.6	O K
240 min Winter	29.526	0.576	0.0	9.4	9.4	170.7	O K
360 min Winter	29.539	0.589	0.0	10.2	10.2	174.7	O K
480 min Winter	29.547	0.597	0.0	10.8	10.8	177.0	O K
600 min Winter	29.554	0.604	0.0	11.3	11.3	179.2	O K
720 min Winter	29.557	0.607	0.0	11.6	11.6	180.0	O K
960 min Winter	29.551	0.601	0.0	11.0	11.0	178.3	O K
1440 min Winter	29.516	0.566	0.0	8.6	8.6	167.7	O K
2160 min Winter	29.463	0.513	0.0	6.2	6.2	151.9	O K
2880 min Winter	29.351	0.401	0.0	6.0	6.0	118.8	O K
4320 min Winter	29.088	0.138	0.0	6.0	6.0	40.8	O K
5760 min Winter	28.983	0.033	0.0	5.8	5.8	9.8	O K
7200 min Winter	28.964	0.014	0.0	5.0	5.0	4.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
5760 min Summer	0.898	0.0	728.5	3224
7200 min Summer	0.751	0.0	754.1	3816
8640 min Summer	0.649	0.0	774.0	4416
10080 min Summer	0.574	0.0	788.8	5144
15 min Winter	76.886	0.0	160.7	166
30 min Winter	49.908	0.0	217.2	244
60 min Winter	30.968	0.0	287.6	310
120 min Winter	18.650	0.0	351.0	384
180 min Winter	13.718	0.0	389.4	416
240 min Winter	10.984	0.0	417.6	436
360 min Winter	8.013	0.0	458.9	496
480 min Winter	6.403	0.0	490.1	556
600 min Winter	5.378	0.0	514.8	606
720 min Winter	4.662	0.0	535.5	686
960 min Winter	3.719	0.0	568.8	784
1440 min Winter	2.701	0.0	617.1	1048
2160 min Winter	1.960	0.0	681.5	1576
2880 min Winter	1.560	0.0	720.2	2020
4320 min Winter	1.130	0.0	773.0	2644
5760 min Winter	0.898	0.0	823.5	3104
7200 min Winter	0.751	0.0	853.7	3816

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Cascade Summary of Results for Hydrobrake-03.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Winter	28.951	0.001	0.0	4.4	4.4	0.3	O K
10080 min Winter	28.950	0.000	0.0	3.9	3.9	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Winter	0.649	0.0	877.6	4440
10080 min Winter	0.574	0.0	895.7	0

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Cascade Rainfall Details for Hydrobrake-03.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.100	Shortest Storm (mins)	15
Ratio R	0.407	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.188

Time (mins) From:	To:	Area (ha)
0	4	0.188

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Cascade Model Details for Hydrobrake-03.SRCX

Storage is Online Cover Level (m) 30.550

Cellular Storage Structure

Invert Level (m) 28.950 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	312.0	312.0	1.300	0.0	372.1
0.100	312.0	319.1	1.400	0.0	372.1
0.200	312.0	326.1	1.500	0.0	372.1
0.300	312.0	333.2	1.600	0.0	372.1
0.400	312.0	340.3	1.700	0.0	372.1
0.500	312.0	347.3	1.800	0.0	372.1
0.600	312.0	354.4	1.900	0.0	372.1
0.700	312.0	361.5	2.000	0.0	372.1
0.800	312.0	368.5	2.100	0.0	372.1
0.900	0.0	372.1	2.200	0.0	372.1
1.000	0.0	372.1	2.300	0.0	372.1
1.100	0.0	372.1	2.400	0.0	372.1
1.200	0.0	372.1	2.500	0.0	372.1

Complex Outflow Control

Hydro-Brake® Optimum

Unit Reference	MD-SHE-0121-6000-0600-6000
Design Head (m)	0.600
Design Flow (l/s)	6.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	121
Invert Level (m)	28.850
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.600	6.0
Flush-Flo™	0.202	6.0
Kick-Flo®	0.435	5.2
Mean Flow over Head Range	-	5.0

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

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Hydro-Brake® Optimum

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.3	1.200	8.3	3.000	12.8	7.000	19.2
0.200	6.0	1.400	8.9	3.500	13.8	7.500	19.9
0.300	5.9	1.600	9.5	4.000	14.7	8.000	20.5
0.400	5.5	1.800	10.0	4.500	15.5	8.500	21.1
0.500	5.5	2.000	10.6	5.000	16.3	9.000	21.8
0.600	6.0	2.200	11.0	5.500	17.1	9.500	22.4
0.800	6.9	2.400	11.5	6.000	17.8		
1.000	7.6	2.600	12.0	6.500	18.5		

Orifice

Diameter (m) 0.125 Discharge Coefficient 0.600 Invert Level (m) 29.450

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Cascade Summary of Results for Porous-CP-to-HB01.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	Hydrobrake-01.srcx	(None)

Half Drain Time : 6 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	30.221	0.241	0.0	18.0	18.0	7.9	O K
30 min Summer	30.234	0.254	0.0	18.7	18.7	8.7	O K
60 min Summer	30.219	0.239	0.0	17.8	17.8	7.7	O K
120 min Summer	30.185	0.205	0.0	14.2	14.2	5.7	O K
180 min Summer	30.161	0.181	0.0	11.6	11.6	4.4	O K
240 min Summer	30.145	0.165	0.0	9.8	9.8	3.7	O K
360 min Summer	30.123	0.143	0.0	7.4	7.4	2.8	O K
480 min Summer	30.108	0.128	0.0	6.1	6.1	2.2	O K
600 min Summer	30.097	0.117	0.0	5.2	5.2	1.8	O K
720 min Summer	30.089	0.109	0.0	4.6	4.6	1.6	O K
960 min Summer	30.080	0.100	0.0	3.7	3.7	1.3	O K
1440 min Summer	30.070	0.090	0.0	2.7	2.7	1.1	O K
2160 min Summer	30.058	0.078	0.0	1.9	1.9	0.8	O K
2880 min Summer	30.052	0.072	0.0	1.6	1.6	0.7	O K
4320 min Summer	30.044	0.064	0.0	1.1	1.1	0.6	O K
5760 min Summer	30.039	0.059	0.0	0.9	0.9	0.5	O K
7200 min Summer	30.035	0.055	0.0	0.7	0.7	0.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	76.886	0.0	14.2	13
30 min Summer	49.908	0.0	19.5	21
60 min Summer	30.968	0.0	25.0	36
120 min Summer	18.650	0.0	30.7	66
180 min Summer	13.718	0.0	34.2	96
240 min Summer	10.984	0.0	36.7	126
360 min Summer	8.013	0.0	40.3	186
480 min Summer	6.403	0.0	43.1	246
600 min Summer	5.378	0.0	45.2	308
720 min Summer	4.662	0.0	47.1	366
960 min Summer	3.719	0.0	50.0	488
1440 min Summer	2.701	0.0	54.2	728
2160 min Summer	1.960	0.0	58.5	1084
2880 min Summer	1.560	0.0	61.4	1432
4320 min Summer	1.130	0.0	65.3	2152
5760 min Summer	0.898	0.0	67.7	2888
7200 min Summer	0.751	0.0	69.3	3664

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Cascade Summary of Results for Porous-CP-to-HB01.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	30.033	0.053	0.0	0.6	0.6	0.4	O K
10080 min Summer	30.031	0.051	0.0	0.6	0.6	0.3	O K
15 min Winter	30.238	0.258	0.0	18.9	18.9	9.0	O K
30 min Winter	30.240	0.260	0.0	19.1	19.1	9.2	O K
60 min Winter	30.211	0.231	0.0	17.1	17.1	7.2	O K
120 min Winter	30.168	0.188	0.0	12.3	12.3	4.8	O K
180 min Winter	30.142	0.162	0.0	9.5	9.5	3.6	O K
240 min Winter	30.126	0.146	0.0	7.7	7.7	2.9	O K
360 min Winter	30.102	0.122	0.0	5.7	5.7	2.0	O K
480 min Winter	30.088	0.108	0.0	4.6	4.6	1.6	O K
600 min Winter	30.081	0.101	0.0	3.9	3.9	1.4	O K
720 min Winter	30.077	0.097	0.0	3.4	3.4	1.3	O K
960 min Winter	30.070	0.090	0.0	2.7	2.7	1.1	O K
1440 min Winter	30.058	0.078	0.0	1.9	1.9	0.8	O K
2160 min Winter	30.049	0.069	0.0	1.4	1.4	0.6	O K
2880 min Winter	30.044	0.064	0.0	1.1	1.1	0.6	O K
4320 min Winter	30.037	0.057	0.0	0.8	0.8	0.4	O K
5760 min Winter	30.033	0.053	0.0	0.6	0.6	0.4	O K
7200 min Winter	30.030	0.050	0.0	0.5	0.5	0.3	O K
8640 min Winter	30.028	0.048	0.0	0.5	0.5	0.3	O K
10080 min Winter	30.026	0.046	0.0	0.4	0.4	0.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	0.649	0.0	70.3	4264
10080 min Summer	0.574	0.0	70.9	5120
15 min Winter	76.886	0.0	16.3	13
30 min Winter	49.908	0.0	22.2	22
60 min Winter	30.968	0.0	28.4	38
120 min Winter	18.650	0.0	34.9	68
180 min Winter	13.718	0.0	38.8	98
240 min Winter	10.984	0.0	41.5	128
360 min Winter	8.013	0.0	45.6	188
480 min Winter	6.403	0.0	48.7	248
600 min Winter	5.378	0.0	51.2	308
720 min Winter	4.662	0.0	53.3	364
960 min Winter	3.719	0.0	56.6	490
1440 min Winter	2.701	0.0	61.4	722
2160 min Winter	1.960	0.0	66.3	1096
2880 min Winter	1.560	0.0	69.7	1464
4320 min Winter	1.130	0.0	74.4	2196
5760 min Winter	0.898	0.0	77.4	2920
7200 min Winter	0.751	0.0	79.4	3552
8640 min Winter	0.649	0.0	80.9	4344
10080 min Winter	0.574	0.0	81.9	5200

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Cascade Rainfall Details for Porous-CP-to-HB01.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.100	Shortest Storm (mins)	15
Ratio R	0.407	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.123

Time (mins) From:	To:	Area (ha)
0	4	0.123

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Cascade Model Details for Porous-CP-to-HB01.SRCX

Storage is Online Cover Level (m) 30.590

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	6.0
Membrane Percolation (mm/hr)	1000	Length (m)	115.0
Max Percolation (l/s)	191.7	Slope (1:X)	150.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	29.980	Membrane Depth (m)	0

Pipe Outflow Control

Diameter (m)	0.150	Entry Loss Coefficient	0.500
Slope (1:X)	80.0	Coefficient of Contraction	0.600
Length (m)	10.000	Upstream Invert Level (m)	30.000
Roughness k (mm)	0.600		

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Cascade Summary of Results for Porous-CP-to-HB02.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	Hydrobrake-02.SRCX	(None)

Half Drain Time : 0 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	30.020	0.000	0.0	44.7	44.7	0.0	O K
30 min Summer	30.020	0.000	0.0	38.7	38.7	0.0	O K
60 min Summer	30.020	0.000	0.0	27.6	27.6	0.0	O K
120 min Summer	30.020	0.000	0.0	17.8	17.8	0.0	O K
180 min Summer	30.020	0.000	0.0	13.4	13.4	0.0	O K
240 min Summer	30.020	0.000	0.0	10.8	10.8	0.0	O K
360 min Summer	30.020	0.000	0.0	7.9	7.9	0.0	O K
480 min Summer	30.020	0.000	0.0	6.3	6.3	0.0	O K
600 min Summer	30.020	0.000	0.0	5.3	5.3	0.0	O K
720 min Summer	30.020	0.000	0.0	4.6	4.6	0.0	O K
960 min Summer	30.020	0.000	0.0	3.7	3.7	0.0	O K
1440 min Summer	30.020	0.000	0.0	2.6	2.6	0.0	O K
2160 min Summer	30.020	0.000	0.0	1.9	1.9	0.0	O K
2880 min Summer	30.020	0.000	0.0	1.5	1.5	0.0	O K
4320 min Summer	30.020	0.000	0.0	1.1	1.1	0.0	O K
5760 min Summer	30.020	0.000	0.0	0.9	0.9	0.0	O K
7200 min Summer	30.020	0.000	0.0	0.7	0.7	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	76.886	0.0	14.4	0
30 min Summer	49.908	0.0	19.6	0
60 min Summer	30.968	0.0	25.0	0
120 min Summer	18.650	0.0	30.6	0
180 min Summer	13.718	0.0	34.1	0
240 min Summer	10.984	0.0	36.5	0
360 min Summer	8.013	0.0	40.1	0
480 min Summer	6.403	0.0	42.8	0
600 min Summer	5.378	0.0	45.0	0
720 min Summer	4.662	0.0	46.8	0
960 min Summer	3.719	0.0	49.7	0
1440 min Summer	2.701	0.0	53.9	0
2160 min Summer	1.960	0.0	58.2	0
2880 min Summer	1.560	0.0	61.2	0
4320 min Summer	1.130	0.0	65.3	0
5760 min Summer	0.898	0.0	67.9	0
7200 min Summer	0.751	0.0	69.6	0

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Cascade Summary of Results for Porous-CP-to-HB02.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	30.020	0.000	0.0	0.6	0.6	0.0	O K
10080 min Summer	30.020	0.000	0.0	0.5	0.5	0.0	O K
15 min Winter	30.020	0.000	0.0	44.8	44.8	0.0	O K
30 min Winter	30.020	0.000	0.0	33.5	33.5	0.0	O K
60 min Winter	30.020	0.000	0.0	21.7	21.7	0.0	O K
120 min Winter	30.020	0.000	0.0	13.2	13.2	0.0	O K
180 min Winter	30.020	0.000	0.0	9.8	9.8	0.0	O K
240 min Winter	30.020	0.000	0.0	7.8	7.8	0.0	O K
360 min Winter	30.020	0.000	0.0	5.7	5.7	0.0	O K
480 min Winter	30.020	0.000	0.0	4.6	4.6	0.0	O K
600 min Winter	30.020	0.000	0.0	3.8	3.8	0.0	O K
720 min Winter	30.020	0.000	0.0	3.3	3.3	0.0	O K
960 min Winter	30.020	0.000	0.0	2.6	2.6	0.0	O K
1440 min Winter	30.020	0.000	0.0	1.9	1.9	0.0	O K
2160 min Winter	30.020	0.000	0.0	1.4	1.4	0.0	O K
2880 min Winter	30.020	0.000	0.0	1.1	1.1	0.0	O K
4320 min Winter	30.020	0.000	0.0	0.8	0.8	0.0	O K
5760 min Winter	30.020	0.000	0.0	0.6	0.6	0.0	O K
7200 min Winter	30.020	0.000	0.0	0.5	0.5	0.0	O K
8640 min Winter	30.020	0.000	0.0	0.4	0.4	0.0	O K
10080 min Winter	30.020	0.000	0.0	0.4	0.4	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	0.649	0.0	70.8	0
10080 min Summer	0.574	0.0	71.6	0
15 min Winter	76.886	0.0	16.5	0
30 min Winter	49.908	0.0	22.3	0
60 min Winter	30.968	0.0	28.3	0
120 min Winter	18.650	0.0	34.7	0
180 min Winter	13.718	0.0	38.5	0
240 min Winter	10.984	0.0	41.3	0
360 min Winter	8.013	0.0	45.4	0
480 min Winter	6.403	0.0	48.4	0
600 min Winter	5.378	0.0	50.8	0
720 min Winter	4.662	0.0	52.9	0
960 min Winter	3.719	0.0	56.2	0
1440 min Winter	2.701	0.0	61.0	0
2160 min Winter	1.960	0.0	65.9	0
2880 min Winter	1.560	0.0	69.4	0
4320 min Winter	1.130	0.0	74.2	0
5760 min Winter	0.898	0.0	77.3	0
7200 min Winter	0.751	0.0	79.6	0
8640 min Winter	0.649	0.0	81.1	0
10080 min Winter	0.574	0.0	82.3	0

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Cascade Rainfall Details for Porous-CP-to-HB02.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.100	Shortest Storm (mins)	15
Ratio R	0.407	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.121

Time (mins) From:	To:	Area (ha)
0	4	0.121

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Cascade Model Details for Porous-CP-to-HB02.SRCX

Storage is Online Cover Level (m) 30.630

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	8.0
Membrane Percolation (mm/hr)	1000	Length (m)	76.3
Max Percolation (l/s)	169.6	Slope (1:X)	40.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	30.020	Membrane Depth (m)	0

Pipe Outflow Control

Diameter (m)	0.150	Entry Loss Coefficient	0.500
Slope (1:X)	80.0	Coefficient of Contraction	0.600
Length (m)	10.000	Upstream Invert Level (m)	28.850
Roughness k (mm)	0.600		

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Cascade Summary of Results for BlueRoof-01.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	Hydrobrake-01.srcx	(None)

Half Drain Time : 268 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	34.642	0.042	0.0	1.0	1.0	44.0	O K
30 min Summer	34.655	0.055	0.0	1.8	1.8	58.2	O K
60 min Summer	34.669	0.069	0.0	2.6	2.6	72.7	O K
120 min Summer	34.681	0.081	0.0	3.9	3.9	85.6	O K
180 min Summer	34.685	0.085	0.0	4.2	4.2	89.1	O K
240 min Summer	34.686	0.086	0.0	4.3	4.3	90.1	O K
360 min Summer	34.687	0.087	0.0	4.4	4.4	91.4	O K
480 min Summer	34.687	0.087	0.0	4.5	4.5	91.9	O K
600 min Summer	34.687	0.087	0.0	4.5	4.5	91.8	O K
720 min Summer	34.687	0.087	0.0	4.4	4.4	91.2	O K
960 min Summer	34.685	0.085	0.0	4.3	4.3	89.5	O K
1440 min Summer	34.681	0.081	0.0	3.9	3.9	85.5	O K
2160 min Summer	34.676	0.076	0.0	3.3	3.3	80.0	O K
2880 min Summer	34.672	0.072	0.0	2.9	2.9	75.3	O K
4320 min Summer	34.664	0.064	0.0	2.3	2.3	67.4	O K
5760 min Summer	34.659	0.059	0.0	2.0	2.0	61.5	O K
7200 min Summer	34.654	0.054	0.0	1.7	1.7	57.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	99.825	0.0	33.5	64
30 min Summer	65.339	0.0	48.5	66
60 min Summer	40.718	0.0	72.6	80
120 min Summer	24.507	0.0	90.1	122
180 min Summer	17.966	0.0	100.3	174
240 min Summer	14.329	0.0	107.3	202
360 min Summer	10.392	0.0	117.6	262
480 min Summer	8.272	0.0	125.2	328
600 min Summer	6.925	0.0	131.2	392
720 min Summer	5.987	0.0	136.1	460
960 min Summer	4.754	0.0	143.8	590
1440 min Summer	3.431	0.0	153.8	852
2160 min Summer	2.471	0.0	174.2	1232
2880 min Summer	1.956	0.0	182.1	1612
4320 min Summer	1.405	0.0	191.3	2344
5760 min Summer	1.110	0.0	206.5	3088
7200 min Summer	0.925	0.0	211.7	3824

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Cascade Summary of Results for BlueRoof-01.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	34.651	0.051	0.0	1.5	1.5	53.7	O K
10080 min Summer	34.648	0.048	0.0	1.3	1.3	50.9	O K
15 min Winter	34.647	0.047	0.0	1.3	1.3	49.6	O K
30 min Winter	34.662	0.062	0.0	2.2	2.2	65.3	O K
60 min Winter	34.677	0.077	0.0	3.4	3.4	81.1	O K
120 min Winter	34.691	0.091	0.0	4.8	4.8	95.3	O K
180 min Winter	34.695	0.095	0.0	5.1	5.1	99.4	O K
240 min Winter	34.695	0.095	0.0	5.1	5.1	100.1	O K
360 min Winter	34.696	0.096	0.0	5.2	5.2	100.8	O K
480 min Winter	34.695	0.095	0.0	5.1	5.1	100.0	O K
600 min Winter	34.694	0.094	0.0	5.0	5.0	98.5	O K
720 min Winter	34.692	0.092	0.0	4.9	4.9	96.7	O K
960 min Winter	34.688	0.088	0.0	4.6	4.6	92.8	O K
1440 min Winter	34.682	0.082	0.0	3.9	3.9	86.2	O K
2160 min Winter	34.675	0.075	0.0	3.2	3.2	78.6	O K
2880 min Winter	34.669	0.069	0.0	2.6	2.6	72.7	O K
4320 min Winter	34.660	0.060	0.0	2.0	2.0	62.9	O K
5760 min Winter	34.654	0.054	0.0	1.7	1.7	56.5	O K
7200 min Winter	34.650	0.050	0.0	1.4	1.4	52.1	O K
8640 min Winter	34.646	0.046	0.0	1.2	1.2	48.6	O K
10080 min Winter	34.643	0.043	0.0	1.1	1.1	45.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	0.796	0.0	214.9	4544
10080 min Summer	0.701	0.0	216.2	5280
15 min Winter	99.825	0.0	39.3	62
30 min Winter	65.339	0.0	56.3	65
60 min Winter	40.718	0.0	83.0	78
120 min Winter	24.507	0.0	102.6	120
180 min Winter	17.966	0.0	114.1	172
240 min Winter	14.329	0.0	122.0	204
360 min Winter	10.392	0.0	133.6	272
480 min Winter	8.272	0.0	142.2	344
600 min Winter	6.925	0.0	149.0	416
720 min Winter	5.987	0.0	154.6	486
960 min Winter	4.754	0.0	163.3	622
1440 min Winter	3.431	0.0	174.8	890
2160 min Winter	2.471	0.0	197.1	1276
2880 min Winter	1.956	0.0	206.4	1676
4320 min Winter	1.405	0.0	217.4	2420
5760 min Winter	1.110	0.0	234.2	3168
7200 min Winter	0.925	0.0	240.6	3888
8640 min Winter	0.796	0.0	244.9	4672
10080 min Winter	0.701	0.0	247.1	5376

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Cascade Rainfall Details for BlueRoof-01.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.100	Shortest Storm (mins)	15
Ratio R	0.407	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Green Roof

Area (m³)	1107	Evaporation (mm/day)	3
Depression Storage (mm)	5	Decay Coefficient	0.050

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.020116	32	36	0.004061	64	68	0.000820	96	100	0.000166
4	8	0.016470	36	40	0.003325	68	72	0.000671	100	104	0.000136
8	12	0.013484	40	44	0.002722	72	76	0.000550	104	108	0.000111
12	16	0.011040	44	48	0.002229	76	80	0.000450	108	112	0.000091
16	20	0.009039	48	52	0.001825	80	84	0.000368	112	116	0.000074
20	24	0.007400	52	56	0.001494	84	88	0.000302	116	120	0.000061
24	28	0.006059	56	60	0.001223	88	92	0.000247			
28	32	0.004961	60	64	0.001002	92	96	0.000202			

Time Area Diagram

Total Area (ha) 0.176

Time (mins) From:	To:	Area (ha)
0	4	0.176

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Cascade Model Details for BlueRoof-01.SRCX

Storage is Online Cover Level (m) 35.000

Cellular Storage Structure

Invert Level (m) 34.600 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	1107.0	1107.0	1.300	0.0	1127.0
0.100	1107.0	1120.3	1.400	0.0	1127.0
0.200	0.0	1127.0	1.500	0.0	1127.0
0.300	0.0	1127.0	1.600	0.0	1127.0
0.400	0.0	1127.0	1.700	0.0	1127.0
0.500	0.0	1127.0	1.800	0.0	1127.0
0.600	0.0	1127.0	1.900	0.0	1127.0
0.700	0.0	1127.0	2.000	0.0	1127.0
0.800	0.0	1127.0	2.100	0.0	1127.0
0.900	0.0	1127.0	2.200	0.0	1127.0
1.000	0.0	1127.0	2.300	0.0	1127.0
1.100	0.0	1127.0	2.400	0.0	1127.0
1.200	0.0	1127.0	2.500	0.0	1127.0

Pipe Outflow Control

Diameter (m) 0.150 Entry Loss Coefficient 0.500
Slope (1:X) 1.0 Coefficient of Contraction 0.600
Length (m) 3.000 Upstream Invert Level (m) 34.600
Roughness k (mm) 0.600

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Cascade Summary of Results for BlueRoof-02.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	Hydrobrake-01.srcx	(None)

Half Drain Time : 263 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	34.632	0.032	0.0	0.5	0.5	19.3	O K
30 min Summer	34.642	0.042	0.0	0.8	0.8	25.7	O K
60 min Summer	34.653	0.053	0.0	1.3	1.3	32.1	O K
120 min Summer	34.662	0.062	0.0	1.8	1.8	37.9	O K
180 min Summer	34.665	0.065	0.0	1.9	1.9	39.6	O K
240 min Summer	34.666	0.066	0.0	2.0	2.0	40.1	O K
360 min Summer	34.667	0.067	0.0	2.0	2.0	40.7	O K
480 min Summer	34.667	0.067	0.0	2.0	2.0	40.9	O K
600 min Summer	34.667	0.067	0.0	2.0	2.0	40.8	O K
720 min Summer	34.667	0.067	0.0	2.0	2.0	40.5	O K
960 min Summer	34.665	0.065	0.0	1.9	1.9	39.6	O K
1440 min Summer	34.662	0.062	0.0	1.8	1.8	37.5	O K
2160 min Summer	34.657	0.057	0.0	1.6	1.6	34.8	O K
2880 min Summer	34.654	0.054	0.0	1.4	1.4	32.6	O K
4320 min Summer	34.649	0.049	0.0	1.1	1.1	29.5	O K
5760 min Summer	34.644	0.044	0.0	0.9	0.9	27.0	O K
7200 min Summer	34.641	0.041	0.0	0.8	0.8	24.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	99.825	0.0	15.0	68
30 min Summer	65.339	0.0	21.9	71
60 min Summer	40.718	0.0	32.9	84
120 min Summer	24.507	0.0	40.8	124
180 min Summer	17.966	0.0	45.5	178
240 min Summer	14.329	0.0	48.7	204
360 min Summer	10.392	0.0	53.3	266
480 min Summer	8.272	0.0	56.8	330
600 min Summer	6.925	0.0	59.5	396
720 min Summer	5.987	0.0	61.7	462
960 min Summer	4.754	0.0	65.2	594
1440 min Summer	3.431	0.0	69.7	850
2160 min Summer	2.471	0.0	78.5	1224
2880 min Summer	1.956	0.0	82.0	1588
4320 min Summer	1.405	0.0	85.9	2336
5760 min Summer	1.110	0.0	92.2	3104
7200 min Summer	0.925	0.0	94.2	3816

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Cascade Summary of Results for BlueRoof-02.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	34.638	0.038	0.0	0.7	0.7	23.3	O K
10080 min Summer	34.636	0.036	0.0	0.6	0.6	22.0	O K
15 min Winter	34.636	0.036	0.0	0.6	0.6	21.8	O K
30 min Winter	34.648	0.048	0.0	1.0	1.0	28.9	O K
60 min Winter	34.659	0.059	0.0	1.7	1.7	35.9	O K
120 min Winter	34.670	0.070	0.0	2.1	2.1	42.4	O K
180 min Winter	34.673	0.073	0.0	2.3	2.3	44.5	O K
240 min Winter	34.674	0.074	0.0	2.3	2.3	44.8	O K
360 min Winter	34.674	0.074	0.0	2.3	2.3	45.1	O K
480 min Winter	34.674	0.074	0.0	2.3	2.3	44.7	O K
600 min Winter	34.672	0.072	0.0	2.2	2.2	44.0	O K
720 min Winter	34.671	0.071	0.0	2.2	2.2	43.1	O K
960 min Winter	34.668	0.068	0.0	2.0	2.0	41.2	O K
1440 min Winter	34.662	0.062	0.0	1.8	1.8	37.7	O K
2160 min Winter	34.656	0.056	0.0	1.5	1.5	33.9	O K
2880 min Winter	34.652	0.052	0.0	1.3	1.3	31.3	O K
4320 min Winter	34.645	0.045	0.0	0.9	0.9	27.6	O K
5760 min Winter	34.641	0.041	0.0	0.8	0.8	24.6	O K
7200 min Winter	34.637	0.037	0.0	0.7	0.7	22.5	O K
8640 min Winter	34.634	0.034	0.0	0.6	0.6	20.9	O K
10080 min Winter	34.632	0.032	0.0	0.5	0.5	19.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	0.796	0.0	95.3	4576
10080 min Summer	0.701	0.0	95.6	5256
15 min Winter	99.825	0.0	17.7	65
30 min Winter	65.339	0.0	25.5	68
60 min Winter	40.718	0.0	37.6	80
120 min Winter	24.507	0.0	46.6	122
180 min Winter	17.966	0.0	51.8	174
240 min Winter	14.329	0.0	55.4	210
360 min Winter	10.392	0.0	60.6	276
480 min Winter	8.272	0.0	64.5	348
600 min Winter	6.925	0.0	67.6	420
720 min Winter	5.987	0.0	70.1	490
960 min Winter	4.754	0.0	74.1	626
1440 min Winter	3.431	0.0	79.3	884
2160 min Winter	2.471	0.0	89.0	1272
2880 min Winter	1.956	0.0	93.1	1644
4320 min Winter	1.405	0.0	97.8	2424
5760 min Winter	1.110	0.0	104.9	3168
7200 min Winter	0.925	0.0	107.4	3880
8640 min Winter	0.796	0.0	109.1	4664
10080 min Winter	0.701	0.0	109.8	5376

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Cascade Rainfall Details for BlueRoof-02.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.100	Shortest Storm (mins)	15
Ratio R	0.407	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Green Roof

Area (m³)	639	Evaporation (mm/day)	3
Depression Storage (mm)	5	Decay Coefficient	0.050

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.011612	32	36	0.002344	64	68	0.000473	96	100	0.000096
4	8	0.009507	36	40	0.001919	68	72	0.000388	100	104	0.000078
8	12	0.007784	40	44	0.001571	72	76	0.000317	104	108	0.000064
12	16	0.006373	44	48	0.001287	76	80	0.000260	108	112	0.000052
16	20	0.005218	48	52	0.001053	80	84	0.000213	112	116	0.000043
20	24	0.004272	52	56	0.000862	84	88	0.000174	116	120	0.000035
24	28	0.003497	56	60	0.000706	88	92	0.000143			
28	32	0.002863	60	64	0.000578	92	96	0.000117			

Time Area Diagram

Total Area (ha) 0.067

Time (mins) From:	To:	Area (ha)
0	4	0.067

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Cascade Model Details for BlueRoof-02.SRCX

Storage is Online Cover Level (m) 35.000

Cellular Storage Structure

Invert Level (m) 34.600 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	639.0	639.0	1.300	0.0	654.2
0.100	639.0	649.1	1.400	0.0	654.2
0.200	0.0	654.2	1.500	0.0	654.2
0.300	0.0	654.2	1.600	0.0	654.2
0.400	0.0	654.2	1.700	0.0	654.2
0.500	0.0	654.2	1.800	0.0	654.2
0.600	0.0	654.2	1.900	0.0	654.2
0.700	0.0	654.2	2.000	0.0	654.2
0.800	0.0	654.2	2.100	0.0	654.2
0.900	0.0	654.2	2.200	0.0	654.2
1.000	0.0	654.2	2.300	0.0	654.2
1.100	0.0	654.2	2.400	0.0	654.2
1.200	0.0	654.2	2.500	0.0	654.2

Pipe Outflow Control

Diameter (m) 0.100 Entry Loss Coefficient 0.500
Slope (1:X) 1.0 Coefficient of Contraction 0.600
Length (m) 3.000 Upstream Invert Level (m) 34.600
Roughness k (mm) 0.600

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Cascade Summary of Results for Hydrobrake-01.srcx

Upstream Structures	Outflow To	Overflow To
BlueRoof-01.SRCX BlueRoof-02.SRCX Porous-CP-to-HB01.SRCX	Hydrobrake-03.SRCX	(None)

Half Drain Time : 273 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	29.787	0.237	0.0	4.0	4.0	43.9	O K
30 min Summer	29.872	0.322	0.0	4.0	4.0	59.7	O K
60 min Summer	29.971	0.421	0.0	4.0	4.0	77.9	O K
120 min Summer	30.087	0.537	0.0	4.0	4.0	99.5	O K
180 min Summer	30.154	0.604	0.0	4.0	4.0	111.8	O K
240 min Summer	30.193	0.643	0.0	4.0	4.0	119.2	O K
360 min Summer	30.243	0.693	0.0	4.0	4.0	128.3	O K
480 min Summer	30.273	0.723	0.0	4.0	4.0	134.0	O K
600 min Summer	30.289	0.739	0.0	4.0	4.0	136.9	O K
720 min Summer	30.293	0.743	0.0	4.0	4.0	137.6	O K
960 min Summer	30.273	0.723	0.0	4.0	4.0	133.9	O K
1440 min Summer	30.221	0.671	0.0	4.0	4.0	124.2	O K
2160 min Summer	30.139	0.589	0.0	4.0	4.0	109.1	O K
2880 min Summer	30.052	0.502	0.0	4.0	4.0	93.0	O K
4320 min Summer	29.834	0.284	0.0	4.0	4.0	52.6	O K
5760 min Summer	29.678	0.128	0.0	4.0	4.0	23.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	99.825	0.0	99.3	31
30 min Summer	65.339	0.0	137.9	47
60 min Summer	40.718	0.0	190.2	142
120 min Summer	24.507	0.0	233.8	228
180 min Summer	17.966	0.0	259.1	284
240 min Summer	14.329	0.0	276.6	334
360 min Summer	10.392	0.0	302.3	426
480 min Summer	8.272	0.0	321.6	514
600 min Summer	6.925	0.0	336.8	612
720 min Summer	5.987	0.0	349.4	724
960 min Summer	4.754	0.0	369.4	914
1440 min Summer	3.431	0.0	397.0	1166
2160 min Summer	2.471	0.0	439.7	1556
2880 min Summer	1.956	0.0	460.7	1964
4320 min Summer	1.405	0.0	487.6	2676
5760 min Summer	1.110	0.0	518.3	3312

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Cascade Summary of Results for Hydrobrake-01.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
7200 min Summer	29.586	0.036	0.0	4.0	4.0	6.7	O K
8640 min Summer	29.550	0.000	0.0	4.0	4.0	0.0	O K
10080 min Summer	29.550	0.000	0.0	3.5	3.5	0.0	O K
15 min Winter	29.823	0.273	0.0	4.0	4.0	50.7	O K
30 min Winter	29.926	0.376	0.0	4.0	4.0	69.7	O K
60 min Winter	30.059	0.509	0.0	4.0	4.0	94.4	O K
120 min Winter	30.202	0.652	0.0	4.0	4.0	120.7	O K
180 min Winter	30.281	0.731	0.0	4.0	4.0	135.3	O K
240 min Winter	30.329	0.779	0.0	4.0	4.0	144.3	O K
360 min Winter	31.068	1.518	0.0	5.2	5.2	154.4	FLOOD
480 min Winter	32.052	2.502	0.0	6.4	6.4	156.0	FLOOD
600 min Winter	32.053	2.503	0.0	6.4	6.4	157.2	FLOOD
720 min Winter	32.052	2.502	0.0	6.4	6.4	155.9	FLOOD
960 min Winter	32.050	2.500	0.0	6.4	6.4	154.4	FLOOD
1440 min Winter	30.352	0.802	0.0	4.1	4.1	148.6	O K
2160 min Winter	30.229	0.679	0.0	4.0	4.0	125.8	O K
2880 min Winter	30.098	0.548	0.0	4.0	4.0	101.5	O K
4320 min Winter	29.761	0.211	0.0	4.0	4.0	39.0	O K
5760 min Winter	29.574	0.024	0.0	4.0	4.0	4.5	O K
7200 min Winter	29.550	0.000	0.0	3.6	3.6	0.0	O K
8640 min Winter	29.550	0.000	0.0	3.1	3.1	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
7200 min Summer	0.925	0.0	533.0	3896
8640 min Summer	0.796	0.0	543.6	0
10080 min Summer	0.701	0.0	549.9	0
15 min Winter	99.825	0.0	114.1	34
30 min Winter	65.339	0.0	157.8	67
60 min Winter	40.718	0.0	216.3	172
120 min Winter	24.507	0.0	264.6	248
180 min Winter	17.966	0.0	293.2	304
240 min Winter	14.329	0.0	313.2	354
360 min Winter	10.392	0.0	341.8	430
480 min Winter	8.272	1.7	363.8	476
600 min Winter	6.925	2.9	380.6	582
720 min Winter	5.987	1.6	395.1	668
960 min Winter	4.754	0.0	417.8	788
1440 min Winter	3.431	0.0	449.1	1216
2160 min Winter	2.471	0.0	496.6	1644
2880 min Winter	1.956	0.0	520.5	2088
4320 min Winter	1.405	0.0	552.2	2768
5760 min Winter	1.110	0.0	587.0	3280
7200 min Winter	0.925	0.0	604.6	0
8640 min Winter	0.796	0.0	617.3	0

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Cascade Summary of Results for Hydrobrake-01.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Winter	29.550	0.000	0.0	2.7	2.7	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Winter	0.701	0.0	625.8	0

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Cascade Rainfall Details for Hydrobrake-01.srcx

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.100	Shortest Storm (mins)	15
Ratio R	0.407	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.167

Time (mins) From:	To:	Area (ha)
0	4	0.167

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Cascade Model Details for Hydrobrake-01.srcx

Storage is Online Cover Level (m) 30.650

Cellular Storage Structure

Invert Level (m) 29.550 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	195.0	195.0	1.300	0.0	242.5
0.100	195.0	200.6	1.400	0.0	242.5
0.200	195.0	206.2	1.500	0.0	242.5
0.300	195.0	211.8	1.600	0.0	242.5
0.400	195.0	217.3	1.700	0.0	242.5
0.500	195.0	222.9	1.800	0.0	242.5
0.600	195.0	228.5	1.900	0.0	242.5
0.700	195.0	234.1	2.000	0.0	242.5
0.800	195.0	239.7	2.100	0.0	242.5
0.900	0.0	242.5	2.200	0.0	242.5
1.000	0.0	242.5	2.300	0.0	242.5
1.100	0.0	242.5	2.400	0.0	242.5
1.200	0.0	242.5	2.500	0.0	242.5

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0095-4000-1000-4000
Design Head (m)	1.000
Design Flow (l/s)	4.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	95
Invert Level (m)	29.310
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	4.0
Flush-Flo™	0.294	4.0
Kick-Flo®	0.629	3.2
Mean Flow over Head Range	-	3.5

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

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Hydro-Brake® Optimum Outflow Control

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.0	1.200	4.3	3.000	6.7	7.000	10.0
0.200	3.9	1.400	4.7	3.500	7.2	7.500	10.3
0.300	4.0	1.600	5.0	4.000	7.6	8.000	10.6
0.400	3.9	1.800	5.3	4.500	8.1	8.500	10.9
0.500	3.8	2.000	5.5	5.000	8.5	9.000	11.2
0.600	3.4	2.200	5.8	5.500	8.9	9.500	11.5
0.800	3.6	2.400	6.0	6.000	9.3		
1.000	4.0	2.600	6.2	6.500	9.6		

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Cascade Summary of Results for Hydrobrake-02.SRCX

Upstream Structures	Outflow To	Overflow To
Porous-CP-to-HB02.SRCX	Hydrobrake-03.SRCX	(None)

Half Drain Time : 92 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	29.454	0.104	0.0	7.9	7.9	50.2	O K
30 min Summer	29.481	0.131	0.0	8.0	8.0	63.5	O K
60 min Summer	29.498	0.148	0.0	8.0	8.0	71.9	O K
120 min Summer	29.500	0.150	0.0	8.0	8.0	72.6	O K
180 min Summer	29.495	0.145	0.0	8.0	8.0	70.2	O K
240 min Summer	29.487	0.137	0.0	8.0	8.0	66.5	O K
360 min Summer	29.471	0.121	0.0	8.0	8.0	58.7	O K
480 min Summer	29.457	0.107	0.0	7.9	7.9	51.8	O K
600 min Summer	29.444	0.094	0.0	7.9	7.9	45.6	O K
720 min Summer	29.433	0.083	0.0	7.8	7.8	40.1	O K
960 min Summer	29.415	0.065	0.0	7.6	7.6	31.7	O K
1440 min Summer	29.394	0.044	0.0	6.5	6.5	21.4	O K
2160 min Summer	29.375	0.025	0.0	5.3	5.3	12.2	O K
2880 min Summer	29.364	0.014	0.0	4.4	4.4	6.7	O K
4320 min Summer	29.351	0.001	0.0	3.5	3.5	0.7	O K
5760 min Summer	29.350	0.000	0.0	2.9	2.9	0.0	O K
7200 min Summer	29.350	0.000	0.0	2.4	2.4	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	99.825	0.0	56.4	18
30 min Summer	65.339	0.0	75.0	32
60 min Summer	40.718	0.0	94.2	60
120 min Summer	24.507	0.0	114.2	96
180 min Summer	17.966	0.0	125.9	128
240 min Summer	14.329	0.0	134.1	162
360 min Summer	10.392	0.0	145.9	230
480 min Summer	8.272	0.0	154.7	294
600 min Summer	6.925	0.0	162.3	358
720 min Summer	5.987	0.0	168.2	420
960 min Summer	4.754	0.0	177.9	540
1440 min Summer	3.431	0.0	192.4	780
2160 min Summer	2.471	0.0	207.5	1144
2880 min Summer	1.956	0.0	218.4	1500
4320 min Summer	1.405	0.0	234.3	2204
5760 min Summer	1.110	0.0	245.5	0
7200 min Summer	0.925	0.0	254.1	0

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Cascade Summary of Results for Hydrobrake-02.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	29.350	0.000	0.0	2.1	2.1	0.0	O K
10080 min Summer	29.350	0.000	0.0	1.8	1.8	0.0	O K
15 min Winter	29.470	0.120	0.0	7.9	7.9	58.0	O K
30 min Winter	29.500	0.150	0.0	8.0	8.0	72.9	O K
60 min Winter	29.522	0.172	0.0	8.0	8.0	83.5	O K
120 min Winter	29.525	0.175	0.0	8.0	8.0	84.7	O K
180 min Winter	29.517	0.167	0.0	8.0	8.0	80.9	O K
240 min Winter	29.506	0.156	0.0	8.0	8.0	75.7	O K
360 min Winter	29.483	0.133	0.0	8.0	8.0	64.3	O K
480 min Winter	29.461	0.111	0.0	7.9	7.9	53.8	O K
600 min Winter	29.442	0.092	0.0	7.9	7.9	44.7	O K
720 min Winter	29.426	0.076	0.0	7.8	7.8	37.0	O K
960 min Winter	29.406	0.056	0.0	7.1	7.1	27.0	O K
1440 min Winter	29.382	0.032	0.0	5.7	5.7	15.3	O K
2160 min Winter	29.363	0.013	0.0	4.4	4.4	6.1	O K
2880 min Winter	29.352	0.002	0.0	3.6	3.6	0.9	O K
4320 min Winter	29.350	0.000	0.0	2.6	2.6	0.0	O K
5760 min Winter	29.350	0.000	0.0	2.1	2.1	0.0	O K
7200 min Winter	29.350	0.000	0.0	1.7	1.7	0.0	O K
8640 min Winter	29.350	0.000	0.0	1.5	1.5	0.0	O K
10080 min Winter	29.350	0.000	0.0	1.3	1.3	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	0.796	0.0	261.0	0
10080 min Summer	0.701	0.0	266.7	0
15 min Winter	99.825	0.0	64.2	18
30 min Winter	65.339	0.0	84.6	32
60 min Winter	40.718	0.0	106.0	60
120 min Winter	24.507	0.0	128.4	110
180 min Winter	17.966	0.0	141.5	138
240 min Winter	14.329	0.0	150.3	176
360 min Winter	10.392	0.0	164.0	248
480 min Winter	8.272	0.0	173.9	316
600 min Winter	6.925	0.0	182.1	380
720 min Winter	5.987	0.0	189.0	440
960 min Winter	4.754	0.0	200.0	558
1440 min Winter	3.431	0.0	216.1	796
2160 min Winter	2.471	0.0	233.1	1164
2880 min Winter	1.956	0.0	245.7	1500
4320 min Winter	1.405	0.0	263.5	0
5760 min Winter	1.110	0.0	276.3	0
7200 min Winter	0.925	0.0	286.1	0
8640 min Winter	0.796	0.0	294.1	0
10080 min Winter	0.701	0.0	300.7	0

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Cascade Rainfall Details for Hydrobrake-02.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.100	Shortest Storm (mins)	15
Ratio R	0.407	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.199

Time (mins) From:	To:	Area (ha)
0	4	0.199

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Cascade Model Details for Hydrobrake-02.SRCX

Storage is Online Cover Level (m) 30.630

Cellular Storage Structure

Invert Level (m) 29.350 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	510.0	510.0	1.300	0.0	559.7
0.100	510.0	519.0	1.400	0.0	559.7
0.200	510.0	528.1	1.500	0.0	559.7
0.300	510.0	537.1	1.600	0.0	559.7
0.400	510.0	546.1	1.700	0.0	559.7
0.500	510.0	555.2	1.800	0.0	559.7
0.600	0.0	559.7	1.900	0.0	559.7
0.700	0.0	559.7	2.000	0.0	559.7
0.800	0.0	559.7	2.100	0.0	559.7
0.900	0.0	559.7	2.200	0.0	559.7
1.000	0.0	559.7	2.300	0.0	559.7
1.100	0.0	559.7	2.400	0.0	559.7
1.200	0.0	559.7	2.500	0.0	559.7

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0136-8000-0680-8000
Design Head (m)	0.680
Design Flow (l/s)	8.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	136
Invert Level (m)	29.270
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.680	8.0
Flush-Flo™	0.231	8.0
Kick-Flo®	0.492	6.9
Mean Flow over Head Range	-	6.7

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

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Hydro-Brake® Optimum Outflow Control

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.9	1.200	10.4	3.000	16.1	7.000	24.1
0.200	7.9	1.400	11.2	3.500	17.4	7.500	25.0
0.300	7.9	1.600	12.0	4.000	18.5	8.000	25.8
0.400	7.6	1.800	12.6	4.500	19.6	8.500	26.6
0.500	6.9	2.000	13.3	5.000	20.6	9.000	27.4
0.600	7.5	2.200	13.9	5.500	21.6	9.500	28.1
0.800	8.6	2.400	14.5	6.000	22.5		
1.000	9.6	2.600	15.1	6.500	23.4		

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Cascade Summary of Results for Hydrobrake-03.SRCX

Upstream Structures	Outflow To	Overflow To
Hydrobrake-01.srcx	(None)	(None)
BlueRoof-01.SRCX		
BlueRoof-02.SRCX		
Porous-CP-to-HB01.SRCX		
Hydrobrake-02.SRCX		
Porous-CP-to-HB02.SRCX		

Half Drain Time : 175 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	29.199	0.249	0.0	6.0	6.0	73.8	O K
30 min Summer	29.283	0.333	0.0	6.0	6.0	98.8	O K
60 min Summer	29.358	0.408	0.0	6.0	6.0	120.9	O K
120 min Summer	29.443	0.493	0.0	6.0	6.0	146.1	O K
180 min Summer	29.480	0.530	0.0	6.6	6.6	157.2	O K
240 min Summer	29.496	0.546	0.0	7.3	7.3	161.8	O K
360 min Summer	29.511	0.561	0.0	8.2	8.2	166.3	O K
480 min Summer	29.520	0.570	0.0	8.9	8.9	168.9	O K
600 min Summer	29.517	0.567	0.0	8.7	8.7	168.0	O K
720 min Summer	29.512	0.562	0.0	8.3	8.3	166.7	O K
960 min Summer	29.503	0.553	0.0	7.7	7.7	163.8	O K
1440 min Summer	29.478	0.528	0.0	6.5	6.5	156.5	O K
2160 min Summer	29.431	0.481	0.0	6.0	6.0	142.5	O K
2880 min Summer	29.386	0.436	0.0	6.0	6.0	129.2	O K
4320 min Summer	29.327	0.377	0.0	6.0	6.0	111.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	99.825	0.0	190.8	154
30 min Summer	65.339	0.0	258.8	197
60 min Summer	40.718	0.0	341.6	242
120 min Summer	24.507	0.0	417.0	298
180 min Summer	17.966	0.0	460.8	340
240 min Summer	14.329	0.0	491.4	374
360 min Summer	10.392	0.0	536.0	418
480 min Summer	8.272	0.0	569.8	482
600 min Summer	6.925	0.0	596.3	568
720 min Summer	5.987	0.0	618.7	634
960 min Summer	4.754	0.0	654.6	744
1440 min Summer	3.431	0.0	705.5	984
2160 min Summer	2.471	0.0	772.8	1428
2880 min Summer	1.956	0.0	811.3	1820
4320 min Summer	1.405	0.0	864.6	2724

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Cascade Summary of Results for Hydrobrake-03.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
5760 min Summer	29.226	0.276	0.0	6.0	6.0	81.8	O K
7200 min Summer	29.136	0.186	0.0	6.0	6.0	55.1	O K
8640 min Summer	29.050	0.100	0.0	6.0	6.0	29.7	O K
10080 min Summer	28.997	0.047	0.0	5.9	5.9	13.9	O K
15 min Winter	29.233	0.283	0.0	6.0	6.0	83.8	O K
30 min Winter	29.319	0.369	0.0	6.0	6.0	109.4	O K
60 min Winter	29.415	0.465	0.0	6.0	6.0	137.7	O K
120 min Winter	29.497	0.547	0.0	7.4	7.4	162.1	O K
180 min Winter	29.518	0.568	0.0	8.8	8.8	168.5	O K
240 min Winter	29.529	0.579	0.0	9.6	9.6	171.5	O K
360 min Winter	29.542	0.592	0.0	10.4	10.4	175.5	O K
480 min Winter	29.561	0.611	0.0	11.9	11.9	181.1	O K
600 min Winter	29.558	0.608	0.0	11.6	11.6	180.3	O K
720 min Winter	29.551	0.601	0.0	11.0	11.0	178.0	O K
960 min Winter	29.535	0.585	0.0	10.0	10.0	173.5	O K
1440 min Winter	29.519	0.569	0.0	8.9	8.9	168.8	O K
2160 min Winter	29.482	0.532	0.0	6.7	6.7	157.6	O K
2880 min Winter	29.427	0.477	0.0	6.0	6.0	141.4	O K
4320 min Winter	29.346	0.396	0.0	6.0	6.0	117.4	O K
5760 min Winter	29.163	0.213	0.0	6.0	6.0	63.3	O K
7200 min Winter	29.007	0.057	0.0	5.9	5.9	17.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
5760 min Summer	1.110	0.0	913.7	3520
7200 min Summer	0.925	0.0	943.3	4176
8640 min Summer	0.796	0.0	966.0	4664
10080 min Summer	0.701	0.0	982.4	5248
15 min Winter	99.825	0.0	217.5	171
30 min Winter	65.339	0.0	293.8	216
60 min Winter	40.718	0.0	386.4	266
120 min Winter	24.507	0.0	470.4	322
180 min Winter	17.966	0.0	519.6	332
240 min Winter	14.329	0.0	553.9	352
360 min Winter	10.392	0.0	603.9	402
480 min Winter	8.272	0.0	642.0	484
600 min Winter	6.925	0.0	672.0	578
720 min Winter	5.987	0.0	697.3	670
960 min Winter	4.754	0.0	737.9	724
1440 min Winter	3.431	0.0	795.2	1024
2160 min Winter	2.471	0.0	870.6	1492
2880 min Winter	1.956	0.0	914.6	1988
4320 min Winter	1.405	0.0	975.5	2984
5760 min Winter	1.110	0.0	1031.7	3552
7200 min Winter	0.925	0.0	1065.7	3960

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Cascade Summary of Results for Hydrobrake-03.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Winter	28.972	0.022	0.0	5.4	5.4	6.6	O K
10080 min Winter	28.959	0.009	0.0	4.8	4.8	2.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Winter	0.796	0.0	1092.2	4496
10080 min Winter	0.701	0.0	1112.3	5224

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Cascade Rainfall Details for Hydrobrake-03.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.100	Shortest Storm (mins)	15
Ratio R	0.407	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.188

Time (mins) From:	To:	Area (ha)
0	4	0.188

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Cascade Model Details for Hydrobrake-03.SRCX

Storage is Online Cover Level (m) 30.550

Cellular Storage Structure

Invert Level (m) 28.950 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	312.0	312.0	1.300	0.0	372.1
0.100	312.0	319.1	1.400	0.0	372.1
0.200	312.0	326.1	1.500	0.0	372.1
0.300	312.0	333.2	1.600	0.0	372.1
0.400	312.0	340.3	1.700	0.0	372.1
0.500	312.0	347.3	1.800	0.0	372.1
0.600	312.0	354.4	1.900	0.0	372.1
0.700	312.0	361.5	2.000	0.0	372.1
0.800	312.0	368.5	2.100	0.0	372.1
0.900	0.0	372.1	2.200	0.0	372.1
1.000	0.0	372.1	2.300	0.0	372.1
1.100	0.0	372.1	2.400	0.0	372.1
1.200	0.0	372.1	2.500	0.0	372.1

Complex Outflow Control

Hydro-Brake® Optimum

Unit Reference	MD-SHE-0121-6000-0600-6000
Design Head (m)	0.600
Design Flow (l/s)	6.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	121
Invert Level (m)	28.850
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.600	6.0
Flush-Flo™	0.202	6.0
Kick-Flo®	0.435	5.2
Mean Flow over Head Range	-	5.0

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

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Hydro-Brake® Optimum

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.3	1.200	8.3	3.000	12.8	7.000	19.2
0.200	6.0	1.400	8.9	3.500	13.8	7.500	19.9
0.300	5.9	1.600	9.5	4.000	14.7	8.000	20.5
0.400	5.5	1.800	10.0	4.500	15.5	8.500	21.1
0.500	5.5	2.000	10.6	5.000	16.3	9.000	21.8
0.600	6.0	2.200	11.0	5.500	17.1	9.500	22.4
0.800	6.9	2.400	11.5	6.000	17.8		
1.000	7.6	2.600	12.0	6.500	18.5		

Orifice

Diameter (m) 0.125 Discharge Coefficient 0.600 Invert Level (m) 29.450

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Cascade Summary of Results for Porous-CP-to-HB01.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	Hydrobrake-01.srcx	(None)

Half Drain Time : 7 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	30.270	0.290	0.0	20.7	20.7	11.3	O K
30 min Summer	30.285	0.305	0.0	21.5	21.5	12.6	O K
60 min Summer	30.266	0.286	0.0	20.5	20.5	11.0	O K
120 min Summer	30.220	0.240	0.0	17.9	17.9	7.7	O K
180 min Summer	30.191	0.211	0.0	14.9	14.9	6.0	O K
240 min Summer	30.171	0.191	0.0	12.6	12.6	4.9	O K
360 min Summer	30.144	0.164	0.0	9.7	9.7	3.6	O K
480 min Summer	30.128	0.148	0.0	7.9	7.9	3.0	O K
600 min Summer	30.115	0.135	0.0	6.7	6.7	2.5	O K
720 min Summer	30.105	0.125	0.0	5.9	5.9	2.1	O K
960 min Summer	30.090	0.110	0.0	4.7	4.7	1.6	O K
1440 min Summer	30.077	0.097	0.0	3.4	3.4	1.3	O K
2160 min Summer	30.067	0.087	0.0	2.5	2.5	1.0	O K
2880 min Summer	30.058	0.078	0.0	1.9	1.9	0.8	O K
4320 min Summer	30.049	0.069	0.0	1.4	1.4	0.6	O K
5760 min Summer	30.044	0.064	0.0	1.1	1.1	0.5	O K
7200 min Summer	30.039	0.059	0.0	0.9	0.9	0.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	99.825	0.0	19.5	13
30 min Summer	65.339	0.0	26.6	21
60 min Summer	40.718	0.0	34.0	36
120 min Summer	24.507	0.0	41.5	66
180 min Summer	17.966	0.0	46.0	96
240 min Summer	14.329	0.0	49.0	126
360 min Summer	10.392	0.0	53.5	186
480 min Summer	8.272	0.0	56.9	246
600 min Summer	6.925	0.0	59.5	308
720 min Summer	5.987	0.0	61.7	368
960 min Summer	4.754	0.0	65.3	488
1440 min Summer	3.431	0.0	70.4	734
2160 min Summer	2.471	0.0	75.5	1084
2880 min Summer	1.956	0.0	79.0	1436
4320 min Summer	1.405	0.0	83.6	2184
5760 min Summer	1.110	0.0	86.6	2880
7200 min Summer	0.925	0.0	88.5	3600

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Cascade Summary of Results for Porous-CP-to-HB01.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	30.036	0.056	0.0	0.8	0.8	0.4	O K
10080 min Summer	30.034	0.054	0.0	0.7	0.7	0.4	O K
15 min Winter	30.288	0.308	0.0	21.7	21.7	12.8	O K
30 min Winter	30.295	0.315	0.0	22.0	22.0	13.4	O K
60 min Winter	30.261	0.281	0.0	20.2	20.2	10.6	O K
120 min Winter	30.200	0.220	0.0	16.0	16.0	6.5	O K
180 min Winter	30.168	0.188	0.0	12.4	12.4	4.8	O K
240 min Winter	30.148	0.168	0.0	10.1	10.1	3.8	O K
360 min Winter	30.123	0.143	0.0	7.4	7.4	2.8	O K
480 min Winter	30.105	0.125	0.0	5.9	5.9	2.1	O K
600 min Winter	30.093	0.113	0.0	5.0	5.0	1.7	O K
720 min Winter	30.086	0.106	0.0	4.3	4.3	1.5	O K
960 min Winter	30.077	0.097	0.0	3.4	3.4	1.3	O K
1440 min Winter	30.067	0.087	0.0	2.5	2.5	1.0	O K
2160 min Winter	30.055	0.075	0.0	1.8	1.8	0.8	O K
2880 min Winter	30.049	0.069	0.0	1.4	1.4	0.6	O K
4320 min Winter	30.041	0.061	0.0	1.0	1.0	0.5	O K
5760 min Winter	30.037	0.057	0.0	0.8	0.8	0.4	O K
7200 min Winter	30.033	0.053	0.0	0.7	0.7	0.4	O K
8640 min Winter	30.031	0.051	0.0	0.6	0.6	0.3	O K
10080 min Winter	30.029	0.049	0.0	0.5	0.5	0.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	0.796	0.0	89.8	4400
10080 min Summer	0.701	0.0	90.6	4984
15 min Winter	99.825	0.0	22.3	13
30 min Winter	65.339	0.0	30.2	22
60 min Winter	40.718	0.0	38.5	38
120 min Winter	24.507	0.0	47.0	68
180 min Winter	17.966	0.0	51.9	98
240 min Winter	14.329	0.0	55.4	128
360 min Winter	10.392	0.0	60.4	188
480 min Winter	8.272	0.0	64.2	248
600 min Winter	6.925	0.0	67.2	308
720 min Winter	5.987	0.0	69.7	368
960 min Winter	4.754	0.0	73.7	482
1440 min Winter	3.431	0.0	79.5	734
2160 min Winter	2.471	0.0	85.3	1100
2880 min Winter	1.956	0.0	89.4	1456
4320 min Winter	1.405	0.0	94.9	2152
5760 min Winter	1.110	0.0	98.5	2896
7200 min Winter	0.925	0.0	100.9	3640
8640 min Winter	0.796	0.0	102.6	4288
10080 min Winter	0.701	0.0	103.9	5072

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Cascade Rainfall Details for Porous-CP-to-HB01.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.100	Shortest Storm (mins)	15
Ratio R	0.407	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.123

Time (mins) From:	To:	Area (ha)
0	4	0.123

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Cascade Model Details for Porous-CP-to-HB01.SRCX

Storage is Online Cover Level (m) 30.590

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	6.0
Membrane Percolation (mm/hr)	1000	Length (m)	115.0
Max Percolation (l/s)	191.7	Slope (1:X)	150.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	29.980	Membrane Depth (m)	0

Pipe Outflow Control

Diameter (m)	0.150	Entry Loss Coefficient	0.500
Slope (1:X)	80.0	Coefficient of Contraction	0.600
Length (m)	10.000	Upstream Invert Level (m)	30.000
Roughness k (mm)	0.600		

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Cascade Summary of Results for Porous-CP-to-HB02.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	Hydrobrake-02.SRCX	(None)

Half Drain Time : 0 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	30.186	0.166	0.0	48.5	48.5	1.3	O K
30 min Summer	30.105	0.085	0.0	47.0	47.0	0.3	O K
60 min Summer	30.020	0.000	0.0	36.3	36.3	0.0	O K
120 min Summer	30.020	0.000	0.0	23.4	23.4	0.0	O K
180 min Summer	30.020	0.000	0.0	17.6	17.6	0.0	O K
240 min Summer	30.020	0.000	0.0	14.1	14.1	0.0	O K
360 min Summer	30.020	0.000	0.0	10.2	10.2	0.0	O K
480 min Summer	30.020	0.000	0.0	8.2	8.2	0.0	O K
600 min Summer	30.020	0.000	0.0	6.8	6.8	0.0	O K
720 min Summer	30.020	0.000	0.0	5.9	5.9	0.0	O K
960 min Summer	30.020	0.000	0.0	4.7	4.7	0.0	O K
1440 min Summer	30.020	0.000	0.0	3.4	3.4	0.0	O K
2160 min Summer	30.020	0.000	0.0	2.4	2.4	0.0	O K
2880 min Summer	30.020	0.000	0.0	1.9	1.9	0.0	O K
4320 min Summer	30.020	0.000	0.0	1.4	1.4	0.0	O K
5760 min Summer	30.020	0.000	0.0	1.1	1.1	0.0	O K
7200 min Summer	30.020	0.000	0.0	0.9	0.9	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	99.825	0.0	19.3	11
30 min Summer	65.339	0.0	26.6	18
60 min Summer	40.718	0.0	33.8	0
120 min Summer	24.507	0.0	41.3	0
180 min Summer	17.966	0.0	45.6	0
240 min Summer	14.329	0.0	48.7	0
360 min Summer	10.392	0.0	53.1	0
480 min Summer	8.272	0.0	56.4	0
600 min Summer	6.925	0.0	59.0	0
720 min Summer	5.987	0.0	61.2	0
960 min Summer	4.754	0.0	64.8	0
1440 min Summer	3.431	0.0	69.8	0
2160 min Summer	2.471	0.0	74.9	0
2880 min Summer	1.956	0.0	78.5	0
4320 min Summer	1.405	0.0	83.3	0
5760 min Summer	1.110	0.0	86.4	0
7200 min Summer	0.925	0.0	88.5	0

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Cascade Summary of Results for Porous-CP-to-HB02.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	30.020	0.000	0.0	0.8	0.8	0.0	O K
10080 min Summer	30.020	0.000	0.0	0.7	0.7	0.0	O K
15 min Winter	30.191	0.171	0.0	48.6	48.6	1.4	O K
30 min Winter	30.020	0.000	0.0	43.9	43.9	0.0	O K
60 min Winter	30.020	0.000	0.0	28.5	28.5	0.0	O K
120 min Winter	30.020	0.000	0.0	17.4	17.4	0.0	O K
180 min Winter	30.020	0.000	0.0	12.8	12.8	0.0	O K
240 min Winter	30.020	0.000	0.0	10.2	10.2	0.0	O K
360 min Winter	30.020	0.000	0.0	7.4	7.4	0.0	O K
480 min Winter	30.020	0.000	0.0	5.9	5.9	0.0	O K
600 min Winter	30.020	0.000	0.0	4.9	4.9	0.0	O K
720 min Winter	30.020	0.000	0.0	4.3	4.3	0.0	O K
960 min Winter	30.020	0.000	0.0	3.4	3.4	0.0	O K
1440 min Winter	30.020	0.000	0.0	2.4	2.4	0.0	O K
2160 min Winter	30.020	0.000	0.0	1.7	1.7	0.0	O K
2880 min Winter	30.020	0.000	0.0	1.4	1.4	0.0	O K
4320 min Winter	30.020	0.000	0.0	1.0	1.0	0.0	O K
5760 min Winter	30.020	0.000	0.0	0.8	0.8	0.0	O K
7200 min Winter	30.020	0.000	0.0	0.6	0.6	0.0	O K
8640 min Winter	30.020	0.000	0.0	0.5	0.5	0.0	O K
10080 min Winter	30.020	0.000	0.0	0.5	0.5	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	0.796	0.0	90.0	0
10080 min Summer	0.701	0.0	91.0	0
15 min Winter	99.825	0.0	22.8	11
30 min Winter	65.339	0.0	30.1	0
60 min Winter	40.718	0.0	38.3	0
120 min Winter	24.507	0.0	46.6	0
180 min Winter	17.966	0.0	51.5	0
240 min Winter	14.329	0.0	54.9	0
360 min Winter	10.392	0.0	59.9	0
480 min Winter	8.272	0.0	63.6	0
600 min Winter	6.925	0.0	66.6	0
720 min Winter	5.987	0.0	69.1	0
960 min Winter	4.754	0.0	73.0	0
1440 min Winter	3.431	0.0	78.8	0
2160 min Winter	2.471	0.0	84.6	0
2880 min Winter	1.956	0.0	88.7	0
4320 min Winter	1.405	0.0	94.4	0
5760 min Winter	1.110	0.0	98.1	0
7200 min Winter	0.925	0.0	100.7	0
8640 min Winter	0.796	0.0	102.6	0
10080 min Winter	0.701	0.0	104.0	0

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Cascade Rainfall Details for Porous-CP-to-HB02.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.100	Shortest Storm (mins)	15
Ratio R	0.407	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.121

Time (mins) From:	To:	Area (ha)
0	4	0.121

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Cascade Model Details for Porous-CP-to-HB02.SRCX

Storage is Online Cover Level (m) 30.630

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	8.0
Membrane Percolation (mm/hr)	1000	Length (m)	76.3
Max Percolation (l/s)	169.6	Slope (1:X)	40.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	30.020	Membrane Depth (m)	0

Pipe Outflow Control

Diameter (m)	0.150	Entry Loss Coefficient	0.500
Slope (1:X)	80.0	Coefficient of Contraction	0.600
Length (m)	10.000	Upstream Invert Level (m)	28.850
Roughness k (mm)	0.600		

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Cascade Summary of Results for BlueRoof-01.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	Hydrobrake-02.SRCX	(None)

Half Drain Time : 190 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	34.659	0.059	0.0	2.0	2.0	62.2	O K
30 min Summer	34.677	0.077	0.0	3.4	3.4	81.4	O K
60 min Summer	34.696	0.096	0.0	5.2	5.2	100.6	O K
120 min Summer	34.713	0.113	0.0	6.5	6.5	117.4	O K
180 min Summer	34.718	0.118	0.0	6.9	6.9	121.0	O K
240 min Summer	34.720	0.120	0.0	7.1	7.1	122.4	O K
360 min Summer	34.722	0.122	0.0	7.3	7.3	123.7	O K
480 min Summer	34.722	0.122	0.0	7.3	7.3	123.6	O K
600 min Summer	34.721	0.121	0.0	7.2	7.2	122.7	O K
720 min Summer	34.719	0.119	0.0	7.0	7.0	121.3	O K
960 min Summer	34.714	0.114	0.0	6.6	6.6	117.8	O K
1440 min Summer	34.705	0.105	0.0	5.9	5.9	110.1	O K
2160 min Summer	34.695	0.095	0.0	5.1	5.1	100.1	O K
2880 min Summer	34.688	0.088	0.0	4.5	4.5	92.5	O K
4320 min Summer	34.679	0.079	0.0	3.6	3.6	82.7	O K
5760 min Summer	34.672	0.072	0.0	2.9	2.9	76.1	O K
7200 min Summer	34.667	0.067	0.0	2.5	2.5	70.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	139.755	0.0	53.1	57
30 min Summer	91.475	0.0	74.9	60
60 min Summer	57.005	0.0	107.3	74
120 min Summer	34.310	0.0	131.9	122
180 min Summer	25.153	0.0	146.3	162
240 min Summer	20.060	0.0	156.3	192
360 min Summer	14.548	0.0	170.9	252
480 min Summer	11.581	0.0	181.8	318
600 min Summer	9.696	0.0	190.4	386
720 min Summer	8.382	0.0	197.5	452
960 min Summer	6.656	0.0	208.7	582
1440 min Summer	4.803	0.0	223.9	838
2160 min Summer	3.460	0.0	250.5	1212
2880 min Summer	2.739	0.0	262.6	1572
4320 min Summer	1.968	0.0	277.5	2296
5760 min Summer	1.555	0.0	298.0	3056
7200 min Summer	1.294	0.0	306.8	3816

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Cascade Summary of Results for BlueRoof-01.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	34.662	0.062	0.0	2.2	2.2	65.6	O K
10080 min Summer	34.659	0.059	0.0	2.0	2.0	61.9	O K
15 min Winter	34.666	0.066	0.0	2.4	2.4	69.8	O K
30 min Winter	34.686	0.086	0.0	4.4	4.4	90.7	O K
60 min Winter	34.707	0.107	0.0	6.1	6.1	112.5	O K
120 min Winter	34.734	0.134	0.0	8.6	8.6	130.3	O K
180 min Winter	34.741	0.141	0.0	9.3	9.3	132.9	O K
240 min Winter	34.743	0.143	0.0	9.6	9.6	133.9	O K
360 min Winter	34.742	0.142	0.0	9.5	9.5	133.5	O K
480 min Winter	34.737	0.137	0.0	8.9	8.9	131.5	O K
600 min Winter	34.732	0.132	0.0	8.4	8.4	129.0	O K
720 min Winter	34.726	0.126	0.0	7.8	7.8	126.3	O K
960 min Winter	34.717	0.117	0.0	6.9	6.9	120.4	O K
1440 min Winter	34.704	0.104	0.0	5.8	5.8	108.9	O K
2160 min Winter	34.691	0.091	0.0	4.8	4.8	95.6	O K
2880 min Winter	34.683	0.083	0.0	4.1	4.1	87.3	O K
4320 min Winter	34.673	0.073	0.0	3.0	3.0	76.9	O K
5760 min Winter	34.666	0.066	0.0	2.4	2.4	69.0	O K
7200 min Winter	34.660	0.060	0.0	2.0	2.0	62.7	O K
8640 min Winter	34.655	0.055	0.0	1.8	1.8	58.1	O K
10080 min Winter	34.652	0.052	0.0	1.6	1.6	54.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.114	0.0	313.0	4504
10080 min Summer	0.981	0.0	316.6	5248
15 min Winter	139.755	0.0	61.5	56
30 min Winter	91.475	0.0	86.3	58
60 min Winter	57.005	0.0	122.0	74
120 min Winter	34.310	0.0	149.6	118
180 min Winter	25.153	0.0	165.7	158
240 min Winter	20.060	0.0	177.0	188
360 min Winter	14.548	0.0	193.3	258
480 min Winter	11.581	0.0	205.6	330
600 min Winter	9.696	0.0	215.3	402
720 min Winter	8.382	0.0	223.4	472
960 min Winter	6.656	0.0	236.1	612
1440 min Winter	4.803	0.0	253.4	878
2160 min Winter	3.460	0.0	282.7	1252
2880 min Winter	2.739	0.0	296.6	1612
4320 min Winter	1.968	0.0	314.1	2352
5760 min Winter	1.555	0.0	336.7	3120
7200 min Winter	1.294	0.0	347.2	3832
8640 min Winter	1.114	0.0	354.7	4584
10080 min Winter	0.981	0.0	359.5	5344

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Cascade Rainfall Details for BlueRoof-01.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.100	Shortest Storm (mins)	15
Ratio R	0.407	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Green Roof

Area (m³)	1107	Evaporation (mm/day)	3
Depression Storage (mm)	5	Decay Coefficient	0.050

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.020116	32	36	0.004061	64	68	0.000820	96	100	0.000166
4	8	0.016470	36	40	0.003325	68	72	0.000671	100	104	0.000136
8	12	0.013484	40	44	0.002722	72	76	0.000550	104	108	0.000111
12	16	0.011040	44	48	0.002229	76	80	0.000450	108	112	0.000091
16	20	0.009039	48	52	0.001825	80	84	0.000368	112	116	0.000074
20	24	0.007400	52	56	0.001494	84	88	0.000302	116	120	0.000061
24	28	0.006059	56	60	0.001223	88	92	0.000247			
28	32	0.004961	60	64	0.001002	92	96	0.000202			

Time Area Diagram

Total Area (ha) 0.176

Time (mins) From:	To:	Area (ha)
0	4	0.176

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Cascade Model Details for BlueRoof-01.SRCX

Storage is Online Cover Level (m) 35.000

Cellular Storage Structure

Invert Level (m) 34.600 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	1107.0	1107.0	1.300	0.0	1127.0
0.100	1107.0	1120.3	1.400	0.0	1127.0
0.200	0.0	1127.0	1.500	0.0	1127.0
0.300	0.0	1127.0	1.600	0.0	1127.0
0.400	0.0	1127.0	1.700	0.0	1127.0
0.500	0.0	1127.0	1.800	0.0	1127.0
0.600	0.0	1127.0	1.900	0.0	1127.0
0.700	0.0	1127.0	2.000	0.0	1127.0
0.800	0.0	1127.0	2.100	0.0	1127.0
0.900	0.0	1127.0	2.200	0.0	1127.0
1.000	0.0	1127.0	2.300	0.0	1127.0
1.100	0.0	1127.0	2.400	0.0	1127.0
1.200	0.0	1127.0	2.500	0.0	1127.0

Pipe Outflow Control

Diameter (m) 0.150 Entry Loss Coefficient 0.500
Slope (1:X) 1.0 Coefficient of Contraction 0.600
Length (m) 3.000 Upstream Invert Level (m) 34.600
Roughness k (mm) 0.600

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Cascade Summary of Results for BlueRoof-02.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	Hydrobrake-02.SRCX	(None)

Half Drain Time : 211 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	34.645	0.045	0.0	0.9	0.9	27.6	O K
30 min Summer	34.659	0.059	0.0	1.7	1.7	36.0	O K
60 min Summer	34.674	0.074	0.0	2.3	2.3	44.8	O K
120 min Summer	34.687	0.087	0.0	3.0	3.0	52.6	O K
180 min Summer	34.690	0.090	0.0	3.1	3.1	54.5	O K
240 min Summer	34.691	0.091	0.0	3.2	3.2	55.1	O K
360 min Summer	34.692	0.092	0.0	3.3	3.3	55.6	O K
480 min Summer	34.692	0.092	0.0	3.3	3.3	55.6	O K
600 min Summer	34.691	0.091	0.0	3.2	3.2	55.2	O K
720 min Summer	34.690	0.090	0.0	3.1	3.1	54.5	O K
960 min Summer	34.687	0.087	0.0	3.0	3.0	52.8	O K
1440 min Summer	34.681	0.081	0.0	2.6	2.6	49.3	O K
2160 min Summer	34.673	0.073	0.0	2.3	2.3	44.6	O K
2880 min Summer	34.667	0.067	0.0	2.0	2.0	40.9	O K
4320 min Summer	34.659	0.059	0.0	1.7	1.7	35.7	O K
5760 min Summer	34.654	0.054	0.0	1.4	1.4	32.7	O K
7200 min Summer	34.650	0.050	0.0	1.2	1.2	30.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	139.755	0.0	24.1	62
30 min Summer	91.475	0.0	34.1	63
60 min Summer	57.005	0.0	48.7	80
120 min Summer	34.310	0.0	59.9	122
180 min Summer	25.153	0.0	66.5	166
240 min Summer	20.060	0.0	71.0	196
360 min Summer	14.548	0.0	77.7	256
480 min Summer	11.581	0.0	82.6	322
600 min Summer	9.696	0.0	86.5	388
720 min Summer	8.382	0.0	89.7	454
960 min Summer	6.656	0.0	94.8	586
1440 min Summer	4.803	0.0	101.7	840
2160 min Summer	3.460	0.0	113.4	1216
2880 min Summer	2.739	0.0	118.8	1584
4320 min Summer	1.968	0.0	125.3	2296
5760 min Summer	1.555	0.0	134.0	3040
7200 min Summer	1.294	0.0	137.6	3752

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Cascade Summary of Results for BlueRoof-02.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	34.647	0.047	0.0	1.0	1.0	28.7	O K
10080 min Summer	34.645	0.045	0.0	0.9	0.9	27.1	O K
15 min Winter	34.651	0.051	0.0	1.2	1.2	30.9	O K
30 min Winter	34.666	0.066	0.0	2.0	2.0	40.3	O K
60 min Winter	34.683	0.083	0.0	2.7	2.7	50.2	O K
120 min Winter	34.697	0.097	0.0	3.6	3.6	58.8	O K
180 min Winter	34.700	0.100	0.0	3.8	3.8	60.8	O K
240 min Winter	34.701	0.101	0.0	3.8	3.8	61.1	O K
360 min Winter	34.700	0.100	0.0	3.8	3.8	61.0	O K
480 min Winter	34.699	0.099	0.0	3.7	3.7	59.9	O K
600 min Winter	34.696	0.096	0.0	3.5	3.5	58.5	O K
720 min Winter	34.694	0.094	0.0	3.4	3.4	57.0	O K
960 min Winter	34.689	0.089	0.0	3.1	3.1	54.1	O K
1440 min Winter	34.680	0.080	0.0	2.6	2.6	48.8	O K
2160 min Winter	34.670	0.070	0.0	2.1	2.1	42.5	O K
2880 min Winter	34.663	0.063	0.0	1.8	1.8	38.0	O K
4320 min Winter	34.654	0.054	0.0	1.4	1.4	32.8	O K
5760 min Winter	34.649	0.049	0.0	1.1	1.1	29.8	O K
7200 min Winter	34.645	0.045	0.0	0.9	0.9	27.5	O K
8640 min Winter	34.642	0.042	0.0	0.8	0.8	25.3	O K
10080 min Winter	34.639	0.039	0.0	0.7	0.7	23.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.114	0.0	140.1	4504
10080 min Summer	0.981	0.0	141.4	5248
15 min Winter	139.755	0.0	28.0	59
30 min Winter	91.475	0.0	39.3	62
60 min Winter	57.005	0.0	55.4	78
120 min Winter	34.310	0.0	68.0	120
180 min Winter	25.153	0.0	75.3	170
240 min Winter	20.060	0.0	80.4	198
360 min Winter	14.548	0.0	87.9	268
480 min Winter	11.581	0.0	93.5	340
600 min Winter	9.696	0.0	97.9	410
720 min Winter	8.382	0.0	101.6	480
960 min Winter	6.656	0.0	107.3	616
1440 min Winter	4.803	0.0	115.2	880
2160 min Winter	3.460	0.0	128.1	1256
2880 min Winter	2.739	0.0	134.3	1616
4320 min Winter	1.968	0.0	142.0	2332
5760 min Winter	1.555	0.0	151.7	3064
7200 min Winter	1.294	0.0	156.1	3888
8640 min Winter	1.114	0.0	159.2	4584
10080 min Winter	0.981	0.0	161.1	5344

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Cascade Rainfall Details for BlueRoof-02.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.100	Shortest Storm (mins)	15
Ratio R	0.407	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Green Roof

Area (m³)	639	Evaporation (mm/day)	3
Depression Storage (mm)	5	Decay Coefficient	0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.011612	32	36	0.002344	64	68	0.000473	96	100	0.000096
4	8	0.009507	36	40	0.001919	68	72	0.000388	100	104	0.000078
8	12	0.007784	40	44	0.001571	72	76	0.000317	104	108	0.000064
12	16	0.006373	44	48	0.001287	76	80	0.000260	108	112	0.000052
16	20	0.005218	48	52	0.001053	80	84	0.000213	112	116	0.000043
20	24	0.004272	52	56	0.000862	84	88	0.000174	116	120	0.000035
24	28	0.003497	56	60	0.000706	88	92	0.000143			
28	32	0.002863	60	64	0.000578	92	96	0.000117			

Time Area Diagram

Total Area (ha) 0.067

Time From:	(mins) To:	Area (ha)
0	4	0.067

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Cascade Model Details for BlueRoof-02.SRCX

Storage is Online Cover Level (m) 35.000

Cellular Storage Structure

Invert Level (m) 34.600 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	639.0	639.0	1.300	0.0	654.2
0.100	639.0	649.1	1.400	0.0	654.2
0.200	0.0	654.2	1.500	0.0	654.2
0.300	0.0	654.2	1.600	0.0	654.2
0.400	0.0	654.2	1.700	0.0	654.2
0.500	0.0	654.2	1.800	0.0	654.2
0.600	0.0	654.2	1.900	0.0	654.2
0.700	0.0	654.2	2.000	0.0	654.2
0.800	0.0	654.2	2.100	0.0	654.2
0.900	0.0	654.2	2.200	0.0	654.2
1.000	0.0	654.2	2.300	0.0	654.2
1.100	0.0	654.2	2.400	0.0	654.2
1.200	0.0	654.2	2.500	0.0	654.2

Pipe Outflow Control

Diameter (m) 0.100 Entry Loss Coefficient 0.500
Slope (1:X) 1.0 Coefficient of Contraction 0.600
Length (m) 3.000 Upstream Invert Level (m) 34.600
Roughness k (mm) 0.600

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Cascade Summary of Results for Hydrobrake-01.srcx

Upstream Structures	Outflow To	Overflow To
Porous-CP-to-HB01.SRCX	Hydrobrake-03.SRCX	(None)

Half Drain Time : 328 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	29.893	0.343	0.0	4.0	4.0	63.5	O K
30 min Summer	30.006	0.456	0.0	4.0	4.0	84.6	O K
60 min Summer	30.113	0.563	0.0	4.0	4.0	104.3	O K
120 min Summer	30.182	0.632	0.0	4.0	4.0	117.1	O K
180 min Summer	30.196	0.646	0.0	4.0	4.0	119.6	O K
240 min Summer	30.188	0.638	0.0	4.0	4.0	118.2	O K
360 min Summer	30.156	0.606	0.0	4.0	4.0	112.2	O K
480 min Summer	30.128	0.578	0.0	4.0	4.0	107.0	O K
600 min Summer	30.103	0.553	0.0	4.0	4.0	102.4	O K
720 min Summer	30.079	0.529	0.0	4.0	4.0	98.0	O K
960 min Summer	30.032	0.482	0.0	4.0	4.0	89.2	O K
1440 min Summer	29.934	0.384	0.0	4.0	4.0	71.2	O K
2160 min Summer	29.792	0.242	0.0	4.0	4.0	44.8	O K
2880 min Summer	29.689	0.139	0.0	4.0	4.0	25.8	O K
4320 min Summer	29.575	0.025	0.0	4.0	4.0	4.7	O K
5760 min Summer	29.550	0.000	0.0	3.7	3.7	0.0	O K
7200 min Summer	29.550	0.000	0.0	3.0	3.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	139.755	0.0	72.4	35
30 min Summer	91.475	0.0	95.9	47
60 min Summer	57.005	0.0	120.4	68
120 min Summer	34.310	0.0	145.7	122
180 min Summer	25.153	0.0	160.5	182
240 min Summer	20.060	0.0	170.6	240
360 min Summer	14.548	0.0	185.7	304
480 min Summer	11.581	0.0	197.5	366
600 min Summer	9.696	0.0	206.3	432
720 min Summer	8.382	0.0	214.3	500
960 min Summer	6.656	0.0	226.5	638
1440 min Summer	4.803	0.0	244.9	912
2160 min Summer	3.460	0.0	264.3	1276
2880 min Summer	2.739	0.0	278.0	1616
4320 min Summer	1.968	0.0	298.4	2252
5760 min Summer	1.555	0.0	312.8	0
7200 min Summer	1.294	0.0	324.0	0

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Cascade Summary of Results for Hydrobrake-01.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	29.550	0.000	0.0	2.6	2.6	0.0	O K
10080 min Summer	29.550	0.000	0.0	2.3	2.3	0.0	O K
15 min Winter	29.941	0.391	0.0	4.0	4.0	72.5	O K
30 min Winter	30.069	0.519	0.0	4.0	4.0	96.1	O K
60 min Winter	30.191	0.641	0.0	4.0	4.0	118.8	O K
120 min Winter	30.281	0.731	0.0	4.0	4.0	135.4	O K
180 min Winter	30.301	0.751	0.0	4.0	4.0	139.2	O K
240 min Winter	30.299	0.749	0.0	4.0	4.0	138.7	O K
360 min Winter	30.267	0.717	0.0	4.0	4.0	132.8	O K
480 min Winter	30.229	0.679	0.0	4.0	4.0	125.9	O K
600 min Winter	30.197	0.647	0.0	4.0	4.0	119.8	O K
720 min Winter	30.163	0.613	0.0	4.0	4.0	113.6	O K
960 min Winter	30.094	0.544	0.0	4.0	4.0	100.8	O K
1440 min Winter	29.949	0.399	0.0	4.0	4.0	73.9	O K
2160 min Winter	29.732	0.182	0.0	4.0	4.0	33.7	O K
2880 min Winter	29.600	0.050	0.0	4.0	4.0	9.3	O K
4320 min Winter	29.550	0.000	0.0	3.3	3.3	0.0	O K
5760 min Winter	29.550	0.000	0.0	2.6	2.6	0.0	O K
7200 min Winter	29.550	0.000	0.0	2.2	2.2	0.0	O K
8640 min Winter	29.550	0.000	0.0	1.9	1.9	0.0	O K
10080 min Winter	29.550	0.000	0.0	1.7	1.7	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.114	0.0	333.0	0
10080 min Summer	0.981	0.0	340.5	0
15 min Winter	139.755	0.0	81.5	37
30 min Winter	91.475	0.0	107.7	49
60 min Winter	57.005	0.0	135.1	70
120 min Winter	34.310	0.0	163.1	120
180 min Winter	25.153	0.0	179.9	178
240 min Winter	20.060	0.0	191.5	234
360 min Winter	14.548	0.0	208.7	338
480 min Winter	11.581	0.0	221.4	384
600 min Winter	9.696	0.0	231.6	462
720 min Winter	8.382	0.0	240.5	540
960 min Winter	6.656	0.0	254.3	694
1440 min Winter	4.803	0.0	275.0	996
2160 min Winter	3.460	0.0	296.6	1336
2880 min Winter	2.739	0.0	312.5	1624
4320 min Winter	1.968	0.0	335.4	0
5760 min Winter	1.555	0.0	351.9	0
7200 min Winter	1.294	0.0	364.6	0
8640 min Winter	1.114	0.0	375.0	0
10080 min Winter	0.981	0.0	383.7	0

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Cascade Rainfall Details for Hydrobrake-01.srcx

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.100	Shortest Storm (mins)	15
Ratio R	0.407	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.167

Time (mins) From:	To:	Area (ha)
0	4	0.167

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Cascade Model Details for Hydrobrake-01.srcx

Storage is Online Cover Level (m) 30.650

Cellular Storage Structure

Invert Level (m) 29.550 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	195.0	195.0	1.300	0.0	242.5
0.100	195.0	200.6	1.400	0.0	242.5
0.200	195.0	206.2	1.500	0.0	242.5
0.300	195.0	211.8	1.600	0.0	242.5
0.400	195.0	217.3	1.700	0.0	242.5
0.500	195.0	222.9	1.800	0.0	242.5
0.600	195.0	228.5	1.900	0.0	242.5
0.700	195.0	234.1	2.000	0.0	242.5
0.800	195.0	239.7	2.100	0.0	242.5
0.900	0.0	242.5	2.200	0.0	242.5
1.000	0.0	242.5	2.300	0.0	242.5
1.100	0.0	242.5	2.400	0.0	242.5
1.200	0.0	242.5	2.500	0.0	242.5

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0095-4000-1000-4000
Design Head (m)	1.000
Design Flow (l/s)	4.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	95
Invert Level (m)	29.310
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	4.0
Flush-Flo™	0.294	4.0
Kick-Flo®	0.629	3.2
Mean Flow over Head Range	-	3.5

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

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Hydro-Brake® Optimum Outflow Control

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.0	1.200	4.3	3.000	6.7	7.000	10.0
0.200	3.9	1.400	4.7	3.500	7.2	7.500	10.3
0.300	4.0	1.600	5.0	4.000	7.6	8.000	10.6
0.400	3.9	1.800	5.3	4.500	8.1	8.500	10.9
0.500	3.8	2.000	5.5	5.000	8.5	9.000	11.2
0.600	3.4	2.200	5.8	5.500	8.9	9.500	11.5
0.800	3.6	2.400	6.0	6.000	9.3		
1.000	4.0	2.600	6.2	6.500	9.6		

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Cascade Summary of Results for Hydrobrake-02.SRCX

Upstream Structures	Outflow To	Overflow To
BlueRoof-01.SRCX BlueRoof-02.SRCX Porous-CP-to-HB02.SRCX	Hydrobrake-03.SRCX	(None)

Half Drain Time : 249 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	29.505	0.155	0.0	8.0	8.0	75.0	O K
30 min Summer	29.549	0.199	0.0	8.0	8.0	96.3	O K
60 min Summer	29.596	0.246	0.0	8.0	8.0	119.2	O K
120 min Summer	29.652	0.302	0.0	8.0	8.0	146.3	O K
180 min Summer	29.685	0.335	0.0	8.0	8.0	162.1	O K
240 min Summer	29.705	0.355	0.0	8.0	8.0	171.8	O K
360 min Summer	29.728	0.378	0.0	8.0	8.0	183.0	O K
480 min Summer	29.739	0.389	0.0	8.0	8.0	188.3	O K
600 min Summer	29.740	0.390	0.0	8.0	8.0	189.0	O K
720 min Summer	29.731	0.381	0.0	8.0	8.0	184.6	O K
960 min Summer	29.708	0.358	0.0	8.0	8.0	173.6	O K
1440 min Summer	29.666	0.316	0.0	8.0	8.0	153.0	O K
2160 min Summer	29.604	0.254	0.0	8.0	8.0	123.1	O K
2880 min Summer	29.545	0.195	0.0	8.0	8.0	94.4	O K
4320 min Summer	29.454	0.104	0.0	7.9	7.9	50.2	O K
5760 min Summer	29.410	0.060	0.0	7.4	7.4	29.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	139.755	0.0	158.0	18
30 min Summer	91.475	0.0	214.9	33
60 min Summer	57.005	0.0	289.3	64
120 min Summer	34.310	0.0	353.2	178
180 min Summer	25.153	0.0	390.4	242
240 min Summer	20.060	0.0	416.5	296
360 min Summer	14.548	0.0	454.1	396
480 min Summer	11.581	0.0	482.8	484
600 min Summer	9.696	0.0	505.5	602
720 min Summer	8.382	0.0	524.7	704
960 min Summer	6.656	0.0	554.6	812
1440 min Summer	4.803	0.0	597.0	1042
2160 min Summer	3.460	0.0	656.7	1404
2880 min Summer	2.739	0.0	689.9	1760
4320 min Summer	1.968	0.0	734.0	2424
5760 min Summer	1.555	0.0	779.4	3080

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Cascade Summary of Results for Hydrobrake-02.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
7200 min Summer	29.393	0.043	0.0	6.4	6.4	20.8	O K
8640 min Summer	29.382	0.032	0.0	5.7	5.7	15.3	O K
10080 min Summer	29.373	0.023	0.0	5.1	5.1	11.3	O K
15 min Winter	29.526	0.176	0.0	8.0	8.0	85.4	O K
30 min Winter	29.579	0.229	0.0	8.0	8.0	111.0	O K
60 min Winter	29.639	0.289	0.0	8.0	8.0	140.1	O K
120 min Winter	29.721	0.371	0.0	8.0	8.0	179.8	O K
180 min Winter	29.771	0.421	0.0	8.0	8.0	204.1	O K
240 min Winter	29.796	0.446	0.0	8.0	8.0	216.2	O K
360 min Winter	29.822	0.472	0.0	8.0	8.0	228.9	O K
480 min Winter	29.834	0.484	0.0	8.0	8.0	234.6	O K
600 min Winter	29.837	0.487	0.0	8.0	8.0	236.1	O K
720 min Winter	29.833	0.483	0.0	8.0	8.0	234.0	O K
960 min Winter	29.806	0.456	0.0	8.0	8.0	221.0	O K
1440 min Winter	29.730	0.380	0.0	8.0	8.0	184.1	O K
2160 min Winter	29.621	0.271	0.0	8.0	8.0	131.4	O K
2880 min Winter	29.524	0.174	0.0	8.0	8.0	84.2	O K
4320 min Winter	29.415	0.065	0.0	7.6	7.6	31.5	O K
5760 min Winter	29.389	0.039	0.0	6.2	6.2	19.0	O K
7200 min Winter	29.375	0.025	0.0	5.2	5.2	12.0	O K
8640 min Winter	29.366	0.016	0.0	4.6	4.6	7.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
7200 min Summer	1.294	0.0	804.8	3816
8640 min Summer	1.114	0.0	823.7	4496
10080 min Summer	0.981	0.0	837.4	5240
15 min Winter	139.755	0.0	180.6	18
30 min Winter	91.475	0.0	245.5	33
60 min Winter	57.005	0.0	327.1	122
120 min Winter	34.310	0.0	398.6	218
180 min Winter	25.153	0.0	440.2	286
240 min Winter	20.060	0.0	469.5	330
360 min Winter	14.548	0.0	512.0	418
480 min Winter	11.581	0.0	544.3	504
600 min Winter	9.696	0.0	569.6	598
720 min Winter	8.382	0.0	591.2	708
960 min Winter	6.656	0.0	625.1	900
1440 min Winter	4.803	0.0	673.2	1132
2160 min Winter	3.460	0.0	739.5	1496
2880 min Winter	2.739	0.0	777.4	1844
4320 min Winter	1.968	0.0	828.1	2420
5760 min Winter	1.555	0.0	879.0	3120
7200 min Winter	1.294	0.0	908.4	3888
8640 min Winter	1.114	0.0	931.0	4568

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Cascade Summary of Results for Hydrobrake-02.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Winter	29.358	0.008	0.0	4.0	4.0	4.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Winter	0.981	0.0	947.7	5248

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Cascade Rainfall Details for Hydrobrake-02.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.100	Shortest Storm (mins)	15
Ratio R	0.407	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.199

Time (mins) From:	To:	Area (ha)
0	4	0.199

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Cascade Model Details for Hydrobrake-02.SRCX

Storage is Online Cover Level (m) 30.630

Cellular Storage Structure

Invert Level (m) 29.350 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	510.0	510.0	1.300	0.0	559.7
0.100	510.0	519.0	1.400	0.0	559.7
0.200	510.0	528.1	1.500	0.0	559.7
0.300	510.0	537.1	1.600	0.0	559.7
0.400	510.0	546.1	1.700	0.0	559.7
0.500	510.0	555.2	1.800	0.0	559.7
0.600	0.0	559.7	1.900	0.0	559.7
0.700	0.0	559.7	2.000	0.0	559.7
0.800	0.0	559.7	2.100	0.0	559.7
0.900	0.0	559.7	2.200	0.0	559.7
1.000	0.0	559.7	2.300	0.0	559.7
1.100	0.0	559.7	2.400	0.0	559.7
1.200	0.0	559.7	2.500	0.0	559.7

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0136-8000-0680-8000
Design Head (m)	0.680
Design Flow (l/s)	8.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	136
Invert Level (m)	29.270
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.680	8.0
Flush-Flo™	0.231	8.0
Kick-Flo®	0.492	6.9
Mean Flow over Head Range	-	6.7

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

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Hydro-Brake® Optimum Outflow Control

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.9	1.200	10.4	3.000	16.1	7.000	24.1
0.200	7.9	1.400	11.2	3.500	17.4	7.500	25.0
0.300	7.9	1.600	12.0	4.000	18.5	8.000	25.8
0.400	7.6	1.800	12.6	4.500	19.6	8.500	26.6
0.500	6.9	2.000	13.3	5.000	20.6	9.000	27.4
0.600	7.5	2.200	13.9	5.500	21.6	9.500	28.1
0.800	8.6	2.400	14.5	6.000	22.5		
1.000	9.6	2.600	15.1	6.500	23.4		

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Cascade Summary of Results for Hydrobrake-03.SRCX

Upstream Structures	Outflow To	Overflow To
Hydrobrake-01.srcx	(None)	(None)
Porous-CP-to-HB01.SRCX		
Hydrobrake-02.SRCX		
BlueRoof-01.SRCX		
BlueRoof-02.SRCX		
Porous-CP-to-HB02.SRCX		

Half Drain Time : 159 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	29.410	0.460	0.0	6.0	6.0	136.3	O K
30 min Summer	29.521	0.571	0.0	9.0	9.0	169.2	O K
60 min Summer	29.555	0.605	0.0	11.4	11.4	179.4	O K
120 min Summer	29.560	0.610	0.0	11.8	11.8	180.8	O K
180 min Summer	29.561	0.611	0.0	11.9	11.9	181.0	O K
240 min Summer	29.561	0.611	0.0	11.9	11.9	181.1	O K
360 min Summer	29.561	0.611	0.0	11.9	11.9	181.1	O K
480 min Summer	29.565	0.615	0.0	12.2	12.2	182.3	O K
600 min Summer	29.566	0.616	0.0	12.3	12.3	182.5	O K
720 min Summer	29.566	0.616	0.0	12.3	12.3	182.7	O K
960 min Summer	29.568	0.618	0.0	12.5	12.5	183.2	O K
1440 min Summer	29.574	0.624	0.0	13.0	13.0	184.8	O K
2160 min Summer	29.583	0.633	0.0	13.8	13.8	187.6	O K
2880 min Summer	29.584	0.634	0.0	13.9	13.9	188.0	O K
4320 min Summer	29.578	0.628	0.0	13.4	13.4	186.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	139.755	0.0	279.6	303
30 min Summer	91.475	0.0	375.1	364
60 min Summer	57.005	0.0	490.0	444
120 min Summer	34.310	0.0	595.5	588
180 min Summer	25.153	0.0	657.0	674
240 min Summer	20.060	0.0	700.2	752
360 min Summer	14.548	0.0	762.6	858
480 min Summer	11.581	0.0	811.0	476
600 min Summer	9.696	0.0	848.3	530
720 min Summer	8.382	0.0	880.6	588
960 min Summer	6.656	0.0	931.3	694
1440 min Summer	4.803	0.0	1004.2	924
2160 min Summer	3.460	0.0	1096.6	1300
2880 min Summer	2.739	0.0	1153.4	1696
4320 min Summer	1.968	0.0	1232.0	2400

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Cascade Summary of Results for Hydrobrake-03.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
5760 min Summer	29.551	0.601	0.0	11.0	11.0	178.1	O K
7200 min Summer	29.522	0.572	0.0	9.1	9.1	169.4	O K
8640 min Summer	29.490	0.540	0.0	7.0	7.0	160.1	O K
10080 min Summer	29.400	0.450	0.0	6.0	6.0	133.5	O K
15 min Winter	29.475	0.525	0.0	6.4	6.4	155.5	O K
30 min Winter	29.544	0.594	0.0	10.6	10.6	176.2	O K
60 min Winter	29.559	0.609	0.0	11.7	11.7	180.5	O K
120 min Winter	29.561	0.611	0.0	11.9	11.9	181.0	O K
180 min Winter	29.561	0.611	0.0	11.9	11.9	181.1	O K
240 min Winter	29.561	0.611	0.0	11.9	11.9	181.1	O K
360 min Winter	29.573	0.623	0.0	12.9	12.9	184.6	O K
480 min Winter	29.576	0.626	0.0	13.2	13.2	185.6	O K
600 min Winter	29.583	0.633	0.0	13.8	13.8	187.6	O K
720 min Winter	29.587	0.637	0.0	14.2	14.2	188.8	O K
960 min Winter	29.590	0.640	0.0	14.5	14.5	189.8	O K
1440 min Winter	29.593	0.643	0.0	14.7	14.7	190.6	O K
2160 min Winter	29.594	0.644	0.0	14.8	14.8	190.8	O K
2880 min Winter	29.590	0.640	0.0	14.5	14.5	189.7	O K
4320 min Winter	29.567	0.617	0.0	12.4	12.4	182.8	O K
5760 min Winter	29.532	0.582	0.0	9.8	9.8	172.5	O K
7200 min Winter	29.499	0.549	0.0	7.5	7.5	162.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
5760 min Summer	1.555	0.0	1302.0	3200
7200 min Summer	1.294	0.0	1347.6	4024
8640 min Summer	1.114	0.0	1382.9	4928
10080 min Summer	0.981	0.0	1409.6	5840
15 min Winter	139.755	0.0	317.0	351
30 min Winter	91.475	0.0	425.3	389
60 min Winter	57.005	0.0	551.8	522
120 min Winter	34.310	0.0	669.8	694
180 min Winter	25.153	0.0	739.1	804
240 min Winter	20.060	0.0	787.6	864
360 min Winter	14.548	0.0	858.2	348
480 min Winter	11.581	0.0	911.6	442
600 min Winter	9.696	0.0	954.0	444
720 min Winter	8.382	0.0	990.4	510
960 min Winter	6.656	0.0	1047.5	644
1440 min Winter	4.803	0.0	1130.3	890
2160 min Winter	3.460	0.0	1232.7	1276
2880 min Winter	2.739	0.0	1297.6	1664
4320 min Winter	1.968	0.0	1387.1	2424
5760 min Winter	1.555	0.0	1466.9	3280
7200 min Winter	1.294	0.0	1518.2	4256

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Cascade Summary of Results for Hydrobrake-03.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Winter	29.373	0.423	0.0	6.0	6.0	125.3	O K
10080 min Winter	29.104	0.154	0.0	6.0	6.0	45.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Winter	1.114	0.0	1558.8	5360
10080 min Winter	0.981	0.0	1591.4	5816

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Cascade Rainfall Details for Hydrobrake-03.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.100	Shortest Storm (mins)	15
Ratio R	0.407	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.188

Time (mins) From:	To:	Area (ha)
0	4	0.188

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Cascade Model Details for Hydrobrake-03.SRCX

Storage is Online Cover Level (m) 30.550

Cellular Storage Structure

Invert Level (m) 28.950 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	312.0	312.0	1.300	0.0	372.1
0.100	312.0	319.1	1.400	0.0	372.1
0.200	312.0	326.1	1.500	0.0	372.1
0.300	312.0	333.2	1.600	0.0	372.1
0.400	312.0	340.3	1.700	0.0	372.1
0.500	312.0	347.3	1.800	0.0	372.1
0.600	312.0	354.4	1.900	0.0	372.1
0.700	312.0	361.5	2.000	0.0	372.1
0.800	312.0	368.5	2.100	0.0	372.1
0.900	0.0	372.1	2.200	0.0	372.1
1.000	0.0	372.1	2.300	0.0	372.1
1.100	0.0	372.1	2.400	0.0	372.1
1.200	0.0	372.1	2.500	0.0	372.1

Complex Outflow Control

Hydro-Brake® Optimum

Unit Reference	MD-SHE-0121-6000-0600-6000
Design Head (m)	0.600
Design Flow (l/s)	6.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	121
Invert Level (m)	28.850
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.600	6.0
Flush-Flo™	0.202	6.0
Kick-Flo®	0.435	5.2
Mean Flow over Head Range	-	5.0

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

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Hydro-Brake® Optimum

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.3	1.200	8.3	3.000	12.8	7.000	19.2
0.200	6.0	1.400	8.9	3.500	13.8	7.500	19.9
0.300	5.9	1.600	9.5	4.000	14.7	8.000	20.5
0.400	5.5	1.800	10.0	4.500	15.5	8.500	21.1
0.500	5.5	2.000	10.6	5.000	16.3	9.000	21.8
0.600	6.0	2.200	11.0	5.500	17.1	9.500	22.4
0.800	6.9	2.400	11.5	6.000	17.8		
1.000	7.6	2.600	12.0	6.500	18.5		

Orifice

Diameter (m) 0.125 Discharge Coefficient 0.600 Invert Level (m) 29.450

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Cascade Summary of Results for Porous-CP-to-HB01.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	Hydrobrake-01.srcx	(None)

Half Drain Time : 10 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	30.344	0.364	0.0	23.9	23.9	17.9	O K
30 min Summer	30.363	0.383	0.0	24.6	24.6	19.8	O K
60 min Summer	30.345	0.365	0.0	23.9	23.9	18.0	O K
120 min Summer	30.287	0.307	0.0	21.6	21.6	12.7	O K
180 min Summer	30.243	0.263	0.0	19.2	19.2	9.3	O K
240 min Summer	30.212	0.232	0.0	17.2	17.2	7.3	O K
360 min Summer	30.178	0.198	0.0	13.4	13.4	5.3	O K
480 min Summer	30.157	0.177	0.0	11.1	11.1	4.2	O K
600 min Summer	30.142	0.162	0.0	9.4	9.4	3.5	O K
720 min Summer	30.131	0.151	0.0	8.2	8.2	3.1	O K
960 min Summer	30.114	0.134	0.0	6.6	6.6	2.4	O K
1440 min Summer	30.091	0.111	0.0	4.8	4.8	1.7	O K
2160 min Summer	30.077	0.097	0.0	3.4	3.4	1.3	O K
2880 min Summer	30.071	0.091	0.0	2.8	2.8	1.1	O K
4320 min Summer	30.059	0.079	0.0	2.0	2.0	0.8	O K
5760 min Summer	30.052	0.072	0.0	1.6	1.6	0.7	O K
7200 min Summer	30.047	0.067	0.0	1.3	1.3	0.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	139.755	0.0	28.7	13
30 min Summer	91.475	0.0	38.6	22
60 min Summer	57.005	0.0	49.0	38
120 min Summer	34.310	0.0	59.6	68
180 min Summer	25.153	0.0	65.8	98
240 min Summer	20.060	0.0	70.2	128
360 min Summer	14.548	0.0	76.5	188
480 min Summer	11.581	0.0	81.3	246
600 min Summer	9.696	0.0	85.1	308
720 min Summer	8.382	0.0	88.2	368
960 min Summer	6.656	0.0	93.4	490
1440 min Summer	4.803	0.0	100.8	734
2160 min Summer	3.460	0.0	108.3	1100
2880 min Summer	2.739	0.0	113.6	1456
4320 min Summer	1.968	0.0	121.0	2188
5760 min Summer	1.555	0.0	125.9	2904
7200 min Summer	1.294	0.0	129.4	3608

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Cascade Summary of Results for Porous-CP-to-HB01.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	30.044	0.064	0.0	1.1	1.1	0.5	O K
10080 min Summer	30.041	0.061	0.0	1.0	1.0	0.5	O K
15 min Winter	30.369	0.389	0.0	24.8	24.8	20.4	O K
30 min Winter	30.381	0.401	0.0	25.2	25.2	21.7	O K
60 min Winter	30.346	0.366	0.0	23.9	23.9	18.1	O K
120 min Winter	30.262	0.282	0.0	20.3	20.3	10.8	O K
180 min Winter	30.210	0.230	0.0	17.0	17.0	7.1	O K
240 min Winter	30.183	0.203	0.0	14.0	14.0	5.6	O K
360 min Winter	30.150	0.170	0.0	10.3	10.3	3.9	O K
480 min Winter	30.131	0.151	0.0	8.3	8.3	3.1	O K
600 min Winter	30.119	0.139	0.0	7.0	7.0	2.6	O K
720 min Winter	30.107	0.127	0.0	6.0	6.0	2.2	O K
960 min Winter	30.091	0.111	0.0	4.8	4.8	1.7	O K
1440 min Winter	30.078	0.098	0.0	3.5	3.5	1.3	O K
2160 min Winter	30.067	0.087	0.0	2.5	2.5	1.0	O K
2880 min Winter	30.059	0.079	0.0	2.0	2.0	0.8	O K
4320 min Winter	30.049	0.069	0.0	1.4	1.4	0.6	O K
5760 min Winter	30.044	0.064	0.0	1.1	1.1	0.5	O K
7200 min Winter	30.040	0.060	0.0	0.9	0.9	0.5	O K
8640 min Winter	30.037	0.057	0.0	0.8	0.8	0.4	O K
10080 min Winter	30.034	0.054	0.0	0.7	0.7	0.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.114	0.0	132.1	4384
10080 min Summer	0.981	0.0	134.0	5088
15 min Winter	139.755	0.0	32.6	14
30 min Winter	91.475	0.0	43.7	23
60 min Winter	57.005	0.0	55.3	40
120 min Winter	34.310	0.0	67.2	70
180 min Winter	25.153	0.0	74.2	98
240 min Winter	20.060	0.0	79.1	128
360 min Winter	14.548	0.0	86.2	188
480 min Winter	11.581	0.0	91.5	248
600 min Winter	9.696	0.0	95.8	308
720 min Winter	8.382	0.0	99.4	368
960 min Winter	6.656	0.0	105.1	488
1440 min Winter	4.803	0.0	113.5	722
2160 min Winter	3.460	0.0	122.1	1084
2880 min Winter	2.739	0.0	128.2	1424
4320 min Winter	1.968	0.0	136.7	2200
5760 min Winter	1.555	0.0	142.5	2808
7200 min Winter	1.294	0.0	146.7	3560
8640 min Winter	1.114	0.0	150.0	4368
10080 min Winter	0.981	0.0	152.5	5120

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Cascade Rainfall Details for Porous-CP-to-HB01.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.100	Shortest Storm (mins)	15
Ratio R	0.407	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.123

Time (mins) From:	To:	Area (ha)
0	4	0.123

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Cascade Model Details for Porous-CP-to-HB01.SRCX

Storage is Online Cover Level (m) 30.590

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	6.0
Membrane Percolation (mm/hr)	1000	Length (m)	115.0
Max Percolation (l/s)	191.7	Slope (1:X)	150.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	29.980	Membrane Depth (m)	0

Pipe Outflow Control

Diameter (m)	0.150	Entry Loss Coefficient	0.500
Slope (1:X)	80.0	Coefficient of Contraction	0.600
Length (m)	10.000	Upstream Invert Level (m)	30.000
Roughness k (mm)	0.600		

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Cascade Summary of Results for Porous-CP-to-HB02.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	Hydrobrake-02.SRCX	(None)

Half Drain Time : 1 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	30.360	0.340	0.0	51.6	51.6	5.5	O K
30 min Summer	30.308	0.288	0.0	50.7	50.7	4.0	O K
60 min Summer	30.102	0.082	0.0	46.9	46.9	0.3	O K
120 min Summer	30.020	0.000	0.0	32.7	32.7	0.0	O K
180 min Summer	30.020	0.000	0.0	24.6	24.6	0.0	O K
240 min Summer	30.020	0.000	0.0	19.8	19.8	0.0	O K
360 min Summer	30.020	0.000	0.0	14.4	14.4	0.0	O K
480 min Summer	30.020	0.000	0.0	11.4	11.4	0.0	O K
600 min Summer	30.020	0.000	0.0	9.6	9.6	0.0	O K
720 min Summer	30.020	0.000	0.0	8.3	8.3	0.0	O K
960 min Summer	30.020	0.000	0.0	6.6	6.6	0.0	O K
1440 min Summer	30.020	0.000	0.0	4.7	4.7	0.0	O K
2160 min Summer	30.020	0.000	0.0	3.4	3.4	0.0	O K
2880 min Summer	30.020	0.000	0.0	2.7	2.7	0.0	O K
4320 min Summer	30.020	0.000	0.0	1.9	1.9	0.0	O K
5760 min Summer	30.020	0.000	0.0	1.5	1.5	0.0	O K
7200 min Summer	30.020	0.000	0.0	1.3	1.3	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	139.755	0.0	29.0	12
30 min Summer	91.475	0.0	37.9	19
60 min Summer	57.005	0.0	48.4	34
120 min Summer	34.310	0.0	59.1	0
180 min Summer	25.153	0.0	65.2	0
240 min Summer	20.060	0.0	69.5	0
360 min Summer	14.548	0.0	75.7	0
480 min Summer	11.581	0.0	80.4	0
600 min Summer	9.696	0.0	84.2	0
720 min Summer	8.382	0.0	87.3	0
960 min Summer	6.656	0.0	92.4	0
1440 min Summer	4.803	0.0	99.7	0
2160 min Summer	3.460	0.0	107.2	0
2880 min Summer	2.739	0.0	112.6	0
4320 min Summer	1.968	0.0	120.0	0
5760 min Summer	1.555	0.0	125.1	0
7200 min Summer	1.294	0.0	128.8	0

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Cascade Summary of Results for Porous-CP-to-HB02.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	30.020	0.000	0.0	1.1	1.1	0.0	O K
10080 min Summer	30.020	0.000	0.0	0.9	0.9	0.0	O K
15 min Winter	30.380	0.360	0.0	52.0	52.0	6.2	O K
30 min Winter	30.259	0.239	0.0	49.9	49.9	2.7	O K
60 min Winter	30.020	0.000	0.0	39.9	39.9	0.0	O K
120 min Winter	30.020	0.000	0.0	24.3	24.3	0.0	O K
180 min Winter	30.020	0.000	0.0	17.9	17.9	0.0	O K
240 min Winter	30.020	0.000	0.0	14.3	14.3	0.0	O K
360 min Winter	30.020	0.000	0.0	10.4	10.4	0.0	O K
480 min Winter	30.020	0.000	0.0	8.2	8.2	0.0	O K
600 min Winter	30.020	0.000	0.0	6.9	6.9	0.0	O K
720 min Winter	30.020	0.000	0.0	6.0	6.0	0.0	O K
960 min Winter	30.020	0.000	0.0	4.7	4.7	0.0	O K
1440 min Winter	30.020	0.000	0.0	3.4	3.4	0.0	O K
2160 min Winter	30.020	0.000	0.0	2.4	2.4	0.0	O K
2880 min Winter	30.020	0.000	0.0	1.9	1.9	0.0	O K
4320 min Winter	30.020	0.000	0.0	1.4	1.4	0.0	O K
5760 min Winter	30.020	0.000	0.0	1.1	1.1	0.0	O K
7200 min Winter	30.020	0.000	0.0	0.9	0.9	0.0	O K
8640 min Winter	30.020	0.000	0.0	0.8	0.8	0.0	O K
10080 min Winter	30.020	0.000	0.0	0.7	0.7	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.114	0.0	131.5	0
10080 min Summer	0.981	0.0	133.7	0
15 min Winter	139.755	0.0	32.9	12
30 min Winter	91.475	0.0	43.7	20
60 min Winter	57.005	0.0	54.8	0
120 min Winter	34.310	0.0	66.5	0
180 min Winter	25.153	0.0	73.4	0
240 min Winter	20.060	0.0	78.2	0
360 min Winter	14.548	0.0	85.2	0
480 min Winter	11.581	0.0	90.5	0
600 min Winter	9.696	0.0	94.7	0
720 min Winter	8.382	0.0	98.3	0
960 min Winter	6.656	0.0	104.0	0
1440 min Winter	4.803	0.0	112.3	0
2160 min Winter	3.460	0.0	120.8	0
2880 min Winter	2.739	0.0	126.9	0
4320 min Winter	1.968	0.0	135.5	0
5760 min Winter	1.555	0.0	141.4	0
7200 min Winter	1.294	0.0	145.7	0
8640 min Winter	1.114	0.0	149.1	0
10080 min Winter	0.981	0.0	151.8	0

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Cascade Rainfall Details for Porous-CP-to-HB02.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.100	Shortest Storm (mins)	15
Ratio R	0.407	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.121

Time (mins) From:	To:	Area (ha)
0	4	0.121

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Cascade Model Details for Porous-CP-to-HB02.SRCX

Storage is Online Cover Level (m) 30.630

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	8.0
Membrane Percolation (mm/hr)	1000	Length (m)	76.3
Max Percolation (l/s)	169.6	Slope (1:X)	40.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	30.020	Membrane Depth (m)	0

Pipe Outflow Control

Diameter (m)	0.150	Entry Loss Coefficient	0.500
Slope (1:X)	80.0	Coefficient of Contraction	0.600
Length (m)	10.000	Upstream Invert Level (m)	28.850
Roughness k (mm)	0.600		

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Appendix C – Maintenance and Management Requirements

The Management Company

The responsibility for maintenance of all elements of the development remain with Fairview until handed over to the Management Company.

Handover of external works to the Management Company coincides with completion of the final residential unit.

The Management Company employs a specialist Managing Agent to manage the development which includes all aspects of maintenance.

The Management Company BI registered No. ***'tbc'*** *was incorporated in* ***'tbc'*** *and its directors are currently made up of Fairview representatives plus an appointment from the Managing Agent.*

The Managing Agents are ***'tbc'*** *who have over* ***'tbc'*** *years' experience in the industry.*

At handover the Management Company and Managing Agent receive as built information together with operating and maintenance manuals which detail all maintenance protocols.

Approximately 1 year following completion of the final unit the residents will be invited to elect members to become directors of the Management Company, the Fairview appointed directors at that time resign from the Management Company to be replaced by the elected representatives of the residents.

To ensure continuity and a full understanding of the development and the operation and maintenance of its various components the representative of the Managing Agent remains as a director of the Management Company and the appointment of the Managing Agents is fixed for a minimum period of two years following the date of resignation of the last Fairview director.

After that two year period the Management Company have the right to re-tender the Managing Agent services but it is very rare that a change is made as our original appointments provide an excellent service.

Within the first two years from the final unit completion on the development the residents have two ways in which they can report any defects and problems which would include flooding and that is either to our Aftersales department or to the Managing Agents, the residents are issued with telephone numbers for both which include out of hours emergency response.

After two years our Aftersales contacts are normally replaced by members of the Management Company. The residents therefore have the ability to contact them or the Managing Agents which then remains through the life of the development.

Attenuation (and surface water drainage system generally)

The principle means of surface water disposal from the development is by way of shallow infiltration and cellular attenuation. The latter of these take the form of buried crate-based storage system.

The Management Company will ensure that the following measures are undertaken to ensure the longevity of the surface water drainage system;

Quarterly

i) Inspect the performance of the attenuation system by lifting the cover of the chamber(s) immediately upstream of each feature and check that the outlet pipe (into the crates) is free of obstruction and visible (ie not submerged). If the outlet pipe is submerged then remedial action may be required. Remedial advice to be sought from a suitably qualified consulting infrastructure engineer.

Every 6 months

i) Remove silt build up from *all* catchpits and road gullies.

Annually

i) Select approx. 20% of the development's surface water inspection chambers (situated in accessible non-private areas) and inspect for blockages / silt build up. Remove silt and debris. Rotate on a 5 yearly cycle to cover all such chambers over this period.

Every 2-5 years (depending on outcome of aforementioned inspections)

i) Commission a CCTV survey and report on condition of the surface water piped drainage system upstream of the soakaways to check for structural integrity and hydraulic fluidity. Carry out promptly any remedial work as advised by CCTV company.

Permeable Paving

The access road and external parking areas are to be constructed in permeable block paving in order to;

a) Delay the surface water runoff from these areas, and adjacent driveways, into the ground below, and
b) Enhance the quality of the rainwater percolating through the surface before discharging into the drainage system.

The Freeholders and Management Company will ensure that the following measures are undertaken to ensure the longevity of the pervious pavement;

Quarterly

i) Inspect the pervious pavement for signs of ponding and ensure there is no migration of soils from adjacent landscaped areas or other deleterious material that may prematurely clog up the jointing stone situated in the gaps between the blocks. Ideally this type of inspection should be undertaken immediately following a heavy rainfall event.

ii) Commission vacuum sweeping and brushing of the pervious pavement to ensure joints are kept free of silt. Minimum 3 sweeping per year, thus;
   a) End of Winter (April) – to collect winter debris
   b) Mid-Summer (July/August) – to collect dust, flower and grass-type deposits.
   c) After Autumn leaf fall (November)

The company commissioned to carry out this work should ensure that their vacuum equipment is adjusted accordingly to avoid removal of jointing material. Any lost material should be replaced promptly to avoid the blocks from being dislodged.

Last Resort Remedial Action

i) Should a portion of the pervious pavement become substantially impervious due to excessive siltation, the following procedure should be followed;

   a) Lift block paving and laying course
   b) Break out underlying bitmac base layer and replace with similar compacted depth of course aggregate subbase material to BS EN 13242:2002 Type 4/20, wrapped in geotextile as Terram 1000 or similar.
   c) Renew laying course, replace blocks and renew jointing material

NB. Material removed from the voids or the layers below the surface may contain heavy metals and hydrocarbons and as such may need to be disposed of as 'controlled waste'. Sediment testing should be carried out before disposal to confirm its classification and appropriate disposal methods.

Blue Roofs

Landscaped Podium decks incorporate a Blue Roof system which comprises void formers and outlets in addition to the water-proofing layers and soil/planting zones. They are provided in order to;

a) Collect and delay the surface water runoff from these areas and adjacent rainwater pipes, into the drainage system below.
c) Enhance the quality of the rainwater percolating through the surface before discharging into the drainage system below.

The Freeholders and Management Company will ensure that the following measures are undertaken to ensure the longevity of the Blue Roof system;

1. Following any significant storm event, the outlets should be visually inspected to ensure no blockage has occurred.

2. Following any significant traffic or remedial works that take place on or around the roof, each of the outlets should be visually inspected to ensure all drainage holes are clear and free draining.

3. Quarterly each outlet, should be inspected and cleared of any build up or debris. All leaf litter mainly during an autumnal visit, should be removed from the roof surface. Debris must be removed from the roof and not simply flushed down rainwater pipes.

It is also recommend during maintenance visits to visually inspect the waterproofing system at all upstands, to ensure it is firmly adhered to the detail that it is waterproofing.