

Leanne Richardson
Planning Development Service
Havant Borough Council
Public Service Plaza,
Civic Centre Road
Havant, Hants
PO9 2AX

MJA Ref: SS/23:0133/6430
HCC Ref: SWM/2021/0660
Email: stewarts@mjaconsulting.co.uk

19th January 2023

Dear Leanne,

Outline planning application for up to 43 dwellings, with access from Lower Road and associated landscaping, open space and allotments, and all other matters reserved at Land south of, Lower Road, and west of Old Manor Farm, Havant. APP/21/01071

We refer to the LLFA's comments in regards to the planning application for the above scheme. This letter considers the drainage related comments made on the 1st December 2022. For convenience, the responses are set out below, in the same order as the comments were made, while the corresponding responses are shown in bold text.

LLFA's Comment:

The infiltration rate calculated in GE20814/WP02/220518 is accompanied by a disclaimer stating that testing by other methods in equivalent ground conditions did not achieve suitable results, showing that the rate of infiltration at this location is not uniform or consistent. The rate itself is described as estimated and preliminary in the report.

MJA's Response: We cannot find this disclaimer. The infiltration potential is significant across a large area of the site. In its greenfield state the site does not flood any adjacent land and ultimately runoff soaks away through the topsoil onsite despite the failed test results and within an observed time frame slightly greater than 24 hours. Therefore, in reality, infiltration will occur within the proposed swales, ringed soakaway and basin, though these features have been modelled with zero infiltration to simulate the worst-case scenario. Furthermore, the ground conditions are very similar to the scheme to the east which was approved by the LLFA.

LLFA's Comment:

It is stated that storage is available in the wider system for several 1 in 10 year events. This should not be necessary and suggests that there may be a problem with the design.

MJA's Response: Could you let us know where this is stated please? This may be a poorly worded sentence. The design is modelled and works without the inclusion of the volume of the pipe network and ringed soakaway. These features provide storage over and above the storage within the basin which is sized for the 1 in 100 year +40% event in accordance with NPPF. The basin has storage for two 1 in 10 year events.



LLFA's Comment:

As the boreholes are surcharged for much of the effective depth, the method of modelling them in Micro Drainage (essentially stacking them above each other) does not seem to be an appropriate method. The modelling should possibly take account of the number of boreholes and the surface area of the cross sections, as this may be the only interface for the surface water when groundwater levels are at their highest.

MJA's Response: The boreholes have now been modelled as a cascade system of 25m each. Micro-drainage modelling includes the cross-section and surface area of the 300mm diameter bores. The proposed drainage strategy is an appropriate method.

LLFA's Comment:

It is not clear how the driving head or presence of groundwater is modelled in the calculations. As stated above, it is anticipated that infiltration rates are not a constant variable, and that the full capacity of the boreholes will not be available for storage.

MJA's Response: The calculations have been updated to account for a variable infiltration rate.

LLFA's Comment:

It is not clear whether a falling head test into saturated chalk can effectively demonstrate the effect of the design storm draining to saturated chalk, because of the significant difference in water volume.

MJA's Response: Please see the attached email 'GESL Statement - Manor Farm, Bedhampton Phase 2' from Gavin Roberts at GESL who undertook the ground investigations on site. He points out the infiltration rates observed reflect the saturated condition of the ground and are acceptable to use within the design.

LLFA's Comment:

There is a risk that the effectiveness of the proposed deep bore soakaways may only be proven after they have been completed, which may result in additional deep bore soakaways being required after completion.

MJA's Response: In its greenfield state the site does not flood any adjacent land and ultimately runoff soaks away through the topsoil onsite despite the failed test results and within an observed time frame slightly greater than 24 hours. Therefore, in reality, infiltration will occur within the proposed swales, ringed soakaway and basin though these features have been modelled with zero infiltration to simulate the worst-case scenario. Although the modelled design relies solely on the functionality of the boreholes, the real-world system provides much greater opportunity for infiltration. Furthermore, the ground conditions are very similar to the scheme to the east which was approved by the LLFA.

LLFA's Comment:

The EA's approval relates to the principle of discharging surface water of an appropriate quality to the aquifer, rather than the effectiveness of the design for disposing of surface water for the design storm. In separate correspondence between ourselves and the EA, they have questioned the value of the additional capacity provided by boreholes in saturated ground. We would really appreciate clarification on these points, as we are still not confident that the proposals will be suitable.

MJA's Response: The EA were aware of the full design details on Phase 1 that utilised the same drainage strategy into saturated ground and approved the discharge. Please see attached response from the Environment Agency where their only request was a syphon head arrangement. The boreholes do not provide storage and are for discharge purposes only. There is therefore sufficient certainty that the proposals will be suitable.



Appendix

- a. 6430-001_P5 Drainage Strategy
- b. Phase 2 Bedhampton SW Calculations 100 year 18.01.23
- c. Attenuation Basin 1 in 10 year No Infiltration
- d. GESL Statement - Manor Farm, Bedhampton Phase 2
- e. EA Correspondence RE 22863 Manor Farm, Bedhampton

I trust that the above and enclosed provides you with sufficient information for your purposes. If you need any more details, please do not hesitate to contact us.

Yours sincerely,



Stewart Smith
Drainage Engineer
FOR MJA CONSULTING



Appendix A: 6430-001_P5 Drainage Strategy





KEY:

- Proposed Adoptable Sewers:
- Foul sewer
 - Storm sewer
 - Highway Gully
- Proposed Private Drainage:
- Foul drain
 - Storm drain
 - Rodding eye
 - Yard gully

All private inspection chambers shall be polypropylene non-access chambers in accordance with The Building Regulations, Part H.

Chamber sizes:
Depth to invert <0.6m DN300
Depth to invert >0.6m DN475

Invert levels shown thus: F10.00 S10.00
Indicative finished floor levels: FFL 10.00

Exceedance Flow Path
Network catchment areas are also shown in various colours.

P5	17.01.23	Updated borehole depths to 25m.	SS
P4	31.10.22	Updated drainage strategy.	KTG
P3	21.06.22	Updated drainage strategy.	SS
P2	16.06.22	Updated drainage strategy.	SS
P1	24.09.21	First Issue	SS
REV. No.	DATE	DESCRIPTION	INITIALS

Client

BARGATE HOMES

MJA CONSULTING
CIVIL & STRUCTURAL ENGINEERS

Ipsium Court, 24 The Quadrant,
Abingdon Science Park,
Oxon, OX14 3YS
Tel: 01235 555173
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Project

Land west of
Old Manor Farm

Title

Proposed drainage
strategy

Scale

1:500@A1

Date

Mar'21

Drawing No.

6430:001

Rev

P5

Appendix B: Phase 2 Bedhampton SW Calculations 100 year 18.01.23



MJA Consulting		Page 2					
Monarch House Barton Lane OX14 3NB		Phase 2 Manor Farm Bedhampton Pond + Boreholes					
Date 17/01/2023 File Cascade.CASX		Designed by S.Smith Checked by					
Innovyze		Source Control 2020.1					
Cascade Summary of Results for Pond.SRCX							
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	6.624	1.224	0.0	0.7	0.7	759.8	0 K
10080 min Summer	6.617	1.217	0.0	0.7	0.7	749.3	0 K
15 min Winter	6.145	0.745	0.0	0.5	0.5	207.0	0 K
30 min Winter	6.234	0.834	0.0	0.6	0.6	278.2	0 K
60 min Winter	6.316	0.916	0.0	0.6	0.6	356.4	0 K
120 min Winter	6.392	0.992	0.0	0.6	0.6	439.9	0 K
180 min Winter	6.432	1.032	0.0	0.6	0.6	489.4	0 K
240 min Winter	6.459	1.059	0.0	0.6	0.6	523.5	0 K
360 min Winter	6.498	1.098	0.0	0.6	0.6	574.6	0 K
480 min Winter	6.525	1.125	0.0	0.7	0.7	612.5	0 K
600 min Winter	6.546	1.146	0.0	0.7	0.7	642.3	0 K
720 min Winter	6.563	1.163	0.0	0.7	0.7	667.0	0 K
960 min Winter	6.589	1.189	0.0	0.7	0.7	705.9	0 K
1440 min Winter	6.624	1.224	0.0	0.7	0.7	759.8	0 K
2160 min Winter	6.655	1.255	0.0	0.7	0.7	810.1	0 K
2880 min Winter	6.674	1.274	0.0	0.7	0.7	841.5	0 K
4320 min Winter	6.695	1.295	0.0	0.7	0.7	875.6	0 K
5760 min Winter	6.702	1.302	0.0	0.7	0.7	889.0	Flood Risk
7200 min Winter	6.704	1.304	0.0	0.7	0.7	891.3	Flood Risk
8640 min Winter	6.702	1.302	0.0	0.7	0.7	888.1	Flood Risk
10080 min Winter	6.697	1.297	0.0	0.7	0.7	880.1	0 K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)			
8640 min Summer	1.255	0.0	410.2	8400			
10080 min Summer	1.111	0.0	400.9	8984			
15 min Winter	127.517	0.0	46.2	47			
30 min Winter	85.701	0.0	48.6	61			
60 min Winter	54.957	0.0	100.5	90			
120 min Winter	34.010	0.0	104.2	148			
180 min Winter	25.295	0.0	105.9	208			
240 min Winter	20.351	0.0	106.9	266			
360 min Winter	14.971	0.0	108.0	384			
480 min Winter	12.028	0.0	108.6	500			
600 min Winter	10.141	0.0	108.8	618			
720 min Winter	8.817	0.0	108.9	736			
960 min Winter	7.063	0.0	108.5	972			
1440 min Winter	5.157	0.0	106.9	1444			
2160 min Winter	3.757	0.0	219.8	2148			
2880 min Winter	2.997	0.0	217.1	2852			
4320 min Winter	2.176	0.0	209.3	4244			
5760 min Winter	1.731	0.0	435.1	5608			
7200 min Winter	1.449	0.0	427.4	6984			
8640 min Winter	1.255	0.0	418.4	8304			
10080 min Winter	1.111	0.0	408.1	9592			
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Monarch House Barton Lane OX14 3NB	Phase 2 Manor Farm Bedhampton Pond + Boreholes	
Date 17/01/2023 File Cascade.CASX	Designed by S.Smith Checked by	
Innovyze	Source Control 2020.1	

Cascade Rainfall Details for Pond.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)	19.400	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.778

Time (mins) From:	Time (mins) To:	Area (ha)	Time (mins) From:	Time (mins) To:	Area (ha)	Time (mins) From:	Time (mins) To:	Area (ha)	Time (mins) From:	Time (mins) To:	Area (ha)
0	4	0.100	8	12	0.100	16	20	0.100	24	28	0.100
4	8	0.100	12	16	0.100	20	24	0.100	28	32	0.078

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Cascade Model Details for Pond.SRCX

Storage is Online Cover Level (m) 7.000

Complex Structure

Swale

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	290.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	3.0
Safety Factor	2.0	Slope (1:X)	300.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	5.400	Cap Infiltration Depth (m)	0.500
Base Width (m)	1.0		

Infiltration Basin

Invert Level (m)	10.800	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	1.00
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	506.0	0.500	690.0	1.000	888.0	1.500	1100.0
0.100	542.0	0.600	728.0	1.100	929.0	1.600	1144.0
0.200	578.0	0.700	767.0	1.200	971.0		
0.300	615.0	0.800	807.0	1.300	1013.0		
0.400	651.0	0.900	847.0	1.400	1056.0		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0036-7000-1300-7000
Design Head (m)	1.300
Design Flow (l/s)	0.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	36
Invert Level (m)	5.400
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.300	0.7	Kick-Flo®	0.325	0.4
Flush-Flo™	0.160	0.5	Mean Flow over Head Range	-	0.5

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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Innovyze Source Control 2020.1		

Cascade Rainfall Details for Deep Borehole Soakaway.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)	19.400	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.000

Time (mins)	Area
From: To:	(ha)
0	4 0.000

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Innovyze Source Control 2020.1

Cascade Model Details for Deep Borehole Soakaway.SRCX

Storage is Online Cover Level (m) 100.000

Deep Bore Soakaway Structure

Chamber Invert Level (m) 99.500 Infiltration Coefficient Base (m/hr) 0.05328
Chamber Diameter/Length (m) 1.200 Safety Factor 2.0
Borehole Diameter (m) 0.300
Borehole Depth (m) 25.000

Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)
0.000	0.00000	5.000	0.00051	10.000	0.01810	15.000	0.04742	20.000	0.05328	25.000	0.05328
1.000	0.00000	6.000	0.00051	11.000	0.02396	16.000	0.05328	21.000	0.05328		
2.000	0.00000	7.000	0.00051	12.000	0.02983	17.000	0.05328	22.000	0.05328		
3.000	0.00051	8.000	0.00637	13.000	0.03569	18.000	0.05328	23.000	0.05328		
4.000	0.00051	9.000	0.01224	14.000	0.04155	19.000	0.05328	24.000	0.05328		

Orifice Overflow Control

Diameter (m) 0.150 Discharge Coefficient 0.600 Invert Level (m) 99.600

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Monarch House Barton Lane OX14 3NB	Phase 2 Manor Farm Bedhampton Pond + Boreholes	
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Innovyze	Source Control 2020.1	

Cascade Model Details for Deep Borehole Soakaway - Copy (2).SRCX

Storage is Online Cover Level (m) 100.000

Deep Bore Soakaway Structure

Chamber Invert Level (m) 99.500 Infiltration Coefficient Base (m/hr) 0.05328
Chamber Diameter/Length (m) 1.200 Safety Factor 2.0
Borehole Diameter (m) 0.300
Borehole Depth (m) 25.000

Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)
0.000	0.00000	5.000	0.00051	10.000	0.01810	15.000	0.04742	20.000	0.05328	25.000	0.05328
1.000	0.00000	6.000	0.00051	11.000	0.02396	16.000	0.05328	21.000	0.05328		
2.000	0.00000	7.000	0.00051	12.000	0.02983	17.000	0.05328	22.000	0.05328		
3.000	0.00051	8.000	0.00637	13.000	0.03569	18.000	0.05328	23.000	0.05328		
4.000	0.00051	9.000	0.01224	14.000	0.04155	19.000	0.05328	24.000	0.05328		

Orifice Overflow Control

Diameter (m) 0.150 Discharge Coefficient 0.600 Invert Level (m) 99.600

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Date 17/01/2023 File Cascade.CASX	Designed by S.Smith Checked by CP	
Innovyze	Source Control 2020.1	

Cascade Summary of Results for Deep Borehole Soakaway - Copy (3).SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Overflow (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
10080 min Winter	99.628	25.128	0.1	0.5	0.6	1.9	0 K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
10080 min Winter	1.111	0.0	215.5	9792

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Monarch House Barton Lane OX14 3NB	Phase 2 Manor Farm Bedhampton Pond + Boreholes	
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Innovyze Source Control 2020.1

Cascade Model Details for Deep Borehole Soakaway - Copy (3).SRCX

Storage is Online Cover Level (m) 100.000

Deep Bore Soakaway Structure

Chamber Invert Level (m) 99.500 Infiltration Coefficient Base (m/hr) 0.05328
Chamber Diameter/Length (m) 1.200 Safety Factor 2.0
Borehole Diameter (m) 0.300
Borehole Depth (m) 25.000

Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)
0.000	0.00000	5.000	0.00051	10.000	0.01810	15.000	0.04742	20.000	0.05328	25.000	0.05328
1.000	0.00000	6.000	0.00051	11.000	0.02396	16.000	0.05328	21.000	0.05328		
2.000	0.00000	7.000	0.00051	12.000	0.02983	17.000	0.05328	22.000	0.05328		
3.000	0.00051	8.000	0.00637	13.000	0.03569	18.000	0.05328	23.000	0.05328		
4.000	0.00051	9.000	0.01224	14.000	0.04155	19.000	0.05328	24.000	0.05328		

Orifice Overflow Control

Diameter (m) 0.150 Discharge Coefficient 0.600 Invert Level (m) 99.600

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Monarch House
Barton Lane
OX14 3NB

Phase 2 Manor Farm
Bedhampton
Pond + Boreholes

Date 17/01/2023
File Cascade.CASX

Designed by S.Smith
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Source Control 2020.1

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Cascade Summary of Results for Deep Borehole Soakaway - Copy (4).SRCX

Upstream Structures

Outflow To

Overflow To

Deep Borehole Soakaway - Copy (3).SRCX

(None)

Deep Borehole Soakaway - Copy (5).SRCX

Deep Borehole Soakaway - Copy (2).SRCX

Deep Borehole Soakaway.SRCX

Pond.SRCX

Half Drain Time : 303 minutes.

Storm Event

Max Level (m)

Max Depth (m)

Max Infiltration (l/s)

Max Overflow (l/s)

Max Outflow (l/s)

Max Volume (m³)

Status

15 min Summer

99.615

25.115

0.1

0.2

0.3

1.9

OK

30 min Summer

99.617

25.117

0.1

0.2

0.3

1.9

OK

60 min Summer

99.618

25.118

0.1

0.2

0.3

1.9

OK

120 min Summer

99.620

25.120

0.1

0.2

0.3

1.9

OK

180 min Summer

99.620

25.120

0.1

0.3

0.4

1.9

OK

240 min Summer

99.621

25.121

0.1

0.3

0.4

1.9

OK

360 min Summer

99.621

25.121

0.1

0.3

0.4

1.9

OK

480 min Summer

99.622

25.122

0.1

0.3

0.4

1.9

OK

600 min Summer

99.622

25.122

0.1

0.3

0.4

1.9

OK

720 min Summer

99.622

25.122

0.1

0.3

0.4

1.9

OK

960 min Summer

99.622

25.122

0.1

0.3

0.4

1.9

OK

1440 min Summer

99.623

25.123

0.1

0.3

0.4

1.9

OK

2160 min Summer

99.623

25.123

0.1

0.3

0.4

1.9

OK

2880 min Summer

99.624

25.124

0.1

0.3

0.4

1.9

OK

4320 min Summer

99.624

25.124

0.1

0.3

0.4

1.9

OK

5760 min Summer

99.624

25.124

0.1

0.4

0.4

1.9

OK

Storm Event

Rain (mm/hr)

Flooded Volume (m³)

Overflow Volume (m³)

Time-Peak (mins)

15 min Summer

127.517

0.0

9.5

421

30 min Summer

85.701

0.0

11.8

428

60 min Summer

54.957

0.0

30.4

360

120 min Summer

34.010

0.0

34.1

428

180 min Summer

25.295

0.0

36.0

402

240 min Summer

20.351

0.0

37.1

1058

360 min Summer

14.971

0.0

38.5

738

480 min Summer

12.028

0.0

39.3

628

600 min Summer

10.141

0.0

39.8

600

720 min Summer

8.817

0.0

40.0

806

960 min Summer

7.063

0.0

40.0

1076

1440 min Summer

5.157

0.0

38.8

1456

2160 min Summer

3.757

0.0

85.3

2972

2880 min Summer

2.997

0.0

82.8

2924

4320 min Summer

2.176

0.0

75.3

4264

5760 min Summer

1.731

0.0

167.1

6048

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Monarch House
Barton Lane
OX14 3NB

Date 17/01/2023
File Cascade.CASX

Phase 2 Manor Farm
Bedhampton
Pond + Boreholes

Designed by S.Smith
Checked by CP

Innovyze

Source Control 2020.1

Page 2



Cascade Summary of Results for Deep Borehole Soakaway - Copy (4).SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Overflow (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
7200 min Summer	99.624	25.124	0.1	0.3	0.4	1.9	0 K
8640 min Summer	99.624	25.124	0.1	0.4	0.4	1.9	0 K
10080 min Summer	99.624	25.124	0.1	0.4	0.4	1.9	0 K
15 min Winter	99.616	25.116	0.1	0.2	0.3	1.9	0 K
30 min Winter	99.618	25.118	0.1	0.2	0.3	1.9	0 K
60 min Winter	99.619	25.119	0.1	0.2	0.3	1.9	0 K
120 min Winter	99.620	25.120	0.1	0.3	0.4	1.9	0 K
180 min Winter	99.621	25.121	0.1	0.3	0.4	1.9	0 K
240 min Winter	99.621	25.121	0.1	0.3	0.4	1.9	0 K
360 min Winter	99.622	25.122	0.1	0.3	0.4	1.9	0 K
480 min Winter	99.622	25.122	0.1	0.3	0.4	1.9	0 K
600 min Winter	99.623	25.123	0.1	0.3	0.4	1.9	0 K
720 min Winter	99.623	25.123	0.1	0.3	0.4	1.9	0 K
960 min Winter	99.623	25.123	0.1	0.3	0.4	1.9	0 K
1440 min Winter	99.623	25.123	0.1	0.3	0.4	1.9	0 K
2160 min Winter	99.624	25.124	0.1	0.3	0.4	1.9	0 K
2880 min Winter	99.624	25.124	0.1	0.4	0.4	1.9	0 K
4320 min Winter	99.624	25.124	0.1	0.4	0.4	1.9	0 K
5760 min Winter	99.625	25.125	0.1	0.4	0.5	1.9	0 K
7200 min Winter	99.625	25.125	0.1	0.4	0.5	1.9	0 K
8640 min Winter	99.625	25.125	0.1	0.4	0.5	1.9	0 K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
7200 min Summer	1.449	0.0	160.1	6880
8640 min Summer	1.255	0.0	151.9	8176
10080 min Summer	1.111	0.0	142.7	9384
15 min Winter	127.517	0.0	10.4	689
30 min Winter	85.701	0.0	12.7	382
60 min Winter	54.957	0.0	32.4	398
120 min Winter	34.010	0.0	36.2	602
180 min Winter	25.295	0.0	38.0	408
240 min Winter	20.351	0.0	39.2	348
360 min Winter	14.971	0.0	40.6	1234
480 min Winter	12.028	0.0	41.4	1236
600 min Winter	10.141	0.0	41.9	936
720 min Winter	8.817	0.0	42.1	786
960 min Winter	7.063	0.0	42.1	1088
1440 min Winter	5.157	0.0	40.9	1808
2160 min Winter	3.757	0.0	90.1	1992
2880 min Winter	2.997	0.0	87.6	2848
4320 min Winter	2.176	0.0	80.2	3960
5760 min Winter	1.731	0.0	178.2	6160
7200 min Winter	1.449	0.0	171.0	5672
8640 min Winter	1.255	0.0	162.6	8968

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Cascade Model Details for Deep Borehole Soakaway - Copy (4).SRCX

Storage is Online Cover Level (m) 100.000

Deep Bore Soakaway Structure

Chamber Invert Level (m) 99.500 Infiltration Coefficient Base (m/hr) 0.05328
Chamber Diameter/Length (m) 1.200 Safety Factor 2.0
Borehole Diameter (m) 0.300
Borehole Depth (m) 25.000

Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)
0.000	0.00000	5.000	0.00051	10.000	0.01810	15.000	0.04742	20.000	0.05328	25.000	0.05328
1.000	0.00000	6.000	0.00051	11.000	0.02396	16.000	0.05328	21.000	0.05328		
2.000	0.00000	7.000	0.00051	12.000	0.02983	17.000	0.05328	22.000	0.05328		
3.000	0.00051	8.000	0.00637	13.000	0.03569	18.000	0.05328	23.000	0.05328		
4.000	0.00051	9.000	0.01224	14.000	0.04155	19.000	0.05328	24.000	0.05328		

Orifice Overflow Control

Diameter (m) 0.150 Discharge Coefficient 0.600 Invert Level (m) 99.600

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Monarch House Barton Lane OX14 3NB	Phase 2 Manor Farm Bedhampton Pond + Boreholes	
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Cascade Summary of Results for Deep Borehole Soakaway - Copy (5).SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Overflow (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
5760 min Summer	99.620	25.120	0.1	0.3	0.4	1.9	0 K
7200 min Summer	99.620	25.120	0.1	0.2	0.3	1.9	0 K
8640 min Summer	99.620	25.120	0.1	0.2	0.3	1.9	0 K
10080 min Summer	99.620	25.120	0.1	0.2	0.3	1.9	0 K
15 min Winter	99.611	25.111	0.1	0.1	0.2	1.9	0 K
30 min Winter	99.612	25.112	0.1	0.1	0.2	1.9	0 K
60 min Winter	99.614	25.114	0.1	0.1	0.2	1.9	0 K
120 min Winter	99.615	25.115	0.1	0.2	0.3	1.9	0 K
180 min Winter	99.616	25.116	0.1	0.2	0.3	1.9	0 K
240 min Winter	99.616	25.116	0.1	0.2	0.3	1.9	0 K
360 min Winter	99.617	25.117	0.1	0.2	0.3	1.9	0 K
480 min Winter	99.617	25.117	0.1	0.2	0.3	1.9	0 K
600 min Winter	99.618	25.118	0.1	0.2	0.3	1.9	0 K
720 min Winter	99.618	25.118	0.1	0.2	0.3	1.9	0 K
960 min Winter	99.618	25.118	0.1	0.2	0.3	1.9	0 K
1440 min Winter	99.619	25.119	0.1	0.2	0.3	1.9	0 K
2160 min Winter	99.619	25.119	0.1	0.2	0.3	1.9	0 K
2880 min Winter	99.620	25.120	0.1	0.2	0.3	1.9	0 K
4320 min Winter	99.620	25.120	0.1	0.3	0.4	1.9	0 K
5760 min Winter	99.621	25.121	0.1	0.3	0.4	1.9	0 K
7200 min Winter	99.621	25.121	0.1	0.3	0.4	1.9	0 K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
5760 min Summer	1.731	0.0	108.9	6696
7200 min Summer	1.449	0.0	102.8	6096
8640 min Summer	1.255	0.0	95.5	5856
10080 min Summer	1.111	0.0	87.2	10136
15 min Winter	127.517	0.0	3.4	690
30 min Winter	85.701	0.0	5.4	555
60 min Winter	54.957	0.0	16.9	522
120 min Winter	34.010	0.0	20.6	534
180 min Winter	25.295	0.0	22.4	488
240 min Winter	20.351	0.0	23.6	512
360 min Winter	14.971	0.0	25.1	674
480 min Winter	12.028	0.0	26.1	1052
600 min Winter	10.141	0.0	26.7	930
720 min Winter	8.817	0.0	27.1	984
960 min Winter	7.063	0.0	27.3	1192
1440 min Winter	5.157	0.0	26.7	1442
2160 min Winter	3.757	0.0	60.6	3236
2880 min Winter	2.997	0.0	58.7	3364
4320 min Winter	2.176	0.0	52.5	4272
5760 min Winter	1.731	0.0	119.5	4712
7200 min Winter	1.449	0.0	113.3	6136

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Cascade Summary of Results for Deep Borehole Soakaway - Copy (5).SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Overflow (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
8640 min Winter	99.621	25.121	0.1	0.3	0.4	1.9	0 K
10080 min Winter	99.621	25.121	0.1	0.3	0.4	1.9	0 K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
8640 min Winter	1.255	0.0	105.9	8568
10080 min Winter	1.111	0.0	97.5	10992

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Cascade Model Details for Deep Borehole Soakaway - Copy (5).SRCX

Storage is Online Cover Level (m) 100.000

Deep Bore Soakaway Structure

Chamber Invert Level (m) 99.500 Infiltration Coefficient Base (m/hr) 0.05328
Chamber Diameter/Length (m) 1.200 Safety Factor 2.0
Borehole Diameter (m) 0.300
Borehole Depth (m) 25.000

Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)
0.000	0.00000	5.000	0.00051	10.000	0.01810	15.000	0.04742	20.000	0.05328	25.000	0.05328
1.000	0.00000	6.000	0.00051	11.000	0.02396	16.000	0.05328	21.000	0.05328		
2.000	0.00000	7.000	0.00051	12.000	0.02983	17.000	0.05328	22.000	0.05328		
3.000	0.00051	8.000	0.00637	13.000	0.03569	18.000	0.05328	23.000	0.05328		
4.000	0.00051	9.000	0.01224	14.000	0.04155	19.000	0.05328	24.000	0.05328		

Orifice Overflow Control

Diameter (m) 0.150 Discharge Coefficient 0.600 Invert Level (m) 99.600

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Monarch House Barton Lane OX14 3NB	Phase 2 Manor Farm Bedhampton Pond + Boreholes	
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Innovyze	Source Control 2020.1	

Cascade Summary of Results for Deep Borehole Soakaway - Copy (6).SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Overflow (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
5760 min Summer	99.615	25.115	0.1	0.2	0.3	1.9	0 K
7200 min Summer	99.615	25.115	0.1	0.2	0.2	1.9	0 K
8640 min Summer	99.615	25.115	0.1	0.2	0.2	1.9	0 K
10080 min Summer	99.614	25.114	0.1	0.1	0.2	1.9	0 K
15 min Winter	95.415	20.915	0.1	0.0	0.1	1.5	0 K
30 min Winter	99.581	25.081	0.1	0.0	0.1	1.9	0 K
60 min Winter	99.608	25.108	0.1	0.0	0.1	1.9	0 K
120 min Winter	99.610	25.110	0.1	0.1	0.2	1.9	0 K
180 min Winter	99.611	25.111	0.1	0.1	0.2	1.9	0 K
240 min Winter	99.611	25.111	0.1	0.1	0.2	1.9	0 K
360 min Winter	99.612	25.112	0.1	0.1	0.2	1.9	0 K
480 min Winter	99.612	25.112	0.1	0.1	0.2	1.9	0 K
600 min Winter	99.613	25.113	0.1	0.1	0.2	1.9	0 K
720 min Winter	99.613	25.113	0.1	0.1	0.2	1.9	0 K
960 min Winter	99.613	25.113	0.1	0.1	0.2	1.9	0 K
1440 min Winter	99.614	25.114	0.1	0.1	0.2	1.9	0 K
2160 min Winter	99.615	25.115	0.1	0.2	0.2	1.9	0 K
2880 min Winter	99.615	25.115	0.1	0.2	0.2	1.9	0 K
4320 min Winter	99.615	25.115	0.1	0.2	0.3	1.9	0 K
5760 min Winter	99.616	25.116	0.1	0.2	0.3	1.9	0 K
7200 min Winter	99.616	25.116	0.1	0.2	0.3	1.9	0 K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
5760 min Summer	1.731	0.0	56.8	5672
7200 min Summer	1.449	0.0	54.0	6760
8640 min Summer	1.255	0.0	50.0	6112
10080 min Summer	1.111	0.0	45.1	10144
15 min Winter	127.517	0.0	0.0	1371
30 min Winter	85.701	0.0	0.0	1437
60 min Winter	54.957	0.0	2.9	916
120 min Winter	34.010	0.0	6.2	1246
180 min Winter	25.295	0.0	8.0	736
240 min Winter	20.351	0.0	9.1	742
360 min Winter	14.971	0.0	10.7	740
480 min Winter	12.028	0.0	11.7	790
600 min Winter	10.141	0.0	12.4	1150
720 min Winter	8.817	0.0	12.9	984
960 min Winter	7.063	0.0	13.6	1092
1440 min Winter	5.157	0.0	13.7	1558
2160 min Winter	3.757	0.0	32.8	2464
2880 min Winter	2.997	0.0	32.1	2524
4320 min Winter	2.176	0.0	28.3	3932
5760 min Winter	1.731	0.0	66.0	7528
7200 min Winter	1.449	0.0	62.6	5800

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Cascade Summary of Results for Deep Borehole Soakaway - Copy (6).SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Overflow (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
8640 min Winter	99.616	25.116	0.1	0.2	0.3	1.9	0 K
10080 min Winter	99.616	25.116	0.1	0.2	0.3	1.9	0 K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
8640 min Winter	1.255	0.0	58.0	7112
10080 min Winter	1.111	0.0	52.5	8760

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Cascade Model Details for Deep Borehole Soakaway - Copy (6).SRCX

Storage is Online Cover Level (m) 100.000

Deep Bore Soakaway Structure

Chamber Invert Level (m) 99.500 Infiltration Coefficient Base (m/hr) 0.05328
Chamber Diameter/Length (m) 1.200 Safety Factor 2.0
Borehole Diameter (m) 0.300
Borehole Depth (m) 25.000

Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)
0.000	0.00000	5.000	0.00051	10.000	0.01810	15.000	0.04742	20.000	0.05328	25.000	0.05328
1.000	0.00000	6.000	0.00051	11.000	0.02396	16.000	0.05328	21.000	0.05328		
2.000	0.00000	7.000	0.00051	12.000	0.02983	17.000	0.05328	22.000	0.05328		
3.000	0.00051	8.000	0.00637	13.000	0.03569	18.000	0.05328	23.000	0.05328		
4.000	0.00051	9.000	0.01224	14.000	0.04155	19.000	0.05328	24.000	0.05328		

Orifice Overflow Control

Diameter (m) 0.150 Discharge Coefficient 0.600 Invert Level (m) 99.600

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Cascade Summary of Results for Deep Borehole Soakaway - Copy (7).SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Overflow (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
4320 min Summer	99.609	25.109	0.1	0.0	0.1	1.9	0 K
5760 min Summer	99.609	25.109	0.1	0.1	0.1	1.9	0 K
7200 min Summer	99.609	25.109	0.1	0.1	0.1	1.9	0 K
8640 min Summer	99.609	25.109	0.1	0.1	0.1	1.9	0 K
10080 min Summer	99.609	25.109	0.1	0.0	0.1	1.9	0 K
15 min Winter	74.500	0.000	0.0	0.0	0.0	0.0	0 K
30 min Winter	74.500	0.000	0.0	0.0	0.0	0.0	0 K
60 min Winter	89.777	15.277	0.0	0.0	0.0	1.1	0 K
120 min Winter	93.649	19.149	0.1	0.0	0.1	1.4	0 K
180 min Winter	95.489	20.989	0.1	0.0	0.1	1.5	0 K
240 min Winter	96.664	22.164	0.1	0.0	0.1	1.6	0 K
360 min Winter	98.324	23.824	0.1	0.0	0.1	1.7	0 K
480 min Winter	99.487	24.987	0.1	0.0	0.1	1.8	0 K
600 min Winter	99.603	25.103	0.1	0.0	0.1	1.9	0 K
720 min Winter	99.605	25.105	0.1	0.0	0.1	1.9	0 K
960 min Winter	99.606	25.106	0.1	0.0	0.1	1.9	0 K
1440 min Winter	99.608	25.108	0.1	0.0	0.1	1.9	0 K
2160 min Winter	99.609	25.109	0.1	0.1	0.1	1.9	0 K
2880 min Winter	99.609	25.109	0.1	0.1	0.1	1.9	0 K
4320 min Winter	99.610	25.110	0.1	0.1	0.2	1.9	0 K
5760 min Winter	99.610	25.110	0.1	0.1	0.2	1.9	0 K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
4320 min Summer	2.176	0.0	4.9	4104
5760 min Summer	1.731	0.0	8.9	5328
7200 min Summer	1.449	0.0	9.8	6840
8640 min Summer	1.255	0.0	9.8	8336
10080 min Summer	1.111	0.0	8.9	9592
15 min Winter	127.517	0.0	0.0	0
30 min Winter	85.701	0.0	0.0	0
60 min Winter	54.957	0.0	0.0	1834
120 min Winter	34.010	0.0	0.0	1596
180 min Winter	25.295	0.0	0.0	1596
240 min Winter	20.351	0.0	0.0	1572
360 min Winter	14.971	0.0	0.0	1616
480 min Winter	12.028	0.0	0.0	1560
600 min Winter	10.141	0.0	0.1	1576
720 min Winter	8.817	0.0	0.6	1400
960 min Winter	7.063	0.0	1.5	1602
1440 min Winter	5.157	0.0	2.4	1610
2160 min Winter	3.757	0.0	7.0	2548
2880 min Winter	2.997	0.0	8.0	3148
4320 min Winter	2.176	0.0	7.8	4288
5760 min Winter	1.731	0.0	17.1	5960

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Cascade Summary of Results for Deep Borehole Soakaway - Copy (7).SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Overflow (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
7200 min Winter	99.611	25.111	0.1	0.1	0.2	1.9	0 K
8640 min Winter	99.611	25.111	0.1	0.1	0.2	1.9	0 K
10080 min Winter	99.611	25.111	0.1	0.1	0.2	1.9	0 K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
7200 min Winter	1.449	0.0	17.3	6432
8640 min Winter	1.255	0.0	16.4	8128
10080 min Winter	1.111	0.0	14.7	8448

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Cascade Model Details for Deep Borehole Soakaway - Copy (7).SRCX

Storage is Online Cover Level (m) 100.000

Deep Bore Soakaway Structure

Chamber Invert Level (m) 99.500 Infiltration Coefficient Base (m/hr) 0.05328
Chamber Diameter/Length (m) 1.200 Safety Factor 2.0
Borehole Diameter (m) 0.300
Borehole Depth (m) 25.000

Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)
0.000	0.00000	5.000	0.00051	10.000	0.01810	15.000	0.04742	20.000	0.05328	25.000	0.05328
1.000	0.00000	6.000	0.00051	11.000	0.02396	16.000	0.05328	21.000	0.05328		
2.000	0.00000	7.000	0.00051	12.000	0.02983	17.000	0.05328	22.000	0.05328		
3.000	0.00051	8.000	0.00637	13.000	0.03569	18.000	0.05328	23.000	0.05328		
4.000	0.00051	9.000	0.01224	14.000	0.04155	19.000	0.05328	24.000	0.05328		

Orifice Overflow Control

Diameter (m) 0.150 Discharge Coefficient 0.600 Invert Level (m) 99.600

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Innovyze Source Control 2020.1

Cascade Summary of Results for Deep Borehole Soakaway - Copy (8).SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Overflow (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
4320 min Summer	90.951	16.451	0.0	0.0	0.0	1.2	0 K
5760 min Summer	91.173	16.673	0.0	0.0	0.0	1.2	0 K
7200 min Summer	91.102	16.602	0.0	0.0	0.0	1.2	0 K
8640 min Summer	90.963	16.463	0.0	0.0	0.0	1.2	0 K
10080 min Summer	90.729	16.229	0.0	0.0	0.0	1.1	0 K
15 min Winter	74.500	0.000	0.0	0.0	0.0	0.0	0 K
30 min Winter	74.500	0.000	0.0	0.0	0.0	0.0	0 K
60 min Winter	74.500	0.000	0.0	0.0	0.0	0.0	0 K
120 min Winter	74.500	0.000	0.0	0.0	0.0	0.0	0 K
180 min Winter	74.500	0.000	0.0	0.0	0.0	0.0	0 K
240 min Winter	74.500	0.000	0.0	0.0	0.0	0.0	0 K
360 min Winter	74.500	0.000	0.0	0.0	0.0	0.0	0 K
480 min Winter	74.500	0.000	0.0	0.0	0.0	0.0	0 K
600 min Winter	76.274	1.774	0.0	0.0	0.0	0.1	0 K
720 min Winter	82.631	8.131	0.0	0.0	0.0	0.6	0 K
960 min Winter	87.331	12.831	0.0	0.0	0.0	0.9	0 K
1440 min Winter	89.861	15.361	0.0	0.0	0.0	1.1	0 K
2160 min Winter	91.487	16.987	0.0	0.0	0.0	1.2	0 K
2880 min Winter	92.418	17.918	0.0	0.0	0.0	1.3	0 K
4320 min Winter	93.266	18.766	0.0	0.0	0.0	1.3	0 K
5760 min Winter	93.610	19.110	0.1	0.0	0.1	1.4	0 K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
4320 min Summer	2.176	0.0	0.0	4492
5760 min Summer	1.731	0.0	0.0	5848
7200 min Summer	1.449	0.0	0.0	7272
8640 min Summer	1.255	0.0	0.0	8552
10080 min Summer	1.111	0.0	0.0	9288
15 min Winter	127.517	0.0	0.0	0
30 min Winter	85.701	0.0	0.0	0
60 min Winter	54.957	0.0	0.0	0
120 min Winter	34.010	0.0	0.0	0
180 min Winter	25.295	0.0	0.0	0
240 min Winter	20.351	0.0	0.0	0
360 min Winter	14.971	0.0	0.0	0
480 min Winter	12.028	0.0	0.0	0
600 min Winter	10.141	0.0	0.0	2298
720 min Winter	8.817	0.0	0.0	2878
960 min Winter	7.063	0.0	0.0	2634
1440 min Winter	5.157	0.0	0.0	2472
2160 min Winter	3.757	0.0	0.0	2780
2880 min Winter	2.997	0.0	0.0	3156
4320 min Winter	2.176	0.0	0.0	4360
5760 min Winter	1.731	0.0	0.0	5776

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Cascade Summary of Results for Deep Borehole Soakaway - Copy (8).SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Overflow (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
7200 min Winter	93.686	19.186	0.1	0.0	0.1	1.4	0 K
8640 min Winter	93.641	19.141	0.1	0.0	0.1	1.4	0 K
10080 min Winter	93.492	18.992	0.0	0.0	0.0	1.3	0 K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
7200 min Winter	1.449	0.0	0.0	7048
8640 min Winter	1.255	0.0	0.0	8440
10080 min Winter	1.111	0.0	0.0	9864

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Cascade Model Details for Deep Borehole Soakaway - Copy (8).SRCX

Storage is Online Cover Level (m) 100.000

Deep Bore Soakaway Structure

Chamber Invert Level (m) 99.500 Infiltration Coefficient Base (m/hr) 0.05328
Chamber Diameter/Length (m) 1.200 Safety Factor 2.0
Borehole Diameter (m) 0.300
Borehole Depth (m) 25.000

Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)
0.000	0.00000	5.000	0.00051	10.000	0.01810	15.000	0.04742	20.000	0.05328	25.000	0.05328
1.000	0.00000	6.000	0.00051	11.000	0.02396	16.000	0.05328	21.000	0.05328		
2.000	0.00000	7.000	0.00051	12.000	0.02983	17.000	0.05328	22.000	0.05328		
3.000	0.00051	8.000	0.00637	13.000	0.03569	18.000	0.05328	23.000	0.05328		
4.000	0.00051	9.000	0.01224	14.000	0.04155	19.000	0.05328	24.000	0.05328		

Orifice Overflow Control

Diameter (m) 0.150 Discharge Coefficient 0.600 Invert Level (m) 99.600

Appendix C: Attenuation Basin 1 in 10 year No Infiltration



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Source Control 2020.1

Summary of Results for 10 year Return Period

Half Drain Time : 5348 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m ³)	Status
15 min Summer	5.913	0.513	0.0	0.5	0.5	80.0	0 K
30 min Summer	5.973	0.573	0.0	0.5	0.5	105.5	0 K
60 min Summer	6.028	0.628	0.0	0.5	0.5	133.4	0 K
120 min Summer	6.080	0.680	0.0	0.5	0.5	164.0	0 K
180 min Summer	6.110	0.710	0.0	0.5	0.5	183.0	0 K
240 min Summer	6.130	0.730	0.0	0.5	0.5	196.9	0 K
360 min Summer	6.159	0.759	0.0	0.6	0.6	217.4	0 K
480 min Summer	6.178	0.778	0.0	0.6	0.6	232.3	0 K
600 min Summer	6.193	0.793	0.0	0.6	0.6	244.0	0 K
720 min Summer	6.205	0.805	0.0	0.6	0.6	253.5	0 K
960 min Summer	6.222	0.822	0.0	0.6	0.6	268.1	0 K
1440 min Summer	6.244	0.844	0.0	0.6	0.6	287.0	0 K
2160 min Summer	6.260	0.860	0.0	0.6	0.6	301.9	0 K
2880 min Summer	6.267	0.867	0.0	0.6	0.6	308.4	0 K
4320 min Summer	6.267	0.867	0.0	0.6	0.6	308.2	0 K
5760 min Summer	6.261	0.861	0.0	0.6	0.6	302.9	0 K
7200 min Summer	6.255	0.855	0.0	0.6	0.6	297.0	0 K
8640 min Summer	6.249	0.849	0.0	0.6	0.6	292.0	0 K
10080 min Summer	6.244	0.844	0.0	0.6	0.6	287.3	0 K
15 min Winter	5.937	0.537	0.0	0.5	0.5	89.7	0 K

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Discharge Volume (m ³)	Time-Peak (mins)
15 min Summer	55.614	0.0	38.3	46
30 min Summer	36.694	0.0	40.5	61
60 min Summer	23.276	0.0	82.0	90
120 min Summer	14.404	0.0	85.9	150
180 min Summer	10.791	0.0	87.9	208
240 min Summer	8.764	0.0	89.2	268
360 min Summer	6.528	0.0	90.7	386
480 min Summer	5.292	0.0	91.6	504
600 min Summer	4.495	0.0	92.2	624
720 min Summer	3.932	0.0	92.5	742
960 min Summer	3.183	0.0	92.7	980
1440 min Summer	2.361	0.0	92.1	1456
2160 min Summer	1.750	0.0	186.1	2172
2880 min Summer	1.414	0.0	185.3	2888
4320 min Summer	1.047	0.0	181.2	4120
5760 min Summer	0.846	0.0	362.5	4792
7200 min Summer	0.716	0.0	358.8	5560
8640 min Summer	0.626	0.0	351.3	6320
10080 min Summer	0.558	0.0	340.8	7152
15 min Winter	55.614	0.0	39.2	46

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Summary of Results for 10 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control Σ (l/s)	Max Outflow (l/s)	Max Volume (m ³)	Status
30 min Winter	5.999	0.599	0.0	0.5	0.5	118.3	0 K
60 min Winter	6.057	0.657	0.0	0.5	0.5	149.7	0 K
120 min Winter	6.112	0.712	0.0	0.5	0.5	184.2	0 K
180 min Winter	6.143	0.743	0.0	0.5	0.5	205.8	0 K
240 min Winter	6.164	0.764	0.0	0.6	0.6	221.6	0 K
360 min Winter	6.194	0.794	0.0	0.6	0.6	245.0	0 K
480 min Winter	6.215	0.815	0.0	0.6	0.6	262.2	0 K
600 min Winter	6.231	0.831	0.0	0.6	0.6	275.7	0 K
720 min Winter	6.243	0.843	0.0	0.6	0.6	286.8	0 K
960 min Winter	6.262	0.862	0.0	0.6	0.6	304.0	0 K
1440 min Winter	6.287	0.887	0.0	0.6	0.6	327.0	0 K
2160 min Winter	6.306	0.906	0.0	0.6	0.6	346.7	0 K
2880 min Winter	6.316	0.916	0.0	0.6	0.6	356.9	0 K
4320 min Winter	6.323	0.923	0.0	0.6	0.6	363.2	0 K
5760 min Winter	6.319	0.919	0.0	0.6	0.6	359.4	0 K
7200 min Winter	6.311	0.911	0.0	0.6	0.6	351.4	0 K
8640 min Winter	6.304	0.904	0.0	0.6	0.6	344.2	0 K
10080 min Winter	6.296	0.896	0.0	0.6	0.6	336.4	0 K

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Discharge Volume (m ³)	Time-Peak (mins)
30 min Winter	36.694	0.0	41.5	61
60 min Winter	23.276	0.0	84.2	90
120 min Winter	14.404	0.0	88.0	148
180 min Winter	10.791	0.0	90.0	206
240 min Winter	8.764	0.0	91.2	264
360 min Winter	6.528	0.0	92.7	380
480 min Winter	5.292	0.0	93.5	496
600 min Winter	4.495	0.0	94.0	614
720 min Winter	3.932	0.0	94.2	730
960 min Winter	3.183	0.0	94.3	964
1440 min Winter	2.361	0.0	93.5	1432
2160 min Winter	1.750	0.0	189.8	2124
2880 min Winter	1.414	0.0	188.4	2812
4320 min Winter	1.047	0.0	183.2	4152
5760 min Winter	0.846	0.0	371.1	5416
7200 min Winter	0.716	0.0	367.1	5904
8640 min Winter	0.626	0.0	361.0	6752
10080 min Winter	0.558	0.0	352.5	7680

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	10	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.400	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.778

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From:	To:	From:	To:	From:	To:	From:	To:
0	4 0.100	8	12 0.100	16	20 0.100	24	28 0.100
4	8 0.100	12	16 0.100	20	24 0.100	28	32 0.078

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Model Details

Storage is Online Cover Level (m) 7.000

Complex Structure

Swale

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	290.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	3.0
Safety Factor	2.0	Slope (1:X)	300.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	5.400	Cap Infiltration Depth (m)	0.500
Base Width (m)	1.0		

Infiltration Basin

Invert Level (m)	10.800	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	1.00
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	506.0	0.500	690.0	1.000	888.0	1.500	1100.0
0.100	542.0	0.600	728.0	1.100	929.0	1.600	1144.0
0.200	578.0	0.700	767.0	1.200	971.0		
0.300	615.0	0.800	807.0	1.300	1013.0		
0.400	651.0	0.900	847.0	1.400	1056.0		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0036-7000-1300-7000
Design Head (m)	1.300
Design Flow (l/s)	0.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	36
Invert Level (m)	5.400
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.300	0.7	Kick-Flo®	0.325	0.4
Flush-Flo™	0.160	0.5	Mean Flow over Head Range	-	0.5

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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Appendix D: GESL Statement - Manor Farm, Bedhampton Phase 2



From:
Sent:
To:
Cc:
Subject:



Gents

The following is in response to comments received from the LLFA with regards to the drainage strategy for this site.

From observation and what we know of the site, it formerly comprised arable farmland and whilst some surface ponding of storm water, or saturation of Topsoil has been observed at times following prolonged or heavy rainfall events, this water did appear to drain into the ground even if this occurred at a rate at which trial pit soakage testing is not successful. We are not aware of any significant flooding on the site, nor flooding from the site onto adjacent land such as the adjacent railway cutting. It is understood that the design had assumed shallow soils to be effectively impermeable whereas some, albeit slow, infiltration and loss of storm water might actually occur from swales and the like, as per observations noted above.

Infiltration testing at greater depth, i.e. within boreholes has been undertaken. On each occasion, groundwater was present within the borehole. Groundwater was present at c. 2.1m bgl prior to commencement of the testing in BH01 (test section 7-10m bgl, i.e. flooded test section). At the time of testing in the deeper borehole (BH101), groundwater had risen from an initial strike depth of 6.4m bgl to 4.5m bgl after drilling was paused for 20 minutes and water was standing at c. 2.7m bgl in the monitoring well c. one week after testing. Winter groundwater monitoring exercises on this site have recorded groundwater standing at c. 2-3m bgl, typically c.2-2.5m bgl. It is thus considered that the infiltration testing undertaken in both BH01 and BH101 reflect a shallow groundwater body, with water discharging into saturated strata. As such, modelling utilising the infiltration rates derived from testing would account for saturated ground conditions and groundwater at shallow depth.

As noted above, testing in BH01 was limited to a screened section at 7-10m bgl, whilst testing in BH101 was undertaken in the borehole on completion of drilling, i.e. testing over the full depth zone of Chalk encountered including saturated zone within the borehole. A higher infiltration rate was derived from the testing in BH101 than in BH01, which may indicate that more permeable zones were present outside of the depth range tested in BH01.

It is understood that deeper borehole soakaways are being proposed, i.e. as deep as 25m bgl. The degree of weathering would be anticipated to reduce with depth and there is potential to get into a more jointed rock mass where joints are likely to be the primary pathway for flow. On the basis of the investigations and testing undertaken to date, it is not considered unreasonable to assume that similar rates infiltration might be achievable for deeper boreholes.

It is understood from discussion with yourselves that the borehole soakaways form the final stage of a drainage strategy, the aim of which is to capture, store and attenuate peak storm flow. Testing was undertaken into saturated strata and thus any outcome from such testing would account for these conditions and would be considered to present a reasonably pessimistic condition, e.g. as may be expected of winter conditions. Whilst the LLFA has commented that *"the full capacity of the boreholes will not be available for storage"*, it would appear that the storage is at shallow depth using swales, filter zones and basin with infiltration via borehole soakaway at an attenuated rate, i.e. borehole soakaways not providing the storage element.

I trust the above is of assistance.

Kind regards

Gavin

Gavin Roberts

CGeol, BEng (Hons), MSc, FGS
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Appendix E: EA Correspondence RE 22863 Manor Farm, Bedhampton



From: Deacon, Simon <simon.deacon@environment-agency.gov.uk>
Sent: 22 November 2018 09:27
To: Stuart Magowan; J.Bucknall@portsmouthwater.co.uk
Cc: Rachel Davies; CEP | Reception
Subject: RE: 22863 Manor Farm, Bedhampton

Hi Stuart, from an initial review it looks like a good proposal. As a precautionary measure, can a syphon head system or similar be included on the soakaway that could capture any free phase hydrocarbons that may pass the pond and swales?

Regards, Simon

Simon Deacon BSc MSc CGeol FGS
Technical Specialist
Groundwater, Hydrology & Contaminated Land
Solent South Downs Area



Environment Agency | Chichester Office | Portfield Depot | Oving Road | Chichester | West Sussex | PO20 2AG
Tel ext: +442084747511 Tel int: 47511
Email: simon.deacon@environment-agency.gov.uk



See our new Twitter account - [@GeoscienceEA](https://twitter.com/GeoscienceEA)



'The Environment Agency's approach to groundwater protection' has been updated:
- [updated version](#)

From: Stuart Magowan [<mailto:stuart@civil.co.uk>]
Sent: 21 November 2018 12:50
To: Deacon, Simon <simon.deacon@environment-agency.gov.uk>;
J.Bucknall@portsmouthwater.co.uk
Cc: Rachel Davies <Rachel@bargatehomes.co.uk>; CEP | Reception <reception@civil.co.uk>
Subject: 22863 Manor Farm, Bedhampton

Hi Simon and James

Further to our very productive meeting on 5 November I attach a preliminary sustainable Drainage Note and Sketch SuDS layout detailing the proposed principles for the surface water SuDS system design and water quality mitigation for your review and comment.

I would be pleased to receive any initial comments or suggestions you may have or agreement in principle to this proposed strategy to mitigate any potential contamination of the aquifer/groundwater?

I am due to meet the Hampshire SuDS team tomorrow and will let you know how we get on.

If you have any queries please do not hesitate to contact me.

Regards

Stuart

Stuart Magowan

Tel: 01273 424424

Email: stuart@civil.co.uk

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