Samuel House, 5 Fox Valley Way
Stocksbridge, Sheffield, S36 2AA

Date: 6th April 2022

Our Ref: CRM.1132.021.HY.L.001.B

Application No.: 20/00315/OUT

FAO: Joann Meneaud
Gloucester City Council

[redacted]

Dear Joann

Hempsted Lane, Gloucester, GL2 5DB - LLFA Response Letter

Introduction

Enzygo Ltd produced a Flood Risk Assessment (Reference. CRM.1132.021.HY.R.001.A, December 2019), supported by an outline surface water drainage strategy, for a proposed residential development, located on land west of Hempsted Lane, Gloucester (the 'Site').

Following submission of the Flood Risk Assessment, Gloucester City Council provided an email response from the Drainage Advisor, requesting further information and clarity regarding the drainage strategy.

Extracts from the email on the 6th July 2020 are included below, together with the Enzygo Ltd response. A copy of the email is included as Attachment 1.

Enzygo Ltd Response

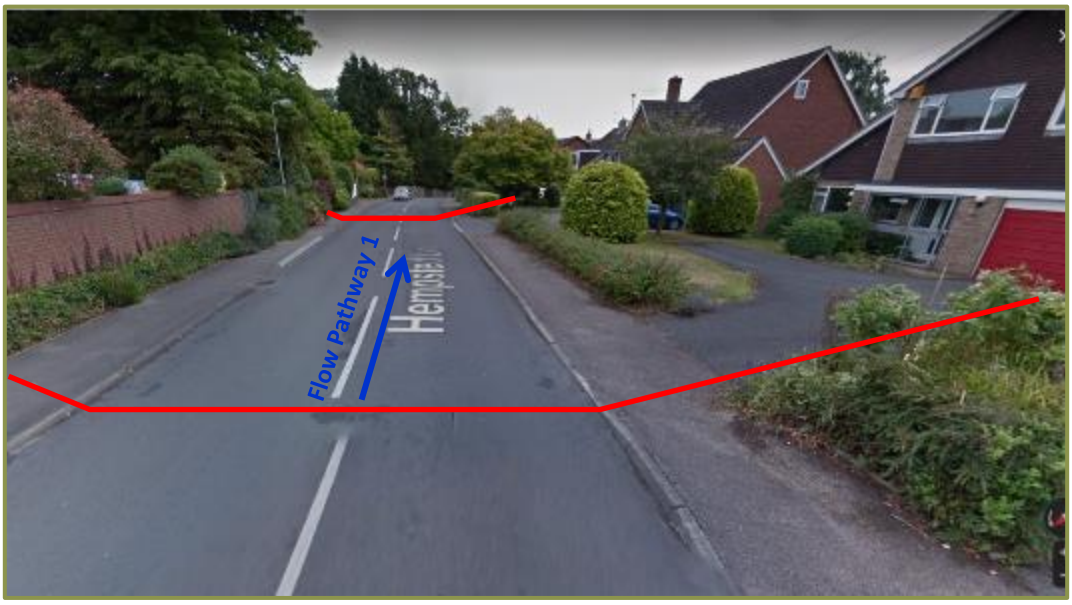
An intercept ditch / swale is required along the top of the development to protect it from overland runoff from the north.

The residential dwellings to the north of the Site are served by a surface water drainage network (see Figure 4 below). Storm events beyond the design standard of the network would shed overland as shallow flows, following the local topography (south) towards the Site.

Hempsted Lane is orientated south-east to the north-east of the Site and is served by highways drainage with road gullies observed along the road adjacent to the Site (Figure 1 - Flow Pathway 1). Note, the residential dwellings (including gardens and driveways) between the northern boundary and Hempsted Lane to the north are topographically higher than the highway. Any overland flows are mostly going to be intercepted and conveyed along the highway (mostly up to 150mm) as per the Environment Agency complex surface water mapping (Figure 2, top).

Rea Lane is orientated south-west to the north-west of the Site and was not observed to be served by highways drainage (Figure 1, bottom). However there is a notable embankment associated with a hedgerow along the Site boundary. Any overland flows are mostly going to be intercepted and conveyed along the highway (mostly up to 150mm) as per the Environment Agency complex surface water mapping (Figure 2 - Flow Pathway 2).

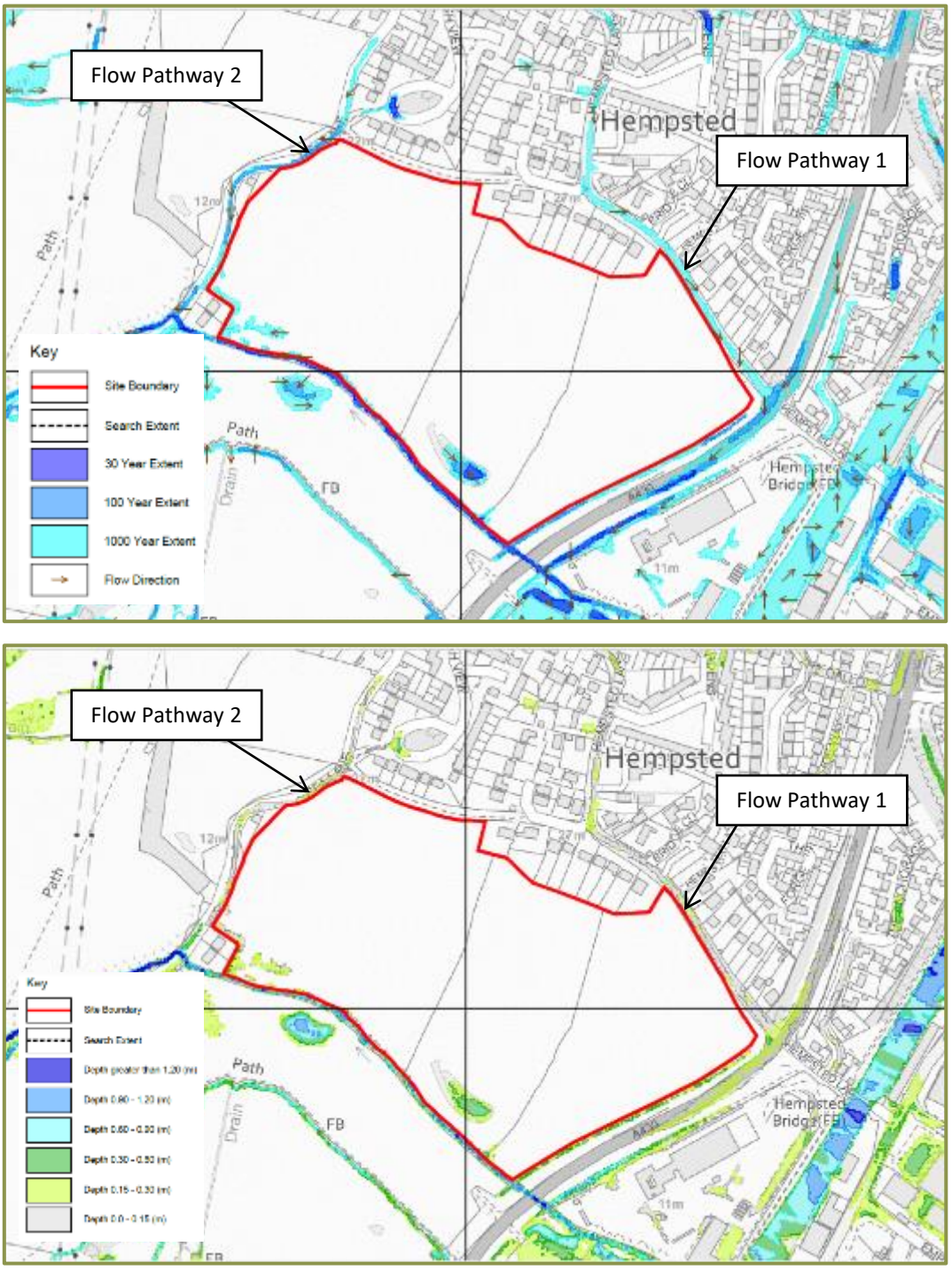
Figure 1: Google Street View of Highways to the North of the Site



View looking south-east along Hempstead Lane (Site to the right, beyond the residential dwellings).

View looking south-west along Rea Lane (Site to the left, beyond the hedgerow).

Figure 2: Environment Agency Complex Surface Water Flood Mapping



Top: Return Periods. Bottom: Depths.

Revised drainage drawings are included in Attachment 2. Swales are positioned along the north-west and north-east boundary, which then conveys flows through the western and eastern extents of the Site (respectively), with outfalls to Hempsted Brook to the south. Any runoff entering the Site from the identified flow pathways along the adjacent highways would be intercepted by the swales.

The extent and position of the interception swales are such that a gravity connection to watercourse can be established, without significantly impacting the developable area on an already constrained Site (i.e. flood extent, steep topography, and sewer easements).

The swales have been designed with the following parameters:

- Depth: 0.50m
- Site slope: 1:3
- Bed width: 0.50m

The swales have been 3D-cut into the topography to show the required land take.

Check dams will be required along the length of the swales to reduce the velocity of flows (preventing erosion) and to provide a degree of attenuation/reduce time runoff takes to enter Hempsted Brook, thereby providing betterment compared to existing conditions whereby runoff would shed uncontrolled to the watercourse.

Culverted reaches will be required beneath crossing points.

Residual surface water flood risk would be mitigated by setting finished floor levels above external levels.

A review of QBar (permissible discharge rate) and the attenuation volume is needed. These could have an impact on the space required for the basin.

Revised runoff and attenuation calculations are included in Attachment 3, which are based on impermeable areas (3.5ha) and cv value of 1.0. A revised attenuation basin is included in Attachment 2 (revised drainage drawings).

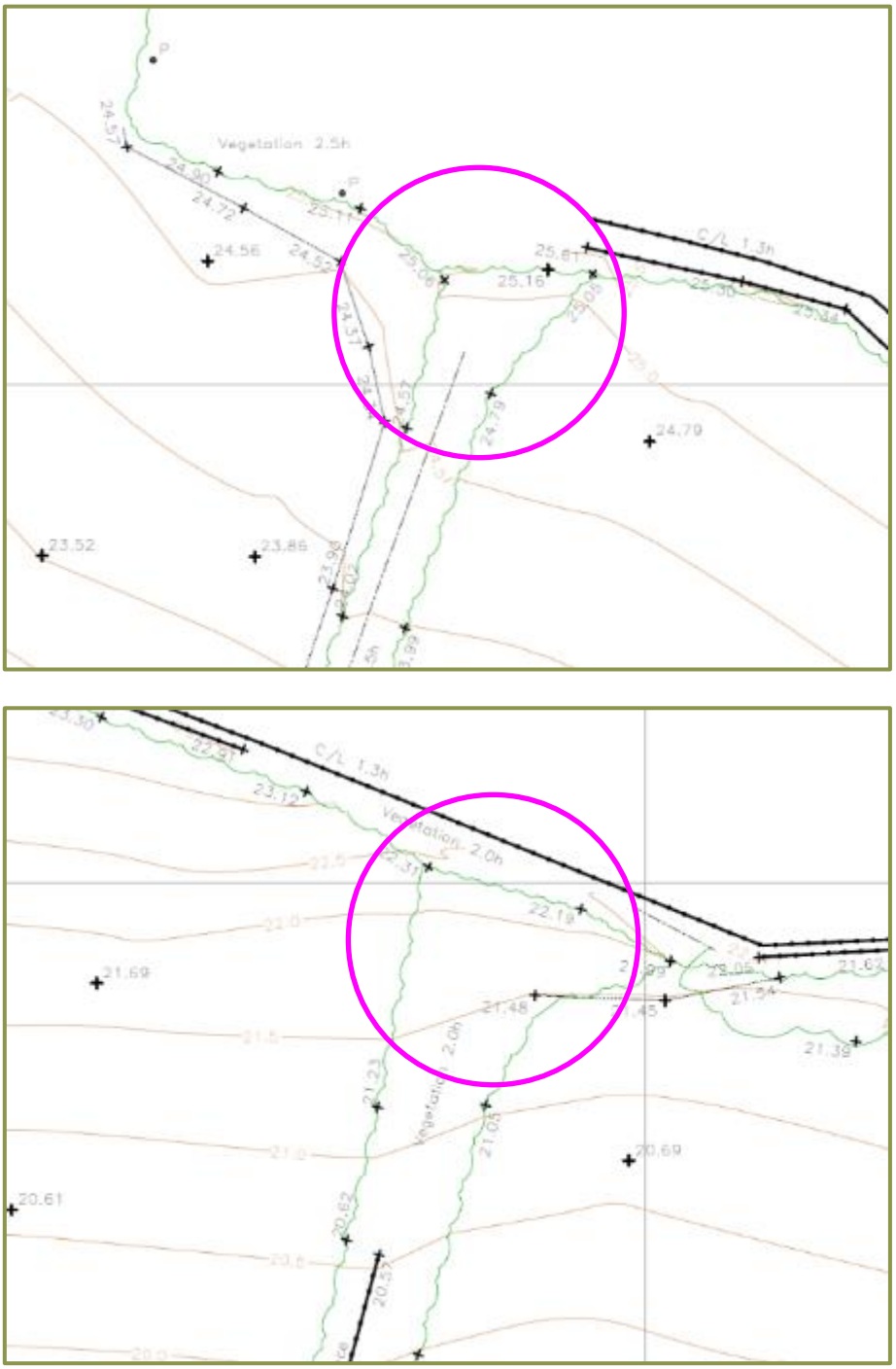
More commitment to SuDS provision is needed.

Indicative drainage calculations are included in Attachment 3, which include an allowance for permeable paving for cul-de-sacs roads (3,083m^2). The indicative attenuation volume for the paving is 369m^3, which provides a reduction to the required volume provided by the detention basin. Permeable paving and gullies will provide two stages of surface water treatment.

Revised drainage drawings are included in Attachment 2, which shows surface water drainage runs being directed to two swales orientated north to south, along the reaches of Drain 1 and 2. The swales will direct flows to the proposed detention basin, which will provide additional stages of treatment before discharging to Hempsted Brook. Check dams will be required along the length of the swales to reduce the velocity of flows and prevent erosion.

As per the topographic survey (Figure 3) and Severn Trent Water asset plans (Figure 4), there are no outlets from an upstream drainage network. As such, additional attenuation volume within the basin will not be required.

Figure 3: Topographic Survey Extracts



Top: Upstream reach of Drain 1. Bottom: Upstream reach of Drain 2.

Figure 4: Severn Trent Water Asset Plan Extract

Basin too rectilinear (man-made) looking / the basin may need reconfiguring to produce an acceptable design (no large bund).

Revised drainage drawings are included in Attachment 2, which includes a revised basin profile.

Sections through the basin are required so we can see if it can be accommodated, in an acceptable manner, into the space allocated.

Revised drainage drawings are included in Attachment 2, which include basin cross sections.

The culverted watercourses should be opened up.

As per the above, the watercourses have been integrated into the SuDS drainage strategy, conveying flows to the detention basin.

Closure

We trust that the details presented herein are self-explanatory and clear. If, for any reason you should have any queries or comments, please do not hesitate to contact me.

Yours sincerely,

[redacted]

Enzygo Ltd

Attachment 1 - LLFA Email

Attachment 2 - Revised Drainage Drawings

Attachment 3 - Revised Drainage Calculations

Attachment 1 – LLFA Email

[redacted]

Hello Paul,
Comments from our Drainage Adviser area set out below. You will note the request for some further information and clarification.
Regards
Joann

The key points are:

- An intercept ditch / swale is required along the top of the development to protect it from overland runoff from the north.
- A review of QBar (permissible discharge rate) and the attenuation volume is needed. These could have an impact on the space required for the basin.
- More commitment to SuDS provision is needed.
- Basin too rectilinear (man-made) looking.
- Sections through the basin are required so we can see if it can be accommodated, in an acceptable manner, into the space allocated.
- The basin may need reconfiguring to produce an acceptable design (no large bund).
- The culverted watercourses should be opened up.

The EA is a statutory consultee and should provide bespoke comments on this application.

Flood Risk At The Site

Flood maps show that the application site includes flood zone 2 and flood zone 3 areas.

However, no built development is proposed in the flood zone 2 and 3 areas, and so I don't have any concerns about fluvial flood risk at the site.

My only comment on flood risk from other sources is that due consideration will need to be given to surface runoff arriving at the development site from the uphill areas to the north. Due to the sloping site and the clay soils this could be significant. We would expect to see an intercept ditch/swale at detailed design stage.

The sequential test can be considered as passed by virtue of the fact a sequential approach has been taken to site layout and all development is within flood zone 1. The exception test does not need to be addressed ('more vulnerable' development in flood zone 1).

Please note that the EA will make their own evaluation over flood risk at the site, which may differ from my comments.

Impact Of The Development On Flood Risk Elsewhere

- Surface Water Runoff Rates

It is accepted that infiltration is not viable.

In line with GCC/LLFA guidance, surface water runoff is to be attenuated to QBar.

I have some questions over the discharge rate / attenuation volume calculations.

A QBar value for the site of 17.3 l/s has been calculated based on a developable area of 6.3 ha.

However, the attenuation volume calculations seem to have been calculated based on the smaller (impermeable) area of 3.52 ha, with no allowance for the permeable areas.

The runoff from the permeable areas has to go somewhere. It will either:

1) Be captured by the on-site drainage - in which case that area can be include in the QBar calculations, but the attenuation volume calculations will need to make allowance for the runoff.

or

2) Not be captured by the on-site drainage – in which case that area should not be included in the QBar calculations.

Where runoff volumes are being calculated for a defined area of impermeable surfacing (as they are here), we would normally expect the cv value to be 0.95. Here, Cv values of 0.75 / 0.84 (summer / winter) have been used. Clarification is sought.

N.B. There are some small discrepancies between (developable / impermeable) areas quoted in the different sections / plans but these can be ironed at detailed design.

SuDS

On a large Greenfield site such as this we expect to see a very good level of above ground SuDS provision. As well as source control and attenuation, we would expect to see SUDS included for conveyance (for example, swales instead of pipes). Please see the attached SuDS layout for another development site which demonstrates the inclusion of SuDs for surface water conveyance. The FRA does say that swales and filter strips are options applicable to the development however, we require to see more commitment that these will actually be incorporated. For example, the FRA should include text along the lines of, '*swales, filter strips, water butts and permeable paving will be incorporated into the development*', and where possible, some commitment to the extents of these SuDS. For example, '*where practicable, every dwelling shall be fitted with a water butt*'. Also, where possible, indicative positions/extents should be shown on the drainage layout plan (swales for example).

It is particularly important that SuDS attenuation basins are well designed and well integrated. Basins should be as naturalistic as possible with varying side slopes (max 1 in 4). If they are to form part of public open space / play space they should have good access. Low flows should be channelled within a shallow swale within the basin so the basin is kept as accessible (dry) as possible

for as much of the time as possible, unless the basin is designed as a wet pond. The photo below shows the style of basin preferred. A permanently wet area is good for wildlife.

Further notes on attenuation basins:

- Basins to incorporate a 3.5 m wide safety / maintenance bench around the perimeter.
- Basin sides to have varying gradients (max 1 in 4)
- Inlets and outlets to be finished in pitched stone rather than RC concrete
- Key clamp railings to be avoided
- Basin topography to be as naturalistic as possible. In particular, unnatural looking bunds and 'perched' basins are to be avoided

Whilst we do not need to see the full detailed design of the basin as part of outline planning application it needs to be demonstrated that the attenuation volume required can be comfortably, and safely, accommodated within the space allocated. With this in mind, an outline planning application should include a few indicative sections. I would like to request that these are submitted.

Looking at the drainage layout plan, and with reference to the guidance above, a few comments spring to mind:

The basin has rather man-made rectilinear layout; this should be softened.

I suspect that the layout shown involves a tall bund on the downslope side, although until we see sections it is hard to tell. As set out above, perched basins and large bunds are to be avoided. They look unnatural and also pose a risk in the sense of presenting a potential breach (bank failure) opportunity.

A more linear basin, working with contours, would sit better.

The applicant should indicate how the SuDS features will be maintained. Subject to acceptable design, and an agreed commuted sum, the City Council may agree to take on the responsibility for

the maintenance of certain above ground SuDS features in public open space. Where an application does not include a SuDS maintenance schedule, a condition to this effect will be required.

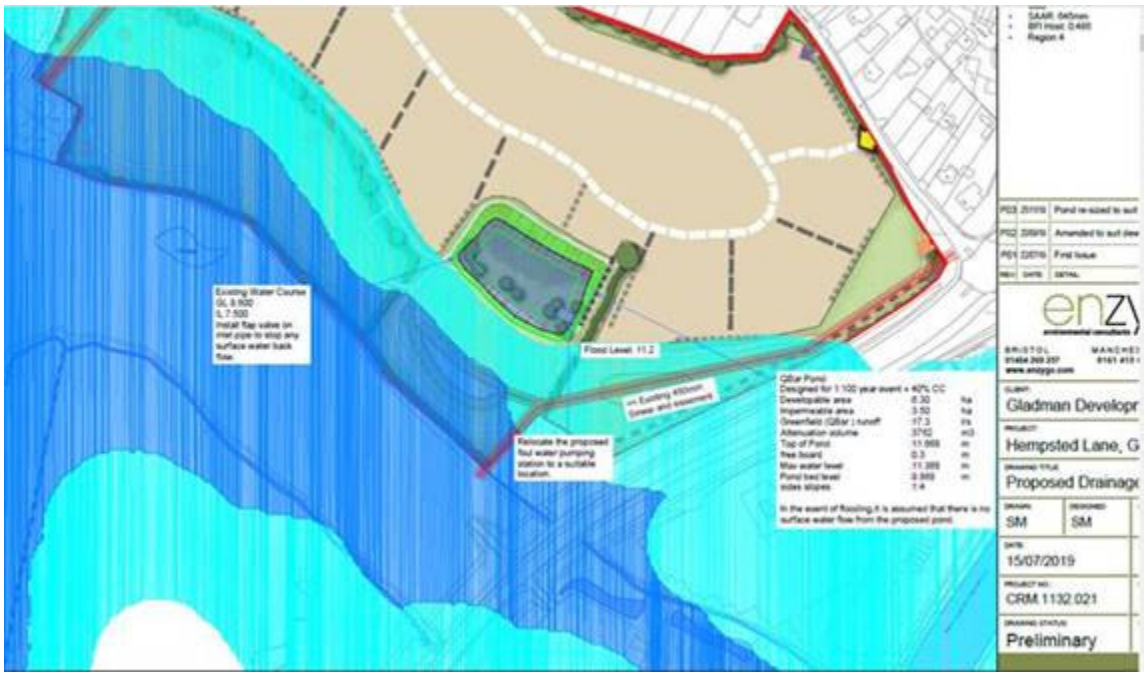
From a water quality perspective, the water quality objectives set out in the publication CIRIA C753 should be met. Please note that traditional gullies/slot drains and interceptors alone, will not meet the objectives. All vehicular areas need to meet the required standards. Here, the basin in conjunction with the swales and permeable paving should deliver adequate water quality provison.

All SuDS proposals will need to be reviewed by the archaeologist.

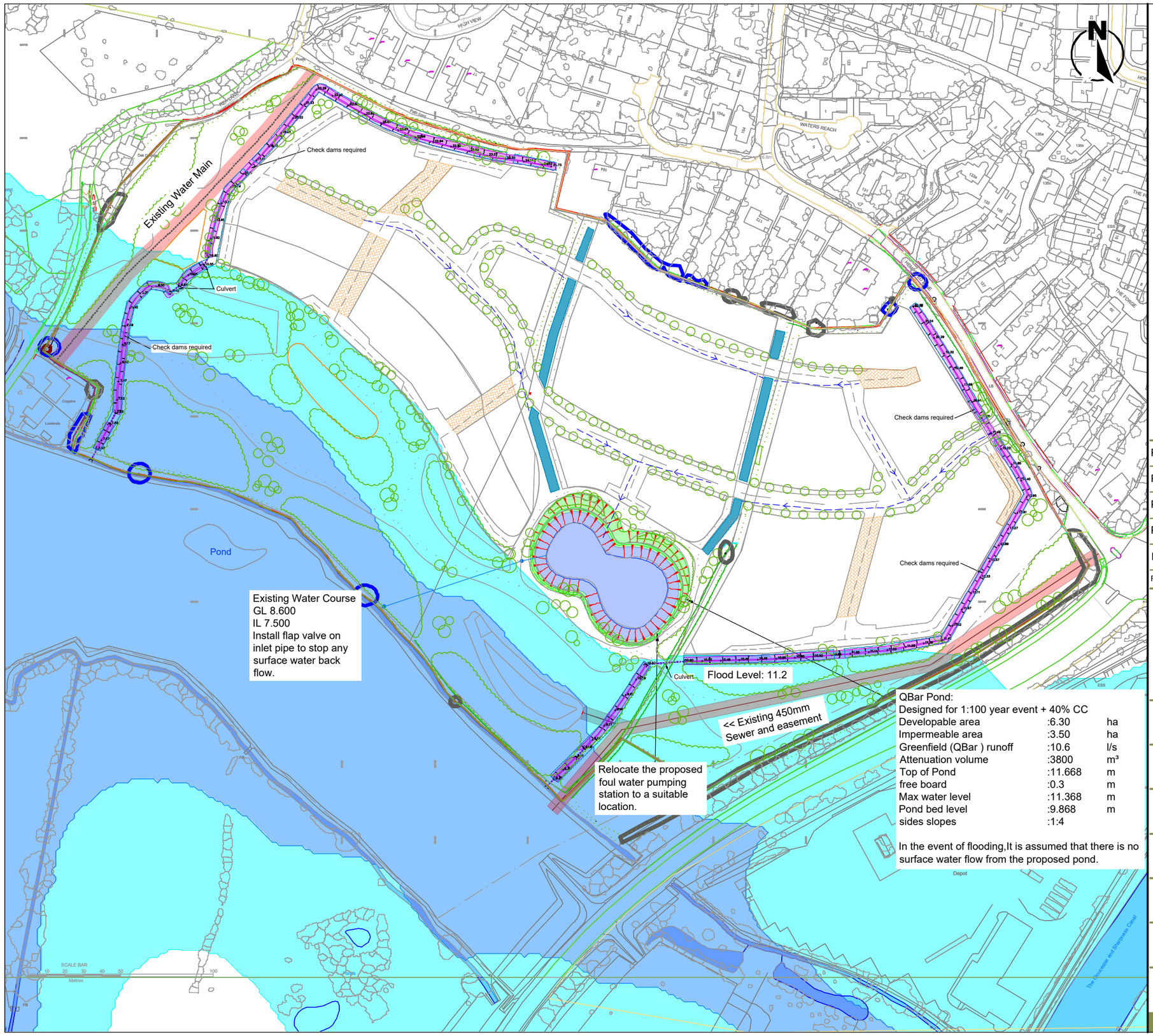
Watercourses

Gloucester City Council requires that an 8 m corridor be kept free of development to each side of watercourses (measured from top of bank). This is achieved for Hempsted Brook (Black Ditch) as there is no development in this area. The 4 m corridor (4 m to each side) proposed for the smaller on-site watercourses is considered acceptable here.

These on-site watercourses currently have culverted sections due to previous infilling by the landowner. We require that these culverted sections are removed and the watercourses / ditches reinstated. This is in line with sections 3.5.39 and 3.5.40 of the City Plan. Currently, if the culverted sections block, the repercussions are minimal as flood would simply flow across the fields to the Hempsted Brook. However, in event that the site is developed, blockages could have more serious consequences.



Attachment 2 – Revised Drainage Drawings



NOTES

1. Do not scale from this drawing
2. All dimensions are in meters unless stated otherwise
3. This drawing is to be read in conjunction with all relevant drawings and documents associated with this project.
4. All surveyed information including levels and layout is provided by others
5. All existing and proposed dimensions, levels and locations to be checked and verified by the main contractor on site prior to the commencement of the works and any anomalies reported to the engineer.
6. All works, workmanship and materials on private drainage to be in accordance with the civil engineering specification for water industry 7th edition published by the water research council.

Drainage Design

- Drainage is designed Using Flow running FEH 13 point data
- SAAR: 645mm
- BFI Host19: 0.453
- Region 4

Key

Indicative Surface Water Sewer

Permeable Paving

REV:	DATE:	DETAIL:	DES:	CHK:	APP:
P05	06/04/22	Updated with latest DFP	EA	MT	MT
P04	29/03/22	Pond re-sized to suit LLFA comments, swales and indicative SW routes added	EA	DA	DA
P03	25/11/19	Pond re-sized to suit latest DFP	WW	SM	EC
P02	20/09/19	Amended to suit developable area	SM	MGg	BF
P01	22/07/19	First Issue	SM	MGg	BF

enzygo environmental consultants

BRISTOL 01454 269 237 www.enzygo.com
MANCHESTER 0161 413 6444
SHEFFIELD 0114 321 5151 hello@enzygo.com

CLIENT: Gladman Developments Ltd

PROJECT: Hempsted Lane, Gloucester

DRAWING TITLE: Proposed Drainage

DRAWN:	DESIGNED:	CHECKED:	APPROVED:
SM	SM	MGg	BF

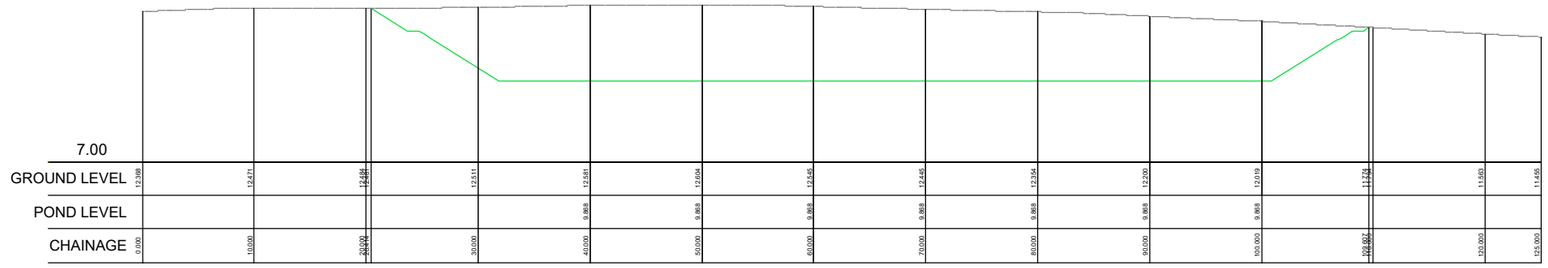
DATE:	SCALE @ A3:
15/07/2019	1:2000

PROJECT NO.:	DRAWING NO.:
CRM.1132.021	001

DRAWING STATUS:	ISSUE:
Preliminary	P05

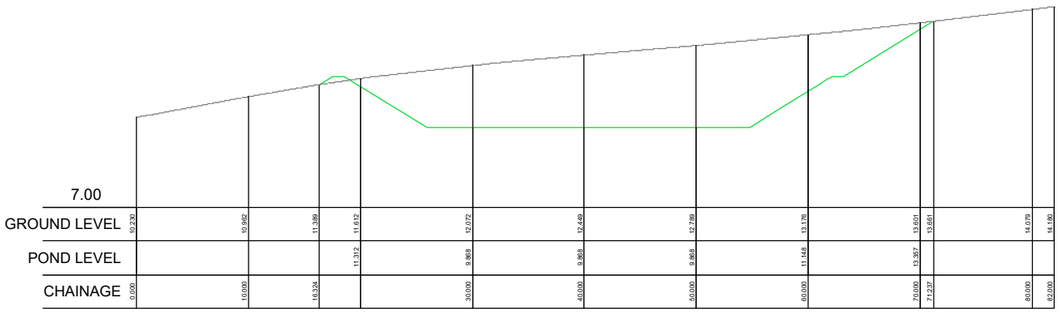
Section A-A

Horiz. 1:250
Vert. 1:100



Section B-B

Horiz. 1:250
Vert. 1:100



Section C-C

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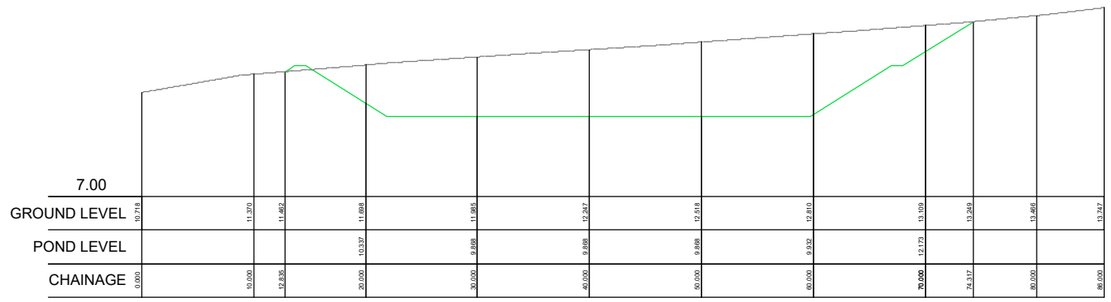
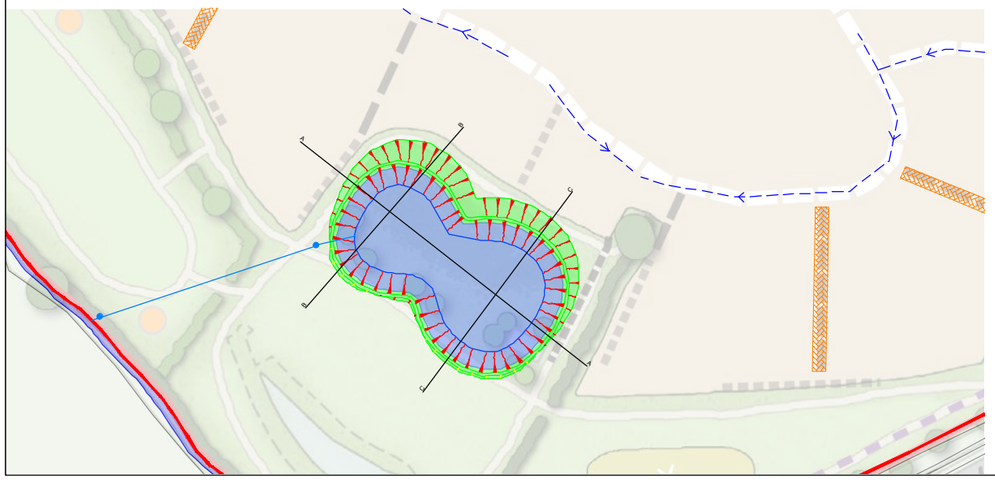
Vert. 1:100





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REV:	DATE:	DETAIL:	DES:	CHK:	APP:
P01	29/03/22	First Issue	EA	DA	DA

enzygo environmental consultants

BRISTOL 01454 269 237 www.enzygo.com
MANCHESTER 0161 413 6444
SHEFFIELD 0114 321 5151 hello@enzygo.com

CLIENT: Gladman Developments Ltd

PROJECT: Hempsted Lane, Gloucester

DRAWING TITLE: Proposed Basin Sections

DRAWN:	DESIGNED:	CHECKED:	APPROVED:
EA	EA	DA	DA

DATE:	SCALE @ A3:
29/03/2022	NTS

PROJECT NO.:	DRAWING NO.:
CRM.1132.021	002

DRAWING STATUS:	ISSUE:
Preliminary	P01

Attachment 3 – Revised Drainage Calculations

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Liz Austin
Site name:	Hempsted Lane
Site location:	Gloucester

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

Site Details

Latitude:	51.84730° N
Longitude:	2.26985° W
Reference:	1348007850
Date:	Mar 29 2022 14:05

Runoff estimation approach FEH Statistical

Site characteristics

Total site area (ha): 3.5

Methodology

Q_{MED} estimation method:	Calculate from BFI and SAAR
BFI and SPR method:	Specify BFI manually
HOST class:	N/A
BFI / BFIHOST:	0.453
Q_{MED} (l/s):	
Q_{BAR} / Q_{MED} factor:	1.12

Hydrological characteristics

	Default	Edited
SAAR (mm):	655	645
Hydrological region:	4	4
Growth curve factor 1 year:	0.83	0.83
Growth curve factor 30 years:	2	2
Growth curve factor 100 years:	2.57	2.57
Growth curve factor 200 years:	3.04	3.04

Notes

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

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

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

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

(3) Is SPR/SPRHOST ≤ 0.3?

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

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):		10.55
1 in 1 year (l/s):		8.76
1 in 30 years (l/s):		21.1
1 in 100 year (l/s):		27.11
1 in 200 years (l/s):		32.07

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	10.453	0.585	10.6	1258.0	O K
30 min Summer	10.627	0.759	10.6	1685.0	O K
60 min Summer	10.810	0.942	10.6	2162.0	O K
120 min Summer	10.964	1.096	10.6	2584.5	O K
180 min Summer	11.054	1.186	10.6	2841.7	O K
240 min Summer	11.116	1.248	10.6	3023.1	O K
360 min Summer	11.197	1.329	10.6	3266.3	O K
480 min Summer	11.248	1.380	10.6	3420.4	O K
600 min Summer	11.282	1.414	10.6	3524.7	O K
720 min Summer	11.305	1.437	10.6	3597.6	O K
960 min Summer	11.333	1.465	10.6	3684.1	O K
1440 min Summer	11.344	1.476	10.6	3720.1	O K
2160 min Summer	11.313	1.445	10.6	3620.9	O K
2880 min Summer	11.262	1.394	10.6	3463.4	O K
4320 min Summer	11.169	1.301	10.6	3181.4	O K
5760 min Summer	11.098	1.230	10.6	2971.0	O K
7200 min Summer	11.050	1.182	10.6	2831.5	O K
8640 min Summer	11.015	1.147	10.6	2730.2	O K
10080 min Summer	10.990	1.122	10.6	2658.5	O K
15 min Winter	10.453	0.585	10.6	1258.0	O K
30 min Winter	10.627	0.759	10.6	1685.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	145.339	0.0	892.9	31
30 min Summer	97.425	0.0	888.5	45
60 min Summer	62.696	0.0	1720.5	76
120 min Summer	37.790	0.0	1636.0	134
180 min Summer	27.931	0.0	1597.3	194
240 min Summer	22.466	0.0	1580.0	254
360 min Summer	16.437	0.0	1574.9	372
480 min Summer	13.106	0.0	1588.9	492
600 min Summer	10.967	0.0	1608.6	612
720 min Summer	9.466	0.0	1621.7	730
960 min Summer	7.484	0.0	1633.7	968
1440 min Summer	5.337	0.0	1625.0	1446
2160 min Summer	3.775	0.0	3178.9	2160
2880 min Summer	2.946	0.0	3104.3	2680
4320 min Summer	2.070	0.0	2954.0	3340
5760 min Summer	1.620	0.0	5408.4	4104
7200 min Summer	1.355	0.0	5610.7	4912
8640 min Summer	1.181	0.0	5604.7	5792
10080 min Summer	1.060	0.0	5320.3	6656
15 min Winter	145.339	0.0	892.9	31
30 min Winter	97.425	0.0	888.7	45

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	10.810	0.942	10.6	2162.2	O K
120 min Winter	10.964	1.096	10.6	2585.1	O K
180 min Winter	11.054	1.186	10.6	2843.0	O K
240 min Winter	11.117	1.249	10.6	3025.2	O K
360 min Winter	11.199	1.331	10.6	3270.1	O K
480 min Winter	11.250	1.382	10.6	3425.8	O K
600 min Winter	11.284	1.416	10.6	3531.8	O K
720 min Winter	11.308	1.440	10.6	3606.3	O K
960 min Winter	11.336	1.468	10.6	3696.2	O K
1440 min Winter	11.350	1.482	10.6	3739.4	O K
2160 min Winter	11.323	1.455	10.6	3652.7	O K
2880 min Winter	11.275	1.407	10.6	3503.1	O K
4320 min Winter	11.167	1.299	10.6	3173.8	O K
5760 min Winter	11.080	1.212	10.6	2918.9	O K
7200 min Winter	11.012	1.144	10.6	2722.4	O K
8640 min Winter	10.955	1.087	10.6	2559.2	O K
10080 min Winter	10.906	1.038	10.6	2423.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	62.696	0.0	1720.8	74
120 min Winter	37.790	0.0	1636.3	132
180 min Winter	27.931	0.0	1597.3	192
240 min Winter	22.466	0.0	1579.7	250
360 min Winter	16.437	0.0	1573.9	366
480 min Winter	13.106	0.0	1587.5	484
600 min Winter	10.967	0.0	1606.6	602
720 min Winter	9.466	0.0	1619.0	718
960 min Winter	7.484	0.0	1629.8	952
1440 min Winter	5.337	0.0	1619.0	1412
2160 min Winter	3.775	0.0	3171.6	2084
2880 min Winter	2.946	0.0	3099.0	2736
4320 min Winter	2.070	0.0	2960.2	3424
5760 min Winter	1.620	0.0	5410.0	4336
7200 min Winter	1.355	0.0	5620.0	5272
8640 min Winter	1.181	0.0	5689.1	6224
10080 min Winter	1.060	0.0	5463.0	7160

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 381394 216553 SO 81394 16553
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	1.000
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 3.500

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	0.875	4	8	0.875	8	12	0.875	12	16	0.875

Model Details

Storage is Online Cover Level (m) 11.668

Tank or Pond Structure

Invert Level (m) 9.868

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1930.0	1.500	3183.4	1.800	3463.5

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0142-1060-1500-1060
Design Head (m)	1.500
Design Flow (l/s)	10.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	142
Invert Level (m)	9.858
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	10.6
Flush-Flo™	0.442	10.6
Kick-Flo®	0.939	8.5
Mean Flow over Head Range	-	9.2

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.1	1.200	9.5	3.000	14.7	7.000	22.1
0.200	9.6	1.400	10.3	3.500	15.8	7.500	22.8
0.300	10.3	1.600	10.9	4.000	16.9	8.000	23.5
0.400	10.6	1.800	11.5	4.500	17.8	8.500	24.2
0.500	10.6	2.000	12.1	5.000	18.8	9.000	24.9
0.600	10.4	2.200	12.7	5.500	19.6	9.500	25.5
0.800	9.7	2.400	13.2	6.000	20.5		
1.000	8.8	2.600	13.7	6.500	21.3		