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JOB NUMBER: **MD1356**

PROJECT: **PROPOSED DEVELOPMENT, CHRISTON BANK FARM**

CLIENT: MR R JEFFREYS

REPORT NUMBER: MD1356/rep/001 Rev A

REPORT TITLE: **FLOOD RISK & DRAINAGE ASSESSMENT**

Prepared with reasonable care and attention:

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Marc J Haley
B.Eng (Hons) C.Eng M.I.C.E.

M DESIGN civil, structural & environmental engineering
Unit 4 Bewick House, Horsley Business Centre, Horsley Village, Northumberland, NE15 0NY
t 01661 854444 **f** 01661 854455 **e** info@mdesign.uk.com **w** www.mdesign.uk.com

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EXECUTIVE SUMMARY

M Design were commissioned by Mr R Jeffreys to undertake a Flood Risk Assessment (FRA) in support of the proposed development at Christon Bank Farm.

The development was found to be in Flood Zone 1 and therefore not at risk of flooding. Other sources of flooding have been investigated within this report.

The proposal for the site is the construction of a residential development consisting of up to 5 dwellings. No site layout has been produced at the time of producing this report. There is a large stable building on site which will be demolished as part of the works.

It is important to ensure that the drainage is designed in a manner that does not increase the likelihood of flooding either on site or elsewhere in the catchment area.

In summary the this report will ensure that the site is not at risk of flooding and the drainage will be designed in a manner that does not increase the risk of flooding in the area. Development of this site will be shown to be appropriate in relation to flood risk within the body of this report.

1 INTRODUCTION

M Design were commissioned by Mr R Jeffreys to undertake a Flood Risk Assessment (FRA) in support of the proposed development at Christon Bank Farm.

The planning process requires an assessment to be made of any flood risks related to proposed developments. In particular this involves two key issues; whether the development itself would be at risk of being flooded or whether the development would increase the risk of flooding elsewhere. This assessment is contained within this report which has been prepared for submission with the planning application.

The study also assesses the potential requirements for any surface water storage within the on-site infrastructure design.

1.2 Scope of Report

The following tasks were undertaken in the preparation of this report:

- A site visit was carried out in order to identify any risks of flooding to the site, identify drainage patterns, receiving watercourses, and to identify any constraints to the drainage system that may restrict the proposed development;
- Liaison with the Environment Agency was undertaken to establish occurrences of flooding in the area;
- Calculations were undertaken to establish the current surface water runoff from the site
- An evaluation was made of how the proposed development would affect the existing surface water runoff.

1.3 Consultations and Data Sources

The following tasks were undertaken in the preparation of this report:

- Environment Agency Flood Maps;
- Landmark Information Group Maps;
- Institute of Hydrology (1994) Report 124 – Flood Estimation for Small Catchments;
- CIRIA Document 624 ‘Development and Flood Risk’
- Environment Agency;

2 Site Description

2.1 Site Location

The site is located to the east of the B6347 south of Christon Bank. The centre of the site is at NZ 210 223. The site elevation is approximately 128.5m A.O.D.

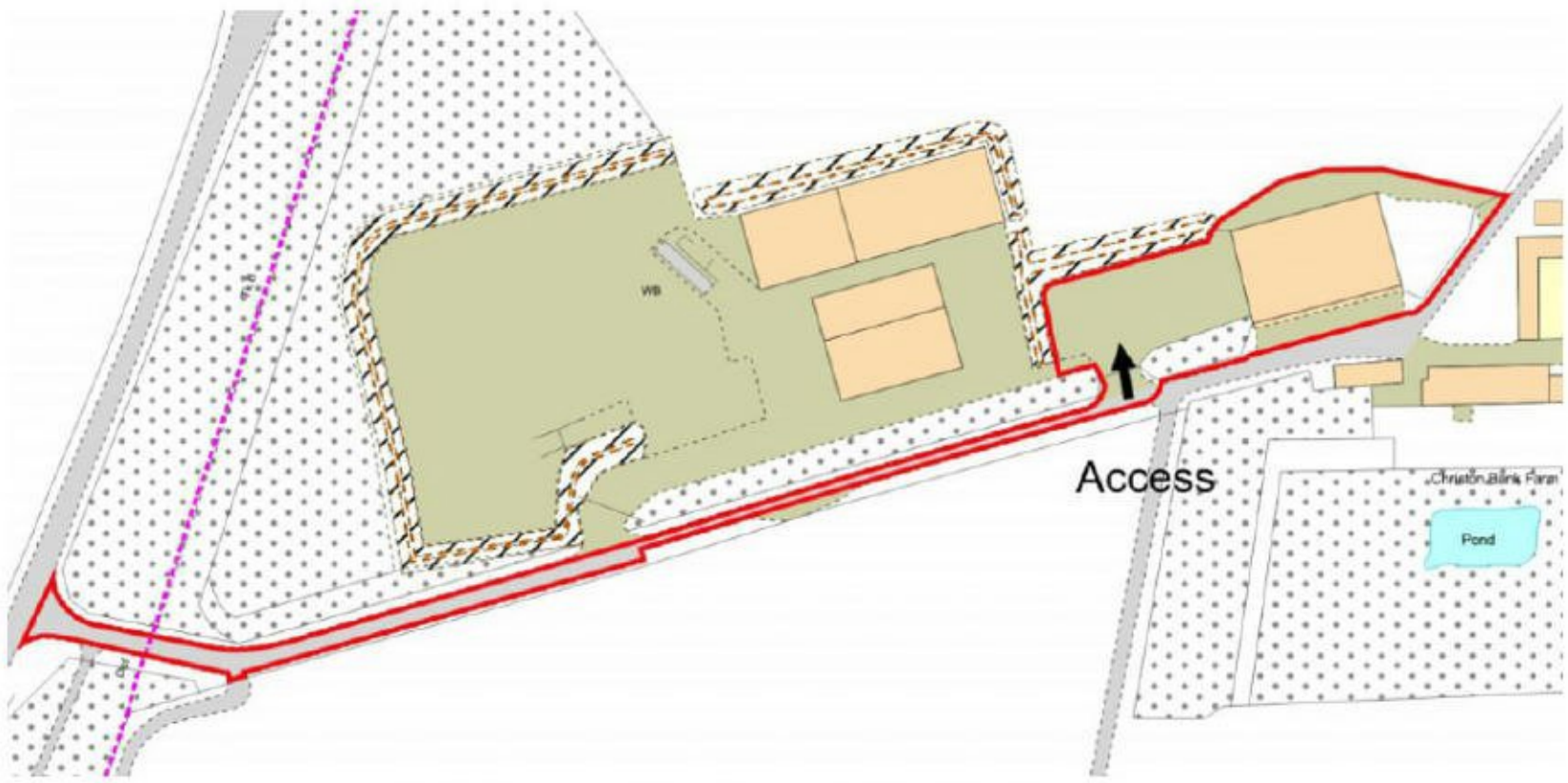


Fig 2.1 Proposed Development at Christon Bank Farm.

The site is situated within the grounds of the exiting farm. It is accessed via a junction to the west. There are agricultural buildings to the west and residential dwellings to the east. An aerial photograph is included within this report as Appendix A.

2.2 Site Walkover Survey

A site visit was conducted by M Design on 15th May 2019 in order to determine key site topographical and drainage features.

The site generally slopes towards the north western boundary. There is a large agricultural building which takes up the large majority of the site; this will be demolished as part of the development. There is a drainage system on site which collects the surface water from the existing building. This is discussed within the body of this report.

2.3 Site Flooding Potential

The development is shown by the Environment Agency flood maps to lie within flood zone 1.

The Environment Agency's definition of this is stated below:

Flood Zone 1

Definition
This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).

Appropriate uses
All uses of land are appropriate in this zone.

FRA requirements
For development proposals on sites comprising one hectare or above the vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off, should be incorporated in a FRA. This need only be brief unless the factors above or other local considerations require particular attention. See Annex E for minimum requirements.

Policy aims
In this zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage techniques.

To establish if the proposed development is appropriate within Flood Zone 1 the vulnerability of the site is to be assessed. Referring to the table below, the proposed works would be classed as "**More Vulnerable**".

Table D.2: Flood Risk Vulnerability Classification

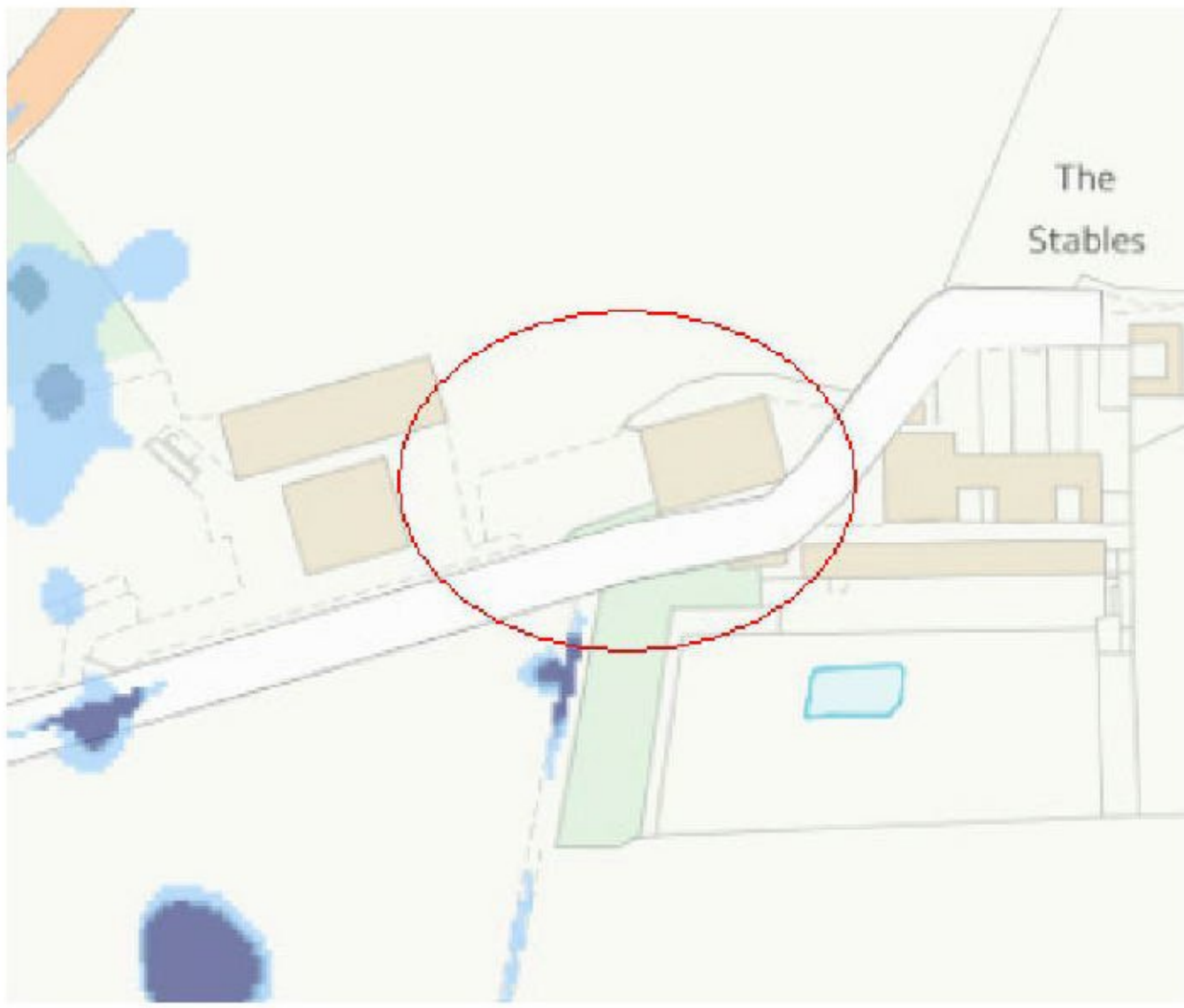
Essential Infrastructure	• Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk, and strategic utility infrastructure, including electricity generating power stations and grid and primary substations.
Highly Vulnerable	• Police stations, Ambulance stations and Fire stations and Command Centres and telecommunications installations required to be operational during flooding. • Emergency dispersal points. • Basement dwellings. • Caravans, mobile homes and park homes intended for permanent residential use. • Installations requiring hazardous substances consent.19
More Vulnerable	• Hospitals. • Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels. • Buildings used for: dwelling houses; student halls of residence; drinking establishments; nightclubs; and hotels. • Non–residential uses for health services, nurseries and educational establishments. • Landfill and sites used for waste management facilities for hazardous waste.20 • Sites used for holiday or short-let caravans and camping, **subject to a specific warning and evacuation plan**.
Less Vulnerable	• Buildings used for: shops; financial, professional and other services; restaurants and cafes; hot food takeaways; offices; general industry; storage and distribution; non–residential institutions not included in 'more vulnerable'; and assembly and leisure. • Land and buildings used for agriculture and forestry. • Waste treatment (except landfill and hazardous waste facilities). • Minerals working and processing (except for sand and gravel working). • Water treatment plants. • Sewage treatment plants (if adequate pollution control measures are in place).

Table D.3: Flood Risk Vulnerability and Flood Zone 'Compatibility'

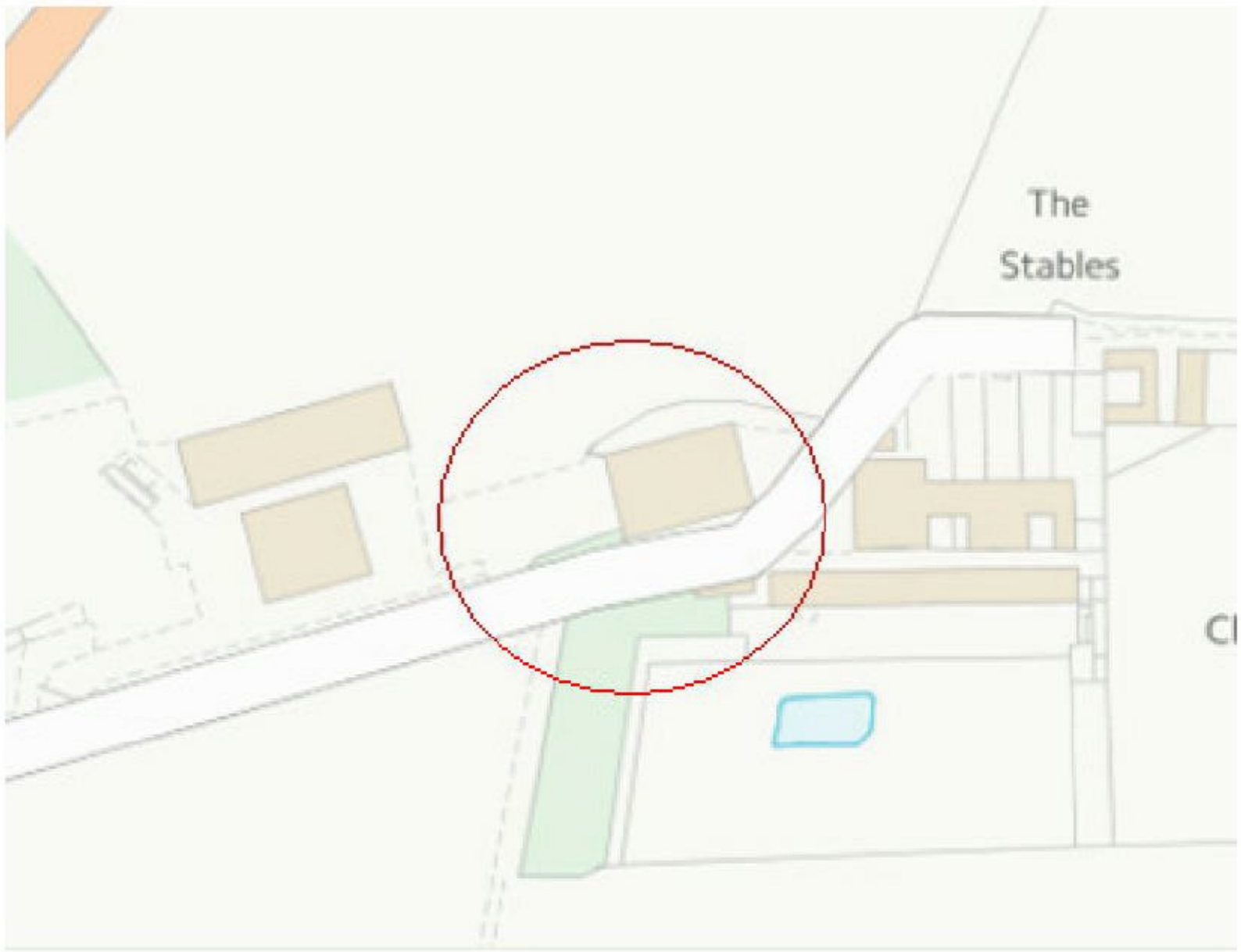
Flood Risk Vulnerability classification (see Table D2)	Essential Infrastructure	Water compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Zone 1	YES	YES	YES	YES	YES
Zone 2	YES	YES	Exception Test Required	YES	YES
Zone 3a	Exception Test Required	YES	NO	Exception Test Required	YES
Zone 3b 'Functional Floodplain'	Exception Test Required	YES	NO	NO	NO

As shown previously the site is within **Flood Zone 1** and is classed as **More Vulnerable**. Table D.3 confirms that the development is appropriate and no exception test is required.

M Design have also considered risk of flooding for other sources. The plan below shows that there is no risk to the site from surface water flooding.



The plan shows that there is no risk of surface water flooding on site. The risk of flooding due to a reservoir in the area failing has also been considered. The plan below shows that there is not risk from this.



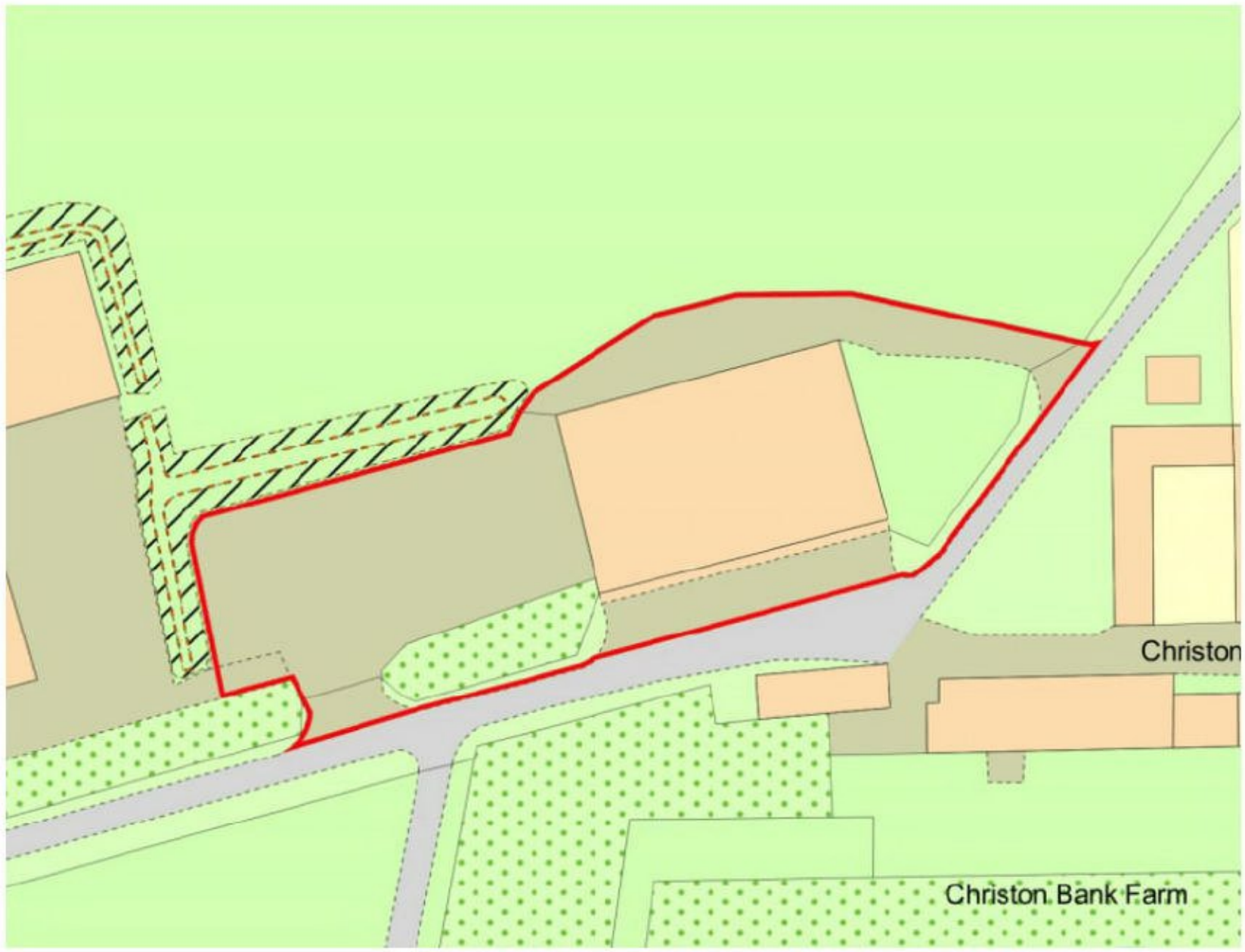
In summary the site has been shown to be free from risk of flooding from main rivers, seas and reservoirs and surface water. The site is therefore deemed acceptable in terms of flood risk.

M DESIGN civil, structural & environmental engineering
Unit 4 Bewick House, Horsley Business Centre, Horsley Village, Northumberland, NE15 0NY
t 01661 854444 **f** 01661 854455 **e** info@mdesign.uk.com **w** www.mdesign.uk.com

3 Proposed Development

3.1 Proposed Development Description

The proposal for the site is to demolish the existing building and construct up to 5 dwellings, these will be served by an access road and parking areas. There is no site layout available at the time of producing this report so an impermeable area will be assumed for the surface water calculations.



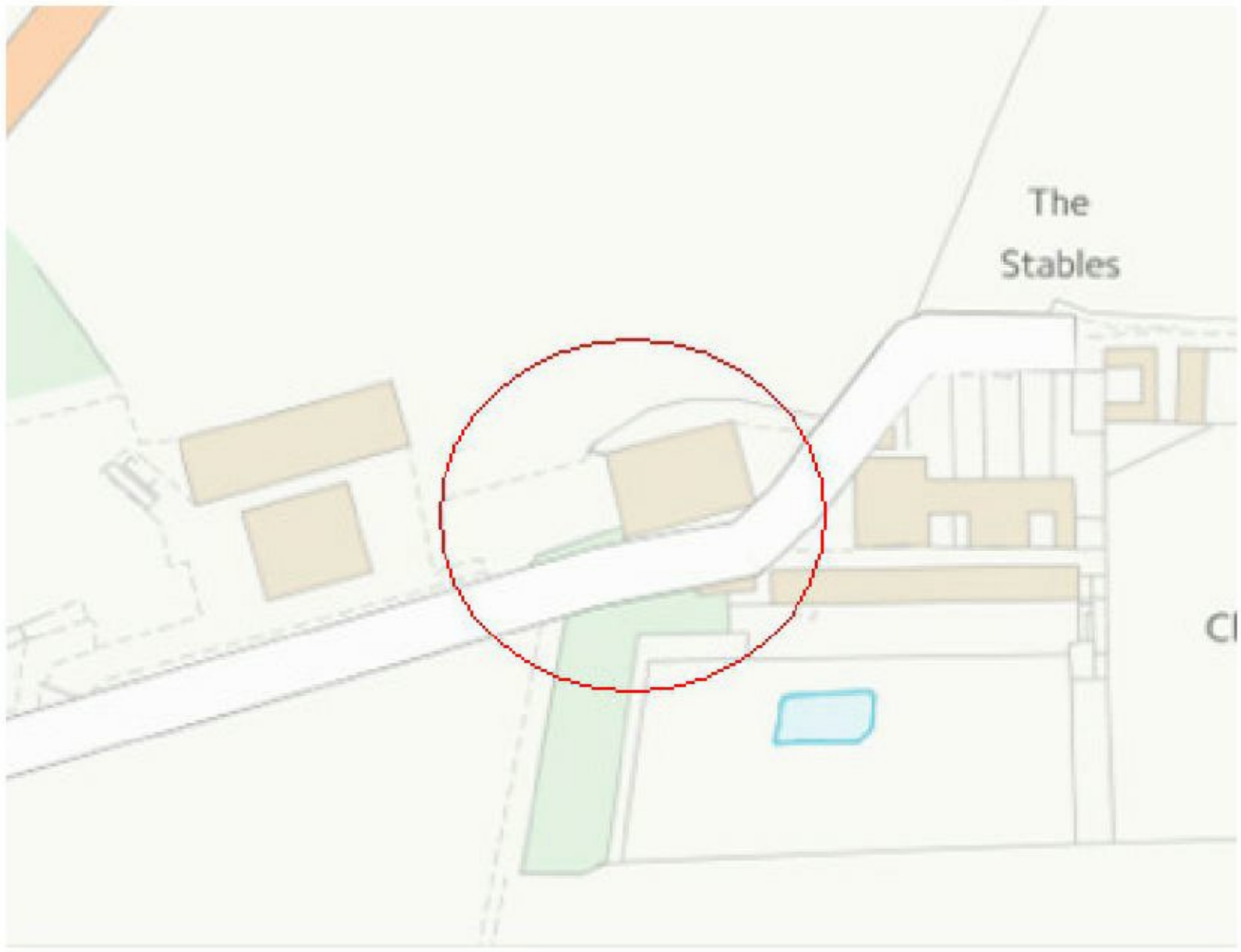
Site Area

3.2 Proposed Development Surface Water Runoff & Proposals

Following the Building Regulations hierarchy of surface water disposal methods, the first option to be in investigated will be via sustainable urban drainage techniques such as soakaways.

There has not been a site investigation carried out at this time, however from local knowledge it is assumed that the ground conditions will be heavy clays and as a result soakaways will not be viable. This will be confirmed once a site investigation is carried out.

The second option would be for the surface water to be discharged into a local watercourse or sewer. However there is no watercourse in the location of the site.



The final option is to dispose the flows into an existing sewer system. A site visit has confirmed that there is a sewer system which serves the existing building. A rain water pipe was removed and water was poured in and was viewed flowing unrestricted into this system. There is also a hardstanding area used as a car park which could drain into this pipe.

Photograph Showing RWP in North West Corner Discharging into Sewer

Photograph Showing RWP in North East Corner Discharging into Sewer

M DESIGN civil, structural & environmental engineering
Unit 4 Bewick House, Horsley Business Centre, Horsley Village, Northumberland, NE15 0NY
t 01661 854444 **f** 01661 854455 **e** info@mdesign.uk.com **w** www.mdesign.uk.com

Photograph Showing RWP in South East Corner Discharging into Sewer

This shows that the surface water from the site currently discharges, unrestricted into the existing pipe network on site. Therefore this could provide a suitable discharge location for the proposed development.

The client has confirmed that the pipe flows east away from the development and also picks up the surface water drainage from the existing dwellings to the east.

This would be the most logical location to dispose the surface water flows from the development. The pipe has been accepting the unrestricted flows from the existing site and the client has stated that there have been no flooding issues.

This pipe will be investigated within the detailed design stage with a CCTV survey to confirm it is in a suitable condition to accept the flows and any repairs/replacements carried out depending on the results. .

However the local authority has raised concerns as there is no record of the route or final discharge point of this pipe and on site investigations could not confirm this at this stage. As a result an alternative route has been suggested.

M DESIGN civil, structural & environmental engineering
Unit 4 Bewick House, Horsley Business Centre, Horsley Village, Northumberland, NE15 0NY
t 01661 854444 **f** 01661 854455 **e** info@mdesign.uk.com **w** www.mdesign.uk.com

There is an existing NWL surface water system to the north of the development this flows into a culverted watercourse. As discussed in the next section of this report this is in a similar location to the proposed foul water connection.

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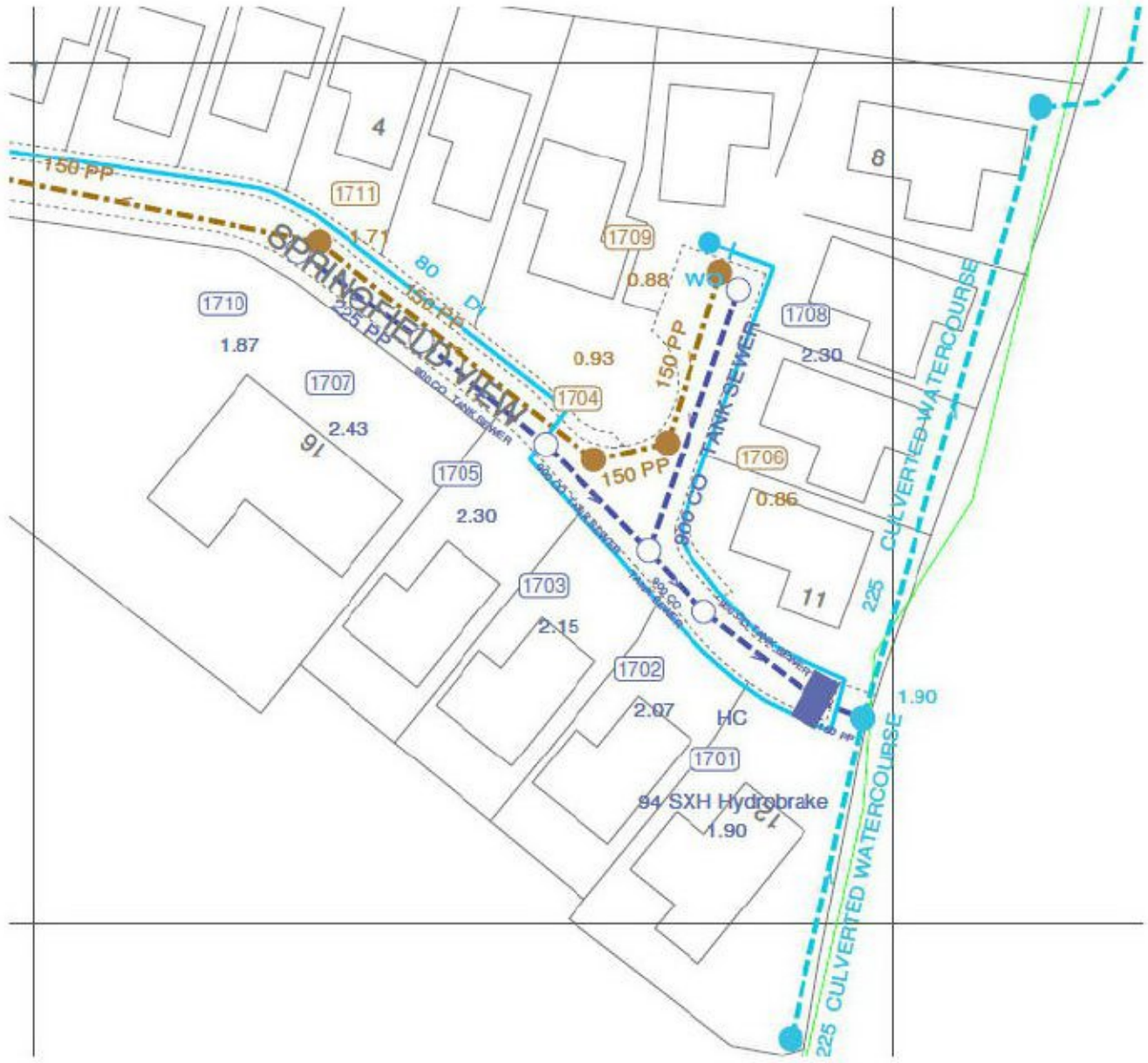
Unit 4 Bewick House, Horsley Business Centre, Horsley Village, Northumberland, NE15 0NY
t 01661 854444 **f** 01661 854455 **e** info@mdesign.uk.com **w** www.mdesign.uk.com



It is possible that this culverted watercourse is actually where the existing pipework from the site discharged into.

It is proposed that if the sewers on site can not be investigated sufficiently to confirm the final outfall then a surface water off site connection would discharge the flows either into the NWL sewers or directly into the culverted watercourse. If the flows are to be discharged into the existing NWL sewers a developers enquiry will be submitted to NWL to confirm the connection is acceptable.

A level survey will be required tyo ensure a gravity connection is possible, however checking the levels on google earth has shown that the site is approximately 8m higher that the proposed discharge location which is 380m away giving an average gradient of 1 in 47.5 so it is envisaged that a connection will be possible.

The above have highlighted that if soakaways are not a viable option then there are 3 possible locations for the surface water discharge. Each will be investigated fully prior to the final drainage design and the findings presented to the local authority for approval.

M DESIGN civil, structural & environmental engineering
Unit 4 Bewick House, Horsley Business Centre, Horsley Village, Northumberland, NE15 0NY
t 01661 854444 **f** 01661 854455 **e** info@mdesign.uk.com **w** www.mdesign.uk.com

Whichever final discharge location is chosen. the proposed drainage system will be restricted by the use of a hydrobrake and surface water attenuation provided on site. This will ensure that the surface water discharge from the site will actually be reduced by the works.

As a conservative approach only the existing building impermeable area has been taken into consideration event though some areas of the car park could also be discharge into the system. The building footprint of 950m2 has been discharging freely into the sewer.

Taking the above parameters into consideration, in inputting them into Microdrainage, the existing 1 in 1 year summer surface water run off rate has been calculated to be approximately 7.9 l/s.

Summary of Results

Return Period (year)	1
Storm Duration (mins)	30
Profile Type	Summer
Margin for Flood Risk warning (mm)	300
Analysis Time Step	2.5 second increment (extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

PN	Water Lev. (m)	Surcharged Depth (m)	Flooded Vol (m^3)	Flow/ Capacity	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	125.719	0.119	0.000	1.21	0.0	7.9	SURCH'ED
1.001	125.323	-0.027	0.000	0.88	0.0	7.9	O K

Even if the system was only running at 75% efficiency this would still give a run off rate of 5.9 l/s.

This flow rate also increases when taking into consideration a 1 in 100 year storm event as shown below.

Summary of Results

Return Period (years)	100
Storm Duration (mins)	30
Profile Type	Summer
Margin for Flood Risk warning (mm)	300
Analysis Time Step	2.5 second increment (extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

PN	Water Lev. (m)	Surcharged Depth (m)	Flooded Vol (m^3)	Flow/ Capacity	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	126.503	0.903	3.053	1.99	0.0	13.0	FLOOD
1.001	125.584	0.234	0.000	1.40	0.0	12.5	SURCH'ED

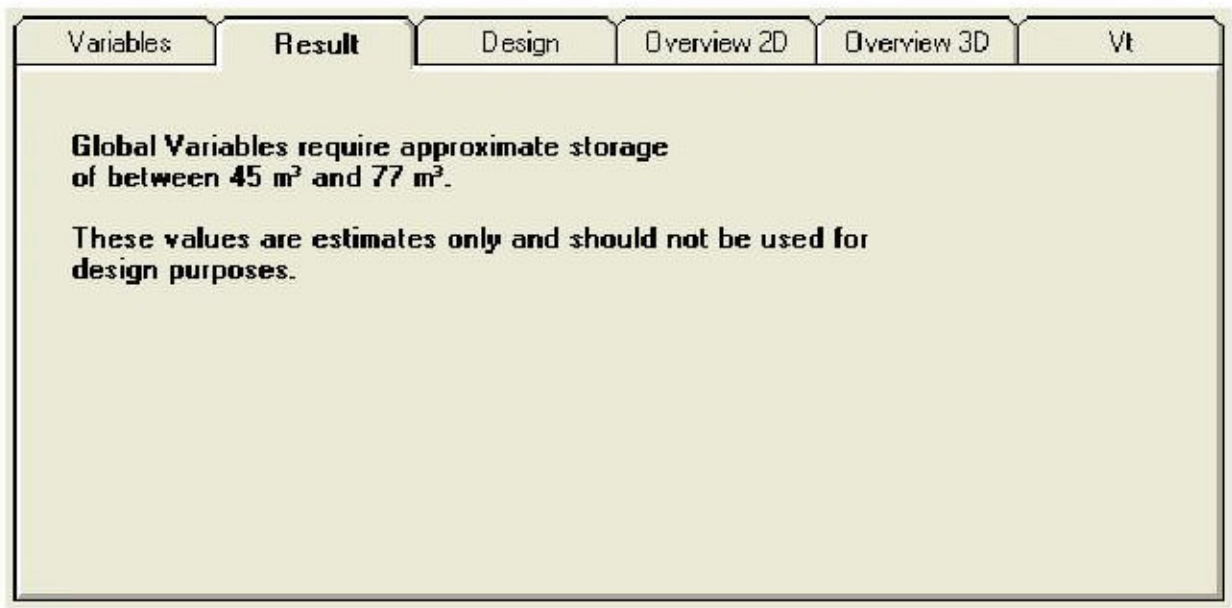
To ensure that the development does not increase the risk of flooding either on site or elsewhere the surface water flows will be restricted to 5 l/s prior to being discharged into the existing pipe. This provides betterment over the existing situation as it reduces the discharge rate into the existing system, especially in the larger storm events.

As there is no site layout available an impermeable area will need to be estimated. The site area is approximately 3800m2. Taking a conservative approach and assuming 40% of this will be developed that will give an impermeable area of 1520m2.

As the proposed surface water flows will be restricted to 5 l/s surface water attenuation will be required. This could be in the form of storage crates situated within the access road of the development.

The storage will be designed to accommodate a 1 in 100 year storm event with an allowance for 20% climate change. The 1 in 100 year plus 40% climate change will also be modelled to ensure no properties will be at risk from flooding.

The proposed impermible area has been estimated to be 1520m2. Taking this into account and the restricted flow rate of 5 l/s the following storage volume has been estimated (based on a 1 in 100 year storm event with an allowance for 40% climate change)



This estimate has been used as a base to create a Microdrainage model using storage crates which runs the proposed impermeable area through a series of storm evens. The 1 in 100 year storm events with an allowance for 40% climate change have been assessed,

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The most logical location to position to house the storage crates would be below the access road and this is what the below design has been based on. There is also the option of providing each plot with its own attenuation system. The final design will be confirmed following the production of the site layout.

The calculations below are based on a 22m x 3.5m x 0.8m deep storage crate system and a 5 l/s discharge rate into the existing manhole on site.

Summary of Results For 100 Year Return Period

Sort By Storm Duration — Half Drain Time : 81 minutes

Storm Duration (mins)	Rain (mm/hr)	Time To Vol Peak (mins)	Max Water Level (m)	Max Depth (m)	Max Control (l/s)	Max Filtration (l/s)	E. Max Outflow (l/s)	Maximum Volume (m³)	Status
15 Summer	75.56	17	100.260	0.260	4.1	0.0	4.1	19.1	O K
30 Summer	52.22	31	100.344	0.344	4.1	0.0	4.1	25.2	O K
60 Summer	34.59	60	100.412	0.412	4.1	0.0	4.1	30.1	O K
120 Summer	22.17	92	100.450	0.450	4.1	0.0	4.1	32.9	O K
180 Summer	16.84	126	100.454	0.454	4.1	0.0	4.1	33.2	O K
240 Summer	13.75	160	100.445	0.445	4.1	0.0	4.1	32.6	O K
360 Summer	10.24	230	100.413	0.413	4.1	0.0	4.1	30.2	O K
480 Summer	8.32	296	100.378	0.378	4.1	0.0	4.1	27.6	O K
600 Summer	7.07	362	100.342	0.342	4.2	0.0	4.2	25.0	O K
720 Summer	6.18	426	100.305	0.305	4.1	0.0	4.1	22.3	O K
960 Summer	5.00	538	100.234	0.234	4.1	0.0	4.1	17.1	O K
1440 Summer	3.70	764	100.172	0.172	3.7	0.0	3.7	12.6	O K
2160 Summer	2.73	1124	100.126	0.126	3.0	0.0	3.0	9.2	O K
2880 Summer	2.20	1472	100.100	0.100	2.6	0.0	2.6	7.3	O K
4320 Summer	1.61	2204	100.076	0.076	2.0	0.0	2.0	5.5	O K
5760 Summer	1.29	2936	100.061	0.061	1.6	0.0	1.6	4.5	O K
7200 Summer	1.09	3672	100.052	0.052	1.4	0.0	1.4	3.8	O K
8640 Summer	0.95	4400	100.045	0.045	1.2	0.0	1.2	3.3	O K
10080 Summer	0.85	5136	100.041	0.041	1.1	0.0	1.1	3.0	O K
15 Winter	75.56	17	100.296	0.296	4.1	0.0	4.1	21.6	O K
30 Winter	52.22	31	100.391	0.391	4.1	0.0	4.1	28.6	O K
60 Winter	34.59	58	100.470	0.470	4.1	0.0	4.1	34.4	O K
120 Winter	22.17	96	100.510	0.510	4.1	0.0	4.1	37.3	O K
180 Winter	16.84	136	100.510	0.510	4.1	0.0	4.1	37.3	O K
240 Winter	13.75	174	100.493	0.493	4.1	0.0	4.1	36.1	O K
360 Winter	10.24	248	100.441	0.441	4.1	0.0	4.1	32.3	O K
480 Winter	8.32	320	100.384	0.384	4.2	0.0	4.2	28.1	O K
600 Winter	7.07	386	100.325	0.325	4.1	0.0	4.1	23.8	O K
720 Winter	6.18	442	100.258	0.258	4.1	0.0	4.1	18.9	O K
960 Winter	5.00	538	100.187	0.187	4.0	0.0	4.0	13.7	O K
1440 Winter	3.70	778	100.133	0.133	3.1	0.0	3.1	9.7	O K
2160 Winter	2.73	1124	100.093	0.093	2.4	0.0	2.4	6.8	O K
2880 Winter	2.20	1472	100.075	0.075	2.0	0.0	2.0	5.5	O K
4320 Winter	1.61	2204	100.056	0.056	1.4	0.0	1.4	4.1	O K
5760 Winter	1.29	2936	100.045	0.045	1.2	0.0	1.2	3.3	O K
7200 Winter	1.09	3672	100.038	0.038	1.0	0.0	1.0	2.8	O K
8640 Winter	0.95	4392	100.033	0.033	0.9	0.0	0.9	2.4	O K
10080 Winter	0.85	5136	100.029	0.029	0.8	0.0	0.8	2.1	O K

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Unit 4 Bewick House, Horsley Business Centre, Horsley Village, Northumberland, NE15 0NY
t 01661 854444 **f** 01661 854455 **e** info@mdesign.uk.com **w** www.mdesign.uk.com

Summary of Results For 100 Year Return Period (+40%)

Sort By Storm Duration Half Drain Time : 115 minutes

Storm Duration (mins)	Rain (mm/hr)	Time To Vol Peak (mins)	Max Water Level (m)	Max Depth (m)	Max Control (l/s)	Max Filtration (l/s)	E. Max Outflow (l/s)	Maximum Volume (m³)	Status
15 Summer	105.79	18	100.376	0.376	4.1	0.0	4.1	27.5	O K
30 Summer	73.11	32	100.498	0.498	4.1	0.0	4.1	36.5	O K
60 Summer	48.42	60	100.603	0.603	4.4	0.0	4.4	44.1	O K
120 Summer	31.04	96	100.666	0.666	4.6	0.0	4.6	48.7	O K
180 Summer	23.58	130	100.681	0.681	4.7	0.0	4.7	49.8	O K
240 Summer	19.25	164	100.676	0.676	4.6	0.0	4.6	49.5	O K
360 Summer	14.34	234	100.646	0.646	4.5	0.0	4.5	47.2	O K
480 Summer	11.64	304	100.611	0.611	4.4	0.0	4.4	44.7	O K
600 Summer	9.89	370	100.575	0.575	4.3	0.0	4.3	42.0	O K
720 Summer	8.66	438	100.539	0.539	4.2	0.0	4.2	39.4	O K
960 Summer	7.00	570	100.472	0.472	4.1	0.0	4.1	34.5	O K
1440 Summer	5.18	822	100.346	0.346	4.1	0.0	4.1	25.3	O K
2160 Summer	3.82	1128	100.196	0.196	4.1	0.0	4.1	14.4	O K
2880 Summer	3.08	1496	100.155	0.155	3.4	0.0	3.4	11.3	O K
4320 Summer	2.26	2204	100.107	0.107	2.7	0.0	2.7	7.8	O K
5760 Summer	1.81	2936	100.086	0.086	2.2	0.0	2.2	6.3	O K
7200 Summer	1.53	3672	100.073	0.073	1.9	0.0	1.9	5.3	O K
8640 Summer	1.33	4400	100.064	0.064	1.7	0.0	1.7	4.6	O K
10080 Summer	1.18	5136	100.057	0.057	1.5	0.0	1.5	4.1	O K
15 Winter	105.79	18	100.425	0.425	4.1	0.0	4.1	31.1	O K
30 Winter	73.11	32	100.563	0.563	4.2	0.0	4.2	41.2	O K
60 Winter	48.42	60	100.688	0.688	4.7	0.0	4.7	50.3	O K
120 Winter	31.04	104	100.759	0.759	4.9	0.0	4.9	55.5	O K
180 Winter	23.58	138	100.774	0.774	5.0	0.0	5.0	56.6	O K
240 Winter	19.25	178	100.762	0.762	4.9	0.0	4.9	55.8	O K
360 Winter	14.34	254	100.712	0.712	4.8	0.0	4.8	52.1	O K
480 Winter	11.64	326	100.656	0.656	4.6	0.0	4.6	48.0	O K
600 Winter	9.89	398	100.600	0.600	4.4	0.0	4.4	43.9	O K
720 Winter	8.66	470	100.546	0.546	4.2	0.0	4.2	39.9	O K
960 Winter	7.00	606	100.444	0.444	4.1	0.0	4.1	32.5	O K
1440 Winter	5.18	808	100.218	0.218	4.1	0.0	4.1	16.0	O K
2160 Winter	3.82	1144	100.145	0.145	3.3	0.0	3.3	10.6	O K
2880 Winter	3.08	1500	100.107	0.107	2.7	0.0	2.7	7.8	O K
4320 Winter	2.26	2204	100.078	0.078	2.0	0.0	2.0	5.7	O K
5760 Winter	1.81	2904	100.063	0.063	1.6	0.0	1.6	4.6	O K
7200 Winter	1.53	3672	100.053	0.053	1.4	0.0	1.4	3.9	O K
8640 Winter	1.33	4368	100.046	0.046	1.2	0.0	1.2	3.4	O K
10080 Winter	1.18	5056	100.041	0.041	1.1	0.0	1.1	3.0	O K

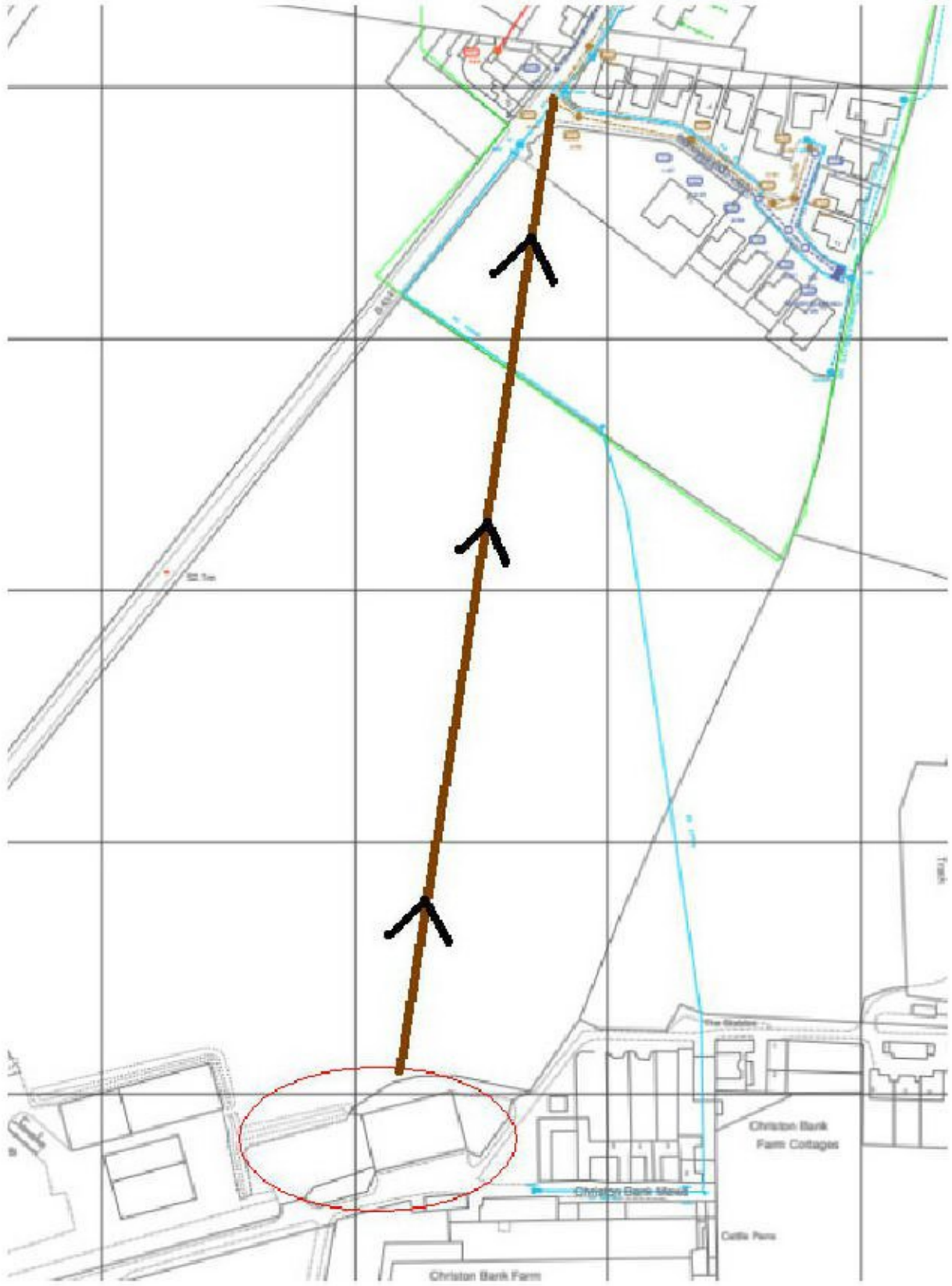
The site boundary is approximately 40m x 90m so there will be adequate space on site to house this system. At the detailed design stage the client will look at using SUD systems such as permeable surfaces which will reduce the permeable area and therefore reduce the storage volume required. 10 % additional impermeable area will be allowed in the final design to allow for urban creep.

In summary, if soakaways are found not to be viable, the proposed surface water drainage from the site will be restricted to 5 l/s and discharged into the existing drainage system in the area. As this is a reduction on the existing unrestricted flows into this system this is deemed as a satisfactory means of surface water disposal.

The full drainage design will be carried out following the production of the proposed site layout. The site has been shown not to be at risk from flooding and will not increase the risk of flooding elsewhere. The proposals are therefore deemed acceptable in terms of flood risk.

3.3 Proposed Development Foul Water Runoff & Proposals

There are no foul water manholes in the location of the site. The existing properties use sewer treatment plants. However the client owns the field to the north of the site which falls north towards the main village which does have a foul sewer system. It is proposed that a new foul pipe is installed across this field connecting to the NWL adopted system.



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NWL will be consulted in the form of a developers enquiry and a level survey carried out to ensure there is adequate fall to achieve a gravity connection. If a gravity connection is not achievable then a pumping station or treatment plants will be required.

4 Conclusions

4.1 Conclusions

This report has shown that the development will be carried out taking into consideration the flood risk on site and also elsewhere in the catchment area.

The possibility of using soakaways will be investigated prior to the final drainage design. The surface water flows from the development will be restricted to 5l/s and attenuation provided on site.

A survey has been conducted and this proves that there is an existing unrestricted connection from the site. There are also alternative discharge locations to the north which have been discussed within he report. The new drainage system, with its restriction will provide betterment over the existing situation and actually reduce the risk of flooding in the area.

A full drainage design along with calculations will be carried out and submitted to the relevant parties for approval prior to any on site works.

The client will also investigate the use of using SUDs techniques such permeable paving and permeable construction for the driveways. This is to be confirmed in the detailed design stage.

The flood risk to the site has been assessed and the site is not at risk from flooding from rivers, sea, surface water or reservoir flooding.

The drainage system on site the site will not increase the risk of flooding elsewhere in the catchment area. The site is therefore deemed to be acceptable in terms of flood risk.

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Appendix A

Aerial Photograph of Site

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Unit 4 Bewick House, Horsley Business Centre, Horsley Village, Northumberland, NE15 0NY
t 01661 854444 **f** 01661 854455 **e** info@mdesign.uk.com **w** www.mdesign.uk.com

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