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Colwall Mill Farm. Flood Risk Assessment

Prepared for Mr & Mrs Recordon

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1.0	6th March 2016	Draft for comment
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Confidential

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1 SUMMARY

1.1 Purpose

This flood risk assessment is intended to accompany an application for planning permission to

1.2 Overview

Site characteristics					
Location	Colwall Mill Farm, Colwall, Herefordshire, nearest postcode WR13 6HH				
NGR	SO 737 431	**Size (ha)**	N/A	**Existing land use status**	Stables.
Development proposal	Conversion of agricultural buildings to residential use				

Flooding issues					
Source of flooding	**Flood risk**			**Comments**	**Further investigation required?**
	Low	**Medium**	**High**		
Rivers	✓			The site is not near a main river and is mapped as flood zone 1	No
Sea	✓			The site is a minimum of 90.0 m AOD and well above tidal influence..	No
Surface water	✓			There is no mapped risk of surface water within the site.	No
Groundwater	✓			The site is not on an aquifer and there are no mapped superficial deposits	No
Artificial sources	✓			There are no significant bodies of water retained above natural ground level, above the site.	No

2 DEVELOPMENT DESCRIPTION AND LOCATION

2.1 Proposed development

It is proposed to develop existing farm buildings to residential use at Colwall Mill Farm, Colwall, Herefordshire, nearest postcode WR13 6HH. The location of the site is shown in Figure 2.1.

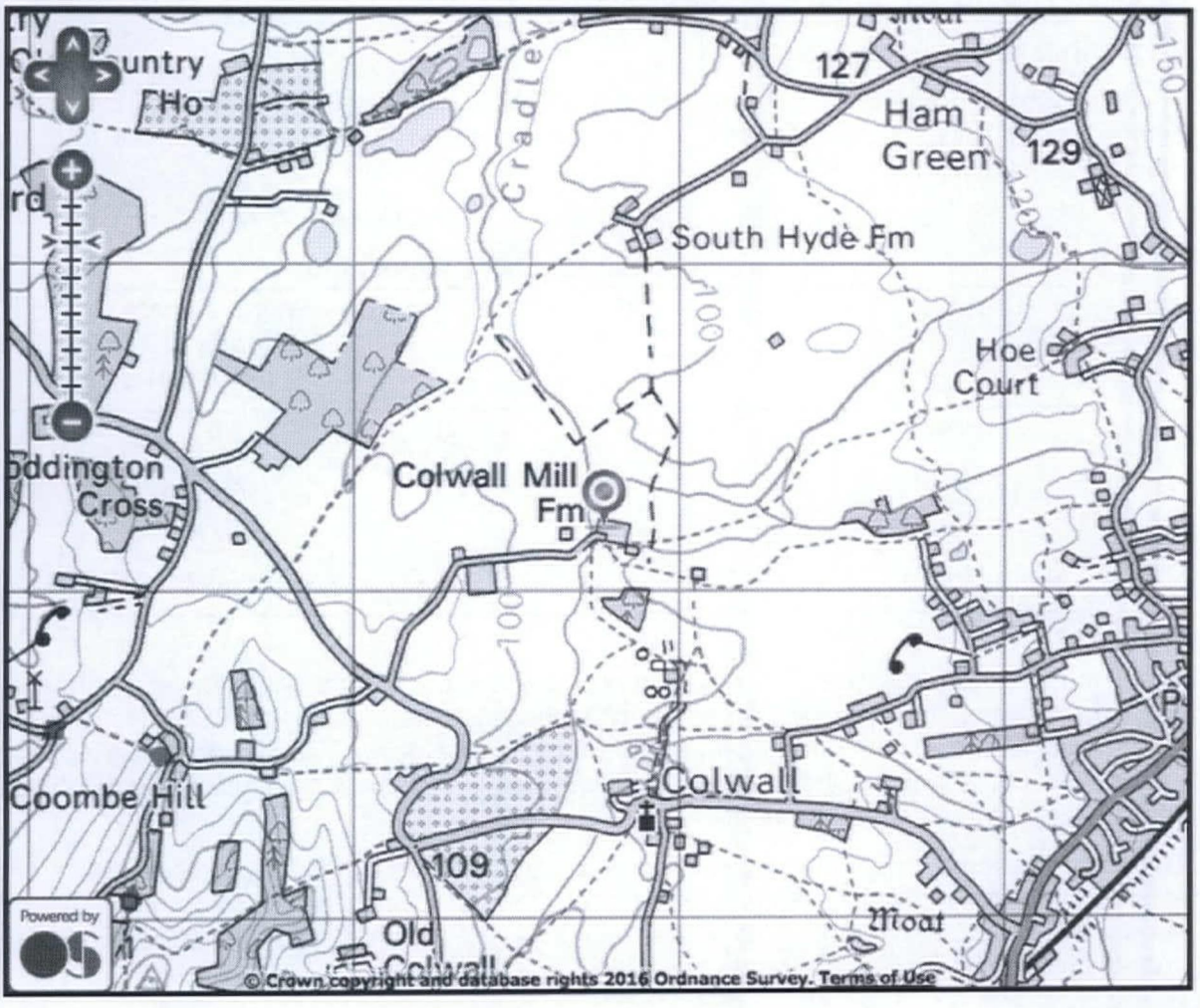

Figure 2.1 Site Location

The Site is a rural location close to the Cradley Brook in the Teme catchment. It is close to the headwaters of the Cradley Brook which flows northwards and has a catchment of approximately 14.4 Km^2 to the Site[1].

The development would include provision of ground floor sleeping accommodation. The development is within the footprint of the existing buildings and has a total area[2] of 50 m^2.

A site plan and proposed development plans are provided in Appendix 1

2.1.1 Existing surface water drainage

The existing buildings are thought to drain to the nearby watercourse. A survey of surface water drainage has not been undertaken.

[1] Catchment area derived digitally from FEH mapping

[2] Building areas measured from site plans and are approximate.

2.1.2 Geology

The site is underlain by the Raglan Mudstone Formation, composed of siltstone and mudstone with no superficial deposits recorded at this location[3]. A borehole drilled at the Farm in 1958 recorded "purpley red mudstone – no sandstones or stoney beds" which confirms the geological map description.

The soils are described as "Slowly permeable seasonally wet acid loamy and clayey soils" with impeded drainage[4]. These are described as typical of seasonally wet pastures and woodlands which drain to the local stream network.

2.1.3 Rainfall Characteristics

The standard average annual rainfall for this location is 694 mm. The rainfall depths for different probabilities (return periods) at the site are shown in Table 2.1, derived from the Flood Estimation Handbook (FEH)[5].

Table 2.1 Calculated Rainfall Depths (mm)

Duration	Return Period (years)	Current (mm)	With Climate Change (30% increase)
6 Hour	1	20.3	26.4
6 Hour	10	36.3	47.2
6 Hour	30	47.7	62.0
6 Hour	100	64.7	84.1

The 6 hour duration is used as an estimate of the most critical duration for a drainage system, following the DEFRA non-statutory technical standards for SuDS[6]. Note this is determined as the estimated critical duration for possible downstream sites where flooding may result, and is not intended to be the critical duration for the Site drainage system itself, which will be a much shorter period.

The return periods chosen are 1 and 10 years, as a guide to commonly experienced storm events, 30 years, which is a design standard for drainage design for which runoff should not appear on the surface, and 100 years, which is the commonly accepted standard for protection of buildings.

2.2 Greenfield Runoff

The DEFRA technical guidance suggests the runoff from developments should emulate Greenfield runoff where feasible. Greenfield runoff is an estimate of the likely runoff from the site before development occurred and is calculated using equations derived from natural river catchments. Available data from such catchments is limited and restricted to much larger areas than individual development sites, so Greenfield runoff is therefore a guide rather than a precise runoff calculation.

[3] BGS Geology of Britain viewer, http://mapapps.bgs.ac.uk/geologyofbritain/home.html

[4] Soilscapes online soils viewer, Cranfield University, http://www.landis.org.uk/soilscapes

[5] Centre for Ecology and Hydrology. Flood Estimation Handbook, 1999, revised 2006.

[6] Sustainable Drainage Systems Non-statutory technical standards for sustainable drainage systems. DEFRA March 2015

Greenfield runoff has been estimated using the standard FEH approach[7] for calculating the median flood (QMED, for a notional 50 Ha site, with an areal reduction to allow for the small size of the development area.

This methodology uses information on the site area, annual rainfall and soil type to calculate the median Greenfield peak runoff rate, QMED, from a revision to the FEH statistical approach updated by SC050050/SR (reported in EA Operational Instruction 940_08)[8] is as follows:

$$Qmed = 8.3062 \times (0.01 \times AREA)^{0.851} \times 0.1536^{(1000 / SAAR)} \times FARL^{3.4451} \times 0.0460^{(BFIHOST \times BFIHOST)}, m^3/s$$

where:

Qmed is the median annual flow rate; the 1:2 year event.
AREA is the area of the catchment in ha.
SAAR is the standard average annual rainfall for the period 1961 to 1990 in mm.
FARL is a reservoir attenuation function and is set at 1.0 and therefore has effectively been ignored. This means that areas with water bodies which attenuate the runoff will over-predict the greenfield runoff rate.
BFIHOST is the base flow index derived using the HOST classification

Using the information from the site from the FEH, median peak flow of 0.0475 l/s (2.85 l/min) is derived. The median peak flow has an annual probability of 1 in 2, and other probabilities can be derived from it as shown in Table 2.2.

These runoff rates are very low and it is accepted[9] that using a vortex control device and practical minimum pipe sizes it is often not practical to control the discharge rate to below 2 l/s. The practical Greenfield runoff rate from the site is therefore taken 2 l/s.

Table 2.2 Calculated Greenfield Runoff Rates

Return Period (years)	Peak Greenfield Rate (l/s)
1	0.04
10	0.05
30	0.06
100	0.1

The volume of Greenfield runoff can be simply calculated using the standard percentage runoff from the soil characteristics. This has been done for the 6 hour duration rainfall events over the 50 m^2 site in Table 2.3.

[7] Centre for Ecology and Hydrology. Flood Estimation Handbook, 1999, revised 2006

[8] Environment Agency (2008) Improvements to the Flood Estimation Handbook statistical method. Operational Instruction 940_08.

[9] Defra/ Environment Agency document 'Preliminary rainfall runoff management for developments' (2011), W5-074/A/TR/1 rev. E.

Table 2.3 Calculated Greenfield Runoff Volume

Duration	Return Period (years)	Rainfall (mm)	Greenfield Runoff Volume (m^3)
6 Hour	1	20.3	0.48
6 Hour	10	36.3	0.85
6 Hour	30	47.7	1.12
6 Hour	100	64.7	1.52

3 PLANNING POLICY

3.1 National Flood Policy

National policy on planning and flood risk is provided by the National Planning Policy Framework (NPPF) and supplementary guidance.

Residential development is classified in technical guidance to the NPPF as "more vulnerable".

Flood risk has been mapped nationally by the Environment Agency to show the flood zones used in the NPPF. Figure 3.1 shows the planning flood zones in the vicinity of the site and indicates that the site is in Flood Zone 1 "Low flood risk". This is described as having an annual flood risk of less than 1 in 1000, though this covers only flooding from main rivers and not from other flood sources. These other sources are considered in subsequent sections of this report.

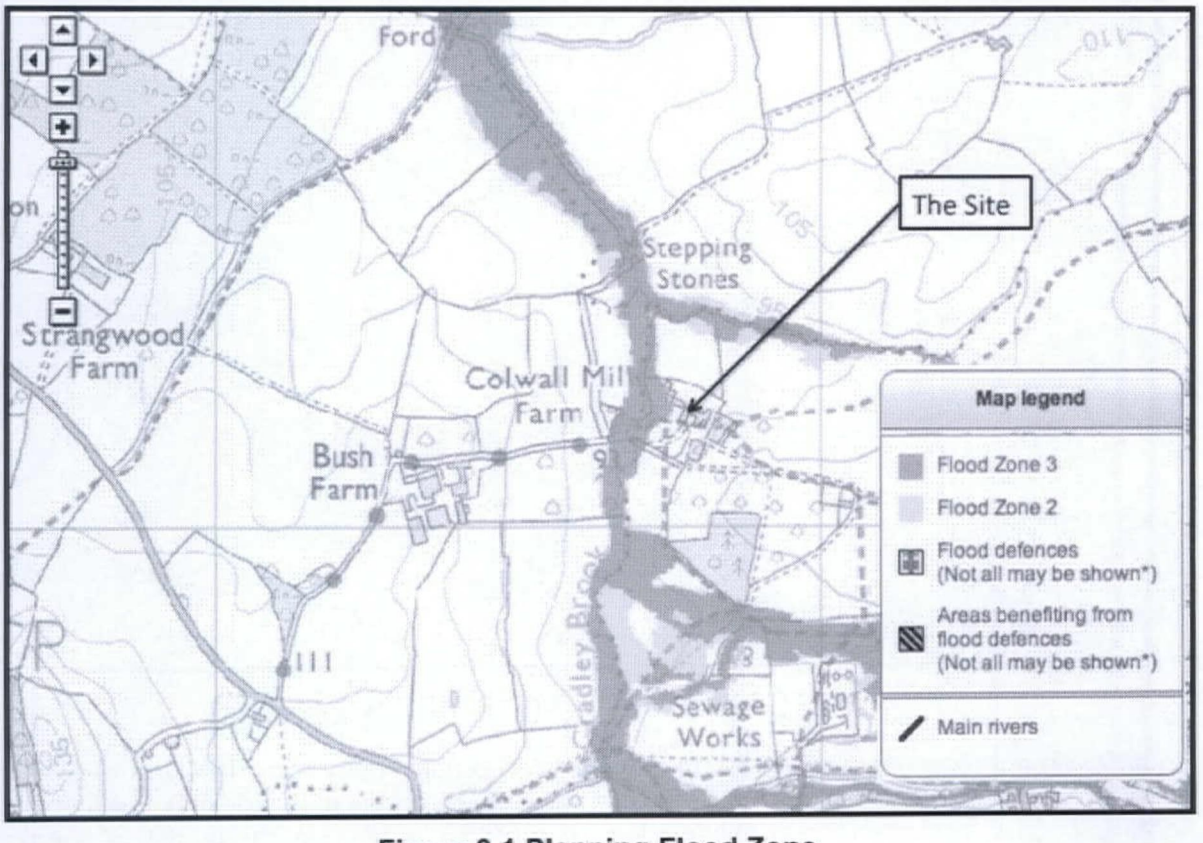

Figure 3.1 Planning Flood Zone

More vulnerable development, such as is proposed at the site, is considered by the NPPF as acceptable in flood zone 1.

3.2 Sequential and Exception test

The sequential and exception tests are not required for more vulnerable development in flood zone 1.

4 DEFINITION OF FLOOD HAZARD

4.1 Historical records

There are no known records of historical flooding at the site

4.2 Sources of flooding

4.2.1 Fluvial flooding

The flood risk arising from rivers is mapped nationally by the Environment Agency, and their onsite flood map is shown in Figure 4.1.

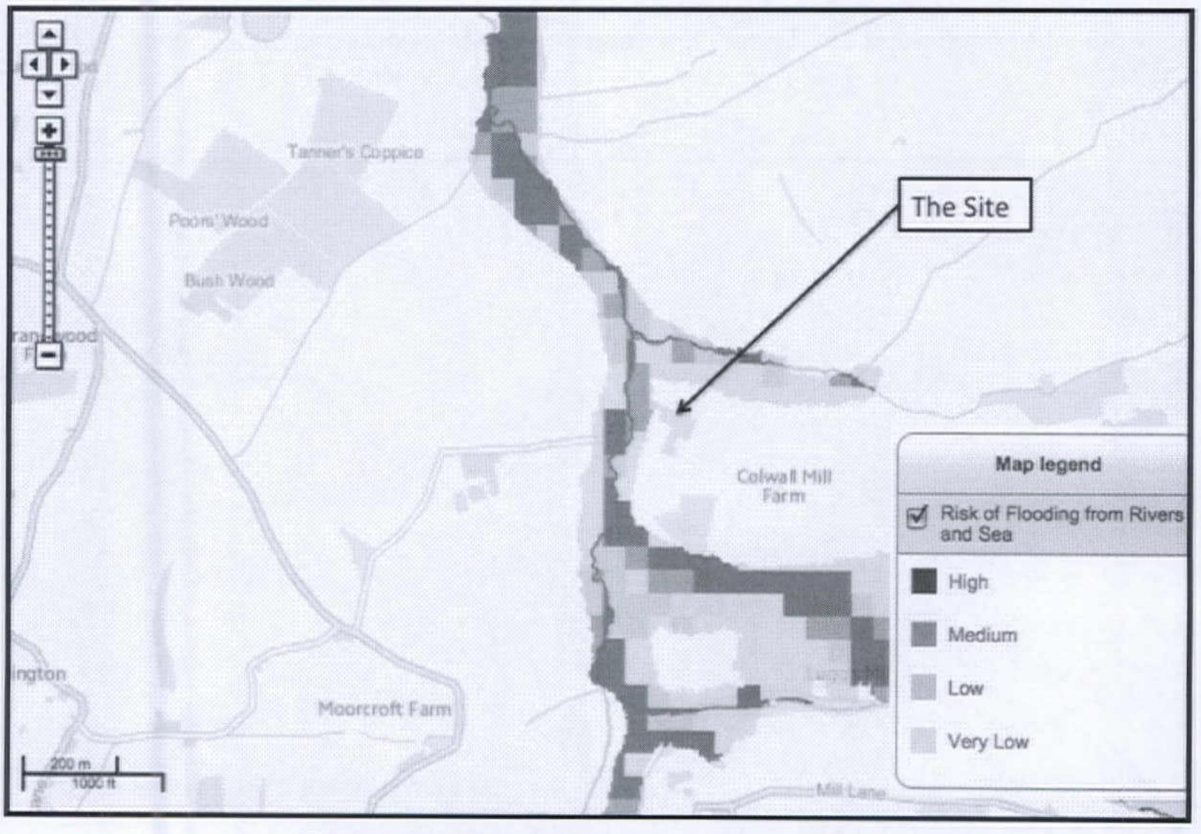

Figure 4.1 Flood Risk from Rivers and Sea

Some overbank flooding along the Cradley Brook is predicted to occur in extreme events, however the Site is elevated above the predicted level of flooding and the likelihood of flooding from this source is thus expected to be very low, ie with an annual risk of flooding less than 1 in 1000.

The mapped flood risk is for the current scenario with no consideration of possible climate change increases. However, the maximum like effect of climate in the 100 year lifetime of the building will not increase the 1 in 100 flood level to the current 1 in 1000 level so the Site will remain outside of the 1 in 100 plus climate change event throughout its life.

4.2.2 Surface water flooding

A map of modelled surface water flooding is also available online and is reproduced in Figure 4.2. Surface water will move down the watercourse valley but there is no overland route identified that could affect the Site or local topographic low that could collect surface water on the Site itself. The likelihood of flooding from this source is therefore considered to be very low.

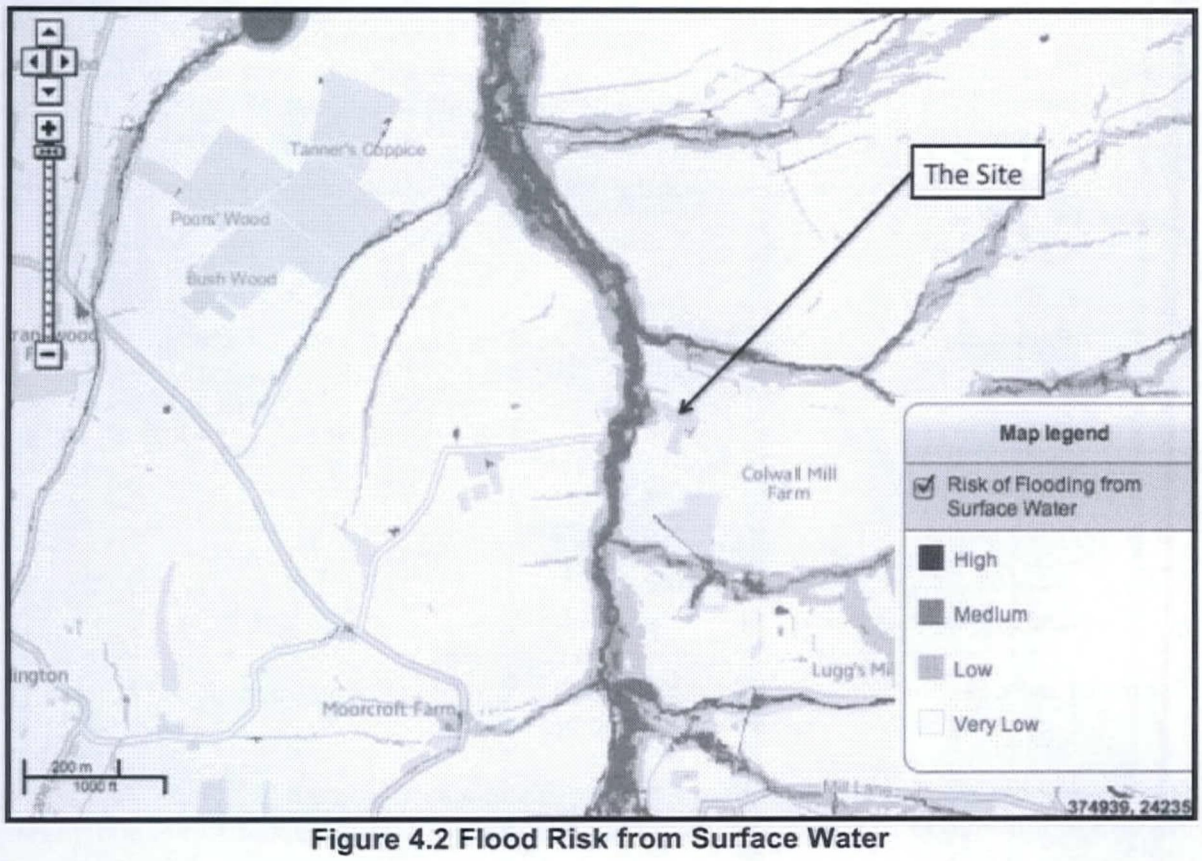

Figure 4.2 Flood Risk from Surface Water

4.2.3 Groundwater flooding

The site is underlain by mudstones and siltstones which are not productive aquifers and do not hold or transmit large volumes of groundwater. There are no superficial deposits recorded on or near the site, so the likelihood of groundwater flooding is considered to be very low.

4.2.4 Catastrophic flooding

This source includes release of large volumes of stored water, such as in reservoirs and canals, due to catastrophic failure. There are no identified sources of stored water in the catchment upstream of the Site that could cause inundation so the probability of flooding from this source is negligible.

4.3 Flood Hazard at the Site

The above review has indicated that there is a very low likelihood of flooding to the Site from all potential sources considered.

5 CLIMATE CHANGE

The NPPF requires that the effects of climate change on surface runoff be considered for new development. The NPPF Technical guidance document suggests increases in intense rainfall and peak runoff are likely to occur over the lifetime of current developments.

The increases suggested in Table 5 of the NPPF Technical Guidance are reproduced in Table 5.1 below.

Parameter	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
Peak rainfall intensity	+5%	+10%	+20%	+30%
Peak river flow	+10%	+20%		
Offshore wind speed	+5%		+10%	
Extreme wave height	+5%		+10%	

Table 5.1 Increase in hydrological parameter due to climate change (reproduced from NPPF Technical Guidance, Table 5.

This type of development is considered to have a lifetime of at least 100 years, so towards the end of that period the peak flow in the watercourse can be expected to have increased by 20% and rainfall intensity by 30%.

The level attained by peak flows is not known precisely at this site but a conservative assumption would be that the present 1 in 1000 year flood extent may become the 1 in 100 year extent. The development is outside of the mapped flood extent for the 1 in 1000 year event at present, so can be considered to remain outside of the 1 in 100 year event throughout its lifetime.

The increase in peak rainfall during the period to 2115 will tend to increase runoff from the site and this is considered below.

6 DETAILED DEVELOPMENT PROPOSAL

6.1 Development layout

The detailed layout of the development is shown in Appendix 1. Residential accommodation is proposed within the footprint of existing farm buildings.

6.2 Policy Requirements

The DEFRA non-statutory technical standards for SuDS[10] brings a national approach to drainage of new development consistent with the National Planning Policy Framework. The guidance presents standards which should be adopted where feasible.

Relevant standards state:

> **S2** For Greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event should never exceed the peak greenfield runoff rate for the same event.
>
> **S3** For developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event must be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event.
>
> **S4** Where reasonably practicable, for greenfield development, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event should never exceed the greenfield runoff volume for the same event.
>
> **S5** Where reasonably practicable, for developments which have been previously developed, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event must be constrained to a value as close as is reasonably practicable to the greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for that event.
>
> **S6** Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with **S4** or **S5** above, the runoff volume must be discharged at a rate that does not adversely affect flood risk.

As the site is already developed the runoff rate and volume from the site should not exceed the existing rate and volume, and preferably should be reduced to Greenfield rates. Whilst the development area will match the existing the rate and volume of runoff may increase as a result of climate change.

It has already been noted that it is impractical to limit the runoff from a small site such as this to rates less than 2 l/s, and that current and the Greenfield rate of runoff is very much lower than this. It would not therefore be possible to match Greenfield rates if runoff is to be discharged through a normal piped system.

6.3 Drainage and disposal route

Generally, the aim should be to discharge surface run off as high up the following hierarchy of drainage options as reasonably practicable[11]:

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[10] Sustainable Drainage Systems Non-statutory technical standards for sustainable drainage systems. DEFRA March 2015

1. into the ground (infiltration);
2. to a surface water body;
3. to a surface water sewer, highway drain, or another drainage system;
4. to a combined sewer.

The preferred route for disposal is therefore by infiltration. The existing buildings may already be drained by this route in which case the new development can use the current drainage system. It is recommended that the existing drainage system be investigated to assess if this is the case

If the existing drainage is directed to the watercourse it is recommended that a site soakage test be undertaken to assess if a soakaway would be feasible at the site. The soakage test should be undertaken to meet the requirements of BRE 365[12].

If drainage to a soakaway is not feasible the next preferred route would be to the nearby watercourse.

[11] NPPF Planning Policy Guidance, paragraph: 080 Reference ID: 7-080-20150323
[12] BRE, 1991, Digest 365, Soakaway design

7 FLOOD RISK MANAGEMENT MEASURES

7.1 Mitigation

The site is in flood zone 1 and no other source of flooding has been identified. Flood resilience and resistance measures should not therefore be required for the development.

7.2 Safe Access and Egress

The main vehicular access to the Site crosses the Cradley Brook to enter Colwall Mill Farm and this is the only public road access available for vehicles. This route may become impassable for a time during flood events. It is recommended that a depth board be provided at the lowest point on the access road and clearly marked to indicate safe depths.

A dry route is available for people on foot that leads from the development along a track to South Hyde Farm and thence onto a public road to Ham Green all of which is in flood zone 1 (see Figure 2.1). This route may also be passable by vehicles with some off-road capability which are readily available in rural areas. Other public tracks lead southwards to Colwall and Lugg's Mill Farm and these would also provide dry access for residents.

The length of time the main access route will be impassable in the 1 in 100 year event cannot be established accurately from the information available. The Cradley Brook is a small watercourse with a predicted time to peak from catchment characteristics of 2.9 hours so it is likely to be very limited. Residents would therefore be best advised to remain in the properties whilst the access approach is impassable. In case of emergency one of the routes identified above could be used.

8 OFF SITE IMPACT

The site is in a rural location and no flood risk receptors can be identified downstream for several kilometres. The proposal is maintaining the footprint of the existing buildings and off site flood risk impacts of the development will be minimal. The roof and surface water drainage will remain as existing. It is acknowledged that climate change may increase the runoff rates and volumes over the lifetime of the development, although this would also occur with the existing buildings.

If possible the drainage should go to soakaway, which would remove any potential impacts on downstream flood receptors.

9 CONCLUSIONS

- It is proposed to develop existing agricultural buildings at Colwall Mill Farm for residential use. The proposed development will maintain the existing building footprint.
- The site is in fluvial flood zone 1 and residential land use is acceptable within the NPPF framework. No other source of flood risk has been identified.
- The site access crosses a nearby watercourse and may become impassable for short periods during extreme floods. It is recommended that a safe flood depth by established on the access track. It is likely that access to and from the development will not be possible during extreme peak flows. Due to the short time this will occur it is recommended that the residents remain in the property, however dry access routes have been identified in the case of emergency.
- The existing drainage system for the buildings should be investigated and the disposal route identified. If the existing system is to an adequate soakaway system then this could be re-used for the new development. If it is to the watercourse then the possibility of using a soakaway should be investigated.
- If drainage has to be to the watercourse then it will not be possible to achieve greenfield runoff rates because these are too low. Potential impacts to flood risk receptors will in any case be minimal, and no receptors have been identified for several kilometres downstream.
- The proposed development therefore appears to have no significant flood risk consequences.

10 REPORT LIMITATIONS

This report has been prepared with all reasonable skill, care and diligence. The work undertaken to provide the basis of this report comprised a study of available documented information from a variety of sources.

The opinions given in this report have been dictated by the finite data on which are they based and are relevant only to the purpose for which the report was commissioned.

Information reviewed should not be considered exhaustive and has accepted in good faith as providing true and representative data with respect to site conditions. Should additional information become available which may influence the opinion expressed in this report, the right to review such information and, if warranted, to alter the opinions accordingly is reserved.

It should be noted that any risks identified in this report are perceived risks based on the information reviewed.

The recommendations contained in this report represent our professional opinions. These opinions were arrived at in accordance with currently accepted industry practices at this time and as such are not guarantee that the sites are free of hazardous conditions.

This report has been prepared solely for the use of the named client, and may not be relied upon by other parties without written consent.

11 APPENDIX 1 – SITE PLANS