Level 2 SFRA

Wycombe District Council

Level 2 Strategic Flood Risk Assessment

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Contents

1. Introduction

Wycombe District Council (WDC) commissioned Jacobs UK in November 2016 to undertake a Level 2 Strategic Flood Risk Assessment (SFRA) leading on from the Level 1 SFRA prepared by the Council in November 2014[1]. This Level 2 SFRA has been prepared in accordance with the National Planning Policy Framework (NPPF).

1.1 Background

WDC is in the process of producing an emerging Local Plan which outlines the Council's long-term development aspirations for the period 2013-2033. Once adopted, this will replace the existing adopted plan for the District. As part of the supporting evidence to the Local Plan, information is required on the probability and likelihood of flooding to inform the allocation of potential development sites. The Council will use the assessment of flood risk contained within both the Level 1 and this Level 2 SFRA to inform and support development and flood risk policies of the emerging Local Plan and help inform decisions when determining planning applications.

1.1.1 Level 1 SFRA

The Level 1 SFRA was completed by WDC in 2014 and was developed to provide an overview of flood risk within the District, a methodology for the application of the Sequential Test and the information necessary for WDC to apply the Sequential Test to potential new developments during the site allocation process. The intention being, where possible, to steer new development to available sites which have the lowest probability of flooding as designated by the Environment Agency (EA) published flood maps.

However, following the application of the Sequential Test and given the development pressures on Wycombe District, a number of potential development sites remain, which encroach into medium to high flood risk areas (Flood Zones 2 and 3).

The Level 1 SFRA identified Wycombe Critical Drainage Areas (WCDA) to delineate those areas across the District at elevated risk of flooding from local sources including surface water, groundwater and ordinary watercourses. The delineation was based upon the 'Medium' extent of the EA Updated Flood Map for Surface Water (uFMfSW). Development in such areas will require a site-specific flood risk assessment in accordance with paragraph 103 of the NPPF.

1.2 Requirement for a Level 2 SFRA

Section 102 of the NPPF indicates that if following the application of the Sequential Test it is not possible to locate all necessary development on sites with a lower probability of flooding, WDC should consider the flood vulnerability of the proposed development and matching this with an appropriate site at medium to higher probability of flooding. This may also require the application of the Exception Test where applicable.

In these cases, National Planning Policy Guidance (NPPG)[2] states that a Level 2 SFRA should be prepared as a critical evidence base to provide sufficient information for the Council to assess the likelihood of the development passing the Exception Test if allocated. For the Exception Test to be passed:

- "it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a Strategic Flood Risk Assessment where one has been prepared; and
- a site-specific flood risk assessment must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall."

[1] Wycombe District Council Strategic Flood Risk Assessment Level 1 Update, Jacobs, November 2014
[2] https://www.gov.uk/guidance/local-planning-authorities-strategic-flood-risk-assessment#level-2-strategic-flood-risk-assessment

Given the development pressures on Wycombe District the emerging local plan includes allocation sites partially within Flood Zones 2 and 3. Consequently a Level 2 SFRA is required to provide sufficient information to apply the Exception Test to such sites.

1.3 Aims and Objectives

The purpose of this Level 2 SFRA is to provide the evidence to demonstrate whether the allocation sites can pass the second part of the Exception Test, help inform the decision making process as to their allocation and whether or not the sites will be deliverable. A list of the proposed allocation sites is included in Appendix A.

In order to produce this evidence base, a detailed assessment has been made of the risk of flooding from all sources to all the proposed allocation sites. This approach utilises hydraulic modelling of the River Thames and the Wye/Hughenden Stream, and data made available to local authorities by the EA. A detailed methodology is included in Section 2.

1.4 Wycombe Planning Policy

This SFRA is part of the evidence base supporting the emerging WDC Local Plan. The new plan will set out a vision for growth and development for the District to 2033, including where new homes, employment and shops will be located and which areas will be protected. At present, the intention is to submit the Local Plan for examination by the Planning Inspectorate in 2018.

1.4.1 Existing Planning Policy

The key policy in regards to existing flood risk policy is Policy DM17: *Planning for Flood Risk Management*. This policy states that:

"Developments that are in Flood Risk Zones 2 or 3 (as identified on the Policies Map) and have not been allocated in a Local Plan document by the Council will only be permitted where it has been demonstrated that:

> *a) There are no other sites available in a lower flood risk zone as a result of a sequential assessment including an assessment against allocations in this (or any subsequent) Local Plan document; and where appropriate*
>
> *B) That the requirements of the exceptions test as set out in national policy have been met. In such circumstances the requirements of 2a) to 2g) below will also need to be fulfilled.*

2) Applications on allocated sites greater than 1ha or that are in Flood Risk Zones 2 or 3 will need to be supported by:

> *a) A flood risk assessment which demonstrates that the most appropriate layout of development on site in terms of flood risk has been applied; and*
>
> *b) Demonstration that a sequential approach has been taken within the site, directing the most vulnerable uses to the areas of lowest flood risk; and*
>
> *c) Demonstration that resilient and resistant construction methods for managing residual risk and delivering an overall reduction in flood risk have been assessed; and*
>
> *d) The provision of space for flood water storage through the use of open space or areas above ground (where appropriate).*
>
> *e) Demonstration that flood risk is not increased elsewhere and where possible reduced,*
>
> *f) Demonstration that all forms of flooding are taken into account including groundwater and surface water flooding, and*

g) Demonstration that Sustainable Drainage Systems (SuDS) are incorporated where feasible.

Flood Zones 2 and 3 are identified on the Policies Map although applicants should consult with the EA *for any updates to it.*

Identification of additional areas of risk may trigger a requirement for a Flood Risk Assessment."

'Areas of flood risk', noted to be those in Flood Zones 2 and 3 are shown on the DSAP inset maps 20a-g and 21a-f.

1.4.2 Emerging Planning Policy

The WDC emerging Local Plan was consulted on in 2016 (June to August) and will be published for further consultation in autumn 2017. The new Local Plan will replace the adopted Core Strategy (2008) and saved policies of the existing Local Plan (2004), and it will sit alongside the Delivery and Site Allocations Plan, once adopted.

The key policy with regards to flood risk is Policy DM39 (Managing Flood Risk and Sustainable Drainage Systems), the wording of which is currently evolving. This will replace DM17 of the DSAP (2013) Flood Zones 2 and 3 when adopted.

1.4.3 Strategic Flood Management

In 2016 Buckinghamshire County Council (BCC) published its Local Flood Risk Management Strategy (LFRMS). The strategy was produced to *"comply with the first of the statutory duties of BCC as Lead Local Flood Authority as stipulated by the Flood and Water Management Act 2010 and as lead Risk Management Authority (RMA). This document updates the Buckinghamshire County Council (BCC) Local Flood Risk Strategy 2013-17".*

The key aim of the Strategy is to reduce the likelihood and detrimental consequences of flooding in a way which does not compromise the interconnected needs of the economy, society and environment in the future. This document demonstrates the ways in which BCC's Strategic Flood Management Team will manage local flood risk through the following principles:

- Improve understanding of flood risk across Buckinghamshire to inform strategic and prioritised local flood risk management
- Provide support to local planning authorities to minimise future development in flood risk areas, increase resistance and resilient building design and seek to use development to reduce flood risk elsewhere
- Lead and work together with partners to manage the existing "local" flood risk
- Engage with the public and local communities to improve awareness of flood risk and ensure work is guided and informed by local knowledge and successes are shared with everyone
- Pursue integrated flood management approaches across the whole event life cycle
- Seek funding from a variety of sources to support flood risk management activities and implement projects
- Recognise the pressures and opportunities that a changing climate presents and take action to mitigate threats and exploit opportunities wherever possible
- Provide support and information to our partners who undertake emergency flood management

It should be noted that these principles also fall in line with the overarching focus of the Strategic Objectives set out by BCC. These guide the activities and delivery of all of the services of the organisation, which range from education to social care to strategic planning.

1.5 Study Area

Wycombe District is situated to the north west of London in the county of Buckinghamshire. The District covers an area of approximately 32,457 hectares and has a population of approximately 172,000 (2011 Census), mainly centred in and around the town of High Wycombe.

The River Thames forms the southern boundary of the District and has extensive Flood Zones attributed to it. The River Wye flows through High Wycombe to its confluence with the Thames at Bourne End; this watercourse does have areas of Flood Zones 2 and 3 associated with it and in urbanised areas. The Hughenden Stream flows in a southerly direction to its confluence with the Wye in High Wycombe. The northern areas of the catchment are rural, but it does have flood zones associated with it in the urban area of the town. There are fluvial flood zones to the north of the District attributed to a series of watercourses that flow north- westwards towards Aylesbury Vale District, these flood zones are generally in rural areas with few properties at risk.

Groundwater flooding is a key risk across Wycombe District. A detailed summary is included in Section 4.3.4 of the Level 1 SFRA but generally, the chalk geology does give rise to areas of groundwater emergence risk. There is also the added risk of dry valleys, which are seemingly at low risk flooding when groundwater levels rise as occurred in the winter of 2013-14.

Based on the Risk of Flooding from Surface Water (RoFSW) previously the updated Flood Map for Surface Water (uFMfSW) national mapping provided by the EA, a high number of residential and commercial properties in the District could be at risk of flooding from local sources (principally surface runoff generated by intense rainfall, groundwater and ordinary watercourses), with the main concentration in High Wycombe and Marlow. This was confirmed during the winter 2013-14 flood events when numerous flooding incidents were recorded in these areas by BCC and WDC. Further details are included in Section 4.3.3 of the Level 1 SFRA.

Local Flood Risk

Buckinghamshire County Council, Wycombe District Council and their partners have responsibilities for managing local flood risk, i.e. flood risk from sources other than Main Rivers, and reservoirs, principally meaning surface runoff, groundwater and ordinary watercourses.

Surface runoff – rainwater (including snow and other precipitation) which is on the surface of the ground (whether or not it is moving), and has not entered a watercourse, drainage system or public sewer. Note that the term 'surface water' is used generically to refer to water on the surface and is often associated with periods of intense rainfall.

Groundwater – water which is below the surface of the ground and in direct contact with the ground or subsoil. It is most likely to occur in areas underlain by permeable rocks, called aquifers. These can be extensive, regional aquifers, such as the Chalk of the Chilterns, or may be more local sand or river gravels in valley bottoms underlain by less permeable rocks.

Ordinary watercourse – all watercourses that are not designated Main River, Lead Local Flood Authorities have lead responsibility for the management of flood risk

2. Methodology

The Level 1 SFRA provides an overview of the different sources of flooding across the District in order to apply the Sequential Test and allocate potential development sites; it is intended to be used as a reference document to inform policy and reduce flood risk to property within the District. WDC have identified a number of potential site allocations for future development in the emerging Local Plan which are partly within medium to high flood risk areas but provide wider sustainability benefits to the community that outweigh flood risk.

This section of the Level 2 SFRA summaries the approach taken to assess the risk of flooding to these sites in order to assess whether the development can pass the second part of the Exception Test and to make recommendations on the requirements of a future site-specific Flood Risk Assessment (FRA) in support of a planning application.

2.1 Approach

WDC have identified 58 new allocation sites within the District, a schedule of the sites is included in Appendix A and location plans are included in the site-specific section or Appendix B. These sites vary in terms of risk of flooding and for the purposes of this analysis they have been split into two categories:

- **Lower risk**: sites wholly located outside Flood Zones 2 and 3. NB: the extent considered includes a 50m buffer based on the boundary of Flood Zone 2 extending into Flood Zone 1 as a conservative measure to allow for the potential impact of climate change. Appendix B contains the assessment of flood risk (from all sources) for these sites; and

- **Higher risk**: sites that are within Flood Zones 2 or 3, or within 50m of the extent of Flood Zone 2 and are the primary focus of this Level 2 SFRA.

It should be noted that the terms '*lower'* and '*higher'* risk refer to fluvial flood risk only and does not take into account the risk of flooding from other sources, consequently these terms do not imply an assessment of overall risk. An assessment of all sources of risk to all allocation sites has been undertaken, this SFRA includes plans of the risk in relation to the extent of the sites; for the lower risk sites these are included in Appendix B and for the higher risk sites in Section 3.

2.2 Delineation of Fluvial Flood Zones

The risk of an event (in this instance a flood event) is a function of both the probability that the flood will occur, and the consequence to the community as a direct result of the flood. The Level 1 SFRA assesses the likelihood (or probability) of fluvial (river) flooding, categorising the District into zones of low, medium and high probability in accordance with the NPPF. It then provides recommendations to assist WDC to manage the consequence of flooding in a sustainable manner, for example through the restriction of vulnerable development in areas of highest flood risk.

2.2.1 Published Flood Zones

The delineation of Zones 1 (low), 2 (medium) and 3a (high) is based on EA published Flood Zone Maps, whereas Zone 3b (functional floodplain) has been derived separately via detailed hydraulic modelling. The Flood Map indicates the area that is susceptible to a 1% (1 in 100) Annual Exceedance Probability (AEP) event from rivers, used to delineate Flood Zone 3a. It also indicates the area that has a 0.1% (1 in 1000) AEP chance of flooding from rivers in any given year, which is known as the Extreme Flood Outline, and used to delineate Flood Zone 2.

The EA's Flood Map for Wycombe District, available on its website[3], shows the natural floodplain, ignoring the presence of defences, and therefore areas potentially at risk of flooding from rivers. It has been produced from a combination of a national generalised computer model and available historic flood event outlines. The EA Flood Map used for this Level 2 SFRA was published in November 2016.

2.2.2 SFRA Hydraulic Modelling

The EA's knowledge of the floodplain is continually being improved by a variety of studies, detailed models, data from river flow and level monitoring stations, and actual flooding information. The EA has an ongoing programme of improvement, and updates are made nationally on a quarterly basis.

The 1D River Thames model dates from 2007 and the River Wye/Hughenden Stream EA model 2001, both models utilised photogrammetry to represent the floodplain. Both models have been updated as part of this Level 2 SFRA to include the latest available LiDAR dating from 2014-15 to represent the floodplain. The hydraulic modelling report summarising the updates to the two models is included in Appendix C.

The updated hydraulic model outputs of the River Thames and the River Wye/Hughenden Stream have been utilised to produce additional flood extents for the potential range of climate change scenarios. In addition, the 5% (1 in 20) and 1% (1 in 100) AEP events, used to delineate Flood Zones 3b and 3a respectively, have been reproduced utilising the updated hydraulic models as part of this Level 2 SFRA to provide a comparison to the existing Flood Zone 3b adopted in the Level 1 SFRA for these watercourses and the published EA Flood Zone 3a. Any new development within Flood Zone 3b is likely to measurably impact upon the existing flooding regime, increasing the severity and frequency of flooding elsewhere. The new hydraulic modelling has been undertaken to inform this SFRA, given this was not a full update of the models (which the EA are currently progressing) the individual site assessments indicate where more detailed site-specific hydraulic modelling is likely to be required.

Certain watercourses in the District have not been modelled in detail and therefore do not have a Flood Zone 3b flood extent attributed to them. This includes Lyde, Bonny and Elm Brooks (tributaries of the River Thame in the north of the District), the Hambleden Stream and approximately a 7.5km stretch of the River Thames in the southwest corner of the District.

Where necessary, these areas of Flood Zone 3b were defined using the Risk of Flooding from Rivers and Sea mapping (formerly the National Flood Risk Assessment mapping) High risk zone available from the EA (a conservative approach as this is equivalent to a 3.33% (1 in 30) AEP event. Where detailed hydraulic modelling is unavailable an attempt to consider the future extent of Flood Zone 3a and the risk of flooding to the allocation site due to climate change has been made using the uFMfSW; see Section 2.5.2.1.

2.2.3 Flood Zone Discrepancies

Updating the hydraulic model with more accurate LiDAR data as part of this Level 2 SFRA has led to a discrepancy between published Flood Zone 3a and the predicted 1% (1 in 100) AEP extent based on the new model. In some cases, the extent of the 1% (1 in 100) AEP plus climate change event is smaller than Flood Zone 3a. It is understood that the EA is currently updating the River Wye/Hughenden Stream hydraulic model so it is anticipated that the discrepancy is temporary.

Until the EA publish updated flood extents, it is understood that the EA will rely upon published Flood Zones when reviewing planning applications, they are consulted on. In the meantime, it is therefore recommended that applicants should make reference to both Flood Zone 3 and the updated 1% (1 in 100) AEP extent indicating the implications for the development should Flood Zone 3 change to the modelled extent. Until updated hydraulic modelling is available an applicant may choose to consider a flood zone challenge to update the predicted flood zone extent(s), which is beyond the scope of this SFRA. This is likely to require site-specific

[3] http://www.environment-agency.gov.uk/

hydraulic modelling as indicated in the site assessments to support the subsequent planning application and demonstrate compliance with the Sequential Test, Exception Test and Paragraph 103 of the NPPF.

To provide an accurate representation of risk, this SFRA includes an assessment based on both sets of mapping for allocation sites, with any apparent discrepancy considered in the relevant site allocation section of this SFRA. However, as the updated modelling undertaken is considered more accurate as it uses the most recent digital information available to represent the floodplain, the updated models (including CC) have been relied upon to assess whether a site can pass the second part of the Exception Test for this SFRA.

Prior to EA Flood Map updates, the applicant may choose to consider a Flood Zone challenge to update the predicted Flood Zone extent; however, this is beyond the scope of the SFRA. During this process, it is likely to be necessary for the applicant to undertake their own hydraulic modelling to support the planning application and/or Flood Zone challenge to demonstrate compliance with the Sequential Test and potentially the Exception Test.

2.3 Flood Hazard

Where an allocation site has been identified as at risk of fluvial flooding an assessment has been included of the flood hazard to the site. Flood hazard was calculated in accordance with: *Flood Risk Assessment Guidance for New Development; FD2320/TR2*[4] using the following equation:

Flood Hazard Rating = ((v+0.5)*D) + DF (*where v = velocity (m/s), D = depth (m), DF = debris factor)*

The degree of flood hazard provides a guide to the risk to people from a combination of predicted flood depth and velocity. A 'Debris Factor' is added to the calculation to account for the additional hazard posed by floating debris. A summary of the flood hazard classifications and their description is included in Table 2-1.

Table 2-1 : Flood Hazard Classification

Classification	Degree of Hazard	Description
Low	Caution	Flood Zone with shallow flowing or deep standing water
Moderate	Dangerous for some (i.e. children)	Danger: flood zone with deep or fast flowing water
Significant	Dangerous for most	Danger: flood zone with deep fast flowing water
Extreme	Dangerous for all	Extreme danger: flood zone with deep fast flowing water

2.4 Rate of Onset

Where an allocation site is at risk of fluvial flooding based upon the updated hydraulic modelling, an assessment is included in the individual site assessment of the rate of onset of flooding. This provides an indication of the duration from the start of the rainfall event to when the site is predicted to start flooding. This is important to consider when access is required during a flood event, if it is not possible to avoid development within Flood Zones 2 and 3. Typically, in Wycombe District the River Thames has a substantial rate of onset measured in days and the River Wye 10-20 hours.

[4] Defra and Environment Agency (2005) FD2320/TR2 Flood Risk Assessment Guidance for New Development

2.5 Consideration of Climate Change

There is clear scientific evidence that global climate change is happening now and cannot be ignored. Changes to flood extent due to climate change are likely to be negligible in well-defined valleys, but could be dramatic in very flat areas. Changes in the depth of flooding under the same allowance will increase the probability of a given flood. This means that a site currently located within a lower risk zone (e.g. Flood Zone 2) could in future be re-classified as lying within a high risk zone (e.g. Flood Zone 3a). This in turn could have implications for the type of development that is appropriate according to its vulnerability to flooding.

It is essential that applicants consider the possible change in flood risk over the lifetime of the development as a result of climate change. For planning purposes, the EA assume that the 'lifetime of development' equates to 100 years for residential development, and 60 years for commercial development.

In planning terms, it is essential that WDC considers its response to the potential impacts of climate change within the District. While the impact of climate change may in some areas not markedly increase the extent of, for example, Zone 3a, within that Zone the extent of lower severity flood events could increase significantly. Furthermore, there could be an increase in localised surface water issues. It is essential therefore that the development management process (influencing the design of future development within the District) carefully mitigates against the potential impact that climate change may have upon the risk of flooding.

For this reason, all of the development management recommendations require all floor levels, access routes, drainage systems and flood mitigation measures to be designed with an allowance for climate change within Zones 3b, 3a and 2, as well as within WCDA in Zone 1. This provides a robust and sustainable approach to the potential impacts that climate change may have upon the District over the next 100 years, ensuring that future development is considered in light of the possible increases in flood risk over time.

2.5.1 Level 1 SFRA

The following data was used and assumptions made in the Level 1 SFRA to estimate the future extent of the flood zones as a result of climate change:

- In the absence of detailed hydraulic modelling Flood Zone 3b would broadly become the extent of the current Flood Zone 3a (subject to the free passage of water through urban areas);
- The extent of Future Flood Zone 3a based on hydraulic modelling was only available on the River Thames between Harleyford Manor (near Medmenham) and Hedsor. For other areas the applicant was to assume that the then extent of Flood Zone 3a at the end of this century may be approximated by the then current Zone 2; and
- It was anticipated that an applicant should undertake an analysis of ground levels to determine whether a site currently in Flood Zone 1 should be considered as lying within Flood Zone 2 by 2115.

2.5.2 Current Guidance

Since the Level 1 SFRA was published by WDC the EA updated its guidance[5] on the allowances to be made for the predicted impact of climate change, in February 2016. Of particular relevance to this SFRA is the revised guidance on:

- Peak river flow; and
- Peak rainfall intensity.

NB: The guidance included recommendations for the consideration of other factors, but they are not considered relevant to Wycombe District.

[5] Adapting to Climate Change: Advice for Flood and Erosion Risk Management Authorities. Environment Agency, 2016

2.5.2.1 Peak River Flow and Fluvial Flood Risk

The allowance to be made for the predicted impact of climate change on peak river flows throughout the UK is subject to the location (river basin district[6]), timescale (design-life) to be considered and the vulnerability classification (see Table 2 Paragraph 66 of the NPPG) of the proposed development. For Wycombe District the uplift factors to be applied are summarised in Table 2-2.

Table 2-2 : Recommended Climate Change Allowances for Peak River Flow

Allowance	2015 to 2039	2040-2069	2070-2115
Upper End	25%	35%	70%
Higher Central	15%	25%	35%
Central	10%	15%	25%

Please refer to Figures 101 to 108 included in Appendix D for the predicted impact of climate change across the District based on the current guidance.

Where higher risk allocation sites are not covered by a hydraulic model that includes the predicted extents of fluvial flood risk based on the uplift factors scheduled in Table 2-2 an assessment has been made on the future extent of Flood Zone 3a based upon the proximity of flow paths evident in the uFMfSW. Should the 1% (1 in 100) AEP event increase due to climate change it would follow topography evinced by flow paths for the 0.1% (1 in 1000) AEP uFMfSW surface water event (although not necessarily the full extent). Therefore, if such a flow path was within the site boundary and coincided with Flood Zone 3a it is possible an increase in flows would affect such an area.

Only developments classified as ‘highly vulnerable’ would require additional appraisal (passage of the Exception Test) if the site was currently within Flood Zone 1 and reclassified as 2 as a result of the predicted impact of climate change. The development allocation includes no such sites consequently the predicted future extent of Flood Zone 2 due to climate change has not been developed using the hydraulic models. Where a higher risk site is currently within Flood Zone 1, an appraisal of the risk of it being reclassified as Flood Zone 2 in the future as a result of climate change has been included in the site-specific assessment based upon ground levels.

2.5.2.2 Peak Rainfall Intensities

The updated guidance requires the testing of two uplift factors across England as summarised in Table 2-3. Site-specific FRAs are expected to test the impact of both allowances to understand the potential range of impact based on the design-life of the proposed development.

Table 2-3 : Recommended Climate Change Allowances for Peak Rainfall Intensity

Allowance	Total potential change (1961-90 baseline)		
	2015 to 2039	2040-2069	2070-2115
Upper End	10%	20%	40%
Central	10%	10%	20%

[6] https://www.gov.uk/government/publications/flood-risk-assessments-river-basin-district-maps

2.6 Surface Water Flooding

The risk of surface water flooding has been assessed based upon the uFMfSW, finalised in November 2013. A number of residential and commercial properties in Wycombe District could be at risk of flooding from local sources (principally surface runoff generated by intense rainfall, groundwater and ordinary watercourses). In areas susceptible to local flooding, the volume of runoff and sufficiency of the drainage, ordinary watercourse and sewer systems are critical to determining the degree of flood risk. For this reason, the Level 1 SFRA delineated WCDA across the District. The EA has the ability to delineate Critical Drainage Areas (CDA) to cover such areas, but as is the case across much of the country, has not currently done so within the District. Although WCDA and CDA would both cover areas with critical drainage problems, the variation in name has been adopted to differentiate between those areas delineated by Wycombe's SFRA and those which may be notified by the EA.

The uFMfSW provides extents of surface water flooding for the 3.3% AEP (1 in 30-year), 1% AEP (1 in 100-year) and 0.1% AEP (1 in 1,000-year) rainfall events. These are interpreted as 'High', 'Medium' and 'Low' risk respectively.

The outline of the Medium Risk of Flooding from Surface Water is used in the Level 1 SFRA as a basis to define WCDA. Because the WCDA represents flood risk from different sources, no indication of the likely duration of flooding is given. However, it is emphasised that groundwater flooding from the underlying Chalk can last a number of weeks and can cause substantial damage and disruption because of the long duration, such as that experienced on Hughenden Stream, in Radnage and the Lower Hughenden Valley, as well as the Hambleden Stream and Hambleden valley in Winter 2013-14.

These sources of information have been compared to the allocation site extents to identify those that could be at elevated risk of surface water flooding.

2.7 Groundwater Flooding

The risk of groundwater flooding has been based on a number of sources of information:

- District-wide on the EA's Areas Susceptible to Groundwater Flooding (AStGWF) mapping, which indicate the likelihood of groundwater emergence;
- Figure 12 of the Level 1 SFRA provides mapping of areas of likely groundwater emergence. It should be noted that these were developed for national assessment and therefore provide coarse information; it should not be assumed that areas outside the 'groundwater emergence zone' are not at risk of groundwater flooding;
- The geology of the district is dominated by chalk (see Level 1 SFRA Figure 12). The Level 1 SFRA mapped areas considered to be at increased risk of groundwater flooding where 'dry valleys' overlay permeable chalk geology (Figures 18 -21). These figures identify areas at risk of flooding when groundwater reaches the surface and is then likely to follow topography, in effect following the flow paths identified by the uFMfSW defined as WCDA (see Section 2.66);
- Jacobs undertook analysis for Defra in 2004[7] to identify the scale, distribution and nature of groundwater flooding in England, which identified areas of elevated risk of groundwater emergence; and
- Jacobs has recently undertaken a groundwater flooding risk mapping exercise on behalf of BCC[8] in the vicinity of Princes Risborough to the north of the District. The scope of the study was to develop groundwater flood risk maps in the vicinity of Princes Risborough, to update the risk mapping exercise undertaken to support the 2014 SFRA, which have been included in the assessment of risk.

[7] Strategy for Flood and Coastal Erosion Risk Management: Groundwater Flooding Scoping Study (LDS 23), Defra, 2004
[8] Princes Risborough Flood Risk Mapping – Princes Risborough Groundwater Flooding Phase 1, Buckinghamshire County Council, March 2017

- BCC have provided mapping as completed by JBA in October 2016[9] which has been used throughout the higher risk site assessments. This mapping includes the groundwater head difference across Bucks County.

These sources of information have been compared to the allocation site extents to identify those that could be at increased risk of groundwater flooding.

2.8 Sewer Flooding

The risk of sewer flooding across the District was mapped for the Level 1 SFRA. Thames Water provided information on flooding resulting from surcharge and blockage of surface, combined and foul water sewers for the 20 years preceding April 2014. This data, known as DG5 flooding data, is subject to confidentiality issues and specific incidences where individual properties were affected cannot be divulged. However, Thames Water is allowed to confirm how many properties have been subject to DG5 flooding per postcode area (the first four digits of the postcode are provided only). Given the level of detail available it has not been possible to confirm the exact degree of risk posed to each allocation site by sewer flooding. It is therefore anticipated that the applicant(s) will confirm the degree of risk through liaison with the relevant water company. It is not anticipated that the degree of risk will have changed significantly considering the scale of data in the last three years

2.9 Flood Defence Failure

An assessment of risk to allocations sites would need to consider the implications of the failure of a flood defence or in the longer term, what the implications would be should the maintenance of a flood defence stop. In both cases it would be necessary to assess the implications of a rapid breach of the defence by flood water and how the site development would manage this to ensure it is safe for future users, as required by national planning guidance.

Liaison with the EA and BCC has not identified any raised formal or informal defences that protect the proposed allocation sites. Consequently, breach analysis has not been undertaken as the residual risk of failure is considered to be very low.

2.10 Reservoir Failure

A small number of reservoirs and ponds have been identified within Wycombe District including the lake in West Wycombe Park, those at Little Marlow and lakes adjacent to Copgrove Wood (southwest of Stokenchurch). Of these, only the lake in West Wycombe Park falls under the Reservoirs Act, and is therefore managed in accordance with the Flood & Water Management Act 2010 which amended the Reservoirs Act 1975.

Following a recommendation in the Pitt Review[10], the EA has provided Reservoir Flood Maps for those reservoirs which it regulates under the Reservoirs Act 1975. These show the likely extent of flooding resulting from a dam breach which could be caused by extreme rainfall or floods, as well as structural failure. The predicted flood extent is available online and has been compared to the location of the proposed allocation sites. Where a risk has bene identified it is generally considered low due to the inspection and monitoring regime required of the Reservoirs Act.

[9] 'Some of the responses contained in JBA's Groundwater Flood Map are based on data and information provided by the Natural Environment Research Council (NERC) or its component body the British Geological Survey (BGS). Your use of any information contained in this map which is derived from or based upon NERC/BGS data and information is at your own risk. Neither NERC nor BGS gives any warranty, condition or representation as to the quality, accuracy or completeness of such information and all liability (including for negligence) arising from its use is excluded to the fullest extent permitted by law. Your use of the map constitutes your agreement to bring no claim against NERC or BGS in connection with it.'

[10] The Pitt Review, Learning Lessons from the 2007 Floods, Cabinet Office,2008

3. Individual Site Assessments

3.1 Site 1: 1-9 Shaftesbury Street Detailed Assessment

3.1.1 Site Description

Shaftesbury Street allocation site (planning ref: SHW0584) is located in the north-west of High Wycombe, to the south of the A40 and the River Wye. The National Grid Reference (NGR) for the site is SU 8558 9351. The site is currently community housing and is an area of approximately 0.03ha. The current proposal is construct nine residential properties on the site. This site has been assessed in detail because it is within 50m of the extent of published Flood Zone 2: see Section 2.1.

3.1.2 Fluvial Flood Risk

The fluvial flood risk to the site is presented in Figure 3-1.

Figure 3-1: Site 1 Fluvial Flood Risk

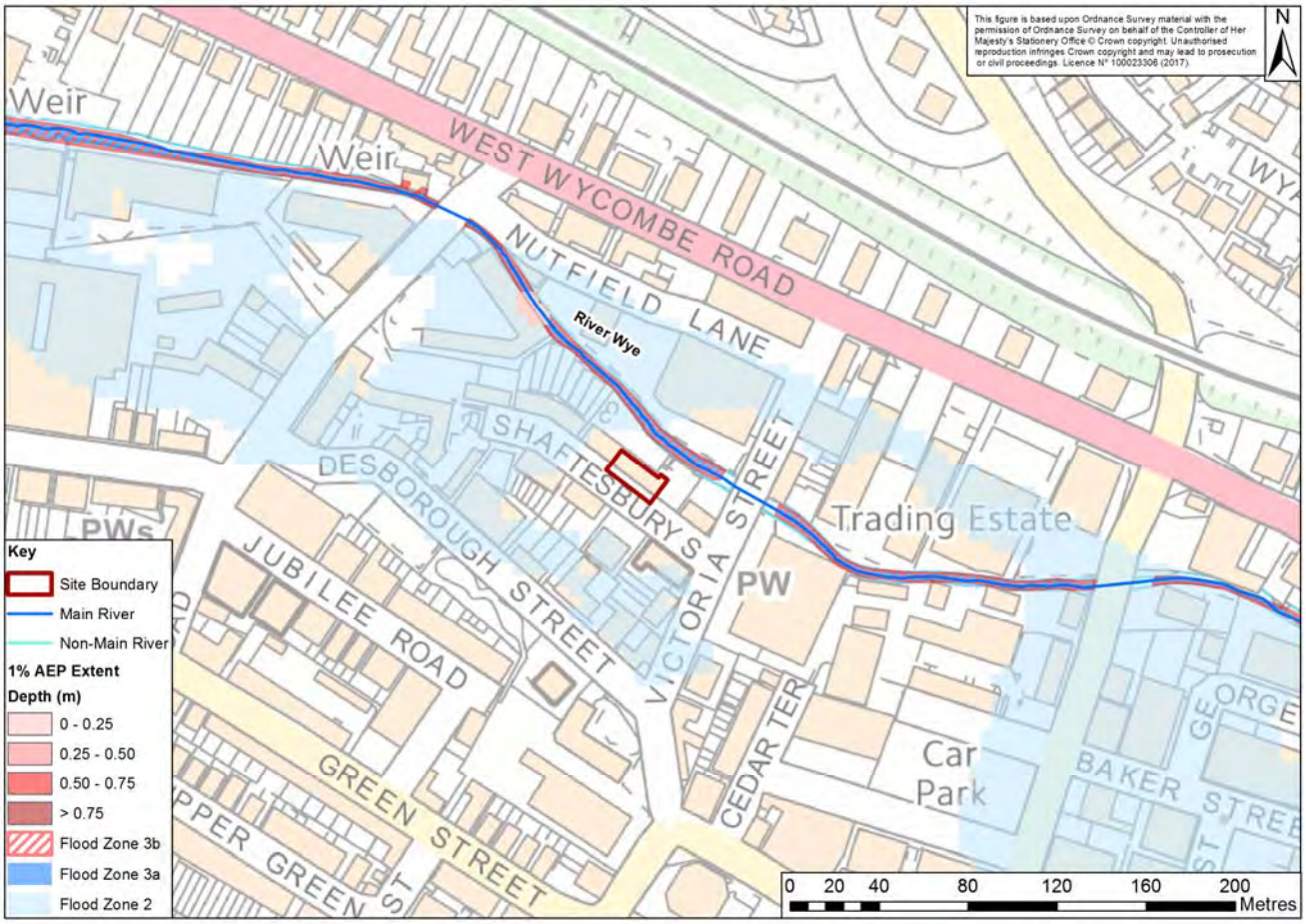


Table 3-1: Site 1 Flood Zone Extents

Flood Zone	1	2	3a	3b	Total
Extent (ha)	0.03	0	0	0	0.03
Coverage (%)	100	0	0	0	-

Table 3-2: Site 1 Modelled 1% (1 in 100) AEP Event Extent

AEP Event	Extent (ha)	%
1% (1 in 100)	0	0

The site boundary bounds 1-9 Shaftesbury Street, High Wycombe. The northern site boundary is approximately 15m to the south of the River Wye. The site falls within Flood Zone 1 and remains in this zone when the predicted impacts of climate change are considered (with the exception of approximately 1% of the site area in the eastern corner); see Table 3-3. The historical flood map does not identify any fluvial flood events that have affected this site.

The fluvial flood zones have been developed using the EA's River Wye/Hughenden Stream hydraulic model, originally developed in 2001 for flood mapping purposes. The representation of the floodplain has been updated for this SFRA utilising LiDAR data from 2015. It should be noted that there appears to be a discrepancy (see Figure 3-1) between the published fluvial flood zones and the predicted flood extents derived from hydraulic modelling, see Section 2.2. However, at this location both versions of the model place the allocation site outside Flood Zone 3.

Both the published Flood Zone 3 and the newly modelled 1% (1 in 100) extent are retained within the river channel at this location. The modelling of the predicted impact of climate change does not place the site within Flood Zone 3 in the future (with the exception of approximately 1% of the site area in the eastern corner - see Figure 3-2).

Figure 3-2 : Site 1 Fluvial Flooding with Climate Change

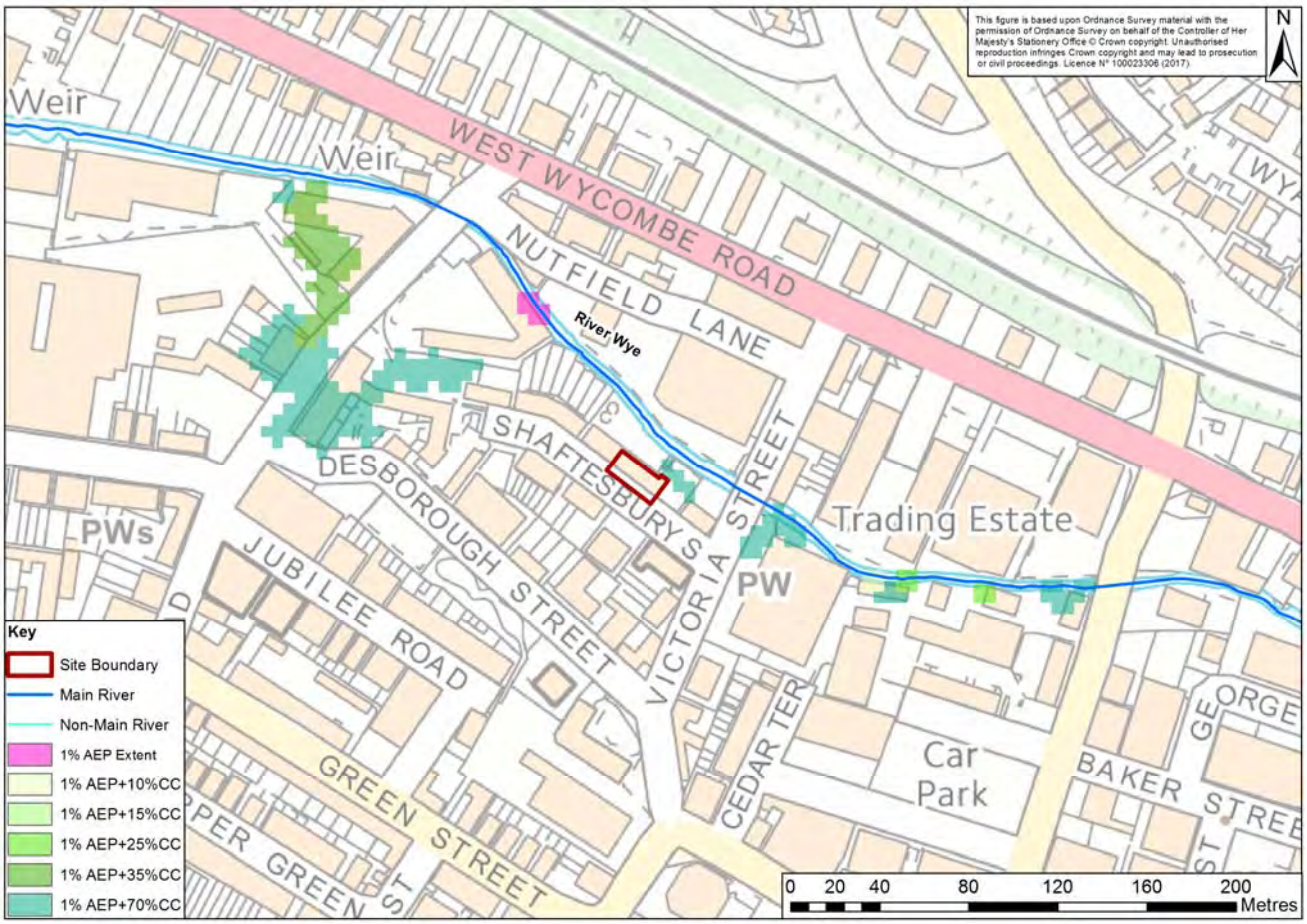


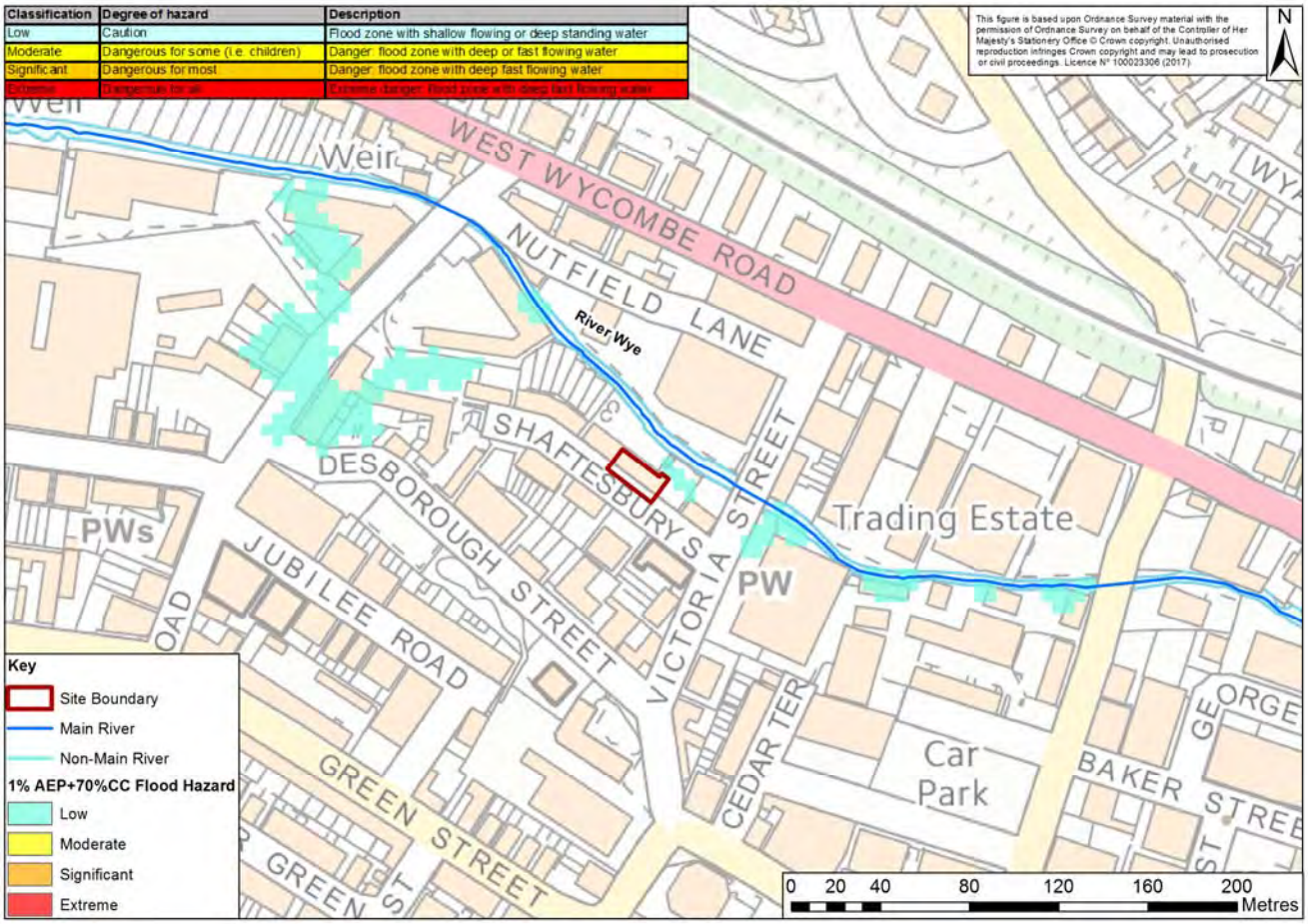
Table 3-3: Site 1 Fluvial Flooding with Climate Change Extents

Climate Change Uplift (%)	10	15	25	35	70	Total
Extent (ha)	0	0	0	0	0.0003	0.03
Coverage (%)	0	0	0	0	1	-

Table 3-3 indicates approximately 1% of the site is at risk of flooding from the 1% (1 in 100) + 70% climate change extent.

Figure 3-3 indicates that the north-eastern corner of the site is designated as having a Low flood hazard. The application should take this into account and ensure safe access and egress from the site is available following development while also taking this into account for the risk of surface water flood risk (see Section 3.1.3.1).

Figure 3-3 : Site 1 Flood Hazard



3.1.2.1 Flood Defence Failure

There are no raised defences in the vicinity of the site.

The River Wye is in culvert at Victoria Street approximately 40m downstream of the eastern site boundary. Should this culvert become blocked it could potentially lead to flooding of the site. A review of the flood zone mapping does not indicate that the culvert is a hydraulic restriction on flow when flowing freely as the flood zone extents do not suggest backing up; Flood Zone 2 indicates a flow path further north across Victoria Street. A review of the EA AIMS and BCC asset databases has not indicated the dimensions of these structures nor

whether they have screens. An applicant would need to consider the likelihood of blockage to the culvert and the consequent risk of flooding at the site.

3.1.3 Risk of Flooding from Other Sources

3.1.3.1 Surface Water

Surface water flood risk based on the uFMfSW is presented in Figure 3-4.

Figure 3-4: Site 1 Surface Water Flood Risk

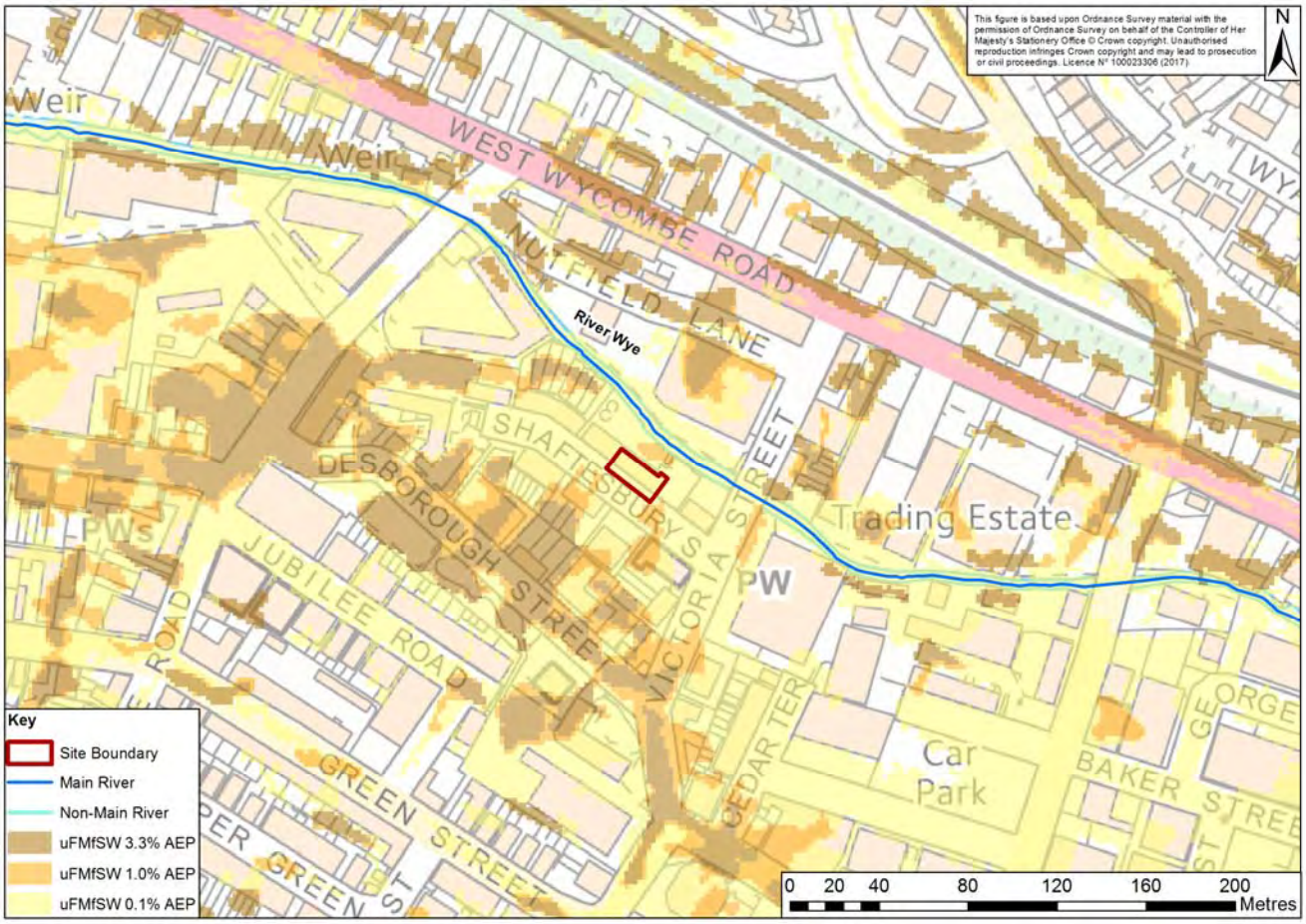


Table 3-4: Site 1 uFMfSW Extents

Event (AEP)	3.33% (1 in 30)	1% (1 in 100)	0.1% (1 in 1000)
Extent (ha)	0	0	0
Coverage (%)	0	0	100

The entirety of the site is located within an area at Low risk of surface water flooding. The site is not indicated to be at risk of flooding from either the 3.33% (1 in 30) or 1% (1 in 100) AEP events (see Table 3-4). There do not appear to be any surface water flow routes through the site, however there is a substantial flow route south of the site along Desborough Street. The Level 1 SFRA indicates that areas in High Wycombe are known to be particularly susceptible to flooding from surface water in urban areas that respond quickly to rainfall.

Climate change has the potential to increase the risk of surface water flooding to the site. Although beyond the scope of this SFRA to quantify the predicted impact, the risk of flooding to those areas currently assessed as 'Low' surface water risk could increase as a result of climate change and consequently they could become re-classified as WCDA. Such a risk would need to be quantified by the applicant in order to demonstrate that the site could be developed safely for future users, taking into account the planning implications of such a result.

3.1.3.2 Groundwater

For the two sources of mapping below, the AStGWF depicts the likelihood of groundwater emergence; the JBA mapping shows depth to groundwater level beneath ground.

A review of the EA's AStGWF mapping indicates that the entirety of the site is at low risk of flooding (within a grid square where between 25% and 50% is at risk of groundwater emergence). The site is not within a zone identified as at risk of groundwater emergence. See Figure 3-5.

Figure 3-5: Site 1 Groundwater Flood Risk

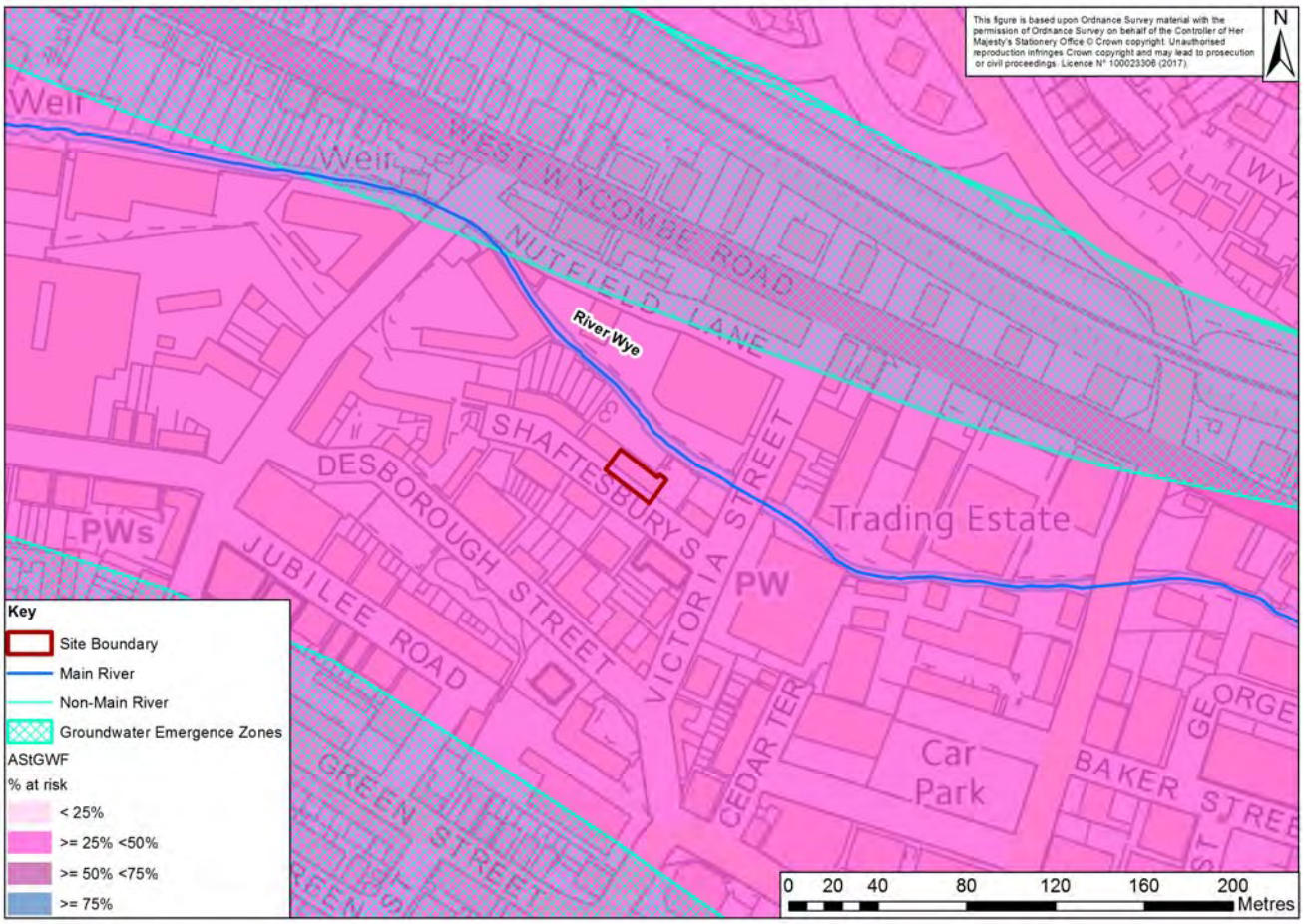
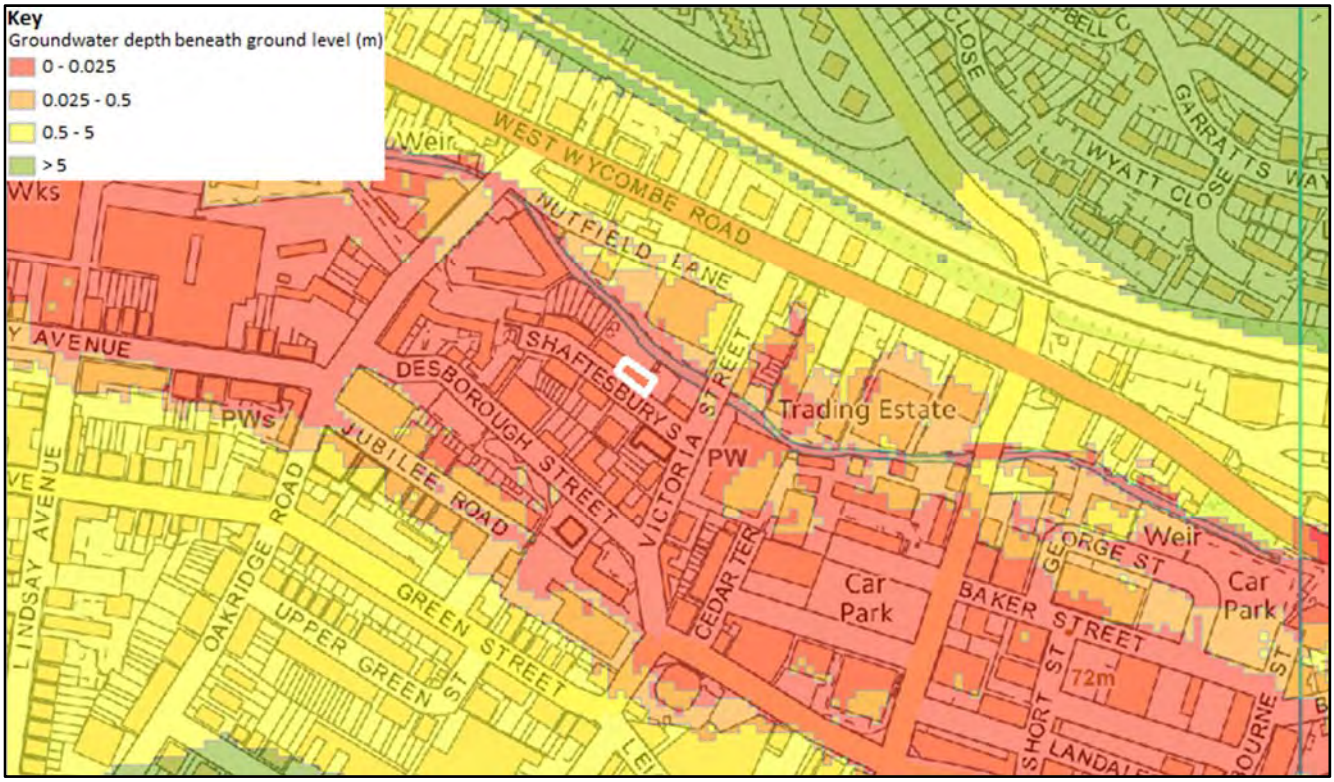


Figure 3-6 depicts groundwater mapping completed by JBA, indicating a high risk of groundwater flooding and that the groundwater levels are either at or very near to (within 0.025m) the ground surface at this site.

Figure 3-6 : Site 1 JBA Groundwater Mapping



3.1.3.3 Sewers

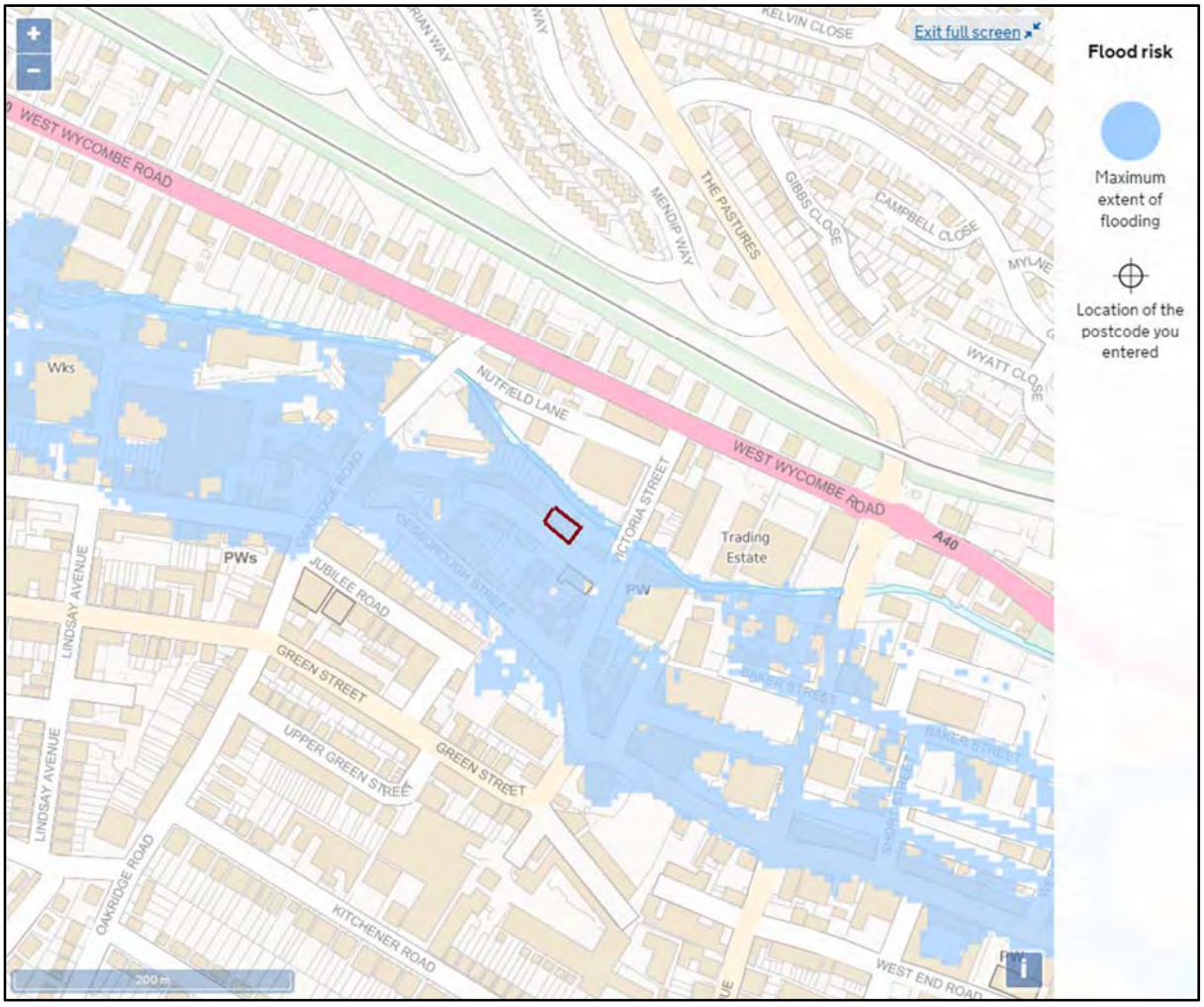
With reference to Figure 7 of the Level 1 SFRA[11], the site is in post code HP12 that recorded 1-5 incidents of sewer flooding affecting properties internally and 6-10 externally in the 20 years preceding 2014.

3.1.3.4 Reservoir Failure

A review of the predicted flood extent as a result of reservoir failure available online indicates that the site is at risk of flooding from such an event. The applicant would need to demonstrate why the risk of flooding due to reservoir failure is considered a Low risk. See Figure 3-7.

[11] Wycombe District Council Strategic Flood Risk Assessment Level 1 Update, Jacobs, November 2014

Figure 3-7: Site 1 Risk of Flooding from Reservoir Failure



Source: https://flood-warning-information.service.gov.uk/long-term-flood-risk/map?map=SurfaceWater © Crown copyright and database rights 2017 OS 100024198

3.1.4 The Exception Test

The proposed development of nine residential properties would be classified as 'More Vulnerable'[12]. The site is currently located within Flood Zone 1 when considering the 1% (1 in 100) +CC AEP event extents (apart from approximately 1% of the north-eastern corner of the site during the +70% CC event). It is anticipated that if this area of the site is avoided, the site could be developed safely and would pass the Exception Test[13].

[12] NPPG Table 2 / Paragraph 066

3.1.5 Flood Risk Management

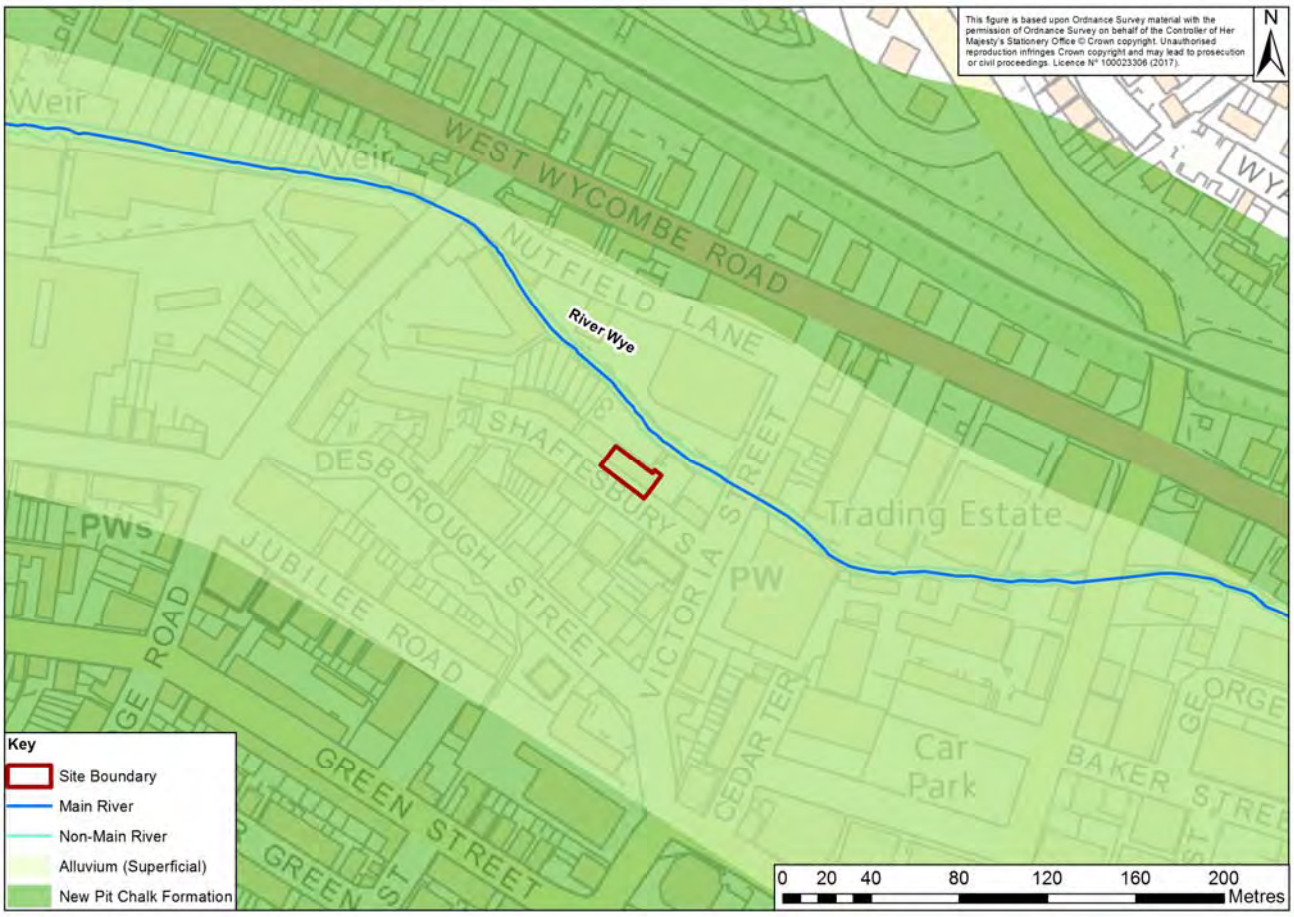
3.1.5.1 Opportunities for Betterment

Given the size of the site it is considered that there is little opportunity for flood risk betterment through the re-development of this site, unless as part of long-term, catchment-wide, incremental reductions in runoff, potentially as part of a defined policy by BCC as the Lead Local Flood Authority (LLFA).

3.1.5.2 Potential Feasibility of Infiltration Measures

A review of the site geology (see Figure 3-8) suggests it is underlain by a layer of Alluvium (superficial deposit) and Chalk bedrock of (New Pit Formation). The thickness of each layer is not included within the information. Surrounding strata have been omitted for clarity if they are not present directly beneath the site. Consequently, infiltration of rainfall directly to ground may be practicable. The proximity of the watercourse may result in locally high groundwater levels potentially reducing the feasibility of such measures. Infiltration should be the first method considered for the drainage of sites and as such, a site-specific FRA would be required to demonstrate the feasibility of infiltration measures.

Figure 3-8 : Site 1 Geology



3.1.5.3 Site-specific Flood Risk Assessment

A site-specific FRA would be required to accompany the planning application for this site because it is at risk of groundwater and reservoir flooding in accordance with WDC policy on Managing flood risk and Sustainable Drainage Systems and is over 1ha in area. The review of flood risk has identified a number of issues that a site-specific FRA would need to consider in addition to those required of national and local planning policy:

- Utilisation of the best available data to confirm fluvial flood risk to the allocation site;
- Demonstration that the risk of flooding from reservoir failure is low;
- How the predicted impacts of climate change could affect the risk of surface water flooding;
- Confirmation of the depth of surface water flooding compared to proposed site levels;
- Demonstrate that the site may be safely accessed during a surface water and/or groundwater flood event;
- Demonstrate how the elevated risk of groundwater flooding would be addressed and mitigated for, as a minimum avoiding the construction of below-ground habitable rooms;
- The suitability of infiltration measures for drainage of the site given the local geology; and
- The likelihood of flooding as a result of a blockage of the River Wye culvert beneath Victoria Street downstream of the site, by the use of further modelling, although flood extents do not suggest it constricts flow.

3.2 Site 5: Abbey Barn North Detailed Assessment

3.2.1 Site Description

Abbey Barn North allocation site (planning ref: HW4) is located in the south-east of High Wycombe, to the south of the A40 and the River Wye, and north of the M40. The NGR for the site is SU 8837 9154. The site is currently marsh/woodland and is an area of approximately 11.3ha. It is proposed to construct 100 residential properties on the site. This site has been assessed in detail because it is within 50m of the extent of published Flood Zone 2: see Section 2.1.

3.2.2 Fluvial Flood Risk

The fluvial flood risk to the site is presented in Figure 3-9.

Figure 3-9: Site 5 Fluvial Flood Risk

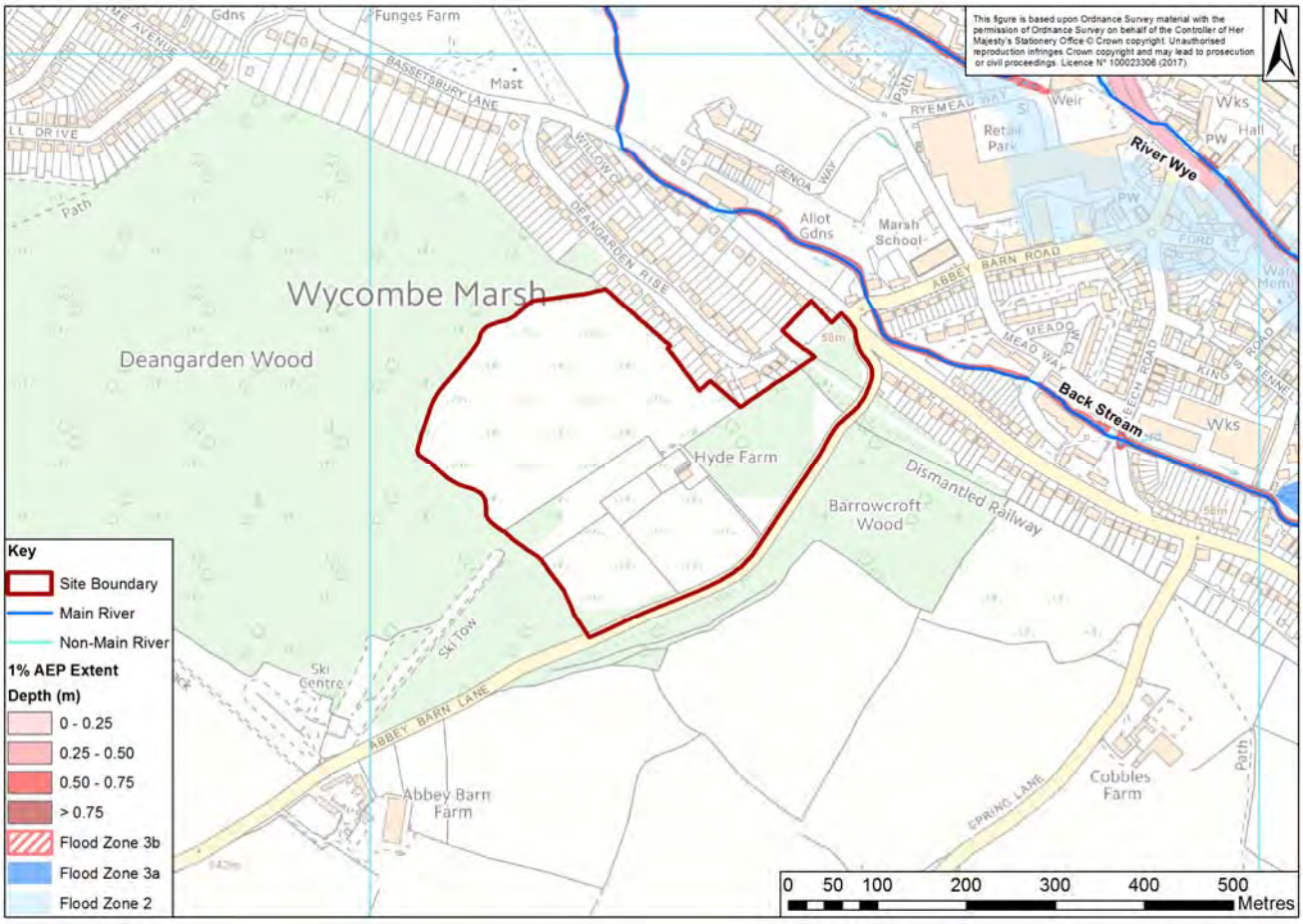


Table 3-5: Site 5 Current Flood Zone Extents

Flood Zone	1	2	3a	3b	Total
Extent (ha)	11.3	0	0	0	11.3
Coverage (%)	100	0	0	0	-

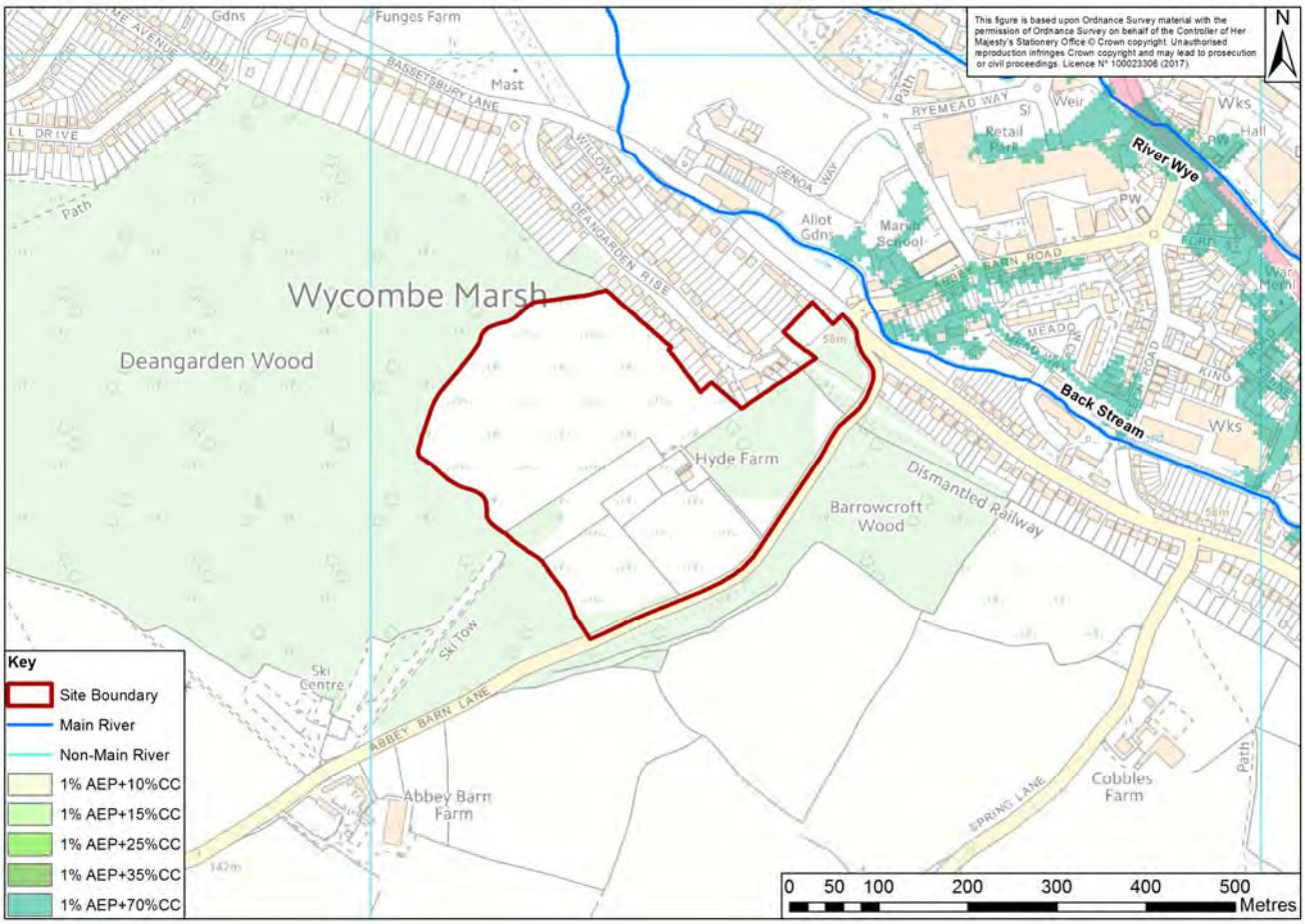
Table 3-6: Site 5 Modelled 1% (1 in 100) AEP Event Extent

AEP Event	Extent (ha)	%
1% (1 in 100)	0	0

The site boundary follows Abbey Barn Lane, the back of the properties on Deangarden Rise and Deangarden Wood. The north-eastern corner of the site is approximately 30m to the south-west of Back Stream. The entirety of the site falls within Flood Zone 1, see Table 3-5. The historical flood map does not identify any fluvial flood events that have affected this site.

The fluvial flood zones have been developed using the EA's River Wye/Hughenden Stream hydraulic model, originally developed in 2001 for flood mapping purposes. The representation of the floodplain has been updated for this SFRA utilising LiDAR data from 2015. It should be noted that there appears to be a discrepancy (see Figure 3-9) between the published fluvial flood zones and the predicted flood extents derived from hydraulic modelling, see Section 2.2. However, at this location both versions of the model place the allocation site outside Flood Zone 3.

Figure 3-10 : Site 5 Fluvial Flooding with Climate Change



As the site is located within Flood Zone 1 and not at risk when climate change is taken into account, mapping of flood depths and flood hazard have not been developed.

3.2.2.1 Flood Defence Failure

There are no raised defences in the vicinity of the site.

3.2.3 Risk of Flooding from Other Sources

3.2.3.1 Surface Water

Surface water flood risk based on the uFMfSW is presented in Figure 3-11.

Figure 3-11: Site 5 Surface Water Flood Risk

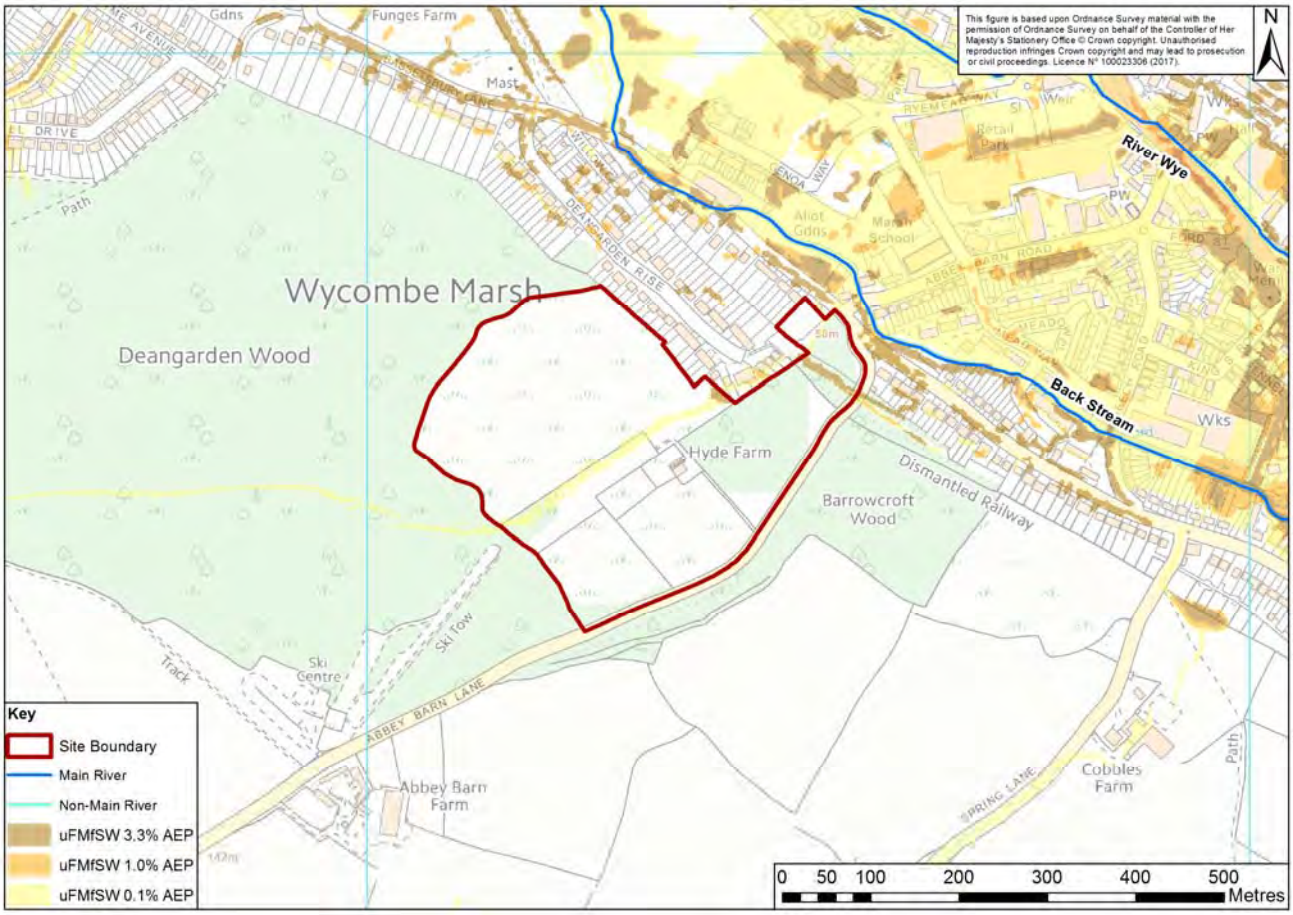


Table 3-7: Site 5 uFMfSW Extents

Event (AEP)	3.33% (1 in 30)	1% (1 in 100)	0.1% (1 in 1000)
Extent (ha)	0.12	0.12	0.56
Coverage (%)	1	1	5

The uFMfSW indicates two narrow flow paths through the site, potentially ordinary watercourses. The main flow path is shown for the 0.1% (1 in 1000) AEP event flowing south-west to north-east after entering the site in south-western corner. A second, smaller flow path is indicated for all three surface water events mapped entering the site from the east in the north-eastern corner of the site. A small area of ponding is indicated adjacent to the boundary, south of the southernmost properties on Deangarden Rise. The indicative flow paths could interact with the development and affect access to and from the site subject to the choice of proposed

access route for the development. The proposed development will need to make accommodation for the flow paths entering the site.

Climate change has the potential to increase the risk of surface water flooding to the site. Although beyond the scope of this SFRA to quantify the predicted impact, the risk of flooding to those areas currently assessed as 'Low' surface water risk could increase as a result of climate change and consequently they could become re-classified as WCDA. Such a risk would need to be quantified by the applicant in order to demonstrate that the site could be developed safely for future users, taking into account the planning implications of such a result.

3.2.3.2 Groundwater

For the two sources of mapping below, the AStGWF depicts the likelihood of groundwater emergence; the JBA mapping indicates depth to groundwater level beneath ground.

A review of the EA's AStGWF mapping indicates that the entirety of the site is at low risk of flooding (within a grid square where between than 25% and 50% is at risk of groundwater emergence). The northern portion of the site is within a zone of elevated risk of groundwater emergence. See Figure 3-12.

Figure 3-12: Site 5 Groundwater Flood Risk

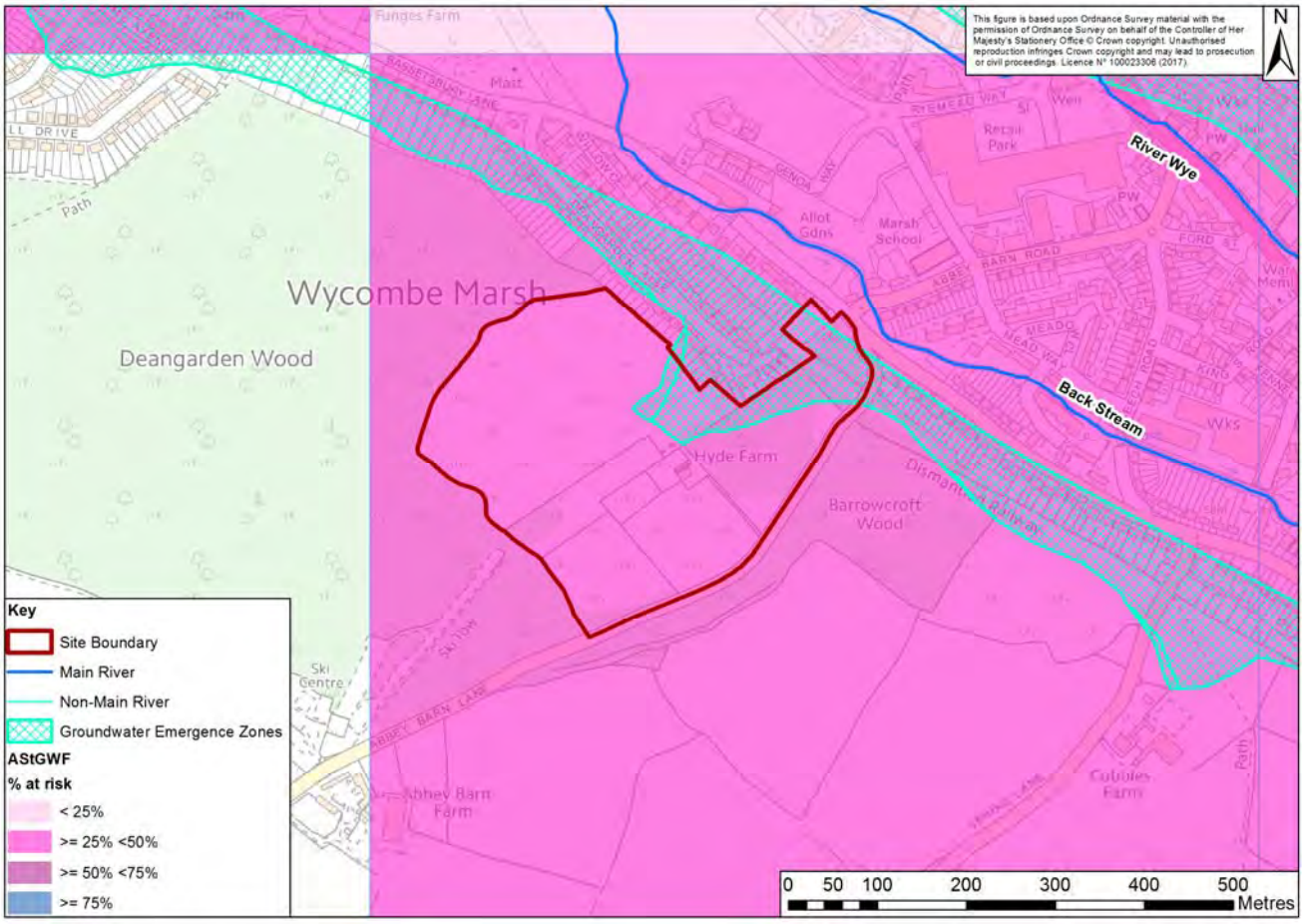
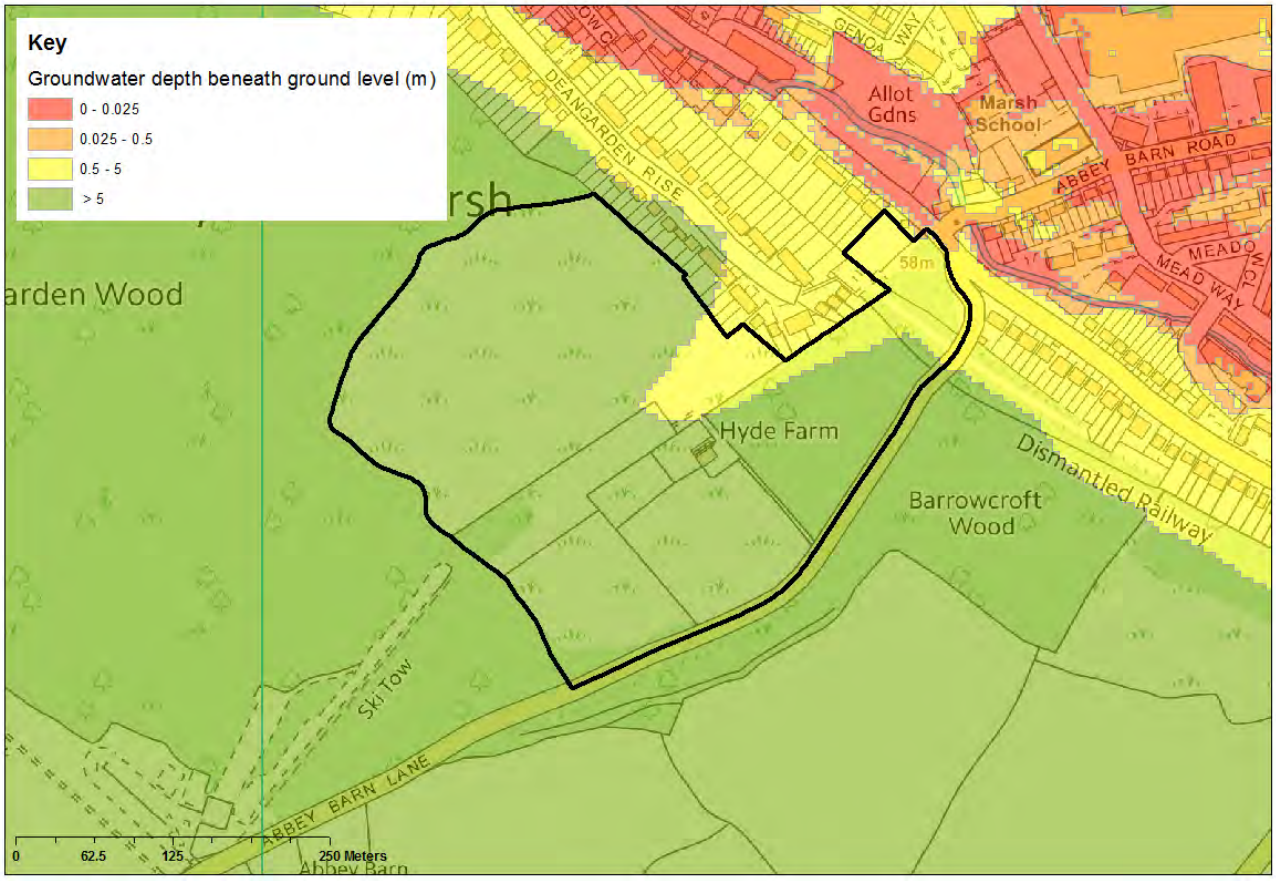


Figure 3-13 depicts groundwater mapping completed by JBA, indicating a high risk of groundwater flooding and that groundwater levels could be within 0.5m of the ground surface at the north eastern extent of this site.

Figure 3-13: Site 5 JBA Groundwater Mapping



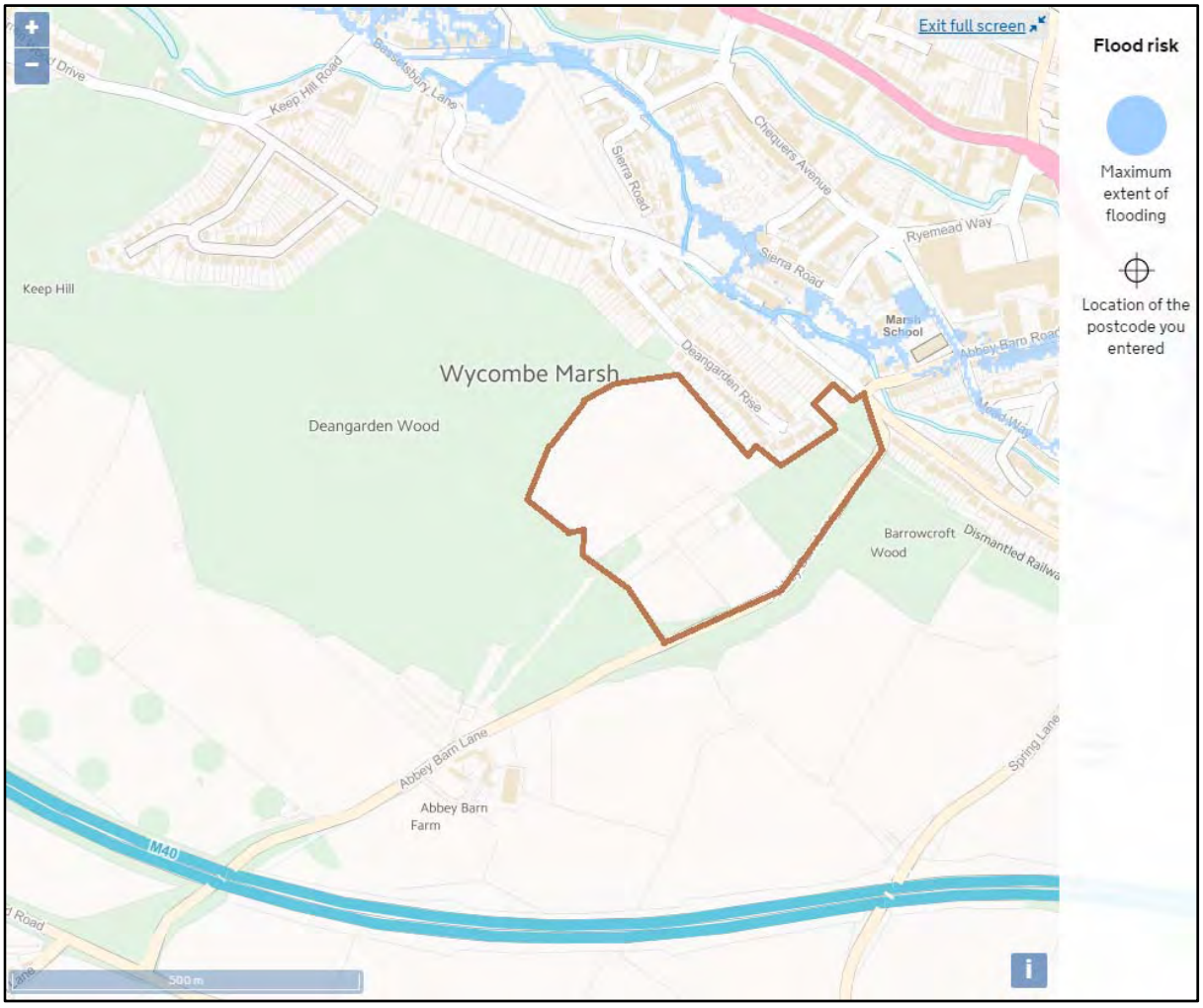
3.2.3.3 Sewers

With reference to Figure 7 of the Level 1 SFRA, the site is in a post code that recorded 1-5 incidents of sewer flooding affecting properties internally and externally in the 20 years preceding 2014.

3.2.3.4 Reservoir Failure

A review of the predicted flood extent as a result of reservoir failure available online indicates that the site is not at risk of flooding from such an event. See Figure 3-14.

Figure 3-14: Site 5 Risk of Flooding from Reservoir Failure



Source: https://flood-warning-information.service.gov.uk/long-term-flood-risk/map?map=SurfaceWater © Crown copyright and database rights 2017 OS 100024198

3.2.4 The Exception Test

The site is located within Flood Zone 1. The proposed development of 100 residential properties would be classified as 'More Vulnerable'[14] and would therefore be acceptable and would not need to pass the Exception Test[15]. Climate change is not predicted to change the level of risk consequently the site could be developed safely.

3.2.5 Flood Risk Management

3.2.5.1 Opportunities for Betterment

The site is located within the lower levels of the valley of the River Wye; there are limited areas of flooding on the northern bank of the Back Stream to the north of the site when climate change is taken into account, although at the extreme 70% allowance. Consequently, it is considered that there are limited opportunities for this site to provide betterment also because the site is predominantly Greenfield and the new development would therefore be expected to mimic existing runoff rates.

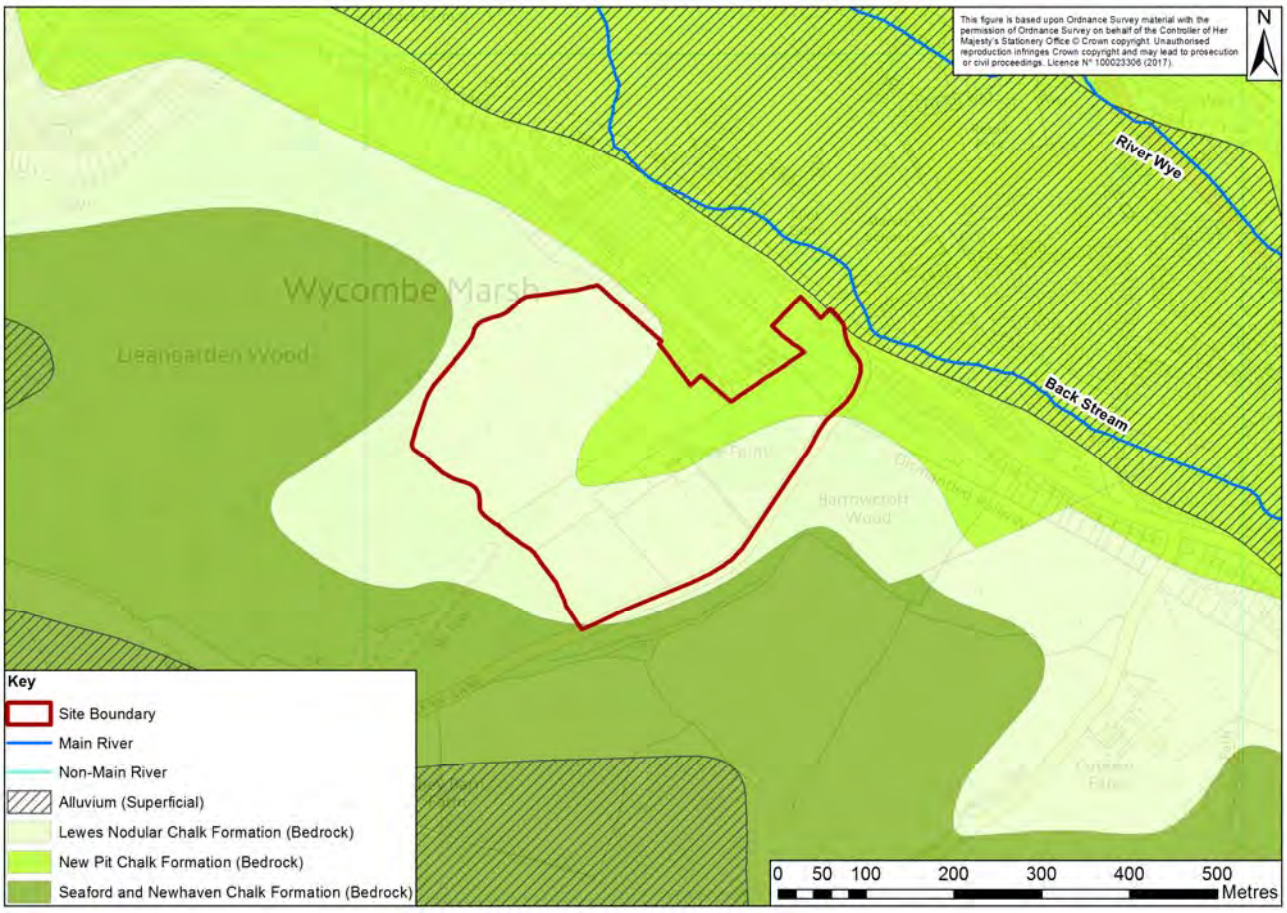
[14] NPPG Table 2 / Paragraph 066
[15] NPPG Table 3 / Paragraph 067

The surface water flow path through the centre of the site that rises from the rural area to the south-west suggests the presence of a local watercourse, this may impact upon existing property immediately to the north of the site, consequently interception and attenuation of this flow path within the development boundary could potentially benefit those presently at risk in addition to its management for the new development

3.2.5.2 Potential Feasibility of Infiltration Measures

A review of the site geology (see Figure 3-15) suggests it is underlain by superficial deposits of Alluvium and Chalk bedrock (New Pit, Lewes Nodular and Seaford and Newhaven Formations). The thickness of each layer is not included within the information. Surrounding strata have been omitted for clarity if they are not present directly beneath the site. Consequently, infiltration of rainfall directly to ground may be practicable. The proximity of the adjacent watercourse may result in locally high groundwater levels potentially reducing the feasibility of such measures. Infiltration should be the first method considered for the drainage of sites and as such, a site-specific FRA would be required to demonstrate the feasibility of infiltration measures.

Figure 3-15 : Site 5 Underlying Geology



3.2.5.3 Site-specific Flood Risk Assessment

A site-specific FRA would be required to accompany the planning application for this site because it is greater than 1ha in size in accordance with NPPF Paragraph 103 and it is located within a WCDA in accordance with WDC policy on Managing flood risk and Sustainable Drainage Systems. The review of flood risk has identified a number of issues that a site-specific FRA would need to consider in addition to those usually required:

- Confirmation of the extent of the two surface water flow paths through the site. The application should consider measures to maintain the flow paths and protect new buildings e.g. building orientation, finished floor levels, SuDS features etc., making allowance for the potential increase in risk due to climate change;
- Consideration of opportunities for betterment via the interception of the flow path from the south-west of the site. Flow attenuation could benefit the development and existing properties downstream;
- Assess the risk on site using best available data (including the new EA River Wye hydraulic model when available);
- Interaction between the surface water flow path and the Back Stream;
- Demonstrate that there is safe access and egress during surface water flood events;
- Suitability of infiltration measures for drainage of the site given the local geology; and
- How the elevated risk of groundwater flooding in the north of the site would be addressed, as a minimum avoiding the construction of below-ground habitable rooms.

3.3 Site 7: Land to the rear of Hughenden Road, High Wycombe Detailed Assessment

3.3.1 Site Description

The Land to the rear of Hughenden Road allocation site (planning ref: HW15) is located to the north-west of High Wycombe, to the north of the A40 and west of Hughenden Road. The NGR for the site is SU 8647 9393. The Hughenden Stream flows north to south and forms part of the western boundary of the site. The site is currently residential and commercial property and is an area of approximately 2.55ha. It is proposed as a regeneration opportunity with a green corridor next to the stream. It is envisaged that the site may provide housing; however, this is dependent on addressing the risk of flooding. This site has been assessed in detail because it is within 50m of the extent of published Flood Zone 2: see Section 2.1.

3.3.2 Fluvial Flood Risk

The fluvial flood risk to the site is presented in Figure 3-16.

Figure 3-16: Site 7 Fluvial Flood Risk

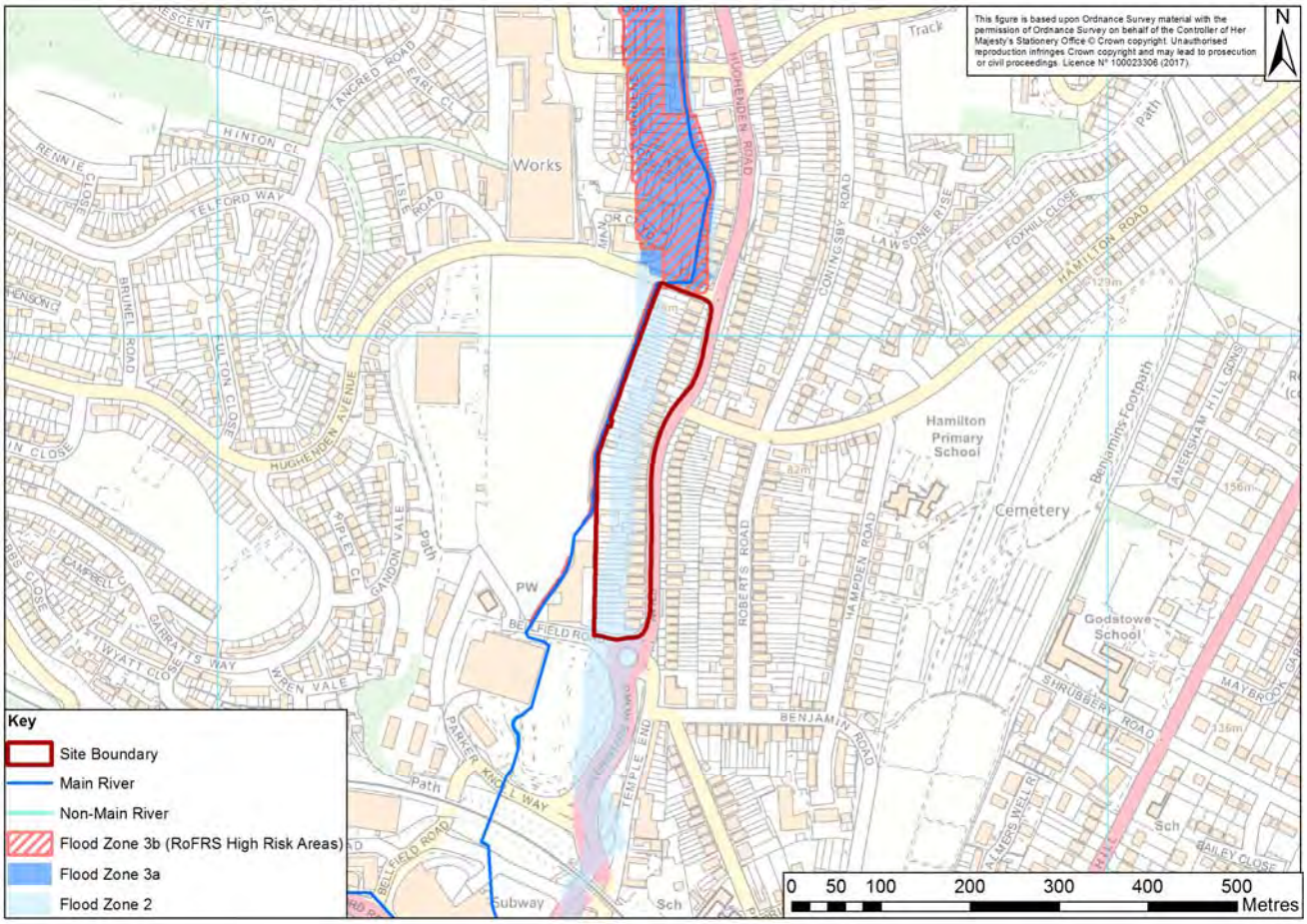


Table 3-8: Site 7 Current Flood Zone Extents

Flood Zone	1	2	3a	3b	Total
Extent (ha)	1.40	1.10	0	0.05	2.55
Coverage (%)	55	44.98	0	0.02	-

The site is bounded to the West by the Hughenden Stream; an EA designated Main River, Hughenden Avenue to the north, Hughenden Road to the east and Bellfield Road to the south. The extreme north-western corner and the western edge of the site are designated as Flood Zone 3b attributed to the Hughenden Stream channel; see Figure 3-16. The historic flood map does not identify any fluvial flood events that have affected this site. The development boundary abuts the Hughenden Stream; the applicant would need to make allowance for a buffer strip along the watercourse from the top of the bank for maintenance activities of eight metres.

Analysis of flood zone mapping suggests the presence of a flow path through the centre of the site in extreme events. This diverges from the path of the Hughenden Stream suggesting that the watercourse is perched on the western side of the valley, it may have been realigned to permit previous development given its course along the western boundary of existing properties. Consequently, the site could be at risk from flood defence failure as a result of an extreme event (for example, culvert blockage – see Section 3.3.2.1) should the watercourse flood upstream resulting in overland flows following the natural topography.

The hydraulic model does not predict flooding along the Hughenden Stream for the 1% (1 in 100) AEP event plus the full range of climate change allowances. It is possible that the extent of Flood Zone 2 could increase due to climate change although this has not been modelled as If the existing extent did increase, it would be likely to be within areas of high surface water flood risk (see Figure 3-17), particularly the flow path entering the site from the east. Although such an area would ideally be avoided, a residential development would be deemed acceptable in accordance with the NPPF if within Flood Zone 2. In the absence of climate change modelling, the effects of climate change should be considered by the applicant to ensure the development could be developed safely.

From Transport for Buckinghamshire's records, there is a known flooding hotspot at the downstream end of the site and a historic flood record from September 2004 adjacent to the site on Hughenden Road.

3.3.2.1 Flood Defence Failure

There are no raised defences in the vicinity of the site.

The Hughenden Stream is in culvert beneath Hughenden Avenue at the northern boundary of the site and Bellfield Road at the southern end of the site (at its lowest point the site is approximately 1.1m higher than the watercourse at this point). An applicant would need to consider the risk of culvert blockage leading to flooding of the site. A review of the BCC asset database and the EA's AIMS database failed to confirm the dimensions of the culvert and whether it includes a debris screen.

3.3.3 Risk of Flooding from Other Sources

3.3.3.1 Surface Water

Surface water flood risk based on the uFMfSW is presented in Figure 3-17.

Figure 3-17: Site 7 Surface Water Flood Risk

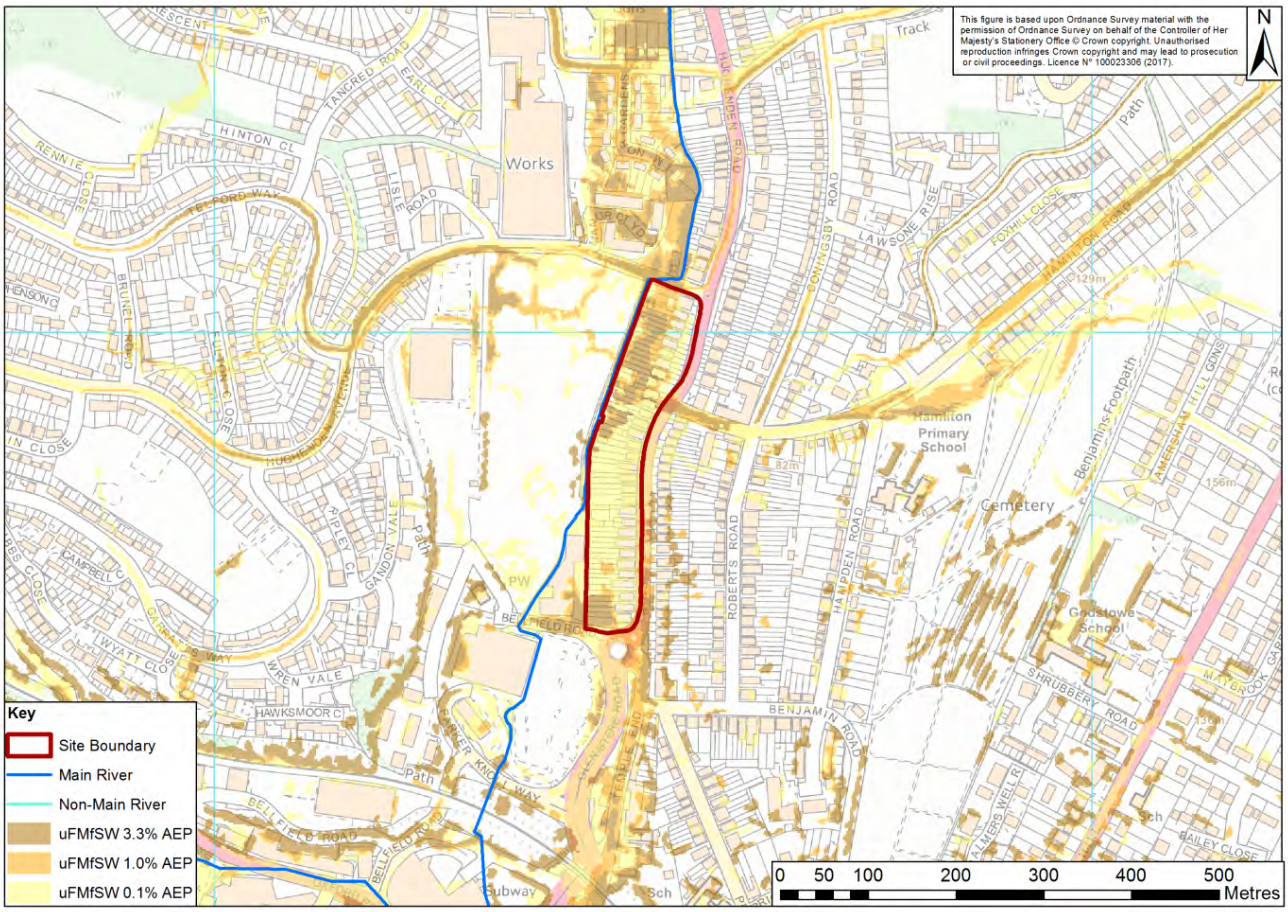


Table 3-9: Site 7 uFMfSW Extents

Event (AEP)	3.33% (1 in 30)	1% (1 in 100)	0.1% (1 in 1000)
Extent (ha)	0.38	0.51	2.3
Coverage (%)	15	20	90

Primarily the north-west of the site appears to be at greatest risk of surface water flooding based on the uFMfSW although this is more likely be fluvial flooding from the Hughenden Stream, approximately 15% of the site is at risk of surface water flooding from a 3.3% (1 in 30) AEP event (see Table 3-9). The uFMfSW indicates flood risk to the western edge of the site (adjacent to the watercourse) is higher than other areas. Due to existing topography, it is likely that surface water flow would travel north to south through the site which is likely to interact with the development and affect access to and from the site.

The extent of the high risk uFMfSW event indicates a flow path entering the site from Hamilton Road to the east. There is a second area of high risk at the southern end of the site which may be directly from the Hughenden

Stream. The Level 1 SFRA indicates that areas in High Wycombe are known to be particularly susceptible to flooding from surface water in urban areas that respond quickly to rainfall.

Climate change has the potential to increase the risk of surface water flooding to the site. Although beyond the scope of this SFRA to quantify the predicted impact, the risk of flooding to those areas currently assessed as 'Low' surface water risk could increase as a result of climate change and consequently they could become re-classified as WCDA. Such a risk would need to be quantified by the applicant in order to demonstrate that the site could be developed safely for future users, taking into account the planning implications of such a result.

3.3.3.2 Groundwater

For the two sources of mapping below, the AStGWF depicts the likelihood of groundwater emergence; the JBA mapping shows depth to groundwater level beneath ground.

A review of EA AStGWF mapping indicates that the majority of the site is at low risk of flooding (within a grid square where between than 25% and 50% is at risk of groundwater emergence). The northern end of the site is at very low risk of flooding (less than 25% is at risk of groundwater emergence). Groundwater emergence mapping suggests that the north-eastern area of the site may be at elevated risk of flooding. See Figure 3-18.

Figure 3-18: Site 7 Groundwater Flood Risk

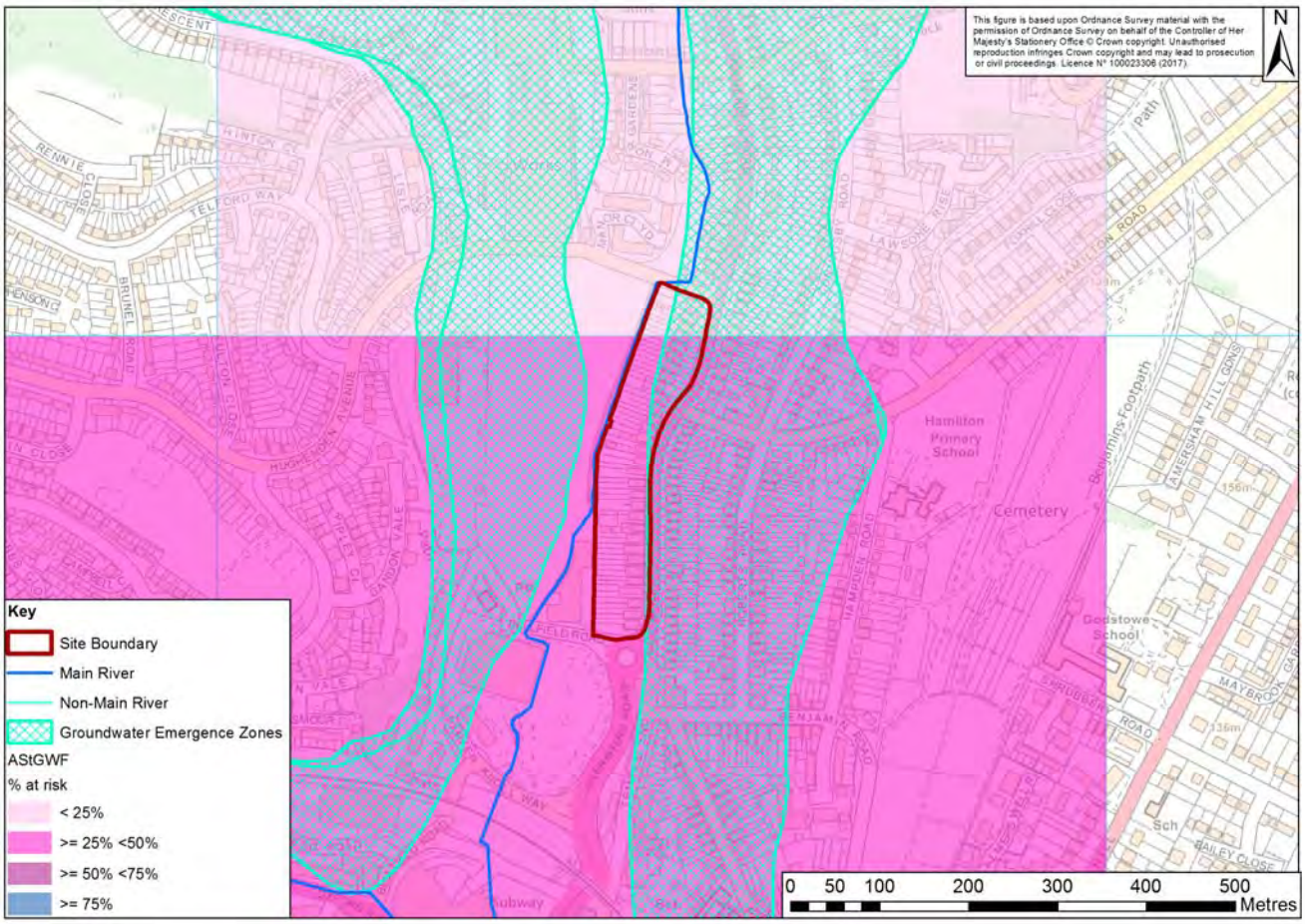
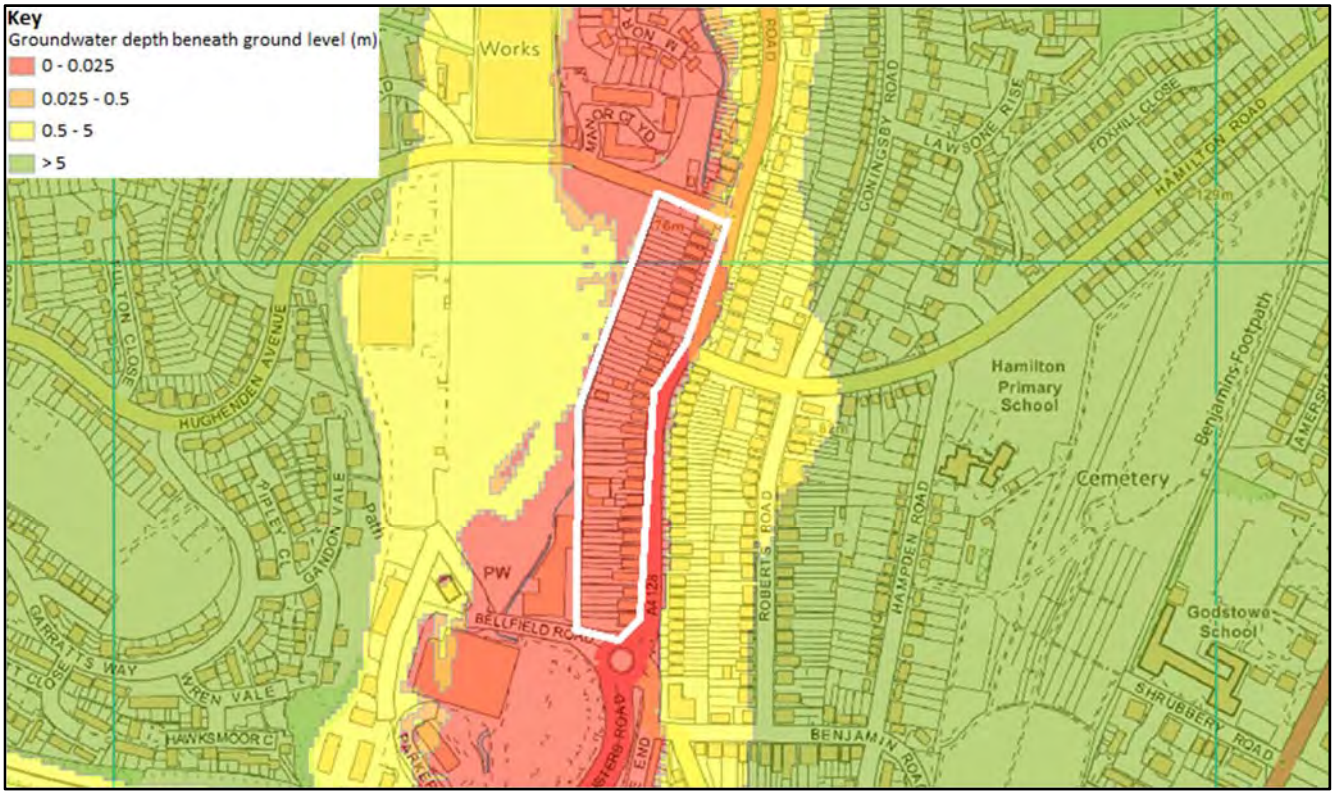


Figure 3-19 depicts groundwater mapping completed by JBA, showing a high risk of groundwater flooding and that the groundwater levels are either at or very near to (within 0.025m) the ground surface at this site.

Figure 3-19 : Site 7 JBA Groundwater Mapping



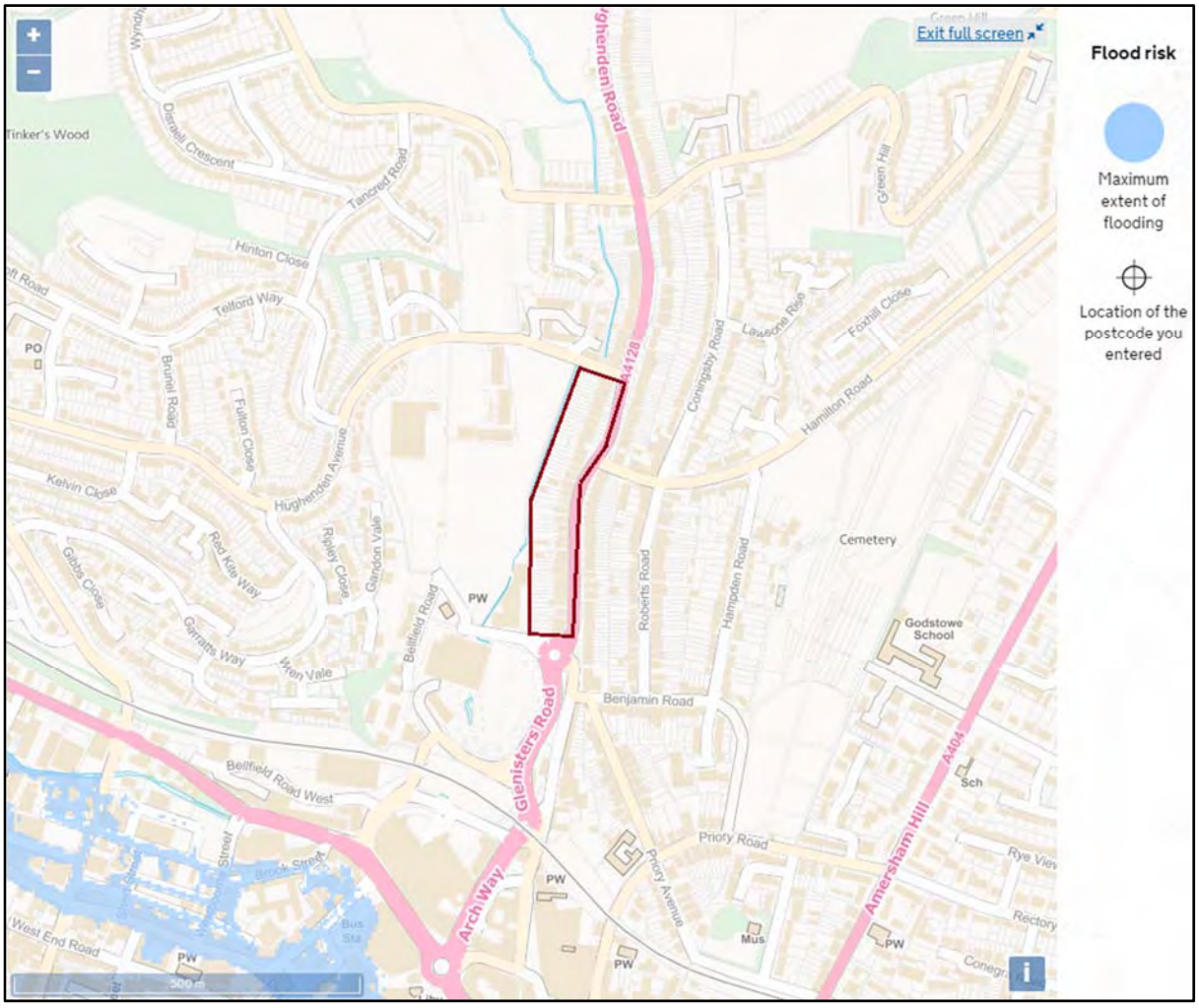
3.3.3.3 Sewers

With reference to Figure 7 of the Level 1 SFRA, the site is in a post code that recorded 6-10 incidents of sewer flooding affecting properties internally and 11-15 externally in the 20 years preceding 2014.

3.3.3.4 Reservoir Failure

A review of the predicted flood extent as a result of reservoir failure available online indicates that the site is not at risk of flooding from such an event. See Figure 3-20.

Figure 3-20: Site 7 Risk of Flooding from Reservoir Failure



Source: https://flood-warning-information.service.gov.uk/long-term-flood-risk/map?map=SurfaceWater © Crown copyright and database rights 2017 OS 100024198

3.3.4 The Exception Test

The site is located within Flood Zones 1, 2 and 3. The proposed development of an unconfirmed number of residential properties would be classified as 'More Vulnerable'[16]. More vulnerable use is not acceptable in flood Zone 3b. However, Flood Zone 3b only represents 0.02% of the site, situated at the most northern part of the site. The proposed development could therefore be allocated subject to avoiding development in 3b. More vulnerable use would be acceptable in Flood Zones 1 and 2 and would not need to pass the Exception Test[17].

3.3.5 Flood Risk Management

3.3.5.1 Opportunities for Betterment

The development may provide an opportunity to reinstate floodplain on the Hughenden Stream via the positioning of new properties and/or their elevation above design flood levels e.g. the 1% (1 in 100) plus climate change peak water level.

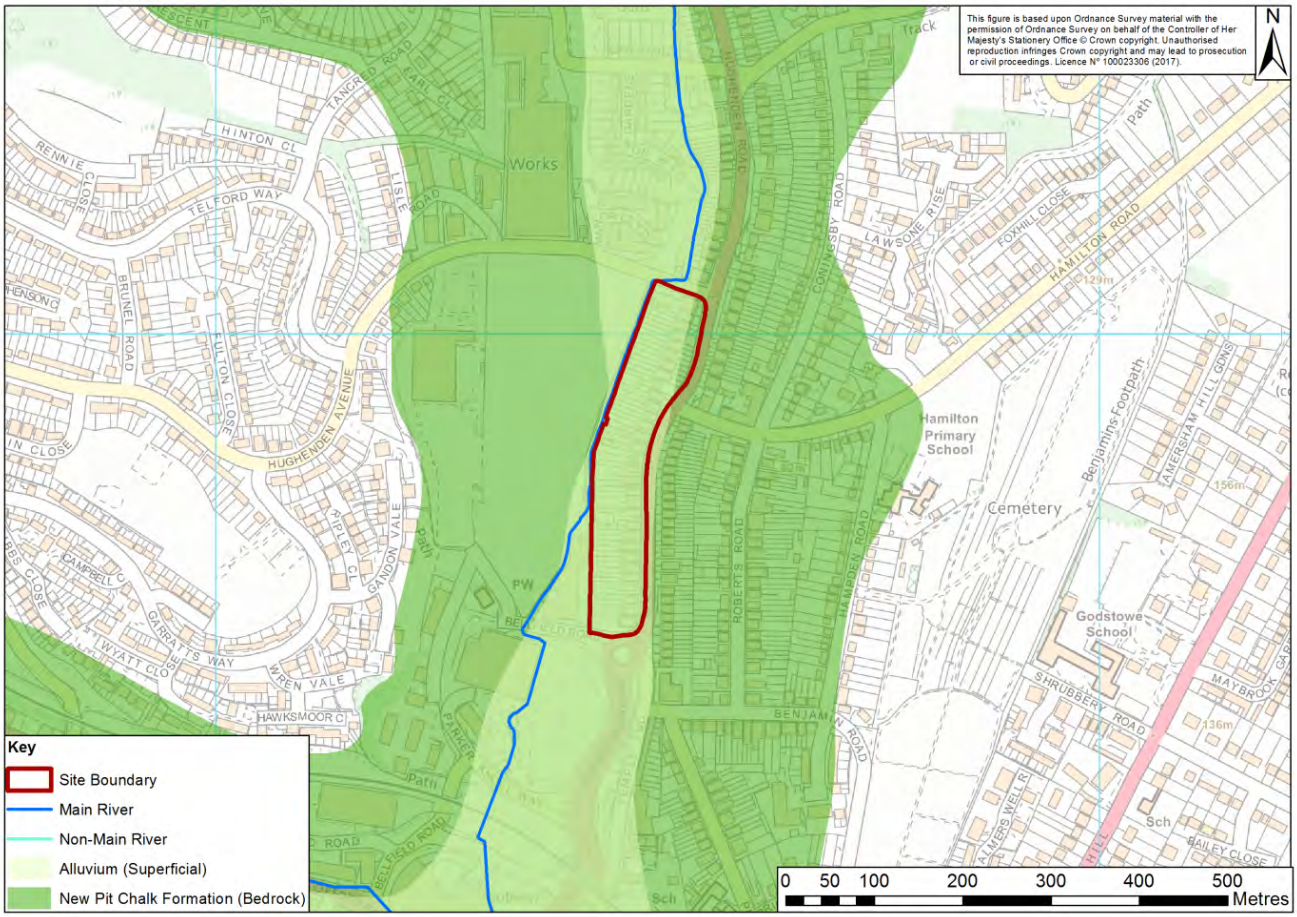
[16] NPPG Table 2 / Paragraph 066
[17] NPPG Table 3 / Paragraph 067

The site is located within the lower levels of the Hughenden Stream before it enters High Wycombe town centre to the south. There may be opportunities to attenuate flows to reduce the risk of fluvial flooding in the town centre although this is likely to be governed more by the River Wye as the larger watercourse so may be of little benefit. Proposals for the attenuation of flows within the development site would need to carefully consider the impact on areas of high flood risk immediately upstream.

3.3.5.2 Potential Feasibility of Infiltration Measures

A review of the site geology (see Figure 3-21) suggests it is underlain by superficial deposits of Alluvium and Chalk bedrock (New Pit Formation). The thickness of each layer is not included within the information. Surrounding strata have been omitted for clarity if they are not present directly beneath the site. Consequently, infiltration of rainfall directly to ground may be practicable. The proximity of the watercourse may result in locally high groundwater levels potentially reducing the feasibility of such measures. Infiltration should be the first method considered for the drainage of sites and as such, a site-specific FRA would be required to demonstrate the feasibility of infiltration measures.

Figure 3-21 : Site 7 Geology



3.3.5.3 Site-specific Flood Risk Assessment

A site-specific FRA would be required to accompany the planning application for this site because it is greater than 1ha in size, in accordance with NPPF Paragraph 103 and it is located within a WCDA in accordance with WDC policy on Managing flood risk and Sustainable Drainage Systems. The review of flood risk has identified a number of issues that a site-specific FRA would need to consider in addition to those usually required:

- The applicant will need to use best available data to consider the need for detailed hydraulic fluvial and surface water modelling of the Hughenden Stream at this location to provide greater certainty of the degree of fluvial flood risk;
- Provision of a buffer zone of a minimum of eight metres along the Hughenden Stream to preserve the biodiversity of the watercourse;
- Consideration in areas of High and Medium risk of flooding (based on the uFMfSW) across the site including how the flow path through the site from Hamilton Road will be maintained or if not maintenance how it will impact downstream, noting that any receptors should not be adversely impacted. The applicant should seek opportunities to design the development to avoid encroachment into the WCDA (areas of High and Medium surface water flood risk based on the uFMfSW) where practicable, allowing for the potential change in these areas due to climate change;
- If avoiding the WCDA is not practicable:
    - Demonstrate that finished floor levels are above the High and Medium uFMfSW risk peak water level (plus an allowance for climate change); and
    - Demonstrate that the flow path can be maintained, or modifications to it as a result of the development will not detrimentally affect third parties.
- Consider and mitigate against the impact of culvert blockage locally to flood risk;
- Demonstrate that safe access and egress can be achieved in the event of surface water, groundwater and/or fluvial flooding;
- Demonstrate how the elevated risk of groundwater flooding would be addressed and mitigated for, as a minimum avoiding the construction of below-ground rooms; and
- The suitability of infiltration measures for drainage of the site given the local geology and the influence of the Hughenden Stream on local groundwater levels.

3.4 Site 10: Former Bassetsbury Allotments, Bassetsbury Lane Detailed Assessment

3.4.1 Site Description

The former Bassetsbury Allotments, Bassetsbury Lane allocation site (planning ref: HW13) is located to the south-east of High Wycombe, to the south of Bowden Lane and North of Bassetsbury Lane. The NGR for the site is SU 8809 9204. The site is currently derelict (former allotments) and has contamination issued. The site is an area of approximately 2.09ha. It is proposed to construct 30 residential properties on the site. This site has been assessed in detail because it is within 50m of the extent of published Flood Zone 2 and encompasses areas of Flood Zone 3b: see Section 2.1.

3.4.2 Fluvial Flood Risk

The fluvial flood risk to the site is presented in Figure 3-22.

Figure 3-22: Site 10 Fluvial Flood Risk

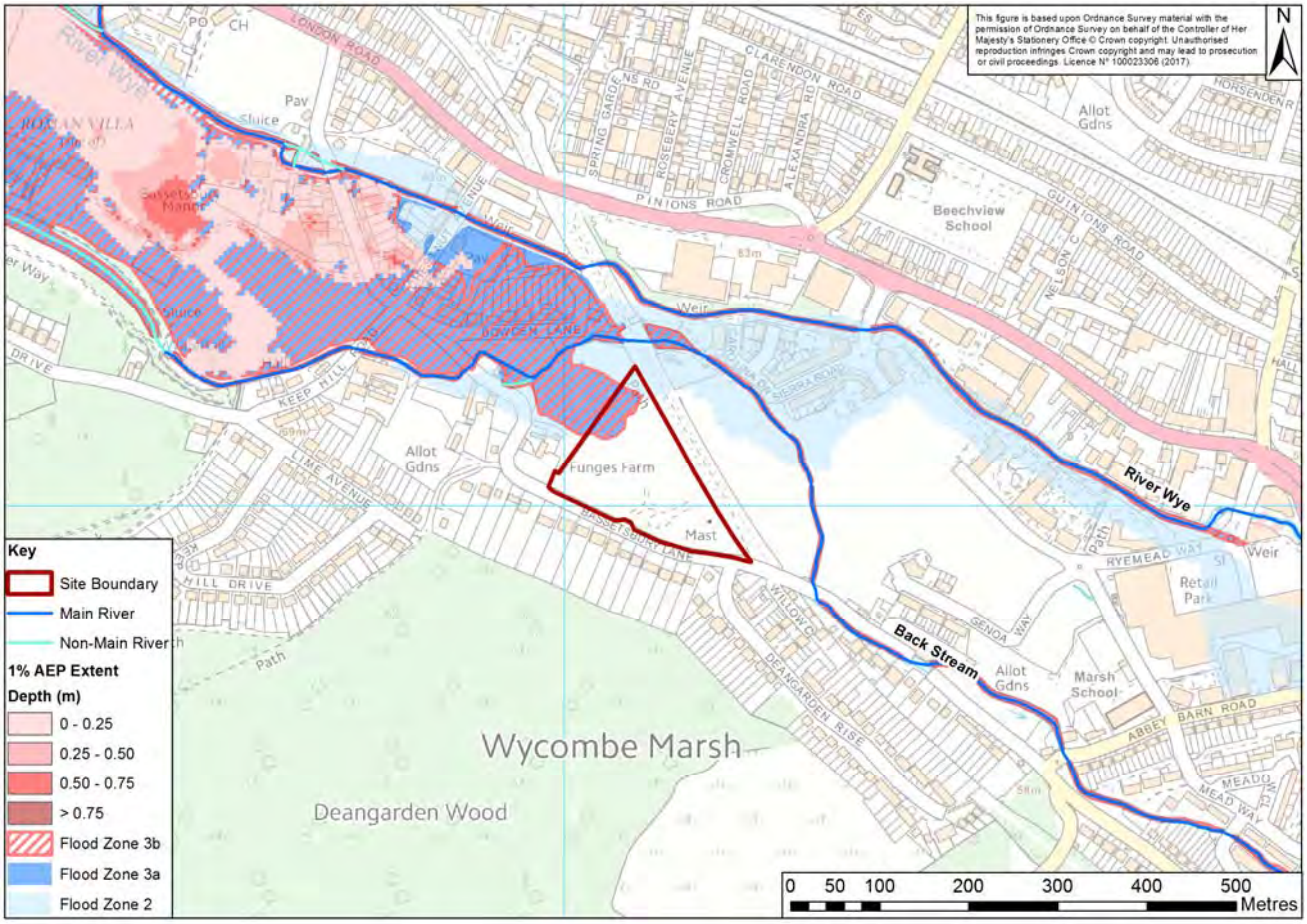


Table 3-10: Site 10 Current Flood Zone Extents

Flood Zone	1	2	3a	3b	Total
Extent (ha)	1.89	0.04	0	0.16	2.09
Coverage (%)	90	2	0	8	-

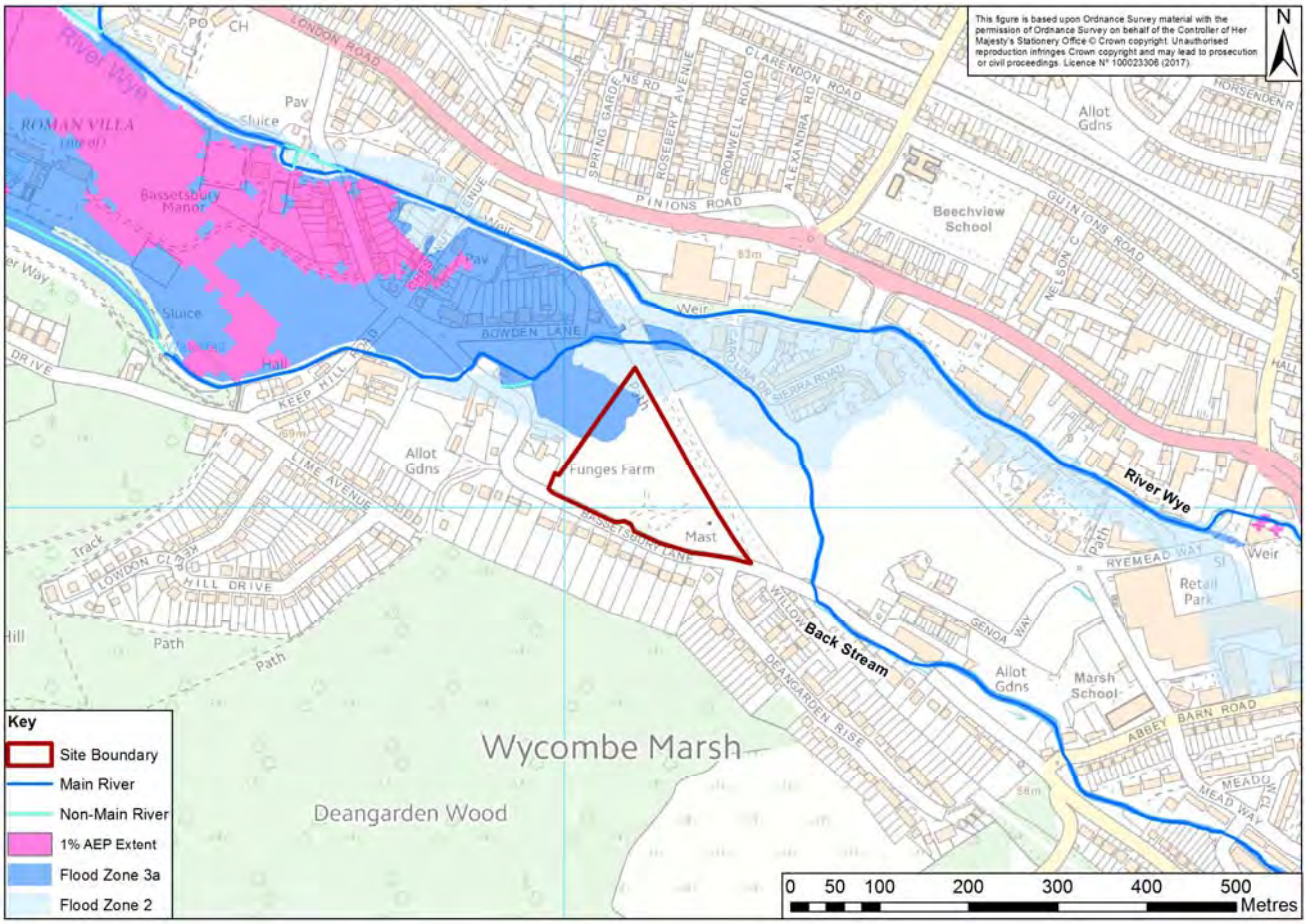
Table 3-11: Site 10 Modelled 1% (1 in 100) AEP Event Extent

AEP Event	Extent (ha)	%
1% (1 in 100)	0	0

The site boundary is approximately 50m to the south of the River Wye and bounds the Back Stream, a tributary to the Wye to the north. The north of the site is within Flood Zones 3b and 2; see Figure 3-22. The historic flood map does not identify any fluvial flood events that have affected this site.

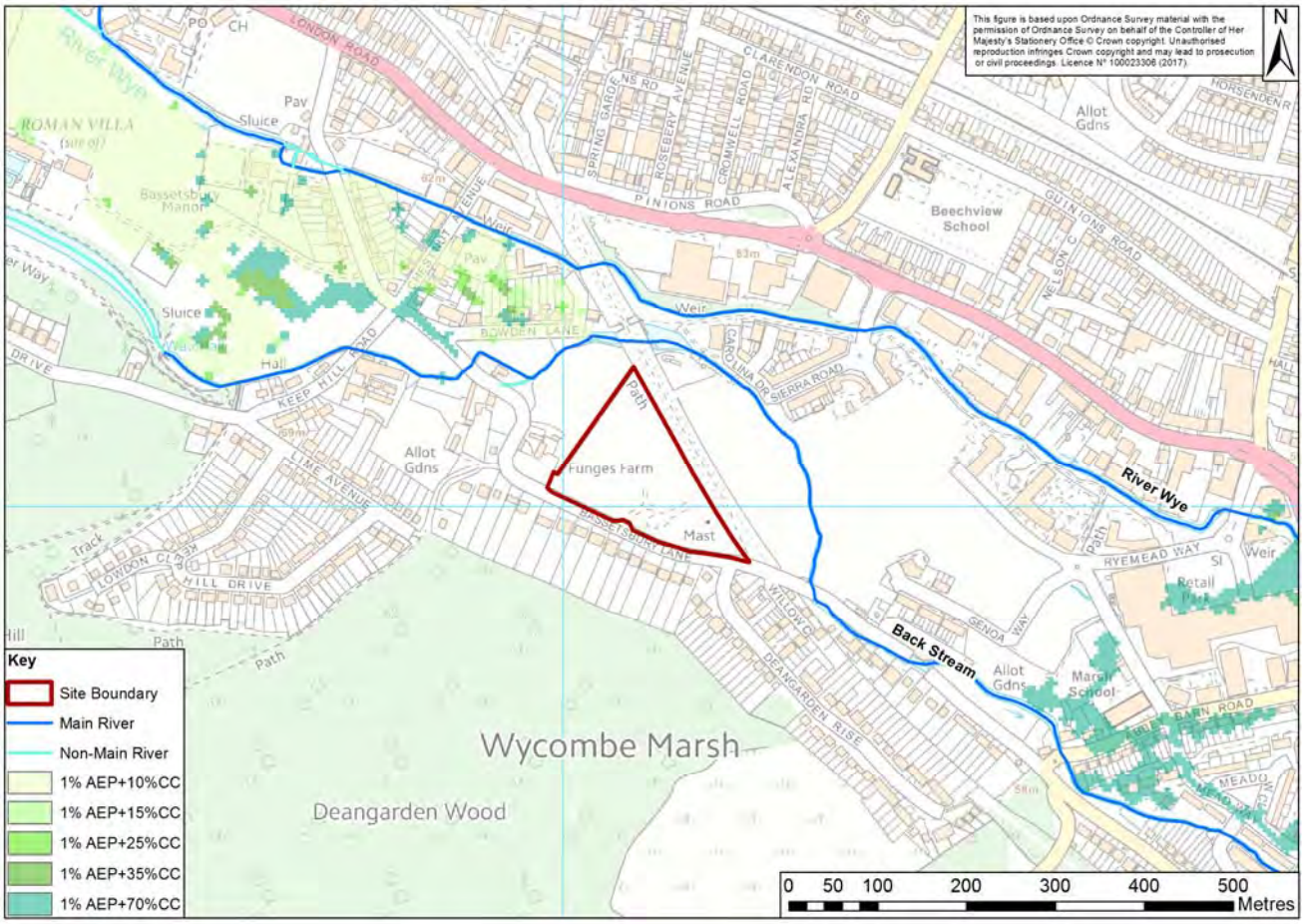
The fluvial flood zones have been developed using the EA's River Wye/Hughenden Stream hydraulic model, originally developed in 2001 for flood mapping purposes. The representation of the floodplain has been updated for this SFRA. As a result, there is a discrepancy between the published extent of Flood Zone 3 and the newly modelled 1% (1 in 100) AEP flood extent (see Figure 3-23).

Figure 3-23 : Flood Zone 3a and Modelled 1% AEP Event Discrepancy



A review of Figure 3-22 indicates that the published Flood Zone 3b and 3a extents are greater than that for the 'with climate-change extents', and extend into the site boundary whereas the newly developed extents for more extreme events do not – refer to Section 2.2. Consequently, the future applicant will need to consider this when developing a site-specific FRA and seek agreement with the EA as to which flood extents to adopt. However, it should be noted that the majority of the site is located within Flood Zone 1.

Figure 3-24 : Site 10 Fluvial Flooding with Climate Change



As the site is not at risk of flooding when climate change is taken into account, mapping of flood depths and flood hazard have not been developed. While the preference would be to avoid development within Flood Zone 2, should the predicted impact of climate change result in an increase in the extent of Flood Zone 2 and encroach to within the site a residential development would remain acceptable in accordance with the NPPF.

3.4.2.1 Flood Defence Failure

There are no raised defences in the vicinity of the site.

The northern boundary is adjacent to a culvert on the Back Stream that passes under a disused railway. The extent of Flood Zone 3 in this area suggests that this culvert (and another on the River Wye approximately 130m north-west of the site) may restrict conveyance and cause water to back-up to the west. Consequently, the site could potentially be at risk of flooding should either of these culverts become blocked. A review of the EA AIMS and BCC asset databases has not indicated the dimensions of these structures or whether they have debris screens. It is recommended therefore that a site-specific FRA for this development includes an assessment of the residual risk of flooding should either of these culverts become blocked.

3.4.3 Risk of Flooding from Other Sources

3.4.3.1 Surface Water

Surface water flood risk based on the uFMfSW to the development site is presented in Figure 3-25.

Figure 3-25: Site 10 Surface Water Flood Risk

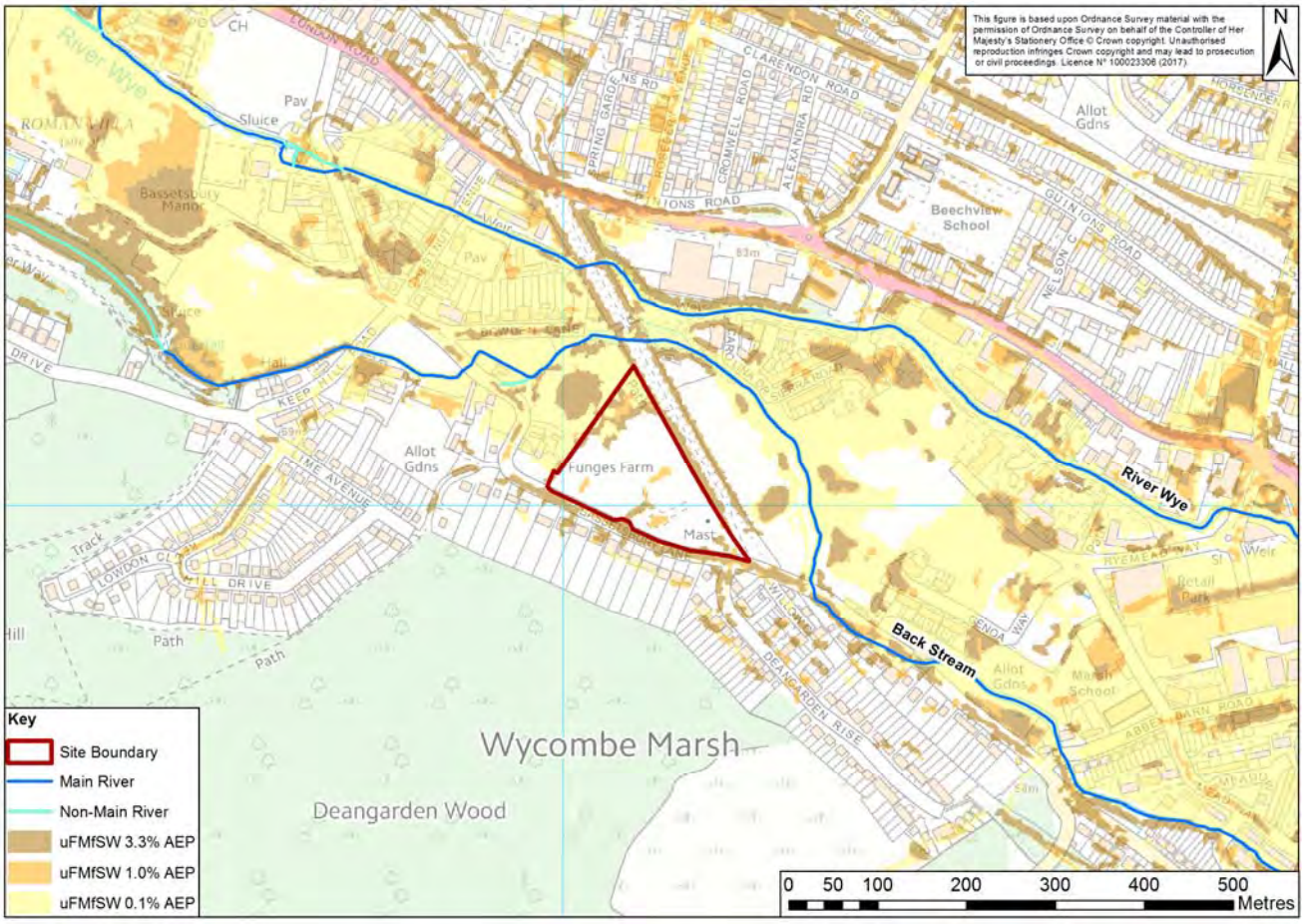


Table 3-12: Site 10 uFMfSW Extents

Event (AEP)	3.33% (1 in 30)	1% (1 in 100)	0.1% (1 in 1000)
Extent (ha)	0.29	0.01	0.04
Coverage (%)	14.0	0.7	2.1

Primarily the north-west of the site appears to be at greatest risk of surface water flooding based on the uFMfSW, approximately 14% of the site is at 'High' risk of surface water flooding from a 3.3% (1 in 30) AEP event (see Table 3-12). It would appear that the raised embankment of the disused railway is an obstacle to the surface water flow path along the Wye valley, consequently flooding is predicted at the toe of the embankment that runs through the site. Another explanation could also be that there is a drain at the toe of the embankment picked up in the Digital Elevation Model of the hydraulic model used to generate the extents which is being filled by the surface water flow, but this could potentially become a preferential flow path through the development site. There are pockets of flooding predicted in the site which may be the result of rainfall filling localised depressions in the hydraulic model used to develop the extents. There appears to be a flow path at the southern

boundary of the site along Bassetsbury Lane which could interact with the development and affect access to and from the site.

Climate change has the potential to increase the risk of surface water flooding to the site. Although beyond the scope of this SFRA to quantify the predicted impact, the risk of flooding to those areas currently assessed as 'Low' surface water risk could increase as a result of climate change and consequently they could become re-classified as WCDA. Such a risk would need to be quantified by the applicant in order to demonstrate that the site could be developed safely for future users, taking into account the planning implications of such a result.

3.4.3.2 Groundwater

For the two sources of mapping below, the AStGWF depicts the likelihood of groundwater emergence; the JBA mapping shows depth to groundwater level beneath ground.

A review of EA AStGWF mapping indicates that the majority of the site is at very low risk of flooding (within a grid square where less than 25% is at risk of groundwater emergence). There are areas at slightly elevated risk of flooding to the south but they do not impinge upon the site extent. See Figure 3-26.

Figure 3-26: Site 10 Groundwater Flood Risk

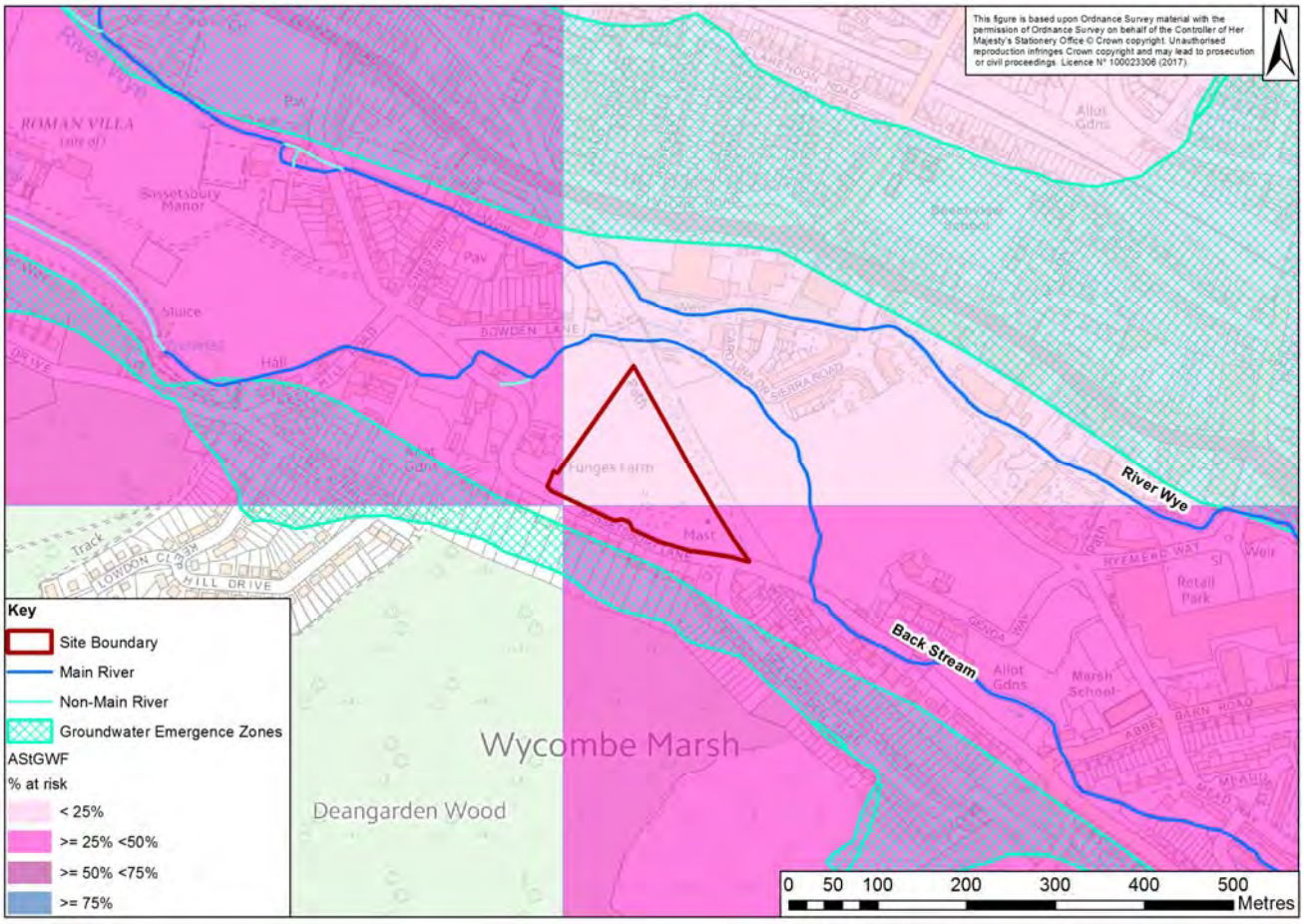
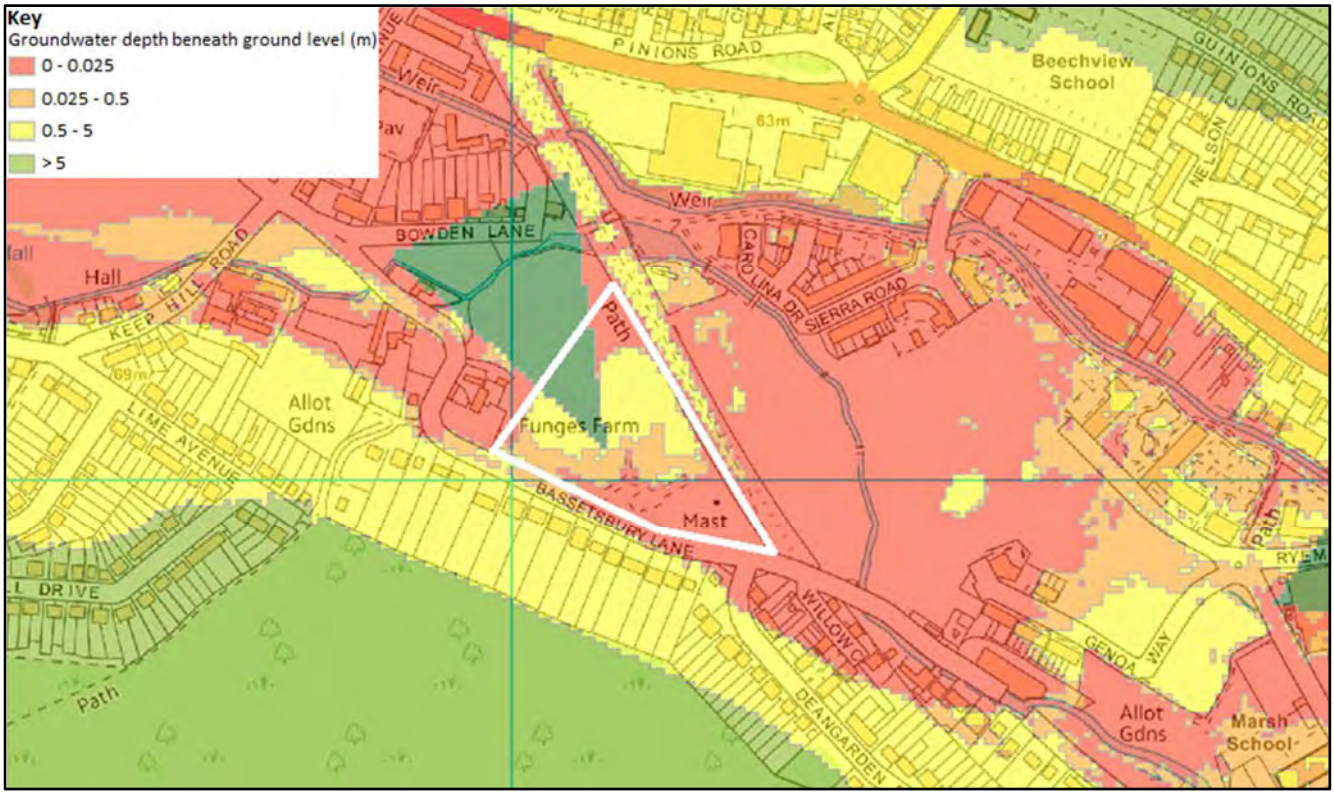


Figure 3-27 depicts groundwater mapping completed by JBA, showing areas of the site at high (within 0.025m of the ground surface), medium (groundwater levels between 0.025m and 0.5m below the ground surface) and low risk of groundwater flooding at this site.

Figure 3-27 : Site 10 JBA Groundwater Mapping



3.4.3.3 Sewers

With reference to Figure 7 of the Level 1 SFRA, the site is in a post code that recorded 1-5 incidents of sewer flooding affecting properties internally in the 20 years preceding 2014.

3.4.3.4 Reservoir Failure

A review of the predicted flood extent as a result of reservoir failure available online indicates that the site is not at risk of flooding from such an event. See **Error! Reference source not found.**.

Figure 3-28: Site 10 Risk of Flooding from Reservoir Failure

Source: https://flood-warning-information.service.gov.uk/long-term-flood-risk/map?map=SurfaceWater © Crown copyright and database rights 2017 OS 100024198

3.4.4 The Exception Test

The site is currently located within Flood Zones 1 and 2 when considering the 1% (1 in 100) +CC AEP event modelling. The proposed development of 30 residential properties would be classified as 'More Vulnerable'[18] and would therefore be acceptable and would not need to pass the Exception Test[19]. The level of risk is not predicted to change when the impact of climate change is considered and therefore the site could be developed safely.

3.4.5 Flood Risk Management

3.4.5.1 Opportunities for Betterment

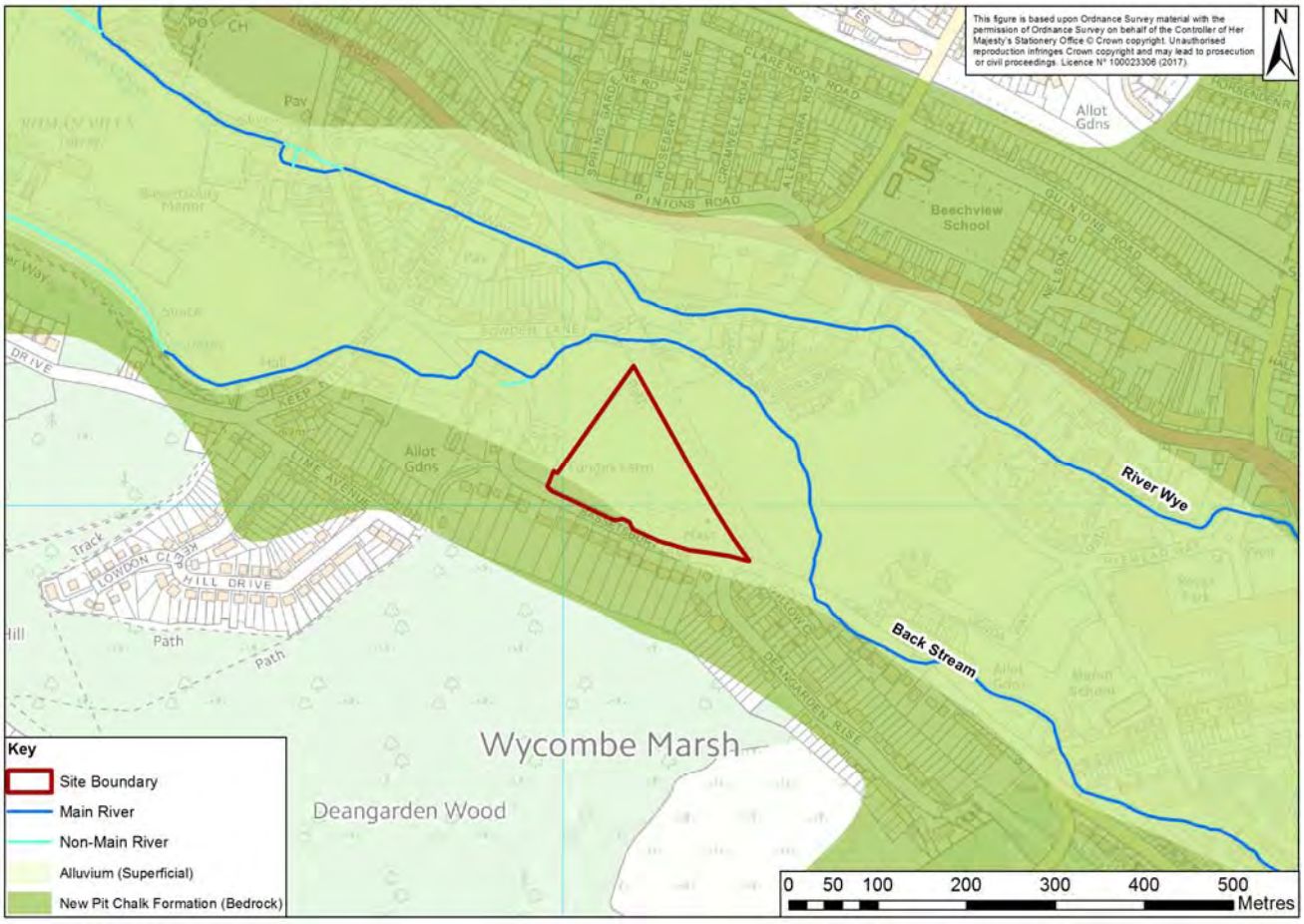
There is property within Flood Zone 2 approximately 600m downstream of the site which could benefit from upstream attenuation at this site; however, published flood maps appear to suggest the dismantled railway embankment and culvert are already providing such benefit based on a review of the published flood extents suggesting they restrict flow.

[18] NPPG Table 2 / Paragraph 066
[19] NPPG Table 3 / Paragraph 067

3.4.5.2 Potential Feasibility of Infiltration Measures

A review of the site geology (see Figure 3-29) suggests it is underlain by superficial deposits of Alluvium and Chalk bedrock (New Pit Formation). The thickness of each layer is not included within the information. Surrounding strata have been omitted for clarity if they are not present directly beneath the site. Consequently, infiltration of rainfall directly to ground may be practicable. The proximity of the watercourses may result in locally high groundwater levels potentially reducing the feasibility of such measures. Infiltration should be the first method considered for the drainage of sites and as such, a site-specific FRA would be required to demonstrate the feasibility of infiltration measures.

Figure 3-29 : Site 10 Underlying Geology



3.4.5.3 Site-specific Flood Risk Assessment

A site-specific FRA would be required to accompany the planning application for this site because it is greater than 1ha in size in accordance with NPPF paragraph 103 and is within a WCDA in accordance with NPPF paragraph 103 and WDC policy on Managing flood risk and Sustainable Drainage Systems. The review of flood risk has identified a number of issues that a site-specific FRA would need to consider in addition to those usually required and which should be reflected in WDC planning policy (see Section 4):

- Utilisation of the best available data to confirm fluvial flood risk to the allocation site;
- The site should be developed in such a manner to avoid encroachment into the WCDA wherever practicable;
- If the development does encroach into the WCDA:

- Demonstrate that finished floor levels are above the High and Medium uFMfSW risk peak water level (plus an allowance for climate change);
- No habitable below-ground rooms are constructed in such areas; and
- Demonstrate that the flow path can be maintained, or modifications to it as a result of the development will not detrimentally affect third parties.

- How the site would be accessed safely given the degree of surface water flood risk to the south on Bassetsbury Lane;
- The suitability of infiltration measures for drainage of the site given the local geology;
- The likelihood of flooding as a result of a blockage of the two culverts to the north of the site on the River Wye and Back Stream; and
- Demonstrate how the elevated risk of groundwater flooding would be addressed ad mitigated for, as a minimum avoiding the construction of below-ground rooms.

3.5 Site 15: Hollands Farm (north), Bourne End Detailed Assessment

3.5.1 Site Description

Hollands Farm (north) allocation site (planning ref: BE2) is located to the east of Bourne End close to the confluence of the River Wye (approximately 60m to the west) and the River Thames (approximately 400m downstream) and south of the A4094. The NGR for the site is SU 9001 8697. The site is currently arable farmland and is an area of approximately 32.0 ha. It is intended to construct 467 residential properties on the site and a school. This site has been assessed in detail because it is within 50m of the extent of published Flood Zone 2: see Section 2.1.

3.5.2 Fluvial Flood Risk

The fluvial flood risk to the site is presented in Figure 3-30.

Figure 3-30: Site 15 Fluvial Flood Risk

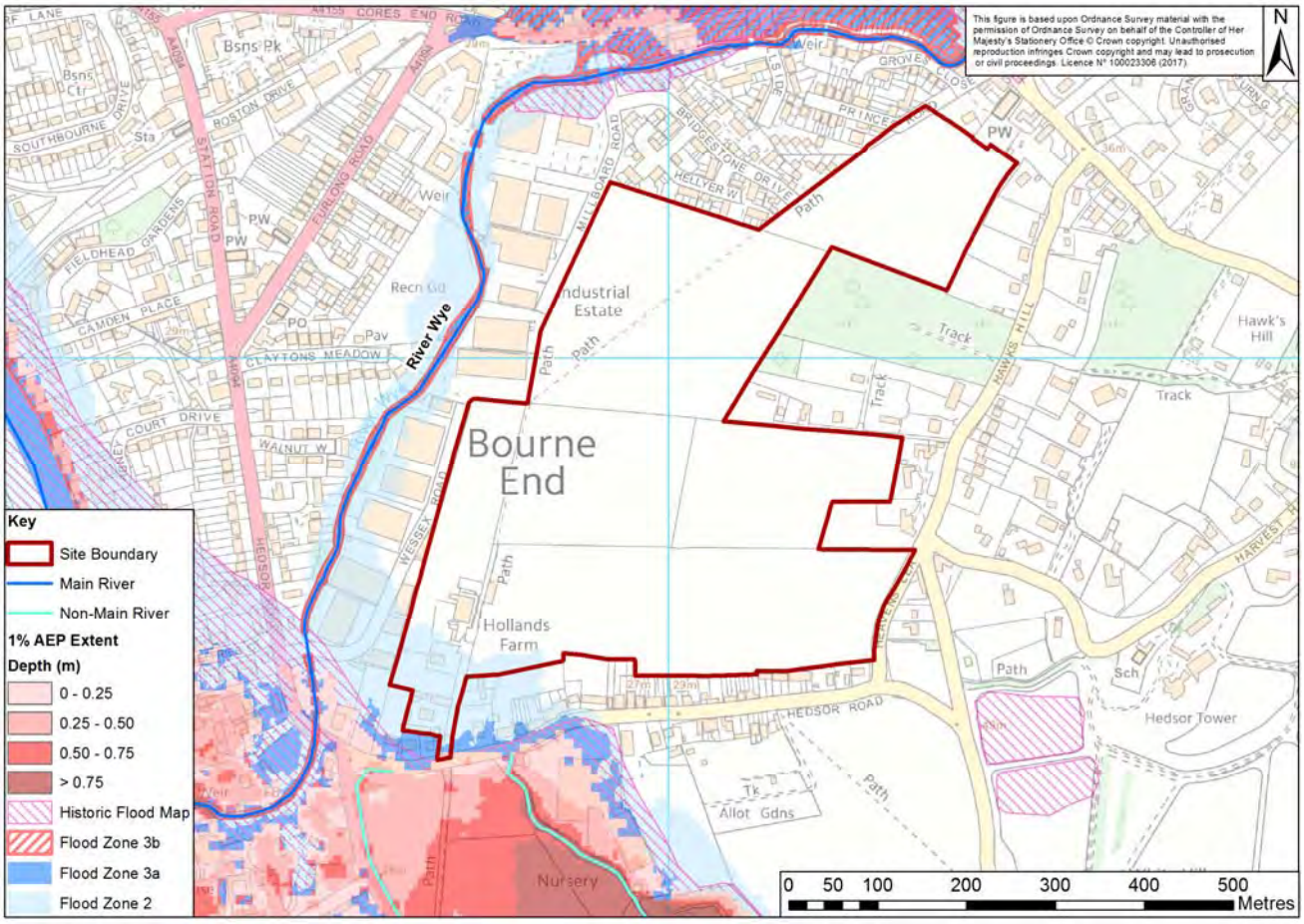


Table 3-13: Site 15 Current Flood Zone Extents

Flood Zone	1	2	3a	3b	Total
Extent (ha)	29.3	2.2	0.5	0	32.0
Coverage (%)	92	7	1	0	-

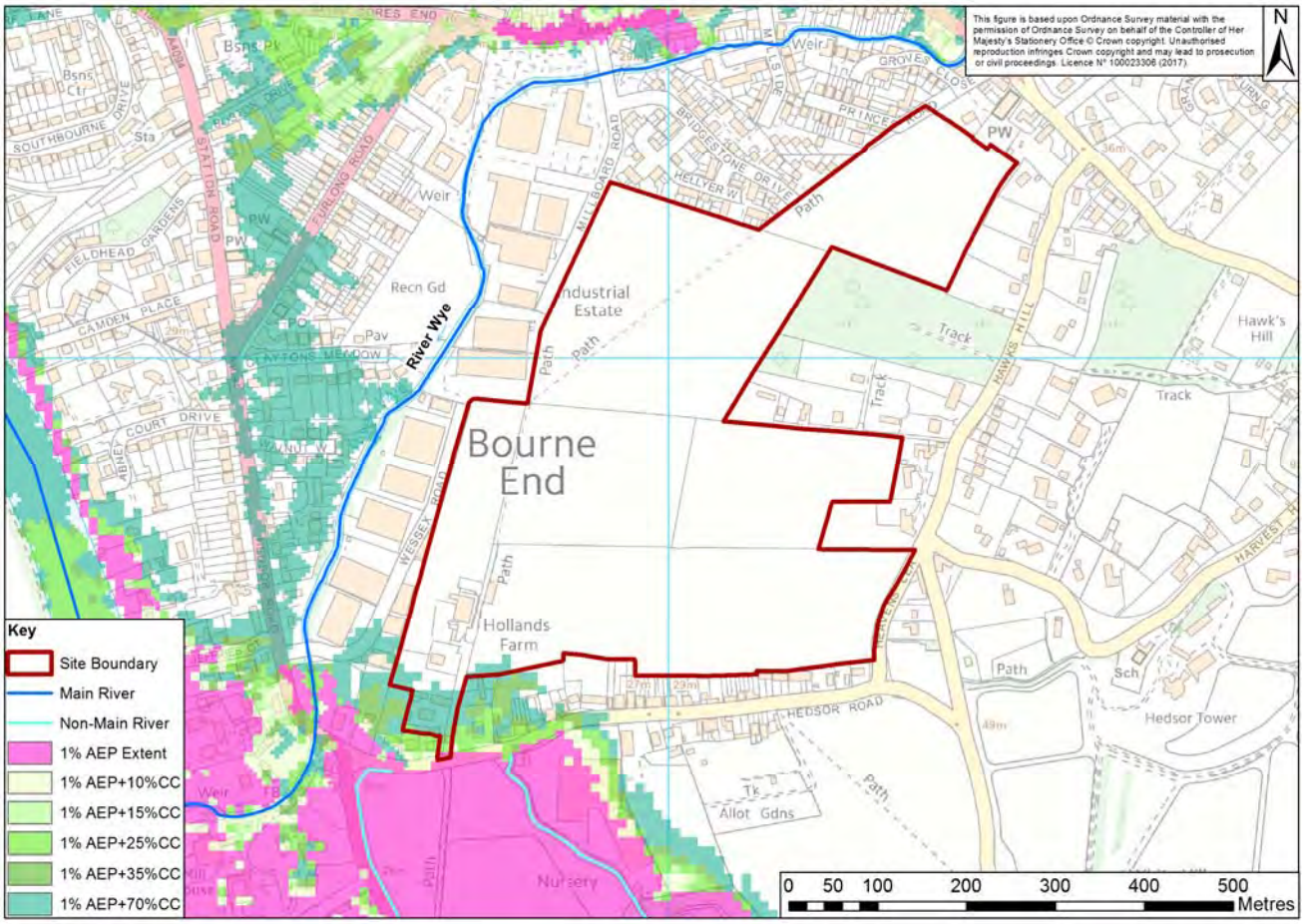
Table 3-14: Site 15 Modelled 1% (1 in 100) AEP Event Extent

AEP Event	Extent (ha)	%
1% (1 in 100)	0.03	0.1

At its closest, the northern end of the site is approximately 50m to the south of the River Wye; the western end is approximately 60m to the east of the river. The south-western corner of the site is encroached by Flood Zone 2 up to Hollands Farm; Flood Zone 3a covers approximately 0.5ha of the south-western corner (see Figure 3-30). The EA historic flood map of the River Thames encroaches into the extreme south-west of the site, encompassing approximately 0.13ha (0.4% of the site) which is within the area in Flood Zone 3. The updated Wye and Thames hydraulic model 1% (1 in 100) AEP event extents only encroach very slightly into the allocation site boundary and it should be feasible to develop the site without encroaching into either extent. EA flood records suggest one property on Hedsor Road was flooded internally from fluvial sources in 2007, immediately south-west of the site boundary.

The published fluvial flood zones in the vicinity of this allocation site have been developed using the EA's River Wye/Hughenden Stream hydraulic model, originally developed in 2001 and the River Thames hydraulic model developed in 2007 both for flood mapping purposes. The representation of the floodplain has been updated for this SFRA utilising LiDAR data from 2015. It should be noted that there appears to be a discrepancy regarding the predicted flood extents derived from hydraulic modelling. A review of Figure 3-30 indicates that the 1% (1 in 100) AEP extent based on the latest modelling is smaller than the published Flood Zone 3. The applicant will need to agree the extent to be adopted for Flood Zone 3 with the EA when developing a site-specific FRA which will require the use of best available data and may require further hydraulic modelling, refer to Section 2.2 for further details. It is noted however that over 90% of the site is within Flood Zone 1 and consequently it is considered that it should be possible to develop the site safely in accordance with the NPPF.

Figure 3-31 : Site 15 Fluvial Flooding with Climate Change



A small section in the south-western corner of the site is predicted to flood for the 1% (1 in 100) + 35% and 70% AEP events although it is less than 0.25m in depth.

Table 3-15: Site 15 Fluvial Flooding with Climate Change Extents

Climate Change Uplift (%)	10	15	25	35	70	Total
Extent (ha)	0.03	0.03	0.16	0.22	0.64	32.0
Coverage (%)	0.1	0.1	0.5	0.7	2.0	-

Table 3-15 indicates approximately 2% of the site is at risk of flooding from the 1% (1 in 100) + 70% climate change extent.

Although the predicted impact of climate change has not been assessed on the extent of Flood Zone 2 and the flood zone should be avoided for development if possible, a residential development would be deemed acceptable in accordance with the NPPF if within Flood Zone 2.

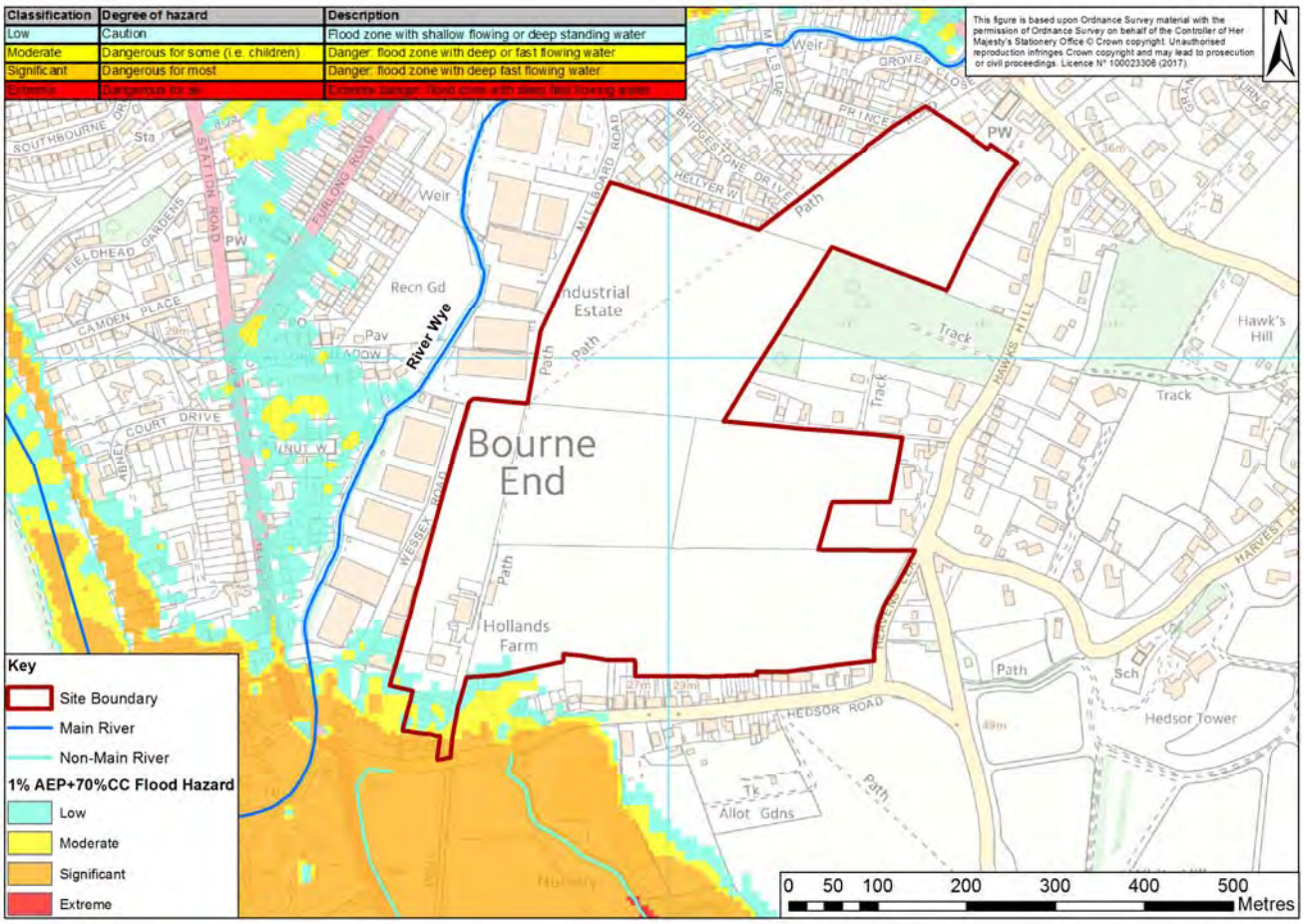
Table 3-16 : Rate of Flood Onset and Time to Maxiumum Extent

Climate Change Uplift (%)	(1% (1 in 100) AEP event)	10	15	25	35	70
Time of Onset	-	-	19:21	17:36	17:06	15:06
Time to Maximum Extent	-	-	19:21	17:36	17:06	18:51

Table 3-16 indicates the time of onset of flooding and the time taken to reach maximum flood extent within the site. It should be noted that the model time steps for the River Thames and River Wye models are two hours and 15 minutes respectively.

Figure 3-32 indicates that the majority of the site is designated as having a Low flood hazard with the very southern corner of the site designated as having Significant flood hazard. The development will need to provide safe access and egress as a result, guiding people away from this area of elevated risk during a fluvial flood event and take this into account for the risk of surface water flood risk (see Section 3.5.3.1).

Figure 3-32 : Site 15 Flood Hazard



3.5.2.1 Flood Defence Failure

There are no raised defences or culverts in the vicinity of the site. The River Wye crosses under the A4094 approximately 70m to the west, although given the size of the channel at this point the risk of blockage is considered to be low. Fluvial flood mapping does not appear to suggest that extreme flows would back-up from this culvert affecting the development site.

3.5.3 Risk of Flooding from Other Sources

3.5.3.1 Surface Water

Surface water flood risk based on the uFMfSW is presented in Figure 3-33.

Figure 3-33: Site 15 Surface Water Flood Risk

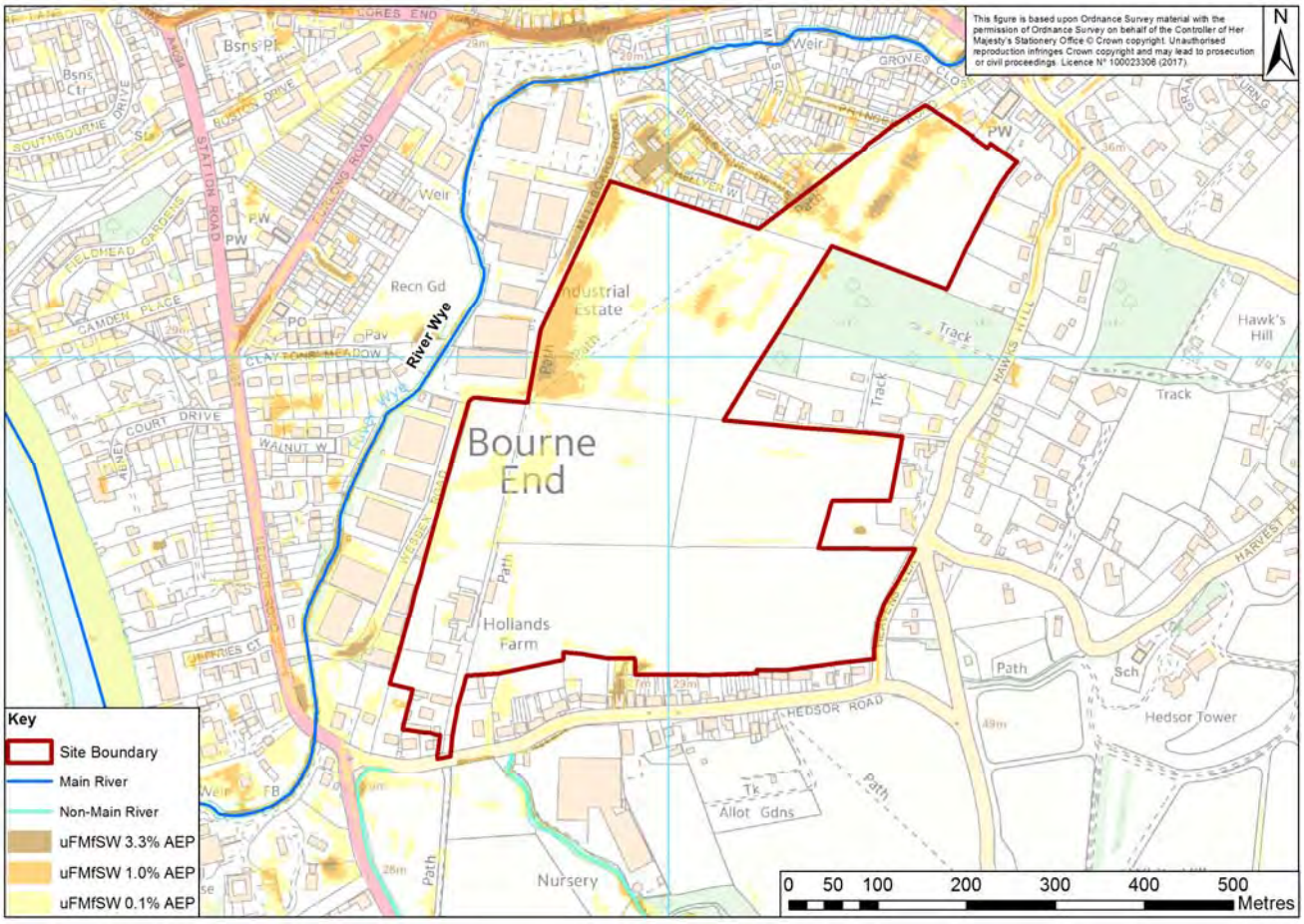


Table 3-17: Site 15 uFMfSW Extent

Event (AEP)	3.33% (1 in 30)	1% (1 in 100)	0.1% (1 in 1000)
Extent (ha)	0.2	1.1	2.3
Coverage (%)	0.6	3.4	7.2

Primarily the north and west of the site appears to be at greatest risk of surface water flooding based on the uFMfSW. There are pockets of flooding predicted in the site which may be the result of rainfall filling localised depressions in the hydraulic model used to develop the extents. There appears to be a flow path through the site, starting at the northern corner and traveling south-west along the western boundary before ponding against an embankment adjacent to Millboard Road. This flow path could interact with the development and affect access to and from the site.

Climate change has the potential to increase the risk of surface water flooding to the site. Although beyond the scope of this SFRA to quantify the predicted impact, the risk of flooding to those areas currently assessed as 'Low' surface water risk could increase as a result of climate change and consequently they could become re-

classified as WCDA. Such a risk would need to be quantified by the applicant in order to demonstrate that the site could be developed safely for future users, taking into account the planning implications of such a result.

3.5.3.2 Groundwater

For the two sources of groundwater risk mapping, the AStGWF depicts the likelihood of groundwater emergence; the JBA mapping inidcates depth to groundwater level beneath ground.

A review of EA AStGWF mapping indicates that the eastern side of the site is at low risk of flooding (within a grid square where less than 25% is at risk of groundwater emergence). The western side of the site is at high risk of flooding (within a grid square where greater than 75% of the area is at risk of groundwater emergence). However further modelling places the eastern half of the site in a zone of elevated risk of groundwater emergency which would need to be considered in the site-specific FRA; see Figure 3-34.

Figure 3-34: Site 15 Risk of Groundwater Flooding

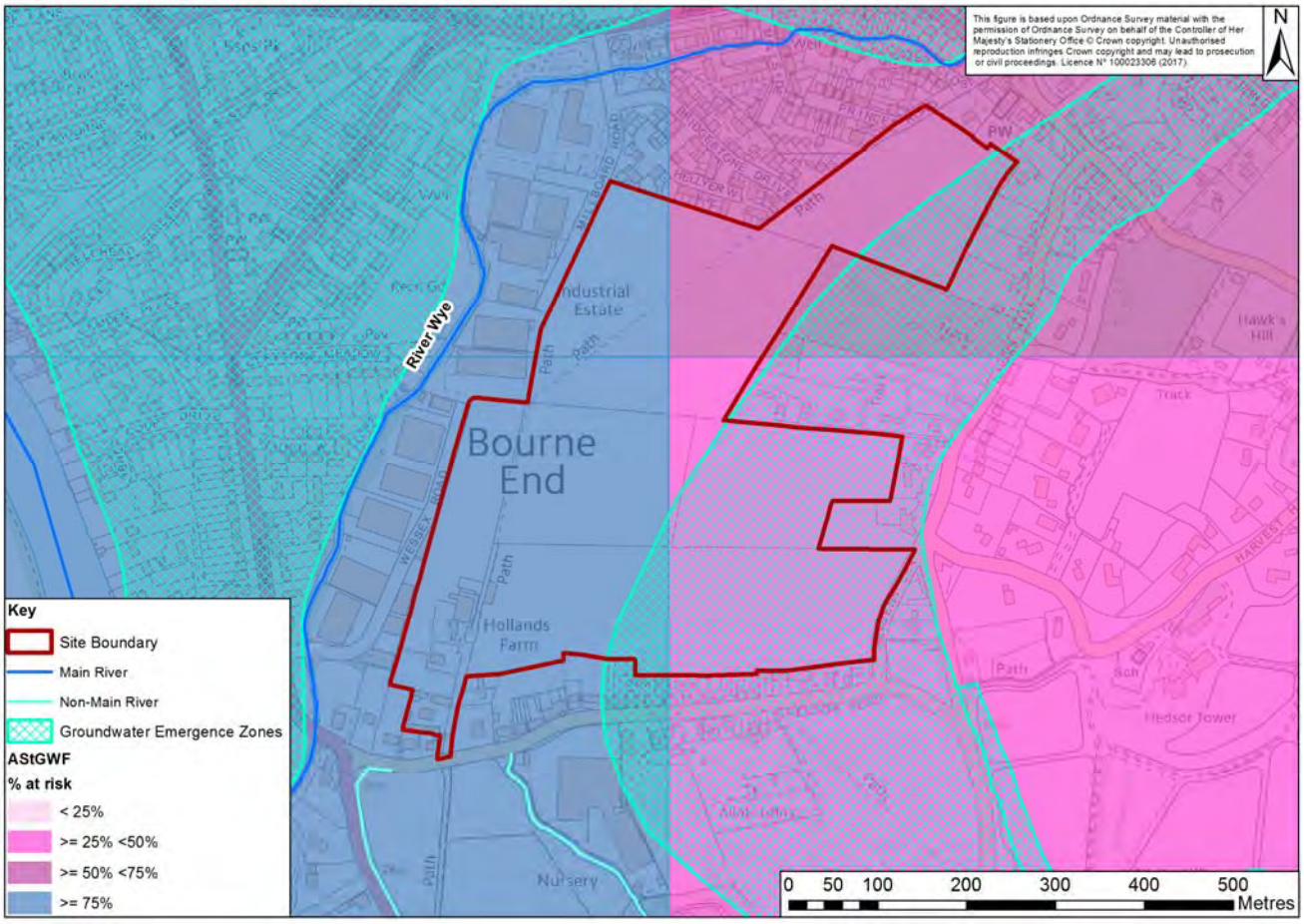
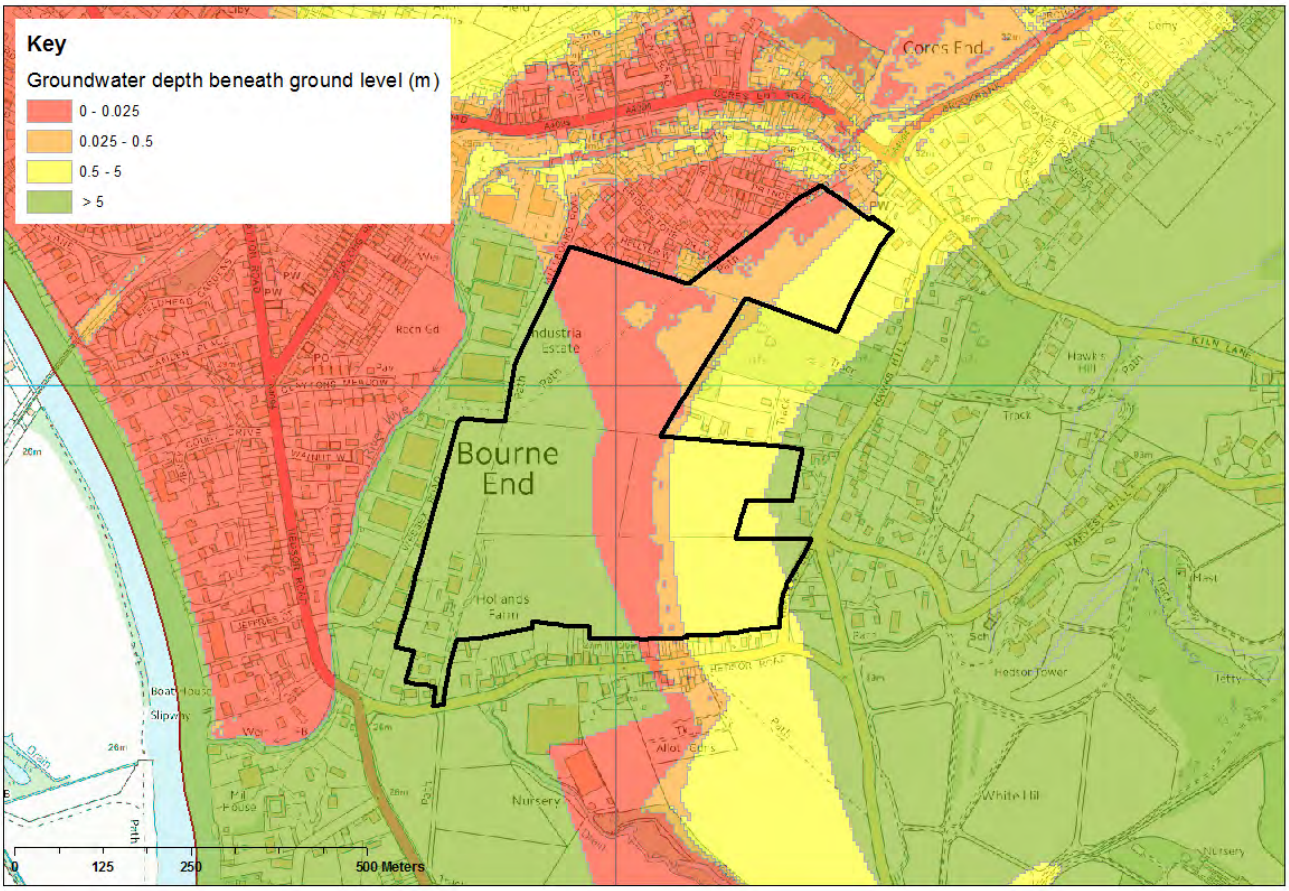


Figure 3-35 depicts groundwater mapping completed by JBA, showing a high risk of groundwater flooding and that the groundwater levels are either at or very near to (within 0.025m) the ground surface within the central sections of this site. The eastern side of the site is shown to have groundwater depths between 0.025-5m; the western is shown to have groundwater depths of greater than 5m.

Figure 3-35 : Site 15 JBA Groundwater Mapping



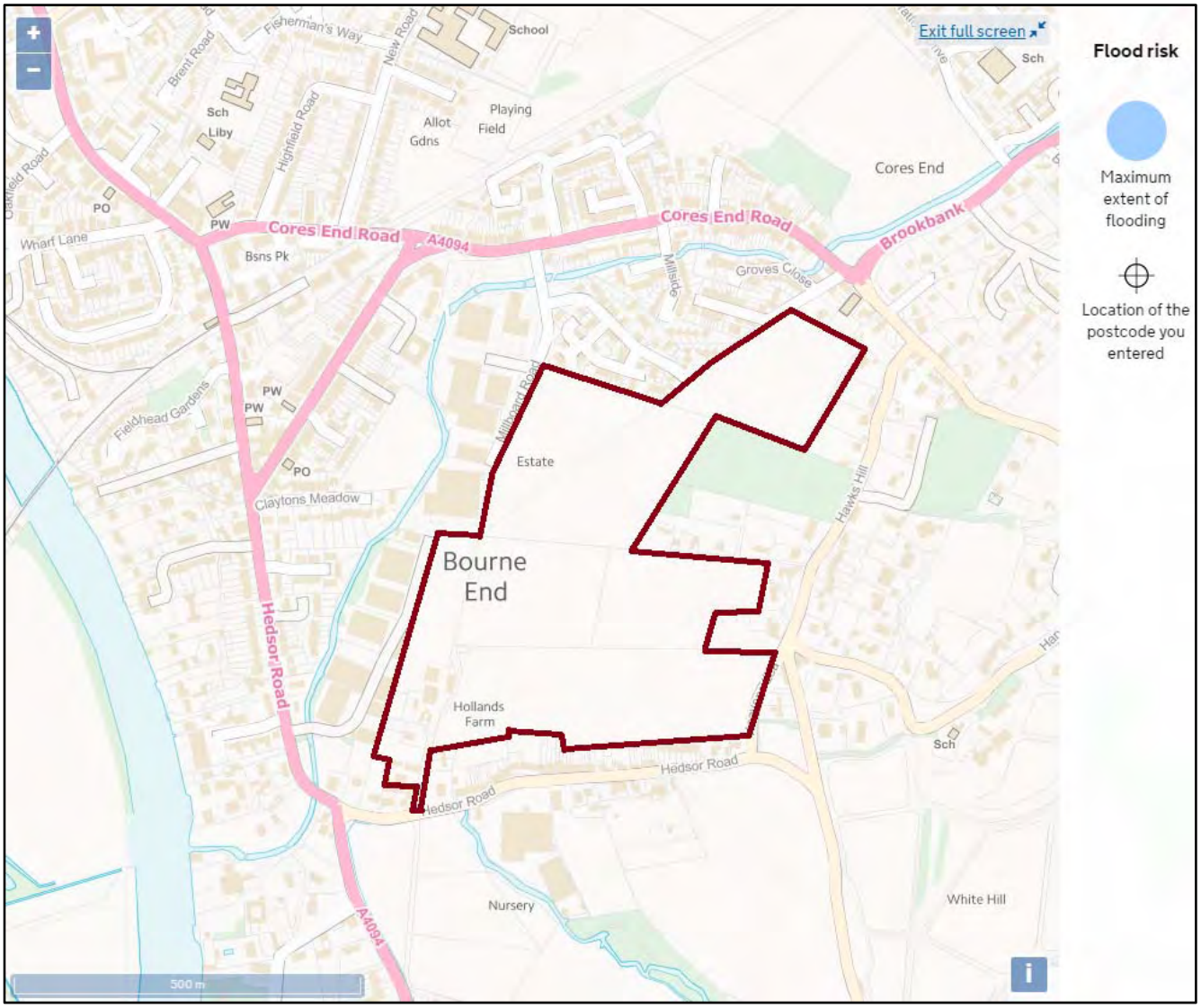
3.5.3.3 Sewers

The Hollands Farm (north) allocation site is entirely located within post code area SL8, as identified in Figure 7 of the Level 1 SFRA. The figure indicates between one and five properties have been reported to flood internally within the post code boundary; between 16 and 20 instances of external flooding have been reported within SL8 in the 20 years preceding 2014.

3.5.3.4 Reservoir Failure

A review of the predicted flood extent as a result of reservoir failure available online indicates that the site is not at risk of flooding from such an event. See Figure 3-36.

Figure 3-36: Site 15 Risk of Flooding from Reservoir Failure



Source: https://flood-warning-information.service.gov.uk/long-term-flood-risk/map?map=SurfaceWater © Crown copyright and database rights 2017 OS 100024198

3.5.4 The Exception Test

The site is currently mostly located within Flood Zone 1 and 2, with 0.1% at the most southern end in the 1 in 100 AEP event. The proposed development of 467 residential properties would be classified as 'More Vulnerable'[20] and can be located within Flood Zones 1 and 2 and would therefore be acceptable and would not need to pass the Exception Test[21]. The area within the south-western corner of the site is designated as Flood Zone 3 and therefore the applicant should seek to not develop this area as sufficient space is available elsewhere within the boundary for the proposed residential development. The level of risk is not predicted to change when the impact of climate change is considered and therefore the site could be developed safely.

The proposed access from the south-west of the site from Hedsor Road does cross Flood Zone 3 and as such the development would have to pass the Exception Test. The final alignment of the proposed access would

[20] NPPG Table 2 / Paragraph 066
[21] NPPG Table 3 / Paragraph 067

affect the planning requirements to be met[1]. If the highway is developed within Flood Zone 3a, the development as a whole should be designed and constructed to remain operational and safe in times of flood in order to pass the Exception Test. In this case the development would include multiple access points, including in Flood Zone 1, consequently this particular access could be closed during a flood event. If located within Flood Zone 3b, additional regulations must be followed to pass the Exception Test: the road should be designed and constructed to:

- Remain operational and safe for users in times of flood;
- Result in no net loss of floodplain storage; and
- Not impede water flows and not increase flood risk elsewhere.

To meet these requirements, the access would not change existing ground levels and the development would include facilities to close this access route during a flood event. The site would remain operational and safe and the access would not change existing flood risk.

Therefore, the site can pass the second part of the Exception Test.

3.5.5 Flood Risk Management

3.5.5.1 Opportunities for Betterment

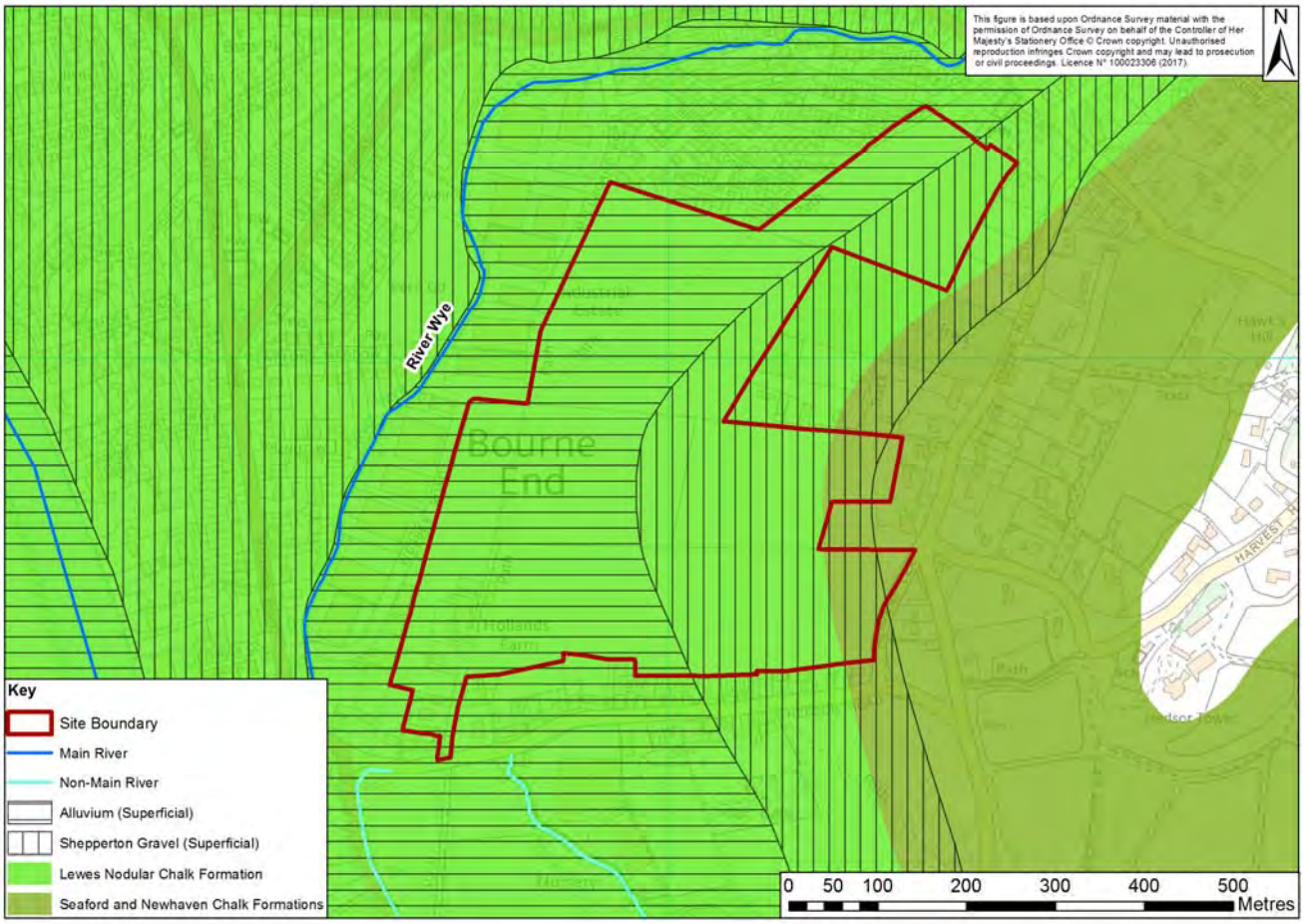
The site is located downstream of the urban area of Bourne End, there are properties downstream between the site and the River Thames, while the site could potentially be used to attenuate flows from the Wye, the distance from the river and the fact that flood risk would be governed by the Thames would appear to suggest that there are few opportunities for betterment. Given that the site is predominantly undeveloped, it would be expected that the runoff would be attenuated to Greenfield rates. There is significant opportunity for a development at this site to reduce flood risk; consequently, a future applicant should liaise with the EA to discuss opportunities for betterment.

3.5.5.2 Potential Feasibility of Infiltration Measures

A review of the site geology (see Figure 3-37) suggests it is underlain by superficial deposits of Alluvium and Shepperton Gravel and Chalk bedrock (Lewes Nodular and Seaford and Newhaven Formations). The thickness of each layer is not included within the information. Surrounding strata have been omitted for clarity if they are not present directly beneath the site. Consequently, infiltration of rainfall directly to ground may be practicable. The proximity of the watercourse may result in locally high groundwater levels potentially reducing the feasibility of such measures. Infiltration should be the first method considered for the drainage of sites and as such, a site-specific FRA would be required to demonstrate the feasibility of infiltration measures.

[1] NPPG Table 3 / Paragraph 067

Figure 3-37 : Site 15 Geology



3.5.5.3 Site-specific Flood Risk Assessment

A site-specific FRA would be required to accompany the planning application for this site because it is greater than 1ha in size in accordance with NPPF paragraph 103 and is within a WCDA in accordance with NPPF paragraph 103 and WDC policy on Managing flood risk and Sustainable Drainage Systems. The review of flood risk has identified a number of site-specific issues the FRA would need to consider:

- Demonstrate how the access from Hedsor Road through Flood Zone 3a would be closed during a flood event;
- The opportunity of flood risk betterment and alleviation, from the River Wye, to Cores End, downstream of the site;
- The applicant would need to use best available data to agree the hydraulic modelling to be adopted to determine the fluvial flood zones. Although their encroachment into the site boundary is very small it would be preferable to avoid the flood zones altogether via the distribution of buildings across the site or the re-drawing of the site boundary;
- The site should be developed in such a manner to avoid encroachment into the WCDA wherever practicable;
- If the development does encroach into the WCDA:
    - Demonstrate that finished floor levels are above the High and Medium uFMfSW risk peak water level (plus an allowance for climate change);
    - No habitable below-ground rooms are constructed in such areas; and

- Demonstrate that the flow path can be maintained, or modifications to it as a result of the development will not detrimentally affect third parties.

- The suitability of infiltration measures for drainage of the site given the local geology;
- Demonstrate how the elevated risk of groundwater flooding would be mitigated, as a minimum avoiding the construction of below-ground habitable rooms in such areas; and
- Given its relatively small size, the area of Flood Zone 3 (including climate change) should not be developed for residential use.
- If an access is provided to the south of the site, to assess what compensatory floodplain storage would be required and to provide signage to warn users and guide them to alternative access routes for safe access and egress during times of flood.

3.6 Site 21: Dashwood Avenue Detailed Assessment

3.6.1 Site Description

Dashwood Avenue allocation site (planning ref: SHW0020) is located to the west of High Wycombe, to the south of the A40 and the River Wye. The NGR for the site is SU 8487 9348. The site is currently factory buildings and is an area of approximately 0.9ha. It is proposed to construct 70 residential properties on the site. This site has been assessed in detail because it is within 50m of the extent of published Flood Zone 2: see Section 2.1.

3.6.2 Fluvial Flood Risk

The risk of fluvial flooding to the development site is indicated in Figure 3-38.

Figure 3-38: Site 21 Fluvial Flood Risk

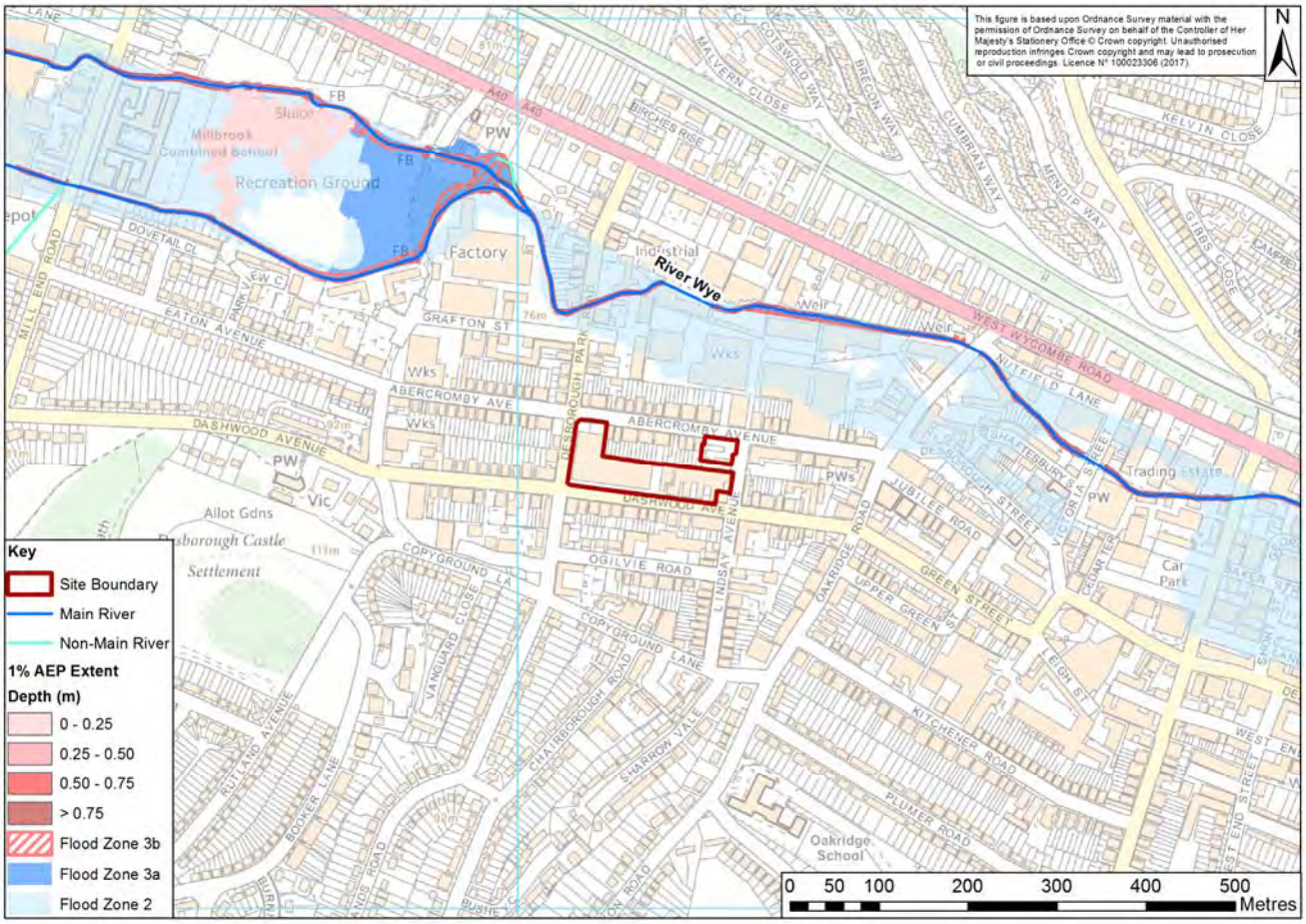


Table 3-18: Site 21 Current Flood Zone Extents

Flood Zone	1	2	3a	3b	Total
Extent (ha)	0.9	0	0	0	0.9
Coverage (%)	100	0	0	0	-

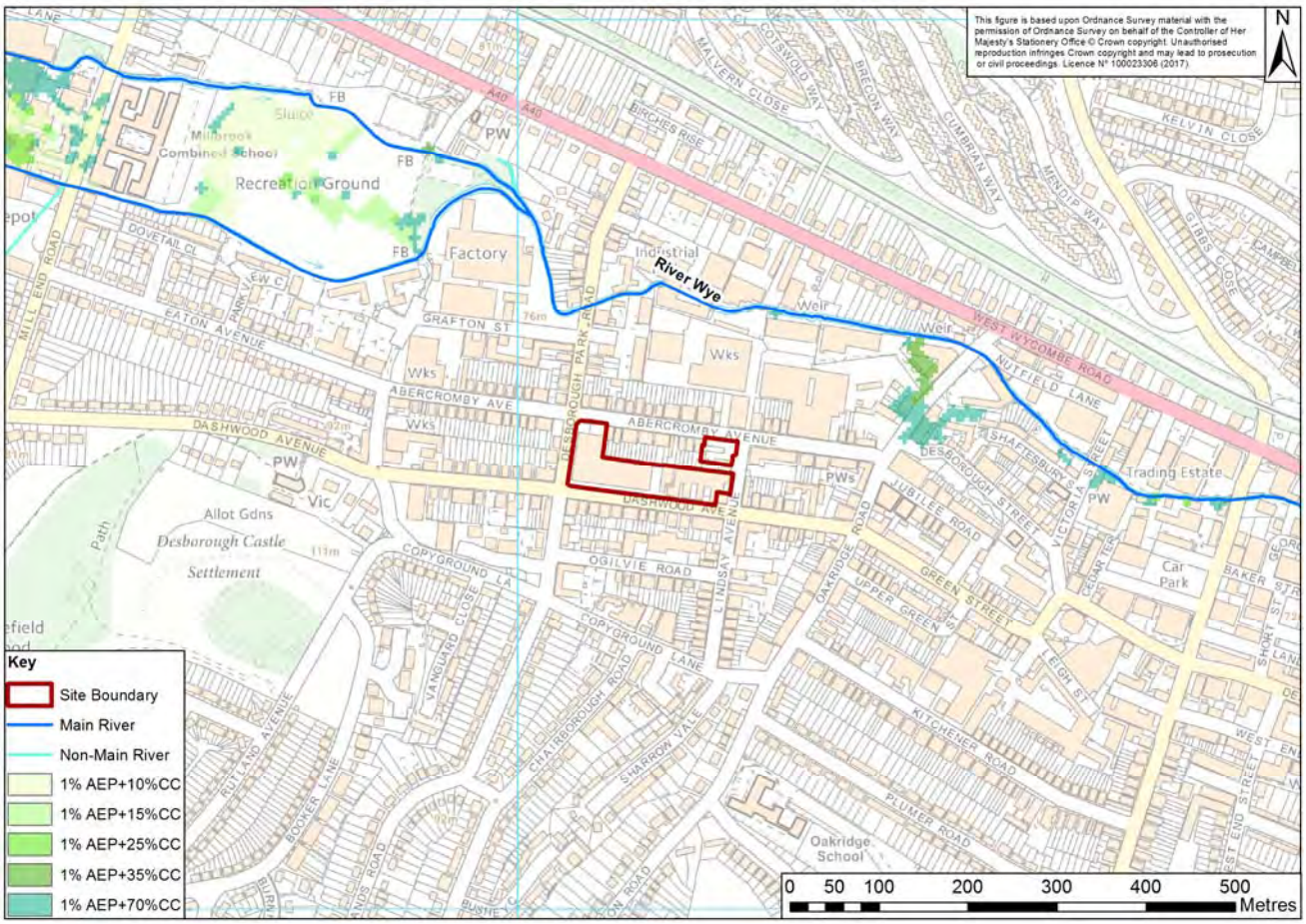
Table 3-19: Site 21 Modelled 1% (1 in 100) AEP Event Extent

AEP Event	Extent (ha)	%
1% (1 in 100)	0	0

The site boundary is approximately 250m to the south of the River Wye and encompasses the factory buildings adjacent to Dashwood Avenue as well as a small area to the north-east adjacent to Abercromby Avenue. The entirety of the site is within Flood Zone 1. The historical flood map does not identify any fluvial flood events that have affected this site.

The fluvial flood zones have been developed using the EA's River Wye/Hughenden Stream hydraulic model, originally developed in 2001 for flood mapping purposes. The representation of the floodplain has been updated for this SFRA utilising LiDAR data from 2015. It should be noted that there appears to be a discrepancy (see Figure 3-38) between the published fluvial flood zones and the predicted flood extents derived from hydraulic modelling, see Section 2.2. However, at this location both versions of the model place the allocation site outside Flood Zone 3.

Figure 3-39 : Site 21 Fluvial Flooding with Climate Change



The site is not predicted to flood when climate change factors are considered. The site is approximately 0.6m higher than the predicted peak Flood Zone 2 water level based upon a comparison of flood extent and LiDAR information, however the proposed residential properties would remain acceptable within Flood Zone 2, although the preference would be to avoid encroachment into flood zones.

3.6.2.1 Flood Defence Failure

There are no raised defences in the vicinity of the site and given the site is within Flood Zone 1 the risk of residual flooding as a result of culvert blockages on the River Wye is considered to be very low.

3.6.3 Risk of Flooding from Other Sources

3.6.3.1 Surface Water

The risk of surface water flooding based on the uFMfSW is included in Figure 3-40.

Figure 3-40: Site 21 Surface Water Flood Risk

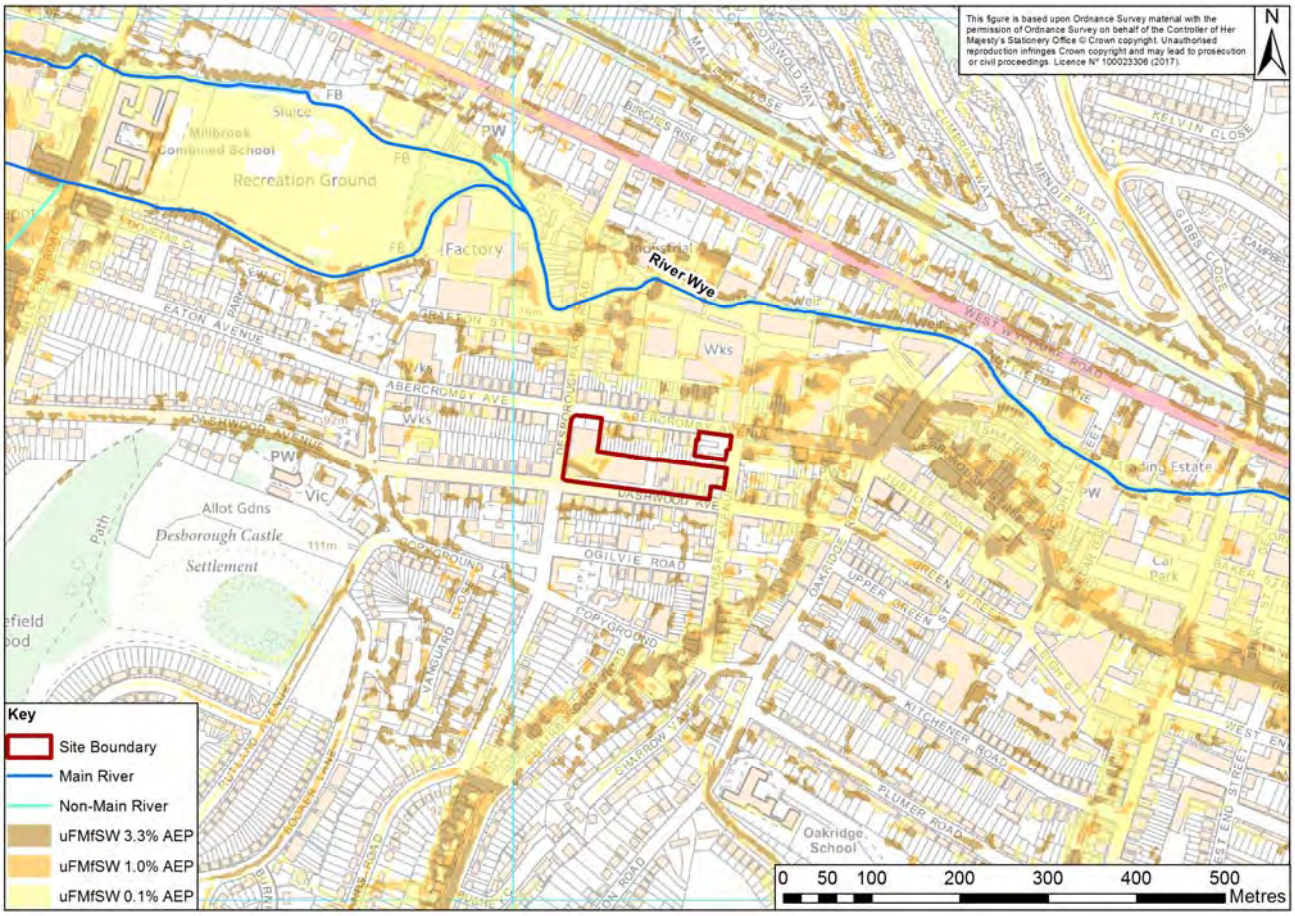


Table 3-20: Site 10 uFMfSW Extents

Event (AEP)	3.33% (1 in 30)	1% (1 in 100)	0.1% (1 in 1000)
Extent (ha)	0.03	0.05	0.14
Coverage (%)	3	5	15

Primarily the westernmost building appears to be at greatest risk of surface water flooding based on the uFMfSW, approximately 15% of the site is at risk of surface water flooding from a 0.1% (1 in 1000) AEP event (see Table 3-20). Flooding is likely to be due to pockets of flooding predicted across the site which may be the result of rainfall filling localised depressions in the hydraulic model used to develop the extents rather than distinct flow paths. There does not appear to be any flow paths through the site itself, however flow paths on roads immediately adjacent could interact with the development and affect access to and from the site. The

Level 1 SFRA indicates that areas in High Wycombe are known to be particularly susceptible to flooding from surface water in urban areas that respond rapidly to rainfall.

3.6.3.2 Groundwater

For the two sources of mapping, the AStGWF depicts the likelihood of groundwater emergence; the JBA mapping inidcates depth to groundwater level beneath ground.

A review of EA AStGWF mapping (see Figure 3-41) indicates that the entirety of the site is at low risk of flooding (within a grid square where between 25% and 50% is at risk of groundwater emergence). There are areas at slightly elevated risk of flooding. The site is within a zone at elevated risk of groundwater emergence. See Figure 3-41.

Figure 3-41: Site 21 Groundwater Flood Risk

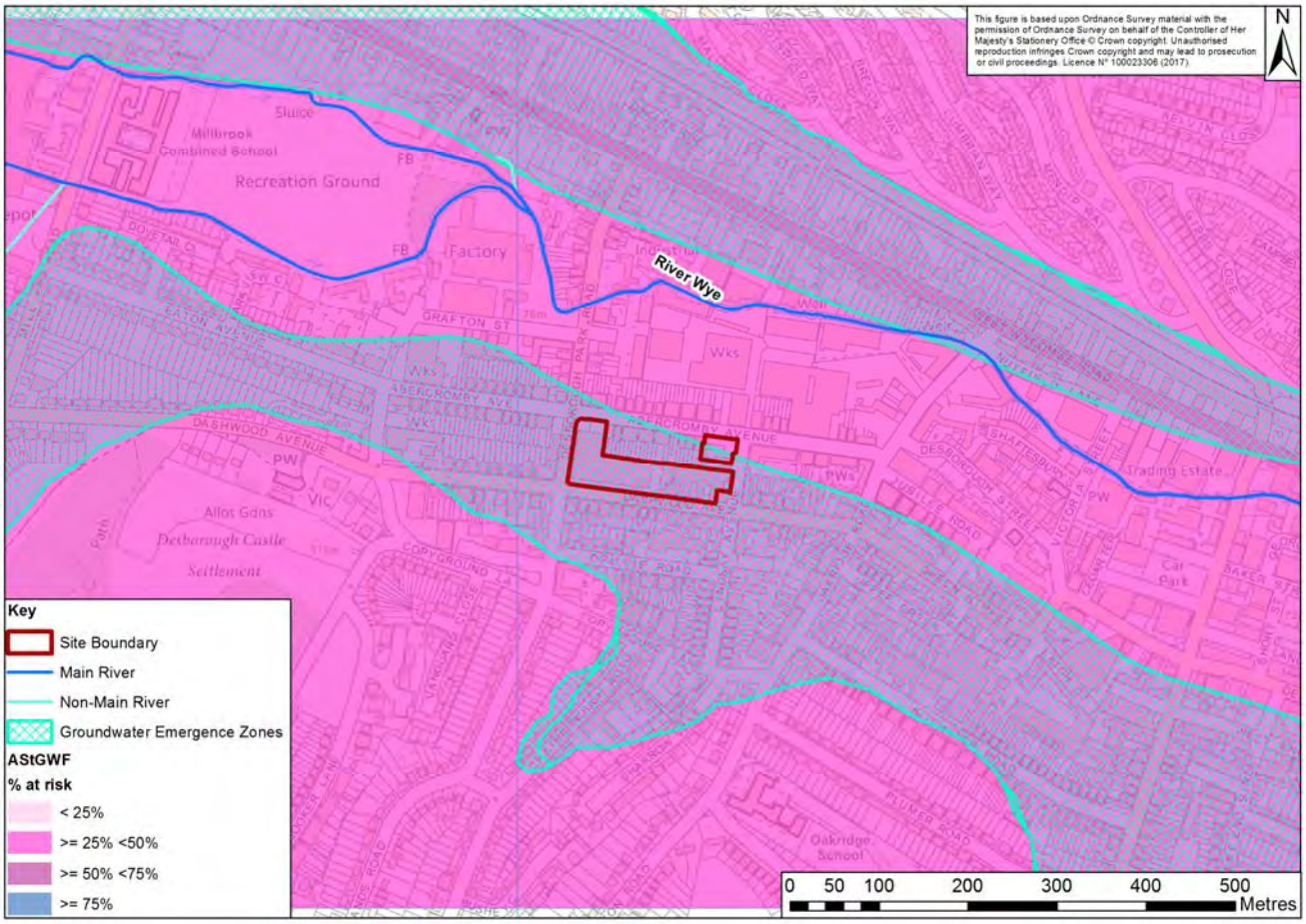
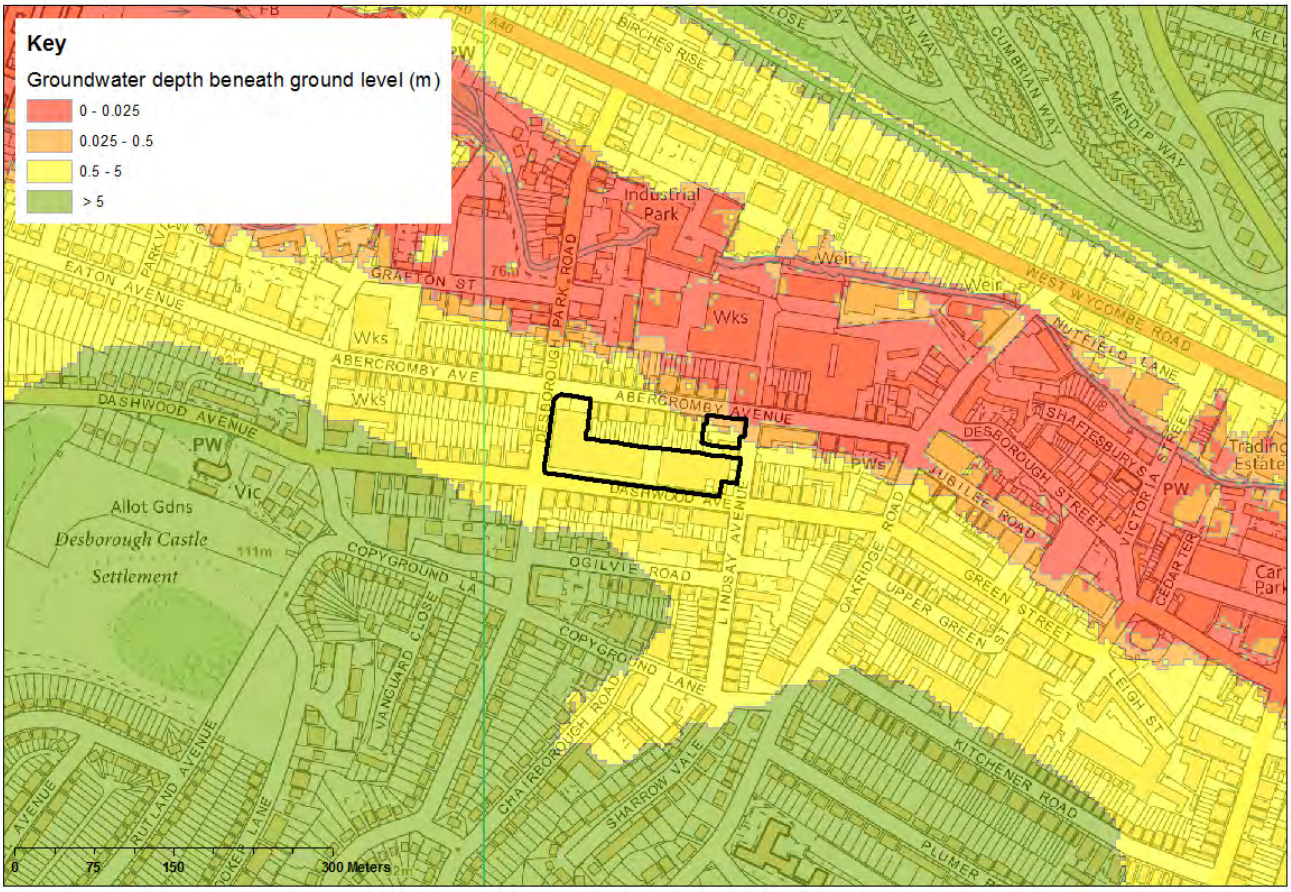


Figure 3-42 depicts groundwater mapping completed by JBA, predicts a medium risk of groundwater flooding and that the groundwater levels are within 5m the ground surface at this site (could be as shallow as 0.5m).

Figure 3-42 : Site 21 JBA Groundwater Mapping



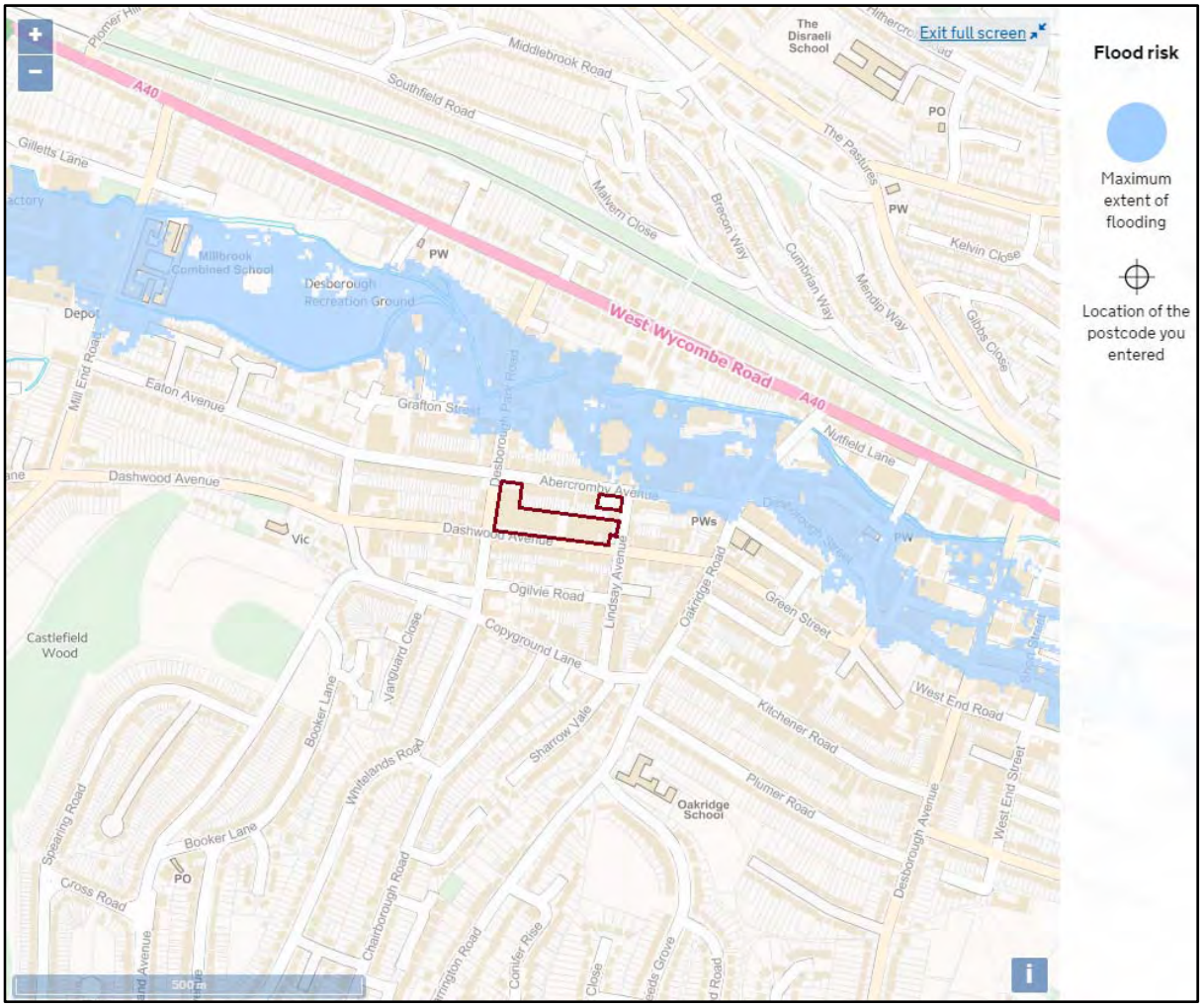
3.6.3.3 Sewers

With reference to Figure 7 of the Level 1 SFRA, the site is in a post code that recorded 1-5 incidents of sewer flooding affecting properties internally and 6-10 externally in the 20 years preceding 2014.

3.6.3.4 Reservoir Failure

A review of the predicted flood extent as a result of reservoir failure available online indicates that the site is not at risk of flooding from such an event; the site lies just outside of the maximum extent of flooding indicated in Figure 3-43.

Figure 3-43: Site 21 Risk of Flooding from Reservoir Failure



Source: https://flood-warning-information.service.gov.uk/long-term-flood-risk/map?map=SurfaceWater © Crown copyright and database rights 2017 OS 100024198

3.6.4 The Exception Test

The site is located within Flood Zone 1 when considering the 1% (1 in 100) +CC AEP event modelling. The proposed development of 70 residential properties would be classified as 'More Vulnerable'[22] and would therefore be acceptable and it would not need to pass the Exception Test[23]. The level of risk is not anticipated to change when the predicted impact of climate change is considered and therefore the site could be developed safely.

3.6.5 Flood Risk Management

3.6.5.1 Opportunities for Betterment

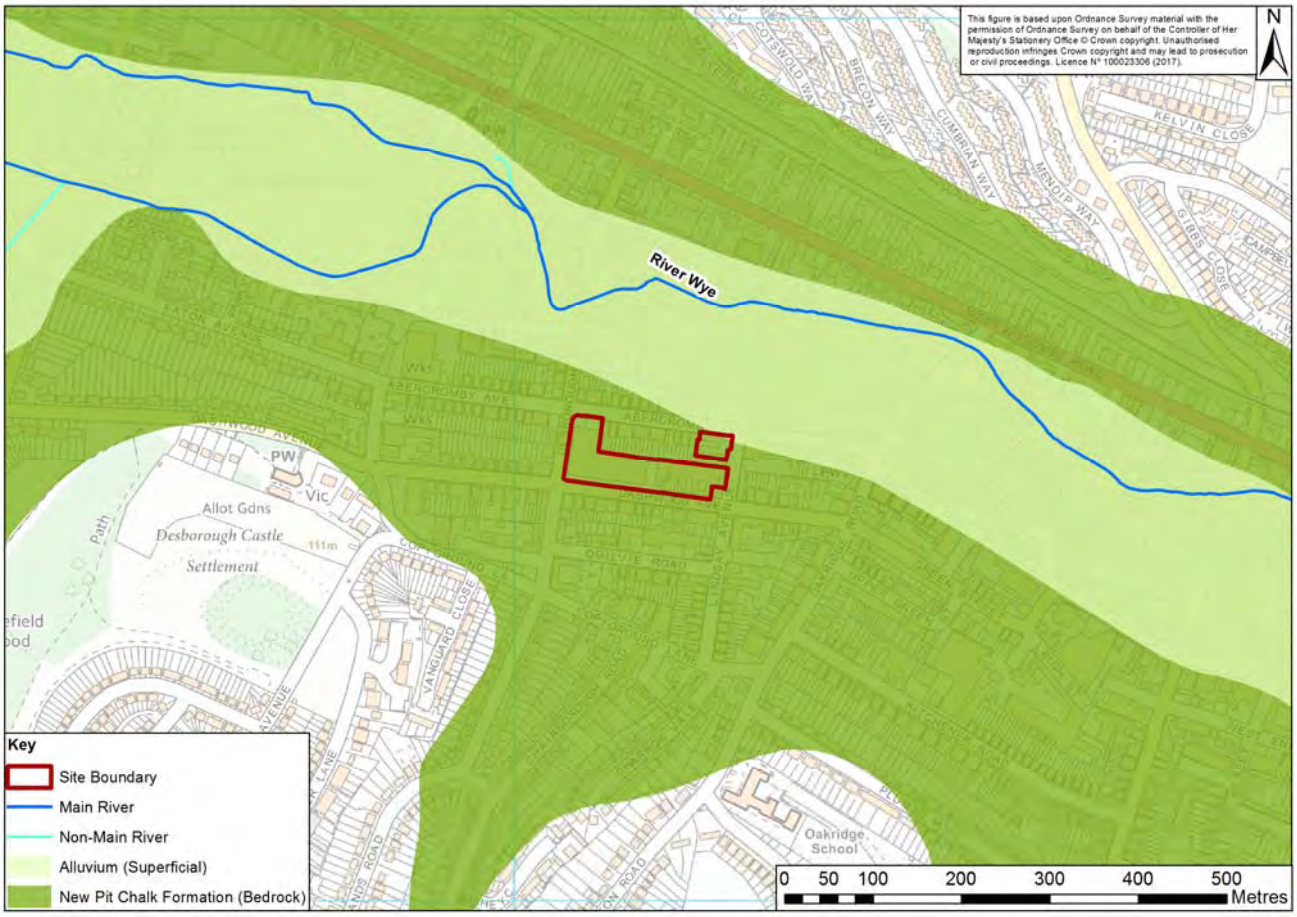
It is considered given its location and size that there is little opportunity for flood risk betterment through the re-development of this site, unless as part of long-term, catchment-wide, incremental reductions in runoff, potentially as part of a defined policy by BCC as the LLFA.

[22] NPPG Table 2 / Paragraph 066
[23] NPPG Table 3 / Paragraph 067

3.6.5.2 Potential Feasibility of Infiltration Measures

A review of the site geology (see Figure 3-44) suggests it is underlain by superficial deposits of Alluvium and Chalk bedrock (New Pit Formation). The thickness of each layer is not included within the information. Surrounding strata have been omitted for clarity if they are not present directly beneath the site. Consequently, infiltration of rainfall directly to ground may be practicable. The proximity of the watercourse may result in locally high groundwater levels potentially reducing the feasibility of such measures. Infiltration should be the first method considered for the drainage of sites and as such, a site-specific FRA would be required to demonstrate the feasibility of infiltration measures.

Figure 3-44 : Site 21 Geology



3.6.5.3 Site-specific Flood Risk Assessment

A site-specific FRA would be required to accompany the planning application because is within a WCDA in accordance with NPPF paragraph 103 and WDC policy on Managing flood risk and Sustainable Drainage Systems. A site-specific FRA would need to consider in addition to those usually required:

- The feasibility of incorporating measures to infiltrate runoff to ground;
- Utilisation of the best available data to confirm fluvial flood risk to the allocation site;
- Demonstrate it is possible to develop the site without encroaching into High or Medium risk areas of surface water flooding (WCDA) where practicable;
- If the development does encroach into the WCDA:

- Demonstrate that finished floor levels are above the High and Medium uFMfSW risk peak water level (plus an allowance for climate change);
- No habitable below-ground rooms are constructed in such areas; and
- Demonstrate that the flow path can be maintained, or modifications to it as a result of the development would not detrimentally affect third parties.

- Demonstrate how the elevated risk of groundwater flooding would be addressed and mitigated for, as a minimum avoiding the construction of below-ground rooms; and
- Demonstrate that safe access and egress can be achieved in the event of surface water and/or groundwater flooding.

3.7 Site 45: Kingsmead Depot, High Wycombe Detailed Assessment

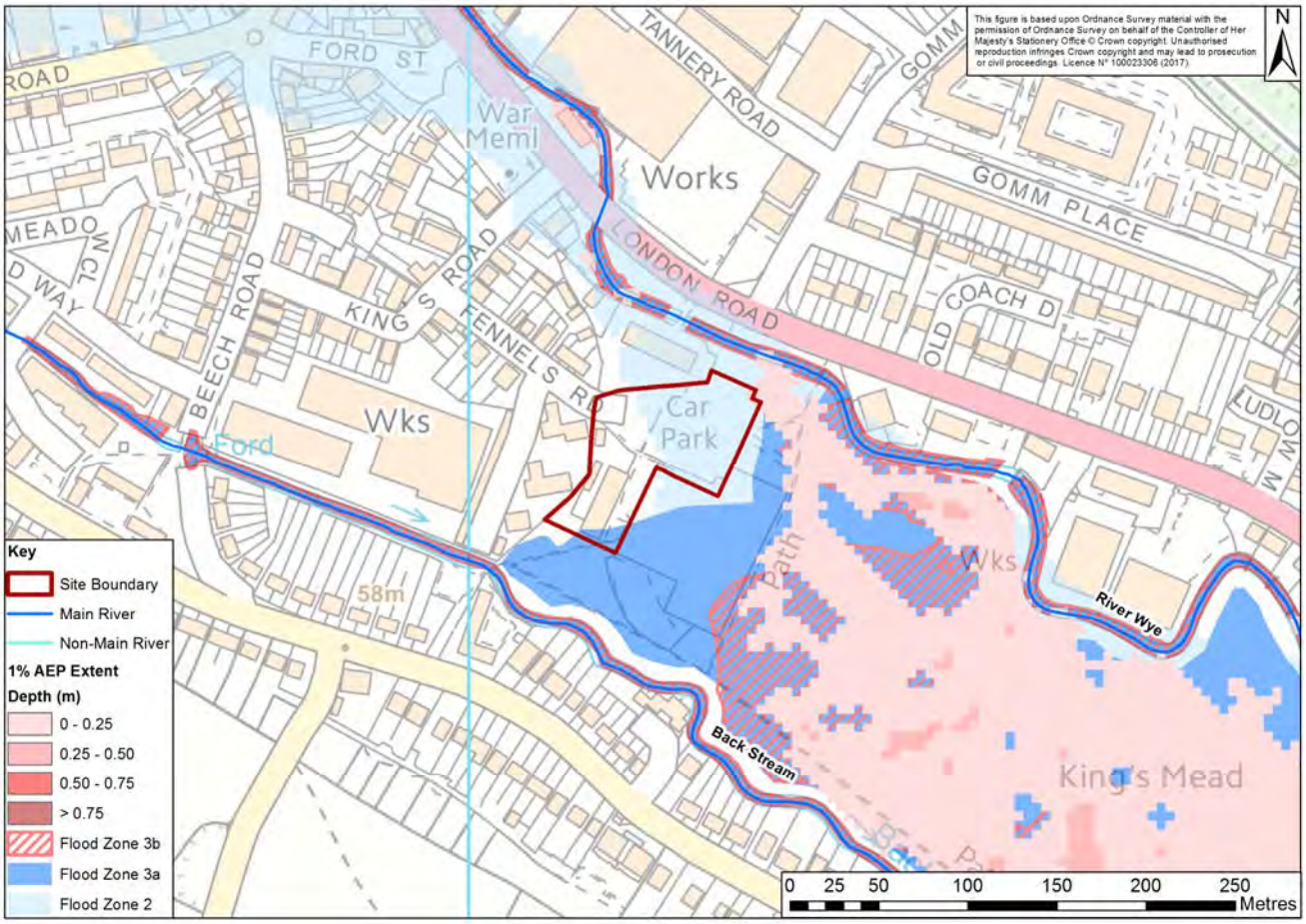
3.7.1 Site Description

The Kingsmead Depot allocation site (planning ref: SHW0359) is located to the south-east of High Wycombe, between the River Wye and Back Stream to the west of Loudwater. The NGR for the site is SU 8898 9156. The site is currently developed and is an area of approximately 0.603ha. The proposed development is mixed use consisting of retail, 50 residential units, a new netball centre and a new road to link to London Road. This site has been assessed in detail because it is within 50m of the extent of published Flood Zone 2: see Section 2.1.

3.7.2 Fluvial Flood Risk

The fluvial flood risk to the site is presented in Figure 3-45.

Figure 3-45: Site 45 Fluvial Flood Risk



The site encompasses the existing car park to the west of the Kingsmead sports complex and three buildings to the south-west. The site is situated between the River Wye to the north and the Back Stream to the south in High Wycombe. The majority of the site is within Flood Zone 1 with approximately 40% of the north-eastern section of the site within Flood Zone 2. The south-eastern corner is within Flood Zone 3a (see Table 3-21). The historical flood map does not identify any fluvial flood events that have affected this site.

Table 3-21: Site 45 Current Flood Zone Extents

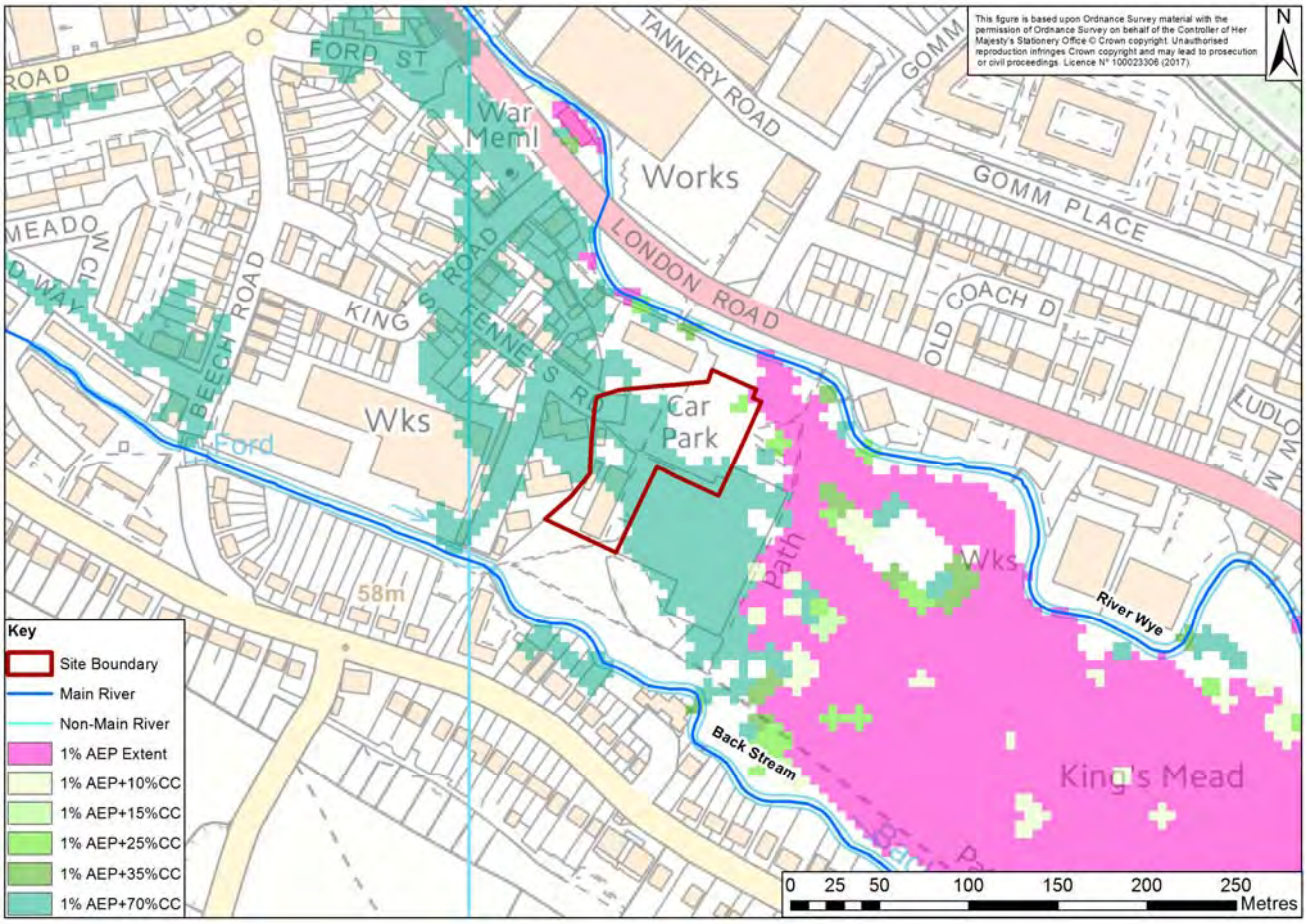
Flood Zone	1	2	3a	3b	Total
Extent (ha)	0.36	0.21	0.03	0	0.6
Percentage Coverage (%)	60	35	5	0	-

Table 3-22: Site 45 Modelled 1% (1 in 100) AEP Event Extent

AEP Event	Extent (ha)	%
1% (1 in 100)	0.01	1

The fluvial flood zones have been developed using the EA's River Wye/Hughenden Stream hydraulic model, originally developed in 2001 for flood mapping purposes. The representation of the floodplain has been updated for this SFRA. It should be noted that there appears to be a discrepancy regarding the predicted flood extents derived from hydraulic modelling. A review of Figure 3-45 indicates that the 1% (1 in 100) AEP extent developed for this SFRA is smaller than published Flood Zone 3. As a result, the new model is predicting that the site is located within Flood Zone 1 (rather than 2 and 3a as per the published flood zones). The assessment of acceptability has been based on the updated hydraulic modelling as it incorporates more recent data to represent the floodplain. However, the applicant will need to use best available data and liaise with the EA to confirm the extents to be adopted to delineate Flood Zones, refer to Section 2.2 for further details.

Figure 3-46 : Site 45 Fluvial Flooding with Climate Change



An area of flooding is predicted in the north-eastern corner of the site for the 1% (1 in 100) + 15% AEP event which increases to approximately 135m^2 for the +25% and +35% extents. The 1% (1 in 100) + 70% AEP event extent suggests a flow path through the site covering approximately 40% of the site area.

Table 3-23: Site 45 Fluvial Flooding with Climate Change Extents

Climate Change Uplift (%)	10	15	25	35	70	Total
Extent (ha)	0.01	0.01	0.02	0.02	0.24	0.60
Percentage Coverage (%)	1	1	4	4	40	-

An area of flooding is predicted in the north-eastern corner of the site for the 1% (1 in 100) + 15% AEP event which increases to approximately 135m^2 for the +25% and +35% extents. The 1% (1 in 100) + 70% AEP event extent suggests a flow path through the site covering approximately 40% of the site area.

Table 3-23 indicates approximately 40% of the site is at risk of flooding from the 1% (1 in 100) + 70% climate change extent.

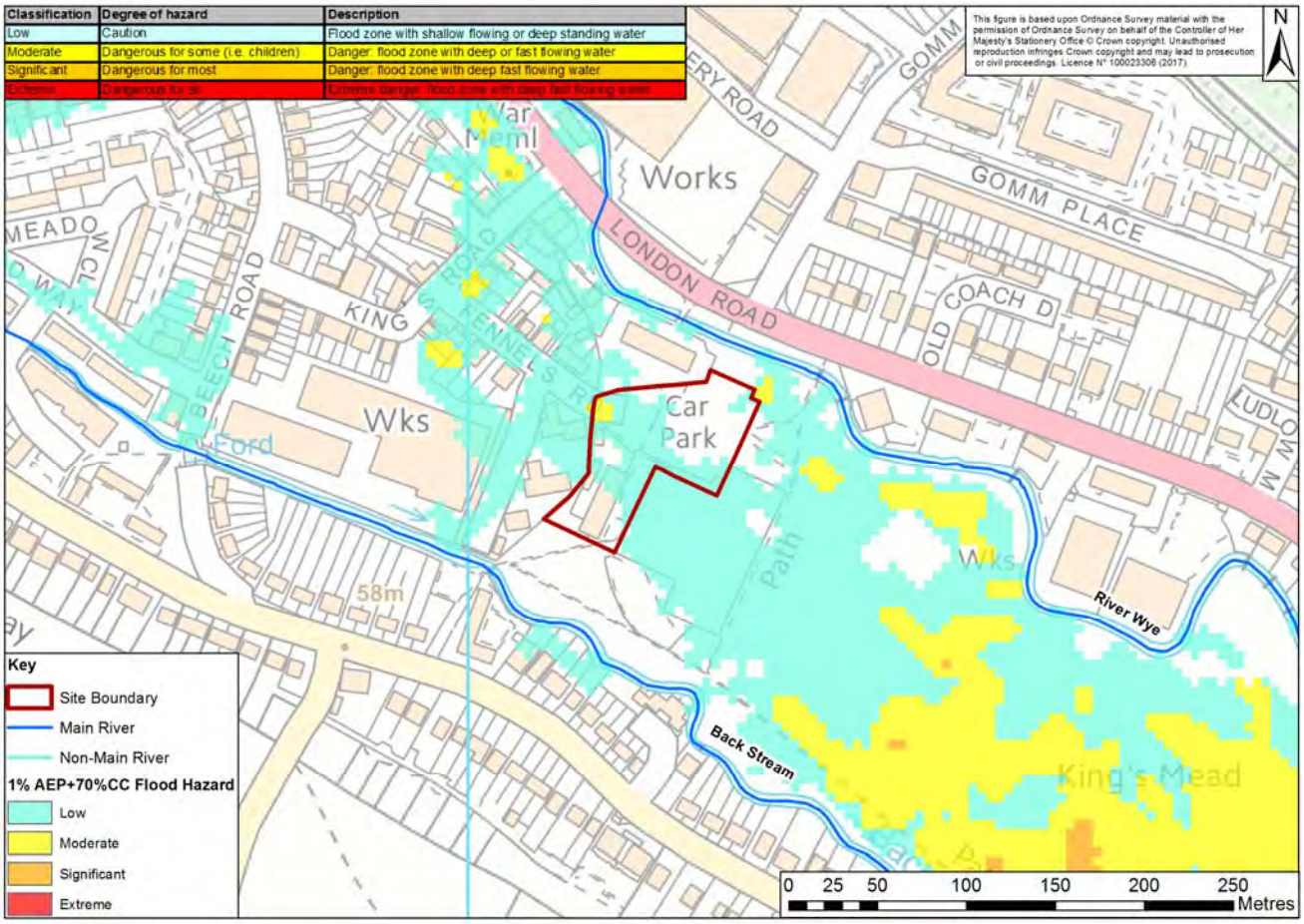
Table 3-24 : Rate of Flood Onset and Time to Maxiumum Extent

Climate Change Uplift (%)	0 (1% (1 in 100) AEP event)	10	15	25	35	70
Time of Onset	-	-	-	14:06	13:06	10:36
Time to Maximum Extent	-	-	-	14:06	13:06	16:21

Table 3-24 indicates the time of onset of flooding and the time taken to reach maximum flood extent within the site. It should be noted that the model time steps for the River Thames and River Wye models are two hours and 15 minutes respectively.

Figure 3-47 indicates that the majority of the site is designated as having a Low flood hazard with localised areas, in the north of the site, designated as Moderate. The application should take this into account and ensure safe access and egress from the site is available after development while also taking this into account for the risk of surface water flood risk (see Section 3.7.3.1).

Figure 3-47 : Site 45 Flood Hazard



3.7.2.1 Flood Defence Failure

There are no raised defences in the vicinity of the site. The Wye and Back Stream are in open channel at this point so it is considered that there is a low risk of flooding as a result of culvert blockage to this site.

3.7.3 Risk of Flooding from Other Sources

3.7.3.1 Surface Water

Surface water flood risk based on the uFMfSW is presented in Figure 3-48.

Figure 3-48: Site 45 Surface Water Flood Risk

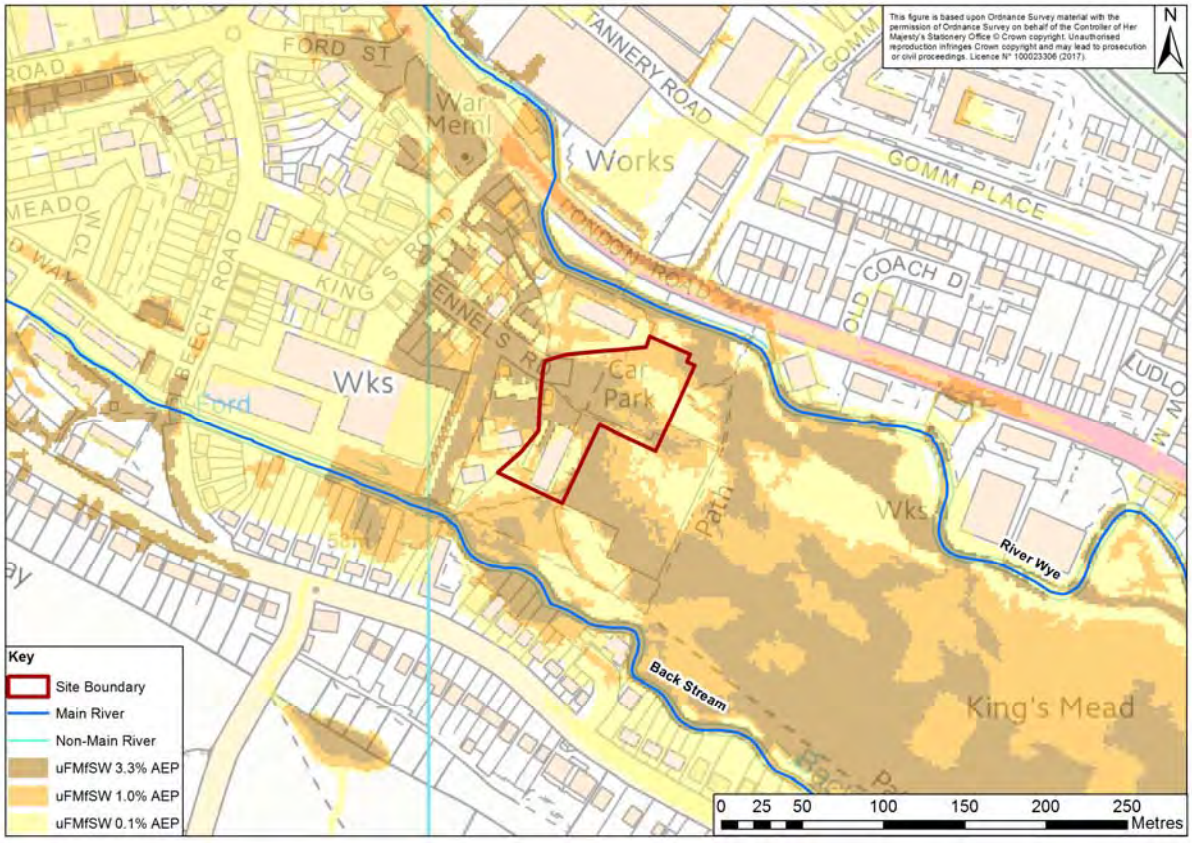


Table 3-25: Site 45 uFMfSW Extents

Event (AEP)	3.33% (1 in 30)	1% (1 in 100)	0.1% (1 in 1000)
Extent (ha)	0.30	0.42	0.54
Percentage Coverage (%)	50	70	90

The majority of the site is at either High or Medium risk of surface water flooding based on the uFMfSW, and consequently designated a WCDA. Approximately 90% of the site is at risk of surface water flooding from a 0.1% (1 in 1000) AEP event (see Table 3-25). There appears to be a flow path through the southern boundary which could interact with the development and affect access to and from the site. The Level 1 SFRA indicates that areas in High Wycombe are known to be particularly susceptible to flooding from surface water in urban areas that respond quickly to rainfall.

3.7.3.2 Groundwater

For the two sources of mapping, the AStGWF depicts the likelihood of groundwater emergence; the JBA mapping indicates depth to groundwater level beneath ground.

A review of EA AStGWF mapping indicates that the entirety of the site is at low risk of flooding (within a grid square where between 25% and 50% is at risk of groundwater emergence), see Figure 3-49.

Figure 3-49: Site 45 Groundwater Flood Risk

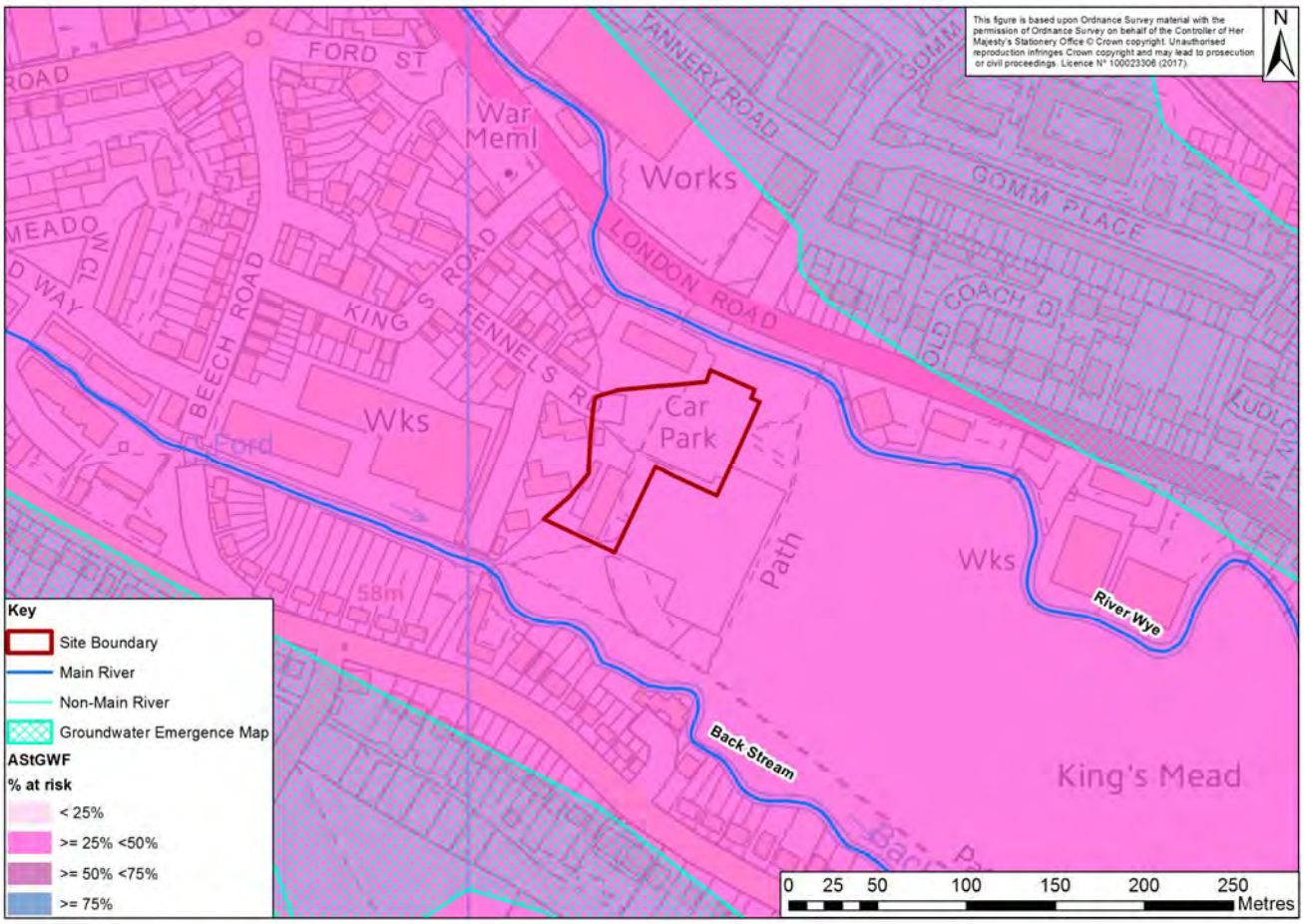
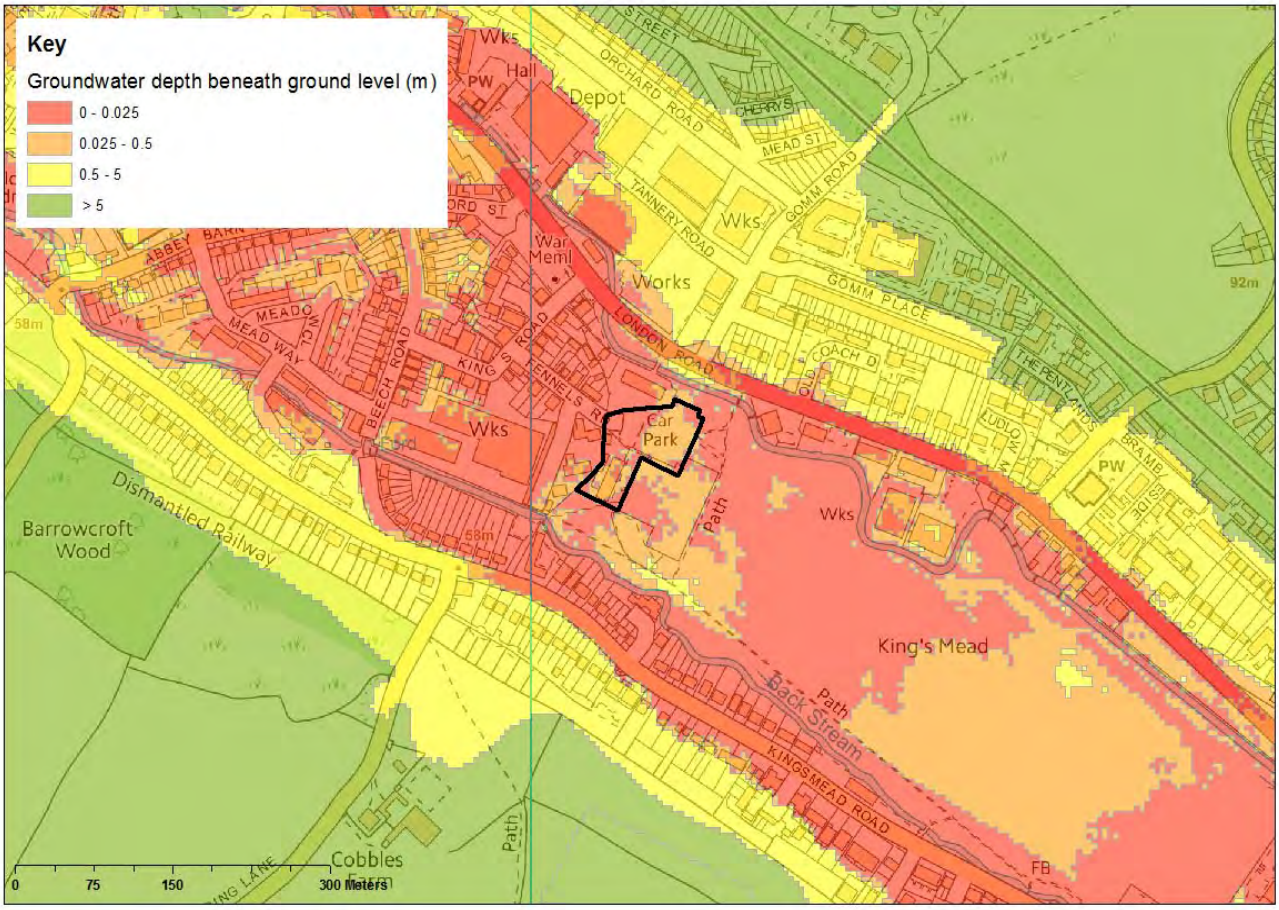


Figure 3-50 depicts groundwater mapping completed by JBA, showing areas of the site at high (within 0.025m of the ground surface) and medium (groundwater levels between 0.025m and 0.5m below the ground surface) risk of groundwater flooding at this site.

Figure 3-50 : Site 45 JBA Groundwater Mapping



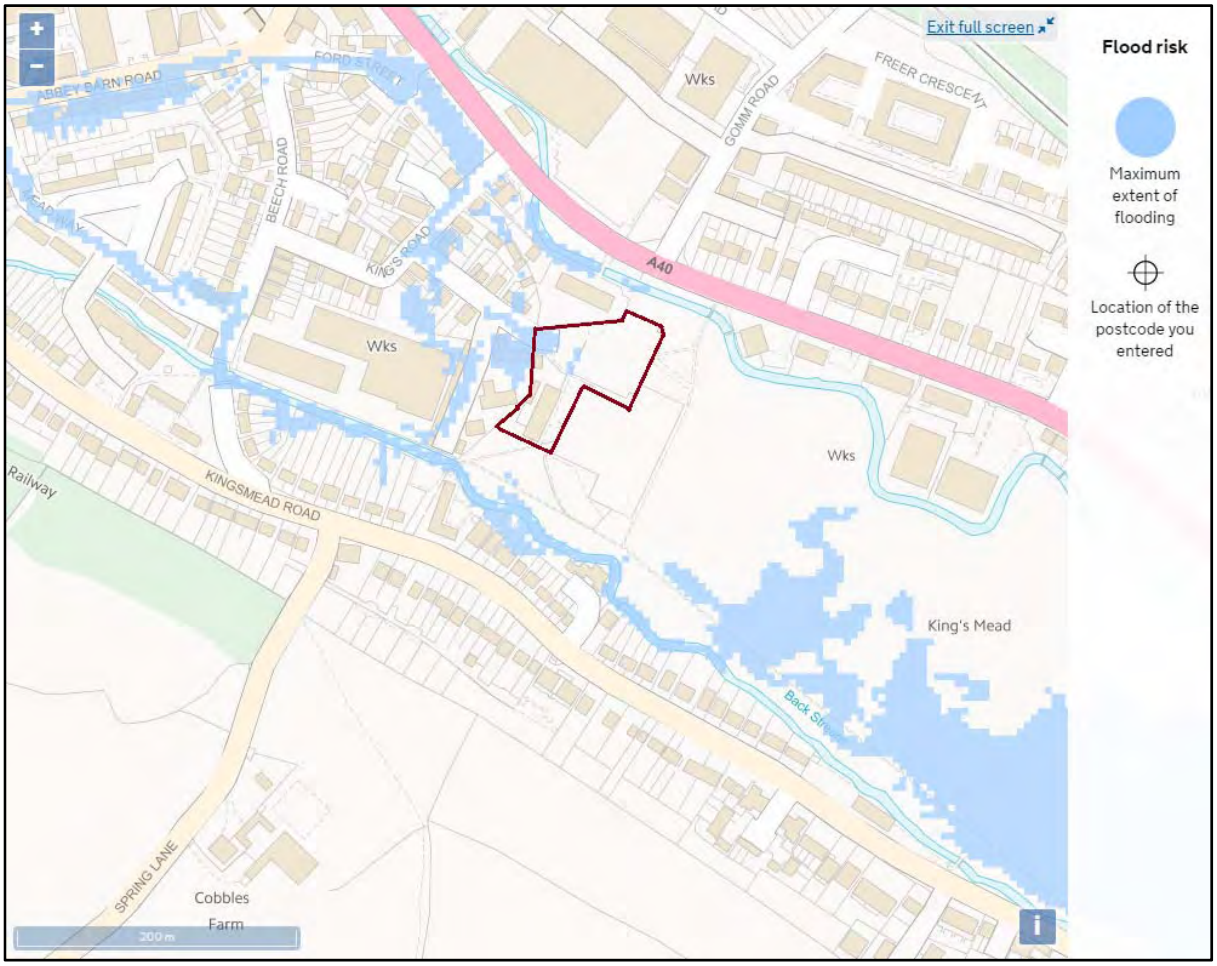
3.7.3.3 Sewers

With reference to Figure 7 of the Level 1 SFRA, the site is in a post code that recorded 1-5 incidents of sewer flooding affecting properties internally and externally in the 20 years preceding 2014.

3.7.3.4 Reservoir Failure

A review of the predicted flood extent as a result of reservoir failure available online indicates that the western edge and a localised section in the central area of the site are at risk of flooding from such an event. See Figure 3-51.

Figure 3-51: Site 45 Risk of Flooding from Reservoir Failure



Source: https://flood-warning-information.service.gov.uk/long-term-flood-risk/map?map=SurfaceWater © Crown copyright and database rights 2017 OS 100024198

3.7.4 The Exception Test

The site is located within Flood Zones 1 and 2 with the south-eastern corner within Flood Zone 3a. The proposed mixed-use development would be classified as 'More Vulnerable' or 'Less Vulnerable'[24].

The applicant would need to avoid development the relatively small area of flooding on the north-east of the site. Assuming a design life beyond 2069, the EA guidance also requires that the applicant consider the impact of the 'higher central' allowance of +70%. This flood event is extensive across the site; the deepest flood depths are on the western boundary (approximately 0.24m at Fennel's Road). Due to the extensive area of the site affected by the 1% (1 in 100) +70% CC AEP event and high risk of surface water flooding, it is unlikely that this site will be able to be developed to remain safe for its lifetime. Therefore, this development would not pass the Exception Test and therefore should not be developed.

[24] NPPG Table 2 / Paragraph 066

3.7.5 Flood Risk Management

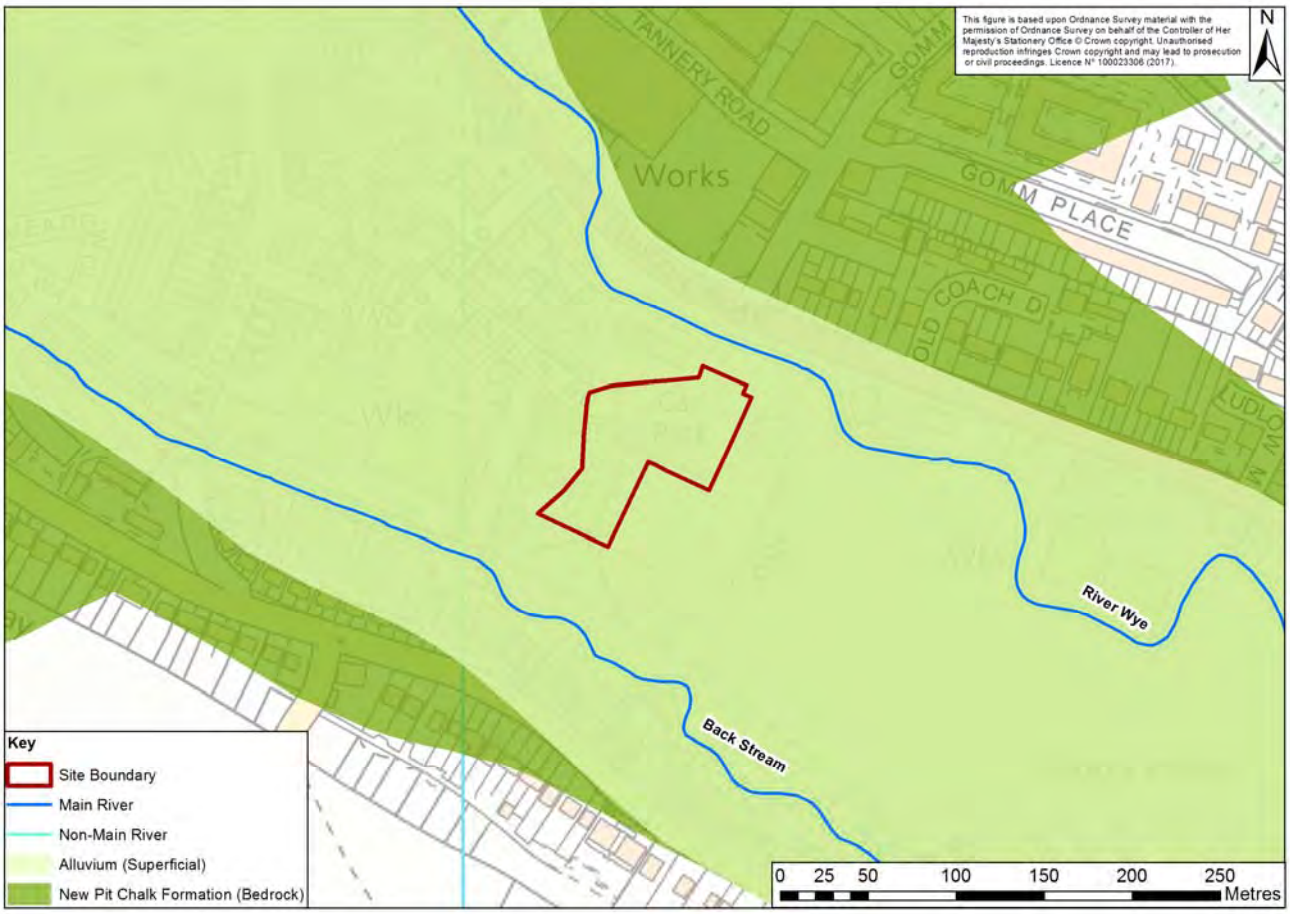
3.7.5.1 Opportunities for Betterment

Given that there is limited property immediately downstream there is considered to be little opportunity to introduce measures to attenuate fluvial flows to achieve betterment. However, the possibility of infiltration of runoff (see Section 3.7.6) could contribute to the reduction in peak flows in the River Wye as part of catchment-wide measures to reduce peak flows.

3.7.6 Applicability of Infiltration Measures

A review of the site geology (see Figure 3-52) suggests it is underlain by a layer of Alluvium (superficial deposit) and Chalk bedrock of (New Pit Formation). The thickness of each layer is not included within the information. Surrounding strata have been omitted for clarity if they are not present directly beneath the site. Consequently, infiltration of rainfall directly to ground may be practicable. The proximity of the two watercourses may result in locally high groundwater levels potentially reducing the feasibility of such measures. Infiltration should be the first method considered for the drainage of sites and as such, a site-specific FRA would be required to demonstrate the feasibility of infiltration measures.

Figure 3-52 : Site 45 Geology



3.7.6.1 Site-specific Flood Risk Assessment

A site-specific FRA would be required to accompany the planning application for this site because it includes areas of Flood Zones 2 and 3 and is within a WCDA in accordance with NPPF paragraph 103 and WDC policy

DM37. The review of flood risk has identified a number of issues that a site-specific FRA would need to consider in addition to those usually required:

- Agreement with the EA of the acceptability of the latest outputs of the Wye hydraulic model as these have a significant impact upon the extent of the flood zones within the site boundary;
- Consider best available data to determine flood depths predicted by the 1% +70% AEP event and if the site could be developed taking these into account,
- Demonstrate that the site may be developed safely taking into account the extensive areas of High risk surface water flooding predicted across the site. Finished floor levels would need to be above such a level plus an allowance for climate change, in addition the applicant would need to demonstrate how the site would be accessed safely during a surface water and/or fluvial and/or groundwater event;
- The suitability of infiltration measures for drainage of the site given the local geology; and
- Demonstrate how the elevated risk of groundwater flooding would be addressed and mitigated for, as a minimum avoiding the construction of below-ground rooms.

3.8 Site 70: Little Marlow Lakes Country Park Detailed Assessment

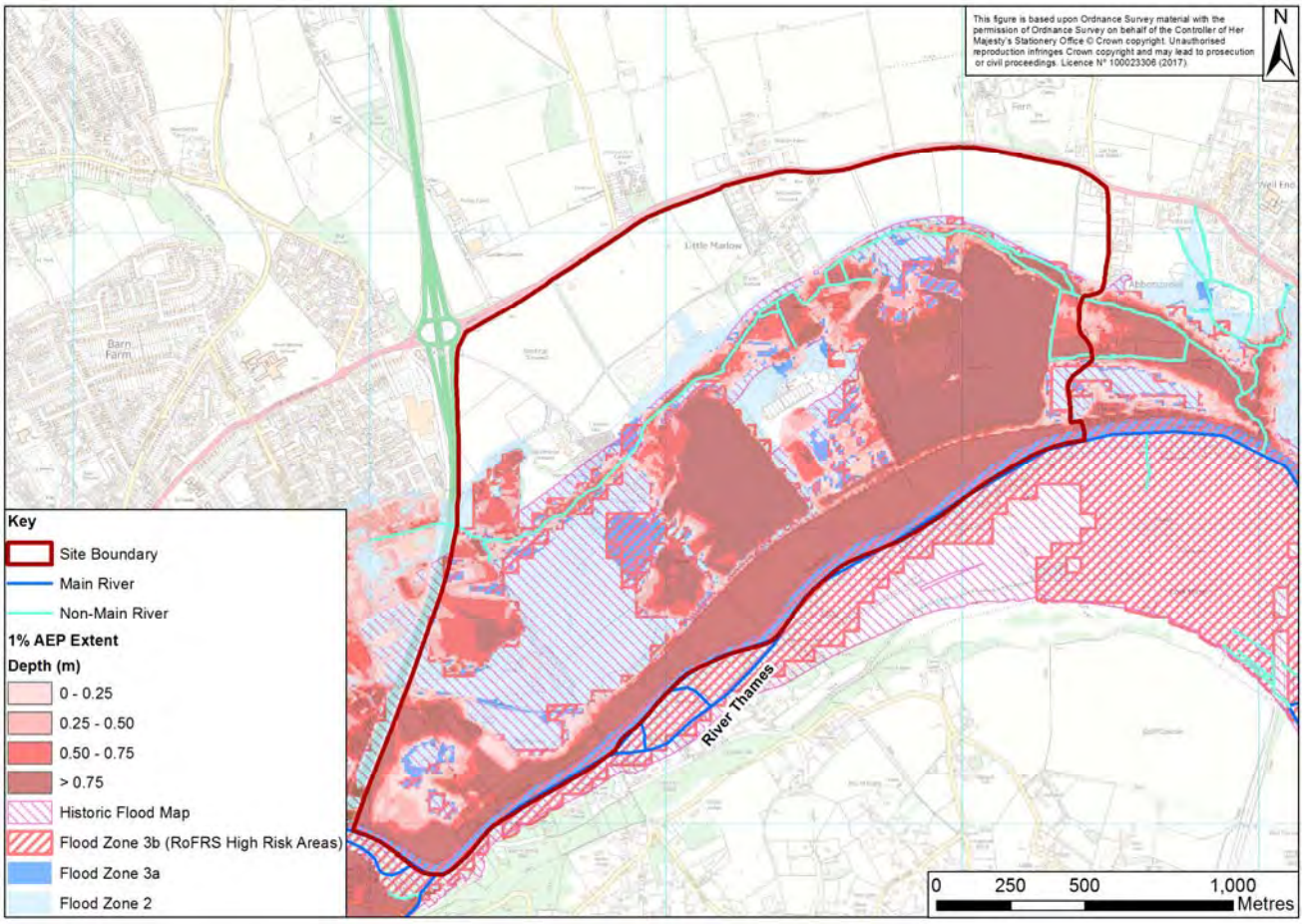
3.8.1 Site Description

Little Marlow, Country Park allocation site (planning ref: RUR6) is located to the east of Marlow, to the south of A4155 and north of the River Thames. The NGR for the site is SU 8772 8743. The site is currently a country park, including a hotel, a restaurant, a sports complex and the Little Marlow Sewage Treatment Works. The total site area is approximately 330ha. It is proposed to develop some sports facilities (likely to have other amenities such as cafés etc.). The proposed development would therefore be classified as 'Less Vulnerable'[25]. This site has been assessed in detail because it is within 50m of the extent of published Flood Zone 2: see Section 2.1.

3.8.2 Fluvial Flood Risk

The fluvial flood risk to the site is presented in Figure 3-53.

Figure 3-53: Site 70 Fluvial Flood Risk



The River Thames acts as the southern site boundary. The site is also bound by the A404 to the west, Marlow Road to the north and Coldmoorholme Lane to the east. The northern section of the site is predominantly within Flood Zone1; see Figure 3-53. Flood Zone 2 and Flood Zone 3a cover approximately 75% and 60% of the southern section of the site respectively. Flood Zone 3b covers approximately 45% of the site in similar areas to those designated as Flood Zone 3a. The historical flood map identifies an area similar to Flood Zone 2 has flooded from past fluvial events; these floods occurred in 1947, 1974, 2000 and 2003.

[25] NPPG Table 2 / Paragraph 066

Table 3-26: Site 70 Current Flood Zone Extents

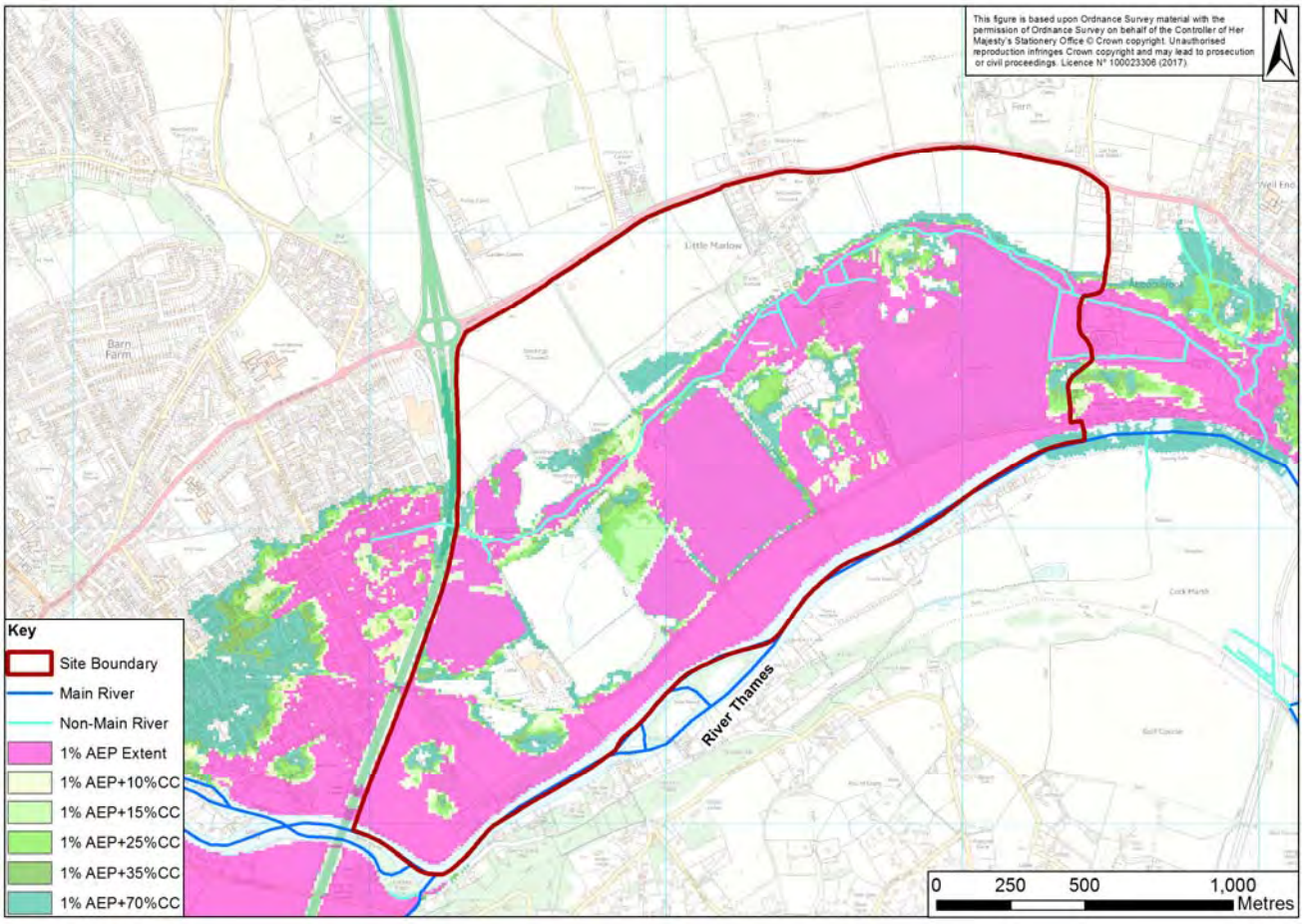
Flood Zone	1	2	3a	3b	Total
Extent (ha)	82.3	82.3	16.5	148.1	329.0
Coverage (%)	25	25	5	45	-

Table 3-27: Site 70 Modelled 1% (1 in 100) AEP Event Extent

AEP Event	Extent (ha)	%
1% (1 in 100)	132	40

The fluvial flood zones have been developed using the EA's River Thames hydraulic model, originally developed in 2007 for flood mapping purposes. The representation of the floodplain has been updated for this SFRA. It should be noted that there appears to be a discrepancy regarding the predicted flood extents derived from hydraulic modelling. Consequently, the applicant would need to use best available data to consider this when developing a site-specific FRA and determine the need for further hydraulic modelling. The applicant would need to liaise with the EA to confirm the extents to be adopted to delineate Flood Zones, refer to Section 2.2 for further details.

Figure 3-54 : Site 70 Fluvial Flooding with Climate Change



The extent of fluvial flood risk from a 1% (1 in 100) AEP event with additional climate change uplift factors indicates a similar flood extent to Flood Zone 2. Flow paths in a northerly direction, from the Thames into the site, following existing topography are likely to occur during flood events. EA flood records confirmed flooding, from fluvial sources, to one property within the south-western section of the site; three properties immediately east of the site boundary have also reported flooding since 2000.

Table 3-28: Site 70 Fluvial Flooding with Climate Change Extents

Climate Change Uplift (%)	10	15	25	35	70	Total
Extent (ha)	165	171	181	188	197	329
Coverage (%)	50	52	55	57	60	-

Table 3-26 indicates approximately 60% of the site is at risk of flooding from the 1% (1 in 100) + 70% climate change extent.

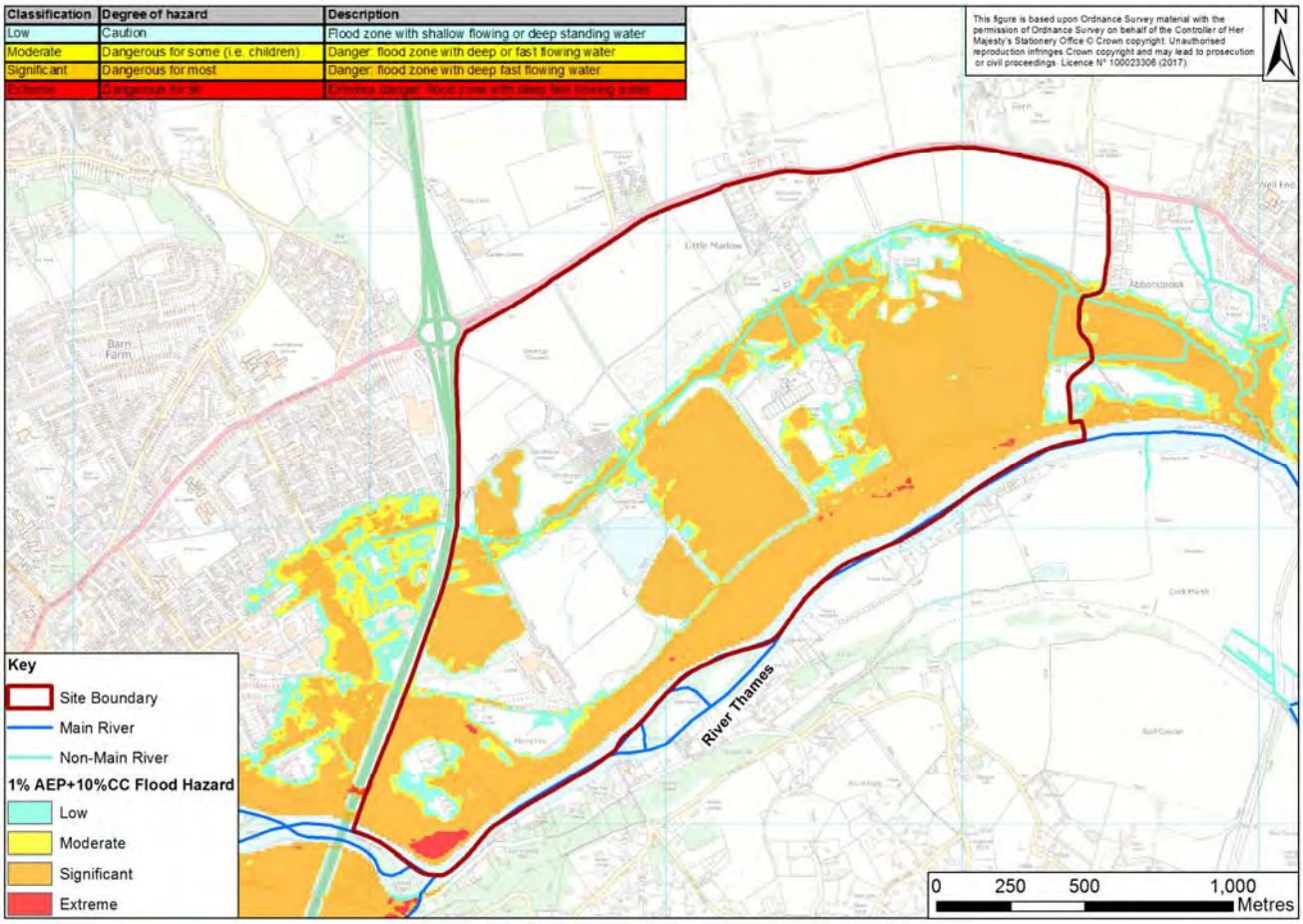
Table 3-29 : Rate of Flood Onset and Time to Maxiumum Extent

Climate Change Uplift (%)	(1% (1 in 100) AEP event)	10	15	25	35	70
Time of Onset	166:00	154:00	150:00	140:00	130:00	100:00
Time to Maximum Extent	458:00	404:00	414:00	392:00	382:00	390:00

Table 3-29 indicates the time of onset of flooding and the time taken to reach maximum flood extent within the site. It should be noted that the model time steps for the River Thames and River Wye models are two hours and 15 minutes respectively.

Figure 3-55 indicates that the majority of the site is designated as having a Significant flood hazard with localised areas designated as Low to Extreme. The application should take this into account and ensure safe access and egress from the site is available after development while also taking this into account for the risk of surface water flood risk (see Section 3.8.3.1).

Figure 3-55 : Site 70 Flood Hazard



3.8.2.1 Flood Defence Failure

There are no raised defences in the vicinity of the site. The Thames is in open channel at this point so it is considered that there is a low risk of flooding as a result of culvert blockage to this site.

3.8.3 Risk of Flooding from Other Sources

3.8.3.1 Surface Water

Surface water flood risk based on the uFMfSW is presented in Figure 3-56.

Figure 3-56: Site 70 Surface Water Flood Risk

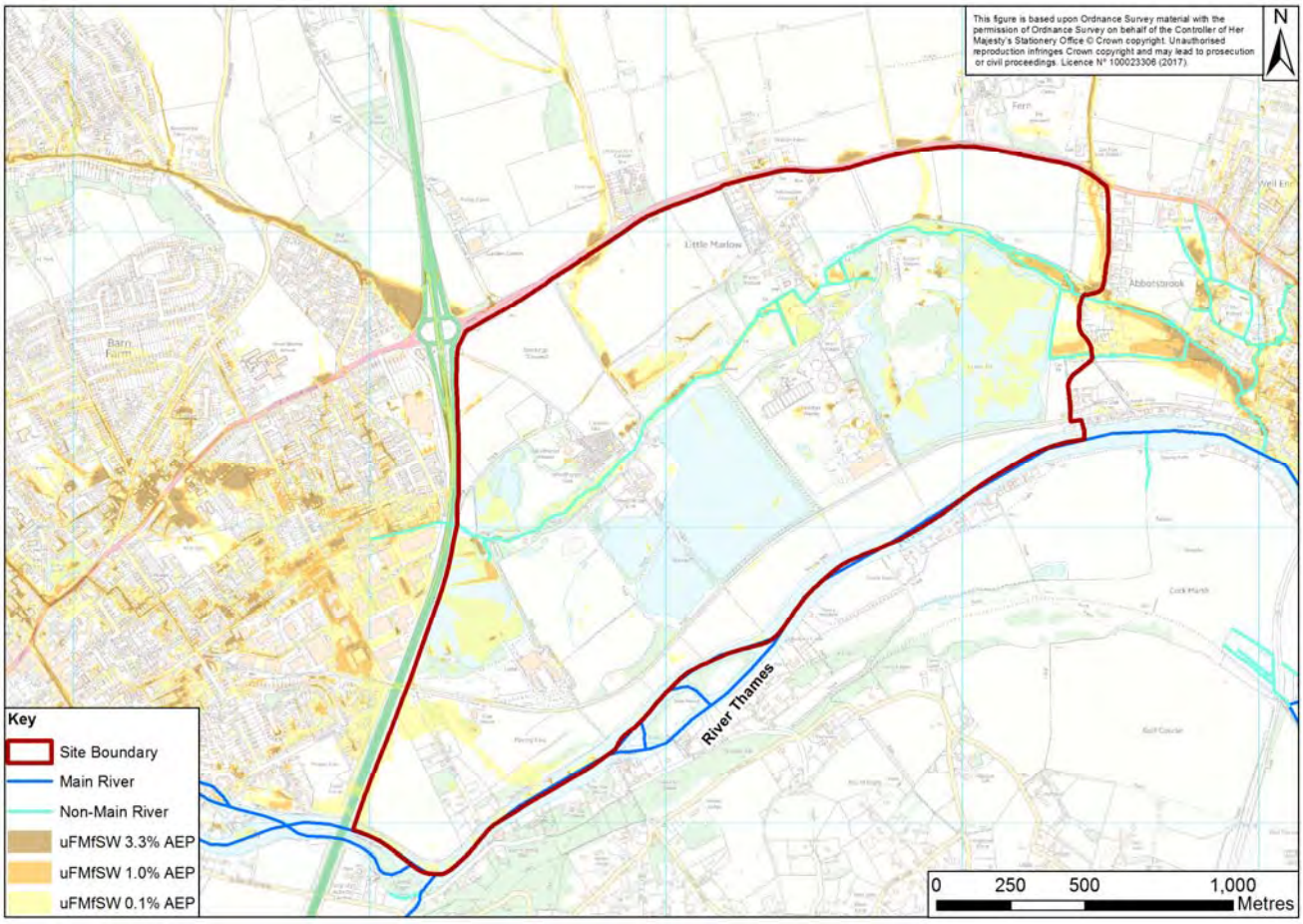


Table 3-30: Site 70 uFMfSW Extents

Event (AEP)	3.33% (1 in 30)	1% (1 in 100)	0.1% (1 in 1000)
Extent (ha)	1.5	3	30
Coverage (%)	0.5	1	9

The site appears to be at greatest risk of surface water flooding from the 0.1% (1 in 1000) AEP event based on the uFMfSW, approximately 9% of the site is at risk of surface water flooding from a 0.1% AEP event (see Table 3-30). There are pockets of flooding predicted in the site (particularly for the 3.3% (1 in 30) and 1% (1 in 100) AEP events) which may be the result of rainfall filling localised depressions in the hydraulic model used to develop the extents. There appear to be several flow paths within the site boundary; however, these likely follow localised topographical gradients in addition to the ordinary watercourse flowing west to east through the site. These small flow paths could interact with the development and affect access to and from the site. The applicant would need to demonstrate the predicted impact of climate change on surface water flood risk and particularly the impact on flood risk form the ordinary watercourse.

3.8.3.2 Groundwater

For the two sources of mapping below, the AStGWF depicts the likelihood of groundwater emergence; the JBA mapping indicates the depth to groundwater below ground.

A review of the EA's AStGWF mapping indicates that the northern edge and south-western corner of the site are at very low risk of flooding (within a grid square where less than 25% is at risk of groundwater emergence). The central-southern area and the north-eastern extremes are at low risk of flooding (within a grid square where between 25% and 50% is at risk of groundwater emergence). The north-western corner of the site has a moderate risk of flooding (within a grid square where between 50% and 75% is at risk of groundwater emergence). Areas in the centre, the east and the south-west of the site are at high risk of flooding (within a grid square where greater than 75% is at risk of groundwater emergence). The majority of the site is within an area deemed at elevated risk of groundwater emergence.

Figure 3-57: Site 70 Groundwater Flood Risk

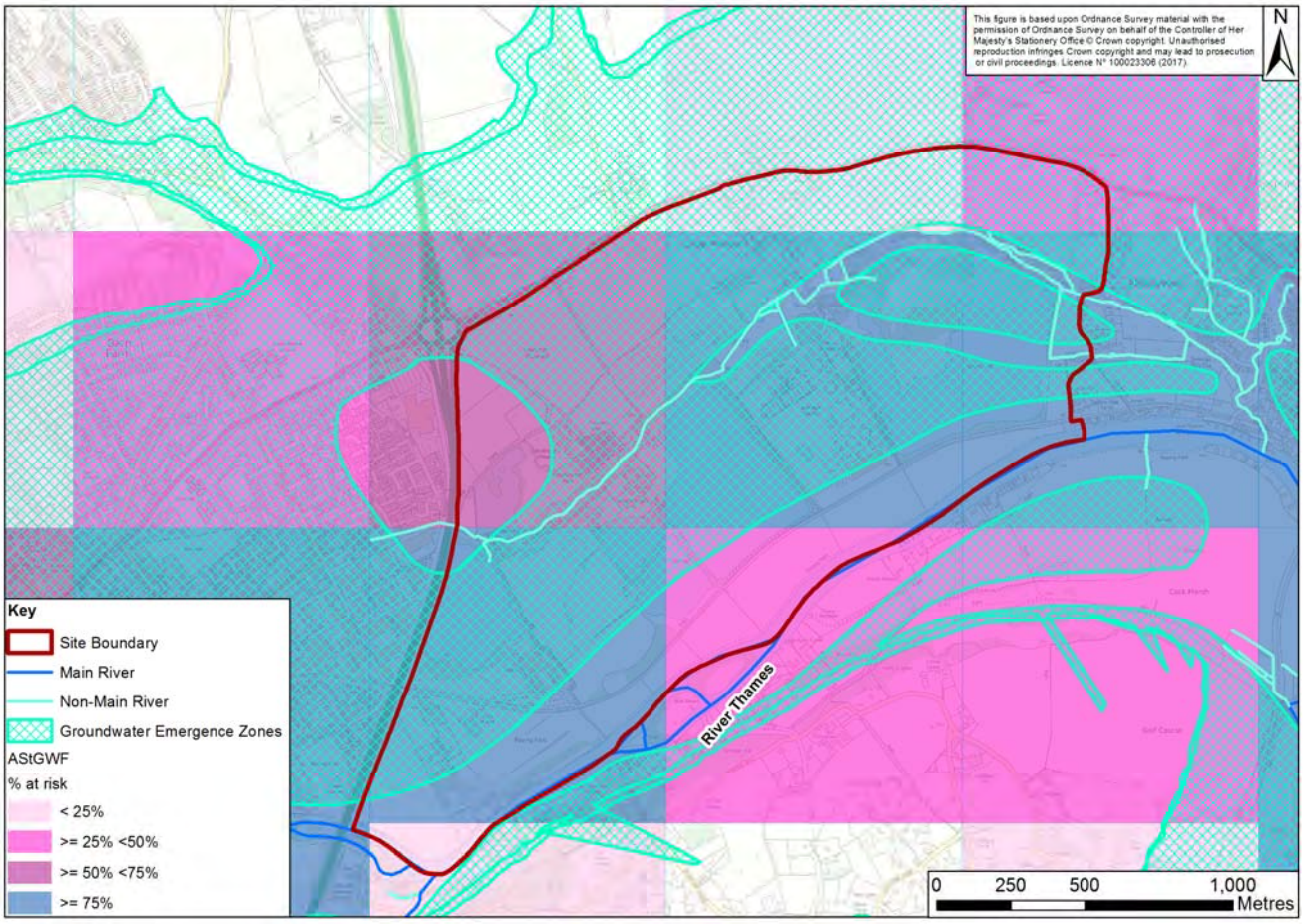
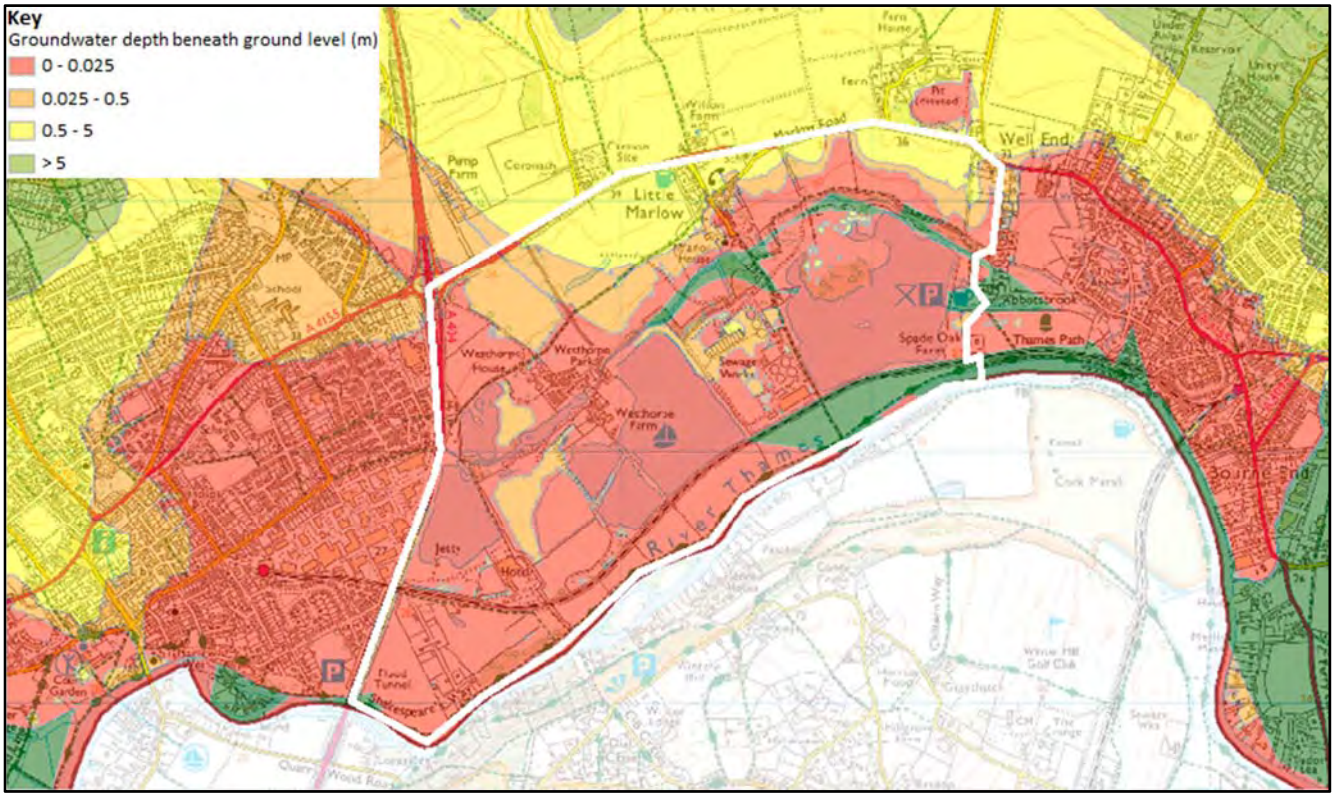


Figure 3-58 depicts groundwater mapping completed by JBA, showing areas of the site at high (within 0.025m of the ground surface), medium (groundwater levels between 0.025m and 0.5m below the ground surface) and low of groundwater flooding at this site.

Figure 3-58 : Site 70 JBA Groundwater Mapping



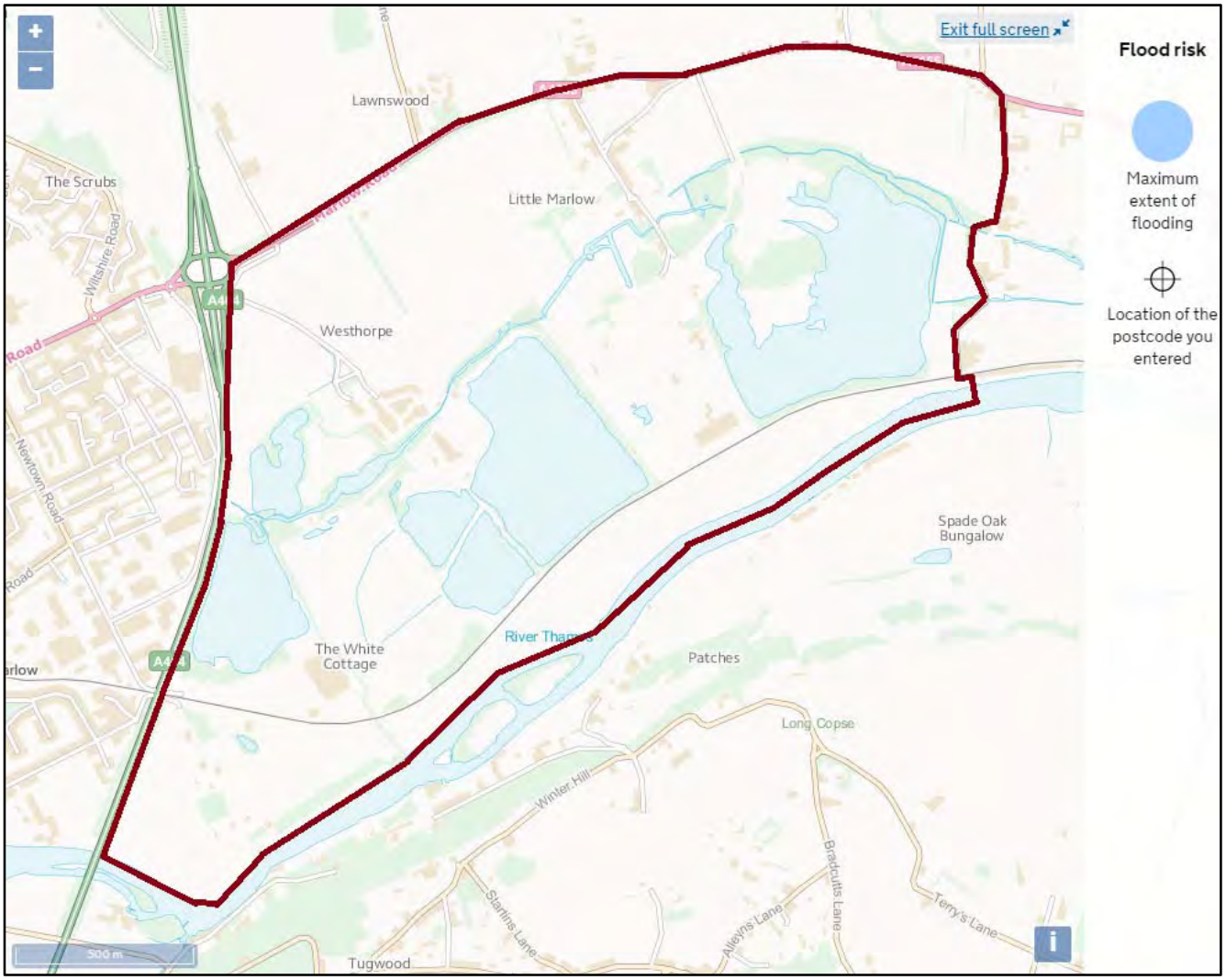
3.8.3.3 Sewers

The Little Marlow allocation site is predominantly located within post code area SL7, with the south-eastern corner lying within SL8, as identified in Figure 7 of the Level 1 SFRA. The Figure indicates between 16 and 25 properties have been reported to flood externally across both post code areas. SL7 has between six and ten and SL8 has between one and five reports of internal flooding.

3.8.3.4 Reservoir Failure

A review of the predicted flood extent as a result of reservoir failure available online indicates that the western edge and a localised section in the central area of the site are at risk of flooding from such an event. See Figure 3-59.

Figure 3-59: Site 70 Risk of Flooding from Reservoir Failure



Source: https://flood-warning-information.service.gov.uk/long-term-flood-risk/map?map=SurfaceWater © Crown copyright and database rights 2017 OS 100024198

3.8.4 The Exception Test

The site is located within Flood Zones 1, 2, 3a and 3b. The site is proposed as a country park with the inclusion of sports facilities (and potentially the inclusion of other amenities such as cafés etc.); the site would therefore be classified as 'Less Vulnerable'[26] and would therefore be acceptable and would not need to pass the Exception Test[27] provided development is located outside of Flood Zone 3b. Based on modelling undertaken for this SFRA the predicted impact of climate change would not affect the risk of flooding however this would need to be confirmed by the applicant to ensure the site would be developed safely.

[26] NPPG Table 2 / Paragraph 066
[27] NPPG Table 3 / Paragraph 067

3.8.5 Flood Risk Management

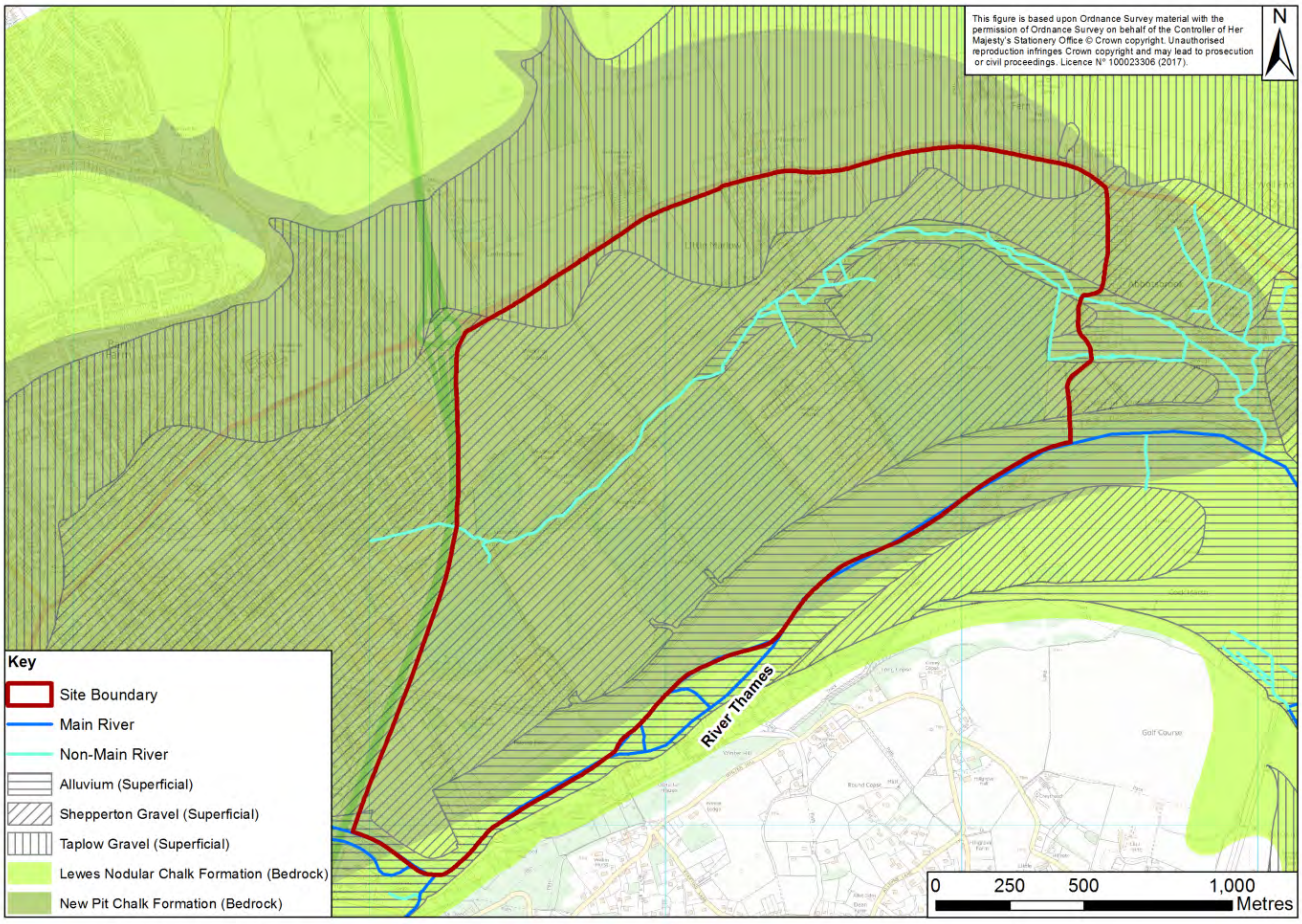
3.8.5.1 Opportunities for Betterment

As the site is proposed as park land and areas are available outside the 1% (1 in 100) AEP +70%CC event extent, it is assumed that there is the possibility to provide storage of flood water from the Thames to reduce flood risk downstream. The development may also provide an opportunity to attenuate flows on the Ordinary Watercourse that flows through the site and potentially mitigate pre-existing flood risk in Bourne End.

3.8.5.2 Potential Feasibility of Infiltration Measures

A review of the site geology (see Figure 3-60) suggests it is underlain by superficial deposits of Alluvium and Gravel (Shepperton and Taplow) and Chalk bedrock (New Pit and Lewes Nodular Formations). The thickness of each layer is not included within the information. Surrounding strata have been omitted for clarity if they are not present directly beneath the site. Consequently, infiltration of rainfall directly to ground may be practicable. The proximity of the watercourse may result in locally high groundwater levels potentially reducing the feasibility of such measures. Infiltration should be the first method considered for the drainage of sites and as such, a site-specific FRA would be required to demonstrate the feasibility of infiltration measures.

Figure 3-60 : Site 70 Geology



3.8.5.3 Site-specific Flood Risk Assessment

A site-specific FRA would be required to accompany the planning application for this site because it is greater than 1ha in size in accordance with NPPF paragraph 103 and is within a WCDA in accordance with NPPF

paragraph 103 and WDC policy on Managing flood risk and Sustainable Drainage Systems. However, given the nature of the proposed development the requirements should be limited. Site-specific considerations for the FRA are:

- Confirm the best available data to assess fluvial flood risk to the site noting that hydraulic modelling has only been undertaken by WDC to inform this SFRA, including confirmation of surface water flood risk as a result of the predicted impact of climate change;
- Confirm feasibility of runoff from impermeable areas in the northern half of the site;
- Ensure there are no increases to existing ground levels within Flood Zones 2 or 3;
- Avoid encroaching into WCDAs should be achievable given the small percentage area at risk of surface water flooding; and
- Confirmation of the suitability of infiltration of runoff to ground based on an assessment of groundwater levels.

3.9 Site 90: Leigh Street, Desborough Area, High Wycombe Detailed Assessment

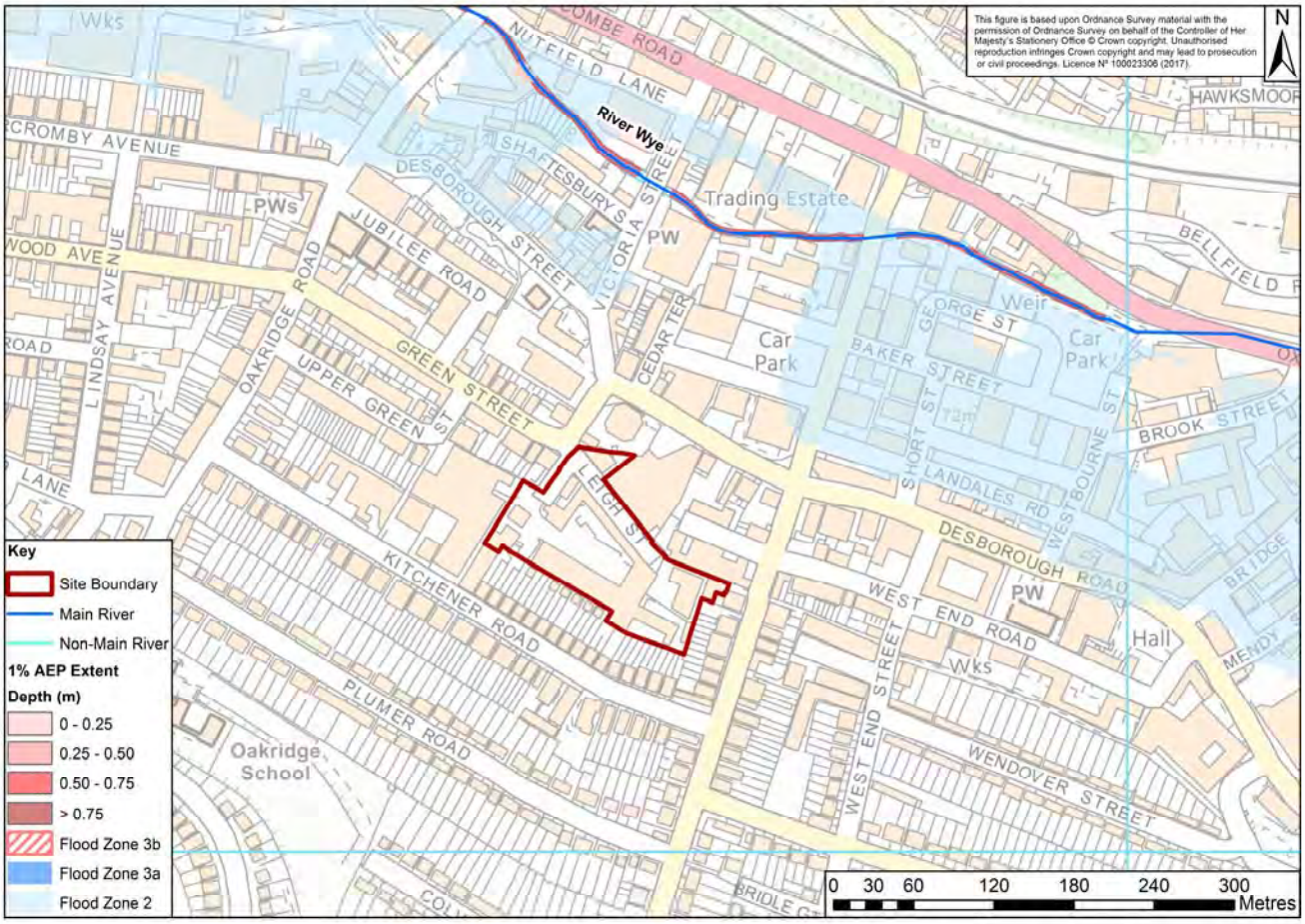
3.9.1 Site Description

The Leigh Street Town Employment Area allocation site (planning ref: HW12) is located to the west of High Wycombe centre, to the south of the A40 and the River Wye. The NGR for the site is SU 8556 9325. The site is currently developed and is an area of approximately 1.2ha. The proposed development is to create 275 residential properties and some employment. This site has been assessed in detail because it is within 50m of the extent of published Flood Zone 2: see Section 2.1.

3.9.2 Fluvial Flood Risk

The fluvial flood risk to the site is presented in Figure 3-61.

Figure 3-61: Site 90 Fluvial Flood Risk



The site boundary is approximately 300m to the south-west of the River Wye and encompasses the majority of the Leigh Street Employment Area. The entirety of the site is located within Flood Zone 1; see Figure 3-62. The historical flood map does not identify any fluvial flood events that have affected this site. The site is not predicted to flood when the climate change factors are considered. The Level 1 SFRA indicates that areas in High Wycombe are known to be particularly susceptible to flooding from the River Wye.

Table 3-31: Site 90 Current Flood Zone Extents

Flood Zone	1	2	3a	3b	Total
Extent (ha)	0	0	0	0	1.2
Coverage (%)	100	0	0	0	-

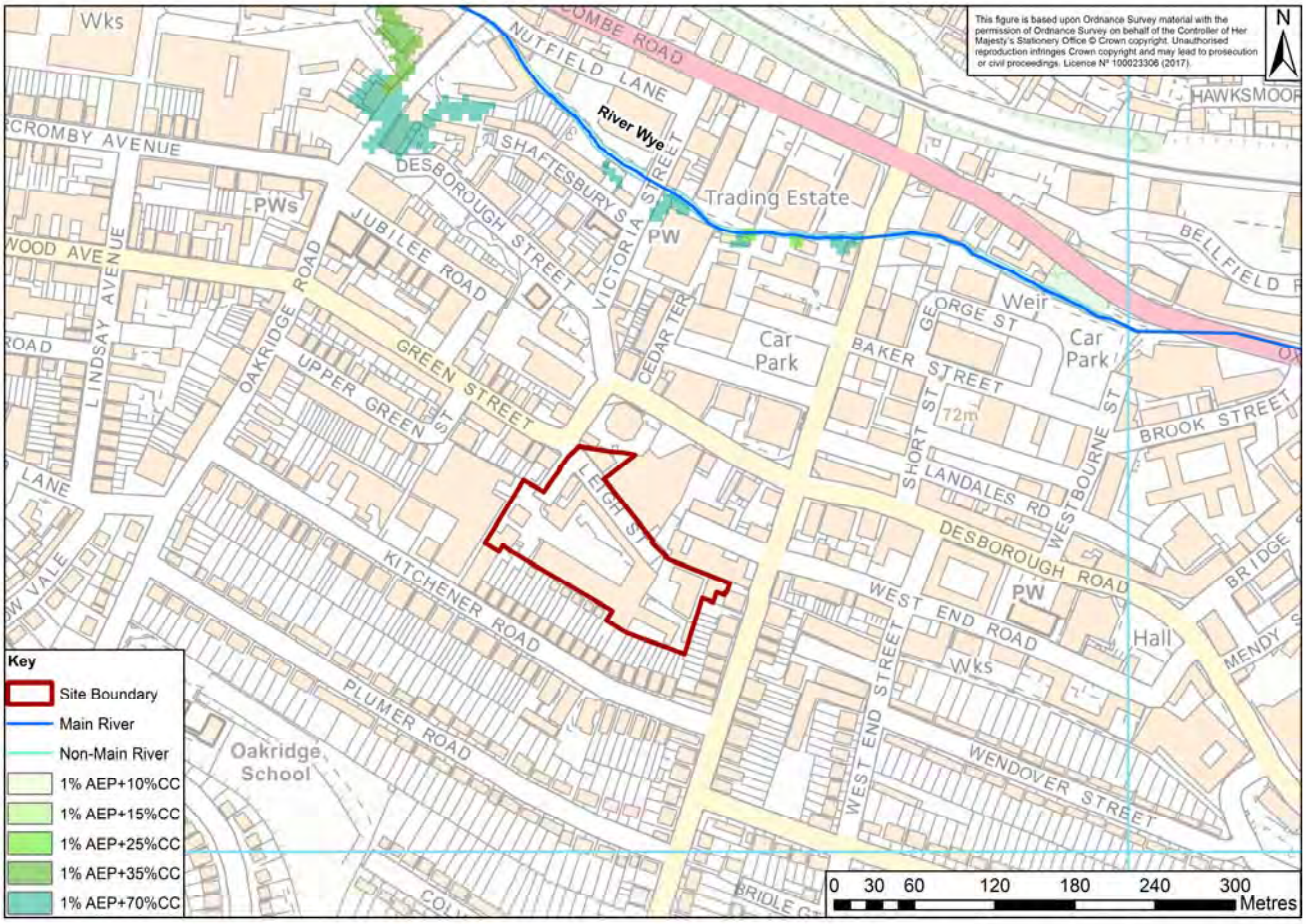
Table 3-32: Site 90 Modelled 1% (1 in 100) AEP Event Extent

AEP Event	Extent (ha)	%
1% (1 in 100)	0	0

The fluvial flood zones have been developed using the EA's River Wye/Hughenden Stream hydraulic model, originally developed in 2001 for flood mapping purposes. The representation of the floodplain has been updated for this SFRA utilising LiDAR data from 2015. It should be noted that there appears to be a discrepancy (see Figure 3-61) between the published fluvial flood zones and the predicted flood extents derived from hydraulic modelling, see Section 2.2. However, at this location both versions of the model place the allocation site outside Flood Zone 3.

Figure 3-62 indicates the predicted flood extents due to climate change indicating the site is not sensitive the predicted impacts; remaining outside Flood Zone 3.

Figure 3-62 : Site 90 Fluvial Flooding with Climate Change



The lowest ground levels at site 90 are approximately 74.6m AOD which is approximately 1.6m above the ground level at the current extent of Flood Zone 2. Given the reduction in extent for the 1% (1 in 100) AEP event based on the updated hydraulic model it is unlikely that this site would fall into Flood Zone 2 once the predicted impact of climate change is considered. Given residential development is proposed it would remain acceptable within Flood Zone 2 in accordance with Table 3 / paragraph 067 of the NPPG.

3.9.2.1 Flood Defence Failure

There are no raised defences in the vicinity of the site. The Wye is in open channel at this point so it is considered that there is a low risk of flooding as a result of culvert blockage to this site.

3.9.3 Risk of Flooding from Other Sources

3.9.3.1 Surface Water

Surface water flood risk based on the uFMfSW is presented in Figure 3-63.

Figure 3-63: Site 90 Surface Water Flood Risk

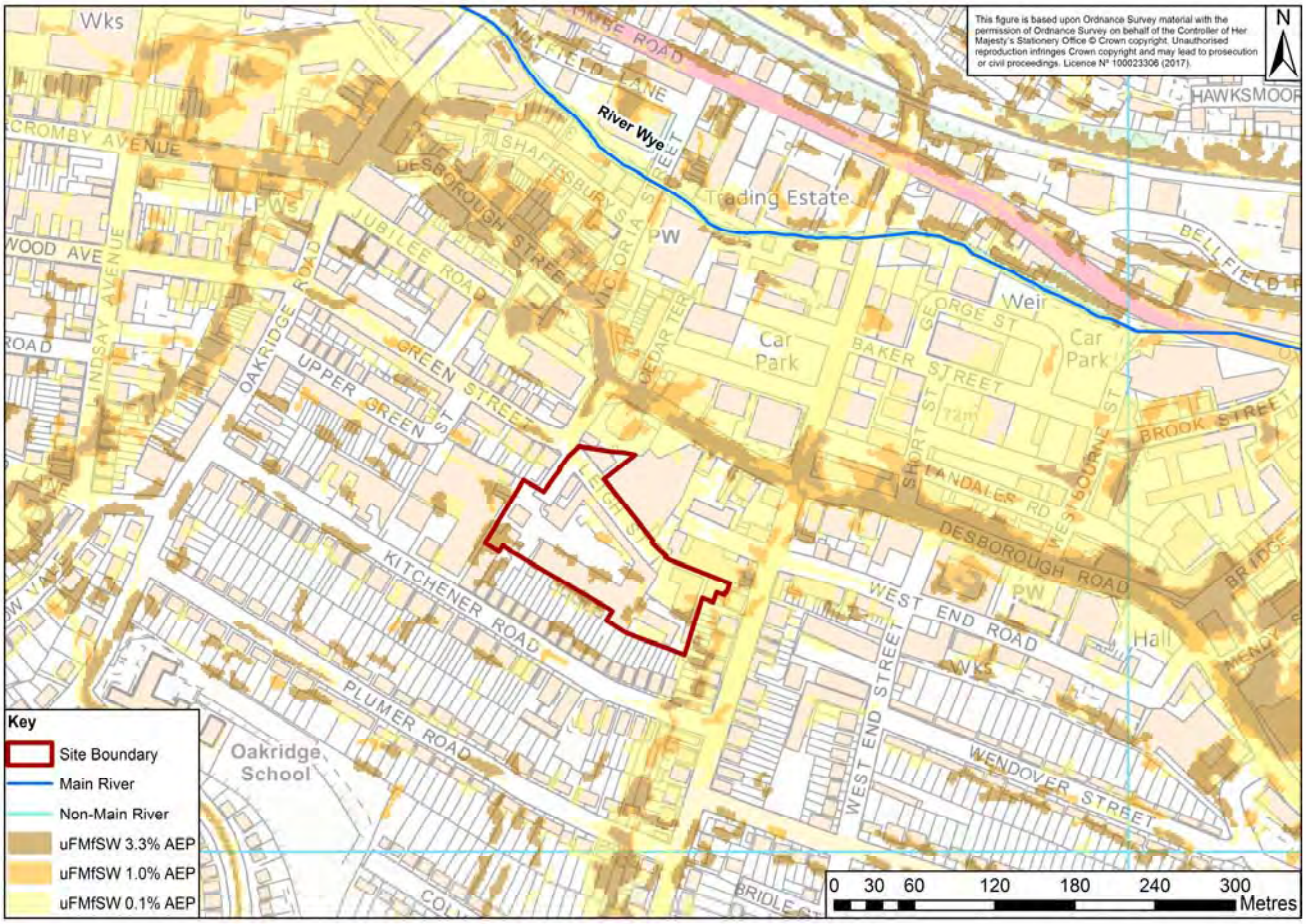


Table 3-33: Site 90 uFMfSW Extents

Event (AEP)	3.33% (1 in 30)	1% (1 in 100)	0.1% (1 in 1000)
Extent (ha)	0.09	0.13	0.36
Coverage (%)	5	7	30

Primarily the southern and eastern sections of the site appear to be at greatest risk of surface water flooding based on the uFMfSW, approximately 30% of the site is at risk of surface water flooding from a 0.1% (1 in 1,000) AEP event (see Table 3-33). There are pockets of flooding predicted in the site which may be the result of rainfall filling localised depressions in the hydraulic model used to develop the extents. There is one flow path through the site, which flows across the eastern edge of the site from the south to the north. There also appears to be a flow path along Leigh Street. These flow paths could interact with the development and affect access to and from the site. The Level 1 SFRA indicates that areas in High Wycombe are known to be particularly susceptible to flooding from surface water in urban areas that respond quickly to rainfall.

Climate change has the potential to increase the risk of surface water flooding to the site. Although beyond the scope of this SFRA to quantify the predicted impact, the risk of flooding to those areas currently assessed as 'Low' surface water risk could increase as a result of climate change and consequently they could become re-classified as WCDA. Such a risk would need to be quantified by the applicant in order to demonstrate that the site could be developed safely for future users, taking into account the planning implications of such a result.

3.9.3.2 Groundwater

For the two sources of mapping below, the AStGWF depicts the likelihood of groundwater emergence; the JBA mapping shows depth to groundwater level beneath ground.

A review of EA AStGWF mapping (see Figure 3-64) indicates that the majority of the site is at low risk of flooding (within a grid square where between 25% and 50% is at risk of groundwater emergence). The majority of the site is situated within a groundwater emergence zone.

Figure 3-64: Site 90 Groundwater Flood Risk

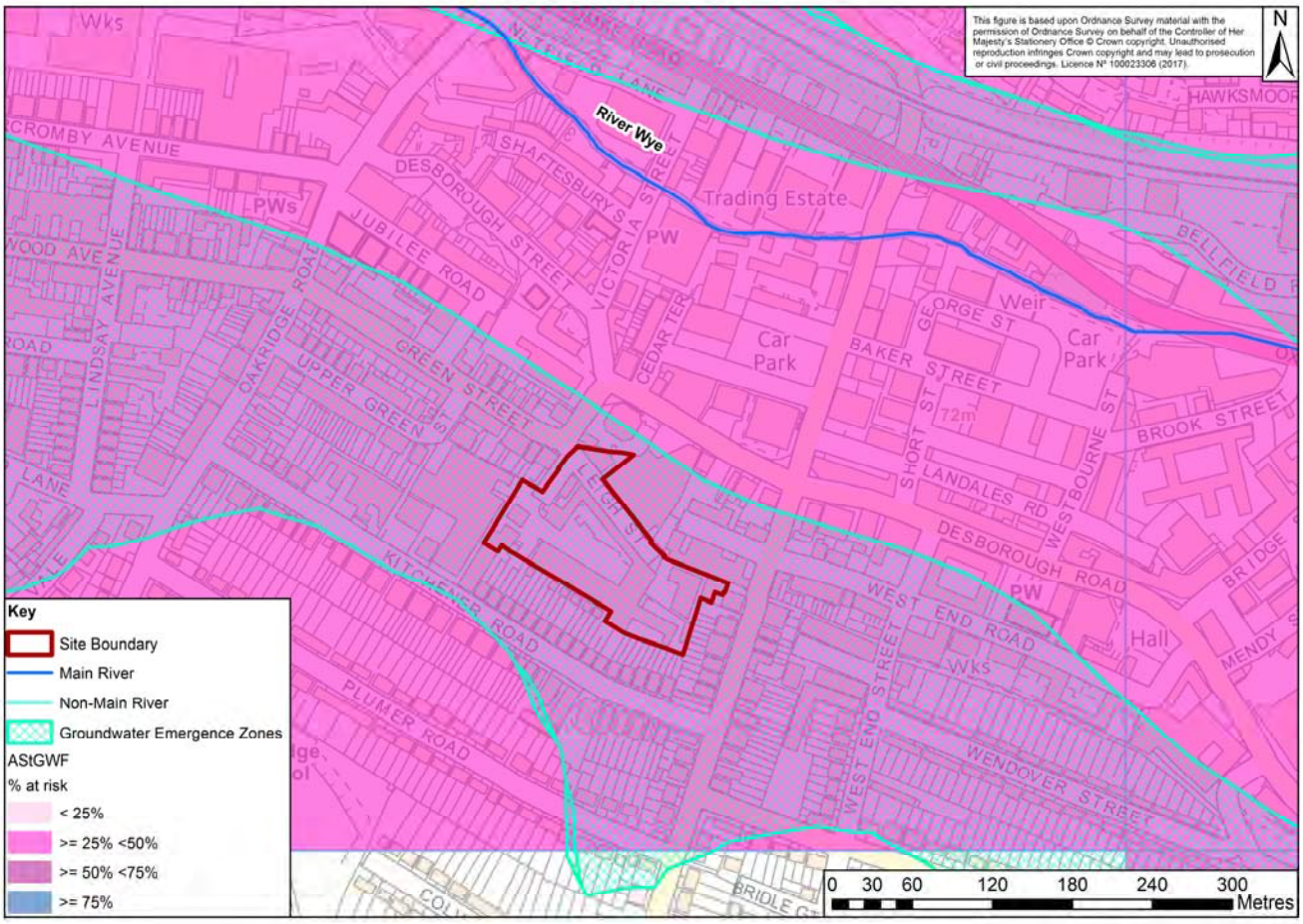
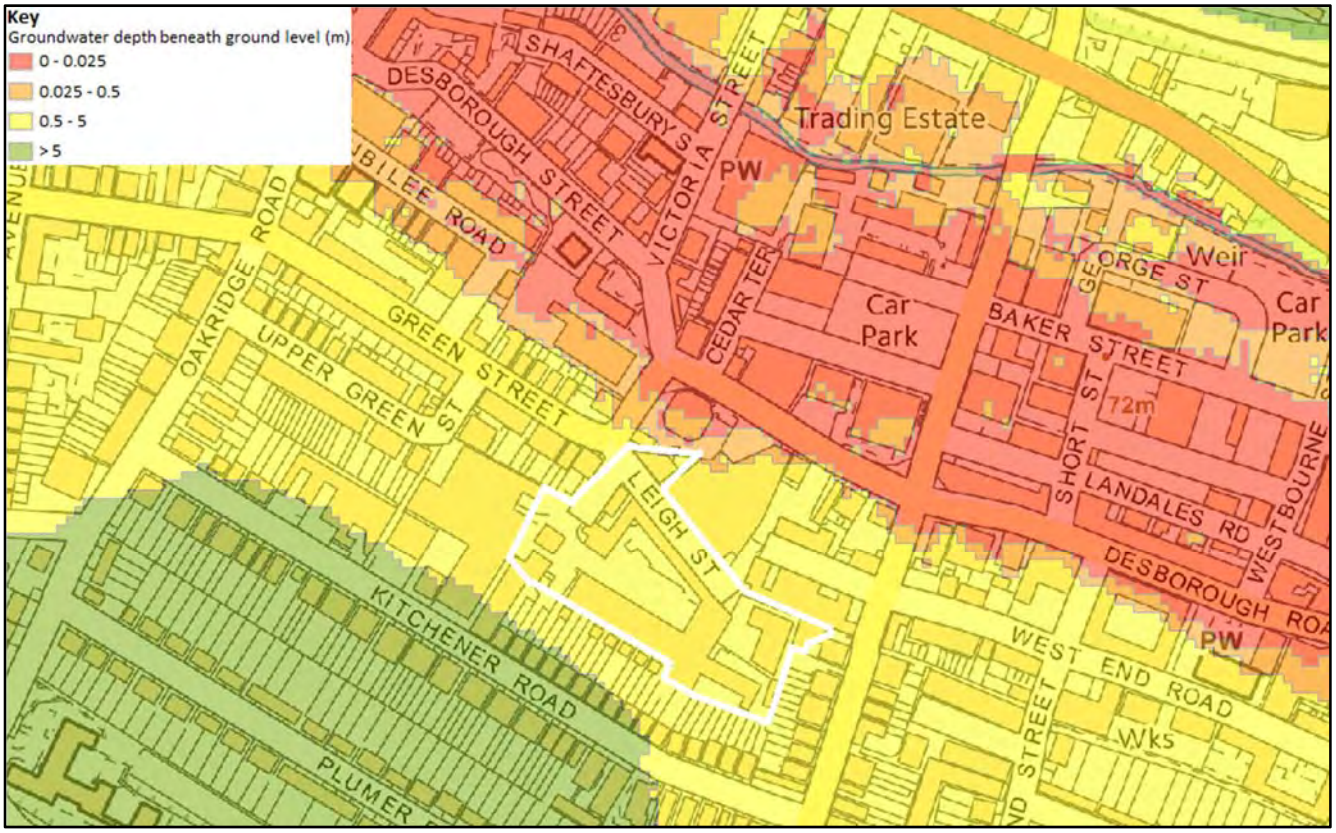


Figure 3-65 depicts groundwater mapping completed by JBA, showing areas of the site at high (within 0.025m of the ground surface) and medium (groundwater levels between 0.025m and 0.5m below the ground surface) risk of groundwater flooding to the northern extent of the site. A low risk of groundwater flooding is shown to the majority of the site.

Figure 3-65 : Site 90 JBA Groundwater Mapping



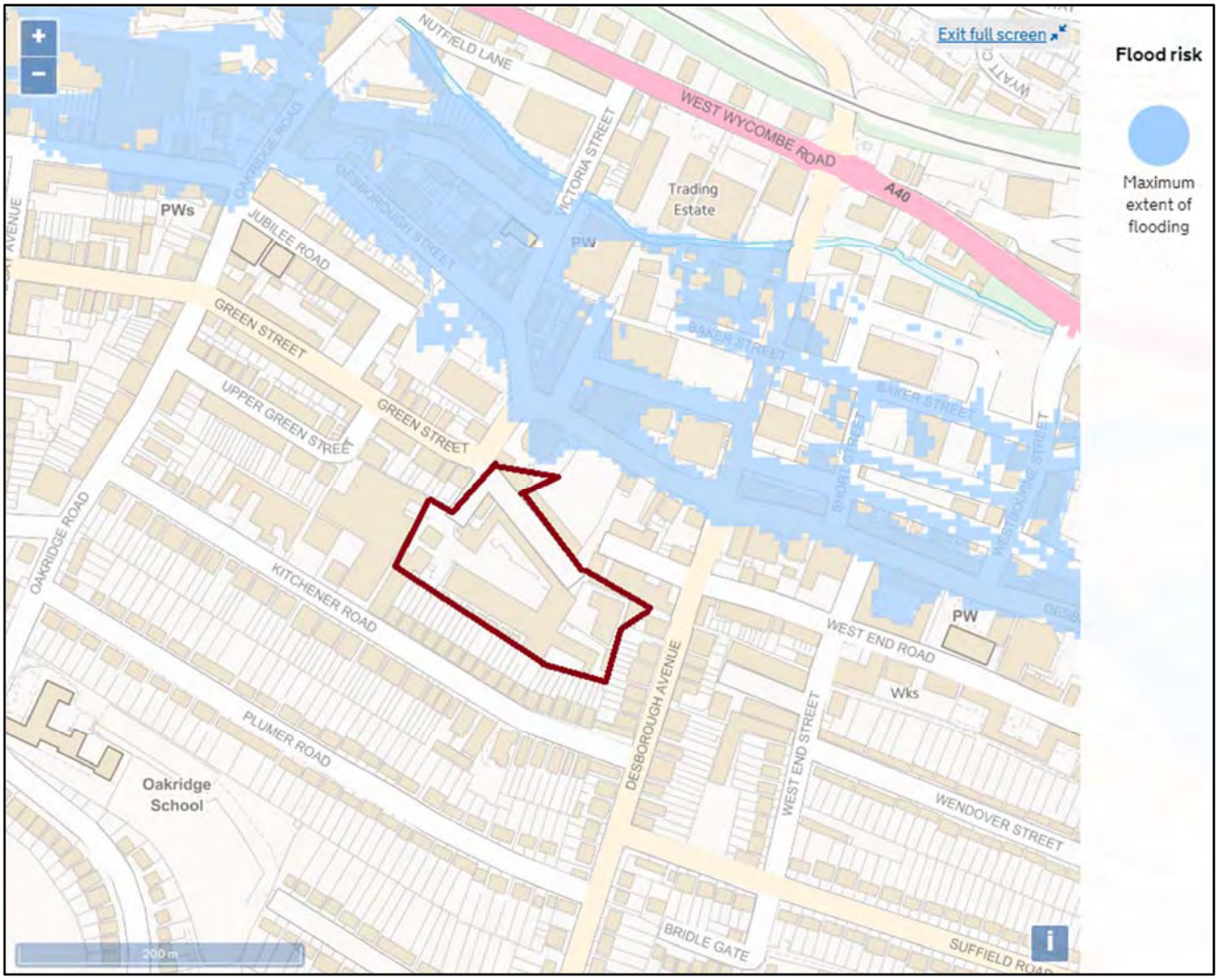
3.9.3.3 Sewers

With reference to Figure 7 of the Level 1 SFRA, the site is in a post code that recorded 1-5 incidents of sewer flooding affecting properties internally and externally in the 20 years preceding 2014.

3.9.3.4 Reservoir Failure

A review of the predicted flood extent as a result of reservoir failure available online indicates that the entire site is outside the risk of flooding from such an event (see Figure 3-66).

Figure 3-66: Site 90 Risk of Flooding from Reservoir Failure



Source: https://flood-warning-information.service.gov.uk/long-term-flood-risk/map?map=SurfaceWater © Crown copyright and database rights 2017 OS 100024198

3.9.4 The Exception Test

The site is located within Flood Zone 1 when considering the 1% (1 in 100) +CC AEP event modelling. The proposed development of 275 residential properties would be classified as 'More Vulnerable'[28] and would therefore be acceptable and it would not need to pass the Exception Test[29]. The level of risk is not going to change when the predicted impact of climate change is considered and therefore the site could be developed safely.

[28] NPPG Table 2 / Paragraph 066
[29] NPPG Table 3 / Paragraph 067

3.9.5 Flood Risk Management

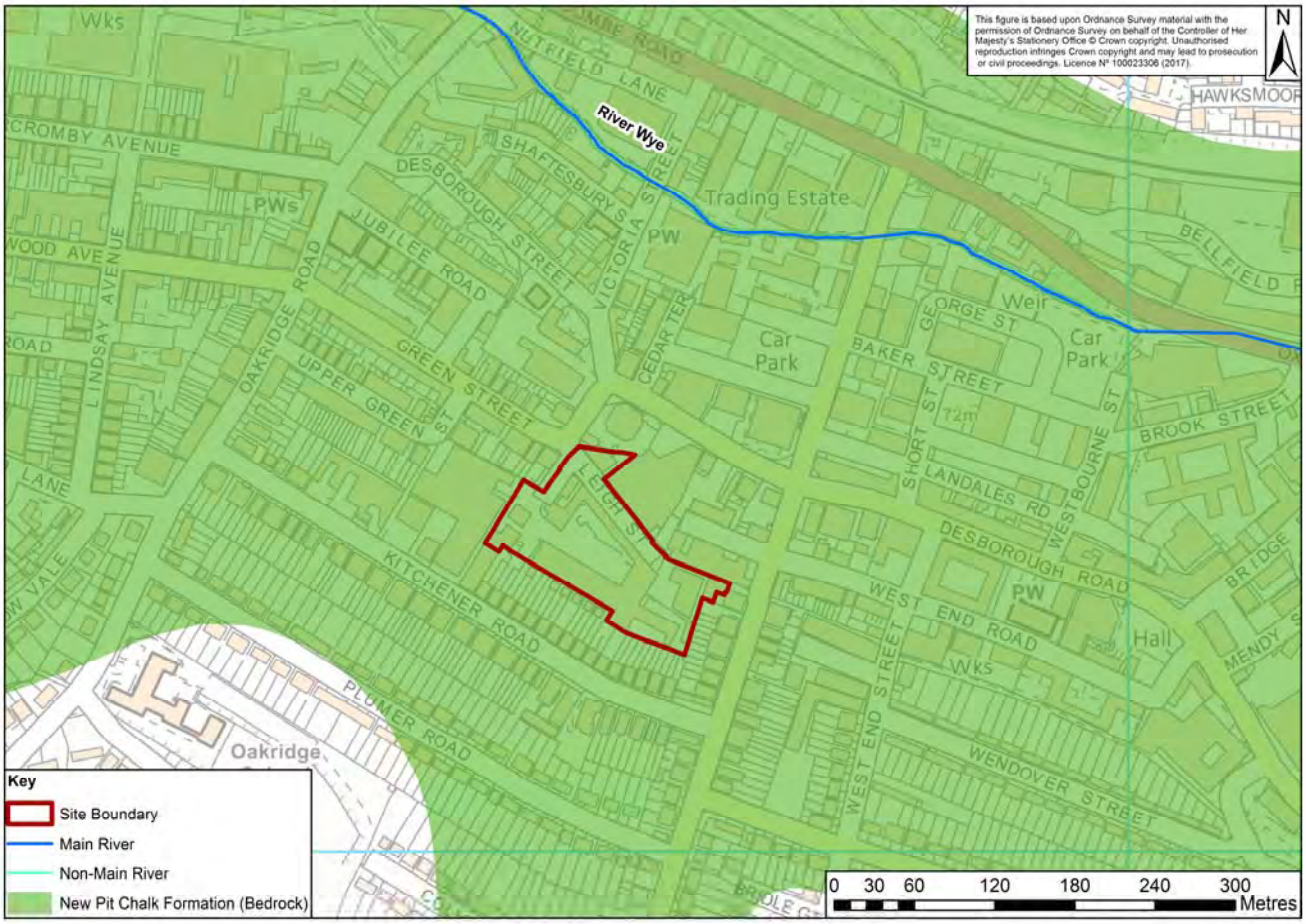
3.9.5.1 Opportunities for Betterment

It is considered given its location and size that there is little opportunity for flood risk betterment through the re-development of this site, unless as part of long-term, catchment-wide, incremental reductions in runoff, potentially as part of a defined policy by BCC as the LLFA.

3.9.5.2 Potential Feasibility of Infiltration Measures

A review of the site geology (see Figure 3-67) suggests it is underlain by Chalk bedrock (New Pit Formation). The thickness of each layer is not included within the information. Surrounding strata have been omitted for clarity if they are not present directly beneath the site. Consequently, infiltration of rainfall directly to ground may be practicable. The proximity of the two watercourses may result in locally high groundwater levels potentially reducing the feasibility of such measures. Infiltration should be the first method considered for the drainage of sites and as such, a site-specific FRA would be required to demonstrate the feasibility of infiltration measures.

Figure 3-67 : Site 90 Geology



3.9.5.3 Site-specific Flood Risk Assessment

A site-specific FRA would be required to accompany the planning application for this site because it is greater than 1ha in size in accordance with NPPF paragraph 103 and is within a WCDA in accordance with NPPF paragraph 103 and WDC policy on Managing flood risk and Sustainable Drainage Systems. The review of flood

risk has identified a number of issues that a site-specific FRA would need to consider in addition to those usually required:

- Utilisation of the best available data to confirm fluvial flood risk to the allocation site;
- The development should avoid encroaching into the WCDA where practicable;
- If the development does encroach into the WCDA:
    - Demonstrate that finished floor levels are above the High and Medium uFMfSW risk peak water level (plus an allowance for climate change);
    - No habitable below-ground rooms are constructed in such areas; and
    - Demonstrate that the flow path can be maintained, or modifications to it as a result of the development would not detrimentally affect third parties.
- Demonstrate that safe access and egress can be achieved in the event of surface water flooding due to the surface water flow routes to the north and east of the site;
- Demonstrate how the elevated risk of groundwater flooding to the site would be addressed, as a minimum avoiding the construction of below-ground habitable rooms; and
- Confirmation of the suitability of infiltration of runoff for drainage based on an assessment of groundwater levels and the local geology.

3.10 Site 93: Slate Meadow, Bourne End Detailed Assessment

3.10.1 Site Description

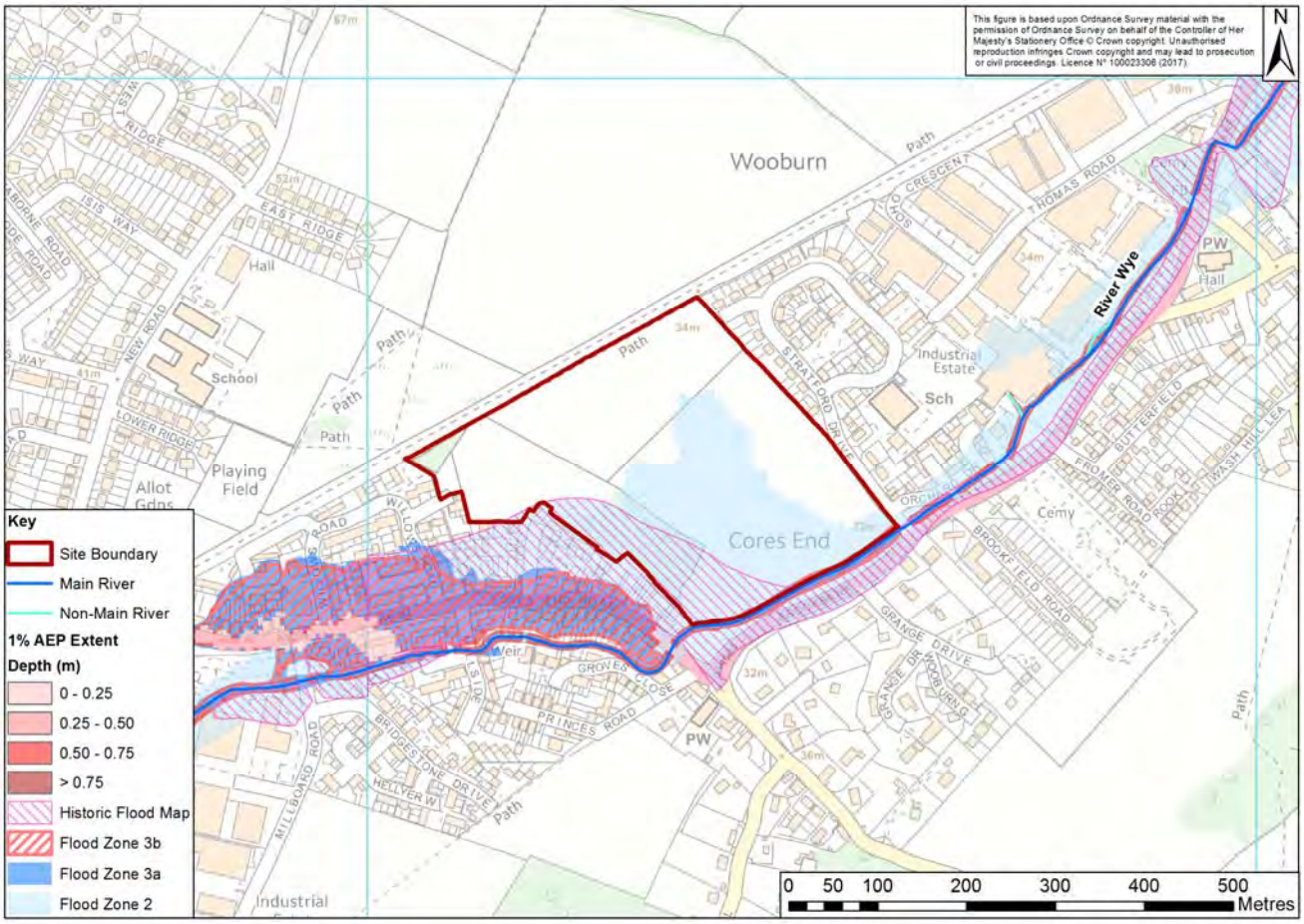
Slate Meadow allocation site (planning ref: BE1 / SBE0033) is located between Wooburn Town and Bourne End to the south-east of High Wycombe and north-west of the A4094. The site is currently farmland and it is used to graze horses. It has an area of approximately 10.3ha. The NGR for the site is SU 9037 8755. The site is currently allocated for the construction of 150 residential properties. The northern part of the site is a designated 'Village Green' and will not be redeveloped. This site has been assessed in detail because it is within 50m of the extent of published Flood Zone 2: see Section 2.1.

It should be noted that all figures within this section have been produced using the planning applicant's hydraulic modelling and not that completed as part of this SFRA. The applicant's modelling has been deemed acceptable by the EA.

3.10.2 Fluvial Flood Risk

The fluvial flood risk to the site is presented in Figure 3-68.

Figure 3-68: Site 93 Fluvial Flood Risk



The River Wye is the southern site boundary. Flood Zone 3b and the published Flood Zone 3 do not encroach into the site boundary from the south-west; the extent of Flood Zone 2 is approximately 4.7ha; see Table 14-1. The historic flood map indicates that the site has flooded in the past. Historical fluvial flood mapping indicates the site was flooded during a fluvial event in 1981.

A Section 19 Flood Investigation Report was completed for the Bourne End area as a result of a flood event that occurred in January-February 2014[30] affecting Cores End. The cause of flooding at Cores End area was the result of rainfall overwhelming of the road drainage network. Emergency works were undertaken during the event to assess the culvert conditions and blockages removed. The report also details several historic fluvial flood events that affected Cores End Road in 2007 and 2008. The full report can be viewed on the BCC website[31].

Table 3-34: Site 93 Current Flood Zone Extents

Flood Zone	1	2	3a	3b	Total
Extent (ha)	5.6	4.7	0	0	10.3
Coverage (%)	54	46	0	0	-

Table 3-35: Site 93 Modelled 1% (1 in 100) AEP Event Extent

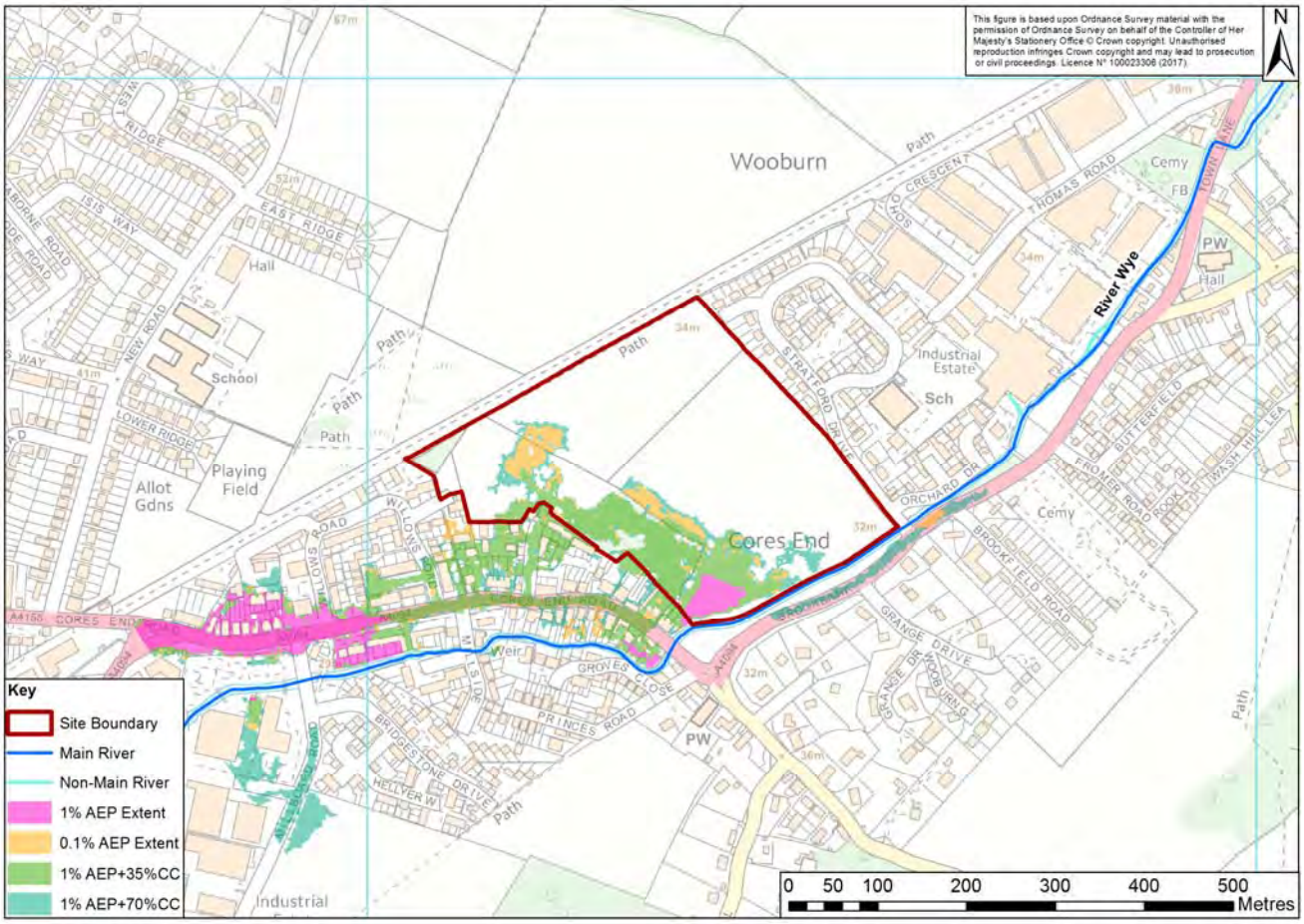
AEP Event	Extent (ha)	%
1% (1 in 100)	0.52	5

The applicant has developed their own hydraulic model of the watercourse which it is understood has been reviewed and accepted by the EA. The hydraulic modelling includes runs to assess the predicted impact of climate change: see Figure 3-69.

[30] Bourne End Flood Investigation Report (BCC, December 2015). Available from: http://www.buckscc.gov.uk/services/environment/flooding/strategic-flood-management/flood-investigations/

[31] Buckinghamshire County Council Flood Investigations. Available from: http://www.buckscc.gov.uk/services/environment/flooding/strategic-flood-management/flood-investigations/

Figure 3-69 : Site 93 Fluvial Flooding with Climate Change



The site is predicted to flood in the southern-most corner of the site from the 1% (1 in 100) + 35% AEP event. The southern section of the site (approximately 25% of whole site area) is predicted to flood from the 1% (1 in 100) + 70% AEP event. This has implications when considering the vulnerability of future users and the design-life of future development.

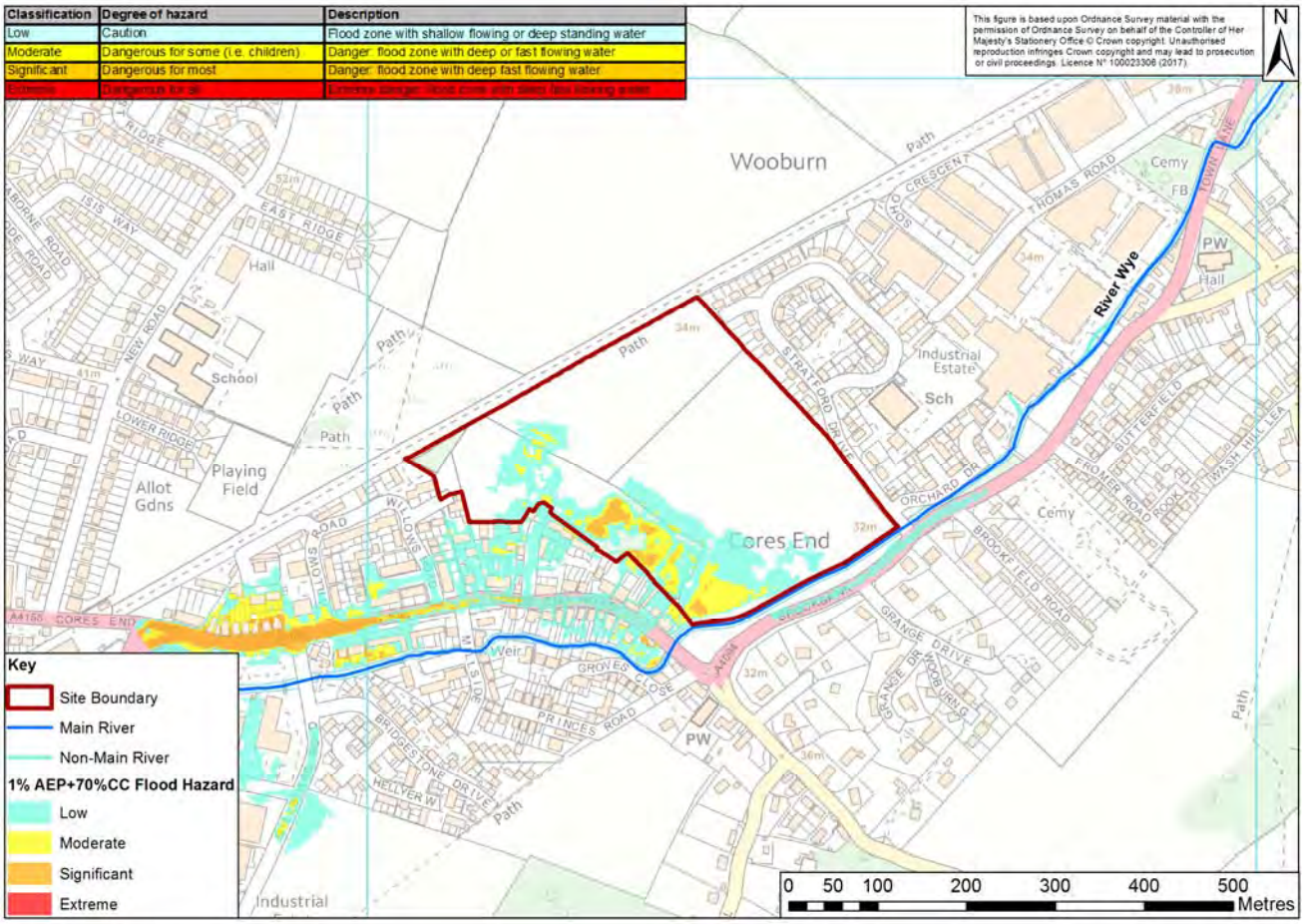
Table 3-36: Site 93 Fluvial Flooding with Climate Change Extents

Climate Change Uplift (%)	35	70	Total
Extent (ha)	1.55	2.06	10.3
Coverage (%)	15	20	-

Table 3-36 indicates approximately 20% of the site is at risk of flooding from the 1% (1 in 100) + 70% climate change extent.

Figure 3-70 indicates that the south-western corner of the site is designated as having a Low flood hazard with localised areas designated as having Moderate or Significant. The application should take this into account and ensure safe access and egress from the site is available after development while also taking this into account for the risk of surface water flood risk (see Section 3.10.3.1).

Figure 3-70 : Site 93 Flood Hazard



3.10.2.1 Flood Defence Failure

There are no raised defences in the vicinity of the site. However, the River Wye does pass through a culvert at Cores End Road immediately downstream / west of the site boundary. Should this culvert block it could increase flood risk to the site, particularly the lower areas in the south-west corner nearest the culvert. This potential risk of blockage and residual flood risk would have to be addressed by a site-specific FRA. A review of the EA AIMS and BCC asset databases has not indicated the dimensions of these structures or whether they have debris screens.

3.10.3 Risk of Flooding from Other Sources

3.10.3.1 Surface Water

Surface water flood risk based on the uFMfSW is presented in Figure 3-71.

Figure 3-71: Site 93 Surface Water Flood Risk

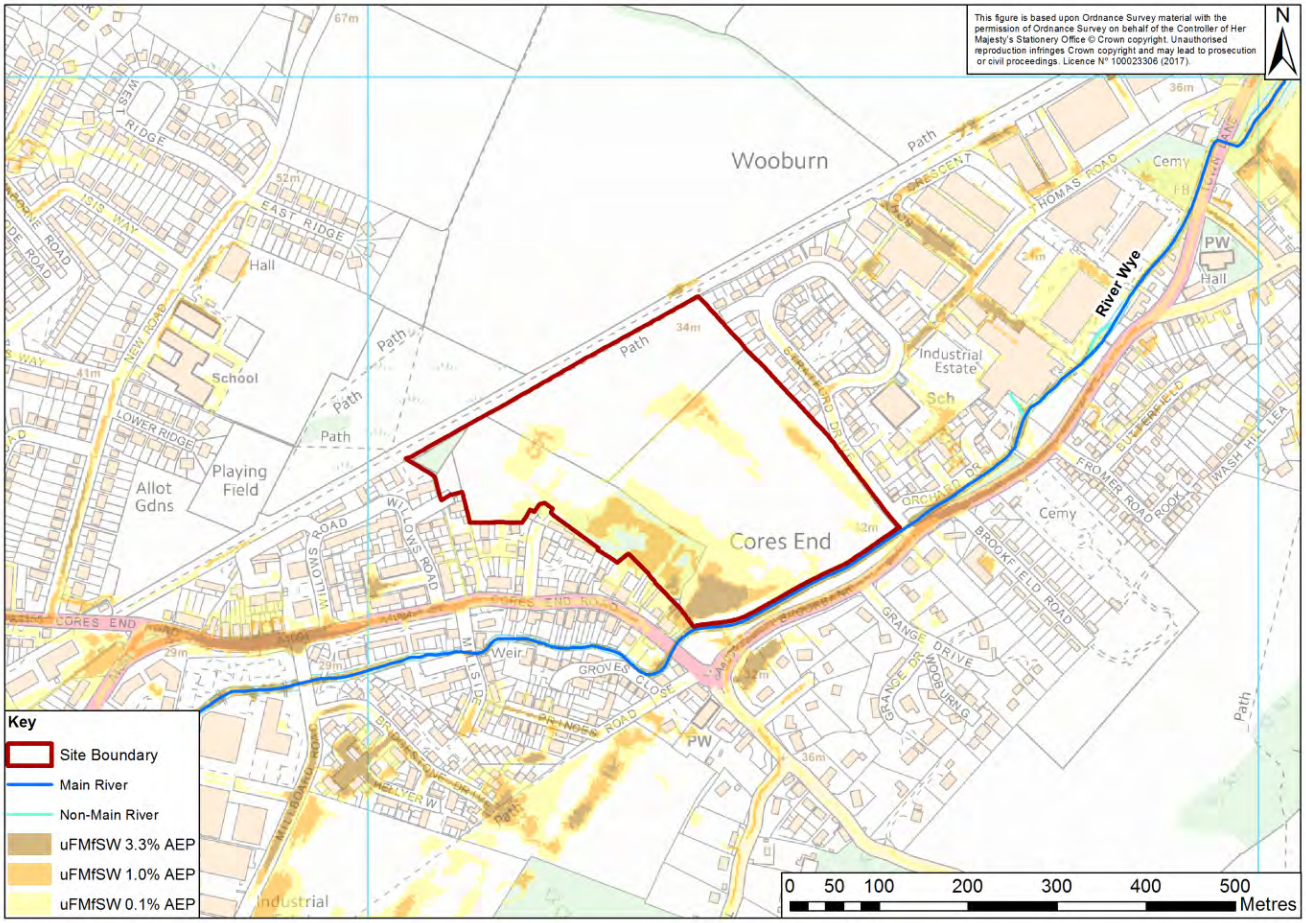


Table 3-37: Site 93 uFMfSW Extents

Event (AEP)	3.33% (1 in 30)	1% (1 in 100)	0.1% (1 in 1000)
Extent (ha)	0.52	1.03	2.06
Coverage (%)	5	10	20

Primarily the southern corner of the site appears to be at greatest risk of surface water flooding based on the uFMfSW as it is lower than the rest of the site. There are pockets of flooding predicted across the site which may be the result of rainfall filling depressions in the hydraulic model used to develop the extents, which would need to be considered when developing the site. There is a surface water flow path along Brookbank (A4094) to the south of the site which would need to be addressed in a site-specific FRA when considering safe access to and from the site.

Climate change has the potential to increase the risk of surface water flooding to the site. Although beyond the scope of this SFRA to quantify the predicted impact, the risk of flooding to those areas currently assessed as 'Low' surface water risk could increase as a result of climate change and consequently they could become re-

classified as WCDA. Such a risk would need to be quantified by the applicant in order to demonstrate that the site could be developed safely for future users, taking into account the planning implications of such a result.

3.10.3.2 Groundwater

For the two sources of mapping below, the AStGWF depicts the likelihood of groundwater emergence; the JBA mapping shows depth to groundwater level beneath ground.

A review of EA AStGWF mapping indicates that the entirety of the site is at moderate risk of flooding (within a grid square where between 50% and 75% of the area is at risk of groundwater emergence). The majority of the site is located within a groundwater emergence zone.

Figure 3-72: Site 93 Groundwater Flood Risk

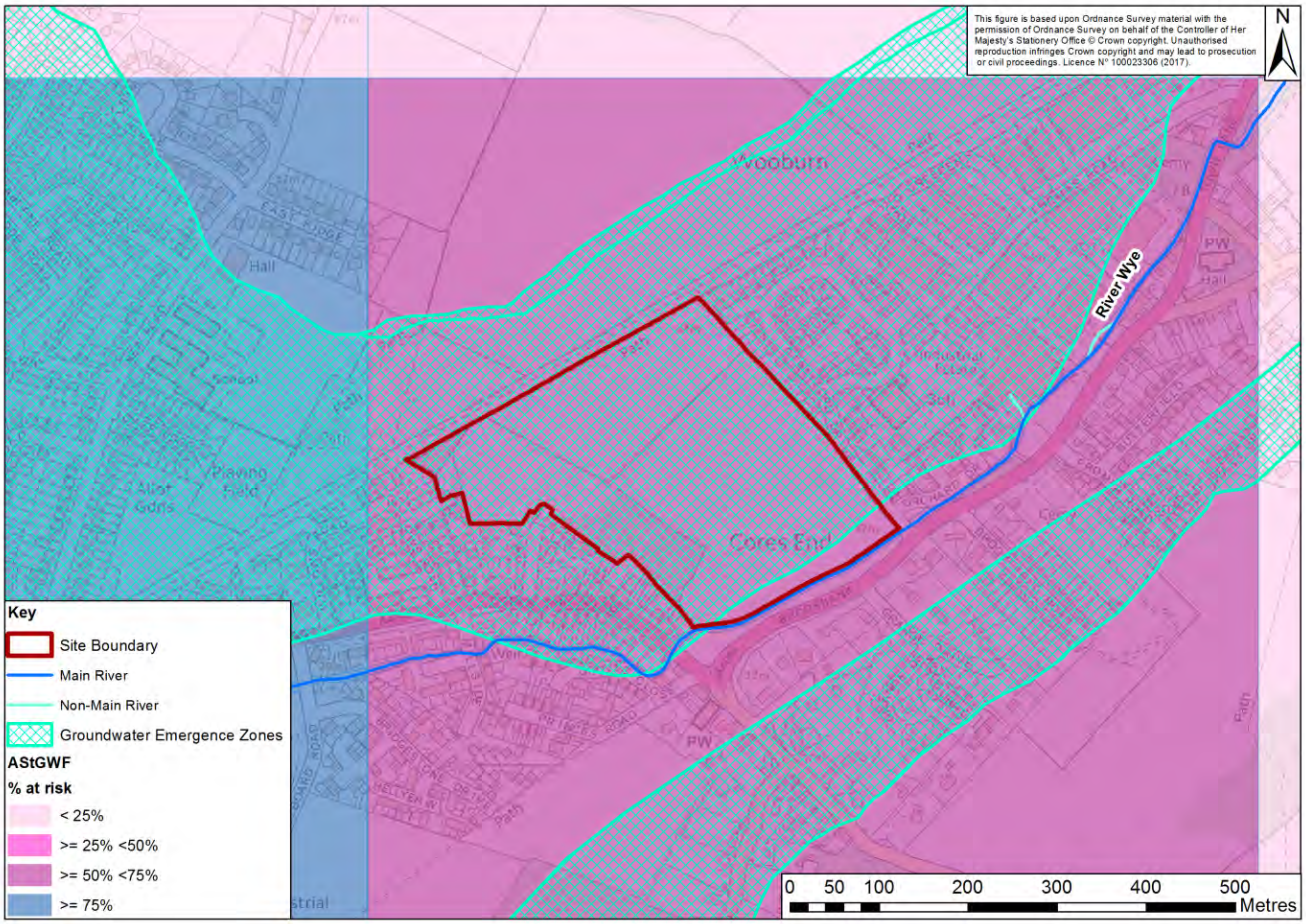
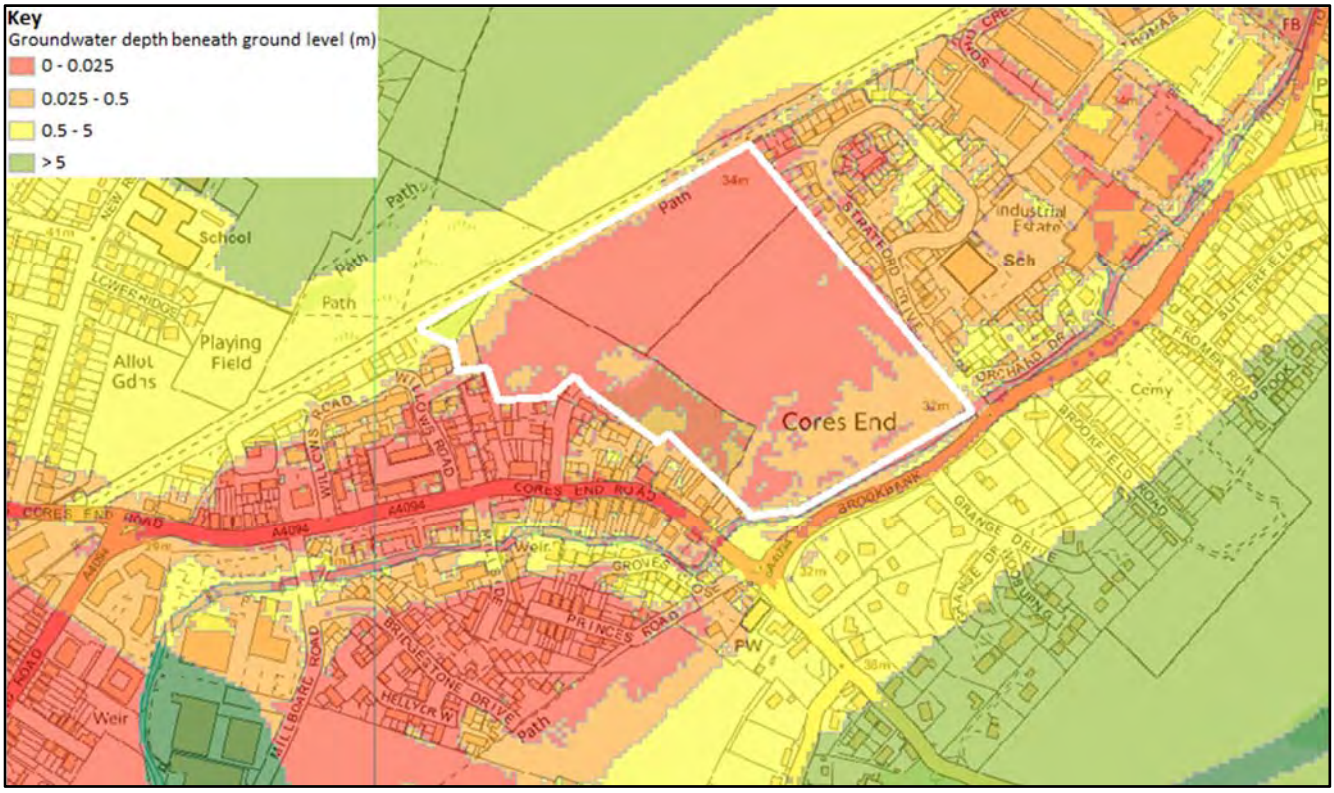


Figure 3-73 depicts groundwater mapping completed by JBA, showing areas of the site at high (within 0.025m of the ground surface), medium (groundwater levels between 0.025m and 0.5m below the ground surface) and low of groundwater flooding at this site.

Figure 3-73 : Site 93 JBA Groundwater Mapping



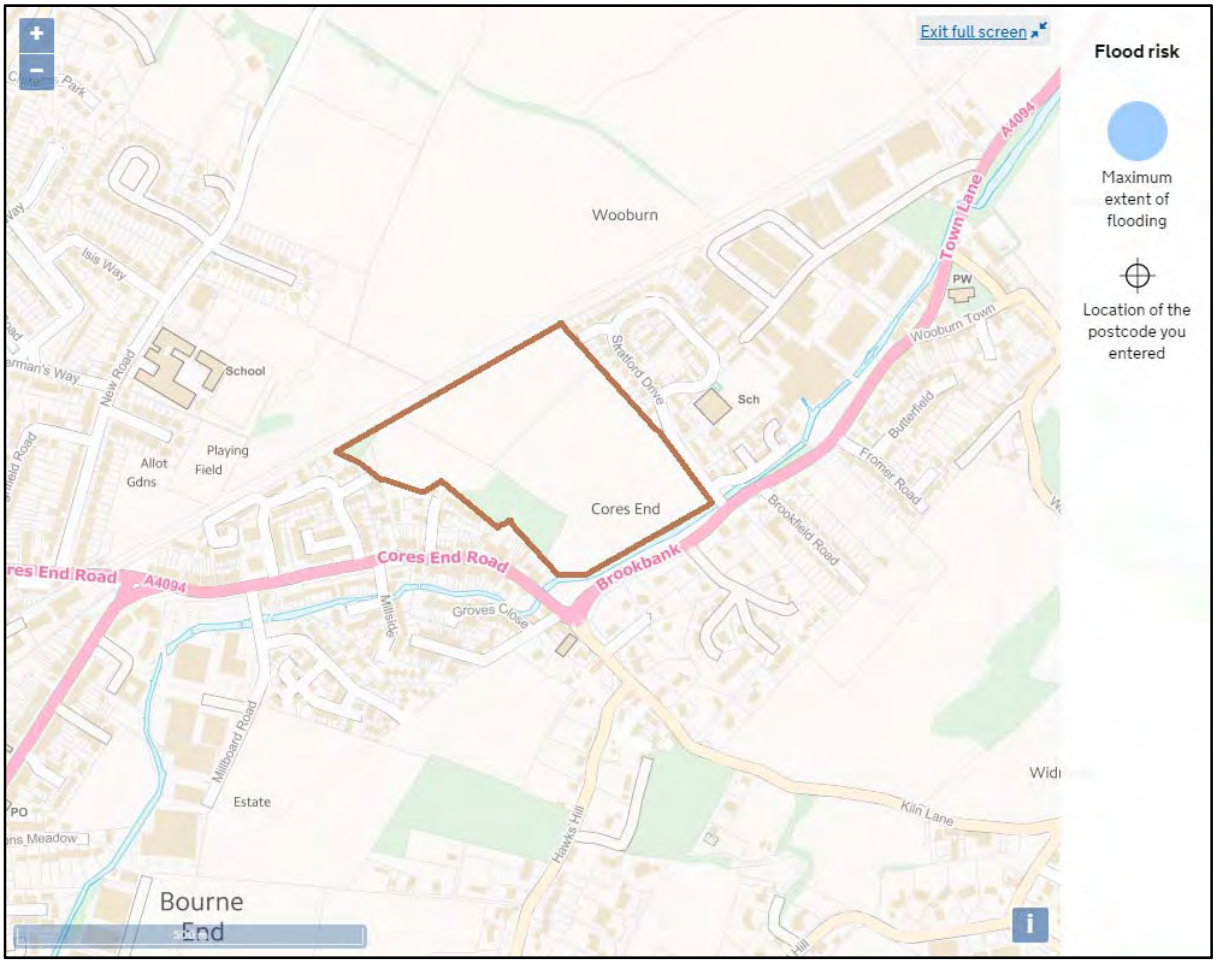
3.10.3.3 Sewers

The Slate Meadow allocation site is predominantly located within post code area HP10, with the north westerly corner lying within SL8, as identified in Figure 7 of the Level 1 SFRA. The Figure indicates between one and five properties have been reported to flood (internally and externally) across HP10 and internally within SL8; between 16 and 20 instances of external flooding have been reported within SL8 in the 20 years preceding 2014.

3.10.3.4 Reservoir Failure

A review of the predicted flood extent as a result of reservoir failure available online indicates that the site is not at risk of flooding from such an event (see Figure 3-74).

Figure 3-74: Site 93 Risk of Flooding from Reservoir Failure



Source: https://flood-warning-information.service.gov.uk/long-term-flood-risk/map?map=SurfaceWater © Crown copyright and database rights 2017 OS 100024198

3.10.4 The Exception Test

The site is mainly located within Flood Zones 1, 2 and with approximately 5% within the 1 in 100 AEP event. The proposed development of 150 residential properties would be classified as 'More Vulnerable'[32]. A sequential approach to the site layout should be followed to place 'More Vulnerable' development within the lowest areas of flood risk on the site.

Hydraulic modelling of the predicted impact of climate change on fluvial flooding indicates the site could be at extensive risk from the 1% (1 in 100) +70% event (approximately 20% of the site). Environment Agency guidance on climate change allowances[33] states the applicant should consider the consequences of both the higher central (35%) and upper end (70%) climate change allowances (based on a design life of 100-years) on the development and should avoid encroachment into the flood extent where possible. Generally, flood depths are less than 150 mm for such an event so it should be possible to avoid flooding of properties at such a depth. There are areas (approximately 0.6ha / 6%) of greater depth of up to 600mm which it should be possible to avoid.

[32] NPPG Table 2 / Paragraph 066
[33] Environment Agency guidance on climate change allowances. Available from: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

Assuming the development can progress without encroaching into the +35% and ideally the +70% extent then the development can pass the second part of the Exception Test.

3.10.5 Flood Risk Management

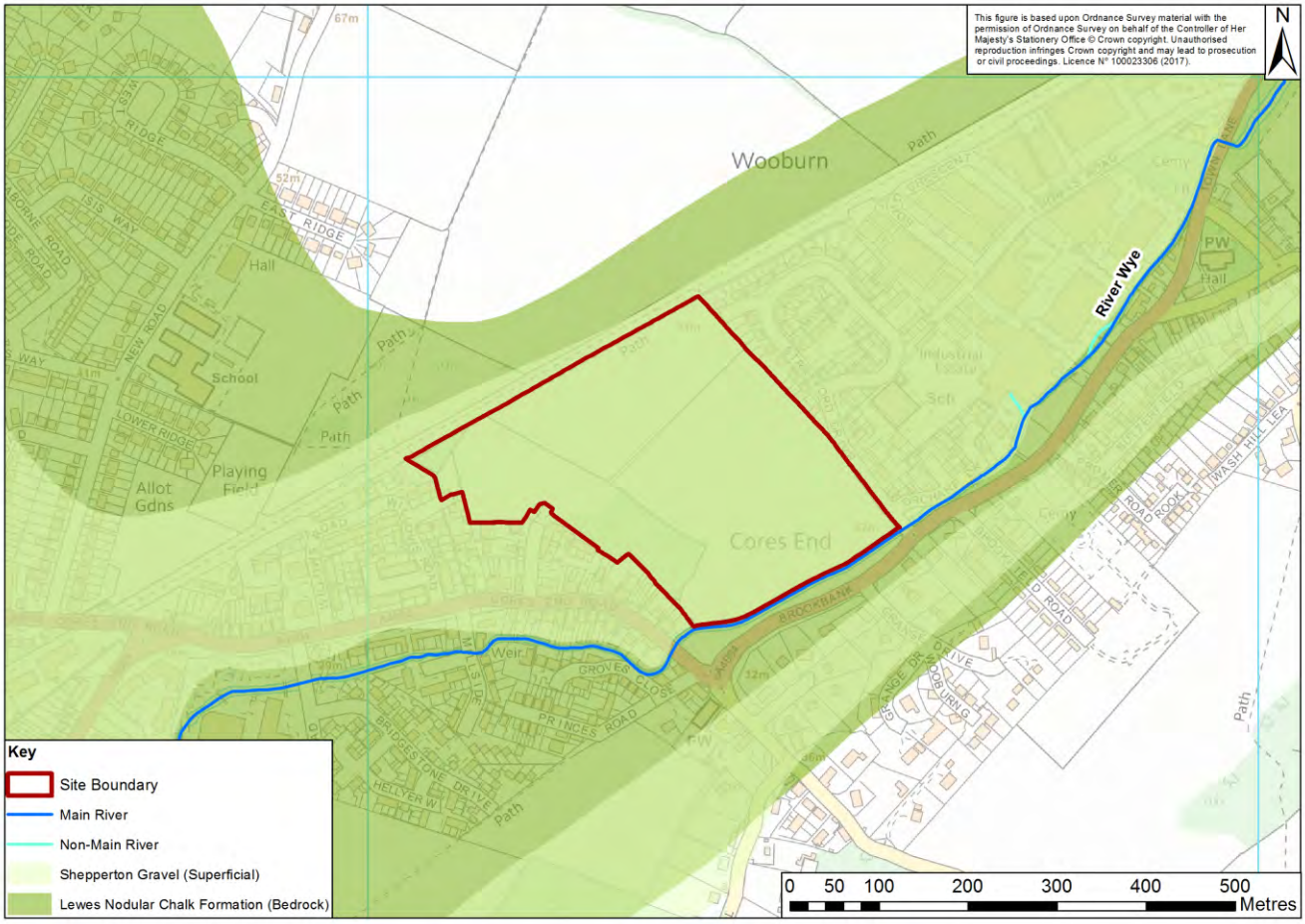
3.10.5.1 Opportunities for Betterment

Given that the site abuts the River Wye to the south and that there is a significant number of properties within Flood Zone 3b immediately downstream, this location could be an opportunity to attenuate flows to alleviate flood risk downstream. Given that this could reduce the development potential of the site it would need to be discussed and agreed by the applicant, WDC and the EA.

3.10.5.2 Potential Feasibility of Infiltration Measures

A review of the site geology (see Figure 3-75) suggests it is underlain by a layer of Shepperton Gravel (superficial deposit) and Chalk bedrock (Lewes Nodular Formation). The thickness of each layer is not included within the information. Surrounding strata have been omitted for clarity if they are not present directly beneath the site. Consequently, infiltration of rainfall directly to ground may be practicable. The proximity of the two watercourses may result in locally high groundwater levels potentially reducing the feasibility of such measures. Infiltration should be the first method considered for the drainage of sites and as such, a site-specific FRA would be required to demonstrate the feasibility of infiltration measures.

Figure 3-75 : Site 93 Geology



3.10.5.3 Site-specific Flood Risk Assessment

A site-specific FRA would be required to accompany the planning application for this site because it is greater than 1ha in size in accordance with NPPF paragraph 103 and is within a WCDA in accordance with NPPF paragraph 103 and WDC policy on Managing flood risk and Sustainable Drainage Systems. The review of flood risk has identified a number of issues that a site-specific FRA would need to consider in addition to those usually required:

Consider whether the site could be developed to avoid encroachment into Flood Zone 3 (including the appropriate allowance for climate change). Consider how this impact of climate change would influence the appropriateness of the development when considering its design life. The residential development is classified as 'More Vulnerable' therefore the applicant would need to consider the impact of the 'higher central' and 'upper end' climate change allowances based on an assumed design life of 100 years;

- How can the site be developed in such a manner to avoid encroachment into the WCDA where practicable;
- If the development does encroach into the WCDA:
    - Demonstrate that finished floor levels are above the High and Medium uFMfSW risk peak water levels (plus an allowance for climate change);
    - No habitable below-ground rooms are constructed in such areas; and
    - Demonstrate that the surface water flow path can be maintained, or modifications to it as a result of the development would not detrimentally affect third parties.
- Demonstrate how the site would be accessed safely given the surface water flow path along Brookbank to the south and the extent of the fluvial flood zones;
- The suitability of infiltration measures for drainage of the site given the gravel geology and the proximity of the River Wye;
- The likelihood of flooding as a result of a blockage of the culvert immediately downstream at Cores End Road on the River Wye. Preventative measures to reduce exacerbation of risk of blockage should be included as part of the development;
- Not develop within ten metres of the River Wye to provide a buffer zone for maintenance activities and to prevent encroachment to the watercourse in accordance with Wycombe District Council's relevant policy on flood risk;
- Consider the provision of attenuation on site to flows on the River Wye to reduce flood risk to properties downstream; and
- Take into consideration the recommendations from the Section 19 Flood Investigation Report 'Bourne End'.

3.11 Site 110: Princes Risborough Expansion Area Detailed Assessment

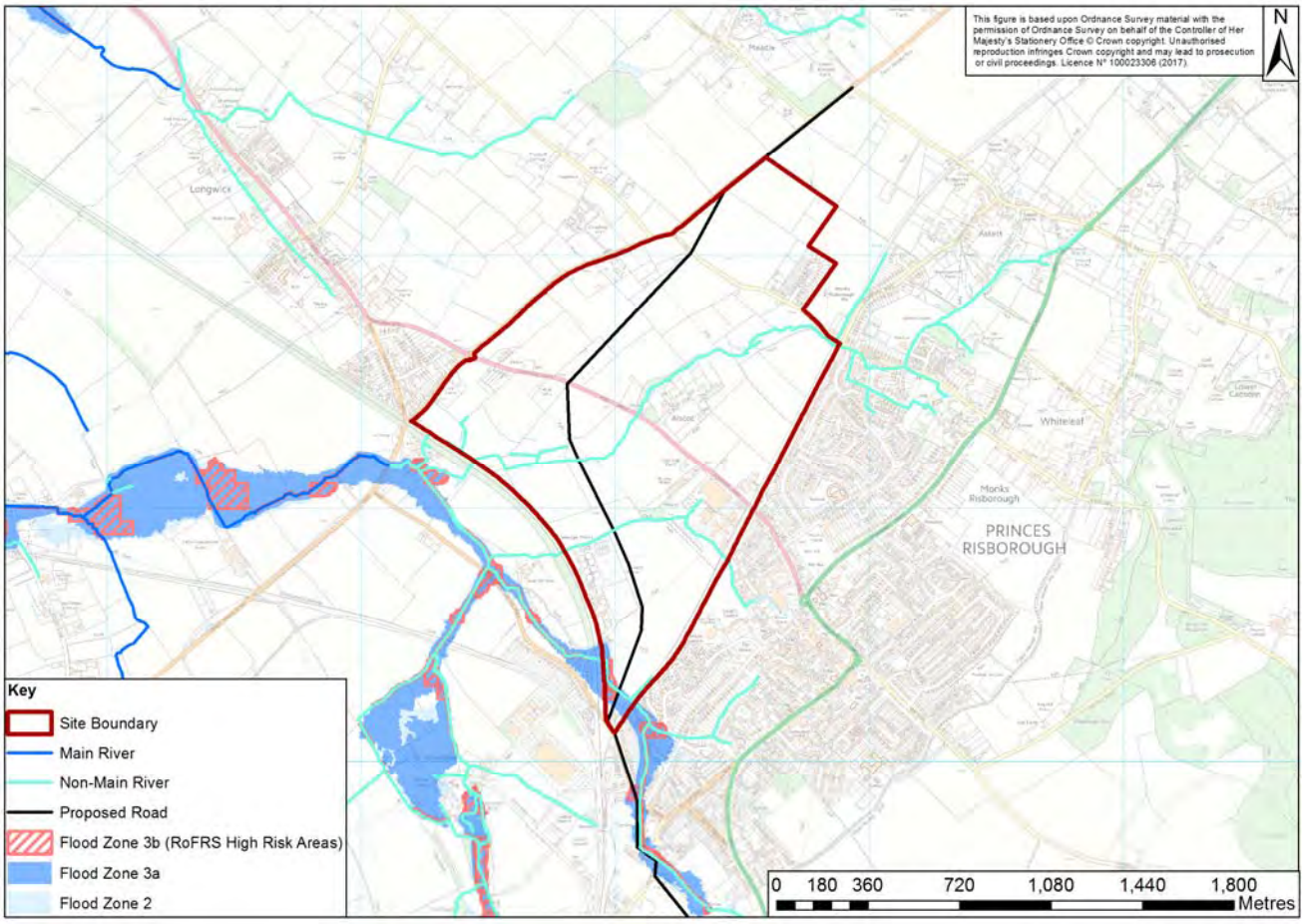
3.11.1 Site Description

Princes Risborough Expansion Area allocation site (planning ref: PR3) is located to the north-west of Princes Risborough, to the north of the railway line and south of Lower Icknield Way. The NGR for the site is SP 8012 0427. The site is currently predominantly farmland and is an area of approximately 177.2ha. The site is currently proposed for the construction of 2,500 residential properties, community buildings, outdoor sports, allotments, parks and a new highway. This site has been assessed in detail because it is within 50m of the extent of published Flood Zone 2: see Section 2.1.

3.11.2 Fluvial Flood Risk

The fluvial flood risk to the site is presented in Figure 3-76.

Figure 3-76: Site 110 Fluvial Flood Risk



The site is bounded by two railway lines to the west and east and Lower Icknield Way to the north. The majority of the site is within Flood Zone 1 with approximately 1%, in the south of the site, designated as Flood Zone 2, Flood Zone 3a and 3b; see Figure 3-76. The historic flood map does not identify any fluvial flood events that have affected this site. The site is not situated within the River Wye or Thames fluvial hydraulic model extents; therefore, the applicant would need to consider the likely impact of climate change factors and how the site would be affected. The applicant should also consider unmapped risk resulting from the ordinary watercourses running through the site. EA historic flooding records suggest one report of internal flooding from fluvial sources has also been recorded on Lower Icknield Way, immediately south-west of the site boundary.

Given that this site is a major urban expansion with the potential to *"significantly change existing settlement patterns"* [5], the applicant would need to consider the impact of H++ allowances for peak river flow.

Table 3-38: Site 110 Current Flood Zone Extents

Flood Zone	1	2	3a	3b	Total
Extent (ha)	173.66	0.89	1.77	0.89	177.1
Coverage (%)	98	0.5	1	0.5	-

In the absence of hydraulic modelling covering this site, the applicant would need to liaise with the EA to confirm the need to undertake detailed hydraulic modelling to confirm the degree of fluvial flood risk from EA designated Main Rivers and ordinary watercourses and the predicted impact of climate change, flood depth and hazard for this allocation site.

An initial assessment was conducted to review the potential impact of climate change on fluvial flood risk using LiDAR data. The site is between 2m and 4m higher than peak water level associated with Flood Zone 2 on the two ordinary watercourses. A conservative estimate suggests that if water levels were to rise by 1m then the area of Flood Zone 2 within the site (in the southern corner) would increase by approximately 50%. Therefore, based on this initial assessment climate change is not anticipated to have a significant impact upon the viability of the proposed development.

3.11.2.1 Flood Defence Failure

There are no raised defences in the vicinity of the site. The nearby watercourses are in open channel at this point so it is considered that there is a low risk of flooding as a result of culvert blockage to this site.

3.11.3 Risk of Flooding from Other Sources

3.11.3.1 Surface Water

Surface water flood risk based on the uFMfSW is presented in Figure 3-77.

Figure 3-77: Site 110 Surface Water Flood Risk

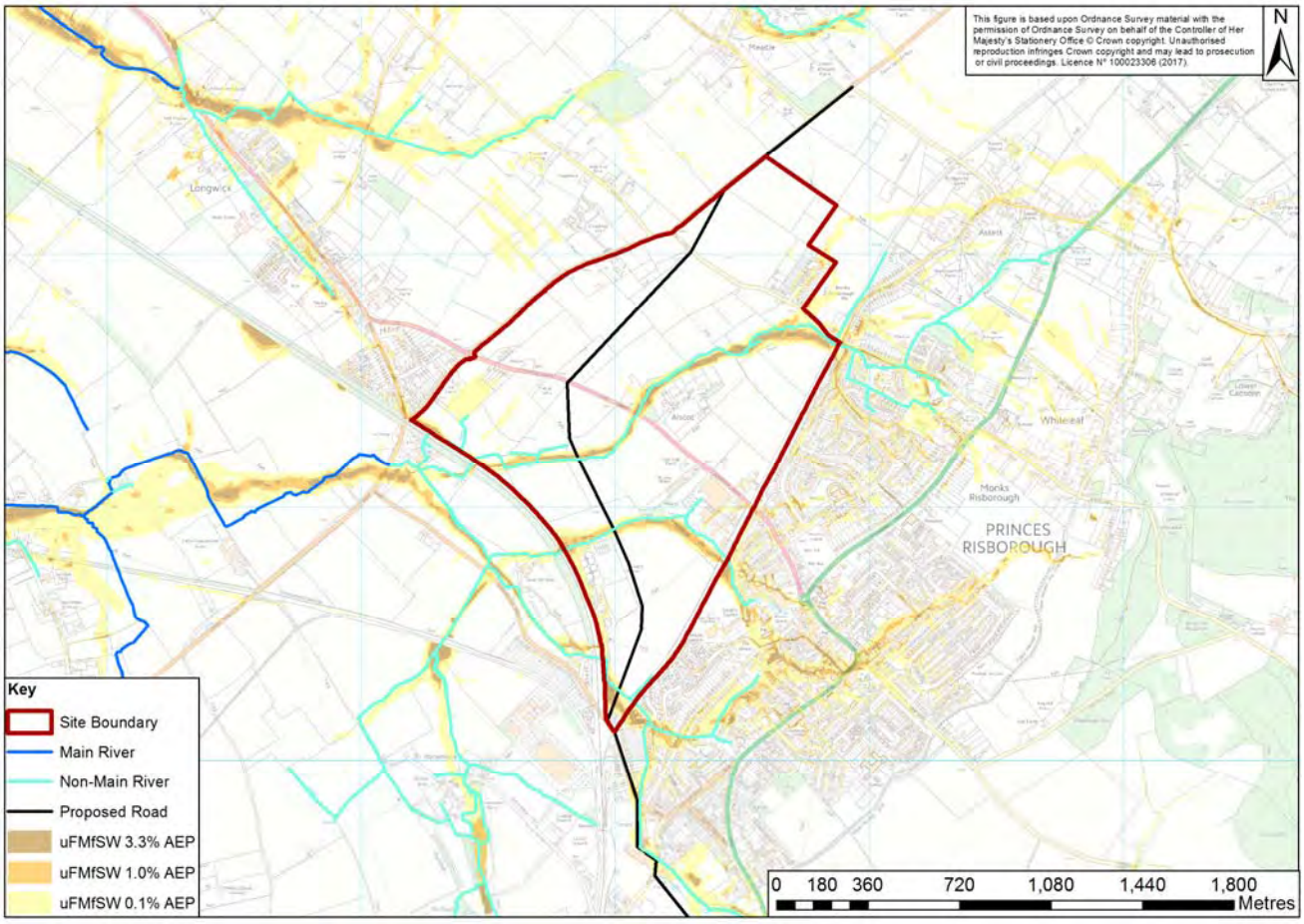


Table 3-39: Site 110 uFMfSW Extents

Event (AEP)	3.33% (1 in 30)	1% (1 in 100)	0.1% (1 in 1000)
Extent (ha)	1.77	5.32	8.86
Coverage (%)	1	3	5

There are two ordinary watercourses that flow through the site broadly from west to east. Both have areas of surface water flood risk attributed to them and have the potential to interact with the development and affect access to and from the site. Approximately 10% of the site is at risk of surface water flooding from a 0.1% (1 in 1,000) AEP event (see Table 3-39). There are pockets of flooding predicted in the site which may partially be the result of rainfall filling depressions in the ground model used to develop the extents. EA historic flooding records indicate there have been two instances of internal surface water flooding to properties on Mill Lane, in the north of the site.

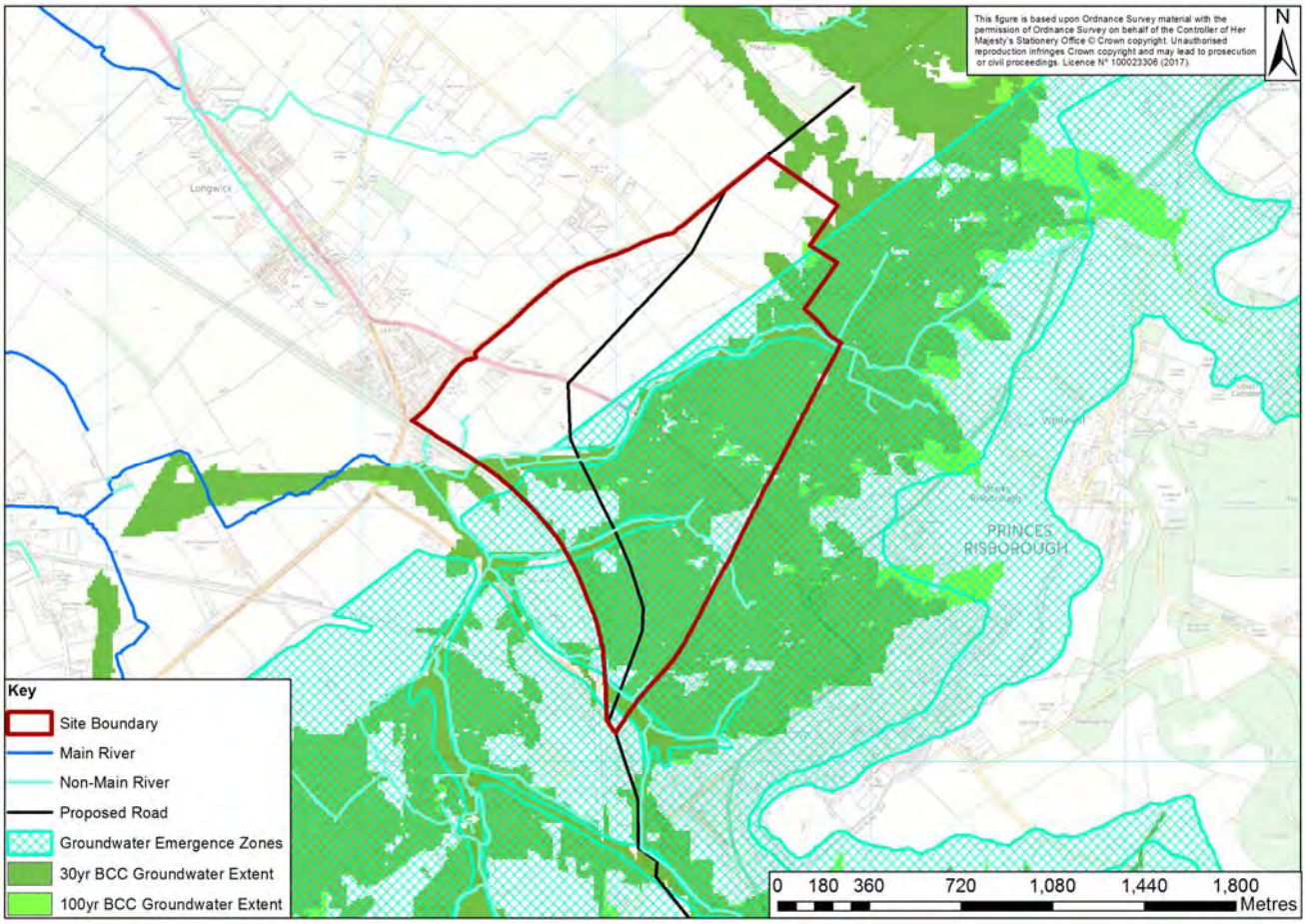
Climate change has the potential to increase the risk of surface water flooding to the site. Although beyond the scope of this SFRA to quantify the predicted impact, the risk of flooding to those areas currently assessed as

'Low' surface water risk could increase as a result of climate change and consequently they could become re-classified as WCDA. Such a risk would need to be quantified by the applicant in order to demonstrate that the site could be developed safely for future users, taking into account the planning implications of such a result.

3.11.3.2 Groundwater

A review of EA AStGWF mapping indicates that the majority of the site is at very low risk of flooding (within a grid square where less than 25% is at risk of groundwater emergence). The southern section of the site is at moderate risk of flooding (within a grid square where between 50% and 75% is at risk of groundwater emergence). BCC groundwater modelling indicates the site is at risk of flooding to the eastern sections of the site from both the 3.33% (1 in 30) and 1% (1 in 100) AEP modelled groundwater events. The majority of the site is located within groundwater emergence zones.

Figure 3-78: Site 110 Groundwater Flood Risk



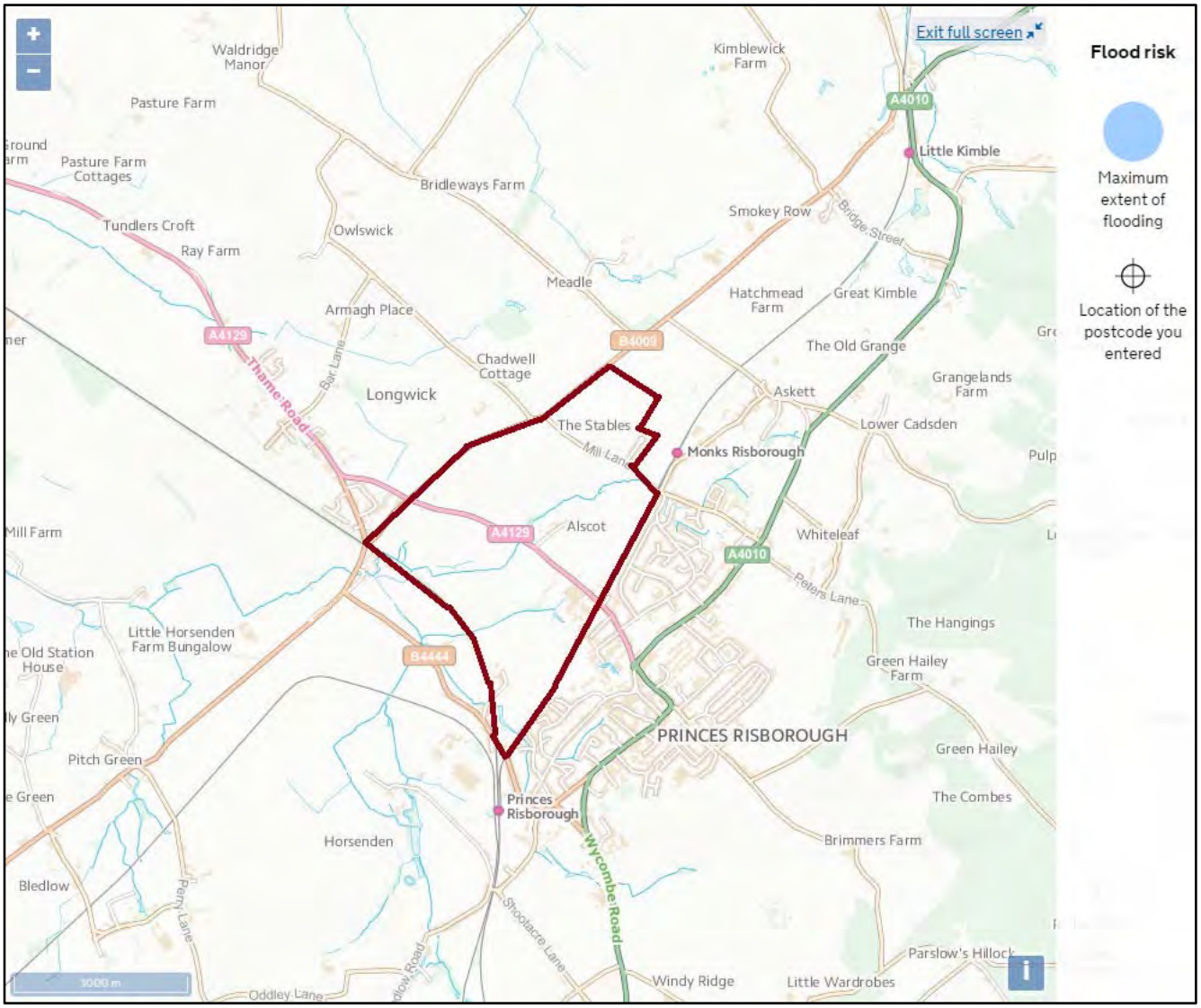
3.11.3.3 Sewers

With reference to Figure 7 of the Level 1 SFRA, the site is in a post code that recorded 1-5 incidents of sewer flooding affecting properties internally and 16-20 externally in the 20 years preceding 2014.

3.11.3.4 Reservoir Failure

A review of the predicted flood extent as a result of reservoir failure available online indicates that the site is not at risk of flooding from such an event. See Figure 3-79.

Figure 3-79: Site 110 Risk of Flooding from Reservoir Failure



Source: https://flood-warning-information.service.gov.uk/long-term-flood-risk/map?map=SurfaceWater © Crown copyright and database rights 2017 OS 100024198

3.11.4 The Exception Test

The site is located within Flood Zones 1, 2, 3a and 3b. The proposed development of 2,500 residential properties would be classified as 'More Vulnerable'[34] and would therefore be acceptable and would not need to pass the Exception Test[35] (provided development was located outside Flood Zone 3a, which given its small proportion of the total site area would appear achievable). The degree of fluvial risk is not predicted to change when the impact of climate change is considered and therefore the site could be developed safely.

The proposed highway is indicatively located to cross a watercourse within areas designated as Flood Zone 3a and 3b as depicted by Figure 3-76. The final alignment of the proposed highway would affect the planning requirements to be met[36]. If the highway is developed within Flood Zone 3a, it should be designed and constructed to remain operational and safe in times of flood in order to pass the Exception Test. If located within

[34] NPPG Table 2 / Paragraph 066
[35] NPPG Table 3 / Paragraph 067
[36] NPPG Table 3 / Paragraph 067

Flood Zone 3b, additional regulations must be followed to pass the Exception Test; the road should be designed and constructed to:

- Remain operational and safe for users in times of flood;
- Result in no net loss of floodplain storage; and
- Not impede water flows and not increase flood risk elsewhere.

Given ground levels on the site it is expected that the new highway crossing of the watercourse could be constructed to include a free span of the extent of Flood Zone 3 (plus an allowance for climate change) to ensure it does not impede flows in the watercourse. The soffit of the bridge would need to be constructed to provide sufficient freeboard above the design water level: the 1% (1 in 100) AEP peak water level. Following Highway's England Design Manual for Roads and Bridges (DMRB) this would be a minimum of 600 mm.

Therefore, the site would pass the second part of the exception's test.

3.11.5 Flood Risk Management

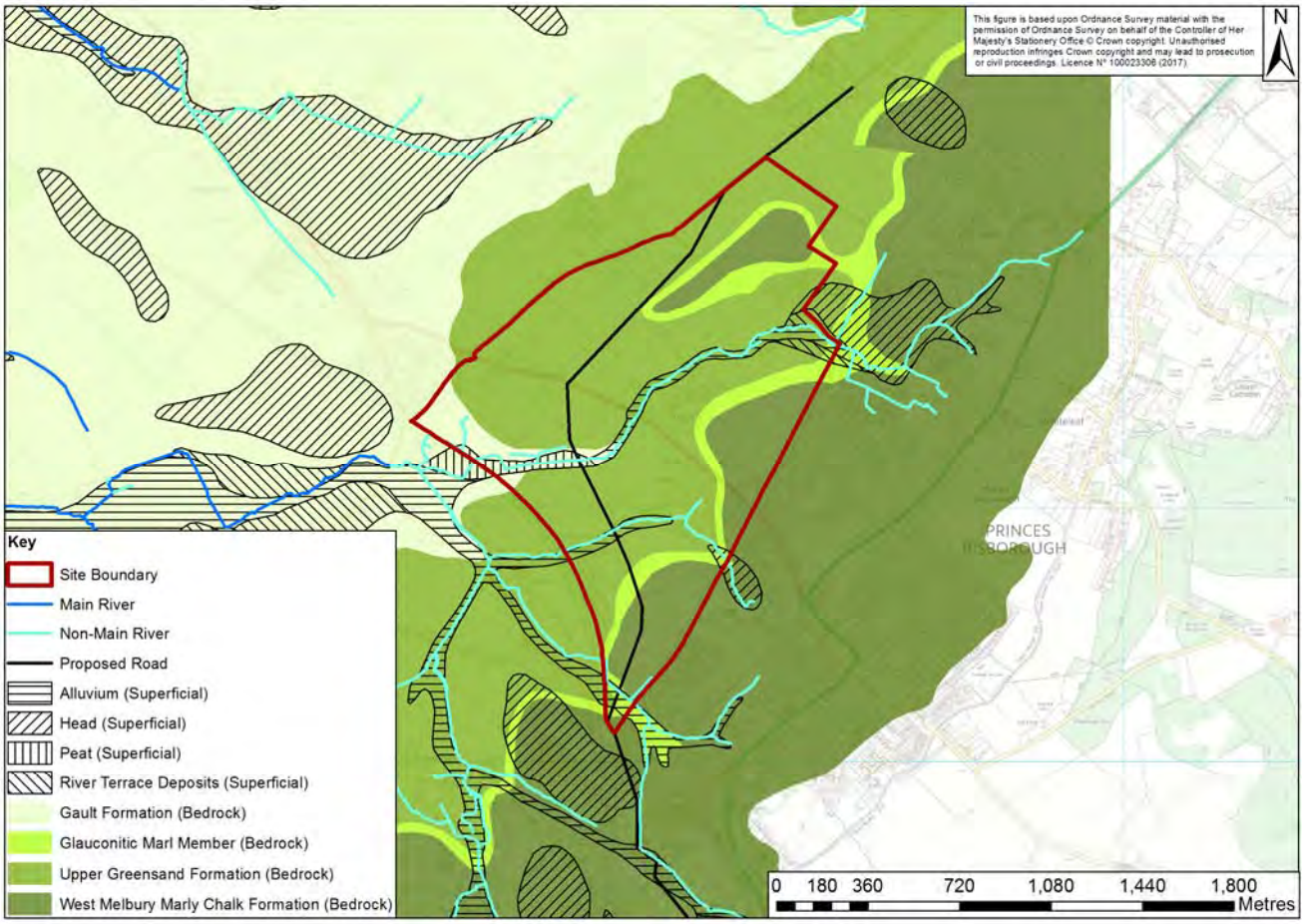
3.11.5.1 Opportunities for Betterment

There is potential to intercept and attenuate fluvial flows in the south-eastern corner of the site. Consideration of how surface water attenuation measures could be installed should also be undertaken to identify opportunities for providing betterment to surface water flood risk across the site. Details of flood risk betterment should be incorporated into a site-specific FRA.

3.11.5.2 Potential Feasibility of Infiltration Measures

A review of the site geology (see Figure 3-80) suggests it is underlain by a layer of Alluvium, Head, Peat and River Terrace Deposits (superficial deposits) and various bedrock (New Pit Chalk, Gault, Upper Greensand, West Melbury Marly Chalk and Glauconitic Formations). The thickness of each layer is not included within the information. Surrounding strata have been omitted for clarity if they are not present directly beneath the site. Consequently, infiltration of rainfall directly to ground may be practicable. The proximity of the watercourses may result in locally high groundwater levels potentially reducing the feasibility of such measures. Infiltration should be the first method considered for the drainage of sites and as such, a site-specific FRA would be required to demonstrate the feasibility of infiltration measures.

Figure 3-80 : Site 110 Geology



3.11.5.3 Site-specific Flood Risk Assessment

A site-specific FRA would be required to accompany the planning application for this site because it is greater than 1ha in size in accordance with NPPF paragraph 103 and is within a WCDA in accordance with NPPF paragraph 103 and WDC policy on Managing flood risk and Sustainable Drainage Systems. The review of flood risk has identified a number of issues that a site-specific FRA would need to consider in addition to those usually required:

- The site is not within an area encompassed by a detailed hydraulic model. Undertake hydraulic modelling of the watercourse to the south of the site and ordinary watercourses through the site to confirm the extent of Flood Zones and the impact of climate change;
- Not develop within ten metres of the ordinary watercourse to provide a buffer zone for maintenance activities and to prevent encroachment in accordance with Wycombe District Council's relevant policy on flood risk;
- Demonstrate how the site would be accessed safely during a surface water event;
- The suitability of infiltration measures for drainage of the site given the local geology;
- The development should not encroach into the WCDA where practicable;
- If the development does encroach into the WCDA:
    - Demonstrate that finished floor levels are above the High and Medium uFMfSW risk peak water level (plus an allowance for climate change); and

- No habitable below-ground rooms are constructed in such areas; and
- Demonstrate that the flow path can be maintained, or modifications to it as a result of the development will not detrimentally affect third parties.

- Avoid encroaching into WCDAs should be achievable given the small percentage area at risk of surface water flooding;
- If the highway is developed within Flood Zone 3a, it should be designed and constructed to remain operational and safe in times of flood in order to pass the Exception Test. If located within Flood Zone 3b, additional regulations must be followed to pass the Exception Test; the road should be designed and constructed to:
    - Remain operational and safe for users in times of flood;
    - Result in no net loss of floodplain storage; and
    - Not impede water flows and not increase flood risk elsewhere.
- Encourage the applicant to design the development in such a way as to avoid encroachment into Flood Zones 2 and certainly 3a. The development would need to pass the Exception Test if it did encroach into Flood Zone 3a (which should be possible due to the small extent covered by designations other than Flood Zone 1); and
- Demonstrate how the elevated risk of groundwater flooding in the south-eastern half of the site would be addressed, as a minimum avoiding the construction of below-ground habitable rooms.

3.11.5.4 Strategic Drainage Strategy

Considering the extent of flood risk across the area from various sources, an expansion-wide drainage strategy should be developed to ensure potential flood risk, amenity and biodiversity benefits are maximised rather than dealing with drainage issues solely at individual plot design.

3.12 Site 113: Princes Estate Expansion, Princes Risborough Detailed Assessment

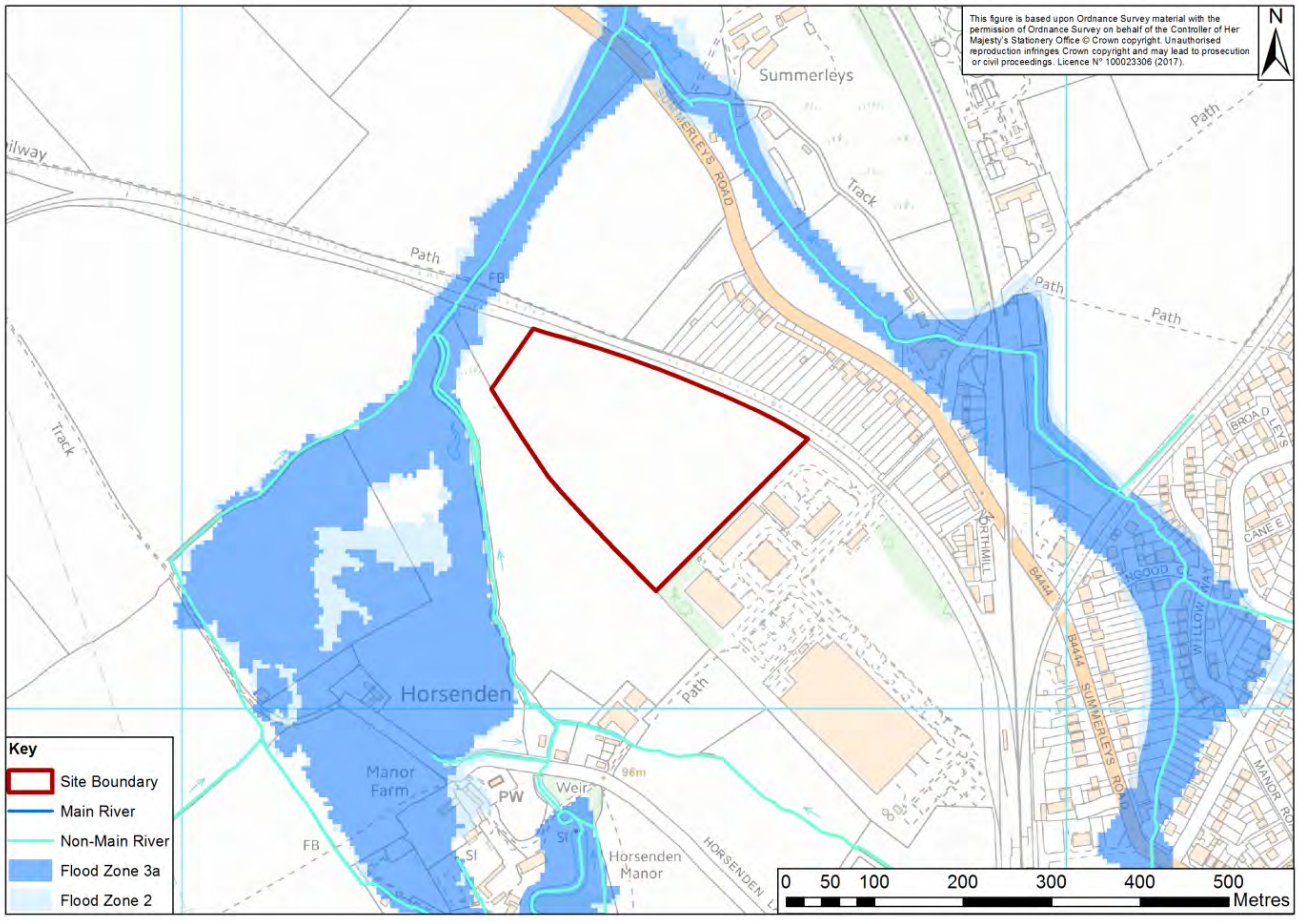
3.12.1 Site Description

Land Adjacent to Regent Park, Princes Risborough allocation site (planning ref: PR9) is located to the west of Princes Risborough, to the south the railway line and north-west of Regent Park. The NGR for the site is SP 7947 0332. The site is currently farmland and is an area of approximately 5.4ha. The site is currently allocated for industrial applications. This site has been assessed in detail because it is within 50m of the extent of published Flood Zone 2: see Section 2.1.

3.12.2 Fluvial Flood Risk

The fluvial flood risk to the site is presented in Figure 3-81.

Figure 3-81: Site 113 Fluvial Flood Risk



The site is bounded by a railway line to the north and the field boundary to the south and east. The entire site is located within Flood Zone 1; see Figure 3-81. The historical flood map does not identify any fluvial flood events that have affected this site. The site is not situated within the River Wye or Thames hydraulic model extents; therefore, the applicant would need to consider the likely impact of climate change factors and how the site would be affected.

Table 3-40: Site 113 Current Flood Zone Extents

Flood Zone	1	2	3a	3b	Total
Extent (ha)	5.4	0	0	0	5.4
Coverage (%)	100	0	0	0	-

In the absence of hydraulic modelling covering this site, the applicant will need to liaise with the EA to confirm the need to undertake detailed hydraulic modelling to confirm the degree of fluvial flood risk and the predicted impact of climate change, predicted flood depth and hazard for this allocation site.

A review of the uFMfSW (see Figure 3-82) does not indicate a flow path for the 0.1% (1 in 1000) AEP flood event intersecting with Flood Zone 2 with within or in the vicinity of the allocation site. Consequently, it is considered unlikely that the site is sensitive to the predicted impact of climate change and would not for example become reclassified as Flood Zone 2 during the assumed 100-year lifetime of the development. The lowest point of the site is at approximately 93.6m AOD, approximately 1m higher than the ground level at the extent of Flood Zone 2. It is therefore considered likely that the site would remain outside Flood Zone 2 once the predicted impact of climate change is considered. The proposed industrial development would remain acceptable in accordance with Table 3 / paragraph 067 of the NPPG if it was within Flood Zone 2.

3.12.2.1 Flood Defence Failure

There are no raised defences in the vicinity of the site. The nearby watercourses are in open channel at this point so it is considered that there is a low risk of flooding as a result of culvert blockage to this site. The ordinary watercourse does cross under the disused railway in culvert approximately 50m to the west of the site. The extent of the fluvial flood zone mapping does not appear to be influenced by this structure (see Figure 3-81) however the uFMfSW mapping (see Figure 3-82) does appear to indicate that flows could back-up from the culvert. The extent of the 0.1% (1 in 1000) surface water flood extent does not reach the site boundary therefore the site is considered to be at low risk of flooding due to culvert blockage.

3.12.3 Risk of Flooding from Other Sources

3.12.3.1 Surface Water

Surface water flood risk based on the uFMfSW is presented in Figure 3-82.

Figure 3-82: Site 113 Surface Water Flood Risk

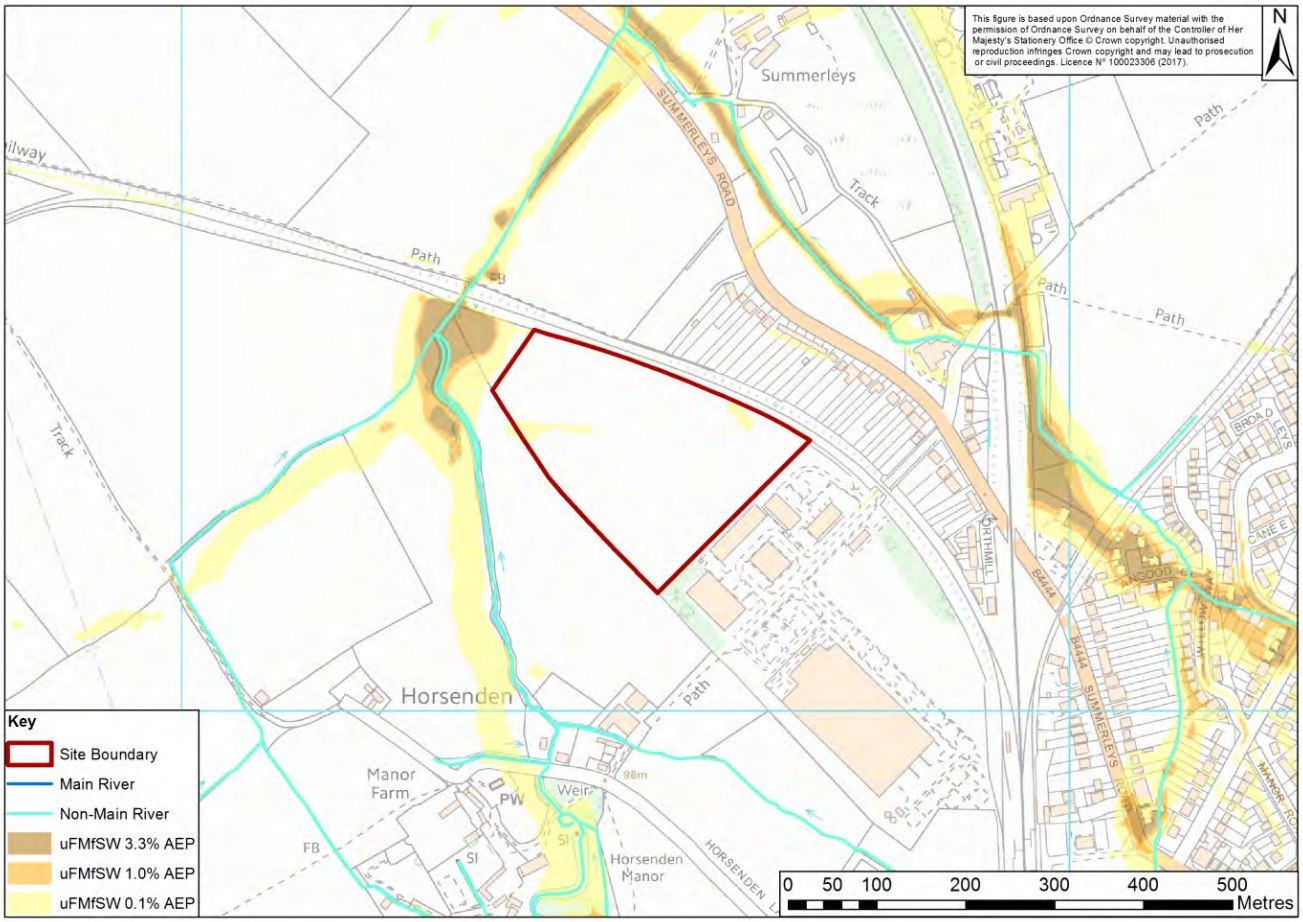


Table 3-41: Site 113 uFMfSW Extents

Event (AEP)	3.33% (1 in 30)	1% (1 in 100)	0.1% (1 in 1000)
Extent (ha)	0	0	0.27
Coverage (%)	0	0	5

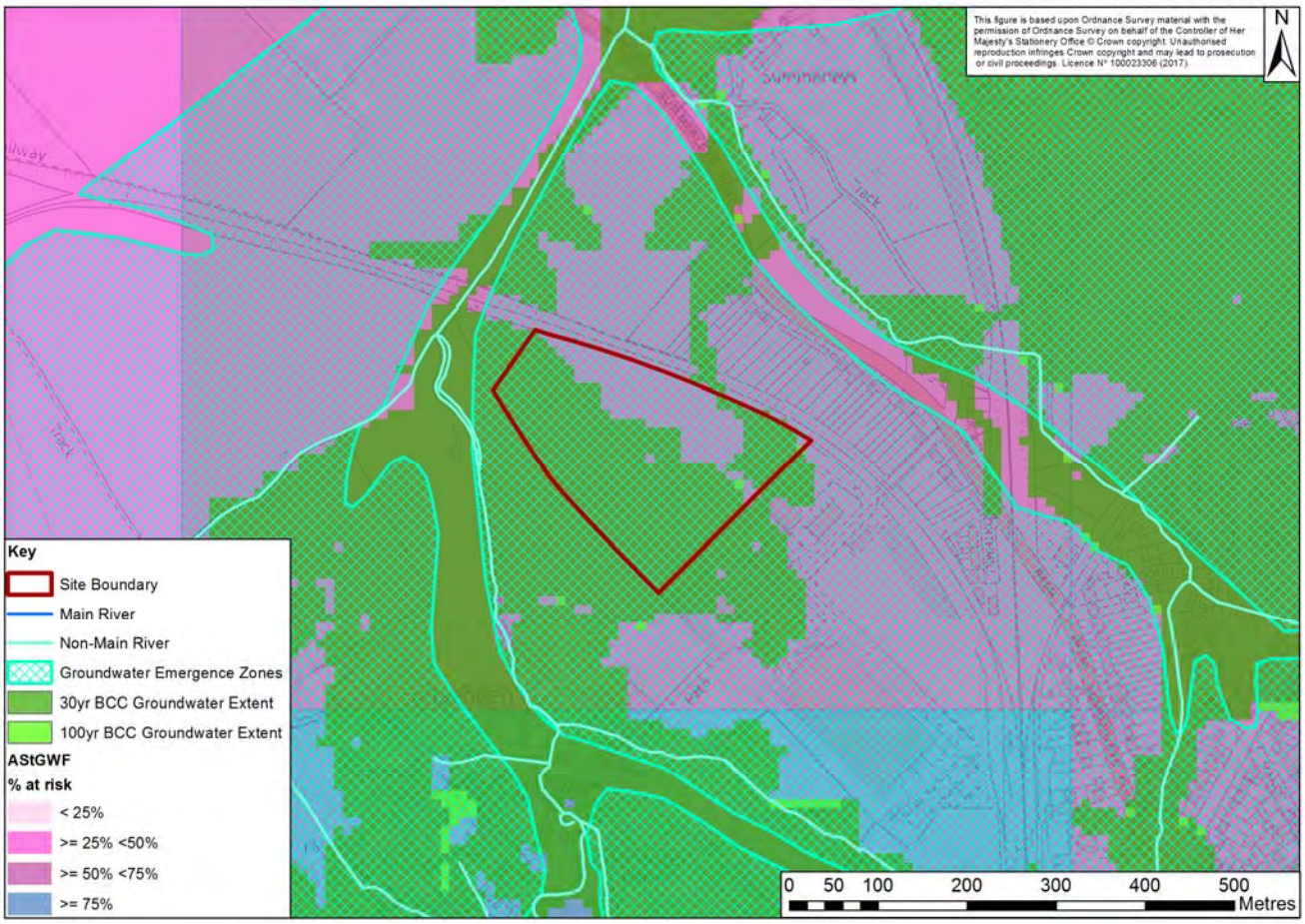
There are two pockets of Low surface water flood risk predicted in the site which may be the result of rainfall filling localised depressions in the hydraulic model used to develop the extents. These localised areas of ponding are in the north-eastern corner and to the west of the site. The uFMfSW indicates no flow paths through the site. The Level 1 SFRA indicates flooding during Winter 2013/14, from surface water/groundwater sources in the area.

3.12.3.2 Groundwater

A review of EA AStGWF mapping indicates that the majority of the site is at moderate risk of flooding (within a grid square where between 50% and 75% is at risk of groundwater emergence). BCC groundwater modelling

indicates the majority of the site is at risk of flooding from both the 3.33% (1 in 30) and 1% (1 in 100) AEP modelled groundwater events. The entirety of the site is located within a groundwater emergence zone.

Figure 3-83: Site 113 Groundwater Flood Risk



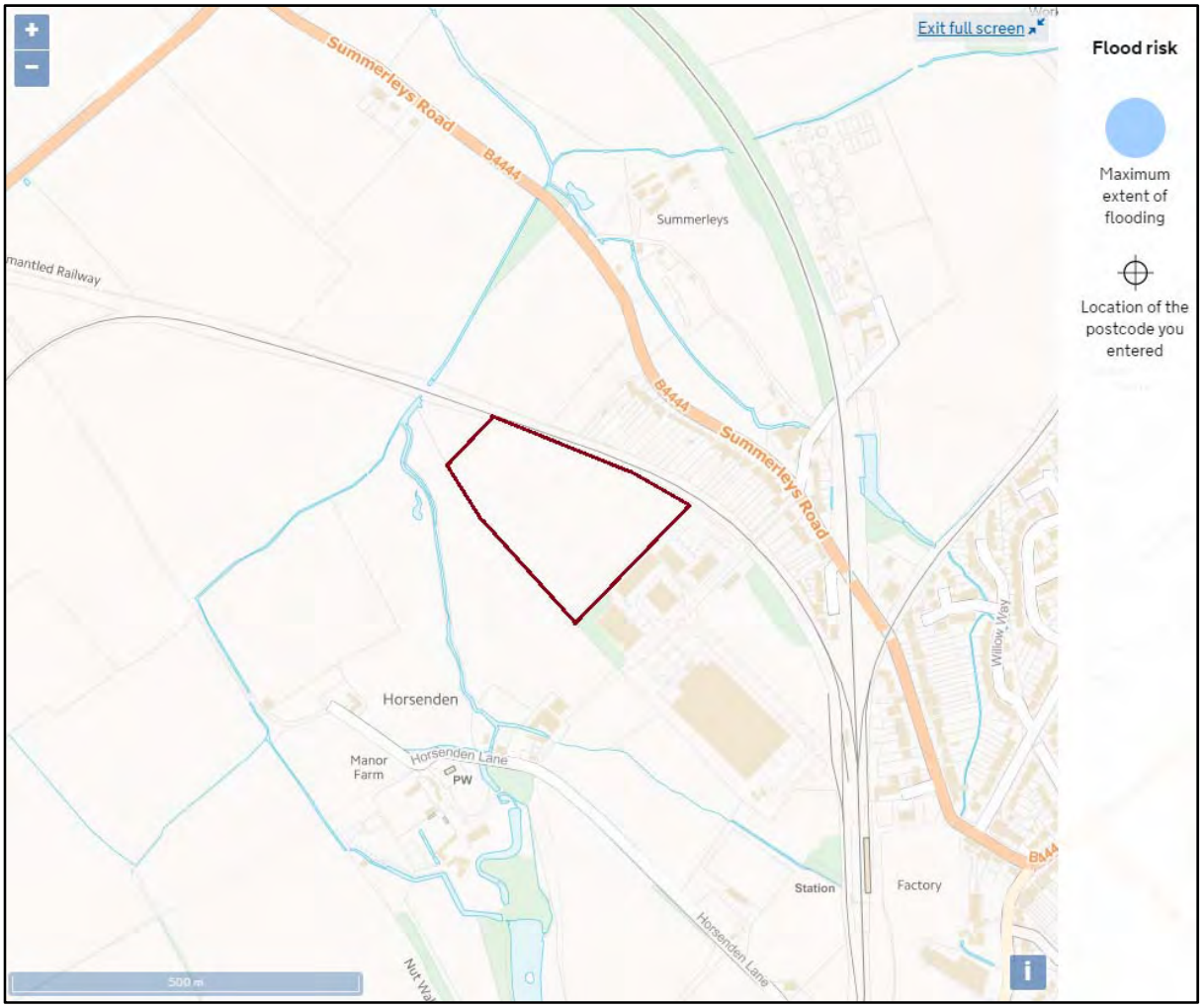
3.12.3.3 Sewers

With reference to Figure 7 of the Level 1 SFRA, the site is in a post code that recorded 1-5 incidents of sewer flooding affecting properties internally and 16-20 externally in the 20 years preceding 2014.

3.12.3.4 Reservoir Failure

A review of the predicted flood extent as a result of reservoir failure available online indicates that the site is not at risk of flooding from such an event. See Figure 3-84.

Figure 3-84: Site 113 Risk of Flooding from Reservoir Failure



Source: https://flood-warning-information.service.gov.uk/long-term-flood-risk/map?map=SurfaceWater © Crown copyright and database rights 2017 OS 100024198

3.12.4 The Exception Test

The site is located within Flood Zone 1. The proposed development is for industrial use would be classified as 'Less Vulnerable'[37] and would therefore be acceptable and would not need to pass the Exception Test[38].

3.12.5 Flood Risk Management

3.12.5.1 Opportunities for Betterment

There appear to be few opportunities for betterment given the location of the site. It is expected that runoff would be attenuated to Greenfield rates if not infiltrated to ground.

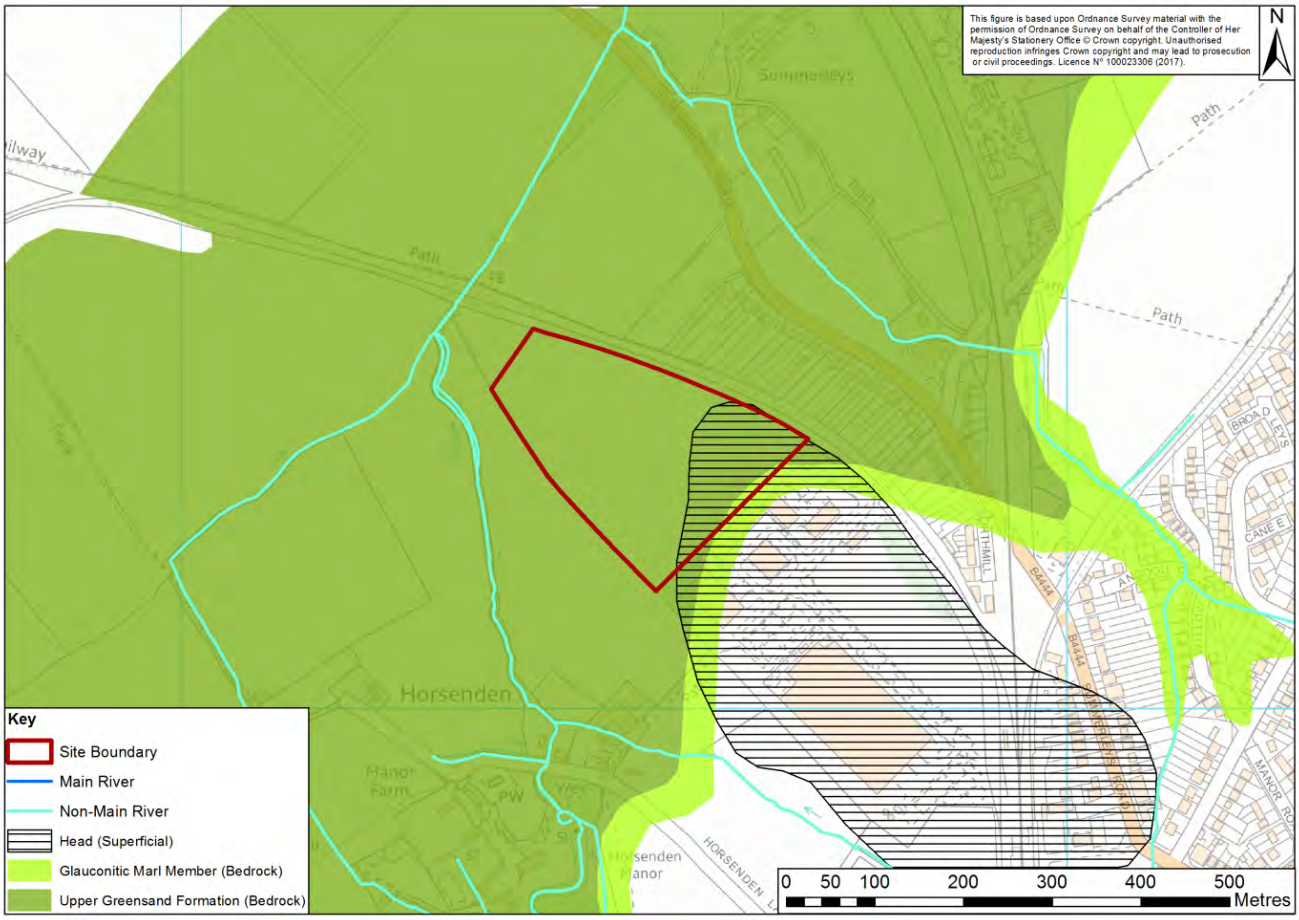
3.12.5.2 Potential Feasibility of Infiltration Measures

A review of the site geology (see Figure 3-85) suggests it is underlain by a layer of Head (superficial deposit) and two types of bedrock (Glauconitic and Upper Greensand Formations). The thickness of each layer is not

[37] NPPG Table 2 / Paragraph 066
[38] NPPG Table 3 / Paragraph 067

included within the information. Surrounding strata have been omitted for clarity if they are not present directly beneath the site. Consequently, infiltration of rainfall directly to ground may be practicable. The proximity of the watercourses may result in locally high groundwater levels potentially reducing the feasibility of such measures. Infiltration should be the first method considered for the drainage of sites and as such, a site-specific FRA would be required to demonstrate the feasibility of infiltration measures.

Figure 3-85 : Site 113 Geology



3.12.5.3 Site-specific Flood Risk Assessment

A site-specific FRA would be required to accompany the planning application for this site because it is greater than 1ha in size in accordance with NPPF paragraph 103. The review of flood risk has identified a number of issues that a site-specific FRA would need to consider in addition to those usually required:

- The site is not within an area included within the extent of a detailed hydraulic model. A hydraulic model will be required to assess the impact of climate change to the development;
- Confirmation of the suitability of infiltration of runoff to ground based on an assessment of groundwater levels; and
- Avoidance of areas designated as at risk of flooding from surface water and groundwater sources;
- Demonstrate how the elevated risk of groundwater flooding in the site would be addressed and mitigated for; and
- How, in the event of groundwater emergence, contamination can be avoided.

3.13 Site 115: Land at Princes Risborough station, Princes Risborough Detailed Assessment

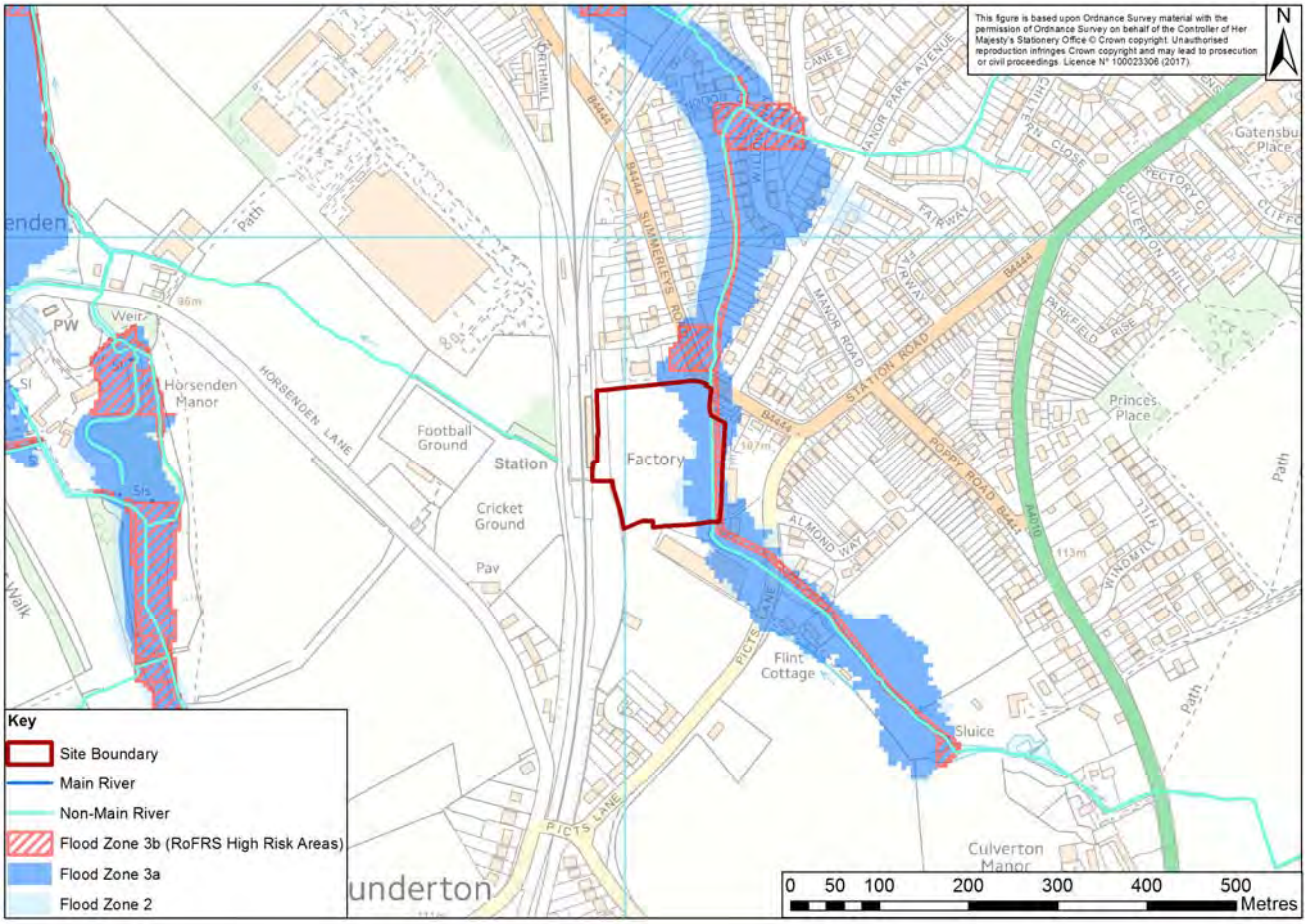
3.13.1 Site Description

Railway Station Site Including Former Hypnos Site, Station Road, Princes Risborough allocation site (planning ref: PR16) is located immediately east of the Princes Risborough Railway Station. The NGR for the site is SP 8002 0278. The site is currently factory buildings and is an area of approximately 2.05ha. The site is currently proposed for mixed use development and a road. This site has been assessed in detail because it is within 50m of the extent of published Flood Zone 2: see Section 2.1.

3.13.2 Fluvial Flood Risk

The fluvial flood risk to the site is presented in Figure 3-86.

Figure 3-86: Site 115 Fluvial Flood Risk



The site is bound to the east by the unnamed watercourse and by the Princes Risborough railway station to the west. The eastern side of the site is within Flood Zones 3a and 2; see Figure 3-86. The historical flood map does not identify any fluvial flood events that have affected this site. The site is not situated within the River Wye or Thames hydraulic model extents; therefore, the applicant would need to consider how the site would be affected by the predicted impact of climate change on fluvial flood risk. The applicant would need to liaise with the EA to confirm the need to undertake detailed hydraulic modelling to confirm the degree of fluvial flood risk and the predicted impact of climate change, flood depth and hazard for the allocation site.

Table 3-42: Site 115 Current Flood Zone Extents

Flood Zone	1	2	3a	3b	Total
Extent (ha)	1.33	0.10	0.51	0.10	2.05
Coverage (%)	65	5	25	5	-

The extents of Flood Zones 2 and 3 can be expected to increase once the predicted impact of climate change is considered, however this is subject to detailed hydraulic modelling of the ordinary watercourse. A review of the 0.1% (1 in 1000) flood extent (see Fig Figure 3-86) does not evince any additional overland flow paths away from the ordinary watercourse to the east of the site so that would remain the principal source of risk. The extents do not vary significantly to Flood Zone 2 therefore any encroachment into this area would need to be carefully considered.

A review of the uFMfSW mapping (see Figure 3-87) does not indicate an overland flow path intersecting the fluvial flood zones which would be an indication of lower topography which could be expected to flood before other (lower) areas due to increased rainfall and flows increasing the extent of the fluvial flood zones due to climate change.

3.13.2.1 Flood Defence Failure

There are no raised defences in the vicinity of the site. Watercourses to the north and west of the site are culverted close to the site boundary. A blockage of these culverts could increase flood risk to the site to greater than indicated in Figure 3-86. It is recommended therefore that a site-specific FRA for this development includes an assessment of the residual risk of flooding should either of these culverts block. A review of the EA AIMS and BCC asset databases has not indicated the dimensions of these structures nor whether they have screens.

3.13.3 Risk of Flooding from Other Sources

3.13.4 Surface Water

Surface water flood risk based on the uFMfSW is presented in Figure 3-87.

Figure 3-87: Site 115 Surface Water Flood Risk

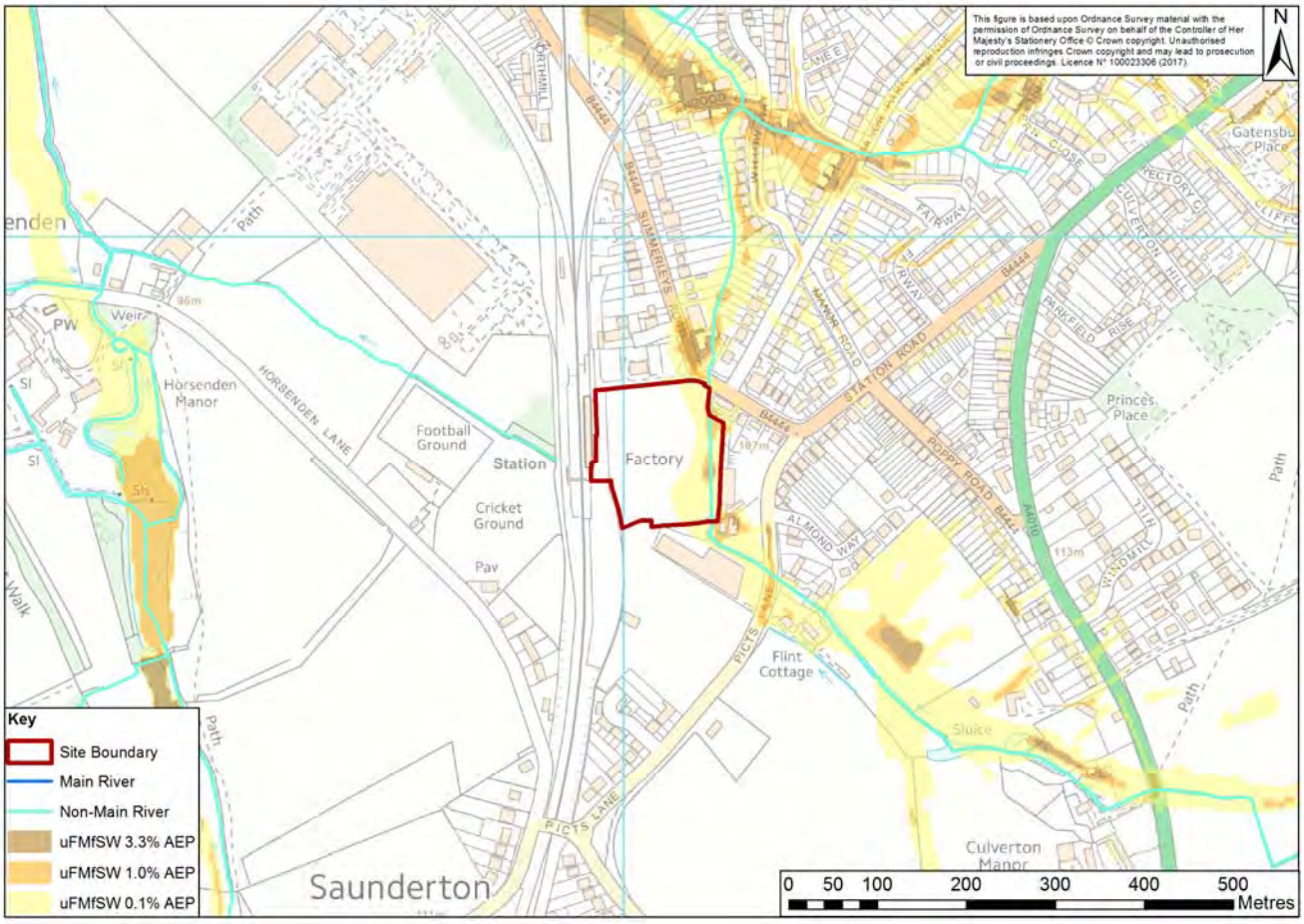


Table 3-43: Site 115 uFMfSW Extents

Event (AEP)	3.33% (1 in 30)	1% (1 in 100)	0.1% (1 in 1000)
Extent (ha)	0.02	0.04	0.62
Coverage (%)	1	2	30

The eastern section of the site, adjacent to the unnamed watercourse, is at risk of flooding from the 0.1% (1 in 1,000) AEP event. There is a pocket of flooding predicted along the eastern boundary of the site which may be the result of rainfall filling the depression in the hydraulic model used to develop the extents. It is likely that there is a flow path within the 0.1% (1 in 1,000) AEP event extent adjacent to the watercourse which could interact with the development and affect access to and from the site. The Level 1 SFRA indicates flooding during Winter 2013/14, from surface water/groundwater sources in the area.

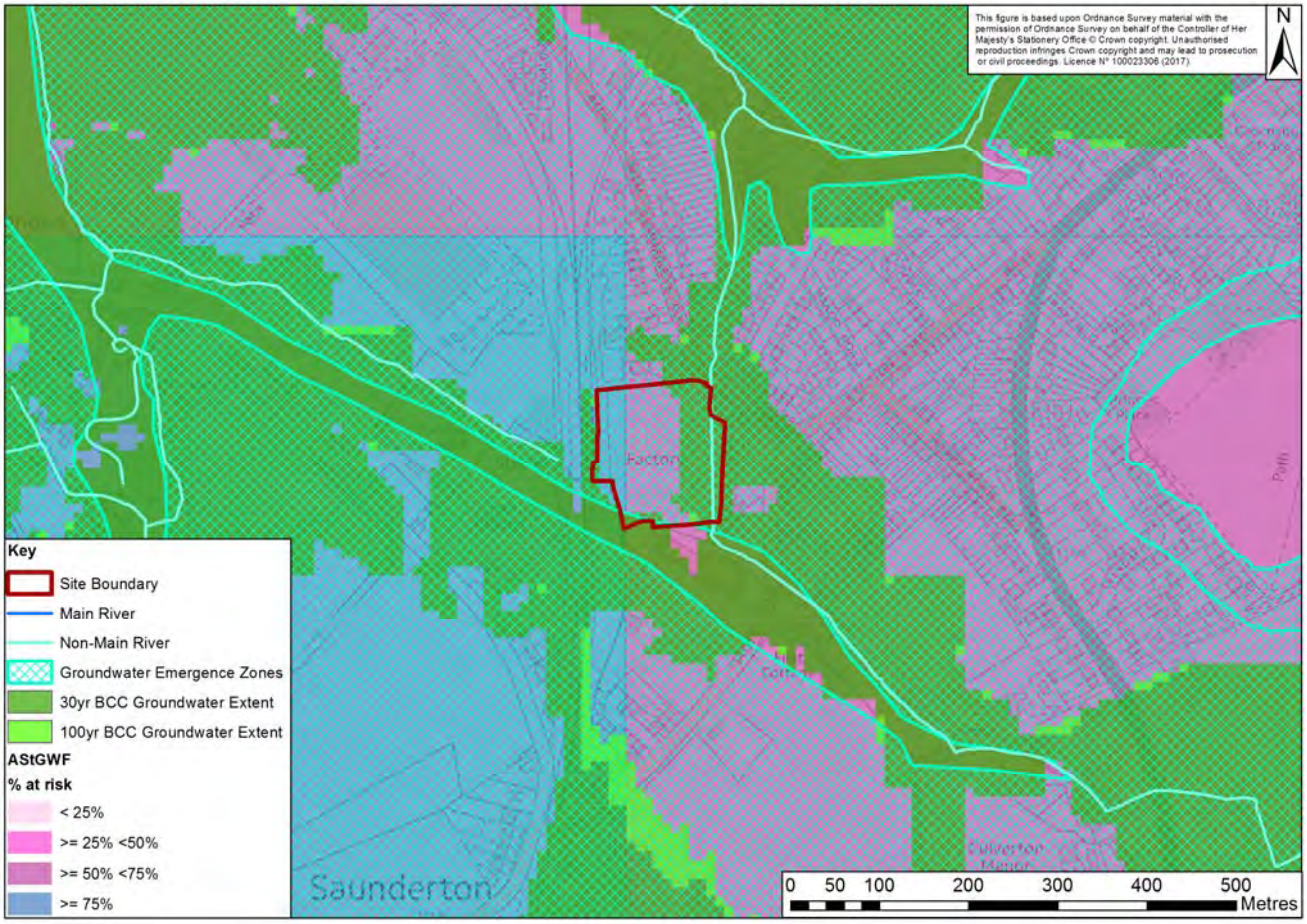
Climate change has the potential to increase the risk of surface water flooding to the site. Although beyond the scope of this SFRA to quantify the predicted impact, the risk of flooding to those areas currently assessed as 'Low' surface water risk could increase as a result of climate change and consequently they could become re-

classified as WCDA. Such a risk would need to be quantified by the applicant in order to demonstrate that the site could be developed safely for future users, taking into account the planning implications of such a result.

3.13.4.1 Groundwater

A review of EA AStGWF mapping indicates that the majority of the site is at moderate risk of flooding in the eastern section of the site (within a grid square where between 50% and 75% is at risk of groundwater emergence). There are areas at slightly elevated risk of flooding along the western edge of the site. BCC groundwater modelling indicates the site is at risk of flooding to the southern and eastern sections of the site from both the 3.33% (1 in 30) and 1% (1 in 100) AEP modelled groundwater events. The majority of the site is located in a groundwater emergence zone.

Figure 3-88: Site 115 Groundwater Flood Risk



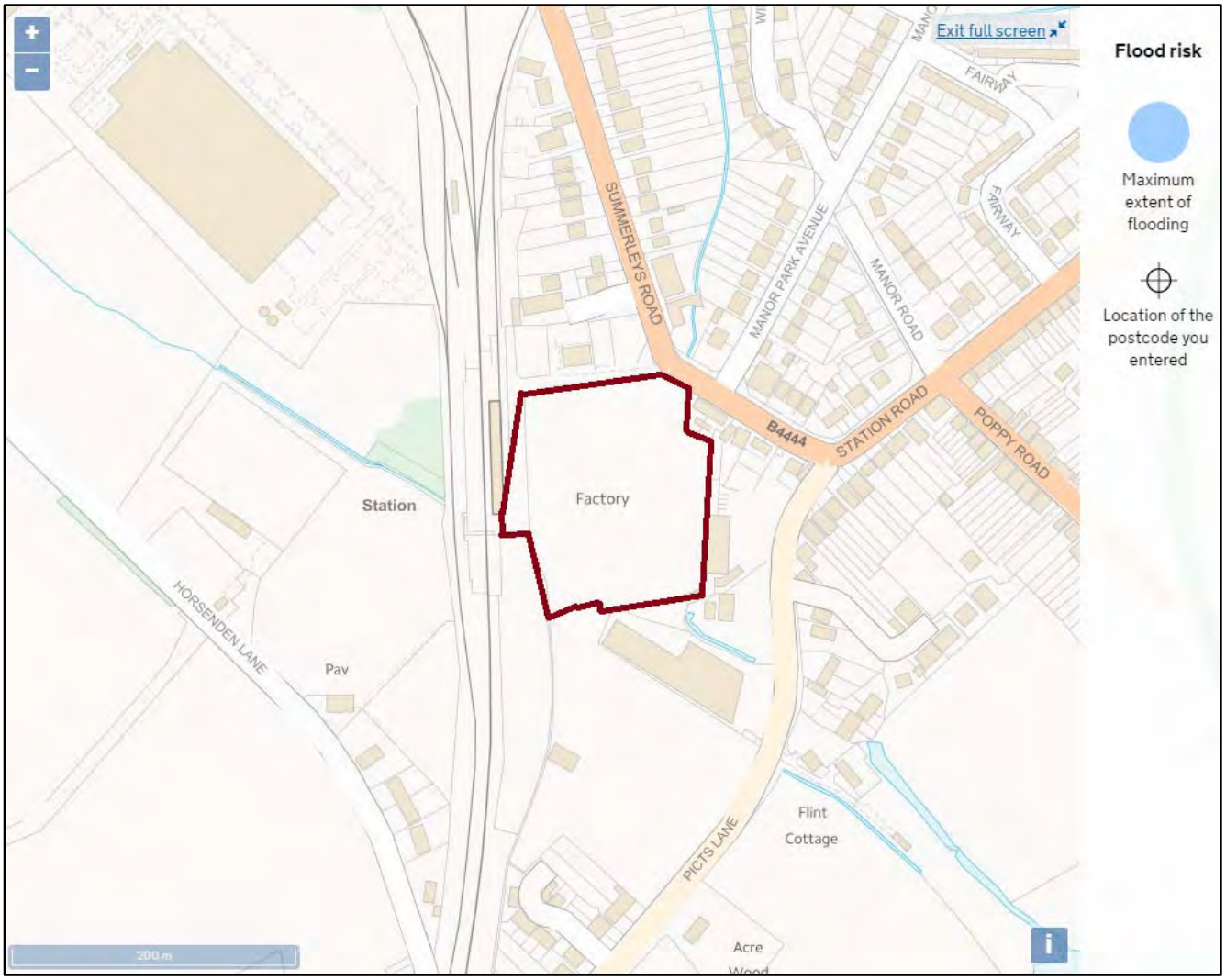
3.13.4.2 Sewers

With reference to Figure 7 of the Level 1 SFRA, the site is in a post code that recorded 1-5 incidents of sewer flooding affecting properties internally and 16-20 externally in the 20 years preceding 2014.

3.13.4.3 Reservoir Failure

A review of the predicted flood extent as a result of reservoir failure available online indicates that the site is not at risk of flooding from such an event. See Figure 3-89.

Figure 3-89: Site 115 Risk of Flooding from Reservoir Failure



Source: https://flood-warning-information.service.gov.uk/long-term-flood-risk/map?map=SurfaceWater © Crown copyright and database rights 2017 OS 100024198

3.13.5 The Exception Test

The site is located within Flood Zones 1, 2, 3a and 3b. The proposed development of 45 mixed-use units would be classified as 'More Vulnerable' or 'Less Vulnerable'[39], depending on the confirmed use, and would therefore be acceptable (provided 'More Vulnerable' development is not located within Flood Zone 3a or 3b, which should be possible for the applicant to avoid) and would not need to pass the Exception Test[40]. The level of risk is anticipated not to change when the predicted impact of climate change is considered and therefore the site could be developed safely.

The proposed highway is indicatively located to cross areas designated as Flood Zone 3a as depicted by Figure 3-86. The final alignment of the proposed highway would affect the planning requirements to be met[41]. If the highway is developed within Flood Zone 3a, it should be designed and constructed to remain operational and safe in times of flood in order to pass the Exception Test.

[39] NPPG Table 2 / Paragraph 066
[40] NPPG Table 3 / Paragraph 067
[41] NPPG Table 3 / Paragraph 067

Immediately north of the site, is a section designated as Flood Zone 3b; therefore, if the proposed highway encroached Flood Zone 3b, additional regulations must be followed to pass the Exception Test; the road should be designed and constructed to:

- Remain operational and safe for users in times of flood;
- Result in no net loss of floodplain storage; and
- Not impede water flows and not increase flood risk elsewhere.

The road that runs north-south through the allocation site would encroach into the predicted extent of Flood Zone 3. The applicant would need to construct a detailed hydraulic model of the watercourse to confirm the extent of flood risk (including an allowance for climate change) and demonstrate how any encroachment and consequent loss of floodplain would be mitigated via compensatory floodplain storage, to ensure the site would be developed without increasing flood risk. Based on the proposed site layout it would be possible to develop the site and achieve no increase to flood risk.

Therefore, the site would pass the second part of the Exception's Test.

3.13.6 Flood Risk Management

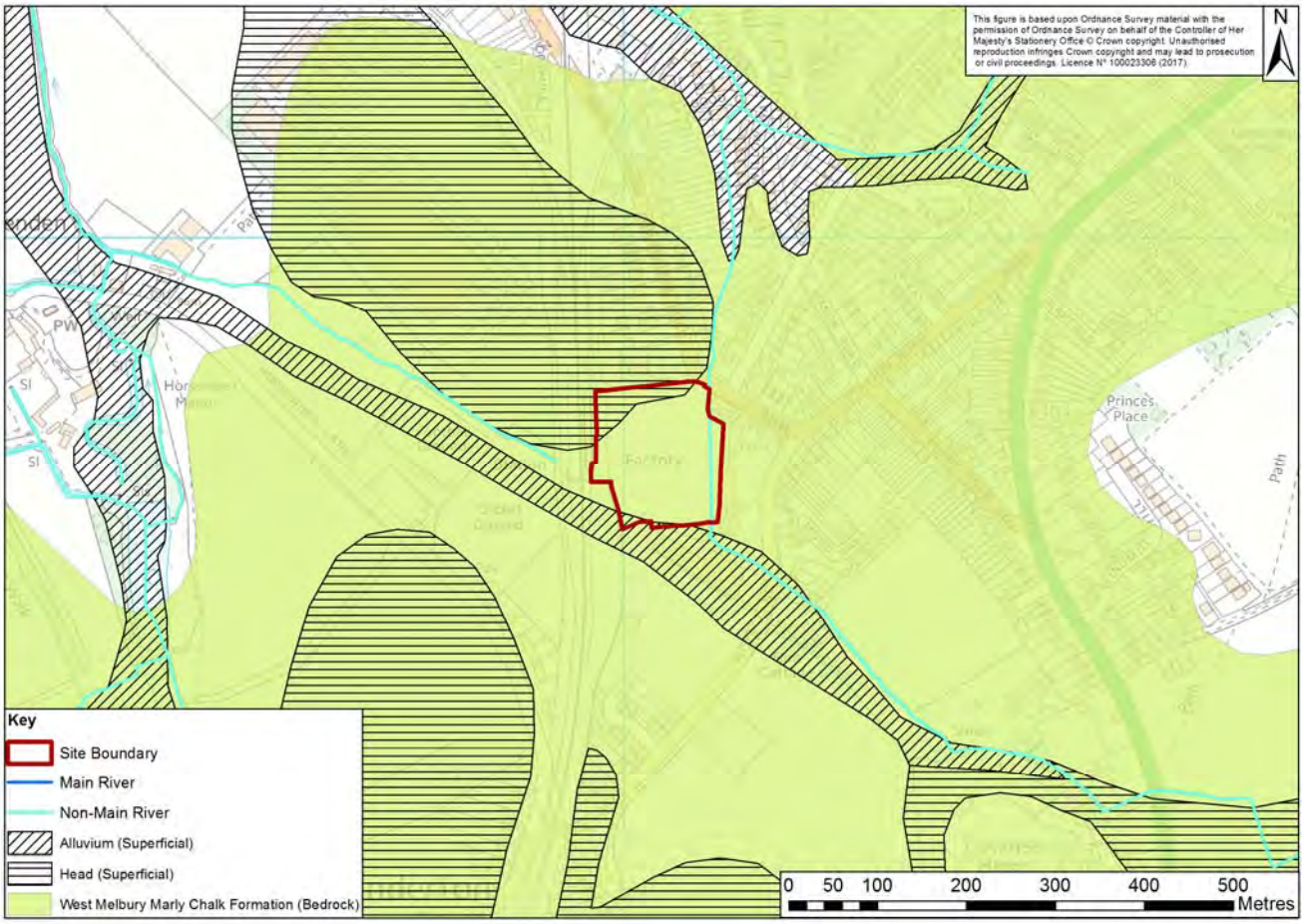
3.13.6.1 Opportunities for Betterment

Opportunities to attenuate flows to reduce the risk of fluvial flooding from the ordinary watercourse downstream of the site should be considered as part of a site-specific FRA.

3.13.6.2 Potential Feasibility of Infiltration Measures

A review of the site geology (see Figure 3-90) suggests it is underlain Alluvium and Head layers (superficial deposits) and Chalk bedrock (West Melbury Marly Formation). The thickness of each layer is not included within the information. Surrounding strata have been omitted for clarity if they are not present directly beneath the site. Consequently, infiltration of rainfall directly to ground may be practicable. Infiltration should be the first method considered for the drainage of sites and as such, a site-specific FRA would be required to demonstrate the feasibility of infiltration measures.

Figure 3-90 : Site 115 Geology



3.13.6.3 Site-specific Flood Risk Assessment

A site-specific FRA would be required to accompany the planning application for this site because it includes areas of Flood Zones 2 and 3 and it is greater than 1ha in size in accordance with NPPF paragraph 103; the site is also located within a WCDA in accordance with NPPF paragraph 103 and WDC policy on Managing flood risk and Sustainable Drainage Systems. The review of flood risk has identified a number of issues that a site-specific FRA would need to consider in addition to those usually required:

- The applicant should design the development in such a way as to avoid encroachment into Flood Zones 2 and 3, if encroachment to Flood Zone 3 cannot be avoided it would be necessary to apply the Exception Test (assuming a 'More Vulnerable' vulnerability classification);
- The applicant should design the development in such a way as to avoid encroachment into the modelled BCC 3.3% (1 in 30) AEP Groundwater Extent, where practicable;
- The site should be developed in such a manner to avoid encroachment into the WCDA wherever practicable;
- If the highway is developed within Flood Zone 3a, it should be designed and constructed to remain operational and safe in times of flood in order to pass the Exception Test. If located within Flood Zone 3b, additional regulations must be followed to pass the Exception Test; the road should be designed and constructed to:
    - Remain operational and safe for users in times of flood;
    - Result in no net loss of floodplain storage; and

- Not impede water flows and not increase flood risk elsewhere.

- If the development does encroach into the WCDA:
  - Demonstrate that finished floor levels are above the High and Medium uFMfSW risk peak water level (plus an allowance for climate change);
  - No habitable below-ground rooms are constructed in such areas; and
  - Demonstrate that the flow path can be maintained, or modifications to it as a result of the development will not detrimentally affect third parties.
- Demonstrate how the site would be accessed safely during both fluvial and surface water events;
- Confirmation of the suitability of infiltration of runoff to ground based on an assessment of groundwater levels;
- The site is not within an area included within the extent of a detailed hydraulic model. A hydraulic model will be required to assess the impact of climate change on the development;
- Not develop within ten metres of the unnamed ordinary watercourse to provide a buffer zone for maintenance activities and to prevent encroachment to the watercourse in accordance with Wycombe District Council's relevant policy on flood risk; and
- Demonstrate how the elevated risk of groundwater flooding in the site would be addressed, as a minimum avoiding the construction of below-ground habitable rooms.

3.14 Site 116: Land to the rear of Poppy Road, Princes Risborough Detailed Assessment

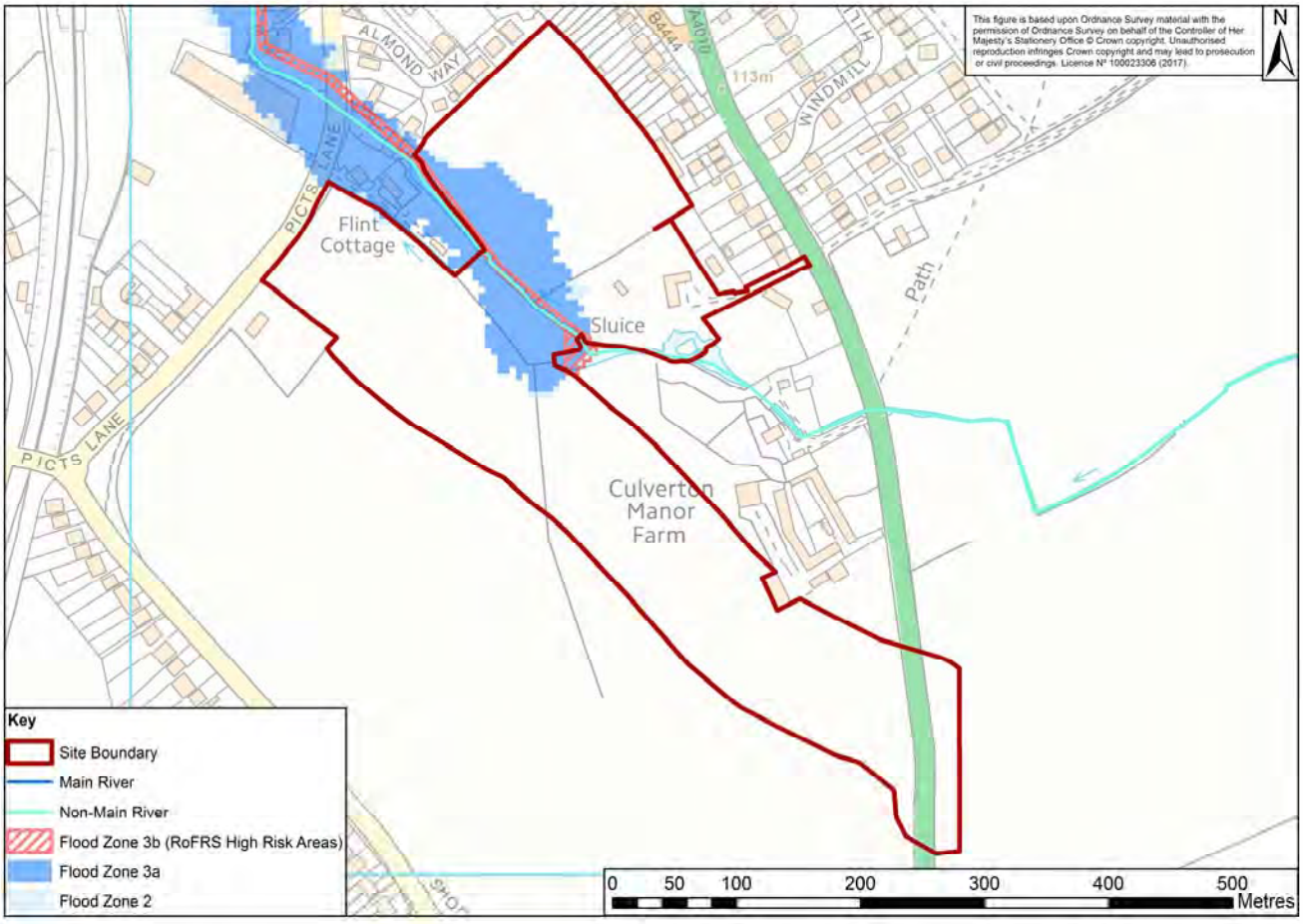
3.14.1 Site Description

The allocation site, Land off Poppy Road including 108 Wycombe Road, is located to the north-west of High Wycombe, to the south of Princes Risborough and immediately west of the A4010. The NGR for the site is SP 8042 0248. The site is currently farmland and is an area of approximately 11.2ha. It is proposed to construct 58 residential properties and a new highway through the site. This site has been assessed in detail because it is within 50m of the extent of published Flood Zone 2: see Section 2.1.

3.14.2 Fluvial Flood Risk

The fluvial flood risk to the site is presented in Figure 3-91.

Figure 3-91: Site 116 Fluvial Flood Risk



An ordinary watercourse passes through the site; see Figure 3-91. The site is bound by the back of properties on Almond Way in the north, Poppy Road and the A4010 to the east and the south of the site is located within the field south of Culverton Farm. The centre of the site is located within Flood Zones 2, 3a and 3b; the remainder of the site is within Flood Zone 1. The historical flood map does not identify any fluvial flood events that have affected this site. The site is not situated within the River Wye or Thames hydraulic model extents; therefore, the applicant would need to consider the likely impact of climate change factors and how it would be affected.

Table 3-44: Site 116 Current Flood Zone Extents

Flood Zone	1	2	3a	3b	Total
Extent (ha)	2.66	0.07	0.85	0.11	3.7
Coverage (%)	72	2	23	3	-

The extent of published Flood Zone 2 is slightly larger than Flood Zone 3, therefore it is anticipated that the extent of Flood Zone 3 is unlikely to change significantly due to climate change. A review of the uFMfSW does not indicate a 0.1% (1 in 1000) AEP surface water flow path beyond the bounds of the fluvial flood zone therefore the extent of Flood Zone 2 is not considered to increase significantly due to climate change.

In the absence of hydraulic modelling covering this allocation site, the applicant will need to liaise with the EA to use best available data to undertake detailed hydraulic modelling to confirm the degree of fluvial flood risk, the predicted impact of climate change, flood depth and hazard. Due to the proposed road and number of potential residential units, a detailed assessment will be required.

3.14.2.1 Flood Defence Failure

There are no raised defences in the vicinity of the site. The nearby watercourse is in open channel through the allocation site, there is a culvert under Picts Lane approximately 60m north-west (downstream) from the site however should this remain blocked the site is at least 0.8m higher than the road so flows would overtop and continue downstream before backing up to the site.

3.14.3 Risk of Flooding from Other Sources

3.14.3.1 Surface Water

Surface water flood risk based on the uFMfSW is presented in Figure 3-92.

Figure 3-92: Site 116 Surface Water Flood Risk

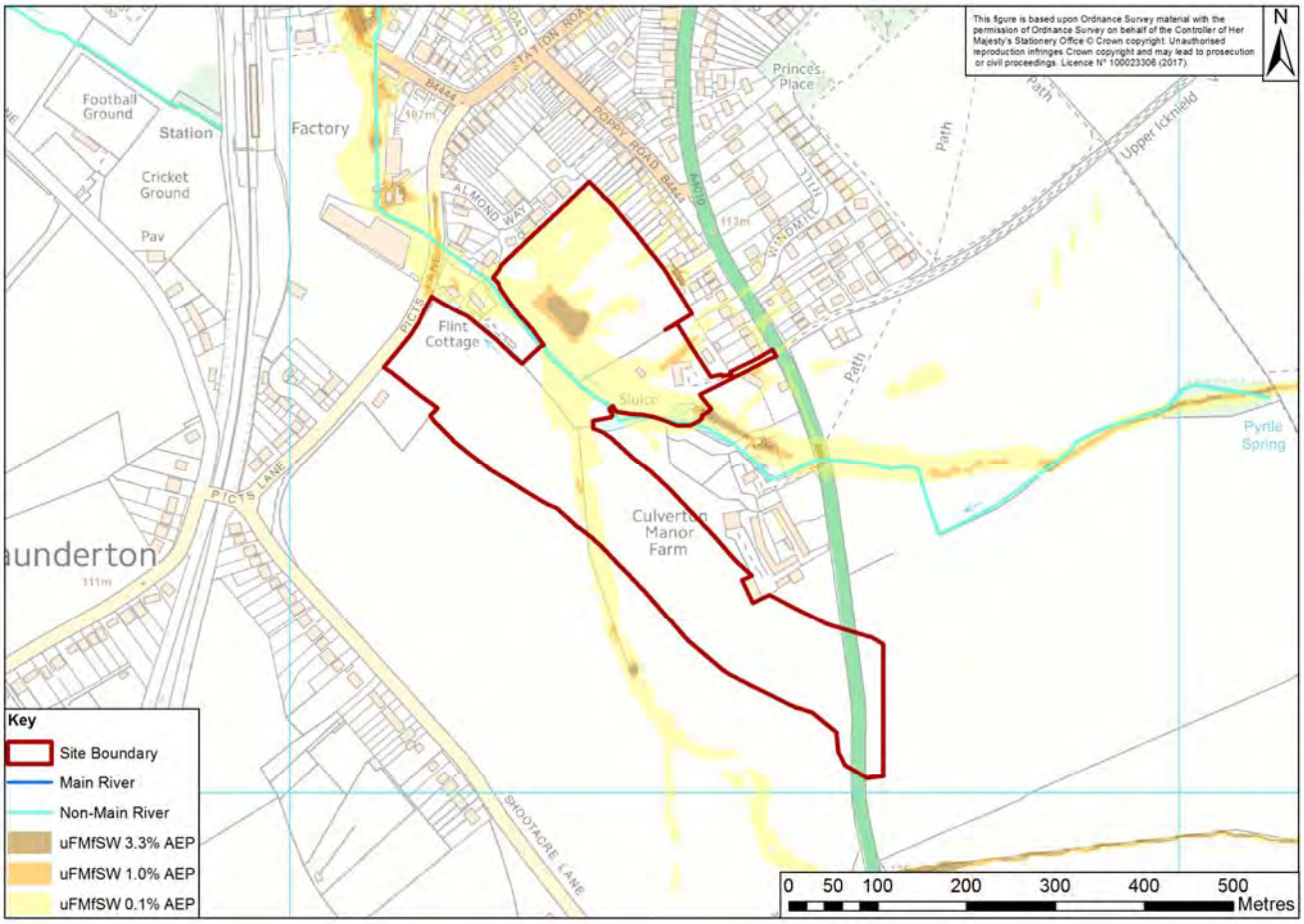


Table 3-45: Site 116 uFMfSW Extents

Event (AEP)	3.33% (1 in 30)	1% (1 in 100)	0.1% (1 in 1000)
Extent (ha)	0.22	0.56	3.36
Coverage (%)	2	5	30

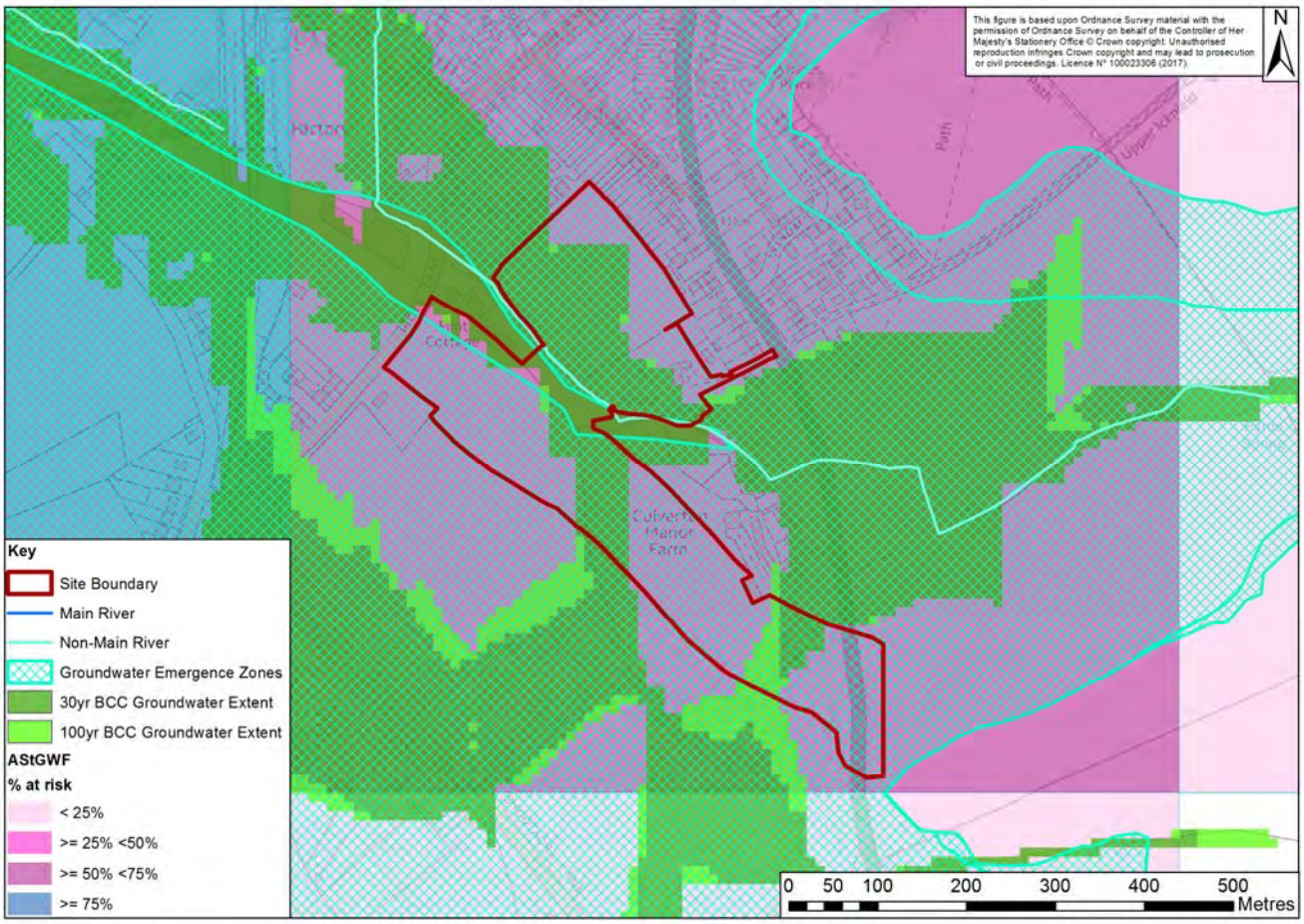
Primarily the northern section of the site appears to be at greatest risk of surface water flooding based on the uFMfSW, approximately 30% of the site is at risk of surface water flooding from a 0.1% (1 in 1,000) AEP event (see Table 3-45). There are pockets of flooding predicted in the site which may be the result of rainfall filling localised depressions in the hydraulic model used to develop the extents. The 0.1% (1 in 1,000) AEP event extent indicates a likely flow path which could interact with the development and affect access to and from the site. The Level 1 SFRA indicates flooding occurred during Winter 2013/14, from surface water/groundwater sources in the area.

Climate change has the potential to increase the risk of surface water flooding to the site. Although beyond the scope of this SFRA to quantify the predicted impact, the risk of flooding to those areas currently assessed as 'Low' surface water risk could increase as a result of climate change and consequently they could become re-classified as WCDA. Such a risk would need to be quantified by the applicant in order to demonstrate that the site could be developed safely for future users, taking into account the planning implications of such a result.

3.14.3.2 Groundwater

A review of EA AStGWF mapping indicates that the entirety of the site is at low risk of flooding (within a grid square where between 25% and 50% is at risk of groundwater emergence). BCC groundwater modelling indicates the site is at risk of flooding to the south-western section of the site from both the 3.33% (1 in 30) and 1% (1 in 100) AEP modelled groundwater events. The majority of the site is located within a groundwater emergence zone.

Figure 3-93: Site 116 Groundwater Flood Risk



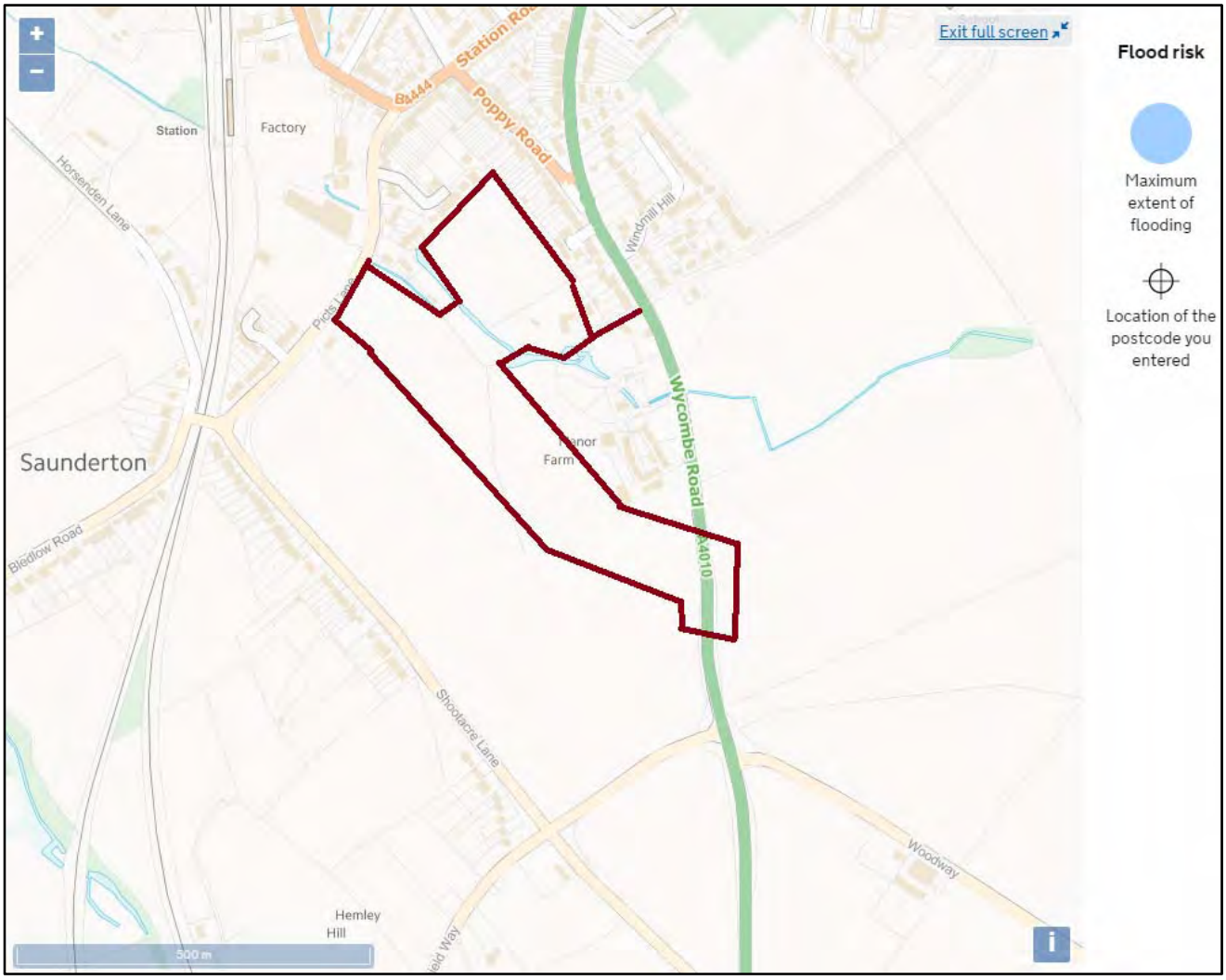
3.14.3.3 Sewers

With reference to Figure 7 of the Level 1 SFRA, the site is in a post code that recorded 1-5 incidents of sewer flooding affecting properties internally and 16-20 externally in the 20 years preceding 2014.

3.14.3.4 Reservoir Failure

A review of the predicted flood extent as a result of reservoir failure available online indicates that the site is not at risk of flooding from such an event. See Figure 3-94.

Figure 3-94: Site 116 Risk of Flooding from Reservoir Failure



Source: https://flood-warning-information.service.gov.uk/long-term-flood-risk/map?map=SurfaceWater © Crown copyright and database rights 2017 OS 100024198

3.14.4 The Exception Test

The site is located within Flood Zones 1, 2 and 3a. The proposed development of 58 residential properties and a new highway would be classified as 'More Vulnerable' and 'Essential Infrastructure'[42] respectively and would therefore be deemed acceptable (provided it did not encroach into Flood Zone 3a, allowing for the predicted impact of climate change), and would not need to pass the Exception Test[43].

If the highway is developed within Flood Zone 3a, it should be designed and constructed to remain operational and safe in times of flood in order to pass the Exception Test.

Given ground levels on the site it is expected that the new highway crossing of the watercourse could be constructed to include a free span of the extent of Flood Zone 3 (plus an allowance for climate change) to ensure it does not impede flows in the watercourse. The soffit of the bridge would need to be constructed to

[42] NPPG Table 2 / Paragraph 066
[43] NPPG Table 3 / Paragraph 067

provide sufficient freeboard above the design water level: the 1% (1 in 100) AEP peak water level. Following Highway's England DMRB this would be a minimum of 600mm.

Therefore, the site would pass the second part of the exception's test.

3.14.5 Flood Risk Management

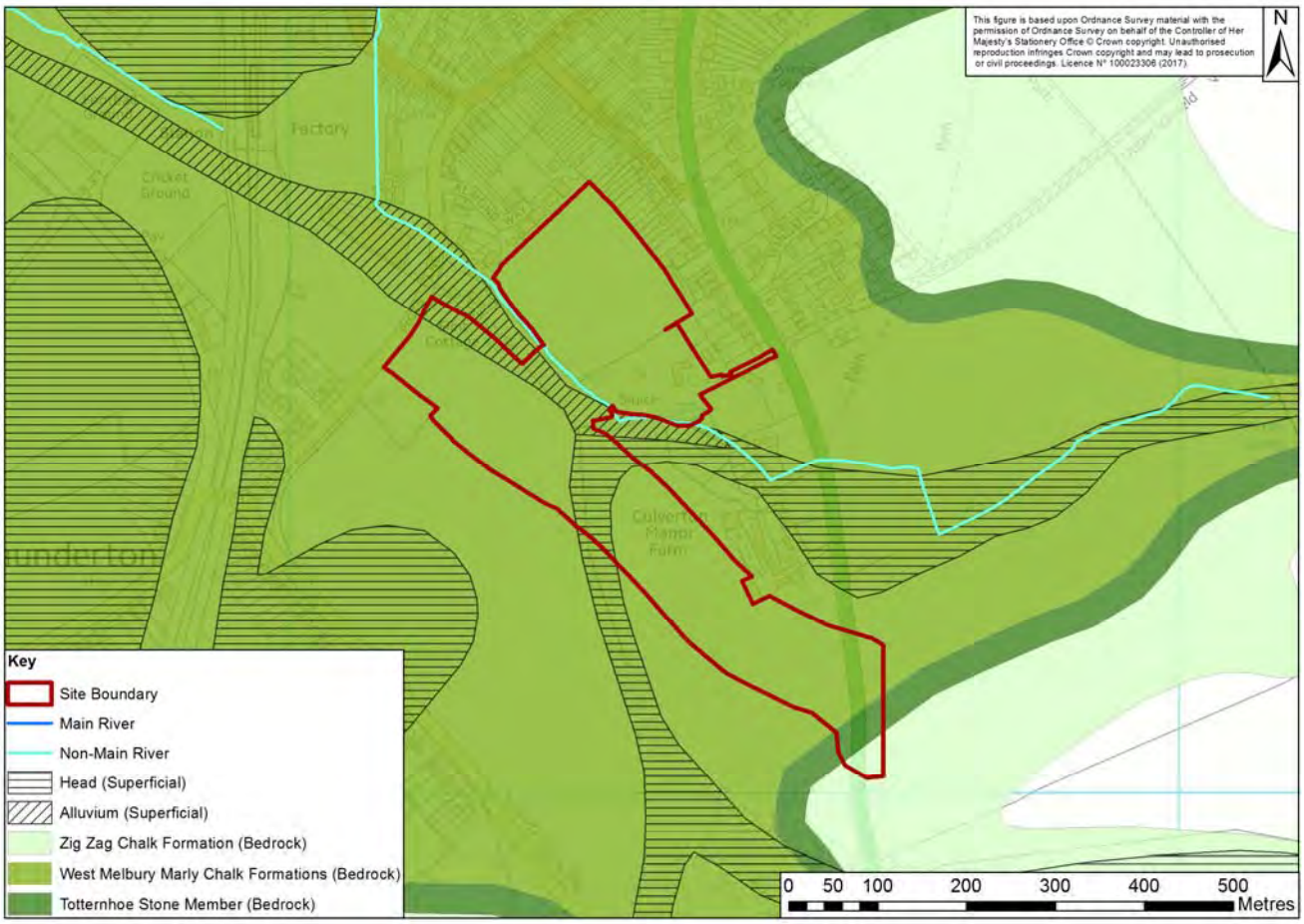
3.14.5.1 Opportunities for Betterment

There are existing properties immediately downstream of the site within Flood Zone 3. Consequently, there is the possibility that attenuation of the ordinary watercourse introduced as part of the development could reduce flows downstream and consequently flood risk.

3.14.5.2 Potential Feasibility of Infiltration Measures

A review of the site geology (see Figure 3-95) suggests it is underlain by layers of Alluvium and Head (superficial deposit) and Chalk (West Melbury Marly and Zig Zag formations) and Stone (Totternhoe Stone) bedrock. The thickness of each layer is not included within the information. Surrounding strata have been omitted for clarity if they are not present directly beneath the site. Consequently, infiltration of rainfall directly to ground may be practicable. The proximity of the watercourse through the site may result in locally high groundwater levels potentially reducing the feasibility of such measures. Infiltration should be the first method considered for the drainage of sites and as such, a site-specific FRA would be required to demonstrate the feasibility of infiltration measures.

Figure 3-95 : Site 116 Geology



3.14.5.3 Site-specific Flood Risk Assessment

A site-specific FRA would be required to accompany the planning application for this site because it is greater than 1ha in size in accordance with NPPF paragraph 103 and is within a WCDA in accordance with NPPF paragraph 103 and WDC policy on Managing flood risk and Sustainable Drainage Systems. The review of flood risk has identified a number of issues that a site-specific FRA would need to consider in addition to those usually required:

- Design the more vulnerable development in such a way as to avoid encroachment into Flood Zones 2 and 3;
- The site is not within an area included within the extent of a detailed hydraulic model, consequently hydraulic modelling will be required to confirm present day flood risk and the predicted impact of climate change;
- Consider how the site can be developed in such a manner to avoid encroachment into the WCDA where practicable;
- If the highway is developed within Flood Zone 3a, the crossing should be designed and constructed to remain operational and safe in times of flood whilst not exacerbating flood risk elsewhere, in order to pass the Exception Test;
- If the development does encroach into the WCDA:
    - Demonstrate that finished floor levels are above the High and Medium uFMfSW risk peak water levels (plus an allowance for climate change);
    - No habitable below-ground rooms are constructed in such areas; and
    - Demonstrate that the surface water flow path can be maintained, or modifications to it as a result of the development will not detrimentally affect third parties.
- Ensure that the development does not impede the surface water flow path indicated on the site;
- Demonstrate that safe access and egress can be achieved during a fluvial, surface water and/or groundwater flood event;
- Demonstrate how the elevated risk of groundwater flooding would be addressed and mitigated for, as a minimum avoiding the construction of below-ground habitable rooms;
- Not develop within ten meters of the ordinary watercourse to provide a buffer zone for maintenance activities and to prevent encroachment to the watercourse in accordance with Wycombe District Council's relevant policy on flood risk;
- Attenuation measures to reduce existing levels of flood risk to properties immediately downstream;
- The suitability of infiltration of runoff to ground based on an assessment of groundwater levels;
- The risk of culvert blockage downstream and how it would be managed as part of the development; and
- Opportunities for betterment via the interception of surface water flow paths through the site, flow attenuation could benefit the development and existing properties downstream.

3.15 Site 137: Land North of Lower Icknield Way, Longwick Site Detailed Assessment

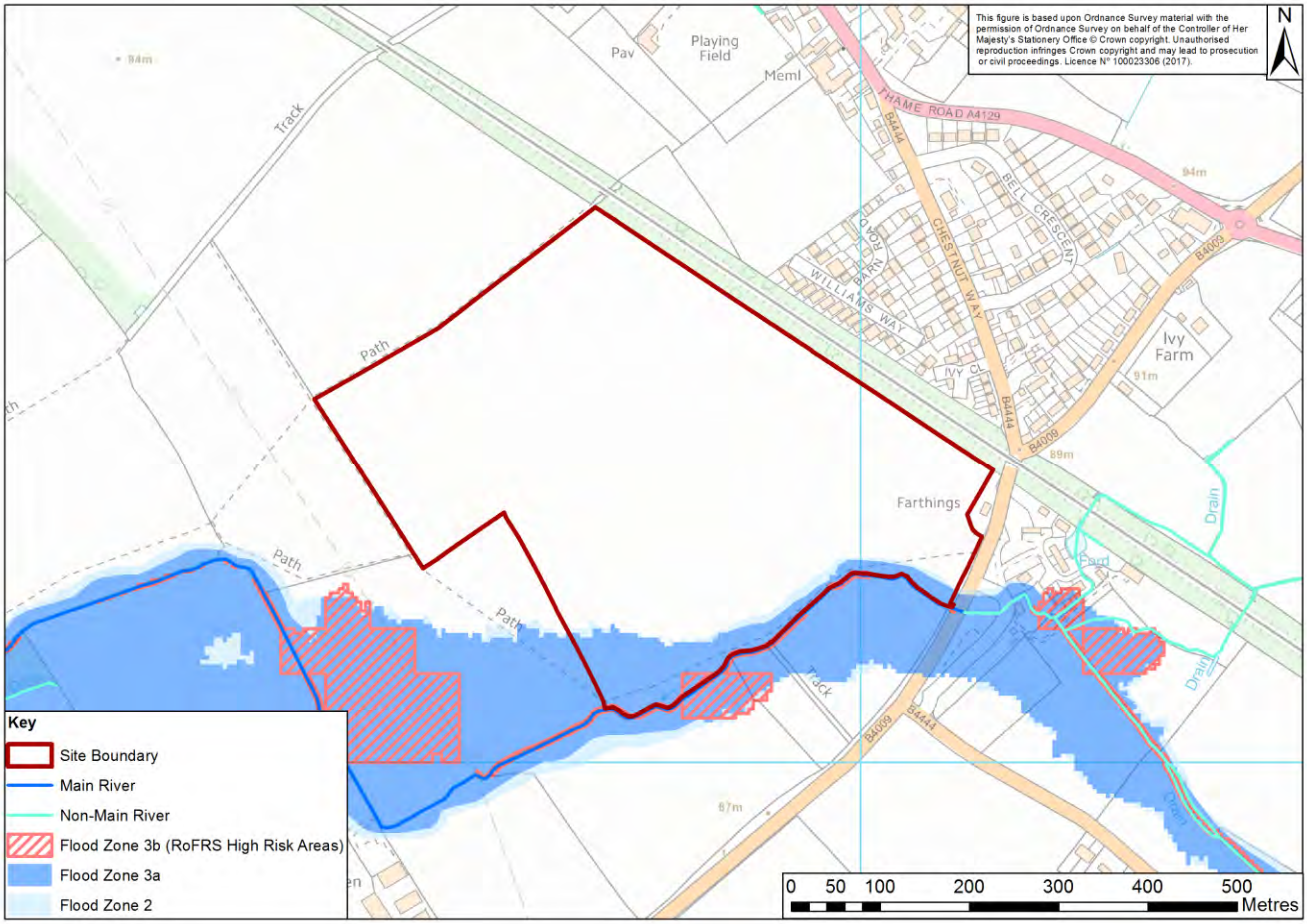
3.15.1 Site Description

The allocation site, Land North of Lower Icknield Way (planning ref: PR10), is located to the north-west of Princes Risborough, to the south of the railway line and Longwick. The NGR for the site is SP 7883 0435. The site is currently farmland and is an area of approximately 22.5ha. The site is currently proposed for employment uses. This site has been assessed in detail because it is within 50m of the extent of published Flood Zone 2: see Section 2.1.

3.15.2 Fluvial Flood Risk

The fluvial flood risk to the site is presented in Figure 3-96.

Figure 3-96: Site 137 Fluvial Flood Risk



The site is bound by the railway line to the north; an unnamed EA designated Main River to the south and the field boundary. The southern corner of the site adjacent to the watercourse is designated as Flood Zone 2 and 3a. Approximately 1% of the site area is designated as Flood Zone 3b adjacent to the watercourse; see Figure 3-96. The historical flood map does not identify any fluvial flood events that have affected this site. The site is not situated within the River Wye or Thames hydraulic model extents; therefore, the applicant would need to consider the likely impact of climate change factors and how the site would be affected.

Table 3-46: Site 137 Current Flood Zone Extents

Flood Zone	1	2	3a	3b	Total
Extent (ha)	20.3	0.2	1.8	0.2	22.5
Coverage (%)	90	1	8	1	-

In the absence of hydraulic modelling covering this site, the applicant will need to liaise with the EA to confirm the need to undertake detailed hydraulic modelling to confirm the degree of fluvial flood risk and the predicted impact of climate change, predicted flood depth and hazard for this allocation site.

A review of the uFMfSW mapping (see Figure 3-97) does not indicate an overland flow path intersecting the fluvial flood zones which would be an indication of lower topography which could be expected to flood before other (lower areas) due to increased rainfall and flows increasing the extent of the fluvial flood zones due to climate change. Consequently, in the absence of detailed hydraulic modelling the fluvial flood extents are not considered to be sensitive to the predicted impacts of climate change.

3.15.2.1 Flood Defence Failure

There are no raised defences in the vicinity of the site. The adjacent watercourse is in open channel at this point so it is considered that there is a low risk of flooding as a result of culvert blockage to this site.

3.15.3 Risk of Flooding from Other Sources

3.15.3.1 Surface Water

Surface water flood risk based on the uFMfSW is presented in Figure 3-97.

Figure 3-97: Site 137 Surface Water Flood Risk

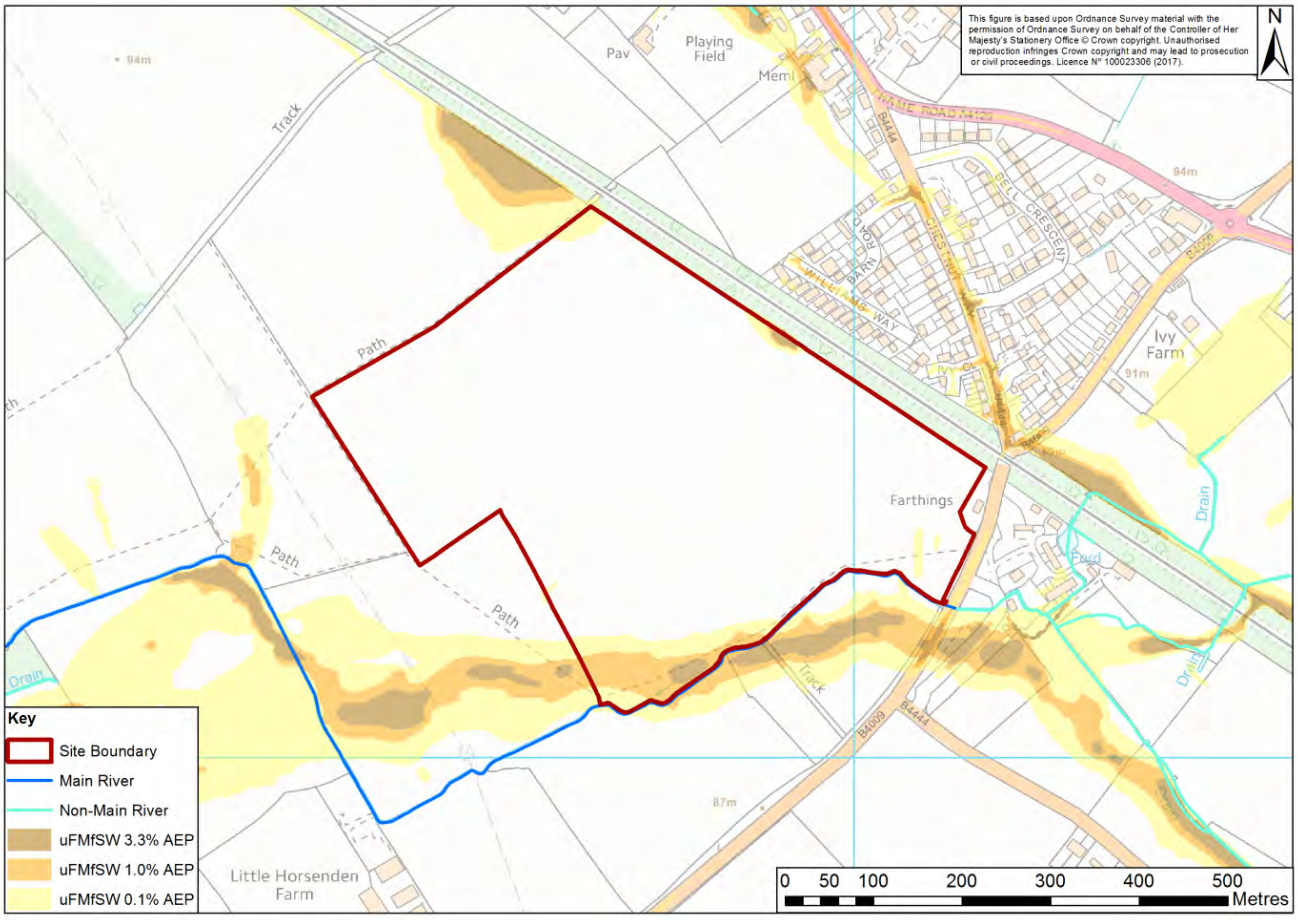


Table 3-47: Site 137 uFMfSW Extents

Event (AEP)	3.33% (1 in 30)	1% (1 in 100)	0.1% (1 in 1000)
Extent (ha)	0.5	0.9	1.6
Coverage (%)	2	4	7

Primarily the south of the site appears to be at greatest risk of surface water flooding based on the uFMfSW, approximately 7% of the site is at risk of surface water flooding from a 0.1% (1 in 1,000) AEP event (see Table 3-47). It would appear there is a flow path following an ordinary watercourse (although not indicated by the detailed river network dataset) which could interact with the development and affect access to and from the site. There are pockets of flooding predicted in the site which may be the result of rainfall filling localised depressions in the hydraulic model used to develop the extents. The Level 1 SFRA indicates flooding during Winter 2013/14, from surface water/groundwater sources in the area.

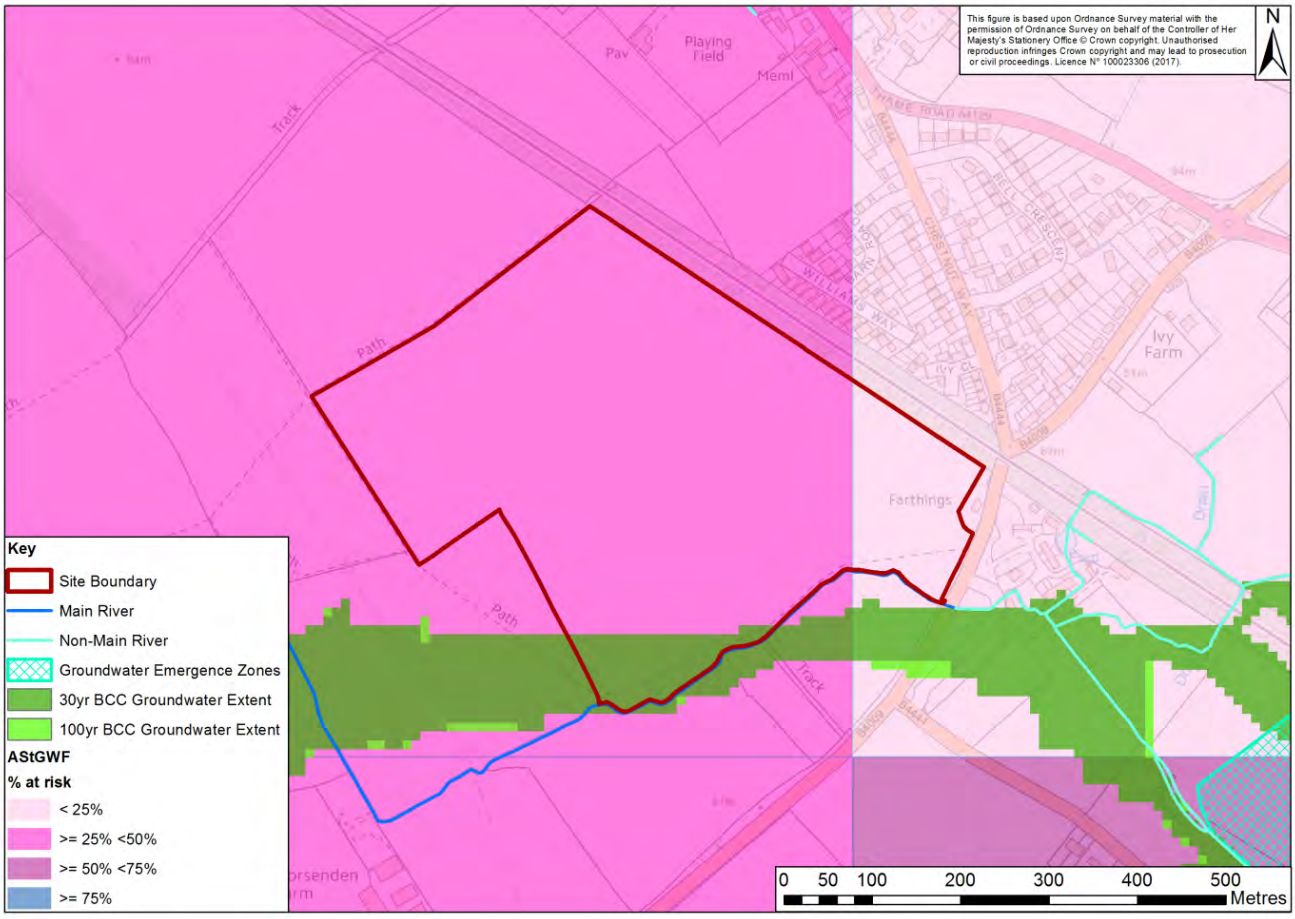
Climate change has the potential to increase the risk of surface water flooding to the site. Although beyond the scope of this SFRA to quantify the predicted impact, the risk of flooding to those areas currently assessed as

'Low' surface water risk could increase as a result of climate change and consequently they could become re-classified as WCDA. Such a risk would need to be quantified by the applicant in order to demonstrate that the site could be developed safely for future users, taking into account the planning implications of such a result.

3.15.3.2 Groundwater

A review of EA AStGWF mapping indicates that the majority of the site is at low risk of flooding (within a grid square where between 25% and 50% is at risk of groundwater emergence). There are areas at slightly lower risk of flooding at the eastern side of the site. BCC groundwater modelling indicates the site is at risk of flooding to the southern section of the site from both the 3.33% (1 in 30) and 1% (1 in 100) AEP modelled groundwater events. The site is not located in a groundwater emergence zone. See Figure 3-98.

Figure 3-98: Site 137 Groundwater Flood Risk



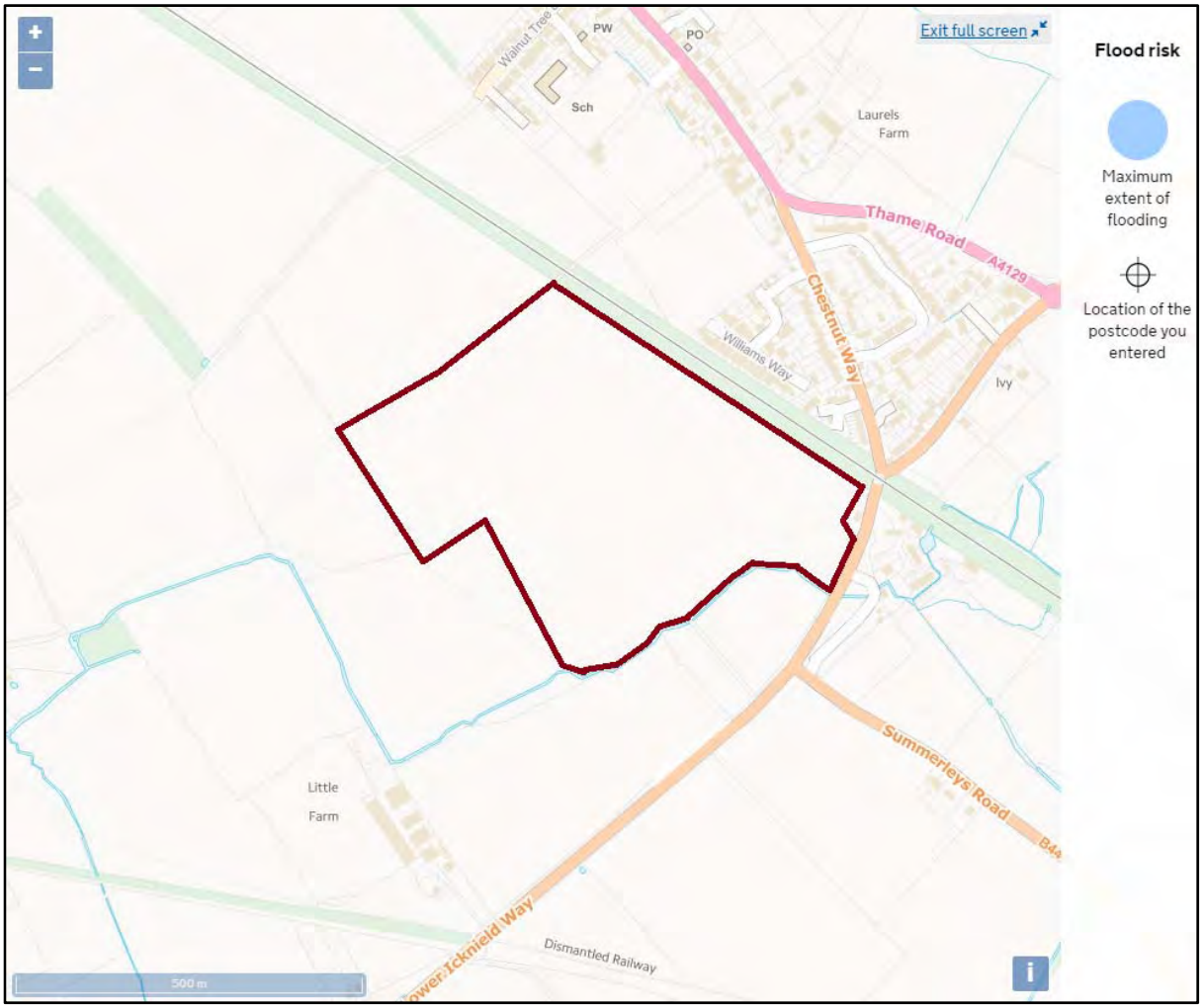
3.15.3.3 Sewers

With reference to Figure 7 of the Level 1 SFRA, the site is in a post code that recorded 1-5 incidents of sewer flooding affecting properties internally and 16-20 externally in the 20 years preceding 2014.

3.15.3.4 Reservoir Failure

A review of the predicted flood extent as a result of reservoir failure available online indicates that the site is not at risk of flooding from such an event. See Figure 3-99.

Figure 3-99: Site 137 Risk of Flooding from Reservoir Failure



Source: https://flood-warning-information.service.gov.uk/long-term-flood-risk/map?map=SurfaceWater © Crown copyright and database rights 2017 OS 100024198

3.15.4 The Exception Test

The site is located within Flood Zones 1, 2, 3a and 3b. The proposed development is for employment use which would be classified as 'Less Vulnerable'[44] and would therefore be acceptable provided it does not encroach the small area in 3b. It would not need to pass the Exception Test[45]. The applicant should avoid developing within the WCDA in the southern section of the site.

3.15.5 Flood Risk Management

3.15.5.1 Opportunities for Betterment

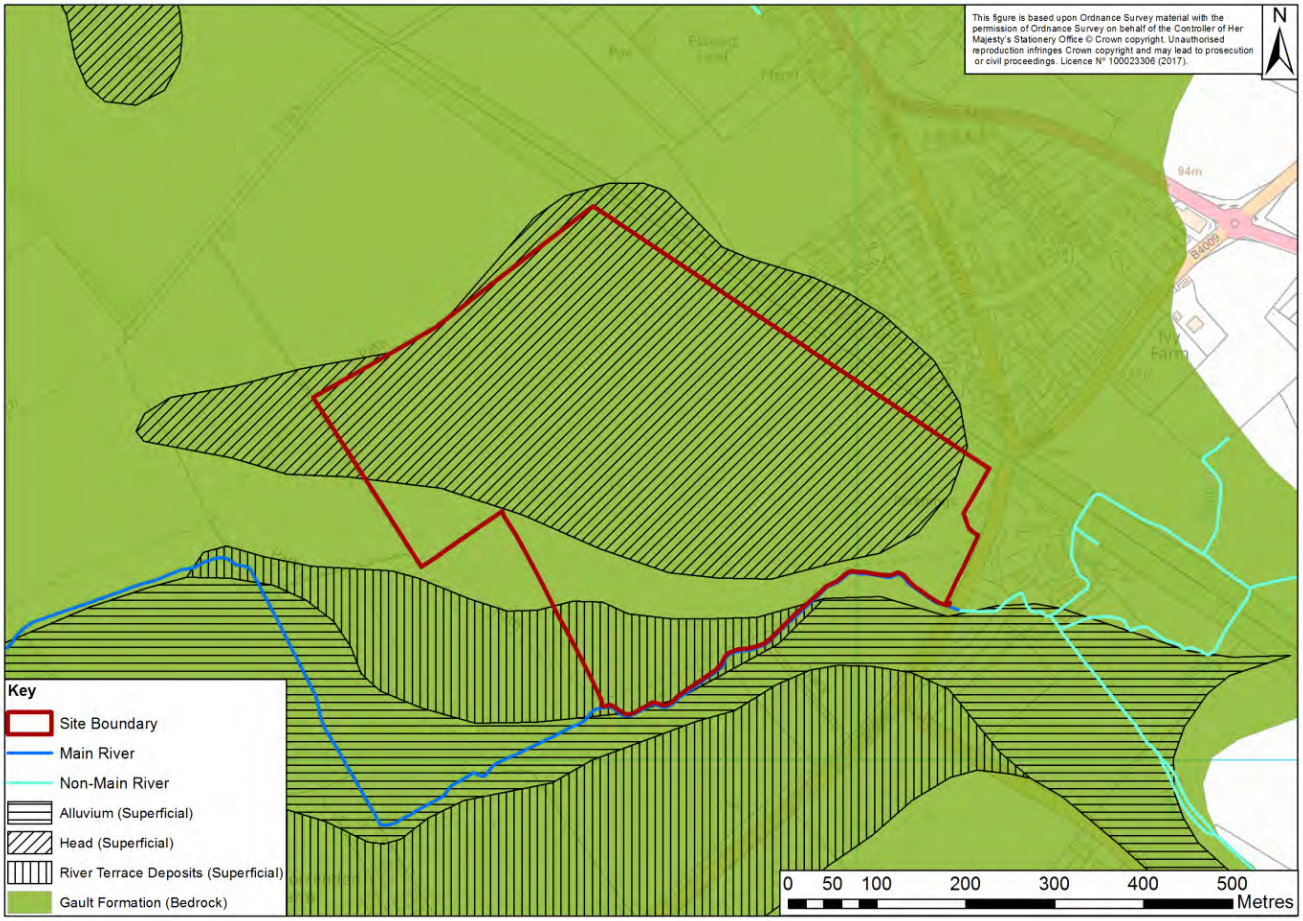
Consideration of how surface water attenuation measures could be installed should also be undertaken to identify opportunities for providing betterment to surface water flood risk across the site. It is noted that there are few properties at risk of flooding immediately downstream of the development site although attenuation of the predicted surface water flow path could benefit others further downstream.

[44] NPPG Table 2 / Paragraph 066
[45] NPPG Table 3 / Paragraph 067

3.15.5.2 Potential Feasibility of Infiltration Measures

A review of the site geology (see Figure 3-100) suggests it is underlain layers of Alluvium, Head and River Terrace Deposits (superficial) and Gault Formation (bedrock). The thickness of each layer is not included within the information. Surrounding strata have been omitted for clarity if they are not present directly beneath the site. Consequently, infiltration of rainfall directly to ground may be practicable. The proximity of the watercourse may result in locally high groundwater levels potentially reducing the feasibility of such measures. Infiltration should be the first method considered for the drainage of sites and as such, a site-specific FRA would be required to demonstrate the feasibility of infiltration measures.

Figure 3-100 : Site 137 Geology



3.15.5.3 Site-specific Flood Risk Assessment

A site-specific FRA would be required to accompany the planning application for this site because it includes areas of Flood Zones 2 and 3 and it is greater than 1ha in size in accordance with NPPF paragraph 103 and is within a WCDA in accordance with NPPF paragraph 103 and WDC policy on Managing flood risk and Sustainable Drainage Systems. The review of flood risk has identified a number of issues that a site-specific FRA would need to consider in addition to those usually required:

- The development should not encroach into the WCDA where practicable;
- If the development does encroach into the WCDA:
    - Demonstrate that finished floor levels are above the High and Medium uFMfSW risk peak water level (plus an allowance for climate change); and

- No habitable below-ground rooms are constructed in such areas; and
- Demonstrate that the flow path can be maintained, or modifications to it as a result of the development will not detrimentally affect third parties.

- Demonstrate how the elevated risk of groundwater flooding in the south of the site would be addressed;
- Opportunities for flood risk betterment; and
- Confirmation of the suitability of infiltration of runoff to ground based on an assessment of groundwater levels.

3.16 Site 141: Westhorpe House Detailed Assessment

3.16.1 Site Description

The Westhorpe House site (planning ref: SWC0082) is located to the south of High Wycombe, to the north of the River Thames and east of the A404 and Marlow. The NGR for the site is SU 8664 8728. The site currently hosts Westhorpe House (a Grade II listed building) and open land is an area of approximately 1.87ha. The current proposal is construct 12 residential properties on the site. This site has been assessed in detail because it is within 50m of the extent of published Flood Zone 2: see Section 2.1.

3.16.2 Fluvial Flood Risk

The fluvial flood risk to the site is presented in Figure 3-1.

Figure 3-101: Site 141 Fluvial Flood Risk

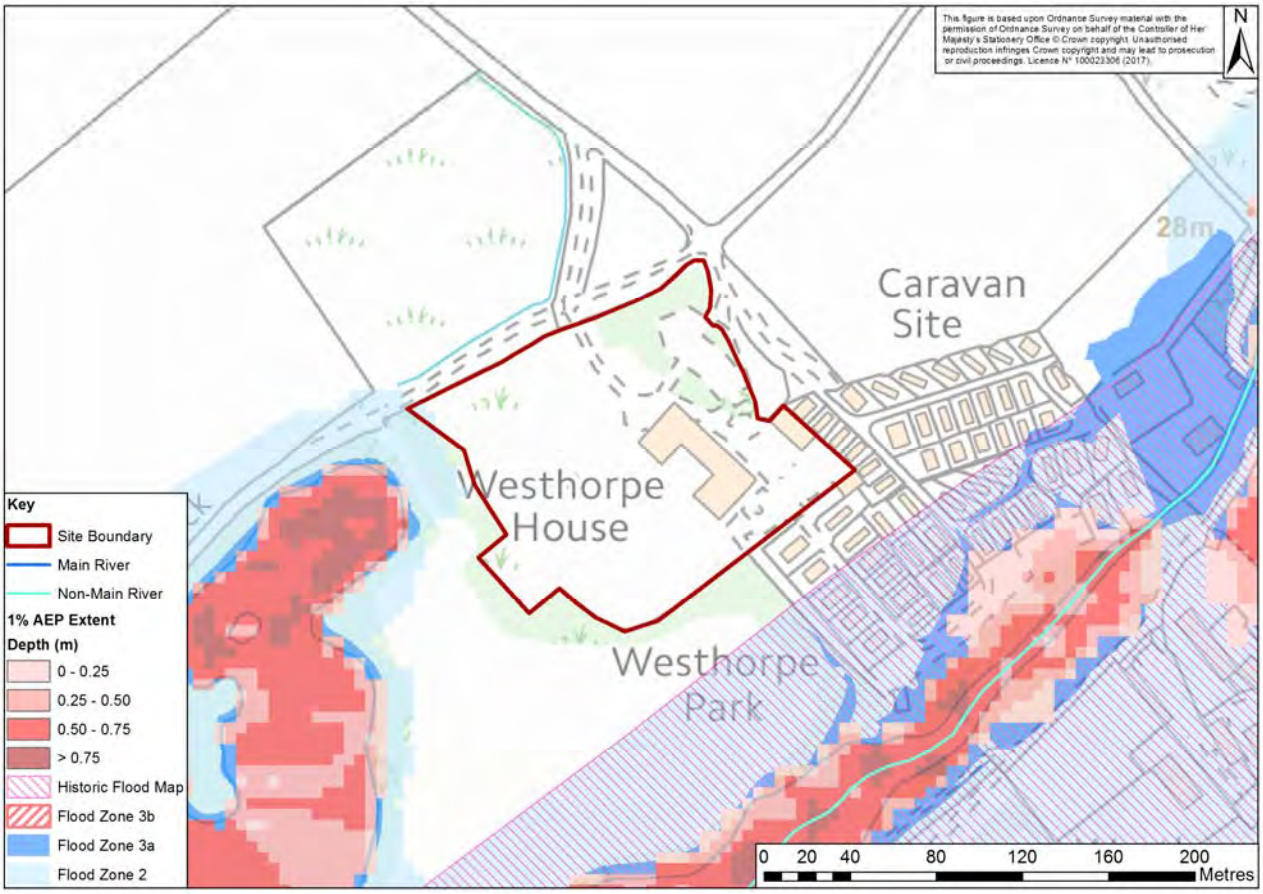


Table 3-48: Site 141 Flood Zone Extents

Flood Zone	1	2	3a	3b	Total
Extent (ha)	1.83	0.04	0	0	1.87
Coverage (%)	98	2	0	0	-

Table 3-49: Site 141 Modelled 1% (1 in 100) AEP Event Extent

AEP Event	Extent (ha)	%
1% (1 in 100)	0	0

The site is bounded by a track to the north, by a road and existing properties to the east and by properties and a field boundary to the south. The site is approximately 850m north of the River Thames. The majority of the site falls within Flood Zone 1 (with the exception of the extreme north-western corner which is in Flood Zone 2). The historical flood map does not identify any fluvial flood events that have affected this site.

Both the published Flood Zone 3 and the newly modelled 1% (1 in 100) extent are predominantly retained within the river channel and lake to the west of the site at this location. The modelling of the predicted impact of climate change places the site within Flood Zone 3 in the future, for the +70% CC scenario (see Figure 3-2).

Figure 3-102 : Site 141 Fluvial Flooding with Climate Change

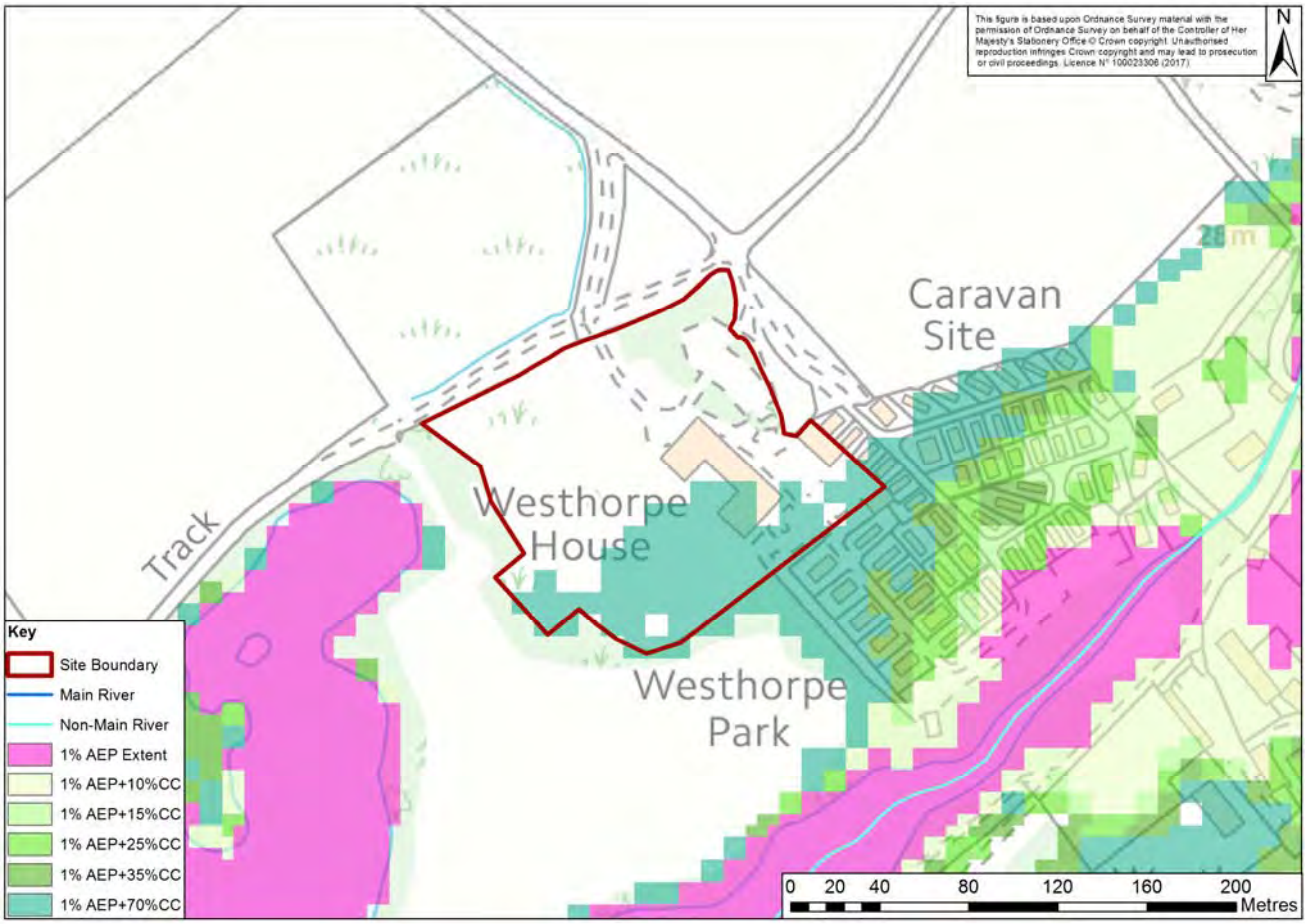


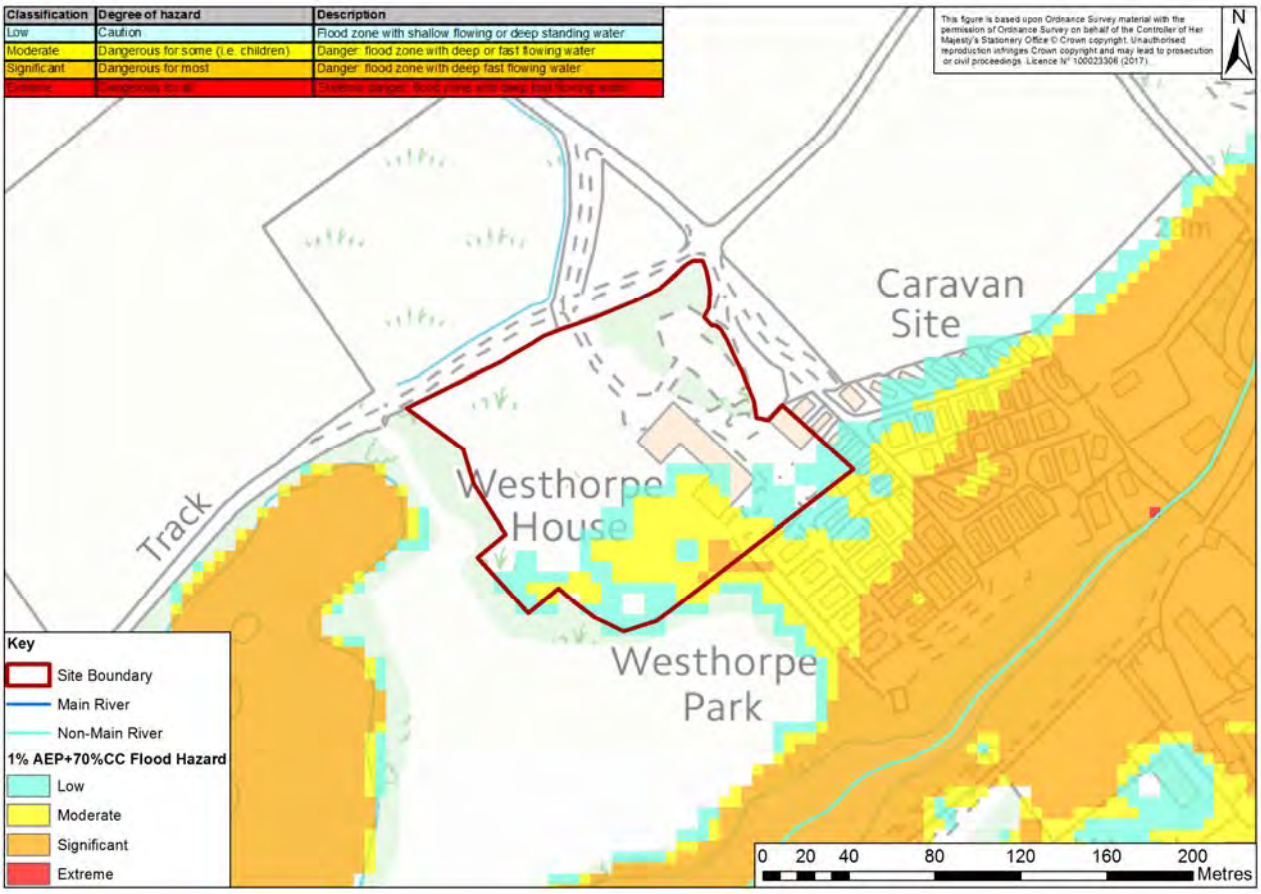
Table 3-50: Site 141 Fluvial Flooding with Climate Change Extents

Climate Change Uplift (%)	10	15	25	35	70	Total
Extent (ha)	0	0	0	0	0.62	1.87
Coverage (%)	0	0	0	0	33	-

Table 3-3 indicates approximately 33% of the site is at risk of flooding from the 1% (1 in 100) + 70% climate change extent.

Figure 3-3 indicates that the southern and south-eastern ends of the site are designated as having Low to Moderate flood hazard. The small area in the south-eastern section of the site (on the site boundary) is designated as having a Significant flood hazard. The application should take this into account and ensure safe access and egress from the site is available following development.

Figure 3-103 : Site 141 Flood Hazard



3.16.2.1 Flood Defence Failure

There are no raised defences in the vicinity of the site.

3.16.3 Risk of Flooding from Other Sources

3.16.3.1 Surface Water

Surface water flood risk based on the uFMfSW is presented in Figure 3-4.

Figure 3-104: Site 141 Surface Water Flood Risk

Table 3-51: Site 141 uFMfSW Extents

Event (AEP)	3.33% (1 in 30)	1% (1 in 100)	0.1% (1 in 1000)
Extent (ha)	0	0.04	0.06
Coverage (%)	0	2	3

The majority of the site is designated as having a Very Low first of surface water flooding (not at risk from a 0.1% (1 in 1000) AEP event). An area along the south-eastern site boundary is however at risk of flooding from both the 3.33% (1 in 30) and 1% (1 in 100) AEP events (see Table 3-4). There do not appear to be any surface water flow routes through the site.

3.16.3.2 Groundwater

For the two sources of mapping below, the AStGWF depicts the likelihood of groundwater emergence; the JBA mapping shows depth to groundwater level beneath ground.

A review of the EA's AStGWF mapping indicates that the entirety of the site is at moderate risk of flooding from groundwater sources (within a grid square where between 50% and 75% is at risk of groundwater emergence). The eastern section of the site is located within a zone identified as at risk of groundwater emergence. See Figure 3-5.

Figure 3-105: Site 141 Groundwater Flood Risk

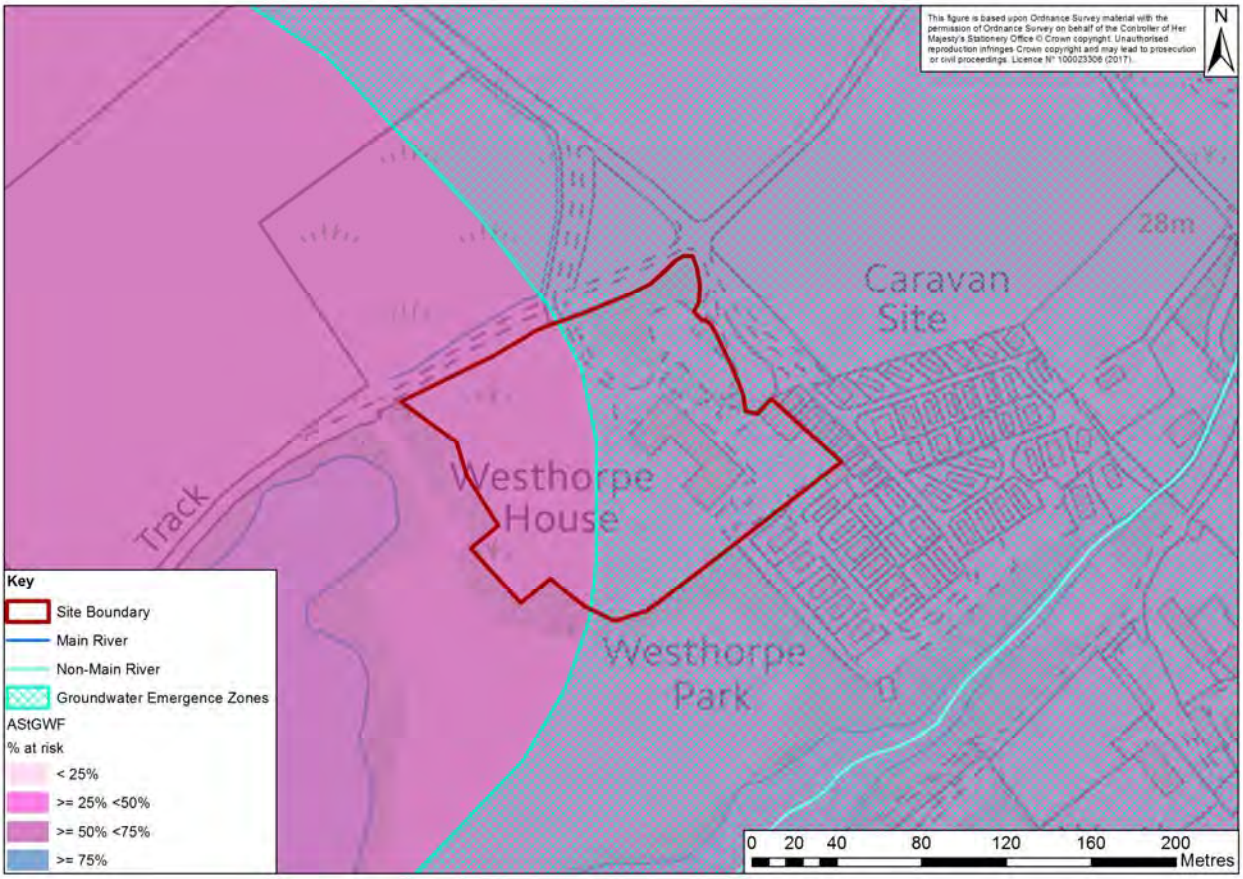
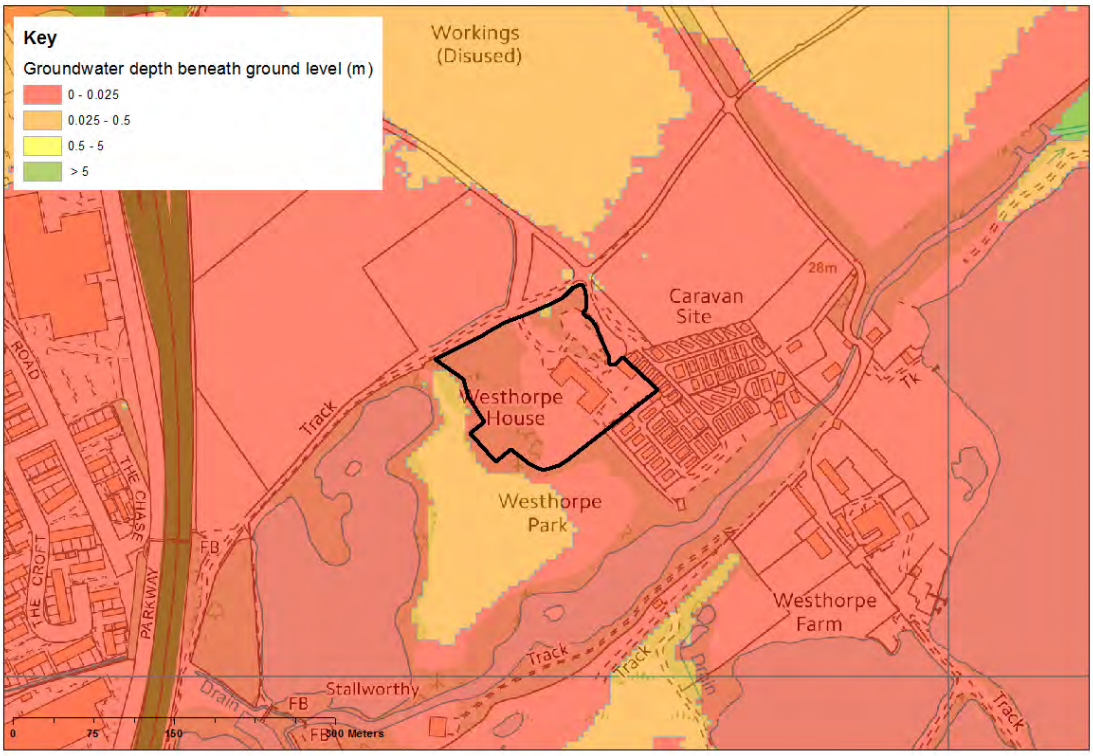


Figure 3-106 depicts groundwater mapping completed by JBA, showing a high risk of groundwater flooding and that the groundwater levels are either at or very near to (within 0.025m) the ground surface at this site.

Figure 3-106 : Site 141 JBA Groundwater Mapping



3.16.3.3 Sewers

With reference to Figure 7 of the Level 1 SFRA[46], the site is located in post code area SL7 that recorded 6-10 incidents of sewer flooding affecting properties internally and 16-20 externally in the 20 years preceding 2014.

3.16.3.4 Reservoir Failure

A review of the predicted flood extent as a result of reservoir failure available online indicates that the site is not at risk of flooding from such an event. See Figure 3-7.

[46] Wycombe District Council Strategic Flood Risk Assessment Level 1 Update, Jacobs, November 2014

Figure 3-107: Site 141 Risk of Flooding from Reservoir Failure

Source: https://flood-warning-information.service.gov.uk/long-term-flood-risk/map?map=SurfaceWater © Crown copyright and database rights 2017 OS 100024198

3.16.4 The Exception Test

The site is currently located within Flood Zones 1 and 2. The proposed development of 12 residential properties would be classified as 'More Vulnerable'[47].

When the predicted impact of climate change is considered for the assumed classification the applicant would need to avoid development in the area predicted to be at risk of flooding on the south of the site. Assuming a design life beyond 2069, the EA guidance requires that the applicant consider the impact of the 'higher central' allowance of +70%. This flood event is extensive across the southern section of the site; the deepest flood depths are on the southern boundary (up to 0.65m adjacent to the boundary). The applicant will need to design the site layout in such a way to incorporate extreme flooding, in doing so the site would pass the second part of the Exception Test.

[47] NPPG Table 2 / Paragraph 066

3.16.5 Flood Risk Management

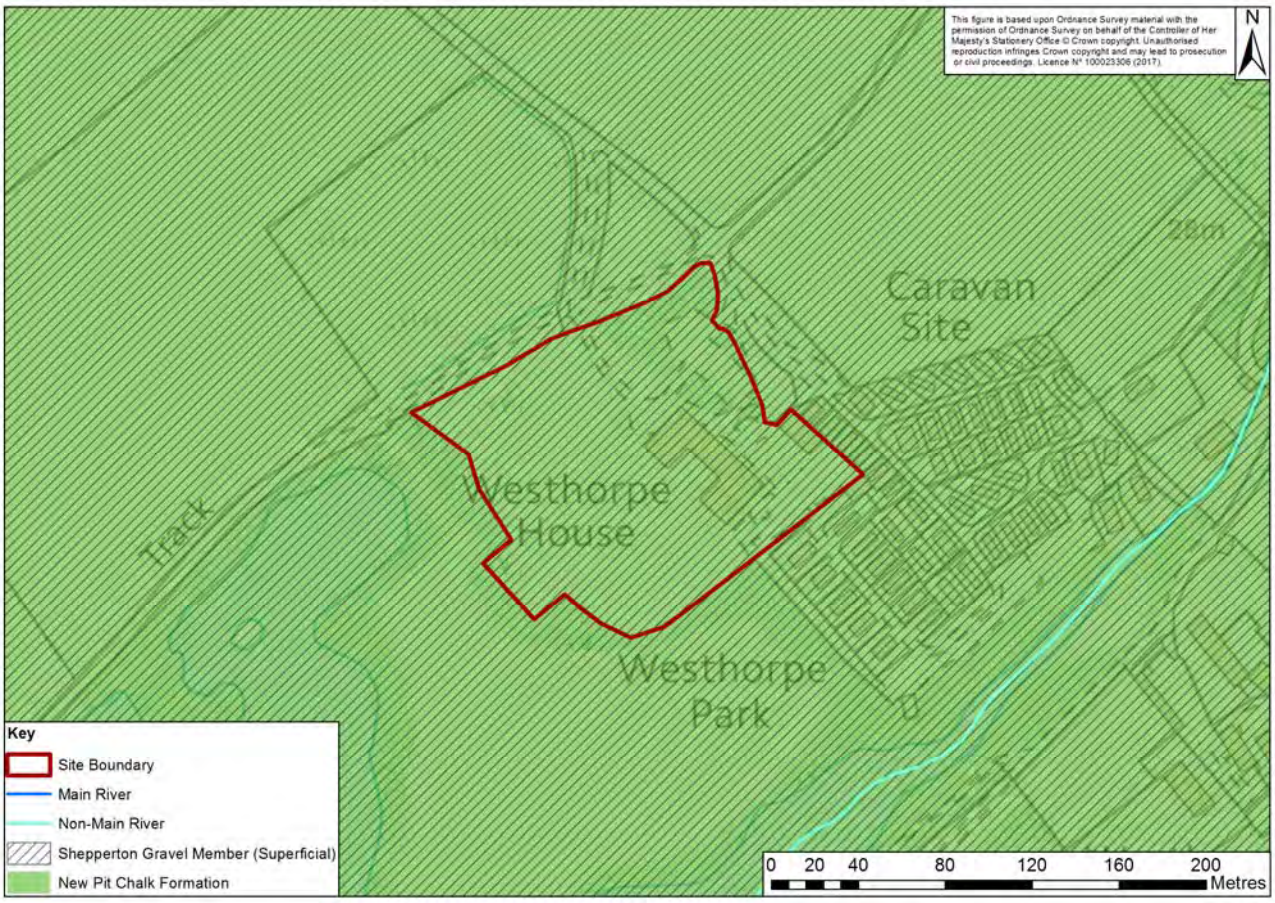
3.16.5.1 Opportunities for Betterment

The site is predominantly located within Flood Zone 1 with no significant surface water flow paths through it, therefore it is considered that there is little opportunity for flood risk betterment through the re-development of this site, unless as part of long-term, catchment-wide, incremental reductions in runoff, potentially as part of a defined policy by BCC as the LLFA.

3.16.5.2 Potential Feasibility of Infiltration Measures

A review of the site geology (see Figure 3-8) suggests it is underlain by a layer of Shepperton Gravel (superficial deposit) and Chalk bedrock (New Pit Formation). The thickness of each layer is not included within the information. Surrounding strata have been omitted for clarity if they are not present directly beneath the site. Consequently, infiltration of rainfall directly to ground may be practicable. The proximity of the lake to the west of the site may result in locally high groundwater levels potentially reducing the feasibility of such measures. Infiltration should be the first method considered for the drainage of sites and as such, a site-specific FRA would be required to demonstrate the feasibility of infiltration measures.

Figure 3-108 : Site 141 Geology



3.16.5.3 Site-specific Flood Risk Assessment

A site-specific FRA would be required to accompany the planning application for this site because it is greater than 1ha in size in accordance with NPPF Paragraph 103. The review of flood risk has identified a number of

issues that a site-specific FRA would need to consider in addition to those required of national and local planning policy:

- Consideration of the risk of groundwater flooding;
- The suitability of infiltration measures for drainage of the site given the local geology and the influence of the adjacent lake on local groundwater levels;
- The risk of flooding from fluvial climate change scenarios and how best to mitigate the effects on development; and
- The risk of flood hazard from climate change scenarios and how these can be mitigated.
- Avoidance of areas designated as at risk of flooding from surface water and groundwater sources, where practicable; and
- Demonstrate how the elevated risk of groundwater flooding in the site would be addressed and mitigated.

4. Sustainable Flood Risk Management

The role of the LLFA is summarised in the Level 1 SFRA. This section provides an overview of WDC's planning requirements for the consideration of flood risk and development to ensure that flood risk is managed sustainably. WDC's requirements of planning applicants under the new Local Plan are set out in the emerging policy on Managing Flood Risk and Sustainable Drainage Systems.

The risk of flooding can never be completely eliminated, but the likelihood and consequences of flooding can be minimised through good management. One of the key aims of the EA's National Flood and Coastal Erosion Risk Management Strategy and the BCC LFRMS is to improve flood risk management in a sustainable way: flood risk must be reduced but not in such a way that it compromises the economic, social and environmental requirements of future generations. One of the defined roles of LLFA's in the Flood & Water Management Act 2010 is for them to aim to contribute towards the achievement of sustainable development.

The primary purpose of the SFRA is to inform decision-making as part of spatial planning policy and development management processes, taking due consideration of the scale and nature of flood risk affecting the District. Responsibility for flood risk management resides with all tiers of government, and indeed individual landowners and planning applicants.

4.1 Site Allocations

This Level 2 SFRA identifies the risk of flooding to the proposed allocation sites across the District, demonstrating whether the development proposals can pass the second part of the Exception Test. A summary of the site assessments and future requirements is included in Appendix A.

The planning process should lead to the avoidance of flood risk by where possible steering development towards the areas of lowest flood risk. The NPPF stipulates the application of a sequential approach to site allocation, utilising the Sequential Test. A flow diagram demonstrating the application of the Sequential Test for a local plan site allocation is provided in the NPPG (Diagram 2 in Flood Risk and Coastal Change, Paragraph 021).

Development sites should be allocated within areas of lowest flood risk in the first instance – in Flood Zone 1 (which relates to flooding from river and sea), but the NPPG stipulates that other sources of flooding must be considered, so WCDAs in Flood Zone 1 must be taken into account. Only if it can be demonstrated that there are no suitable sites within areas with the lowest flood risk (taking into account all sources of flooding) should alternative sites (i.e. within areas that may potentially be at greater risk of flooding) be contemplated, taking account of the vulnerability of the proposed land use. Tables 2 and 3 in the NPPG stipulate 'appropriate' land uses for each Flood Zone.

Table 3 in the NPPG identifies types of development that should not be permitted in particular Flood Zones via the application of the Sequential Test. It also identifies types of development which may be allocated in zones of higher flood risk (from rivers and sea) via the application of the Exception Test.

Paragraph 102 of the NPPF states that "*For the Exception Test to be passed:*

- *it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh the flood risk, informed by a SFRA where one has been prepared; and*
- *a site-specific flood risk assessment must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.'*

The latter point includes a requirement for account to be taken to the future risk from climate change over the lifetime of the development.

The NPPG (SFRA guidance, paragraph 012) states that "*where a Level 1 Assessment shows that land outside flood risk areas cannot appropriately accommodate all the necessary development, it may be necessary to increase the scope of the Assessment to a Level 2 to provide the information necessary for application of the Exception Test where appropriate*".

RECOMMENDATION: WDC to use the findings of this Level 2 SFRA to complete the Sequential Test, and if necessary, the Exception Test, to allocate sites in the Local Plan.

RECOMMENDATION: The recommendations provided for each allocation site in this SFRA should be communicated by WDC to the applicant for them to incorporate in their design proposals. Ultimately, applicants must demonstrate that the site will be developed safely for the lifetime of the development as indicated in emerging policy on Managing Flood Risk and Sustainable Drainage Systems. The design must also demonstrate flood risk is not exacerbated elsewhere to pass the Exception Test and be approved by the planning authority.

4.2 Planning Advice and Windfall Sites

Planning applications can be submitted both for allocation sites and those not formally allocated in the Local Plan: known as windfall sites. Flood risk at windfall sites may not have been previously considered in detail by the local planning authority as part of the SFRA process. The emerging Local Plan policy on Managing Flood Risk and Sustainable Drainage Systems provides applications with clear guidance on what is expected of their application:

"1) Development in any area at risk of flood from any source, where the development has not been allocated in a Local Plan document, will be required to evidence compliance with the sequential test and (as necessary) the exceptions test as set out in national policy (NPPF)."

The NPPF[48] stipulates that a site-specific flood risk assessment (FRA) is required for:

- Development proposals on sites of 1 hectare or greater in FZ1;
- All proposals for new development (including minor development and change of use) in FZ2 and FZ3;
- All proposals for new development (including minor development and change of use) in an area within FZ1 which has critical drainage problems (as notified to the local planning authority by the EA); and
- Where proposed development or a change of use to a more vulnerable class may be subject to other sources of flooding (groundwater or surface water flooding).

Section 5.7 of the Level 1 SFRA summarises WDC's requirements for site-specific FRAs. It is noted that the EA has not notified WDC of any areas within Flood Zone 1 with critical drainage problems at present. However, areas which are likely to be most at risk of flooding from local sources, and where sustainable drainage solutions should be a priority, have been identified in the Level 1 SFRA and have been delineated as WCDA. This is different from the CDA terminology used by the EA but nevertheless effectively means the same thing.

Flooding from local sources also occurs outside the mapped WCDAs within Flood Zone 1, but a FRA is not always required. In this respect, the NPPF requires a FRA for all sites greater than 1ha in area within Zone 1. FRAs for sites in Zone 1 should be proportionate to the level of risk and focus on records of past flooding and sustainable drainage solutions.

The EA provides detailed Standing Advice, available online[49], to assist with both the development and evaluation of FRA. This includes information on their scope and which accompanying plans to be submitted. In addition to a Flood Risk Standing Advice Tool for Local Planning Authorities, advice specific to the fluvial flood zone in which the proposed development lies and the broad size of the development is provided. For example, there is specific standing advice for proposed developments in fluvial Flood Zone 1, which are less than 1ha in

48 Footnote 20, page 24
49 www.gov.uk/planning-applications-assessing-flood-risk

size. It is also noted that a homeowner's guide to flood resilience has been published at http://www.knowyourfloodrisk.co.uk.

For windfall sites each site-specific FRA must follow the Sequential Test, and if required the Exception Test. Paragraph 103 of the NPPF stipulates that *"when determining planning applications, local authorities should ensure flood risk is not increased elsewhere and only consider development appropriate in areas at risk of flooding where, informed by a site specific FRA, it can be demonstrated that:*

- *Within the site, the most vulnerable development is located in areas of lowest flood risk unless there are overriding reasons to prefer a different location; and*
- *The development is appropriately flood resilient and resistant, including safe access and escape routes where required, and that any residual risk can be safely managed, including by emergency planning; and it gives priority to the use of sustainable drainage systems; and"*

Paragraph 104 of the NPPF notes the following exceptions to this:

- *The Sequential Test need not be applied where the proposed site is allocated in the development plan; and*
- *The Sequential and Exception Tests should not be applied for applications for minor development and changes of use, 'except for any proposal involving a change of use to a caravan, camping or chalet site, or to a mobile home or park home site, where the Sequential and Exception Tests should be applied as appropriate'.*

The NPPF requirements are supplemented by planning policies in relation to flooding set out in the BCC LFRMS and in local planning documents produced by WDC, including with regard to FRAs, sustainable drainage and flood resilience. Relevant policies are set out in Section 2.3 of the Level 1 SFRA and in Section 1.4 of this SFRA. In its role as a statutory consultee for planning applications, the EA will provide comment on applications for sites at higher risk of flooding, although their role is set to decrease in future.

A Site-Specific FRA Checklist is provided by the Government as part of the Planning Practice Guidance and should be used as the starting point for all site-specific FRAs. It is available online at: http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastalchange/site-specific-flood-risk-assessment-checklist/

It should be noted that since the policies outlined in DCLG Written Statement HCSWS161 on sustainable drainage systems came into effect on 6 April 2015, the local planning authority is required to consult the relevant LLFA on the management of surface water in planning applications, and satisfy themselves that the proposed minimum standards of operation are appropriate. This policy applies to all developments of ten homes or more and to major commercial development.

Developers should be aware that the EA are continually refining and updating the flood zone mapping. They should therefore consult with the EA to ensure that the latest extents are used when assessing the risk of flooding.

RECOMMENDATION: Applicants should use the Government's FRA checklist as the starting point for any flood risk assessment to be submitted with their planning application, utilising the information contained within the Level 1 and this Level 2 SFRA in both their FRA and design proposals; this will provide the evidence required to enable WDC to undertake the Sequential Test if necessary. In this respect, as noted above, WDC should consider a policy in the Local Plan, which would require developers to utilise the checklist and review the Level 1 and 2 SFRA's as a starting point in relation to flood risk guidance. Equally, planning officers should use the information contained in the checklist, the NPPG and this SFRA to inform their evaluation of planning applications and any accompanying FRAs. It should be noted that, in line with the NPPF, all sources of flooding must be considered, including from surface water and groundwater. When granting planning permission, the use of planning conditions and Section 106 agreements should be considered, where necessary, to prevent any increase in flood risk and to assist in securing flood risk reduction measures.

The SFRA mapping will be of particular use in identifying key information for the FRA, including Flood Zones, WCDA and flood management assets, but must be read in conjunction with the SFRA text. The Level 1 SFRA provides information on flood risk at specific locations and highlights key issues to consider, including the potential effects of climate change on flood risk and location of flood management infrastructure. This Level 2 SFRA also provides the extent of Flood Zone 3a as a result of the predicted impact of climate change as required by the current requirements of EA guidance[5].

However, it is important to note that the SFRA provides the most up-to-date information at the time of writing, but the data could change with time. The SFRA mapping is also taken at a district-wide level and more localised mapping and flood history information will be needed to determine flood risk at specific sites. The EA, BCC and WDC will be important sources for the latest data.

Compliance with current planning policy in relation to flooding contained in the NPPF and in planning policy documents produced by WDC should be demonstrated by applicants in their planning applications and considered by planning officers in their determination of applications, including with regard to FRAs, sustainable drainage and flood resilience.

Key contacts:

- Environment Agency – www.gov.uk/government/organisations/environment-agency;
- Buckinghamshire County Council – www.buckscc.gov.uk/flooding;
- Thames Valley Local Resilience Forum – www.thamesvalleylrf.org.uk; and
- Know Your Flood Risk - http://www.knowyourfloodrisk.co.uk.

4.3 Relocation of Unsuitable Existing Development

Paragraph 100 of the NPPF recommends that, where climate change is expected to increase flood risk so that some existing development may not be sustainable in the long-term, local authorities in their Local Plans should seek to facilitate the relocation of development, including housing, to more sustainable locations.

WDC seeks to address this NPPF recommendation through Policy on Managing Flood Risk and Sustainable Drainage Systems, which will set out the requirement for developers to refer to the SFRA, including Level 2, which will give information on climate change extents to inform regeneration opportunities.

4.4 Safeguarding

Paragraph 100 of the NPPF states: "*Local Plans should safeguard land from development that is required for current and future flood management*". WDC has already identified green infrastructure via the adopted delivery and site allocations plan (e.g. The Rye in High Wycombe). This SFRA identifies those sites that could potentially provide measures to reduce flood risk beyond those required to mitigate for their development, to benefit third parties. Such land may take the form of multi-function green infrastructure. WDC should consider the safeguarding of such areas in collaboration with applicants.

Table 4-1 includes those sites where opportunities for betterment have been identified.

Table 4-1 : Sites with Opportunities for Betterment

Site Ref.	Site
5	Abbey Barn North, High Wycombe
7	Land to the rear of Hughenden Road, High Wycombe
10	Former Bassetsbury Allotments, High Wycombe

Site Ref.	Site
15	Hollands Farm (north), Bourne End
25	Foxes Piece, Marlow
32	Glynswood, Green Hill, High Wycombe
34	Gomm Valley and Ashwells, High Wycombe
56	Land at Terriers Farm, High Wycombe
59	Land of Amersham Road including Tralee Farm, Hazlemere
70	Little Marlow Lakes Country Park
71	Delafield Heights North, Longland Way / Pettifer Way, High Wycombe
72	Delafield Heights South, Longland Way / Pettifer Way, High Wycombe
78	Netley Works, 89 Queens Road, High Wycombe
80	Notcutts Garden Centre, Clay Lane, High Wycombe
93	Slate Meadow, Bourne End
105	Windrush House, Bourne End
110	Princes Risborough Expansion Area
112	Land South of Horns Lane, Princes Risborough
114	Molins Sports Ground, Princes Risborough
115	Railway Station Site Including Former Hypnos Site, Station road, Princes Risborough
116	Land off Poppy Road including 108 Wycombe Road, Princes Risborough
133	Heavens above, 16 High Heavens Wood, Marlow Bottom
135	Westwood, High Wycombe
137	Land North of Lower Icknield Way, Longwick

RECOMMENDATION: In partnership with the EA and BCC, WDC should undertake further work to identify land required for current and future flood management, and, if justified, safeguard it through planning policy. This can include areas within or adjoining allocated development sites which are particularly suitable for flood management purposes. The site allocation assessments in this SFRA include information where it is considered that a site could provide flood risk protection.

4.5 Wycombe Critical Drainage Areas

The NPPF requires a site-specific FRA for all development proposals "*in an area within Zone 1 which has critical drainage problems (as notified to the local planning authority by the Environment Agency)"* and emerging Local Plan policy on Managing Flood Risk and Sustainable Drainage Systems requires that all developments within an area at risk of flooding comply with the NPPF. The EA has not specified any CDA in Wycombe District. However, areas which are likely to be most at risk of flooding from local sources have been identified as part of the Level 1 SFRA (Section 3.4). They have been termed 'Wycombe Critical Drainage Areas' to differentiate them from those areas which could potentially be notified by the EA. The wording of the NPPF is such that it is not clear that an FRA would be required in a Wycombe Area of Critical Drainage because they were not "*notified to the local planning authority by the Environment Agency*". A new policy on Managing Flood Risk and Sustainable Drainage Systems will replace the previous policy DM17, which requires that a development including an area at risk of any source of flooding will have to demonstrate compliance with the Sequential Test and Exception Test in accordance with national planning policy.

RECOMMENDATION: While WCDA are identified in the Level 1 SFRA it is recommended that they are added to the Councils' internal GIS systems for the reviewing of constraints when responding to planning applications.

4.6 LLFA Requirements

The BCC LFRMS[50] contains information with regard to SuDS, which is echoed by current WDC policy. In their role as LLFA, BCC are responsible for managing flooding from local sources. It is important that applicants are made aware of current best practice guidance with regard to sustainable drainage solutions to ensure that such information can be taken into account in development proposals. Best practice guidance on flood management is also published by the EA, National Flood Forum and others. In addition, the WDC Level 1 SFRA contains links to key information with regard to minimising flood risk in new and existing development.

RECOMMENDATION: The WDC website should direct applicants to the BCC website, to provide links of sources of current best practice with regard to SuDS and flood management to be utilised by applicants. It could also be utilised by WDC officers seeking to evaluate FRAs and development proposals.

4.7 Opportunities to Reduce Flooding

Paragraph 100 of the NPPF recommends that Local Plans should seek to reduce the causes and impacts of flooding by *"using opportunities offered by new development"*. The NPPF requires local authorities to work with other local authorities and providers to assess infrastructure needs in their area, including with regard to flood risk (Paragraph 162). Opportunities to reduce flood risk can be informed by the BCC LFRMS (see Section 2.5 of the Level 1 SFRA). Additionally, it has been highlighted in the site assessments included in this report where it is considered that there would be opportunities to mitigate existing flood risk.

Section 106 agreements and Community Infrastructure Levy charges provide potential mechanisms for securing new flood risk reduction infrastructure or contributions towards it. However, account should be taken of the potential impact on the financial viability of development proposals and developers should be pro-active and innovative in managing flood risk.

RECOMMENDATION: WDC should:

- Work with other authorities and bodies, as appropriate, to identify specific flood risk infrastructure required within the District. The BCC LFRMS and the information contained in the SFRA, may be used to assist this process, although more detailed studies are likely to be required;
- Work with developers (and the LLFA in their strategic role) to identify opportunities for new developments to mitigate flood risk to the wider community, noting that this may require the consideration of multiple sites to deliver significant benefits. Potential opportunities are included in this SFRA;
- In identifying and allocating potential development sites, and liaising with applicants, work with BCC to seek reasonable opportunities for flood risk reduction measures as identified in the site assessments in this SFRA;
- Give consideration to a suitable generic policy to be contained within the emerging Local Plan in respect of non-allocated sites where flood risk reduction measures should be sought;
- Encourage BCC to use Community Infrastructure Levy charges as a potential additional tool for securing contributions towards the delivery of flood risk reduction measures where a need has been identified. If appropriate, include wording to this effect in a Local Plan policy, supported by evidence and SPD if necessary.

This section may also be relevant to any neighbourhood plans proposed in future in the District.

[50] Local Flood Risk Management Strategy, Buckinghamshire County Council, May 2016

4.8 Restriction of Permitted Development Rights

Permitted Development (PD) rights allow for some minor development, such as certain sizes of building extension, without planning permission. The NPPG (Flood risk guidance, paragraph 047) states that minor developments, some of which are covered by PD rights such as small extensions, are "*unlikely to raise significant flood risk issues unless they would:*

- H*ave an adverse effect on a watercourse, floodplain or its flood defences;*
- I*mpede access to flood defences and management facilities; or*
- W*here the cumulative impact of such developments would have a significant effect on local flood storage capacity or flood flows".*

Minor developments subject to PD rights, such as some extensions or paving over of gardens, therefore have the ability to raise flood risk and increase surface water runoff. Article 4 of the Town and Country Planning General Permitted Development Order provides a possible vehicle for the removal of PD rights in exceptional circumstances, which the NPPF (Paragraph 200) notes to be "*limited to situations where this is necessary to protect local amenity or the wellbeing of the area"*. This could include situations where minor permitted development has the potential to add to localised flood risk as highlighted above, such as from the cumulative impact of extensions within an area.

If there are areas of the District where PD could lead to an increase in flooding an Article 4 Direction could be explored with the Development Management team. For example, the WCDA's may be locations where this could be considered. There would need to be a strong justification to support this and therefore the implementation of an Article 4 direction would need to be subject to further detailed investigation.

4.9 Princes Risborough Drainage Strategy

The scale of the Princes Risborough Expansion (site 110) warrants specific consideration with regard to drainage and flood risk. The BCC LFRMS requires the consideration of SuDS for new development. Given the scale of this site it would be an opportunity to develop a site-wide drainage and SuDS strategy ahead of individual plot applications to ensure the potential amenity, biodiversity and water quantity and quality improvements are maximised. If such measures are implemented at plot scale, there is the risk that while they would be implemented their benefits would not be maximised as they would be developed in isolation to other plots.

RECOMMENDATION: WDC should – in collaboration with the LLFA – consider the need to undertake an expansion-wide Drainage Strategy considering local sources of flooding including ordinary watercourses, surface water and groundwater flooding across the expansion area. This would identify drainage issues, make allowance for extreme weather events caused by climate change and inform a strategic Sustainable Drainage scheme, making it clear to developers what is required from individual development parcels as these come forward.

4.10 General Recommendations – Minimising Flood Risk and Impacts

When evaluating the flood risk of an existing or proposed development it is important to consider issues of flood resilience and flood resistance – minimising the likelihood of flooding, minimising impacts if the site does flood, and allowing a quick recovery after flooding. Such measures should also be included in the development of design proposals in planning applications, as relevant to the likely level of flood risk at a site. As noted above, the NPPF paragraph 103 requires that planning applications demonstrate that the *'development is appropriately flood resilient and resistant'*, that *'any residual risk can be safely managed'* and *'it gives priority to the use of sustainable drainage systems'*. Potential considerations include:

- A change in land use to reduce the vulnerability of the proposed development;

- Sequential Approach to site layout; placing uses with greater vulnerability to flooding in higher areas within the site to limit the risk or extent of flood damage;
- Minimising / reducing impermeable surfaces (building footprints and areas of hardstanding);
- Raising internal floor levels above the predicted design flood level to reduce the likelihood of the property flooding, taking into account any increase in flood level likely in future as a result of climate change;
- Arranging buildings and solid walls on site to remove obstructions to the overland flow paths of flood waters;
- Identifying potential sources of pollution in the event of flood and seeking to contain them;
- Ensuring there is a safe means of access and escape in the event of a flood;
- Developing a flood evacuation plan in the event of the threat of flood; and
- Subject to matters relating to Building Control, raising electrical wiring and sockets to avoid damage to electrical systems in the event of flood, use of tiled or stone flooring etc.

SuDS is a term used to describe the various approaches that can be used to manage surface water drainage in a way that mimics the natural environment. The management of rainfall (surface water) is considered an essential element of reducing future flood risk to both the site and its surroundings.

WDC, BCC and the EA all strongly advocate the use of SuDS. Adopted Policy DM17 in the Wycombe Delivery and Site Allocations Plan and emerging policy on Managing Flood Risk and Sustainable Drainage Systems in the WDC Local Plan Draft Consultation Document both require the use of SuDS where feasible (see Section 1.4.2). DCLG Written Statement HCWS161 on sustainable drainage systems requires that SuDS are put in place on all major developments, unless they can be demonstrated to be inappropriate. Local planning authorities are required to consult the relevant LLFA (BCC) on these proposals.

A wide variety of SuDS techniques are available, potentially providing both water quality and water quantity improvement benefits on a site by site basis throughout the District. Wherever possible within brownfield areas, the developer should seek to reduce the rate of runoff from the site to the equivalent Greenfield runoff rates (i.e. the rate of runoff generated from the site assuming it were an open grassed area). This is usually within the range of 5 to 9 litres per second per hectare (l/s/ha), depending on site slope and soil porosity. Collectively, the effective application of SuDS as part of all future development has the potential to reduce the risk of flooding within Wycombe District.

Reducing the rate of discharge from urban sites to Greenfield runoff rates is one of the most effective ways of reducing and managing flood risk within the District. Although any reduction in the amount of water that originates from any given site is likely to be small, if applied to sites across the District in a consistent way, the cumulative effect could be significant. There are numerous different ways that SuDS can be incorporated into a development and the most commonly found components of a SuDS system are described in the following table. The appropriate application of a SuDS scheme to a specific development is heavily dependent upon the topography and geology of the site.

Table 4-2: Summary of Potential SuDS Measures to Reduce Flood Risk

SuDS Measure	Description
Pervious surfaces	Surfaces that allow inflow of rainwater into the underlying construction or soil.
Green roofs	Vegetated roofs that reduce the volume and rate of runoff and remove pollution.
Filter drain	Linear drains consisting of trenches filled with a permeable material, often with a perforated pipe in the base of the trench to assist drainage, to store and conduct water; they may also permit infiltration.
Filter strips	Vegetated areas of gently sloping ground designed to drain water evenly off impermeable areas and to filter out silt and other particulates.
Swales	Shallow vegetated channels that conduct and retain water, and may also permit infiltration; the vegetation filters particulate matter.
Basins, Ponds and Wetlands	Areas that may be utilised for surface runoff storage.
Infiltration Devices	Sub-surface structures to promote the infiltration of surface water to ground. They can be trenches, basins or soakaways.
Bioretention areas	Vegetated areas designed to collect and treat water before discharge via a piped system or infiltration to the ground.
Pervious surfaces	Surfaces that allow inflow of rainwater into the underlying construction or soil.

It should be noted that SuDS can have other benefits, depending upon the system installed, in addition to helping to minimise flood risk; these include helping to improve water quality by reducing pollutants, helping to recharge groundwater supplies, reducing the demand for potable water, improving wildlife habitats and helping to provide green corridors and improving local amenity. The cumulative benefits of numerous SuDS schemes over a number of sites in the Borough could therefore be significant.

Table 4-3: Summary of Benefits of SuDS Measures

Most Sustainable	SuDS Technique	Flood Reduction	Water Quality Improvement	Landscape & Wildlife Benefit
	Living roofs	✓	✓	✓
	Basins and ponds - Constructed wetlands - Balancing ponds - Detention basins - Retention ponds	✓	✓	✓
	Filter strips and swales	✓	✓	✓
	Infiltration devices - soakaways - infiltration trenches and basins	✓	✓	✓
	Permeable surfaces and filter drains - gravelled areas - solid paving blocks - porous paving	✓	✓	
Least Sustainable	Tanked systems - over-sized pipes/tanks - storms cells	✓		

There are numerous sources of best practice advice with regard to flood resilience and flood resistance measures, including SuDS. Examples are the EA standing advice for development of FRA and the Know Your Flood Risk guide to flood resilience. These should be consulted in the production of all FRAs.

Key contacts:

- Environment Agency – https://www.gov.uk/government/organisations/environment-agency
- Buckinghamshire County Council – http://www.buckscc.gov.uk/services/environment/flooding/
- CIRIA[51] – www.susdrain.org
- Know Your Flood Risk - http://www.knowyourfloodrisk.co.uk

4.10.1 Building and Development Design

The EA standing advice of finished floor levels (FFLs) includes recommendations for floor levels for new development; ground floor levels should be a minimum of whichever is higher of:

51 Construction Industry Research and Information Association

- 300mm above the general ground level of the site; or
- 600mm above the estimated river or sea flood level.

Raising site levels should be avoided if possible and certainly kept to a minimum in Flood Zone 3 (plus the extent of the relevant climate change allowance).

If these levels cannot be achieved, extra flood resistance or resilience measures should be considered. Where existing development will be below adjacent new raised development appropriate measures (cut off drains or similar) will be required to prevent run off flooding to existing properties.

4.10.2 Basements

The EA provides standing advice on FRAs[52], which states that, an emergency *"escape plan needs to be included for any part of a building that is below the estimated flood level".* The FRA will need to demonstrate that clear internal access to an upper level is available. This of particular importance in Wycombe District where the geology does elevate the risk of groundwater flooding; see Section 4.3.4 of the Level 1 SFRA.

RECOMMENDATION: Habitable rooms in basement developments should not be permitted within Flood Zones 2 or 3 or areas identified as at risk of groundwater flooding without further analysis by the applicant, demonstrating that the development would be safe for future users for its lifetime. WDC should discourage the conversion of existing properties to include a habitable room in such locations. Where this approach conflicts with permitted development, WDC should take the opportunity where possible to explain the potential dangers of developing a habitable room in such locations.

RECOMMENDATION: WDC should encourage developers to consider flood resilience in their developments to permit a quick recovery post-flooding. WDC should continue to mandate the use of SuDS in developments where practicable, as indicated in the BCC FRMS and by the EA.

[52] https://www.gov.uk/guidance/flood-risk-assessment-standing-advice

5. Recommendations

5.1 Hydraulic Modelling

The EA provided hydraulic models of the River Thames and the River Wye and Hughenden Stream to assist in the assessment of flood risk and the predicted impact of climate change to fluvial flood risk to the allocation sites for the SFRA. Given their age updates were made to the representation of the floodplain which has led to discrepancies in the extent of the published Flood Zone 3 and the newly modelled 1% (1 in 100) AEP extent. The new flood extents have been considered in this SFRA when assessing the likelihood of a site to pass the Exception Test. The individual site assessments indicate where it is considered this could have an impact upon the prediction of flood risk and the applicant is urged to consult with the EA at the outset of the design process to confirm the flood zones to be considered and the need for detailed hydraulic modelling beyond that included in this SFRA.

5.2 Allocation Site Summary

All allocation sites have been assessed for all sources of flood risk. A summary of the risk to each site and their potential to deliver flood risk benefits is included in Appendix A. Table 5-1 provides a summary of the key flood risks and whether the Higher risk allocation sites pass the second part of the Exception Test.

Table 5-1: Higher Risk Sites Summary

Site	Detailed Hydraulic Model?	Key Flood Risk Issues	Second Part of Exception Test?
1: 1-9 Shaftsbury Street	Yes	• Fluvial (CC 70% scenario) • Access and egress during a surface water event • Flood risk due to culvert blockage • Groundwater • Impact of climate change of surface water	Pass subject to site layout
5: Abbey Barn North	Yes	• Surface water flow paths through site • Groundwater	Not applicable; the site is in FZ1 (including with CC)
7: Land rear of Hughenden Road	Yes	• Detailed hydraulic modelling • Surface water • Culvert blockage	Not required, subject to site layout
10: Former Bassetsbury Allotments	Yes	• Surface water and safe access and egress • Culvert blockage • Groundwater	Not required; the site is in FZ1 (including with CC)
15: Hollands Farm (north), High Wycombe	Yes	• Surface water • Groundwater • Access and egress during a fluvial flood event	Pass, subject to site layout and access and egress requirements

21: Dashwood Avenue	Yes	• Surface water • Groundwater	Not applicable; the site is in FZ1 (including with CC)
45: Kingsmead Depot	Yes	• Fluvial • Surface water • Groundwater • Reservoir failure	Does not pass
70: Little Marlow Lakes Country Park	Yes	• Fluvial (ordinary watercourse) • Surface water • Groundwater	Not applicable
90: Leigh Street, Desborough Area, High Wycombe	Yes	• Surface water • Groundwater • Impact of climate change of surface water	Not applicable; the site is in FZ1 (including with CC)
93: Slate Meadow, Bourne End	Yes	• Fluvial • Surface Water • Groundwater • Culvert blockage • Impact of climate change of surface water	Pass subject to site layout
110: Princes Risborough Expansion area, Princes Risborough	No	• Fluvial (ordinary watercourse) • Surface water • Groundwater	Pass subject to site layout and highway design
113: Land Adjacent to Regent Park, Princes Risborough	No	• Groundwater	Not applicable (HM)
115: Land at Princes Risborough station, Princes Risborough	No	• Fluvial • Groundwater • Culvert blockage • Impact of climate change of surface water	Pass subject to site layout and highway design
116: Land off Poppy Road including 108 Wycombe Road, Princes Risborough	No	• Fluvial • Surface water • Groundwater • Culvert blockage • Impact of climate change of surface water	Pass subject to site layout and highway design (HM)
137: Land North of Lower Icknield Way, Longwick	No	• Fluvial • Groundwater	Not applicable (HM)
141: Westhorpe House, Little Marlow	Yes	• Fluvial (including climate change) • Groundwater	Pass subject to site layout

		• Impact of climate change of surface water	

Notes:

<u>Site layout</u>: These sites can pass the second part of the Exception Test providing the development proposals avoid encroachment into Flood Zone 3, dependent upon the development vulnerability classification; further details are provided in the site-specific section of this SFRA; and

<u>HM</u>: The assessment of fluvial flood risk at these sites is based upon published flood extents and not detailed hydraulic modelling. Consequently, there is a risk that the predicted extent of flood zones could change as a result of detailed hydraulic modelling potentially changing the assessment. The lack of detailed modelling also means it has not been possible to assess in detail the predicted impact of climate change on fluvial flood extents for this SFRA. Please see site-specific assessments in Section 3 for more detailed assessment of how Flood Zones are likely to change in light of new modelling and climate change assessments and the potential impacts this could have on the proposed development.

Appendix A. Allocation Site Schedule

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Appendix B. Lower Risk Sites Assessment

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Appendix C. Hydraulic Modelling Report

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Appendix D. Climate Change Extents Plans

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