# LOTMEAD FARM VILLAGES

# Environmental Statement

## Appendix 9.1 Flood Risk Assessment

April 2019

LOTMEAD FARM villages

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now part of

# Lotmead Farm Villages, Swindon

## Flood Risk Assessment

On behalf of

ainscough strategic land

Project Ref: 27970/4003 | Rev: - | Date: March 2019

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## Document Control Sheet

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# Executive Summary

This Flood Risk Assessment (FRA) has been prepared by Peter Brett Associates LLP, now part of Stantec, (PBA) to support a planning application for a 2,500 units residential development of the Lotmead Farm Villages site.

In accordance with the fundamental objectives of the National Planning Policy Framework (NPPF), the FRA demonstrates that:

(i) The development is safe;

(ii) The development does not increase flood risk; and,

(iii) The development does not detrimentally affect third parties.

The Environment Agency (EA) Flood Zone map shows the site lies partly within Flood Zones 1, 2 and 3 (as defined in NPPF Planning Practice Guidance (PPG) 'Flood Risk and Coastal Change' Table 1) as follows:

**Flood Zone 1 'Low Probability' (less than 1 in 1,000 (0.1%) annual probability of river or seas flooding)**

**Flood Zone 2 'Medium Probability' (between a 1 in 100 (1%) and 1 in 1,000 (0.1%) annual probability of river flooding; or land having between a 1 in 200 (0.5%) and 1 in 1,000 (0.1%) annual probability of sea flooding)**

**Flood Zone 3 'High Probability' (greater than 1 in 100 (1%) annual probability of river flooding, or greater than 1 in 200 (0.5%) annual probability of sea flooding)**

There is a fluvial flood risk to areas of the Site from the River Cole and Dorcan Stream, where the floodplain extends out from the watercourses, and from the Liden Brook, whose floodplain is disconnected from its channel and runs north following the route of a drainage ditch.

The Development consists primarily of a 'More Vulnerable' residential development. A sequential approach, as advocated by national planning policy, has been followed such that all built development will be located in Flood Zone 1 once constructed. All development is considered appropriate within Flood Zone 1 (ref: National Planning Policy Framework (NPPF) Planning Practice Guidance (PPG) '*Flood Risk and Coastal Change*' Table 1).

A floodplain restoration scheme has been designed along the Liden Brook, to return the Liden Brook floodplain to be adjacent to the river channel. This will result in landscape and ecological improvements as well as providing flood risk benefits, reducing flood risk downstream of the Site by 10mm at the A420 Acorn Bridge. All built development will be located within Flood Zone 1 following completion of these works. The Development will have negligible impact on flood risk upstream of the Site and will reduce flood risk downstream of the Site.

As the built development lies within Flood Zone 1, the Site is already within the area of lowest probability of flooding and the Sequential Test has de-facto been passed. The Sequential Test had been previously undertaken by Swindon Borough Council (SBC) in allocating the New Eastern Villages site.

The site was subject to two outline applications in 2015, which considered separately the wider site and a Phase 1 development parcel. The EA confirmed they held no objection to the original proposals in letters dated August 2015 (Ref *WA/2015/120566/01-L01* and *WA/2015/120562/01-L01)* and October 2015 (Ref *WA/2015/120566/02-L01* and *WA/2015/120562/02-L02*). There have been no significant changes to the flood mitigation scheme proposed within the 2015 applications and the EA have confirmed that the underlying modelling data is unchanged. Swindon Borough Council (SBC) as Lead Local Flood Authority (LLFA) also provided comments with regards to the ordinary watercourses and

surface water management proposals and these comments have been considered in development of the revised proposals.

The FRA provides details of the proposed SuDS surface water drainage strategy to demonstrate there will not be an increase in the rate of surface water runoff from the Site. This utilises swales and basins with outlet controls into the adjacent watercourses. The use of SuDS is deemed important as a form of surface water drainage management for the site and during the detailed design stage the selection of SuDS will be conducted.

As such, the FRA confirms that the Development is safe, it does not increase flood risk and does not detrimentally affect third parties, in accordance with the objectives of the NPPF and the requirements of national and local planning policy.

# 1 Introduction

## 1.1 Scope of Report

1.1.1 This Flood Risk Assessment (FRA) has been prepared by Peter Brett Associates LLP, now part of Stantec, (PBA), on behalf of our client, Ainscough Strategic Land, to support a planning application for a 2,500 units residential development of the Lotmead Farm Villages site.

1.1.2 The report is based on the available flood risk information for the site as detailed in **Section 1.2**, and prepared in accordance with the planning policy requirements set out in **Section 1.3**. The scope of the FRA is consistent with the 'Site-specific Flood Risk Assessment Checklist' from the National Planning Policy Framework (NPPF) Planning Practice Guidance.

1.1.3 The required content of the checklist is detailed below along with specific cross-reference to the content in the FRA as follows:

1) **Development site and location –** see Section 2;

2) **Development proposals** – see Section 5;

3) **Sequential Test** – see Section 5;

4) **Climate change** – see Section 4;

5) **Site-specific flood risk** – see Section 3;

6) **Surface water management** – see Section 7;

7) **Occupants and users of the development** – see Section 5;

8) **Exception Test** – see Section **Error! Reference source not found.** (if applicable)

9) **Residual Risk** – see Section 8;

10) **Flood risk assessment credentials** – PBA has many years of experience in, amongst other areas, the assessment of flood risk, hydrology, flood defence and river engineering. The authors and reviewers of the document are all experienced engineers and members of chartered institutions such as the Chartered Institution of Water and Environmental Management (CIWEM) or the Institution of Civil Engineers (ICE).

## 1.2 Sources of Information

1.2.1 The FRA has been prepared based on the following sources of information:

- Topographic survey of the site (Drawing reference *18422_OGL*) undertaken by Greenhatch Group in October 2013;
- Development proposals by Planit-ie (drawing ref PL1461.1-PLA-00-XX-DR-U-0008-S3-PO4);
- Environment Agency (EA) published '**Open Data'** datasets available online, reproduced with OS mapping under licence to PBA (contains Ordnance Survey data © Crown copyright and database right [2018], contains Environment Agency information © Environment Agency and database right);

- The **Environment Agency (EA) online flood maps** at https://flood-map-for-planning.service.gov.uk/ and https://flood-warning-information.service.gov.uk/long-term-flood-risk;
- **EA Product 4 data** (EA ref *THM102057,* dated October 2018) (EA ref *OX_0327_01,* dated June 2013)
- Swindon Borough Council **Preliminary Flood Risk Assessment** (PFRA), prepared by Halcrow, dated August 2011
- Swindon Borough Council **Local Flood Risk Management Strategy** (LFRMS), prepared by SBC, dated July 2014.
- Swindon Borough Council Level 1 **Strategic Flood Risk Assessment** (SFRA), prepared by Halcrow, dated August 2008.
- Thames Catchment Flood Management Plan (CFMP), dated December 2009.

## 1.3 Relevant Planning Policy

1.3.1 This FRA has been prepared in accordance with the relevant national, regional and local planning policy and statutory authority guidance as follows:

- National policy contained within the revised **National Planning Policy Framework (NPPF)** dated July 2018, issued by Ministry of Housing, Communities and Local Government, with reference to Section 14 'Meeting the challenge of climate change, flooding and coastal change';
- The **NPPF Planning Practice Guidance (PPG)** released in March 2014 ('Flood Risk and Coastal Change' section) and updated in February 2016 to incorporate the EA '**Flood Risk Assessments: Climate Change Allowances'** guidance;
- Local planning policy contained within the Swindon Borough Council '**Local Plan'** (adopted March 2015), with particular reference to policies EN6 and NC3;
- Swindon Borough Council **Sustainable Drainage Systems (SuDS) Vision for New Eastern Villages (NEV) Supplementary Planning Document**, dated February 2017.

## 1.4 Planning History

1.4.1 The site was subject to two outline applications in 2015. A Phase 1 (SBC Ref. S/OUT/15/0754) and Masterplan application (SBC Ref. S/OUT/15/0753), which combined covered the total area of the site covered by this application, were submitted to SBC in May 2015. Planning permission was subsequently refused in June 2016 and refused at public inquiry in June 2018 following an appeal.

1.4.2 The EA confirmed they held no objection to the original proposals in letters dated August 2015 (Ref WA/2015/120566/01-L01 and WA/2015/120562/01-L01) and October 2015 (Ref WA/2015/120566/02-L01 and WA/2015/120562/02-L02).

1.4.3 Swindon Borough Council (SBC) as Lead Local Flood Authority (LLFA) also provided comments with regards to the ordinary watercourses and surface water management proposals and the proposals were revised through the determination period to ensure they met the LLFA's requirements.

1.4.4 The comments provided by statutory consultees through the determination period of the previous applications and the subsequent appeal have been considered in preparation of this Flood Risk Assessment.

## 1.5 Caveats and Exclusions

1.5.1 This FRA has been prepared in accordance with the NPPF and Local Planning Policy. The proposed flood management (including ground floor level recommendations) and surface water management strategies are based on the relevant British Standards (BS8533), the standing advice provided by the EA or based on common practice.

1.5.2 The Construction (Design and Management) Regulations 2015 (CDM Regulations) will apply to any future development of this site which involves "construction" work, as defined by the CDM Regulations. As such it is the responsibility of the proposed developer (ultimate client) to fulfil its duties under the CDM Regulations.

1.5.3 The approach for the FRA and proposals for the surface water management strategy are based on the requirements of the EA and SBC in its role as Lead Local Flood Authority (LLFA).

1.5.4 The findings of this FRA are based on data available at the time of the study and on the subsequent assessment that has been undertaken in relation to the development proposals as outlined in **Section 5**.

1.5.5 The EA Product 4 flood data on which the FRA is based is valid under a 12-month licence. As such, the FRA is accurate at time of issue but we would recommend the end user reviews the validity of the flood data on an annual basis with the EA.

1.5.6 It should be noted that the insurance market applies its own tests to properties in terms of determining premiums and the insurability of properties for flood risk. Those undertaking development in areas which may be at risk of flooding are advised to contact their insurers or the Association of British Insurers (ABI) to seek further guidance prior to commencing development. PBA does not warrant that the advice in this report will guarantee the availability of flood insurance either now or in the future.

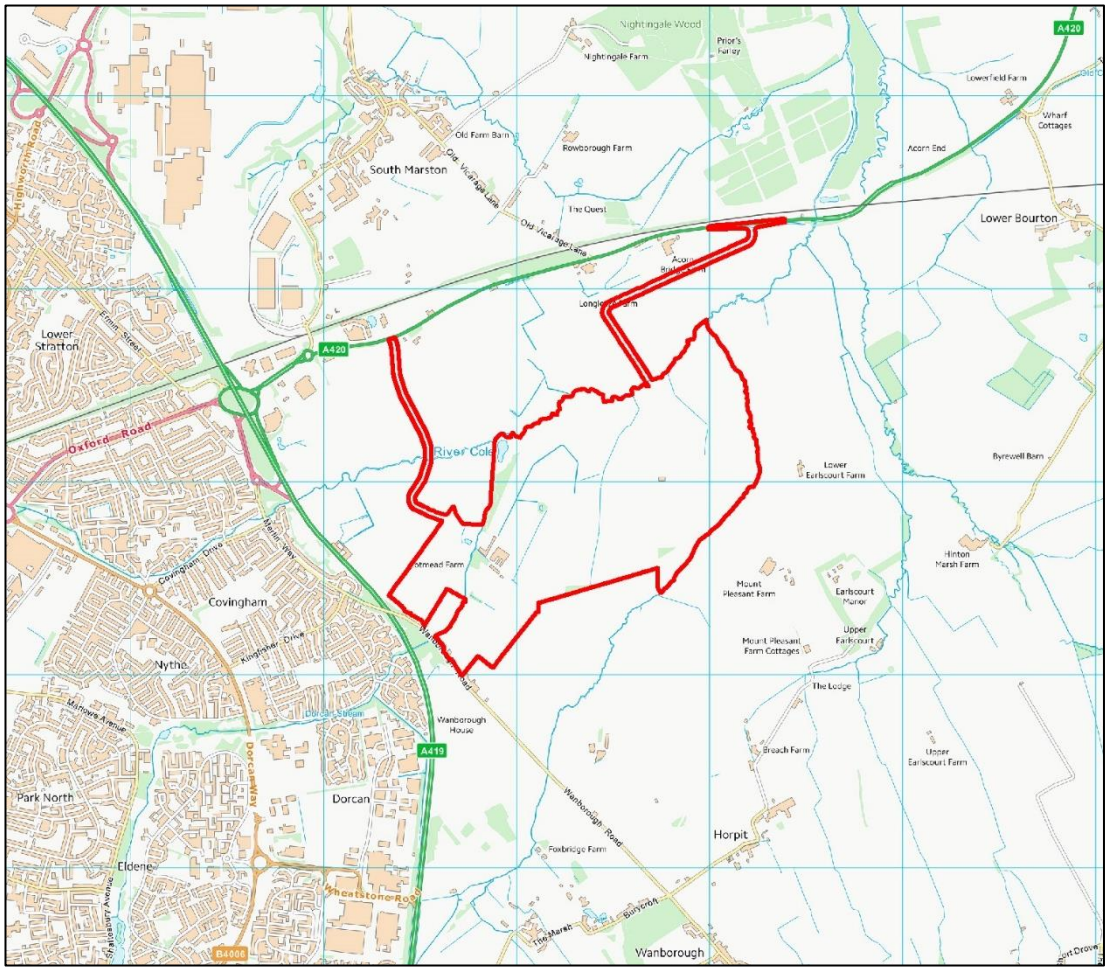
# 2 Site Setting

## 2.1 Site Description

2.1.1 The Lotmead Farm Villages site is located to the east of Swindon, within the area allocated for the Swindon New Eastern Villages. The approximate postcode of the site is SN4 0UY and the centre of the Site is located at approximate grid reference 420,500(E) 186,000(N).

2.1.2 The site lies within the administrative boundary of Swindon Borough Council (SBC). The overall site area is 168.7 ha.

**Figure 2.1: Site Location Plan**

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2.1.3 The Site is located to the east of the A419(T) and south of the A420, east of Swindon. It comprises the Lotmead (Earlscourt) and Lower Lotmead (Lower Earlscourt) villages. A site location plan is provided in **Figure 2.1** and **Appendix A**.

2.1.4 The northern boundary of the Site is largely formed by the River Cole, the eastern boundary by the Liden Brook, the southern boundary by land ownership field boundaries, and the western boundary by the A419(T) and Wanborough Road, the Dorcan Stream and field boundaries.

2.1.5 The Site is largely open farmland, albeit it also comprises – inter alia –:

- Lotmead Farmstead, including dairy farm buildings;

- Lotmead 'Pick Your Own', which comprises various fruit and vegetables, a farmshop/café with outside seating area, animal and bird sanctuary/farm and children play area;
- Lotmead Business Village – renovated farm buildings offering business accommodation; and,
- Lotmead cottages.

2.1.6 The Site also includes a Scheduled Ancient Monument in its south west corner along Wanborough Road, which comprises a former roman settlement, now largely below ground

## 2.2 Topography

2.2.1 A topographic survey of the Site has been undertaken by the Greenhatch Group in October 2013 to Ordnance Datum and Ordnance Survey National Grid (OSBG36) (see **Appendix B**).

2.2.2 Levels at the Site vary from approximately 95m to 88m above Ordnance Datum (aOD). The Site is highest where it meets Wanborough Road. The lowest part of the Site is the north-eastern corner where the Liden Brook meets the Liden Brook.

2.2.3 Gradients at the Site are relatively gentle, with the central third of the Site being roughly flat at an elevation of 91m aOD.

2.2.4 The Site boundaries are largely formed by watercourses, and so the general trend is for the boundaries of the Site to be lower than the centre, with a general fall to the north-east in favour of the dominant watercourse – the River Cole. The road is higher, and so the western boundary of the Site is higher than the rest of the Site.

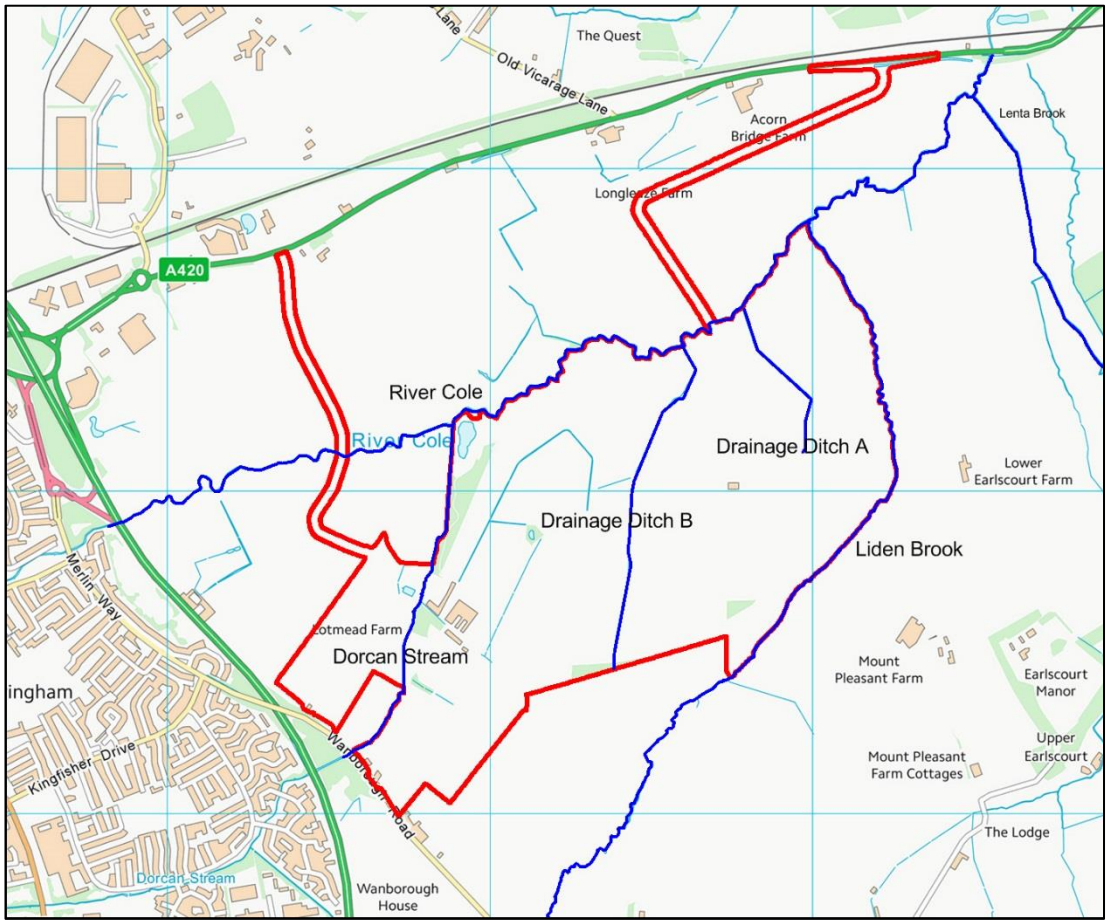
## 2.3 Hydrological Setting

2.3.1 There are a number of designated Main River channels that flow through the Site (see **Figure 2.2**). These are the River Cole, Dorcan Stream and Liden Brook. The Lenta Brook is another Main River tributary of the River Cole lying to the east of the Site and converging with the River Cole just upstream of the A420.

2.3.2 The River Cole flows from west to east along the northern boundary of the Site and is tributed by both the Dorcan Stream and the Liden Brook. The Dorcan Stream is the westernmost of the watercourses on Site and flows from south to north, to the east of the main Lotmead Farm buildings and access. The Liden Brook flows broadly in a south to north direction along the southern and eastern boundaries of the Site; its confluence with the River Cole is at the north eastern corner of the Site.

2.3.3 There are also two land drains (marked as Drainage Ditches A and B in **Figure 2.2** below) across the Site which drain into the River Cole, flowing north-south.

**Figure 2.2: Modelled watercourses through site**

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2.3.4 It is understood that there are five Flood Storage Areas (FSA) located upstream of the Site, within the existing urban area of Swindon, on the River Cole, Dorcan Stream and Liden Brook. Of these, the Wanborough Road flood storage area on the Dorcan Stream is located between the A419(T) and Wanborough Road, close to the Site.

2.3.5 It is understood that flooding has occurred historically in Covingham, upstream of Wanborough Road FSA, which may have been exacerbated by the FSA control structure. Planning policy states that a development cannot increase flood risk to third parties, and therefore this Lotmead Farm Villages Development cannot increase flood risk to existing communities. Furthermore, as demonstrated by the model, the outflow to the FSA and the elevation of Wanborough Road are such significant controls to water levels upstream and downstream that the impact of any development downstream of the FSA would have negligible impact upstream of the FSA.

2.3.6 Opportunities to provide additional benefit to the existing community of Covingham as part of the Development are limited. The control structure at the FSA influences water levels to such an effect that any additional storage provided downstream would have no material impact. Additionally, there is limited scope to provide additional storage immediately downstream of the road due to the presence of the scheduled ancient monument. It is not within the development team's control to dictate or amend operating rules of existing EA flood defence structures or reasonable to provide for possible future scenarios in terms of operating procedures at Wanborough Road FSA and alleviation options for Covingham.

## 2.4 Existing Drainage Arrangements

### On-Site Drainage

2.4.1 The site consists primarily of open agricultural land, such that surface water would either drain via natural infiltration into the ground or would drain to the existing ditches and watercourses within and adjacent to the site.

2.4.2 There are a few farm buildings and also Lotmead Business Park within the Site boundary, which may have private sewer connections, but there are no publicly adopted sewers within the Site marked on the Thames Water Asset Location maps. There are however several Discharge Consents associated with existing buildings on the Site, which would suggest that treated foul and surface water may currently be discharged into the watercourses at the Site rather than discharged to sewers.

2.4.3 There is therefore very little formal surface water drainage at the Site.

2.4.4 Existing impermeable areas within the proposed site are insignificant relative to the total site area.

## 2.5 Geology and Hydrogeology

2.5.1 The majority of the Site is underlain by the Ampthill and Kimmeridge Clay Formation bedrock. Parts of the Site adjacent to the principal watercourses also have superficial alluvial deposits.

2.5.2 The clay bedrock is designated as an Unproductive Stratum. The alluvial deposits are designated as a Secondary A Aquifer. This would indicate that the clay bedrock has a very low permeability, and that the alluvial deposits have some permeability. The infiltration potential of the alluvial deposits would be likely to be dependent on groundwater conditions; infiltration rates and groundwater levels should be determined at detailed design stage through an intrusive site investigation. Therefore, without the benefit of bespoke infiltration testing results, it is considered that the likelihood of widespread, if indeed any, sustainable infiltration drainage is very unlikely.

2.5.3 The EA groundwater maps show that there are no Source Protection Zones associated with the Site.

# 3 Overview of Flood Risk

## 3.1 EA Flood Maps

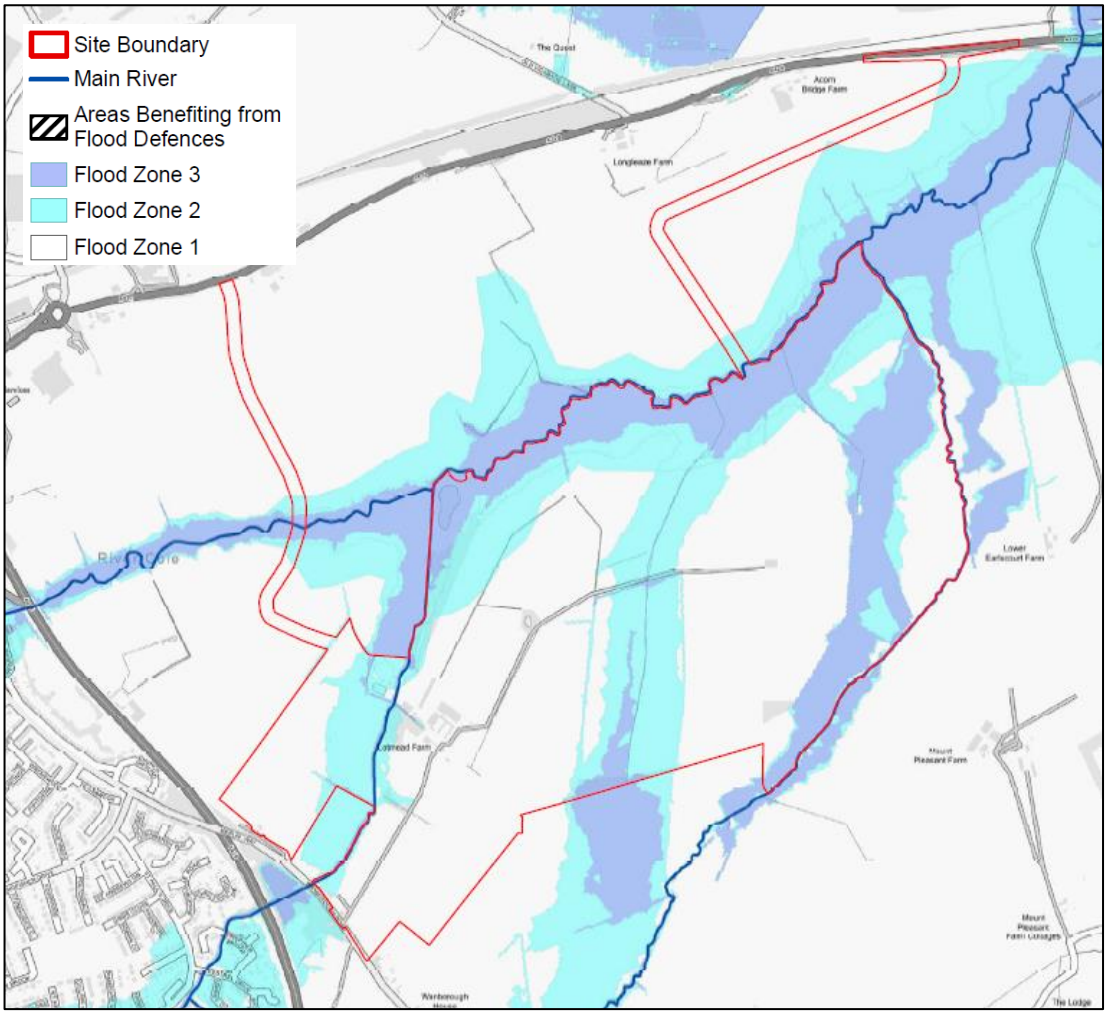
3.1.1 The following maps have been taken from the PBA GIS flood maps report in **Appendix A** based on the EA Opendata datasets available online, and reproduced with OS mapping under licence to PBA.

### Flood Zone Map

3.1.2 The first phase in identifying whether a site is potentially at risk of flooding is to consult the EA's Flood Zone maps, available on the EA's website. This provides an initial indication of the extent of the Flood Zones, which is more detailed site-specific level survey and modelled flood levels. The Flood Zones are defined in Table 1 of the NPPF Planning Practice Guidance (PPG) ('Flood Risk and Coastal Change' section) as follows:

- **Flood Zone 1 'Low Probability'** – Land at less than 1 in 1000 (0.1%) annual probability of river or sea flooding;
- **Flood Zone 2 'Medium Probability'** – Land between 1 in 100 (1%) and 1 in 1000 (0.1%) annual probability of river flooding, or between 1 in 200 (0.5%) and 1 in 1000 (0.1%) annual probability of sea flooding;
- **Flood Zone 3 'High Probability'** – Land at 1 in 100 (1%) or greater annual probability of river flooding, or 1 in 200 (0.5%) or greater annual probability of sea flooding;

**Figure 3.1: EA Flood Zone Map**






3.1.3 The Flood Zone map does not differentiate between Flood Zone 3a 'High Probability' and Flood Zone 3b 'Functional Floodplain' (the defined Flood Zone 3 is effectively a composite of Zone 3a and Zone 3b, and further review of the SFRA is required to define the extent of Zone 3b).

3.1.4 The EA Flood Zone map indicates the site lies within **Flood Zones 1, 2 and 3.**

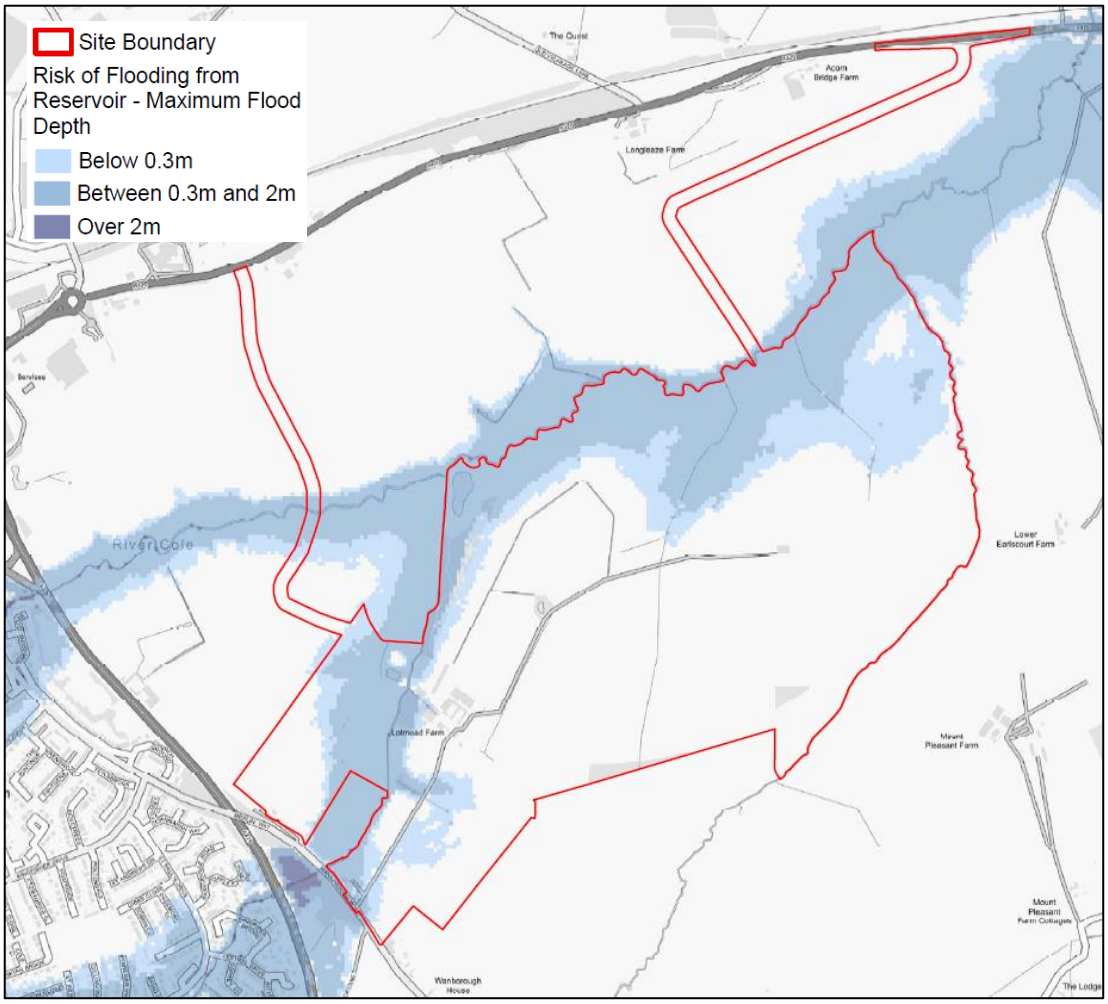
3.1.5 The floodplain, as indicated by the Flood Zones, extends out from the River Cole and Dorcan Stream channel as would be expected for a natural floodplain.

3.1.6 The Liden Brook has a limited floodplain connected to the main channel through the Site. Instead, the maps indicate that there are significant flood flow routes and flood extents along the man-made drainage ditches on Site, from the Liden Brook to the River Cole. The Liden Brook floodplain is disconnected from its watercourse on its left bank.

## Flood Risk from Reservoirs Map

3.1.7 The EA provide maps showing the risk of flooding in the event of a breach from reservoirs, based only on large reservoirs (over 25,000 cubic metres of water). These confirm that the Site may be at risk of flooding from Coate Water in the event of a failure of the reservoir infrastructure.

**Figure 3.2: EA Reservoir Map**






3.1.8 The maps indicate that the depth of flooding would be medium to low, and that any water would be likely to be flowing at less the 0.5m/s. The mapped extents are similar to the mapped fluvial Flood Zones along the River Cole and Dorcan Stream.

3.1.9 As noted in the SFRA, Coate Water is situated approximately 4km south-east of Swindon town centre. The reservoir has a capacity of 527,000m$^3$ and is designated as Category A under the Reservoirs Act 1975. It has undergone annual safety checks by a Supervising Engineer, ten year reviews by an Inspecting Engineer and the Council monitor water levels once a fortnight. The Council has provided assurance that its water supply reservoirs are actively managed and the required safety standards are met.

3.1.10 The reservoir is listed as being maintained by the Council, who has a responsibility under the Reservoirs Act to inspect and maintain the reservoir to a high standard. The Swindon SFRA assesses that the probability of a significant failure of Coate Water is unlikely, and so the probability of reservoir flooding to the Site is considered to be low. However, essential or residential development should not be located in those areas mapped as being at risk in a failure as a pragmatic way of mitigating the risk.

3.1.11 It should be emphasised that the risk of flooding from reservoir breach is very small in any case; the EA are the enforcement authority for the Reservoirs Act (1975) and all large raised reservoirs are inspected and supervised by reservoir panel engineers. The EA's website states:

*'Reservoir flooding is extremely unlikely to happen. There has been no loss of life in the UK from reservoir flooding since 1925. All large reservoirs must be inspected and supervised by reservoir panel engineers. As the enforcement authority for the Reservoirs Act 1975 in England, we ensure that reservoirs are inspected regularly and essential safety work is carried out'.*

3.1.12 The risk of such an occurrence is therefore considered negligible.

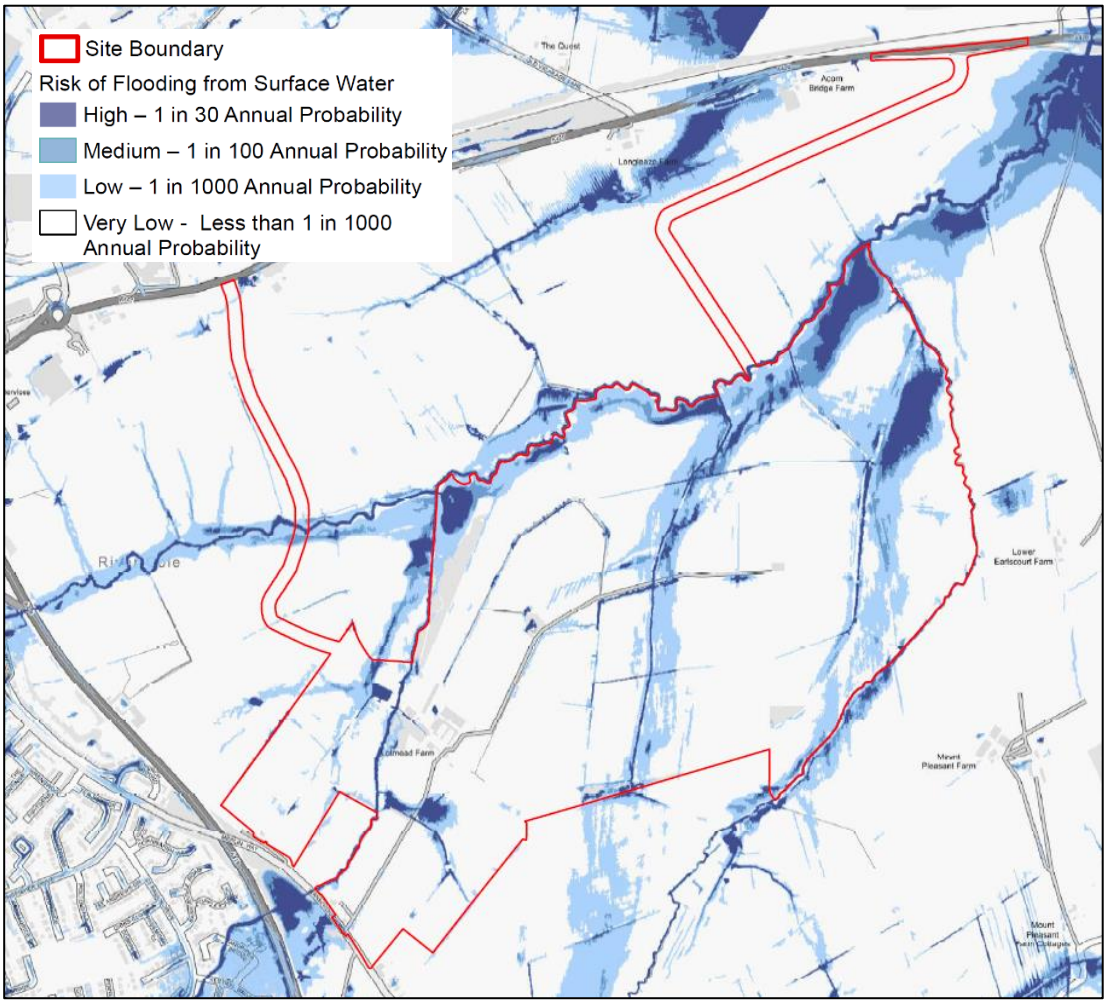
## Flood Risk from Surface Water

3.1.13 The EA 'updated Flood Map for Surface Water' ('uFMfSW') shows where areas could be potentially susceptible to surface water flooding in an extreme rainfall event (see **Appendix A**). The latest mapping assesses flooding resulting from severe rainfall events based on the following three scenarios:

- 1 in 30 (3.3%) annual probability rainfall event ('High' risk);
- 1 in 100 (1%) annual probability rainfall event ('Medium' risk);
- 1 in 1000 (0.1%) annual probability rainfall event ('Low' risk).

3.1.14 Land at lower than 1 in 1000 (0.1%) annual probability of flooding is considered to be 'Very Low' risk of flooding

**Figure 3.3: EA Updated Flood Map for Surface Water**

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3.1.15 The Surface Water Flood Map is generally consistent with the fluvial flood maps, showing concentrations of flows around watercourses and the drainage network at the Site. It also shows some tendency for surface water to accumulate on the field boundaries.

3.1.16 It should be noted that the surface water maps are generated using a generic methodology on a national scale, whereby rainfall is routed over a ground surface model. The analysis does not take account of any specific local information on below-ground drainage infrastructure and infiltration, although an adjustment is included in urban areas to account for the impact of sewerage and a standard infiltration allowance based on soil type. Consequently the mapping provides a guide to potentially vulnerable areas based on the general topography of an area.

## Historic Flood Map

3.1.17 The EA 'Historic Flood Map' is a dataset showing the maximum extent of all individual recorded flood outlines from river, the sea and groundwater and shows areas of land that have previously been subject to flooding. The Historic Flood Map is reproduced in **Appendix A** and shows that areas adjacent to the River Cole and Doran Stream have records of historical fluvial flooding.

3.1.18 The EA also provided individual recorded flood outlines as part of the Product 4 package of flood data (**Appendix C**). This provides records of the floods of 2007.

3.1.19 Further details regarding historic flood events are provided in the SBC PFRA and SFRA as summarised in Sections 3.2 and 3.3 below.

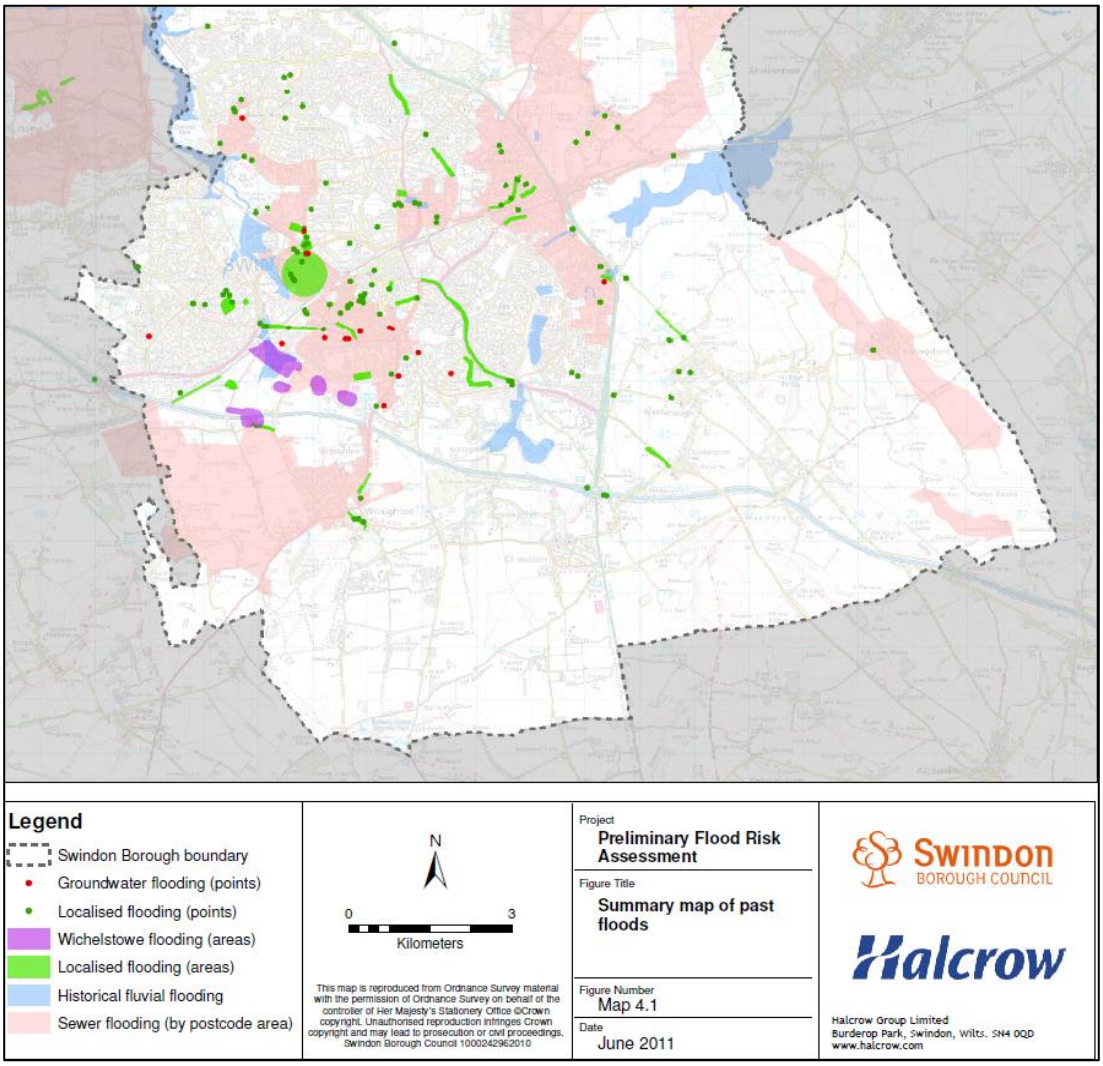
## 3.2 Preliminary Flood Risk Assessment

3.2.1 Swindon Borough Council (SBC) is defined as a Lead Local Flood Authority (LLFA) under the Flood and Water Management Act 2010. The first step of the Flood Risk Regulations is for LLFAs to produce a PFRA providing a high level overview of flood risk from all sources within a local area, including consideration of surface water, groundwater, ordinary watercourses and canals.

3.2.2 SBC published their PFRA in August 2011. The PFRA includes a number of reference figures providing an overview of flood risk. The Flood Risk Area identified in the PFRA is the same as the Environment Agency flood map and so the Site is shown to be located within Flood Zones 1, 2 and 3.

3.2.3 The Swindon PFRA Map 4.1, shows that there has historically been fluvial flooding at the Site, mainly associated with the River Cole. The map shows a localised flooding incident near the entrance to the site on the Wanborough Road, though the resolution of the map is not sufficient to pinpoint the location of this flooding.

**Figure 3.4: PFRA Groundwater Flood Map 4.1**



## 3.3 Strategic Flood Risk Assessment

3.3.1 The SBC SFRA was released in August 2008 to collate all known sources of flooding, and allow the Local Planning Authority to apply the Sequential Test to potential development sites.

3.3.2 The SFRA indicates that the Site was not affected by the significant flood events in 1947, 1968, 1971, 1977, 1992 or 1993, as shown in Tile B4 recreated in **Figure 3.5**.

**Figure 3.5: SFRA Historic Flood Map (Tile B4)**

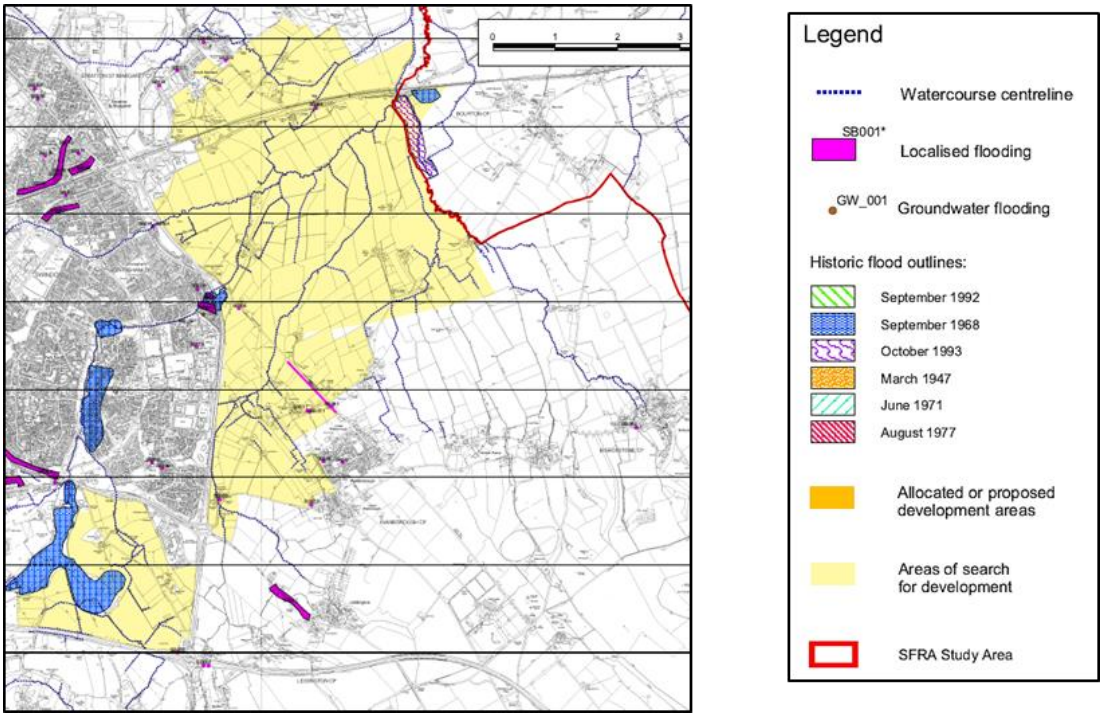
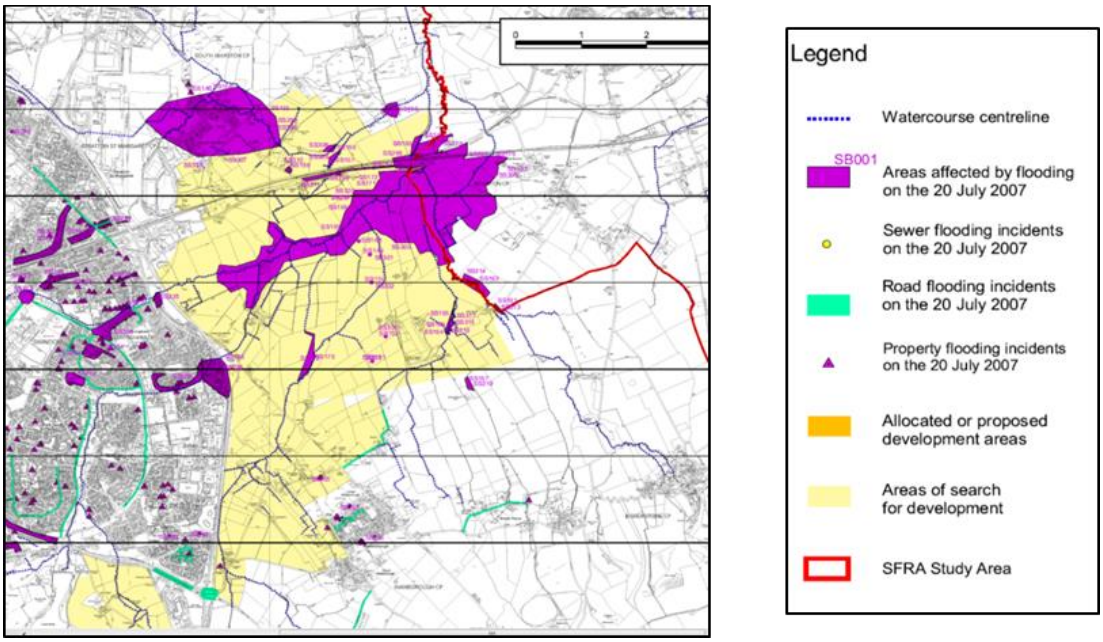


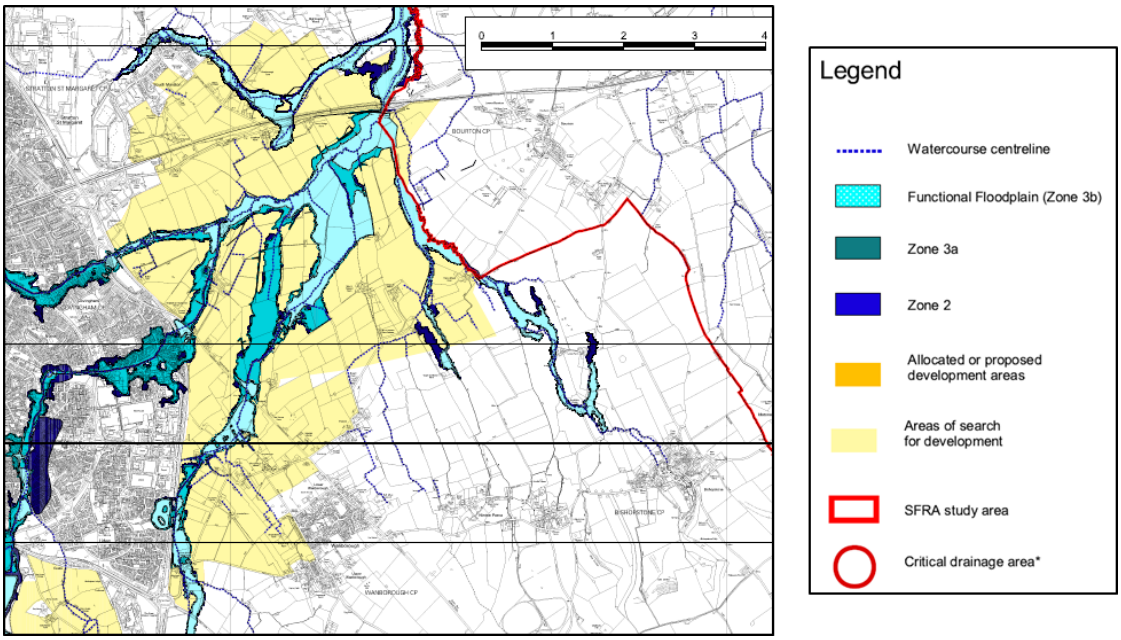

**Figure 3.6: SFRA Flooding 20 July 2007 (Tile C4)**



3.3.3 Significant flooding occurred in July 2007. SFRA Tile C4 (**Figure 3.6**) indicates that the Site was not affected by flooding in during this large event. It also shows local flooding incident SB107, which is recorded as flooding at Lotmead Cottages on Wanborough Road caused by inadequate ditch capacity.

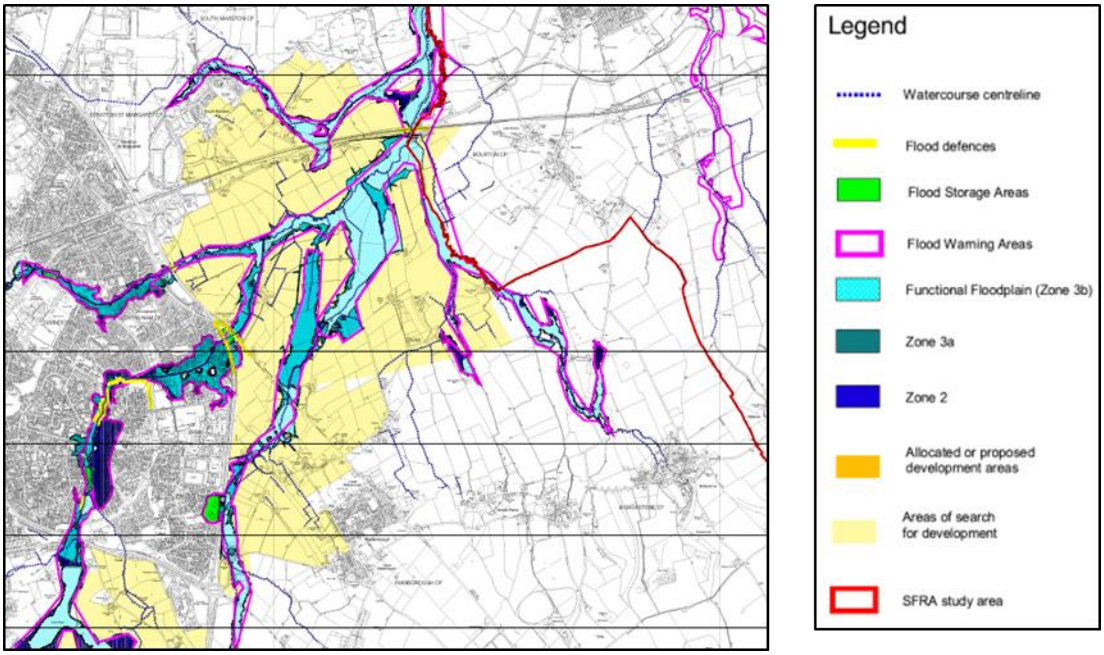
3.3.4 SFRA Tile D4 (**Figure 3.7**) shows that significant areas of the Site are located in Flood Zones 2, 3a and 3b. This appears to be generally consistent with the current EA Flood Zone map.

**Figure 3.7: SFRA Flood Zone Map (Tile D4)**




3.3.5 Tile E4 (**Figure 3.8**) shows that there is a flood storage area to the west of the Site boundary, which corresponds with the Wanborough Road FSA. It also shows that the A419 embankments are considered to be informal flood defences.

**Figure 3.8: SFRA Defences, Flood Warning and Storage Areas (Tile E4)**



3.3.6 The SFRA also states that *"some groundwater flooding may occur in the drift deposits but this is likely to be related directly to surface (river) water and is unlikely to occur in isolation from such events".*

## 3.4 Local Flood Risk Management Strategy

3.4.1 As LLFA for Swindon Borough, the Council has developed a Local Flood Risk Management Strategy (LFRMS) (published July 2014), which focuses on local flood risk from surface water, groundwater and ordinary watercourses, but also considers flooding from rivers. It identifies the responsibilities for flooding within the borough and enables a range of organisations to work together to improve the management of flood risk. It also defines the Council's new role as a LLFA.

3.4.2 The LFRMS contains a general overview of flood risk in Swindon, including a summary of groundwater flooding in the borough. There are very few records of groundwater flooding in Swindon and none of these are incidents of property flooding. The geology of Swindon is such that the risk of flooding from Groundwater is low, but no modelling or numerical assessment is available to quantify this conclusion.

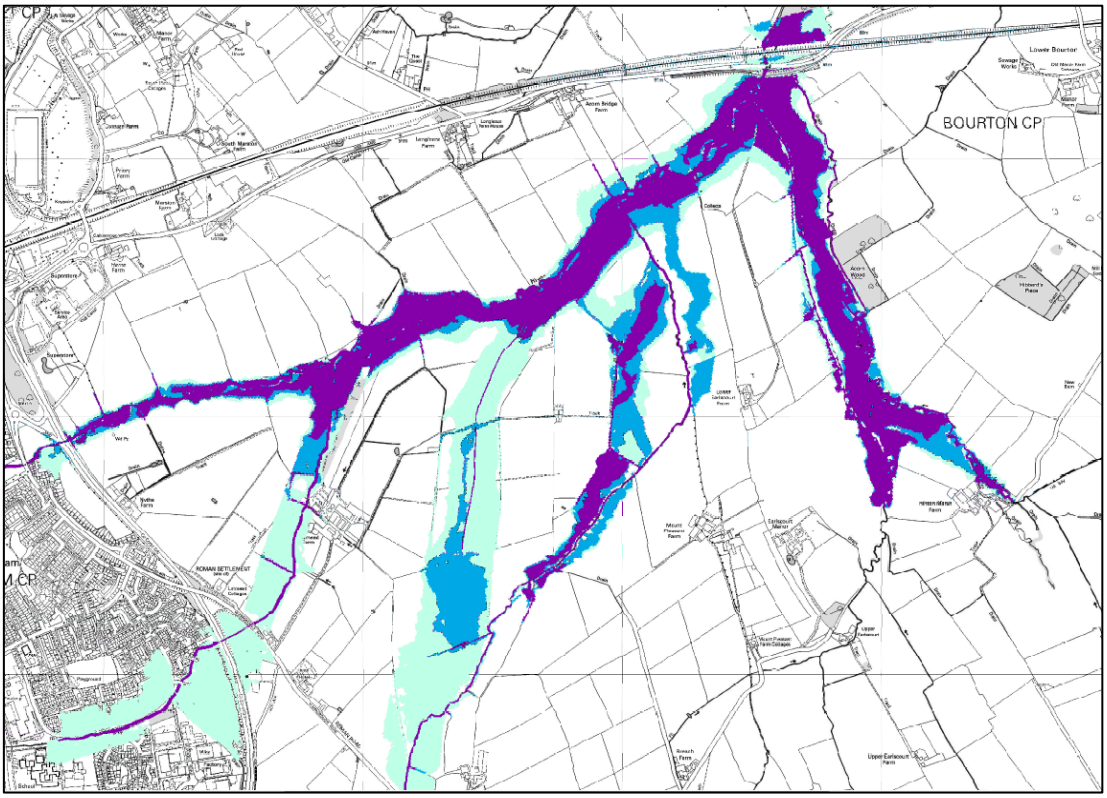
3.4.3 This document highlights that *"It is also important that the impact of climate change is considered when planning new developments to ensure they are sited in areas which will not increase flood risk to the development or surrounding areas in the future."*

## 3.5 EA Modelled Flood Data

3.5.1 The EA created a 1D/2D Estry-TUFlow model for the Swindon Eastern Development Area Group to cover the North Eastern Villages Site and surrounding area. The model was provided to PBA and included two reports:

- Flood Mapping Study Volume 1: Hydrology Report for the River Cole (February 2010);
- Flood Mapping Study Volume 2: Hydraulic modelling report for the River Cole (August 2010).

**Figure 3.9: Flood Zone Map from modelling provided by the EA.**




3.5.2 **Figure 3.9** shows the modelled Flood Zones through the Site. The floodplain flow from the Liden Brook north to the Cole runs separate to the watercourse, creating bands of higher flood risk (Flood Zones 2 and 3) across the Site and islands of Flood Zone 1.

3.5.3 It is noted that the provided EA model outputs include flood levels for a 1 in 100 annual probability +20% allowance for climate change event. However, this allowance has been superseded by the new climate change allowances in the EA guidance released in February 2016. The implications of this new guidance are discussed in Section 4.

## 3.6 PBA Refined Hydraulic Modelling

3.6.1 Following discussion with the EA regarding the requirements/direction for hydraulic modelling of the Site, PBA obtained the current hydraulic model of the Site to establish the baseline flood risk to the Site. This base model was an Estry-TUFLOW model and was the model on which the existing EA Flood Zones were based on. The model is the Eastern Development Area, Swindon Flood Mapping Study (August 2010) and was carried out for the Swindon Eastern Development Area Group.

3.6.2 PBA has reviewed and refined this hydraulic model, incorporating local detail such as topographic survey of the Site and channel survey for Drainage Ditches A and B. This improved ground level data was used to improve understanding of the existing flood risk on the Site.

3.6.3 The technical detail of the hydraulic modelling undertaken is described in the modelling report; a copy of which is included in **Appendix D**.

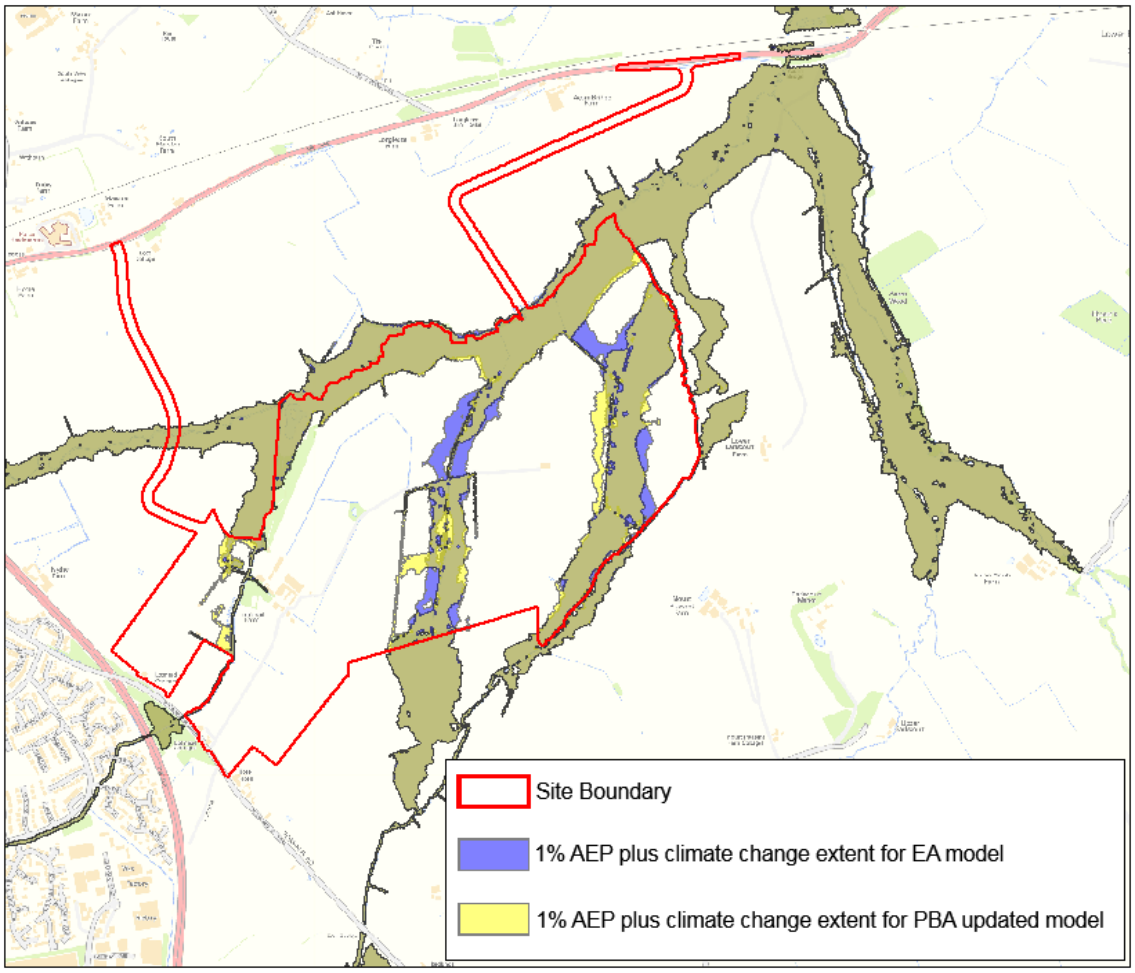
3.6.4 An addendum to the modelling report has also been prepared to account for the updated climate change allowances released in February 2016 (see Section 4). This addendum is

provided in **Appendix D** and should be read in conjunction with the Hydraulic Modelling Report.

3.6.5 **Figure 3.10** is a comparison between the updated PBA model and the existing hydraulic model. This illustrates the updated baseline flood extent on Site for the 1 in 100 year plus climate change event (green-grey areas are where floodplains overlap, i.e. no change in modelled flood levels

3.6.6 The refined baseline flood extents confirm that the Liden Brook floodplain is disconnected from its watercourse. Wide flood extents follow the alignment of the two drainage ditches, although the depths of flooding along these routes is shallow and thus the floodplain volume on this ditches is low.

**Figure 3.10: Comparison of updated PBA model and existing hydraulic model.**






## 3.7 Groundwater Flooding

3.7.1 The Site is located on an Unproductive Stratum, and so groundwater emergence is unlikely to be a problem over the majority of the Site. Perched water could be found at the interface between the more permeable alluvial deposits and less permeable clay bedrock, but this would be likely to occur within areas designated as floodplain, immediately adjacent to the watercourses. Furthermore, groundwater levels in the alluvial deposits would be likely to be dictated by water levels in the watercourses, and so any groundwater emergence would be likely to be coincident with the extent of any fluvial flooding.

3.7.2 It is therefore considered that the probability of groundwater flooding is low, and that any potential for groundwater emergence would be likely to be dominated by fluvial flooding.

## 3.8 Flooding from Infrastructure

3.8.1 There are no sewers or large water mains shown in the vicinity of the Site on the Thames Water Asset Location plans. The risk of flooding from existing foul or freshwater infrastructure is therefore considered to be negligible.

3.8.2 Sewers and water mains required for the Development should be designed to minimise the probability of flooding to properties in the event of a failure.

3.8.3 There are currently no canals in the vicinity of the Site, so the risk of flooding from canals is considered to be low. There are some proposals to reinstate a canal in the vicinity of the Site. If these works are undertaken, the canal development would have to ensure that it does not put this Site Development at risk, in accordance with the reference in the SFRA to the canal. However, it is also considered to be sensible to allow a buffer between the proposed canal route and the Site to help mitigate the future risk.

## 3.9 Summary of Flood Risk

3.9.1 The following table provides an overview of the flood risk to the site, based on the information obtained and detailed in Section 3.

**Table 3.1: Summary of Sources of Flood Risk**

| Source of Flooding | Risk of Flooding to Site | Comment/Justification | Source of data | Mitigation requirements for new development (see Section 5) | Risk of Flooding to Site after mitigation |
|---|---|---|---|---|---|
| **Tidal** | | The site is located inland and none of the watercourses within the vicinity of the site are tidally influenced | - | n/a | |
| **Fluvial** | | There are currently large areas of the site located in Flood Zones 2 and 3 associated with the floodplains of the River Cole, Liden Brook and Dorcan Stream that flow through and adjacent to the site.<br>There are no historic records of fluvial flooding at the site. | EA Product 4 data<br>SFRA Map D4<br>PBA Hydraulic Modelling | A floodplain restoration scheme will be implemented to reduce the areas of floodplain within the site.<br>All new built development will be located in Flood Zone 1. | |
| **Land Drainage (i.e. Surface Water/ Pluvial)** | | There are areas of low, medium and high surface water flood risk across the site associated with the existing watercourse corridors and drainage features. | EA surface water flood maps<br>SFRA | Allow for in floor level recommendations.<br>Liaise with SBC in development of surface water drainage strategy | |
| **Ground water** | | The site is located on unproductive stratum. | BGS Viewer | Allow for in floor level recommendations. | |
| **Reservoir, Canals, Ponds and Other Artificial Sources** | | Areas adjacent to the River Cole and Dorcan Stream are shown to be at medium to low probability of flooding in the event of a breach of the Coate Reservoir located 4km south-west of the site. | EA reservoir flood maps | Risk of flooding from reservoirs is considered to be low. | |
| **Sewers** | | There are no public sewers located within the vicinity of the site. | Thames Water sewer records | Design new sewer infrastructure to minimise probability of flooding. | |
| | | | | | |
| Key: | | **Low/Negligible Risk** – No noticeable impact to site and not considered to be a constraint to development | | | |
| | | **Medium Risk** – Issue requires consideration but not a significant constraint to development | | | |
| | | **High Risk** – Major constraint to development requiring active consideration in mitigation proposals | | | |

# 4 Impact of Climate Change

4.1.1 In considering flood risk to the site, it is necessary to fully consider the potential impacts of climate change for the lifetime of the development within the mitigation measures.

4.1.2 In February 2016 the EA released new guidance on the application of climate change allowances in flood risk assessments:

https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances.

4.1.3 This guidance provides contingency allowances for potential increases in peak river flow in Table 1, and for potential increases in rainfall intensity in Table 2. The latter requires consideration in any surface water drainage strategy for new development and is discussed in **Section 7**.

4.1.4 The peak river flow allowances table provides a range of allowances based on percentile (i.e. the degree of certainty of an event occurring, based on the range of climate change scenarios assessed through scientific investigations). The provided allowances are also subject to the vulnerability classification of the proposed use and the river basin district of the site.

4.1.5 The conditions at the site and consequent peak river flow allowances to be considered as part of the FRA are as detailed in **Table 1**.

**Table 1: Climate Change – Peak River Flow Allowances**

| River Basin District | Flood Zone | Flood Risk Vulnerability Classification | Range of Climate Change Allowances requiring consideration (2070–2115) | | |
|---|---|---|---|---|---|
| | | | Central | Higher Central | Upper End |
| *Thames* | *3* | *More Vulnerable* | ***+25%*** | ***+35%*** | ***+70%*** |

4.1.6 Detailed hydraulic modelling has been undertaken to account for the new climate change allowances. Details are provided in the addendum to the Hydraulic Modelling Report in **Appendix D**.

4.1.7 The estimated climate change flood levels are used in the consideration of mitigation measures as discussed in **Section 5**.

4.1.8 Updated climate projections were presented as part of UKCP18 published on 26th November 2018. The EA have prepared a briefing note that confirms that the 2016 guidance is still the best national representation of how climate change is likely to affect flood risk for peak river flow and peak rainfall intensity. Further research is due to be published in 2019 that may result in changes to these allowances, however, at this stage it is considered reasonable to continue to use the 2016 guidance for planning decision making.

# 5 Proposed Development and Sequential Test

## 5.1 Proposed Development

5.1.1 The proposals comprise:

*An outline application (with all matters reserved save the detailed access off Wanborough Road) for demolition and/or conversion of the existing buildings on site, and redevelopment to provide:*

- *Up to 2,500 residential units (Use Class C3);*
- *Up to 1,780 sq m of community/retail uses (Use Classes D1/D2/A1/A2/A3/A4);*
- *Up to 2,500 sq m of business/employment use (Use Class B1);*
- *A Sports Hub with playing pitches and changing facilities;*
- *2 no. 2 Form Entry Primary Schools (2.2 ha per school);*
- *Open space, strategic landscaping and other green infrastructure (including SUDs and areas for nature conservation);*
- *Other associated road and drainage infrastructure;*
- *Indicative primary access road corridors to the A420 and alignment with the Southern Connector Road; and*
- *Improvements and widening along Wanborough Road for pedestrian, cycle and bus access.*

5.1.2 The development proposals are shown on the Parameter Plan (drawing no PL1461.1-PLA-00-XX-DR-U-0005-S4-P01) included in **Appendix E**.

5.1.3 Residential development has a projected lifetime of development of up to 100 years and therefore the *Upper End* climate change allowance has been considered in the hydraulic modelling.

## 5.2 Flood Risk Vulnerability

5.2.1 NPPF PPG 'Flood Risk and Coastal Change' Table 2 confirms the *'Flood risk vulnerability classification'* of a site, depending upon the proposed usage. This classification is subsequently applied to PPG Table 3 to determine whether:

- The proposed development is suitable for the flood zone in which it is located, and;
- Whether an Exception Test is required for the proposed development.

5.2.2 The proposed residential development is classed as 'more vulnerable' development.

5.2.3 The commercial elements are classed as 'less vulnerable' development.

5.2.4 The location of the proposed 'more vulnerable' and 'less vulnerable' development is in Flood Zone 1.

## 5.3 NPPF Sequential Test

5.3.1 The NPPF follows a sequential risk-based approach in determining the suitability of land for development in flood risk areas, with the intention of steering all new development to the lowest flood risk areas.

5.3.2 NPPF PPG '*Flood Risk and Coastal Change*' Table 2 confirms the '*Flood risk vulnerability classification*' of a site, depending upon the proposed usage. This classification is subsequently applied to PPG Table 3 to determine whether:

- The proposed development is suitable for the flood zone in which it is located, and;
- Whether an Exception Test is required for the proposed development.

5.3.3 As part of the New Eastern Villages development outlined in the Local Plan and Eastern Villages SPD, two villages, known as the Earlscourt villages, have been allocated for development by the Council. Within this FRA and the planning application documentation these two villages are referred to as the Lotmead Farm villages, and so references to Lotmead should be taken to refer to the proposals pertaining to Earlscourt in planning policy documents and correspondence.

5.3.4 As part of the allocation, the New Eastern Villages site was tested (in terms of the principle and strategic acceptability of development) through the Swindon Joint Study (2005) and subsequent testing of the draft Regional Spatial Strategy in 2006/07. It was found to be an acceptable location for large scale development. Consequently, this FRA will not seek to re-apply the Sequential Test.

5.3.5 The Eastern Villages Draft Supplementary Planning Document (July 2013) states that "parts of the Eastern Villages lie within medium and high risk flood zones as defined by the Environment Agency (Flood Zones 2 and 3 respectively) and these are not proposed for development other than for essential infrastructure and those uses identified as acceptable in these zones in the National Planning Policy Framework (NPPF) Technical Guidance covering Flood Risk." Further, the Eastern Villages Supplementary Planning Document Sustainability Appraisal Report (July 2013) sets out that "Only essential infrastructure can be proposed within the Environment Agency flood zones."

5.3.6 The proposed residential and primary school uses would be classed as 'More Vulnerable' development, while the business / employment and retail / community uses would be classed as 'Less Vulnerable'. Some hard and soft infrastructure would be classed as 'Essential Infrastructure' e.g. highways and utilities, and other infrastructure would be 'Water-compatible' e.g. playing fields and water-based amenities.

5.3.7 A sequential approach has been applied in developing the Parameter Plan, in accordance with national and local planning policy, such that the location of the proposed 'More Vulnerable' and 'Less Vulnerable' development is limited to areas of Flood Zone 1 (post-development) – i.e. where all forms of development are considered acceptable. Since these uses are already located in the area at lowest probability of flooding it therefore passes the Sequential Test and does not require the Exception Test.

# 6 Flood Mitigation Strategy

## 6.1 Sequential Approach

6.1.1 The NPPF encourages the application of the 'sequential approach' in the master-planning process for new development, i.e. locating the more sensitive/vulnerable elements of new development in the areas which lie at lowest probability of flooding and, conversely, reserve the areas of the site at greatest risk of flooding for the least vulnerable elements of the development (or, preferably, leave such areas undeveloped or as soft landscaping).

6.1.2 The sequential approach has been followed by ensuring all new built development, regardless of its vulnerability classification, is located in Flood Zone 1.

## 6.2 Building Design

### Ground Floor Levels

6.2.1 Standard requirements for ground floor levels of new development are set out in BS8533:2011 'Assessing and Managing Flood Risk in New Development – Code of Practice'. This recommends floor levels are set a minimum of 300mm above the modelled 1 in 100 annual probability plus allowance for climate change flood level.

6.2.2 It is also recommended that ground floor levels are set a suitable freeboard above surrounding ground (minimum 150mm) to mitigate the residual flood risk associated with excess surface water runoff in an extreme rainfall event. Similarly, exterior ground levels across the site should also be appropriately contoured to direct surface water away from dwellings in such a scenario.

6.2.3 These requirements will need to be considered when the final development levels are developed at the detailed planning application stage.

### Flood Resistant and Flood Resilient Measures

6.2.4 Flood resistant measures aim to keep flood water out of the building by providing barriers and incorporating low permeability measures in the wall and floors. Such measures include demountable defences, water resistant wall rendering, the sealing of ground level vents (e.g. using Ventguard, Ventseal or SmartBrick) and anti-flood valves fitted to all drainage runs exiting the building. Typically, flood resistance measures are effective up to a maximum flood depth of approximately 500mm, with suitable measures incorporated up to the flood level.

6.2.5 Flood resilient measures are incorporated where it is accepted that, in severe flood events, water may enter parts of the building so it is necessary to ensure the building will remain useable after the floodwater has receded and the area has been cleaned. Therefore, the key issue is to incorporate materials that retain their structural integrity and have good drying and cleaning properties (e.g. the use of suitable tiling over areas, with water resilient grout). It is also recommended that services are secured and sockets etc. are located a suitable freeboard above floor level.

6.2.6 All new built development is to be located in Flood Zone 1, at low risk of fluvial flooding. On this basis, flood resistant and flood resilient measures set out above are not required.

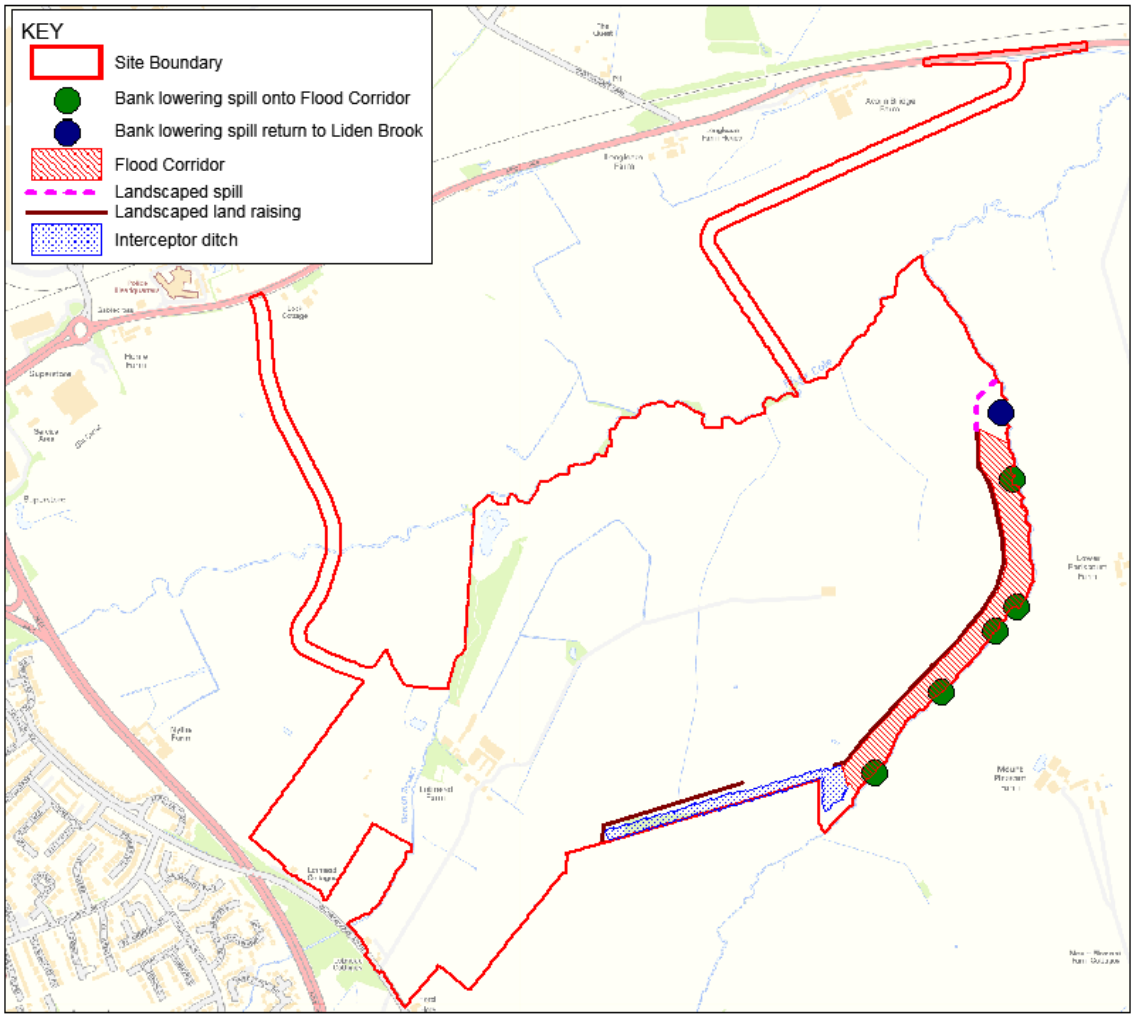
## 6.3 Floodplain Restoration Scheme

6.3.1 As noted in Section 3.6, currently the Liden Brook floodplain is isolated from the watercourse, with flood flows following the alignment of the drainage ditches which run south-north to the River Cole.

6.3.2 It is proposed to restore the Liden Brook floodplain to a more natural state, bringing ecological, hydromorphological and landscape benefits, as well as a reduction in flood risk offsite. The restoration of the Liden Brook floodplain has benefits in terms of masterplanning, as this will remove the wide floodplain within the site and improve connectivity.

6.3.3 A schematic illustration of the proposed restoration scheme is presented in **Figure 6.1**.

**Figure 6.1: Schematic of PBA Floodplain Restoration Scheme**






6.3.4 The scheme diverts the Liden Brook flood flows away from Drainage Ditches A and B and into a flood corridor adjacent to the Liden Brook; restoring the floodplain-watercourse connectivity.

6.3.5 The proposals do not include a traditional 2-stage channel for two reasons: firstly there are a number of trees along the Liden Brook which should be retained for ecological reasons and secondly when option testing using the hydraulic model it was found that a 2-stage channel conveyed water more efficiently than the current floodplain processes and thus caused significant detriment downstream. A 2-stage channel was therefore considered initially but dismissed as unacceptable for both ecological and flood risk reasons.

6.3.6 It is intended that the earthworks required to construct the scheme will be such that there are no 'hard' flood defences or control structures that could fail, but rather that the flood routing is achieved through landscaping areas of lower land or higher land. The scheme therefore looks to use existing drainage features and will incorporate inconspicuous 'naturally' graded ridges

and gullies to help create the flowpaths required to establish a floodplain area along the banks of the Liden Brook.

6.3.7 The scheme will extend an existing field drain across the existing flow path from the Liden Brook to the Drainage Ditch B. From here it will divert flow onto a flood corridor alongside the Liden Brook, before allowing the flow to re-join the Liden Brook at the confluence of the Liden Brook and the River Cole further downstream.

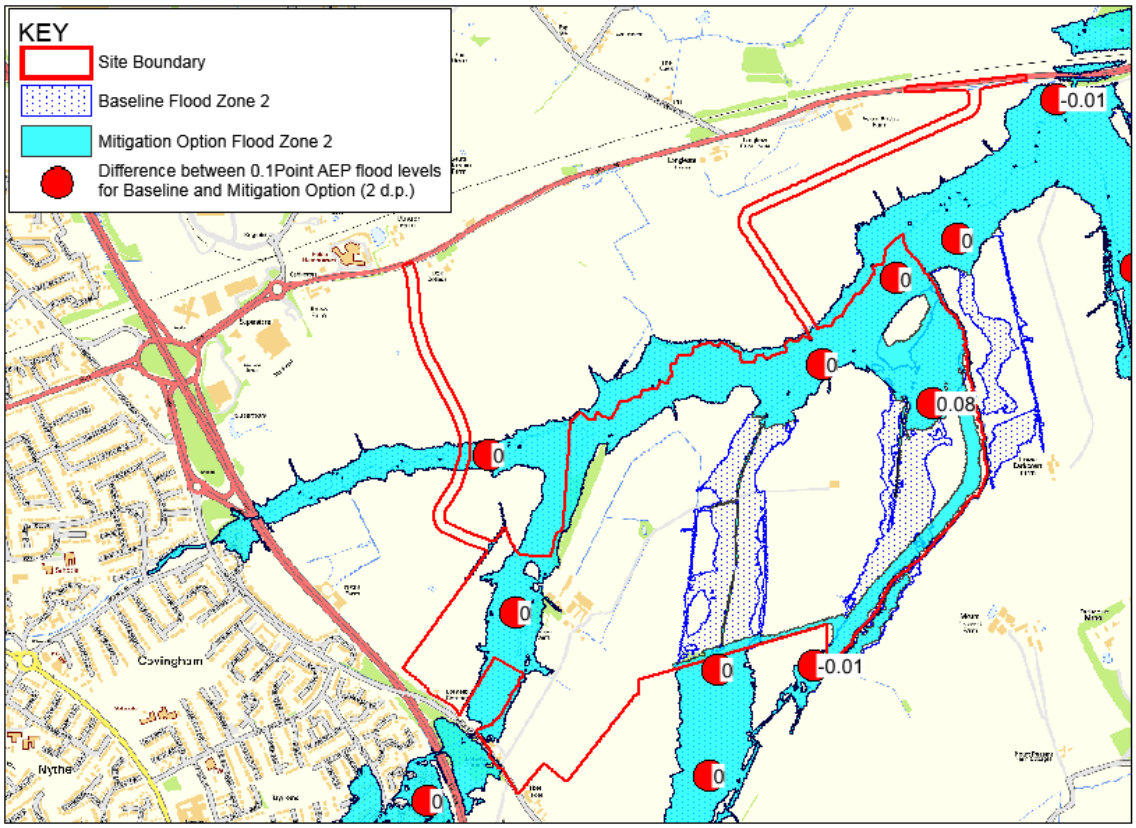
6.3.8 The scheme also includes areas of bank lowering to allow water to flow from the Liden Brook onto the flood corridor in smaller return period events. This allows the proposed mitigation scheme to offer some additional mitigation for water levels in the Liden Brook downstream for the Site.

6.3.9 The proposed changes to the floodplain of the Liden Brook along the eastern boundary involve localised points of land-lowering allowing spillage into the restored floodplain during high flows. At detailed design, the crest levels of the spills will be set to optimise the operation of the scheme to maximise biodiversity and flood risk benefits. It is anticipated that, over time, frequent low-order flood events will result in the establishment of a wet grassland akin to floodplain grazing marsh which will benefit a range of fauna including birds and invertebrates. This would represent a biodiversity gain, due to the establishment of a habitat of greater intrinsic nature conservation value over a wide area along the floodplain, compared with the result in a positive change from the existing improved grassland that is present, which is of limited intrinsic nature conservation value. The flow route along the ditch from the Liden Brook to the River Cole does not come out of bank during low order flood events and thus the proposed development will be an improvement on the existing regime.

6.3.10 The scheme, as presented, is constrained by land ownership. Ideally, the flow route along the Drainage Ditch B would be obstructed closer to the Liden Brook, such that the floodplain never diverts away from the watercourse. There may be opportunities to amend the scheme in future if the relevant landowners are amenable.

6.3.11 The updated baseline model produced by PBA was amended to assess the proposed floodplain restoration scheme. Details of the hydraulic modelling for the floodplain restoration scheme are included in **Appendix D.**

**Figure 6.2: Comparison of Flood Zone 2 extent and levels between PBA Floodplain Restoration Scheme and existing site**

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6.3.12 As is shown in **Figure 6.2**, the post restoration scheme scenario 1 in 1000 year modelled flood extent has been used to advise the Parameter Plan. All built development has been proposed outside of the 1 in 1000 year flood extent, in accordance with local planning policy. All SuDS features would also be located within the post-development outside of the 100 year + Climate Change event.

6.3.13 Modelling has been undertaken to optimise the effectiveness of the scheme and demonstrate that not only does the floodplain restoration not exacerbate flood risk offsite but that there is a small decrease in flood levels at Acorn Bridge as a result of this scheme of approximately 10mm.

6.3.14 The model results (**Table 6.1**) demonstrate that following the completion of the Development, which is linked to **Figure 6.2**, the following impacts will be experienced:

**Table 6.1: Model Results Summary**

| Description | Easting | Northing | BASELINE flood level (m aOD) | POST DEVELOPMENT flood level (m aOD) | Difference between POST DEVELOPMENT and BASELINE (m) |
|---|---|---|---|---|---|
| River Cole upstream of site | 419620 | 186110 | 91.46 | 91.46 | 0 |
| Dorcan Stream upstream of site | 419420 | 184970 | 93.75 | 93.75 | 0 |
| Dorcan Stream west of Phase 1 Development | 419703 | 185590 | 91.92 | 91.92 | 0 |
| Liden Brook Upstream of Green Corridor | 420340 | 185050 | 93.43 | 93.43 | 0 |
| Liden Brook at Floodplain Restoration scheme | 420370 | 185400 | 92.24 | 92.24 | 0 |
| River Cole at confluence with Green Corridor | 420720 | 186410 | 89.63 | 89.63 | 0 |
| Liden Brook upstream of site | 420690 | 185420 | 92.36 | 92.35 | -0.01 |
| Floodplain on site at downstream of Floodplain Restoration Scheme | 421080 | 186280 | 89.72 | 89.80 | 0.08 |
| River Cole at confluence with Liden Brook | 420960 | 186690 | 89.42 | 89.42 | 0 |
| River Cole downstream of site | 421160 | 186820 | 88.88 | 88.88 | 0 |
| Lenta Brook east of site | 421750 | 186730 | 88.85 | 88.85 | 0 |
| River Cole at Acorn Bridge (A420) | 421490 | 187280 | 88.46 | 88.45 | -0.01 |

6.3.15 The floodplain restoration scheme was tested to investigate whether it was possible to provide a downstream betterment greater than the scheme above. However, iterative assessment demonstrated that the flood flows on the River Cole and Dorcan Stream are large and as it is only possible within this landholding to develop schemes which influence the Liden Brook floodplain flows, the scope for greater downstream betterment is limited.

## 6.4 Safe Access

6.4.1 It is necessary to consider and incorporate safe access arrangements as part of the mitigation, to ensure the users/occupants of the development are safe in times of flooding.

6.4.2 The western area of development will maintain safe access to Wanborough Road. The eastern phases of development will be served by new access crossings over the River Cole which will provide safe access and egress towards the A420 north of the site.

6.4.3 Consideration of the safety of any pedestrian route has been based on the guidance in the EA document '*Supplementary Note on Flood Hazard Ratings and Thresholds for Development Planning and Control Purpose – Clarification of the Table 13.1 of FD2320/TR2 and Figure 3.2 of FD2321/TR1*'.

6.4.4 The 'hazard to people' classification has four ratings:

- **Very low hazard** – caution (Flood Hazard Rating ('FHR') less than 0.75)
- **Danger for some** – i.e. children, the elderly and infirm (FHR between 0.75 and 1.25)
- **Danger for most** – includes the general public (FHR between 1.25 and 2.0)
- **Danger for all** – includes the emergency services (FHR greater than 2.0)

6.4.5 All new built development will be located in Flood Zone 1, and safe dry access will be available to all areas of the site via the new highways and access routes provided within the development.

**Figure 6.3: Extract of Table 4.1 from Supplementary Note on Flood Hazard Ratings**

| Velocity (m/s) | Depth of flooding (m) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Debris Factor = 0.5 | | | | Debris Factor = 1 | | | | | | | | |
| | 0.05 | 0.10 | 0.20 | 0.25 | 0.30 | 0.40 | 0.50 | 0.60 | 0.80 | 1.00 | 1.50 | 2.00 | 2.50 |
| 0.00 | | | | | | | | | | | | | |
| 0.10 | | | | | | | | | | | | | |
| 0.3 | | | | | | | | | | | | | |
| 0.50 | | | | | | | | | | | | | |
| 1.00 | | | | | | | | | | | | | |

Danger for some | Danger for most | Danger for all

6.4.6 FD2320 states that '*The outputs of the Flood Risk to People project indicate that flood depths below 0.25 m and velocities below 0.5 m/s are generally considered low hazard. When designing safe access and exit routes, the combinations of depth and velocity on the routes should correspond to the white boxes in the above diagram. As flood depth and/or velocity increase the hazard to people increases. Combinations of depths and velocities in the white boxes (below the 'danger for some' class) are 'very low hazard', but a hazard does remain.'*

6.4.7 As such, continuous safe access is available from the site.

## 6.5 Flood Risk Activity Permit Requirements

6.5.1 Proposed works in, over, under or near a main river or a flood defence require a 'Flood Risk Activity Permit' (FRAP) application to be made to the EA (this replaced the previous 'Flood Defence Consent' (FDC) procedure). This is required to demonstrate any new development does not have a detrimental impact on flood risk, either through impacting the integrity of the existing defence or through preventing maintenance access to the defence.

6.5.2 The proposed new accesses crossing the River Cole from the north and the Floodplain Restoration Scheme will require FRAPs.

6.5.3 Separate consent from SBC, as LLFA, is required for new crossings or development that may impact on minor and ordinary watercourses within and adjacent to the site.

# 7 Surface Water and SuDS

7.1.1 It is proposed to drain the surface water from the development site to existing drains and watercourses within and adjacent to the site.

7.1.2 The discharge of surface water is proposed to be at a rate that is no greater than the present 'greenfield' (pre-development) run-off rate. This will be achieved through the use of SuDS (Sustainable Drainage Systems) measures.

7.1.3 A surface water management strategy suitable to support an outline planning application has been developed.

## 7.2 Overview

7.2.1 As of April 2015, the Lead Local Flood Authority (LLFA) has become a statutory consultee on planning applications for surface water management. As the LLFA, Swindon Borough Council (SBC) are therefore responsible for the approval of surface water drainage systems within new major development. Major development consists of any of the following:

a) the provision of dwelling houses where residential development of 10 or more units; or where the development is to be carried out on a site having an area of 0.5 hectares or more and the number of units is not known;

b) the provision of a building or buildings where the floor space to be created by the development is 1,000 square metres or more; or

c) development carried out on a site having an area of 1 hectare or more.

7.2.2 The following section provides an overview of the existing surface water drainage arrangements and the proposed strategy for the management of surface water from the new development. Further details are provided on PBA Drawing (27970/4005/001*)* and source control models in **Appendix F**.

## 7.3 Planning Policy Requirements

7.3.1 The NPPF recognises that flood risk and other environmental damage can be managed by minimising changes in the volume and rate of surface runoff from development sites, and recommends that priority is given to the use of Sustainable Drainage Systems (SuDS) in new development, this being complementary to the control of development within the floodplain.

7.3.2 NPPF paragraph 165 requires that 'Major developments should incorporate SuDS unless there is clear evidence that this would be inappropriate'. Para 165 item (c) requires that maintenance arrangements are in place to ensure an acceptable standard of operation for the lifetime of the development and item (d) requires that SuDS should, where possible, provide multifunctional benefits.

7.3.3 As the intention of SuDS is to mimic the natural drainage regime of the undeveloped site, the NPPF PPG states the following (consistent with the Building Regulations H3 hierarchy):

> ***...the aim should be to discharge surface water runoff as high up the following hierarchy of drainage options as reasonably practicable:***
>
> ***- into the ground (infiltration),***
>
> ***- to a surface water body,***
>
> ***- to a surface water sewer, highway drain or another drainage system,***
>
> ***- to a combined sewer***

*7.3.4* The key design criteria for aspects of the surface water drainage system are detailed in the DEFRA 'Non statutory technical standards for sustainable drainage systems'.

7.3.5 The Swindon Borough Council Strategic Flood Risk Assessment (SFRA) Level 1, August 2008, states:

- *"Within Swindon it is recommended that priority is given to discharging surface water to watercourses as opposed to the use of infiltration drainage techniques as infiltration techniques may not be viable, … [though] each site should confirm that the presumption is correct."*
- *However, "these SuDS systems attenuate peak flows but do not significantly reduce flood volumes. Discharging attenuated site runoff directly to watercourses should be used instead of routing flows through the sewer network."*
- *"The EA expects attenuation to greenfield rates ... Developers should consult with the EA at an early stage about their SuDS proposals, to ensure that they are adopting the most effective methods for their site."*

7.3.6 The Swindon Borough Council Sustainable Drainage Systems (SuDS) Vision for New Eastern Villages (NEV) Supplementary Planning Document, dated February 2017, states:

- *The SuDS design should provide an effective drainage solution that is fully integrated with, and enhances the character and functionality of the development which it serves. In order for this to happen, drainage must be considered alongside the development planning process from the earliest stage of concept planning. This is a fundamental premise of the SuDS vision for the NEV.*
- *Low rainfall: There should be no discharge from the development for the first 5mm of any rainfall event.*
- *High rainfall: The volume of surface water runoff must not exceed the greenfield runoff rate the 1 in 100 year, 6 hour rainfall event. In addition, the peak flow rate discharged must not be greater than greenfield runoff rate for each of the following scenarios:*
  - *1:1 year greenfield runoff rate for all rainfall return periods up to the 1 in 100 year event;*
  - *1:100 year greenfield runoff rate for return periods above the 1 in 100 year event and up to the 1 in 100 year event including climate change allowance.*
- *The entire NEV development is located in an area with low to no infiltration and high groundwater levels. As a consequence, the assumption has been made that SuDS features that rely upon infiltration will not play any significant role in the drainage of the NEV and any SuDS strategy that incorporates infiltration will not be acceptable without an*

*extensive ground investigation report including infiltration tests to BRE 365 and extensive groundwater monitoring over the winter period.*

- *A development design life of 100yrs+ should be assumed for climate change purposes.*
- *Exceedance flows must be considered within the drainage design and masterplans should include clearly marked exceedance flow paths. Overland surface water flows should be routed away from any vulnerable areas designated in the Flood Risk and Coastal Change Planning Practice Guidance Table 2.*
- *If the outfall of any proposed attenuation facility is likely to be submerged in a 1% (1:100) probability rainfall event, as determined in consultation with the EA, then within 24 hours of top water level being attained the facility must be capable of storing a further 80% additional surface water run-off discharged during a secondary 10% (1:10) probability event. In addition, the drainage system should be designed to operate without flooding during a surcharged condition.*
- *Developers must demonstrate that the quality of surface water runoff will be controlled to an acceptable standard through a designed SuDS treatment train to protect against potential contamination of watercourses, and the treatment train defined in the SuDS manual has been adhered to.*
- *Developers must demonstrate that their proposals maximise the opportunities for improving drainage in the area and reduce the risk of flooding to neighbouring communities where practicable. This requirement is particularly pertinent to any proposed development areas and their associated infrastructure where there are existing watercourses or flow routes flowing through them which provide a drainage function to neighbouring land and sufficient corridors must be provided to maintain, control and enhance existing flood flow routes to reduce the risk of flooding to existing residential areas.*
- *Developers must demonstrate that sufficient space has been allowed to provide adequate easement for all future maintenance activities, including asset replacement at the end of the asset life.*

7.3.7 Policy EN6 of the Swindon Borough Council Local Plan 2026 (adopted March 2015) states:

- *All development shall be required to provide a drainage strategy. Developments will be expected to incorporate sustainable drainage systems and ensure that run-off rates are attenuated to greenfield run-off rates. Higher rates would need to be justified and the risks quantified.*
- *Sustainable drainage systems should seek to enhance water quality and biodiversity in line with The Water Framework Directive.*

## Consideration of Infiltration Drainage

7.3.8 Based on the aforementioned hierarchy, the preferred method for disposal of surface water from the new development is via infiltration drainage.

7.3.9 The SBC SuDS Vision for NEV SPD document states that the site is located in an area of low infiltration and high groundwater levels and therefore an infiltration drainage solution has been discounted.

## Consideration of Discharge to Watercourse

7.3.10 Where infiltration is not appropriate, the next preference in the Building Regulations H3 Hierarchy is discharge to a watercourse.

7.3.11 The site consists primarily of open agricultural land, such that surface water would either drain via natural infiltration into the ground or would drain to the existing ditches and watercourses within and adjacent to the site.

7.3.12 It is proposed to maintain the existing drainage regime by draining the proposed development to the existing ditches and watercourses within and adjacent to the site.

### Consideration of Discharge to Sewer

7.3.13 Where discharge via infiltration or watercourse is not appropriate, the final preference is discharge to a sewer.

7.3.14 There are no publicly adopted sewers within the Site marked on the Thames Water Asset Location maps. It is not proposed to discharge surface water run-off from the development to any public sewer.

## 7.4 Design Criteria

7.4.1 The surface water drainage strategy has been developed based on the following key design criteria:

- Peak run-off rates limited to the existing QBAR runoff rate of 4.67 l/s/ha;
- On-site attenuation designed for the 1 in 100 year storm event;
- +40% increase in rainfall intensity allowance for climate change

## 7.5 Outline Surface Water Drainage Strategy

7.5.1 The surface water drainage strategy has been developed by PBA can be summarised as follows:

- The existing greenfield QBAR run-off rate of 4.67l/s/ha has been calculated using the HR Wallingford *Greenfield runoff estimation for sites* online tool; a copy of the results is provided in **Appendix F**;
- The site has been divided into 8 catchments and 16sub-catchments based on a review of existing levels across the site and the proposed development layout;
- Within each sub-catchment the impermeable area has been calculated based on an assumed 60% impermeable area for residential land uses, and 80% impermeable area for commercial land uses;
- Within each sub-catchment surface water attenuation requirements have been calculated to restrict discharge to the QBAR greenfield run-off rate for all events up to and including the 1 in 100 year rainfall event including a 40% allowance for climate change. FEH 2013 rainfall data has been used within the attenuation calculations;
- Surface Water attenuation is proposed in the form of interlinked linear swale features and strategic attenuation basins located at the downstream point within each catchment;
- All attenuation features are located outside of the 1 in 100 year fluvial floodplain extent, including a 70% allowance for climate change, as required by the EA within the Thames catchment;

- The dimensions of the swales and basins have been developed in WinDes MicroDrainage Source Control. The Cascade function has been used to test the performance of the swales and basins given the interlinked nature of the infrastructure.

- Details of the site-wide outline surface water drainage strategy are provided on PBA Drawing 27970/4005/001 in **Appendix F** and a summary of the storage requirement are set out in section **7.7.**

7.5.2 The surface water drainage design will be developed at the detailed design stage with consideration of the above, and noting the potential evolution of the strategy once the detailed design progresses. This detailed design will consider the following points;

- There is potential for the attenuation requirements in strategic features to decrease when the detail of the individual plots come forward and additional source control measures such as permeable paving are implemented and included within the drainage calculations;

- The profile and form of all attenuation features will vary to suit the final development levels and the location of required access crossings, etc;

- There will be further opportunity to economise on the design and depth of the proposed attenuation features through the introduction of additional features such as check dams;

- It is recognised that the system outfalls to watercourses that have the potential to flood. The network and basin models will be tested with surcharged outfalls to confirm the adequate operation and performance of the system in the event of the receiving watercourse being in flood;

- Ground investigation works will be undertaken to confirm the depth of the ground water table. Proposed attenuation features are provided outside low lying areas and have typical depth of no more than 1.5m. However, if the water table is found to be shallower than the basins bed levels; lining will be provided, appropriate mitigation measures such as changing geometry or provision of linings and under drainage will be considered.

7.5.3 For the purposes of the FRA an outline strategy has been developed to demonstrate it is feasible for the site to meet requirements in relation to attenuation of surface water runoff.

7.5.4 As there is no detailed masterplan at this stage of the planning process, no network or pipe modelling has been done in support of the strategy, nor can detailed proposals for source control measures or additional SUDS features for conveyance or storage be developed. However preliminary checks have been undertaken to confirm drainage of the site by a gravity drainage solution is general feasible.

## 7.6 Design Parameters

### Attenuation Basin Design Parameters

7.6.1 The main attenuation basins will be designed in accordance with guidance set out in CIRIA C753, The SuDS Manual. The key design parameters are:

- All side slopes to be no greater than 1 in 3, to ensure safe access and egress can be achieved and to ensure slope stability. Side slopes to be provided at 1 in 4 where possible.

- Total water depth not to exceed 1.5m for long durations.

- Level terrace to be provided above the maximum 1 in 100 year plus climate change water level to provide safe access to all headwalls.

- The basin will usually be dry and hold no retained water.

- All inlet and outlet pipes will be installed with suitable headwalls units. The size and design of the headwall will be appropriate for the size and depth of pipework and slope of the basin.

- In accordance with Sewers for Adoption, a safety grill will be fitted to all headwalls where required. Handrails will be installed at all headwalls. Where necessary localised regrading of the basin in the vicinity of the headwall will be undertaken to ensure there is level access to the top of the headwall for safe inspection and maintenance. Due to the shallow slope of the basin, safe access to the all headwall aprons can be achieved without the need for fitted step ladders.

- A suitable access strip will be provided around the top of the basin for maintenance access. No significant landscaping or permanent street furniture will be provided within this area, although low level landscaping and removable street furniture will be permitted.

- Where the anticipated maximum depth of the water in the basin warrants it appropriate warning signs and life saving equipment will be provided. A suitable perimeter fence will be provided where appropriate to identify the basin and to prevent unauthorised access by vehicles.

### Swales Design Parameters

7.6.2 The swales will be designed in accordance with guidance set out in CIRIA C753, The SuDS Manual. The key design parameters are:

- Trapezoidal or parabolic cross-section, for ease of construction and maintenance.

- Grass swales designed with a bottom width of 0-5-2.0 m, although narrower or wider swales may be used, subject to suitable assessment.

- Longitudinal slopes constrained to 1 in 200 to 1 in 15. Check dams are incorporated on slopes greater than 1 in 33.

- All side slopes to be no greater than 1 in 3, to ensure safe access and egress can be achieved and to ensure slope stability. Side slopes to be provided at 1 in 4 where possible.

- Normal maximum swale depth is 0.6-1.2m. This can be increased where deemed acceptable by a health and safety risk assessment.

- The swale will usually be dry and hold no retained water.

### Pipe Network Design Parameters

7.6.3 The pipe network will be designed using the MicroDrainage (WinDes) design software. The pipe design will be in accordance with the relevant edition of Sewers for Adoption based upon the following parameters:

- Minimum depth of cover above all pipes of 1.2m

- Minimum offset between proposed manholes and existing kerb lines of 0.5m

- Minimum offset between proposed sewers and existing kerb lines of 1m

- Minimum offset between proposed manholes and existing manholes of 0.5m
- Minimum clearances between proposed sewers and existing utilities of 0.3m
- Pipe material, bedding and surround selected in accordance with BS EN 1295-1 "Structural design of buried pipelines" and The Specification for Highway Works HA 40/01 Determination of Pipe and Bedding Combinations for Drainage Works to ensure structural integrity of the pipe network.

7.6.4 The proposed adoptable piped surface water drainage system will be designed to ensure self-cleansing velocities are achieved in the 1 in 1 year event utilising:

- FSR rainfall data (industry standard practice);
- A volumetric runoff coefficient (cv) of 0.75 in accordance with industry standard practice.

## 7.7 Results summary

7.7.1 Full copies of the microdrainage assessment completed for the strategic drainage features is provided in **Appendix F.**

7.7.2 The impermeable area and discharge rate for each sub-catchment are shown in Table 7.1.

7.7.3 Table 7.1 it should be noted that the intermediate discharge rates for each sub catchment have been determined to balance flows and storage requirements with each catchment such that the overall discharge to the receiving watercourse can be achieved.

7.7.4 It is expected that the intermediate discharge rates will vary as detailed designs are prepared at a later stage to suit evolving designs for the swales and basins but the overall discharge rate will still be limited to 4.67 l/s/ha.

| Catchment | Sub-Catchment | Impermeable Area (ha) | Allowable Discharge Rate (Qbar = 4.67l/s/ha) | Total Discharge Rate per Catchment (Qbar = 4.67l/s/ha) |
|---|---|---|---|---|
| A | A | 4.37 | 20.4 | 20.4 |
| B | B1 | 0.79 | 3.7 | 10.9 |
| | B2 | 1.54 | 7.2 | |
| C | C1 | 4.36 | 20.3 | 54.6 |
| | C2 | 1.61 | 7.5 | |
| | C3 | 2.09 | 9.7 | |
| | C4 | 2.26 | 10.6 | |

| | | | | |
|---|---|---|---|---|
| | C5 | 1.38 | 6.5 | |
| D | D1 | 2.45 | 11.4 | 28.6 |
| | D2 | 3.67 | 17.1 | |
| E | E1 | 0.82 | 3.8 | 15.3 |
| | E2 | 2.46 | 11.5 | |
| F | F | 2.39 | 11.2 | 11.2 |
| G | G1 | 2.76 | 12.9 | 33.1 |
| | G2 | 4.33 | 20.2 | |
| H | H | 2.02 | 9.4 | 9.4 |

**Table 7.1 Surface Water Storage Requirements**

7.7.5 The storage required for each attenuation feature during the 1 in 100 annual probability event, with 40% allowance for climate change is outlined in Table 7.2. The results indicate that there would be no flooding during this extreme event and all surface water storage can be provided within the proposed basins and swales.

| Sub-Catchment | Feature No. | Water level at 1 in 100 annual probability event+40% CC ($m^3$) | Estimated maximum volume 1 in 100 annual probability event+40% CC ($m^3$) |
|---|---|---|---|
| A | Basin 1 | 0.9 | 3600 |
| B1 | Swale 2 | 0.9 | 550 |
| B2 | Basin 2 | 0.9 | 1200 |
| C1 | Swale 3 | 1.3 | 1970 |
| C2 | Swale 4 | 0.6 | 650 |
| C3 | Swale 5 | 1.0 | 420 |
| C4 | Swale 6 | 0.9 | 910 |
| C5 | Swale 7 | 0.5 | 470 |
| C | Basin 2a | 1.5 | 7950 |

| | | | |
|---|---|---|---|
| D1 | Swale 9 | 1.0 | 1550 |
| D2 | Swale 10 | 0.8 | 1020 |
| D2 | Swale 11 | 1.1 | 480 |
| D | Basin 4 | 1.1 | 3480 |
| E1 | Basin 3 | 0.8 | 1970 |
| E2 | Swale 8 | 0.7 | 220 |
| F | Basin 4a | 0.4 | 510 |
| F | Swale 13 | 0.9 | 600 |
| F | Swale 14 | 0.8 | 280 |
| G1 | Swale 15 | 1.3 | 1750 |
| G1 | Swale 16 | 1.2 | 600 |
| G2 | Swale 17 | 1.0 | 2570 |
| H | Basin 5 | 0.8 | 1700 |
| H | Swale 18 | 1.1 | 810 |

**Table 7.2 Storage provided on site**

## 7.8 Designing for Exceedance

7.8.1 The piped system will be designed to accommodate runoff during storm events up to the 1 in 30 year event. In excess of this it is possible that the design standard for the system will be exceeded.

7.8.2 To ensure that in an exceedance event any flooding does not affect properties or discharge from the development, flows up to the 1 in 100 year plus 40% climate change event should be managed on site. This may be achieved by ensuring that site levels are designed to direct flows away from the buildings and towards areas such as car parking or formal landscaping where temporarily shallow flooding can occur, or through the provision of additional storage within the drainage system.

7.8.3 The use of linear swales features throughout the development, to collect and convey surface water, means that the distances to route overland flows in exceedance events to the receiving features, will be minimal.

7.8.4 Proposed overland flow routes are shown in the Surface Water Management Strategy drawing provided in **Appendix F**. These will be reviewed at the detailed design stage once details of the proposed levels within the individual development plots are confirmed.

## 7.9 Pollution Control

7.9.1 Appropriate pollution control measures will be included in the surface water drainage system to minimise the risk of contamination or pollution entering the receiving systems from surface water runoff from the development. It is crucial that as a minimum requirement the water quality of catchment retains its current standards.

7.9.2 Within the development, pollution control will be provided through the retention and bio-remediation of runoff within the basins and swales. Trapped gullies and catch pits will be provided within the piped drainage system and, where necessary, additional measures such as oil interceptors will be provided to treat surface water runoff.

7.9.3 The drainage system will therefore be designed to comply with the requirements of CIRIA 753 'The SuDS Manual', specifically Chapters 26.7 and 27.

7.9.4 The SuDS Manual (CIRIA C753, 2015) describes risks posed by the surface water runoff to the receiving environment as a function of:

- The pollution hazard at a particular site (i.e. the pollution source);
- The effectiveness of SuDS treatment components in reducing levels of pollutants to environmentally acceptable levels (i.e. the pollutant pathway);
- The sensitivity of the receiving environment (the environmental receptor).

7.9.5 The recommended approaches for water quality risk management are given in the SuDS Manual Table 26.1, as shown in Table 3.

**TABLE 26.1 Approaches to water quality risk management**

| Design method | Hazard characterisation | Risk reduction | |
|---|---|---|---|
| | | For surface water | For groundwater |
| Simple index approach | Simple pollution hazard indices based on land use (eg Table 26.2 or equivalent) | Simple SuDS hazard mitigation indices (eg Table 26.3 or equivalent) | Simple SuDS hazard mitigation indices (eg Table 26.4 or equivalent) |
| Risk screening[1] | Factors characterising traffic density and extent of infiltration likely to occur (eg Table 26.5 or equivalent) | N/A | Factors characterising unsaturated soil depth and type, and predominant flow type through the soils (eg Table 26.5 or equivalent) |
| Detailed risk assessment | Site specific information used to define likely pollutants and their significance | More detailed, component specific performance information used to demonstrate that the proposed SuDS components reduce the hazard to acceptable levels | |
| Process-based treatment modelling | Time series rainfall used with generic pollution characteristics to determine statistical distributions of likely concentrations and loadings in the runoff | Models that represent the treatment processes in the proposed SuDS components give estimates of reductions in event mean discharge concentrations and total annual load reductions delivered by the system | |

Note
1 Risk assessment may be required as a result of the risk screening process.

**Table 3 SuDS Manual CIRIA C753 Table 26.1 'Approaches to Water Quality Risk Management'**

7.9.6 In accordance with the above Table 3, the 'Simple Index Approach' will be used as the Pollution Hazard Index characterisation for this site.

7.9.7 Pollution Hazard Indices are given for different land uses in Table 26.2 of the SuDS Manual. This table is shown in Table 4 for reference.

7.9.8 The SuDS manual recommends that the selected SuDS components should have a total SuDS Mitigation Index for each contaminant type that either equals or exceeds the Pollution Hazard Index to provide adequate treatment. The following will have to be achieved for the surface water running off the site:

**Total SuDS mitigation index >=pollution hazard index**

7.9.9 The SuDS 'Mitigation Indices' obtained from Table 26.3 of the SuDS Manual (for surface water) are shown in Table 5.

7.9.10 When more than one SuDS feature is proposed, the following calculation should be followed in order to calculate the 'Mitigation Indices':

**Total SuDS mitigation index = mitigation index1, + 0.5 (mitigation index2)**

7.9.11 A factor of 0.5 is used to account for the reduced performance of the secondary components associated with the already-reduced inflow concentrations.

**TABLE 26.2 Pollution hazard indices for different land use classifications**

| Land use | Pollution hazard level | Total suspended solids (TSS) | Metals | Hydro-carbons |
|---|---|---|---|---|
| Residential roofs | Very low | 0.2 | 0.2 | 0.05 |
| Other roofs (typically commercial/ industrial roofs) | Low | 0.3 | 0.2 (up to 0.8 where there is potential for metals to leach from the roof) | 0.05 |
| Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day | Low | 0.5 | 0.4 | 0.4 |
| Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways[1] | Medium | 0.7 | 0.6 | 0.7 |
| Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways[1] | High | 0.8[2] | 0.8[2] | 0.9[2] |

Table 4 SuDS Manual C753 Table 26.2 'Pollution Hazard Indices'

**TABLE 26.3 Indicative SuDS mitigation indices for discharges to surface waters**

| | Mitigation indices[1] | | |
|---|---|---|---|
| Type of SuDS component | TSS | Metals | Hydrocarbons |
| Filter strip | 0.4 | 0.4 | 0.5 |
| Filter drain | 0.4[2] | 0.4 | 0.4 |
| Swale | 0.5 | 0.6 | 0.6 |
| Bioretention system | 0.8 | 0.8 | 0.8 |
| Permeable pavement | 0.7 | 0.6 | 0.7 |
| Detention basin | 0.5 | 0.5 | 0.6 |
| Pond[4] | 0.7[3] | 0.7 | 0.5 |
| Wetland | 0.8[3] | 0.8 | 0.8 |
| Proprietary treatment systems[5,6] | These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area. | | |

Table 5 SuDS Manual CIRIA C753 Table 26.3 'Indicative SuDS Mitigation Indices'

7.9.12 The proposed land uses requiring surface water drainage for this site are roof areas; private car parking areas and access road surfaces. These will discharge surface water into swales and attenuation basins and eventually outfalls into a watercourse.

7.9.13 From the guidance in Table 5, Table 6 has been prepared to show a summary of the proposed Pollution Hazards levels for the proposed development.

7.9.14 The SuDS 'Mitigation Indices' for each SuDS component have been obtained from Table 26.3 of the SuDs Manual C753 (for surface water) (Table 6) and Table 7 has been prepared which summarises the proposed attenuation basin 'Mitigation Indices'.

7.9.15 A comparison of the information in Table 6 and Table 7 shows that the attenuation basins and swales provided and their corresponding 'Mitigation Indices' are greater than the pollution hazard indices for both land uses on site. On this basis it is considered that the proposed surface water management system provides a greater-than-required level of treatment for a development of this scale and nature.

| Land Use (Source) | Destination of Runoff (Receptor) | Pollution Hazard Level | Total Suspended Solids | Metals | Hydrocarbons |
|---|---|---|---|---|---|
| Residential roof | Watercourse | Very Low | 0.2 | 0.2 | 0.05 |
| Access roads and car parks | Watercourse | Low | 0.5 | 0.4 | 0.4 |
| Other roofs (typically commercial / industrial roofs) | Watercourse | Low | 0.3 | 0.2 | 0.05 |

**Table 6 Pollution hazard index and destination of runoff for the proposed site**

| Destination of Runoff (Receptor) | Type of SuDS Component | Mitigation Indices | | |
|---|---|---|---|---|
| | | Total Suspended Solids (TSS) | Metals | Hydrocarbons |
| Watercourse | Attenuation basins (primary) | 0.5 | 0.5 | 0.6 |
| | Swales (secondary) | 0.25 (i.e. 0.5 x 0.5) | 0.3 (i.e. 0.6 x 0.5) | 0.3 (i.e. 0.6 x 0.5) |
| | **TOTAL** | **0.75** | **0.8** | **0.9** |

**Table 7 SuDS mitigation index**

## 7.10 Adoption and Management

7.10.1 The SBC SuDS Vision for NEV SPD (February 2017) indicates that SBC's current position is that only highways drainage infrastructure will be adopted and states:

- *The Council's preferred option is for a single management company to be set up by the developers. The management company must be incorporated such that they can adopt the assets, and a business plan with a discounted cash flow model must be provided to*

*demonstrate that these companies are fully funded for their maintenance liabilities over the lifetime of the development (100 years).*

- *Thames Water currently will not adopt SuDS serving developments of less than 2,500 properties and will consider developments of >2,500 on a case by case basis.*

- *SBC will take on responsibility for the maintenance of some SuDS as part of their wider public open space and amenity management function and/or where the SuDS provide advantages for the wider community. This option can be linked to the adoption of green space and Green Infrastructure.*

7.10.2 Swales and linear ponds are part of the strategic drainage and are not highways drainage infrastructure. As such, it is not envisaged that they will be adopted by SBC highways.

7.10.3 Long term management of surface water drainage assets, including any SuDS components, is essential to ensure they continue to function to their design standard. As such, a management and maintenance plan will need to be developed in order to ensure the systems continue to work effectively.

7.10.4 The final strategy for adoption of SuDS and the SuDS maintenance plan, including a maintenance schedule and details of easements and outfalls for the drainage system, will be produced at the detailed design phase, once details of any SuDS features to be incorporated into the site have been finalised.

# 8 Residual Risk

8.1.1 It is difficult to completely guard against flooding since extreme events greater than the design standard event are always possible, however, it is practicable to minimise the risk by allowing a substantial freeboard (safety margin) and by using suitable construction and management techniques.

8.1.2 It is recommended that all finished floor levels are set a minimum above surrounding final ground level within development plots to mitigate against any residual risk of groundwater or exceedance during 'extreme' events.

8.1.3 The proposed site levels will be designed so that exceedance flow (when SuDS are potentially overwhelmed by exceptional rainfall in excess of the 1 in 100 annual probability event) is directed away from development and towards the strategic SuDS features.

8.1.4 Given the flat nature of the site, it is possible that in the most extreme events (greater than the 1 in 1,000 annual probability event) that flooding may extend beyond the areas currently mapped. It may therefore be necessary to consider the implementation of flood resistance and / or flood resilience measures for new development, particularly the fringes of development located adjacent to the mapped flood zones.

8.1.5 Construction methodology will be agreed at detailed design with method statements provided prior to any construction being undertaken.

8.1.6 As such, the residual risk is considered to be acceptable for the lifetime of the development.

# 9 Conclusions

9.1.1 This Flood Risk Assessment (FRA) has been prepared by Peter Brett Associates LLP, now part of Stantec, (PBA) to support a planning application for a comprehensive residential-led development of the Lotmead Farm Villages site.

9.1.2 This FRA concludes that:

- The site is in partly within Flood Zones 1, 2 and 3.
- There is fluvial flood risk to parts of the site from the River Cole, Dorcan Stream and Liden Brook.
- The proposed mitigation strategy demonstrates the development is safe through a number of measures as follows:
    - Implementation of a floodplain restoration scheme to return the Liden Brook floodplain adjacent to the river channel and increase the area of Flood Zone 1 available for development within the site;
    - Locating all built development within Flood Zone 1;
    - Ground floor levels to be set above surrounding ground levels to manage residual risk during extreme rainfall events;
    - Continual safe access and egress to the site provided by new highway corridors.
- A surface water drainage strategy has been developed that provides Sustainable Drainage measures which ensure the site continues to drain at existing greenfield rates up to and including extreme rainfall events and accounting for increased rainfall intensity as a result of climate change.

9.1.3 The site is part of the wider New Eastern Villages (NEV) development area allocated in the Swindon Borough Council Local Plan. As part of this allocation the site was tested and found to be an acceptable location for large scale development and therefore the Sequential Test does not need to be re-applied. A sequential approach has been applied in developing the Parameter Plan such that development is limited to areas of Flood Zone 1.

9.1.4 The Environment Agency and Swindon Borough Council, as Lead Local Flood Authority, previously accepted the proposals submitted as part of the 2015 applications at the site. Given there have been no significant changes with respect to the flood risk management and surface water management it is anticipated that the proposals presented within this FRA are acceptable.

9.1.5 In conclusion, the future occupants and users of the proposed development will be safe from flooding and there will be no detrimental impact on third parties. The proposal complies with the National Planning Policy Framework (NPPF) and local planning policy with respect to flood risk and is an appropriate development at this location.

# Appendix A OpenData Flood Maps

Site Boundary

The Quest
OLD VICARAGE LANE
A420
Acorn
Bridge Farm
Longleaze Farm
Acorn Wood
Services
A4312
TRAJAN ROAD
CAPITOL CL
VERULAM CL
MERLIN WAY
DEVA CLOSE
VESPASIAN CL
SWANBROOK
FINCHDALE
HERONSCROFT
THE BUNTINGS
WRENSWOOD
PRITTDENE
TEALSBROOK
CHURCH GROUND
Covingham
Education Facility
SWALLOWDALE
MARTINFIELD
THE HARRIERS
FIELDFARE
KINGSFISHER DRIVE
FOXBRIDGE
FITZMAURICE CL
POLTONDALE
ST ANDREWS GN
ST PAUL'S DRIVE
FORGE CL
CORNMARSH WAY
BASKERVILLE ROAD
POPPLEWELL RD
GIBBS CLOSE
PASSMORE CL
ROBBIN CL
Library
LOVELL CLOSE
COLE CL
SMITAN BROOK
SANDPIPER BRIDGE
KESTREL DRIVE
River Cole
Lotmead Farm
Wanborough House
Lower
Earlscourt Farm
Mount
Pleasant Farm
Earlscourt
Manor
Upper
Earlscourt
Mount
Pleasant
Farm Cottages
The Lodge
N

LOTMEAD FARM VILLAGES, SWINDON

0 250 500 m



pba peterbrett

Client

Ainscough
Strategic Land

1:10,000 @ A3
12/12/18
Drawn: IB
Checked: RP

Site Location

Figure 001 | Rev A

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Site Boundary

The Quest
Acorn Bridge Farm
Longleaze Farm
Services
Covingham
Education Facility
Lotmead Farm
Lower Earlscourt Farm
Mount Pleasant Farm
Earlscourt Manor
Upper Earlscourt
Mount Pleasant Farm Cottages
Wanborough House
The Lodge
A420
A4312
MERLIN WAY
N

# LOTMEAD FARM VILLAGES, SWINDON

0 250 500 m



pba peterbrett

Client
Ainscough Strategic Land

1:10,000 @ A3
12/12/18
Drawn: IB
Checked: RP

## Site Location (Aerial Photography)

Figure 002 | Rev A

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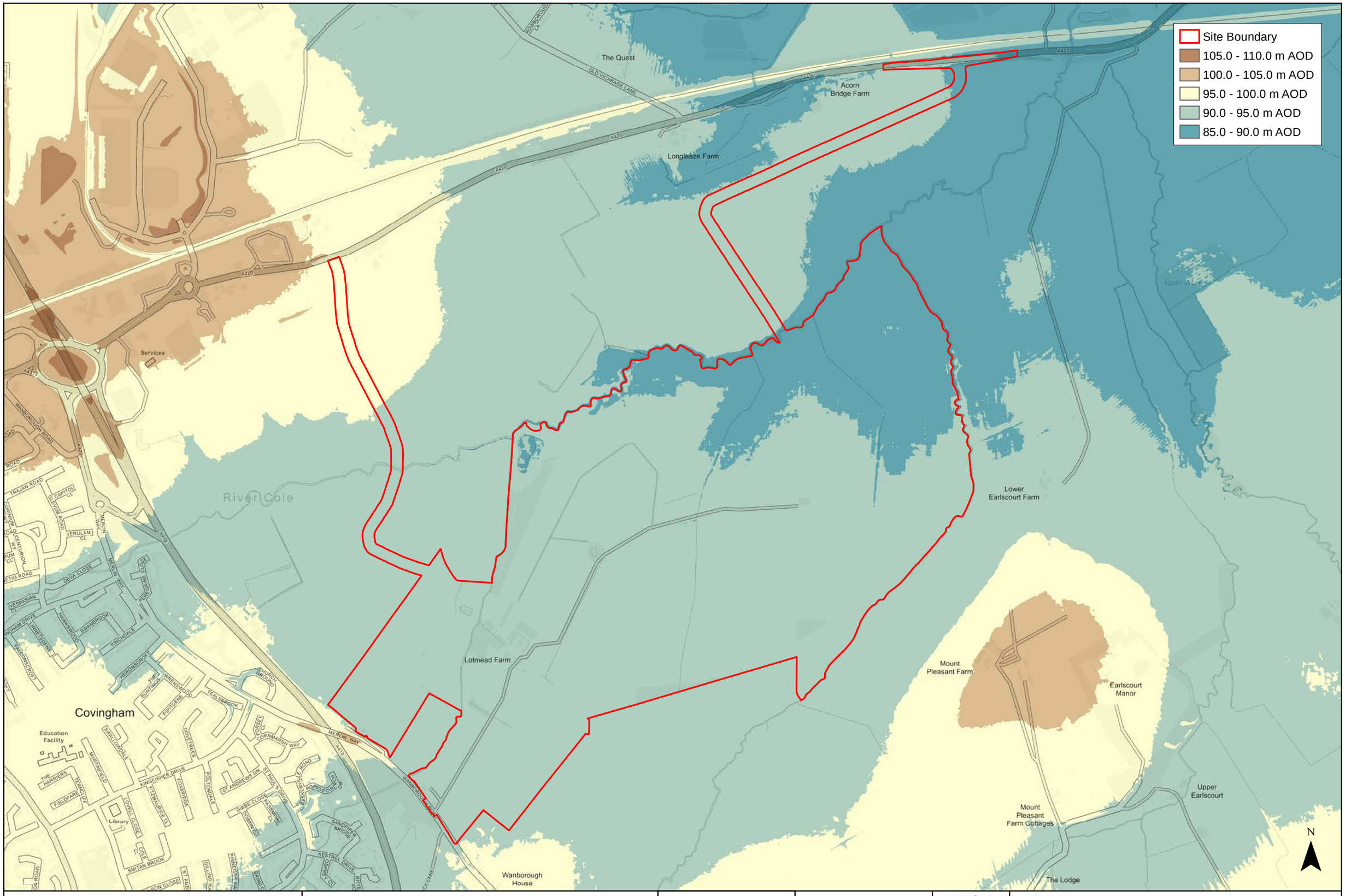


LOTMEAD FARM VILLAGES, SWINDON

0 250 500 m



pba peterbrett

Client: Ainscough Strategic Land

1:10,000 @ A3
12/12/18
Drawn: IB
Checked: RP

Area Topography

Figure 003 | Rev A

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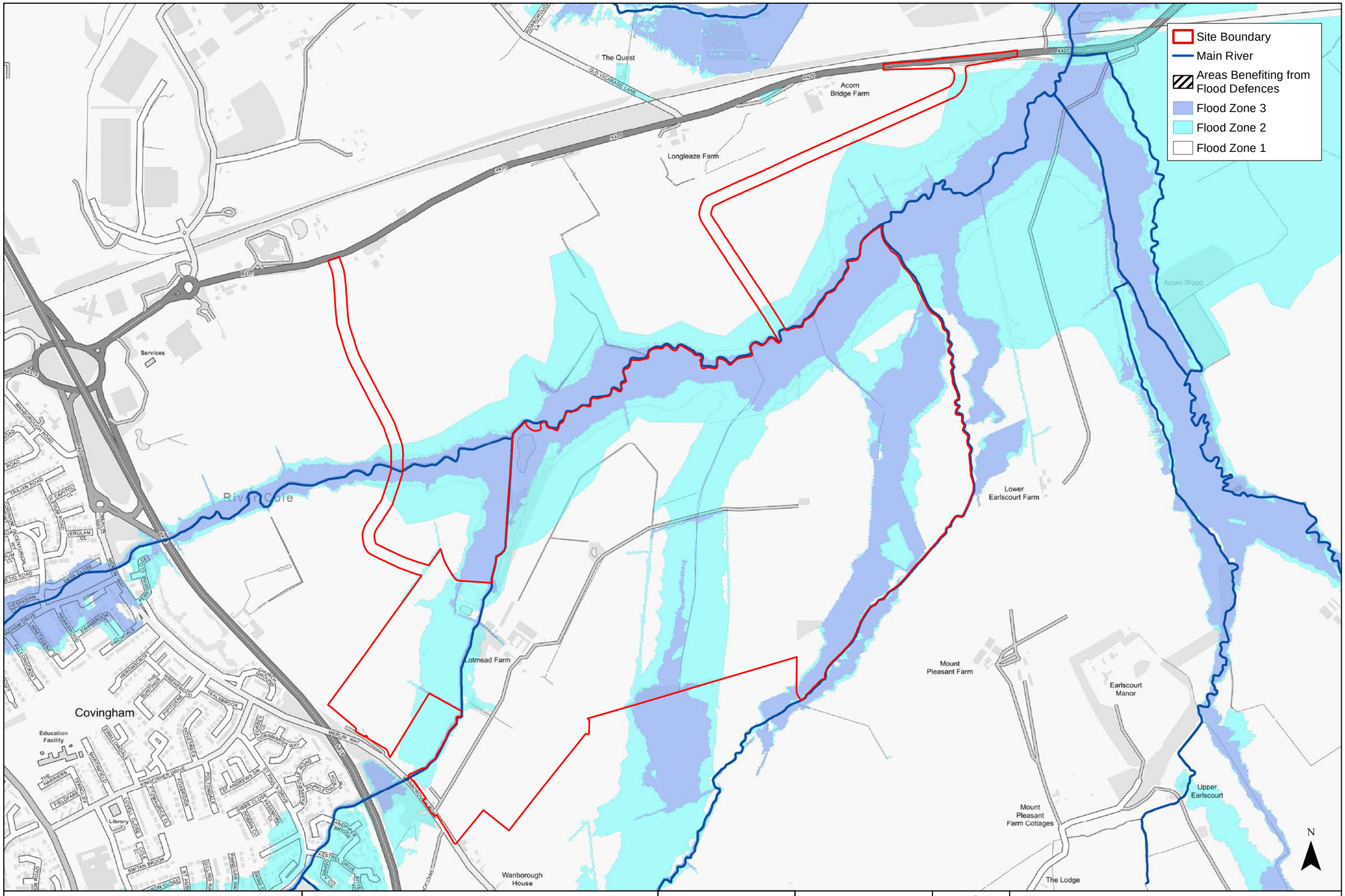


LOTMEAD FARM VILLAGES, SWINDON

0 250 500 m

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Flood Zones refer to the probability of river and/or sea flooding, ignoring the presence of defences

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12/12/18
Drawn: IB
Checked: RP

EA Flood Zone

Figure 004 | Rev A

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Site Boundary

Risk of Flooding from Surface Water

- High – 1 in 30 Annual Probability
- Medium – 1 in 100 Annual Probability
- Low – 1 in 1000 Annual Probability
- Very Low - Less than 1 in 1000 Annual Probability

The Quest
Acorn Bridge Farm
Longleaze Farm
Acorn Wood
Services
Covingham
Education Facility
Lower Earlscourt Farm
Lotmead Farm
Mount Pleasant Farm
Earlscourt Manor
Upper Earlscourt
Mount Pleasant Farm Cottages
Wanborough House
The Lodge
N

# LOTMEAD FARM VILLAGES, SWINDON

0 250 500 m



Maps based on EA updated 'Flood Map for Surface Water' ('uFMfSW') released in 2013 as the latest iteration of a national scale surface water modelling exercise

pba peterbrett

Client: Ainscough Strategic Land

1:10,000 @ A3
12/12/18
Drawn: IB
Checked: RP

## EA Surface Water Flood Risk

Figure 005 | Rev A

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