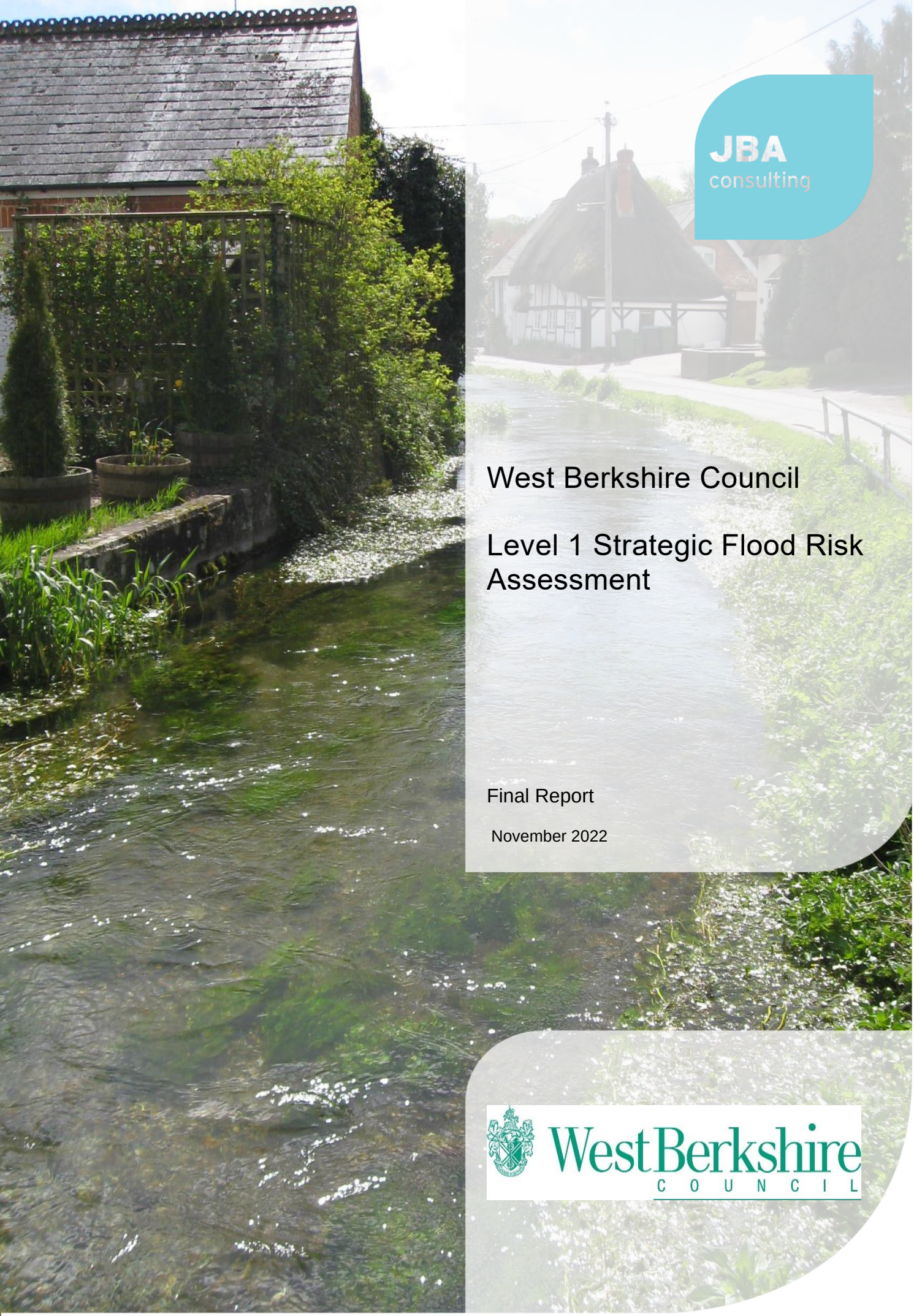

West Berkshire Council

Level 1 Strategic Flood Risk Assessment

Final Report

November 2022

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Revision History

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Final Draft v2.0 / April 2018	
Final Draft Report v3.0 / July 2018	
Final Draft Report v3.2 / August 2018	
Final Report v4.0 / March 2019	Amendments made following Environment Agency consultation response
Final Report v5.0 / June 2019	Amendments made following final Environment Agency response
Final Report v6.0 / October 2022	Amendments made following updates to climate change guidance and PPG
Final Report v7.0 / October 2022	Amendments made following review

Contract

This report describes work commissioned by Bryan Lyttle, on behalf of West Berkshire District Council, by a letter dated 30 May 2017. West Berkshire District Council's representative for the contract was Alistair Buckley of the Development and Planning Service. Anna Beasley, Fiona Hartland and Anna Hastings of JBA Consulting carried out this work.

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Purpose

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Executive Summary

Introduction

This Strategic Flood Risk Assessment (SFRA) 2022 document replaces the Level 1 SFRA published by West Berkshire District Council (the Council) in 2008, and the SFRA update published in October 2015. It forms part of the evidence base for the West Berkshire Local Plan Review to 2036 (LPR) and emerging Minerals and Waste Local Plan (MWLP).

The SFRA is a planning tool that will assist the Council in its selection and development of sustainable development sites away from vulnerable flood risk areas in accordance with the NPPF and its associated Planning Practice Guidance on Flood Risk and Coastal Change.

The report has been prepared to update the work included in the previous SFRA and to provide appropriate supporting evidence for the LPR and MWLP, which will set out a vision and framework for development in West Berkshire, to inform decisions on the location of future housing, employment, waste and minerals developments.

SFRA objectives

The Planning Practice Guidance advocates a tiered approach to risk assessment and identifies the following two levels of SFRA:

Level One: where flooding is not a major issue in relation to potential housing, employment, minerals or waste development sites and where development pressures are low. The assessment should be sufficiently detailed to allow application of the Sequential Test.

Level Two: where land outside Flood Zones 2 and 3 (or areas at high risk from other flood sources) cannot appropriately accommodate all the necessary development creating the need to apply the NPPF's (National Planning Policy Framework) Exception Test. In these circumstances, the assessment should consider the detailed nature of the flood characteristics within a Flood Zone and assessment of other sources of flooding.

Both a Level 1 SFRA and Level 2 SFRA have been prepared for West Berkshire.

SFRA outputs

- Appraisal of all potential sources of flooding, including Main River, ordinary watercourse, surface water, groundwater, reservoir and sewer flooding.
- Updated review of historic flooding incidents.
- Mapping of location and extent of functional floodplain.
- Reporting on the standard of protection provided by existing flood risk management infrastructure.
- An assessment of the potential increase in flood risk due to climate change.
- Recommendations of the criteria that should be used to assess future development proposals and the development of a Sequential Test and sequential approach to flood risk.
- High level screening of the Housing and Economic Land Availability Assessment (HELAA) and potential mineral extraction site allocations against fluvial and surface water flood risk.
- Recommendations of whether the available HELAA and mineral extraction sites will require further assessment within a Level 2 SFRA.

Summary of Level 1 Assessment

The SFRA has considered all sources of flooding including fluvial, surface water, groundwater, sewers and reservoirs within the study area.

Fluvial flood risk is shown to generally be confined to the Main River floodplains of the Rivers Kennet, Pang, Thames, Lambourn and Sulham Brook. Following urbanisation of the floodplain, considerable work has been undertaken to defend and warn against fluvial flooding in West Berkshire.

Surface water flood risk is concentrated in urban areas on the lower slopes of the North Wessex Downs, which receive large volumes of overland flows. Many of the settlements across West Berkshire have experienced flooding in the past, with Thatcham and Newbury particularly affected in July 2007. Many flood alleviation schemes have been planned to manage surface water in the urban areas of the district, and are currently in the process of delivery.

Groundwater flood risk is significant in West Berkshire, with the district severely affected by the flood events of Winter 2013/2014. Jacobs groundwater emergence modelling and JBA groundwater mapping identify the highest risk areas occurring in upper reaches of the Lambourn and Pang Valleys, however elevated groundwater levels are likely to affect all of the major floodplains.

Climate change is predicted to result in more frequent and extreme rainfall events, increasing the frequency and severity (depth/hazard) of flooding from fluvial and surface water sources. The effect of climate change on the Flood Zones and surface water flood risk has been assessed. In most catchments, the extent of Flood Zone 3 is not likely to increase significantly with climate change.

Detail is given in Section 3 on how we assess flood risk for planning using the Flood Zones and datasets covering other sources of flood risk. It outlines the sources of national and local flood risk mapping data, information and evidence that has been available for use in this SFRA.

Guidance for planners and developers

Sections 5, 6 and 7 introduce guidance for both planners and developers. The guidance should be read in conjunction with the NPPF and flood risk **guidance from the Environment Agency**[1]. The guidance addresses requirements for applying the Sequential Test, requirements for development in each of the Flood Zones, making development safe, river restoration and enhancement as part of development, dealing with existing watercourses and assets, developer contributions to flood risk improvements, dealing with surface water runoff and drainage, wastewater, water quality and biodiversity.

Assessment of flood risk in potential development areas

Section 8 outlines the flood risk screening carried out on the potential housing and employment development areas identified within the HELAA, and all potential waste and mineral sites provided within the Preferred Options and 2016 Proposed Sites Consultation.

Where growth cannot be accommodated within areas of low flood risk from all sources, Level 2 SFRA assessments are recommended. Level 2 SFRA assessments are recommended at any sites identified as within Flood Zone 3b, 3a or 2, or at high risk of flooding from other sources, and therefore requiring application of the Exception Test. The Sequential Test must also consider risk of flooding from other sources, and for this reason a Level 2 assessment is also recommended for any sites in Flood Zone 1 where there is a significant flood risk from other sources such as surface water and groundwater. The risk to a site is dependent on the vulnerability of proposed land use, and therefore the requirements for a Level 2 SFRA are specific to housing and employment, or mineral extraction sites. The aim of Level 2 assessments is to consider the nature of the flood characteristics within the Flood Zones and other flood risk datasets for such sites in more detail (including depths, velocities, hazard etc.).

Use of SFRA data

It is important to recognise that the SFRA has been developed using the best available information at the time of preparation. This relates both to the current risk of flooding from rivers, and the potential impacts of future climate change.

Information on flood risk is being updated continuously. The SFRA should be periodically updated as appropriate when new information on flood risk, flood warning or new planning guidance or legislation becomes available. New information on flood risk may be provided by West Berkshire Council, neighbouring authorities, Thames Water and the Environment Agency.

1 Environment Agency (2017) Flood risk assessment for planning applications. Available at: https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications

Next steps

As the Council move forward with their Local Plan, they will use the most up to date information in the Sequential Test, and developers should be aware of the latest information for use in Flood Risk Assessments.

The Flood and Water Management Act (2010), the Localism Act (2011) and the National Planning Policy Framework (2021) all offer opportunities for a more integrated approach to flood risk management and development. As the Council is in the relatively early stages of developing a Local Plan, it has a real chance to make sure development provides improvements to flood risk overall and enhancements to the river environment.

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Abbreviations and definitions

Term	Definition
AIMS	Asset Information Management System (Environment Agency GIS database of assets)
AONB	Area of Outstanding Natural Beauty
CC	Climate change - Long term variations in global temperature and weather patterns caused by natural and human actions.
CDA	Critical Drainage Area - A discrete geographic area (usually a hydrological catchment) where multiple and interlinked sources of flood risk (surface water, groundwater, sewer, main river and/or tidal) cause flooding in one or more Local Flood Risk Zones during severe weather thereby affecting people, property or local infrastructure.
CFMP	Catchment Flood Management Plan- A high-level planning strategy through which the Environment Agency works with their key decision makers within a river catchment to identify and agree policies to secure the long-term sustainable management of flood risk.
CIRIA	Construction Industry Research and Information Association
CSO	Combined sewer overflow
Defra	Department for Environment, Food and Rural Affairs
EA	Environment Agency
EU	European Union
FFL	Finished floor level
Flood defence	Infrastructure used to protect an area against floods as floodwalls and embankments; they are designed to a specific standard of protection (design standard).
Flood Risk Area	An area determined as having a significant risk of flooding in accordance with guidance published by Defra and WAG (Welsh Assembly Government).
Flood Risk Regulations	Transposition of the EU Floods Directive into UK law. The EU Floods Directive is a piece of European Community (EC) legislation to specifically address flood risk by prescribing a common framework for its measurement and management.
Fluvial Flooding	Flooding resulting from water levels exceeding the bank level of a main river
FRA	Flood Risk Assessment - A site specific assessment of all forms of flood risk to the site and the impact of development of the site to flood risk in the area.
FRMP	Flood Risk Management Plan
FWMA	Floods and Water Management Act - Part of the UK Government's response to Sir Michael Pitt's Report on the Summer 2007 floods, the aim of which is to clarify the legislative framework for managing surface water flood risk in England.
Ha	Hectare
HELAA	Housing and Economic Land Availability Assessment. An evidence base document that will inform the preparation of the West Berkshire Local Plan Review to 2036. The HELAA will make a preliminary assessment of the potential suitability and potential of site.
JBA	Jeremy Benn Associates
LFRMS	Local Food Risk Management Strategy
LLFA	Lead Local Flood Authority - Local Authority responsible for taking the lead on local flood risk management
LPA	Local Planning Authority
LPR	West Berkshire Local Plan Review to 2036
Main River	A watercourse shown as such on the Main River Map, and for which the Environment Agency has permissive powers but the riparian owner has the responsibility of maintenance.
MWLP	West Berkshire Minerals and Waste Local Plan
NPPF	National Planning Policy Framework
Ordinary Watercourse	All watercourses that are not designated Main River. Local Authorities or, where they exist, Internal Drainage Boards (IDBs) have similar permissive powers as the

Term	Definition
	Environment Agency in relation to flood defence work. However, the riparian owner has the responsibility of maintenance.
PFRA	Preliminary Flood Risk Assessment
Pitt Review	Comprehensive independent review of the 2007 summer floods by Sir Michael Pitt, which provided recommendations to improve flood risk management in England.
Pluvial flooding	Flooding as a result of high intensity rainfall when water is ponding or flowing over the ground surface (surface runoff) before it enters the underground drainage network or watercourse, or cannot enter it because the network is full to capacity.
PPG	National Planning Policy Guidance
Resilience Measures	Measures designed to reduce the impact of water that enters property and businesses; could include measures such as raising electrical appliances.
Risk	In flood risk management, risk is defined as a product of the probability or likelihood of a flood occurring, and the consequence of the flood.
Return Period	Is an estimate of the interval of time between events of a certain intensity or size, in this instance it refers to flood events. It is a statistical measurement denoting the average recurrence interval over an extended period of time.
RMA	Risk Management Authority
RoFSW	Risk of Flooding from Surface Water map. Environment Agency national map showing risk of flooding from surface water.
SA	Sustainability Appraisal
Sewer flooding	Flooding caused by a blockage or overflow in a sewer or urban drainage system.
SHLAA	Strategic Housing Land Availability Assessment - The Strategic Housing Land Availability Assessment (SHLAA) is a technical piece of evidence to support local plans and Sites & Policies Development Plan Documents (DPDs). Its purpose is to demonstrate that there is a supply of housing land in the authority area which is suitable and deliverable.
SFRA	Strategic Flood Risk Assessment
SoP	Standard of Protection - Defences are provided to reduce the risk of flooding from a river and within the flood and defence field standards are usually described in terms of a flood event return period. For example, a flood embankment could be described as providing a 1 in 100-year standard of protection.
SPD	Supplementary Planning Document
STW	Sewage treatment works
SuDS	Sustainable Drainage Systems - Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques
Surface water flooding	Flooding from surface water runoff as a result of high intensity rainfall when water is ponding or flowing over the ground surface before it enters the underground drainage network or watercourse, or cannot enter it because the network is full to capacity, thus causing what is known as pluvial flooding.
SWMP	Surface Water Management Plan - The SWMP plan should outline the preferred surface water management strategy and identify the actions, timescales and responsibilities of each partner. It is the principal output from the SWMP study.
WCS	Water Cycle Study
WFD	Water Framework Directive

1 Introduction

1.1 Introduction

West Berkshire District Council (the Council) is undertaking the preparation of the West Berkshire Local Plan Review to 2036 (LPR) and a Minerals and Waste Local Plan (MWLP). As part of this process it is preparing an evidence base which will support the policies and allocations included in the two documents. This Level 1 Strategic Flood Risk Assessment is one piece of the evidence base, which will help to inform policy development and the selection of site allocations for inclusion within the LPR and MWLP.

The Council has published a Local Development Scheme which provides a timetable for the LPR. The Council is reviewing its Local Plan to cover the period to 2039. The purpose of the reviewed local plan will be to assess the future levels of needs for new homes (including market, affordable and specialist housing and Gypsy and Traveller accommodation) and employment land and other land uses up to 2039 and to provide an appropriate basis for housing, employment land and infrastructure provision over that period. The review will be wide ranging and in summary will involve:

- A review of the existing Core Strategy strategic objectives;
- A review of the existing spatial strategy for the district;
- A review of all the existing Core Strategy Development Plan Document (DPD) and Housing Site Allocations DPD policies to ensure their continued consistency with national policy;
- The introduction of additional development management policies in response to the review of the saved development management policies not replaced by the Core Strategy or the Housing Site Allocations DPD; and
- The introduction of new policies in response to recent changes in national planning policy and guidance.

The MWLP will form part of the Development Plan for West Berkshire. It will provide planning policy and site allocations which will replace the current Replacement Minerals Local Plan for Berkshire, and the Waste Local Plan for Berkshire, produced jointly by the unitary authorities of Berkshire, between 1995 and 2006[2]. An Issues and Options paper on the MWLP was produced for consultation in January 2014 alongside a Call for Sites, with subsequent consultations on the submitted sites in July 2016, and a Preferred Options in May 2017. Seven mineral extraction sites were proposed for allocation within the preferred options, with no waste sites proposed for allocation (excepting where inert infilling is proposed to be undertaken for restoration of mineral sites).

A Level 1 SFRA was produced in 2008[3] to support development of the current West Berkshire Local Plan. It was revised by a stand-alone chapter in October 2015[4], following changes in national planning and flood risk management policy. These included introduction of the National Planning Policy Framework (NPPF)[5], establishment of the Lead Local Flood Authority (LLFA) within the Flood and Water Management Act (2010)[6], and the evolution of the LLFA role as consultee to the planning system in surface water management considerations.

This document replaces all previous Level 1 SFRAs, taking into account the 2016 updates to climate changes allowances[7], and the West Berkshire Sustainable Drainage Systems (SuDS) Supplementary Planning Document (SPD)[8], adopted in December 2018. The document was further updated in October 2022, to incorporate amendments to the NPPF (July 2021) and Planning Practice Guidance (August 2022), and the release of new climate change allowances based on

2 West Berkshire Council (2017) Current Minerals and Waste Planning Policy. Available at: http://info.westberks.gov.uk/mineralsandwaste.

3 West Berkshire Council (2008) Strategic Flood Risk Assessment Level 1. Available at: https://www.westberks.gov.uk/sfra

4 West Berkshire Council (2015) Strategic Flood Risk Assessment Level 1: Updated to October 2015. Available at: https://www.westberks.gov.uk/sfra

5 Department for Levelling Up, Housing and Communities (2021) National Planning Policy Framework. Accessed online at: National Planning Policy Framework - Guidance - GOV.UK (www.gov.uk).

6 Flood and Water Management Act (2010) Available at: https://www.legislation.gov.uk/ukpga/2010/29/contents.

7 Environment Agency (2016) Flood risk assessments: climate change allowances. Available at: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances.

8 West Berkshire Council (2018) Sustainable Drainage Systems Supplementary Planning Document. Accessed online at: https://info.westberks.gov.uk/sudsspd

UKCP018 data (in July 2021 and May 2022). The Level 1 SFRA will provide appropriate supporting evidence to the LPR and MWLP, and help to inform the location of future development in West Berkshire, as well as decisions on planning applications which arise outside the development plan process.

1.2 Purpose of the Strategic Flood Risk Assessment

The Planning Practice Guidance[9] advocates a tiered approach to risk assessment and identifies the following two levels of SFRA:

- Level 1: where flooding is not a major issue and where development pressures are low. The assessment should be sufficiently detailed to allow application of the Sequential Test.
- Level 2: where land outside Flood Zones 2 and 3 (or areas at high risk from other flood sources) cannot appropriately accommodate all the necessary development creating the need to apply the NPPF's Exception Test. In these circumstances, the assessment should consider the detailed nature of the flood characteristics within a Flood Zone and assessment of other sources of flooding.

At this stage, a Level 1 SFRA has been prepared for West Berkshire. The key objectives of the revised level 1 SFRA are:

1. To take into account the latest flood risk policy and available flood risk data

There is a need to ensure the assessment is in line with the National Planning Policy Framework (NPPF) but also up to date with reference to the following changes to policy and guidance that have occurred since the existing SFRA was completed in 2008 and updated in 2015 as stated in the bullet points below:

- Updated guidance on the new Climate Change Allowances (February 2016, February 2017, July 2021 and May 2022)
- Completion of several Flood Alleviation Schemes in West Berkshire
- Availability of further groundwater flood risk data
- Production of the West Berkshire SuDS SPD (adopted in December 2018)

It is important to note that policy is subject to change and as a result, this is considered a living document.

2. To provide a comprehensive analysis of flood risk in West Berkshire

The assessment should consider the risk of flooding from all sources (Main Rivers, ordinary watercourses, surface water, groundwater, sewer and reservoir flood risk), the implications of this risk, and where possible the assessment should identify the functional floodplain areas within West Berkshire.

This information is required as part of the sustainability appraisal and land use planning process in full compliance with the guidance set out in the NPPF to inform the Council in identifying suitable sites for the LPR and MWLP.

The assessment should also identify the types of measure which may be appropriate to manage the risk, taking account of location, site opportunities, constraints and geology.

3. To enable application of the Sequential Test

The Level 1 SFRA assessment for West Berkshire should enable the application of the Sequential Test to the locations of new development sites to be carried out and to identify whether development can be allocated outside high and medium flood risk areas, based on all sources of flooding, without application of the Exception Test.

1.3 Consultation

The following parties (external to the Council) have been consulted during the preparation of this version of the SFRA:

- Environment Agency

9 Department for Communities and Local Government (2015) Planning Practice Guidance: Flood Risk and Coastal Change. Accessed online at: https://www.gov.uk/guidance/flood-risk-and-coastal-change.

- West Berkshire Council (as Lead Local Flood Authority)
- Thames Water

1.4 SFRA user guide

Section	Contents
1. Introduction	Provides a background to the study, defines objectives, outlines the approach adopted and the consultation performed.
2. The Planning Framework and Flood Risk Policy	Includes information on the implications of recent changes to planning and flood risk policies and legislation, as well as documents relevant to the study.
Level 1 Strategic Flood Risk Assessment	
3. How flood risk is assessed	Provides an overview of flooding and risk, Flood Zones, and what they mean.
4. Understanding flood risk in the West Berkshire	Gives an introduction to the assessment of flood risk and provides an overview of the characteristics of flooding affecting the districts. Provides a summary of responses that can be made to flood risk, together with policy and institutional issues that should be considered. Assessment of residual risk from flood defences, including future protection from climate change.
5. The Sequential and Exception Tests	Describes the application of Sequential and Exception Tests. Describes the modelling and data used for the assessment. Outlines mapping that should be used for the Sequential and Exception Tests
6. Flood risk guidance for planners and developers	Identifies the scope of the assessments that must be submitted in FRAs supporting applications for new development. Provides guidance for developers and outlines conditions set by the LLFA that should be followed.
7. Assessment of flood risk in potential development areas	Summary of flood risk to strategic sites, Housing and Economic Land Availability Assessments (HELAA) sites and all potential Waste and Minerals sites.
8. Surface water run-off and drainage guidance for planners and developers	Advice on managing surface water run-off and flooding
Summary and recommendations	
9. Summary and conclusions	Reviews Level 1 SFRA and provides recommendations

2 The Planning Framework and Flood Risk Policy

2.1 Introduction

The overarching aim of development and flood risk planning policy in the UK is to ensure the potential risk of flooding from all sources is taken into account at every stage of the planning process.

The following section provides an overview of the current planning framework, flood risk policy and flood risk management responsibilities, which inform the subsequent sections of this updated SFRA.

2.2 Localism Act

The Localism Act (2011) provides local communities with greater control in local decision-making, such as deciding the location of new homes and businesses, through the preparation of neighbourhood development plans. It requires local authorities to "engage constructively, actively and on an ongoing basis in any process by means of which development plan documents are prepared so far as relating to a strategic matter"[10].

Neighbourhood Plans are the vehicle through which local communities are able to contribute to making decisions about the location and type of development, and the supporting infrastructure required to enable sustainable development within their areas. A Neighbourhood Plan is written by local people, and "made" or adopted by the Local Planning Authority (LPA), becoming part of the development plan for that LPA. Neighbourhood Plans should take national guidance into account, and should be in general conformity with the LPA's planning policy.

2.3 National Planning Policy Framework

The National Planning Policy Framework (NPPF)[11] was issued on 27 March 2012 and updated on 24 July 2018, 19 February 2019 and subsequently on 20 July 2021 as part of reforms to, firstly, make the planning system less complex and more accessible, and secondly, to protect the environment, promote sustainable growth and replace most of the previously issued Planning Policy Guidance Notes (PPGs) and Planning Policy Statements (PPSs). The NPPF is a source of guidance for LPAs to assist in preparation of Local Plans, as well as for applicants preparing planning submissions.

Paragraphs 160 and 161 of the NPPF states that: "*Strategic policies should be informed by a strategic flood risk assessment, and should manage flood risk from all sources. They should consider cumulative impacts in, or affecting, local areas susceptible to flooding, and take account of advice from the Environment Agency and other relevant flood risk management authorities, such as lead local flood authorities and internal drainage boards. All plans should apply a sequential, risk-based approach to the location of development – taking into account the current and future impacts of climate change– so as to avoid, where possible, flood risk to people and property".*

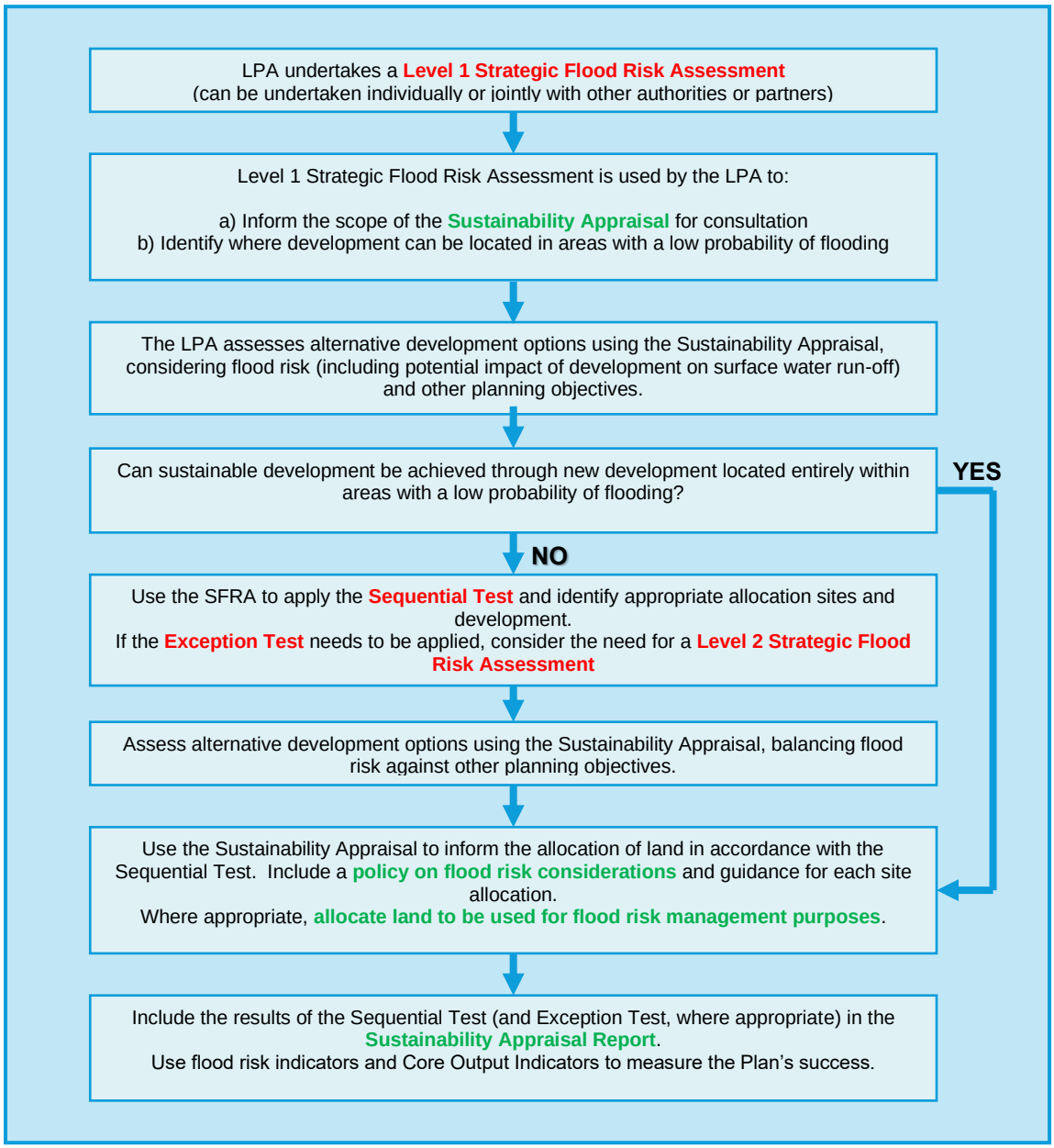
The web-based Planning Practice Guidance on Flood Risk and Coastal Change[12] (henceforth referred to as 'the Planning Practice Guidance') was published alongside the NPPF and was most recently updated in August 2022. The guidance sets out how the policy should be implemented. A flow chart of how flood risk should be taken into account in the preparation of Local Plans is shown in Figure 2-1 below.

10 Department for Communities and Local Government (2011) Localism Act 2011: Section 110. Accessed online at: http://www.legislation.gov.uk/ukpga/2011/20/section/110.

11 Ministry for Housing, Communities and Local Government (2019) National Planning Policy Framework. Accessed online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/779764/NPPF_Feb_2019_web.pdf.

12 Department for Communities and Local Government (2022) Planning Practice Guidance: Flood Risk and Coastal Change, Accessed online at: http://www.gov.uk/ guidance/flood-risk-and-coastal-change/.

Figure 2-1 Flood risk and the preparation of Local Plans



Based on Diagram 1 of the Planning Practice Guidance: Flood Risk and Coastal Change (paragraph 004, Reference ID: 7-021-20140306).

2.3.1 Updates to the NPPF

The NPPF was revised in 2019 to implement the 2017 planning and housing market reforms introduced within the Housing White Paper[13]. Following public consultation on the draft revised NPPF between March and May 2018, the framework was initially released on 24 July 2018. Following a technical consultation, minor updates were made to the Framework, with updated versions published on 19 February 2019 and on 20 July 2021. Central to the reforms is the concept of 'planning for the right homes in the right places'. The key amendments from the 2019 updates are outlined in Section 2.3.1.1 to 2.3.1.4. A further revision of the NPPF, published on 20 July 2021 replaced previous versions, and the key amendment from this update is outlined in Section 2.3.1.5.:

2.3.1.1 Clarification of the Exception Test (Paragraphs 161, 163-168)

Local Plans should not allocate land for development where it is not possible to meet the requirements of the Exception Test.

13 Department for Communities and Local Government (2017) Fixing our broken housing market. Available at: https://www.gov.uk/government/publications/fixing-our-broken-housing-market.

At the planning application stage, it may be necessary to reapply the Exception Test to individual allocated sites, which have undergone the Sequential Test. This may be due to the significant extent or nature of the flood risk identified to a site, or the age of the evidence base used to previously assess the site.

2.3.1.2 Minor Development and Changes of Use (Paragraphs 168)

Minor development and change of use must still follow the Paragraph 103 of the NPPF, excluding the Sequential and Exception Tests, relating to the provision of a site-specific flood risk assessment, and ensuring that flood risk is not increased elsewhere.

2.3.1.3 Cumulative impact on flood risk (Paragraphs 160)

Local Plans must be supported by a SFRA, and provide policies for managing all sources of flood risk.

Planning policy on flood risk should address the cumulative flood risks associated with separate new developments which are located within, or affect, areas susceptible to flooding.

2.3.1.4 The impacts of climate change (Paragraphs 159, 161)

Where climate change is expected to increase flood risk, and lead to development becoming unsustainable in the future, opportunities should be taken to relocate development to more sustainable locations.

2.3.1.5 Planning and flood risk (Paragraph 161)

The Sequential Test should take into account all sources of flood risk, considering current and future flood risk. Prior to the changes to the NPPF in July 2021, the requirement only required consideration of river and sea flood risk when applying the Sequential Test.

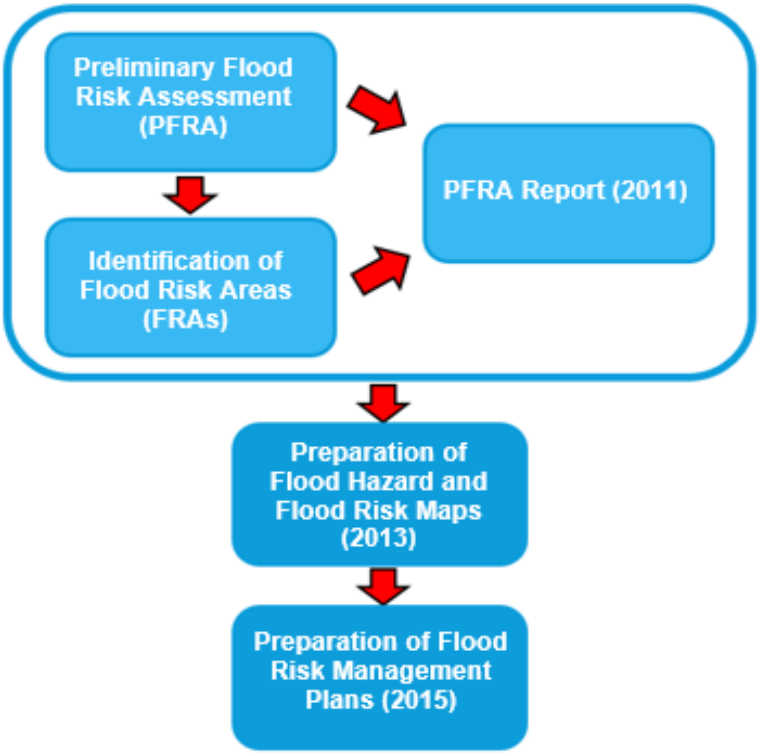
2.4 Flood Risk Regulations (2009) and Flood and Water Management Act (2010)

2.4.1 The Flood Risk Regulations (2009)

The Flood Risk Regulations (2009) were intended to translate the current EU Floods Directive into UK law and place responsibility upon Lead Local Flood Authorities (LLFAs) to manage local flood risk. Under the Regulations, the responsibility for flooding from rivers, the sea and reservoirs lies with the Environment Agency; and responsibility for local sources of flooding, from surface water, groundwater and ordinary watercourses, rests with LLFAs.

Figure 2-2 below illustrates the steps that have / are being taken to implement the requirements of the EU Directive in the UK via the Flood Risk Regulations.

Figure 2-2 Flood Risk Regulation Requirements



Under this action plan in accordance with the Regulations, LLFAs are required to prepare a Preliminary Flood Risk Assessment (PFRA) report. This is a high-level report assessing historic flood incidents and the probability of future flooding within the administrative area. The first PRFA for West Berkshire was produced in 2011, and updated in 2017, as part of a six-year reporting cycle.

2.4.2 Flood and Water Management Act (2010)

The Flood and Water Management Act (FWMA) (2010) aimed to create a simpler and more effective means of managing both flood risk and coastal erosion and implement Sir Michaels Pitt's recommendations following his review of the 2007 floods[14]. The FWMA received Royal Assent in April 2010.

2.4.3 Lead Local Flood Authorities (LLFAs)

The duties of West Berkshire Council, the LLFA for West Berkshire, include:

- Lead responsibility for managing the risk of flooding from surface water, groundwater and ordinary watercourses (often described collectively as 'local flood risk').
- Local Flood Risk Management Strategy (LFRMS) (Section 9): LLFAs must develop, maintain, apply and monitor an LFRMS to outline how to manage flood risk, identify areas vulnerable to flooding and target resources where they are needed most.
- Flood investigations (Section 19): when appropriate and necessary LLFAs must investigate and report on flooding incidents.
- Register of flood risk features (Section 21): LLFAs must establish and maintain a register of structures or features which, in their opinion, are likely to have a significant effect on flood risk in the LLFA area.
- Designation of features (Section 30, Schedule 1): LLFAs may exercise powers to designate structures and features that affect flood risk, requiring the owner to seek consent from the authority to alter, remove or replace it.

14 Cabinet Office (2007) The Pitt Review: Learning Lessons from the 2007 floods. Available at: http://webarchive.nationalarchives.gov.uk/20100702215619/http://archive.cabinetoffice.gov.uk/pittreview/thepittreview/final_report.html

- Consenting (Section 23): Where appropriate, LLFAs will perform consenting of works on ordinary watercourses.

On 18 December 2014, a Written Ministerial Statement laid by the Secretary of State for Communities and Local Government set out changes to the planning process that would apply to major development from 6 April 2015. In considering planning applications, planning authorities should consult the LLFA on the management of surface water, and ensure, through use of planning conditions or obligations, that there are clear arrangements in place for ongoing maintenance over the lifetime of the development.

In March 2015, the LLFA was made a statutory consultee to the planning system, which came into effect on 15 April 2015. As a result, West Berkshire Council are required to provide technical advice on surface water drainage strategies and designs put forward for new major developments.

Major development is defined within the Town and Country Planning Order 2015[15] as:

- Residential development: 10 dwellings or more, or residential development with a site area of 0.5 hectares or more where the number of dwellings is not yet known.
- Non-residential development: provision of a building or buildings where the total floor space to be created is 1,000 square meters or larger or, where the floor area is not yet known, a site area of 1 hectare or larger.

2.4.4 West Berkshire Preliminary Flood Risk Assessment (PFRA)

A Preliminary Flood Risk Assessment (PFRA) is an assessment of historic and future flooding from sources of local flood risk, i.e. surface water, groundwater and ordinary watercourses. It identifies flood risk areas of national significance, to inform the Environment Agency and lead local flood authority planning cycles.

No Flood Risk Areas of national significance were identified by the Environment Agency within West Berkshire. However, Thatcham was recognised as being of national importance in terms of surface water flood risk.

The **West Berkshire PFRA** was produced in June 2011[16] and assessed records of flooding from a wide range of local sources, including Parish Councils, British Waterways and Berkshire Fire and Rescue.

The assessment identified the towns of Thatcham and Newbury as being 'locally significant' Flood Risk Areas, due to the significant socio-economic impacts of flooding in these areas, particularly during the July 2007 floods.

Following commencement of the second Planning Cycle of the Flood Risk Regulations (2009), the West Berkshire PFRA was updated with an addendum produced in 2017[17]. With the exception of the flood event of 2014, which resulted in the culmination of combined fluvial, surface water, groundwater and sewer flooding, there has been no significant change to the understanding of past or future flood risk within West Berkshire since the 2011 PFRA.

However, notably a Flood Risk Area was identified within the District, covering the towns of Newbury and Thatcham. Although ongoing flood defences are aiding alleviation of flood risk, the PFRA identified that there is significant surface water flood risk, and in the case of Newbury also fluvial flood risk, in the settlements.

2.4.5 West Berkshire Local Flood Risk Management Strategy

Under the Flood and Water Management Act (2010), Lead Local Flood Authorities are required to produce a Local Flood Risk Management Strategy (LFRMS). This document provides a framework for flood risk management within the boundary of the authority, setting policies and outlining a plan of deliverable actions.

15 The Town and Country Planning (Development Management Procedure) (England) Order 2015. Available at: http://www.legislation.gov.uk/uksi/2010/2184/contents/made.

16 West Berkshire Council (2011) Preliminary Flood Risk Assessment: West Berkshire. Available at: http://info.westberks.gov.uk/index.aspx?articleid=30451

17 West Berkshire Council (2017) Preliminary Flood Risk Assessment: West Berkshire - 2017 addendum. Available at: https://www.gov.uk/government/publications/preliminary-flood-risk-assessment-west-berkshire-council.

The West Berkshire LFRMS was produced in 2013, and subsequently updated in 2021, following a formal review in 2020. The West Berkshire LFRMS 2021 outlines how the Council, in its role as LLFA, will work with other risk management authority partners to better understand, communicate and manage local flood risk, both now and in the future.

The following objectives were set within the LFRMS:

1. Maintain and update understanding of the flood risk within West Berkshire and increase public awareness.
2. Develop plans to reduce existing flood risk, taking account of people, communities and the environment.
3. Identify measures that aim to reduce existing flood risk.
4. Ensure that planning decisions take full account of flood risk.

An Action Plan, containing 16 measures, was developed to aid delivery of the LFRMS objectives. These measures are due to be actioned by The Council, with support from the other risk management authorities (RMAs).

West Berkshire LFRMS supports the Council's wider Environmental Strategy, and the actions identified in the LFRMS reflect a commitment to tackling climate change.

2.5 Flood Risk Management Plans

Flood Risk Management Plans (FRMPs) are required under the Flood Risk Regulations and highlight the hazards and risks of flooding from rivers, the sea, surface water, groundwater and reservoirs. FRMPs provide catchment scale flood risk planning, and set out how RMAs work together with communities to manage flood risk.

The draft FRMPs were prepared by the Environment Agency in 2015, in partnership with LLFAs and other RMAs, and co-ordinated flood risk management planning with river basin management planning required under the Water Framework Directive. West Berkshire is covered by the Thames River Basin District FRMP[18].

There are no specific measures in the FRMP which come under the ownership of West Berkshire Council in the Thames River Basin, however the Environment Agency is responsible for several measures which fall within the district, as outlined in Table 2-1.

Table 2-1: Overview of key measures proposed for West Berkshire within Thames FRMP.

Measure ID	Location	Measure name	Measure details	Measure Owner
ACT3540	Kennet and tributaries catchment	Water level management	Taking the catchment approach to enhance and expand the floodplain, biodiversity action plan (BAP) habitat and restore urban watercourses.	Environment Agency
ACT5678	Kennet and tributaries catchment	By working with our partners, we will improve local emergency planning	Work with local resilience forum (LRF) partners to prepare for/ respond to/ recover from and review/ improve multi agency response to flooding	Environment Agency
ACT5763	Burghfield and Stanford Dingley	Investigate the benefits of an additional river level gauge at Burghfield and Stanford Dingley	Investigate the benefits of an additional river level gauge	Environment Agency
ACT5825	Eastbury	Construct flood storage area on the River Lambourn to reduce flood risk in Eastbury	Construct flood storage area on the River Lambourn to reduce flood risk in Eastbury	Environment Agency

18 Environment Agency (2015) Thames river basin district flood risk management plan. Available at: https://www.gov.uk/government/publications/thames-river-basin-district-flood-risk-management-plan.

Measure ID	Location	Measure name	Measure details	Measure Owner
ACT5764	Eastbury	Relocate river level gauge to improve accuracy of flood warning service at Eastbury	Relocate river level gauge to improve accuracy of flood warning service	Environment Agency

2.6 River Basin Management Plans and the Water Framework Directive

The Water Framework Directive (WFD) is a European Union directive for the protection of inland surface waters, groundwaters, estuaries and coastal waters. Its objectives include the aim to achieve good status for all water bodies, or good ecological potential and good surface water chemical status for heavily modified water bodies and artificial water bodies. Such considerations need to be accounted for when considering development proposals.

2.7 Catchment Flood Management Plans

Catchment Flood Management Plans (CFMP) are high level policy documents covering large river basin catchments. They aim to set policies for sustainable flood risk management for the whole catchment covering the next 50 to 100 years.

West Berkshire is covered by the Thames CFMP, and it is recognised that a total of 1,000 to 2,000 properties are at risk of flooding across the district. The Thames CFMP catchment is split into sub areas with similar flood risk management types, with one of six policies assigned to each sub area. West Berkshire covers two policy sub areas, with the Kennet catchment located in sub area 1 and settlements close to the Thames confluence located in sub area 2, with the related policies summarised in Table 2-2.

Table 2-2: CFMP Policies for West Berkshire

CFMP	Sub Area	Policy
Thames	1 - Towns and villages in open flood plain (north and west)	Policy 6 - Areas of low to moderate flood risk where the EA will take action with others to store water or manage runoff in locations that provide overall flood risk reduction or environmental benefits.
Thames	2 - Towns and villages in open flood plain (central)	Policy 4- Areas of low, moderate or high flood risk where the flood risk is already being managed effectively, but where further actions may need to be taken to keep pace with climate change

2.8 Surface Water Management Plans (SWMPs)

SWMPs outline surface water issues in a given location, and the preferred options for managing the flood risk. SWMPs are undertaken, when required, by LLFAs in consultation with key local partners who are responsible for surface water management and drainage in their area. SWMPs establish a long-term action plan to manage surface water, and are intended to influence future capital investment, drainage maintenance, public engagement and understanding, land-use planning, emergency planning and future developments.

The **Thatcham SWMP**[19] was developed in 2008 as one of six Defra Pilot SWMPs, following the flooding of around 1100 homes during the July 2007 flood event. The SWMP assessed the integrated mechanisms of flooding within Thatcham, from both rural and urban drainage systems, established the levels of current and future flood risk, and identified the suitability of a number of mitigation options.

The study concluded that no one flood risk management option will resolve the flooding issues in Thatcham, but a combination of both technical flood defence measures, and improvements in emergency planning and public awareness is required. The preferred option within the SWMP

19 West Berkshire Council (2010) Thatcham Surface Water Management Plan - Work in Progress Available at: http://info.westberks.gov.uk/CHttpHandler.ashx?id=40506&p=0.

(Option 5) involved the construction of a series of dry flood storage basins across Thatcham, to capture surface water runoff from the fields above Thatcham and allow the controlled release of water into underground surface water sewers which outfall into the River Kennet to the south of the town. An Action Plan has been developed to accompany the plan.

The **Lambourn Valley Flood Risk Management Plan**[20] was developed in 2013, to assess the flood risk and community concerns in the valley settlements, including Upper Lambourn, Lambourn, Eastbury and Great Shefford. Between 2000 and 2013, the area was affected by integrated flood mechanisms including fluvial, surface water and groundwater sources.

The action plan produced for the Flood Risk Management Plan identified a number of options for managing flood risk in the Lambourn Valley, with actions assigned to West Berkshire Council, Thames Water, the Environment Agency and the Parish Councils. Actions focussed on better understanding and managing the existing flood risk through undertaking surveys and investigations. A further focus was improving community awareness and resilience to flooding, by communicating riparian responsibilities and installing property level resilience measures for properties at a high risk of surface water flooding, as well as ensuring effective flood warning and emergency planning.

2.9 Water Cycle Studies

Future changes in climate and increases in new development can be expected to exert greater pressure on the existing waste water supply and infrastructure within a settlement. A large number of new homes, for instance, may cause the existing water supply infrastructure to become overwhelmed, which would result in adverse effects on the environment both locally and in wider catchments. Planning for water management therefore needs to take these potential challenges into account.

Water Cycle Studies (WCS) assist local authorities in selecting and developing sustainable development allocations, so that there is minimal impact on the environment, water quality, water resources, infrastructure and flood risk. In areas where there may be conflict between any proposed development and environmental requirements, this can be achieved through the recommendation of potential sustainable solutions.

In March 2020, West Berkshire Council commissioned a Phase 2 WCS to help inform the West Berkshire LPR to 2036. The study assessed the potential impacts of future development across West Berkshire on water supply, wastewater collection and treatment, and water quality.

The WCS identified that West Berkshire is an area of serious water stress, and stringent water efficiency targets for new development would be justified. Many of the Wastewater Treatment Works in West Berkshire would require upgrades in order to serve growth during the plan period, and the time taken to undertake these upgrades when phasing development needed to be considered. At two Wastewater Treatment Works, growth in the catchment was identified as having the potential to cause significant deterioration in water quality, although improvements in treatment processes could prevent this deterioration. A series of recommendations were set out in the WCS to address the constraints and requirements arising from potential development growth on the water infrastructure in West Berkshire.

2.10 Infrastructure Delivery Plan

An Infrastructure Delivery Plan (IDP) identifies the infrastructure required for future growth, and schedule of delivery needed to meet anticipated service demands.

The West Berkshire IDP was originally produced in 2010[21], and was updated in March 2013[22] to support the Council's Community Infrastructure Levy, and then again in April 2016[23] to support the Council's Housing Site Allocations Development Plan Document. The Emerging Draft IDP was updated following stakeholder consultation and was published in October 2021. The IDP is a 'living document', which is updated at appropriate stages during the plan-making process.

20 West Berkshire Council (2013) Lambourn Valley Flood Risk Management Plan 2013 - 2016. Available at: http://info.westberks.gov.uk/index.aspx?articleid=30451.

21 West Berkshire Council (2010) Proposed Submission Core Strategy Infrastructure Delivery Plan. Available at: http://info.westberks.gov.uk/CHttpHandler.ashx?id=35829&p=0.

22 West Berkshire Council (2013) Infrastructure Delivery Plan. Available at: https://info.westberks.gov.uk/idp

23 West Berkshire Council (2016) Infrastructure Delivery Plan. Available at: http://info.westberks.gov.uk/CHttpHandler.ashx?id=41472&p=0

The following strategic infrastructure projects are planned within the current timescale of the Local Plan:

- M4 J3-12 Smart Motorway project - commenced in late March 2017 and be completed by the end of March 2022.
- Great Western Rail Electrification - delivery between Oxford and Newbury in 2018 - 2019, with delivery between Southcote and Basingstoke expected by 2024.

2.11 Association of British Insurers Guidance on Insurance and Planning in Flood Risk Areas for Local Planning Authorities in England

The Association of British Insurers (ABI) and the National Flood Forum have published guidance to assist local authorities in England in producing local plans and reviewing planning applications in flood risk areas. The guidance complements the National Planning Policy Framework, and provides the following key recommendations:

- Ensure strong relationships with technical experts on flood risk
- Consider flooding from all sources, taking account of climate change
- Take potential impacts on drainage infrastructure seriously
- Ensure that flood risk is mitigated to acceptable levels for proposed developments
- Make sure Local Plans take account of all relevant costs are regularly reviewed

The government and insurance companies have been working together to develop a new flood re-insurance scheme known as FloodRe. It was launched in April 2016, and is designed to:

- Enable flood cover to be affordable for those households at highest risk of flooding;
- Increase availability and choice of insurers for customers;
- Allow time for government, local authorities, insurers and communities to become better prepared for flooding;
- Create a 'level playing field' for new entrants and existing insurers in the UK home insurance market.

Further details are available on the FloodRe website at www.floodre.co.uk.

2.12 Roles and responsibilities in West Berkshire

Flood risk management responsibilities under the Flood and Water Management Act 2010 and the Flood Risk Regulations 2009 are summarised in Table 2-3.

Table 2-3: Roles and responsibilities in West Berkshire

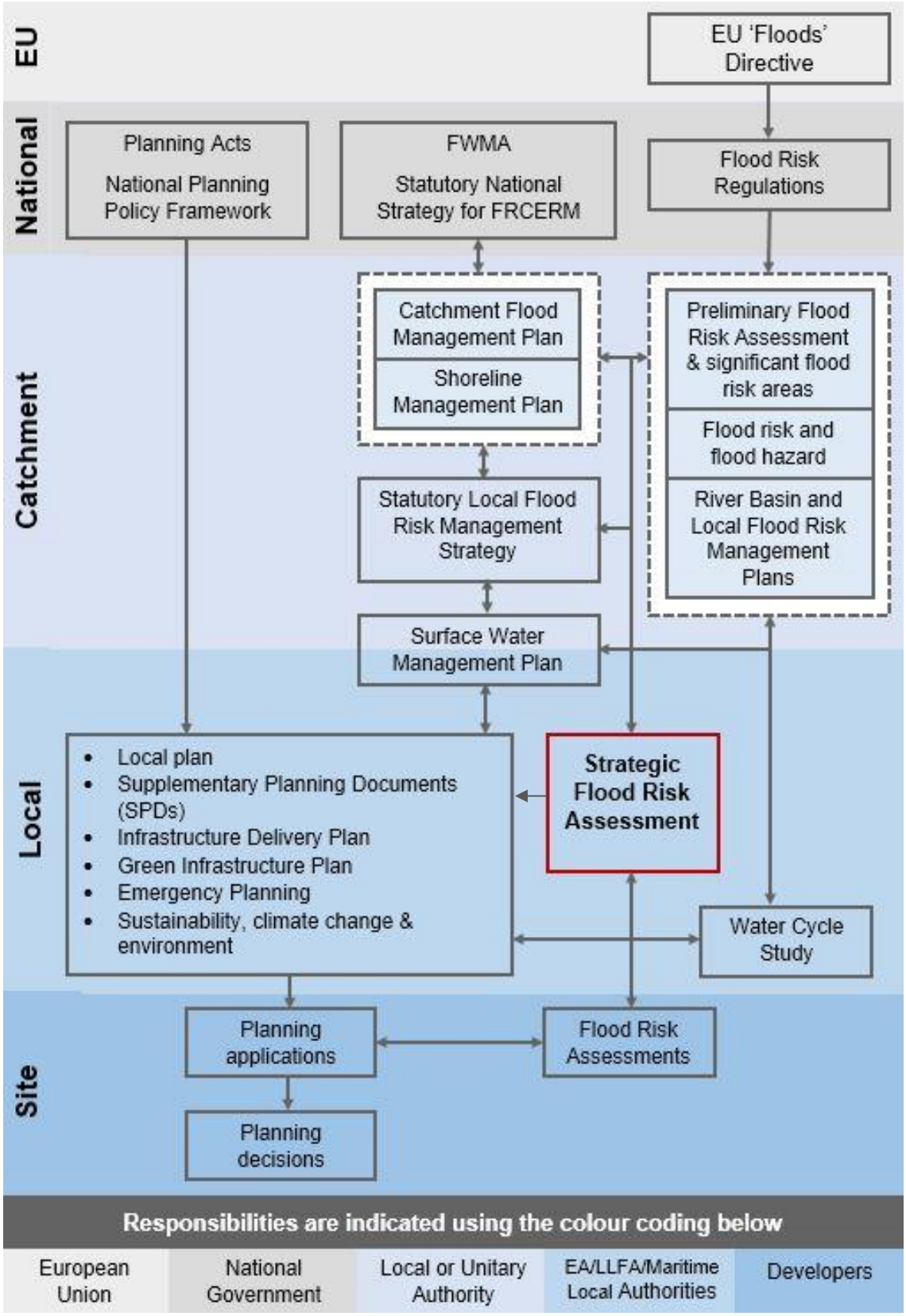
Risk Management Authority (RMA)	Strategic Level	Operational Level
Environment Agency	National Statutory Strategy Reporting and supervision (overview role)	Main Rivers, reservoirs Identify Significant Flood Risk Area Flood Risk and Hazard Maps Flood Risk Management Plan Warn and inform during flood events Enforcement authority for Reservoirs Act 1975 Water Framework Directive (WFD)
Lead Local Flood Authority (West Berkshire Council)	Input to national strategy Formulate and implement local flood risk management strategy	Ordinary watercourses Enforce and consent works (as Land Drainage Authority) Surface water, groundwater, other sources of flooding Prepare and publish a PFRA (and produce flood hazard mapping and flood risk plans in areas of nationally significant flood risk) Identify Flood Risk Areas Maintain a register of 'significant' flood risk assets Designating authority for essential flood infrastructure

Risk Management Authority (RMA)	Strategic Level	Operational Level
		Statutory consultee for surface water drainage proposals on large scale developments

Figure 2-3 outlines the key strategic planning links for flood risk management and associated documents. It shows how the Flood Risk Regulations and the Flood and Water Management Act, in conjunction with the Localism Act "duty to cooperate", introduce a wider requirement for the mutual exchange of information and the preparation of strategies and management plans.

SFRAs contain information that should be referred to in responding to the Flood Risk Regulations and the formulation of local flood risk management strategies and plans. SFRAs are also linked to the preparation of Catchment Flood Management Plans (CFMPs), Surface Water Management Plans (SWMPs) and Water Cycle Studies (WCSs).

Figure 2-3: Strategic planning links and key documents for flood risk



† See Table 2-3 for roles and responsibilities for the preparation of information

3 How flood risk is assessed

This section describes how flood risk is defined and assessed within the SFRA, including the main sources of information, data and mapping.

Planners and developers should use the evidence and maps presented in this SFRA, along with any other available evidence, to identify any risk of flooding from all sources for a particular site.

3.1 Definitions

3.1.1 Flood

Section1 (subsection 1) of the Flood and Water Management Act (FWMA) (2010)[24] defines a flood as:

> **'any case where land not normally covered by water becomes covered by water'**

Section 1 (subsection 2) states that 'it does not matter for the purposes of subsection (1)' whether a flood is caused by:

a. heavy rainfall;
b. a river overflowing or its banks being breached;
c. a dam overflowing or being breached;
d. tidal waters;
e. groundwater; or
f. anything else (including any combination of factors).

Sources of flooding under this definition do not include excess surface water from any part of a sewerage system, unless caused by an increase in the volume of rainwater entering or affecting the system, or a flood caused by a burst water main.

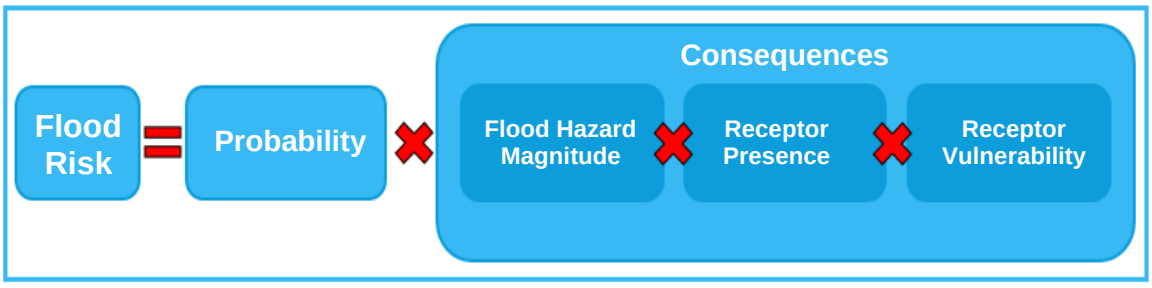
3.1.2 Flood Risk

Section 3 (subsection 1) of the FWMA defines the risk of a potentially harmful event (such as flooding) as:

> **'a risk in respect of an occurrence is assessed and expressed (as for insurance and scientific purposes) as a combination of the probability of the occurrence with its potential consequences.'**

Thus, it is possible to summarise flood risk as:

Flood Risk = (Probability of a flood) x (Scale of the consequences)



Using this definition, it can be seen that:

- **Increasing the probability or chance of a flood being experienced increases the flood risk:** In situations where the probability of a flood being experienced increases gradually over time, for example due to the effects of climate change, then the flood risk will increase.

24 Flood and Water Management Act (2010): http://www.legislation.gov.uk/ukpga/2010/29/pdfs/ukpga_20100029_en.pdf

- **The potential scale of the consequences in a given location can increase the flood risk:**
- Flood Hazard Magnitude: If the direct hazard posed by the depth of flooding, velocity of flow, the speed of onset, rate of risk in flood water or duration of inundation is increased, then the consequences of flooding, and therefore risk, is increased.
- Receptor Presence: The consequences of a flood will be increased if there are more receptors affected, for example with an increase in extent or frequency of flooding. Additionally, if there is new development that increases the probability of flooding (for example, increase in volume of runoff due to increased impermeable surfaces) or increased density of infrastructure then consequences will also be increased.
- Receptor Vulnerability: If the vulnerability of the people, property or infrastructure is increased then the consequences are increased. For example, old or young people are more vulnerable in the event of a flood.

3.2 How fluvial flood risk is assessed

Fluvial flooding is caused by high flows in rivers or streams exceeding the capacity of the river channel and spilling onto the floodplain, usually after periods of heavy rainfall. Fluvial flood risk is present on both Main Rivers (from which the Environment Agency and riparian owners are responsible for managing flood risk) and ordinary watercourses (from which the Council and riparian owners are responsible for managing flood risk).

The assessment of fluvial flood risk in the SFRA is primarily based on the following three types of information:

- Flood Map for Planning (Rivers and Sea), known as Flood Zones
- Actual flood risk
- Residual risk

The Environment Agency Flood Zone mapping is provided in Appendix F, and the fluvial risk from Main Rivers within the four Local Plan Spatial Areas has been summarised in Sections 4.5 to 4.8.

3.2.1 Flood Map for Planning (Rivers and Sea) (Flood Zone 2 and 3)

The NPPF sets out a Sequential Test to steer new development to areas with the lowest probability of flooding. Prior to updates to the NPPF in July 2021, only consideration of river and sea flood risk was required when applying the Sequential Test. This was initially based on the Flood Map for Planning (Rivers and Sea), as provided by the Environment Agency, but as best practice should have been refined by the SFRA to take into account the probability of flooding, other sources of flooding and the impact of climate change. Following publication of the revised NPPF in July 2021, the Sequential Test was amended to consider flood risk *from any source'*

The Flood Map for Planning (Rivers and Sea) is made up of a suite of map layers, including Flood Zone 2 and 3, Defences, Areas Benefiting from Defences, and Flood Storage Areas. There is no distinction in the Flood Map for Planning between Flood Zone 3b, known as the 'functional floodplain' and represented by a 1 in 20-year flood extent, and Flood Zone 3a, the 1 in 100-year flood extent. Further details of how Flood Zone 3b is defined are provided in Section 3.2.3. Following update to the PPG in August 2022, the definition of the functional floodplain (Flood Zone 3b) has been amended to include land with a 1 in 30-year of greater risk of flooding, and land which is designed to flood in more extreme events (such as a flood attenuation scheme).

A concept diagram showing the classification of NPPF Flood Zones graphically, is included in Figure 3-1, with definitions of the Flood Zones provided in Table 3-1. Descriptions and discussion of appropriate development within each Flood Zone is provided in Section 5.2. A fuller discussion of Flood Zones and their relation to planning policy can be found in the NPPF and the Planning Policy Guidance.

Figure 3-1: Definition of Flood Zones

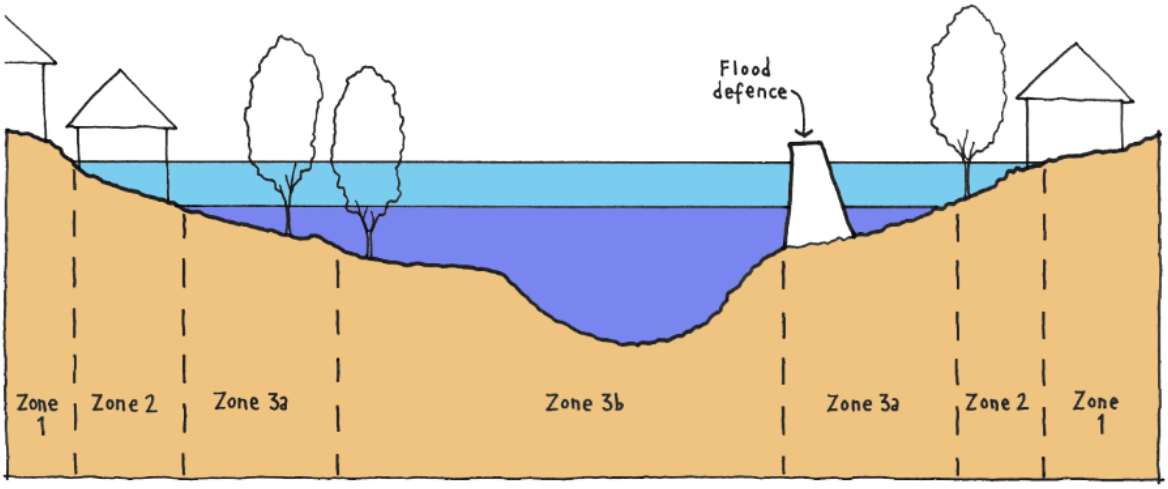


Table 3-1: National Flood Zone descriptions[25]

Zone	Probability	Description
Zone 1	Low	This zone comprises land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding in any year (<0.1%).
Zone 2	Medium	This zone comprises land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (0.1% - 1%) or, in coastal areas, between 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.1% – 0.5%) in any year.
Zone 3a	High	This zone comprises land assessed as having a greater than 1 in 100 annual probability of river flooding (>1.0%) or a greater than 1 in 200 annual probability of flooding from the sea (>0.5%) in any year.
Zone 3b	Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. SFRAs should identify this Flood Zone in discussion with the LPA and the Environment Agency. The identification of functional floodplain should take account of local circumstances.

The Flood Zones describe the land that would flood from rivers if there were no defences present. They are based on broad scale modelling that has been refined with detailed hydraulic models in areas of higher risk. Areas Benefiting from Defences can be identified using the accompanying layers.

Where outlines are not informed by detailed hydraulic modelling, the Flood Map for Planning is based on generalised modelling to provide an indication of flood risk. Whilst the generalised modelling is mostly accurate on a large scale, it is not provided for specific sites or for land where the catchment area of the watercourse falls below 3km². For this reason, the Flood Map for Planning is not of a resolution for use as application evidence to provide details for flooding of individual properties or sites, and for any sites with watercourses on, or adjacent to the site. Accordingly, for site specific assessments it will be necessary to perform more detailed studies in circumstances where flood risk is an issue. Where the Flood Map for Planning is based on generalised modelling, developers may be required to undertake their own detailed modelling.

The most up to date version of the Flood Map for Planning (Rivers and Sea) should always be used, and can be viewed on the Environment Agency's website[26].

For planning purposes under the NPPF, a more detailed breakdown of risk within Flood Zone 3 is required as the flood map for planning does not define Flood Zone 3b. The SFRA is required to define Flood Zone 3b (also known as a functional floodplain), and also assess the impact of climate change on the 1 in 100-year flood event, using more detailed data from hydraulic models where

25 Department of Communities and Local Government (2012) Paragraph 5 Table 1: Flood Zones. Technical Guidance to the National Planning Policy Framework. Accessed online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/6000/2115548.pdf .

26 Flood Map for Planning (Rivers and Sea), Environment Agency (2022), Accessed online at: https://flood-map-for-planning.service.gov.uk/.

available. This information is included in the detailed mapping which accompanies this report and encompasses all the local authority's currently identified sites.

3.2.2 Updating the Flood Zone Mapping

The Environment Agency's Flood Zones 2 and 3 are updated quarterly with any new detailed hydraulic modelling information, and planners and developers should always refer to the most up to date issue. These data sets are now freely available on the Government open data website.

The Flood Zone 3b and the 1 in 100-year flood extent plus climate change provided by the SFRA will not be automatically updated. However, users should be aware that if Flood Zones 3 and 2 have changed, this is an indication that new modelled information is also available which could be used to refine Flood Zone 3b and 3a plus climate change.

3.2.3 Functional Floodplain (Flood Zone 3b)

The 'functional floodplain' is defined as an area of land where water flows or is stored in times of flood. This forms Flood Zone 3b within the NPPF. Following discussion between the Council and Environment Agency, the following definition of the functional floodplain was agreed:

- Use the 1 in 20-year modelled flood extent wherever suitable hydraulic models are available.
- Elsewhere, take a precautionary approach and assume that Flood Zone 3 (1 in 100-year flood extent) represents the functional floodplain.

The definition of the functional floodplain was subsequently amended within the August 2022 updates to the PPG. This states that the functional floodplain should take account of local circumstances, but will normally comprise:

- Land with a 1 in 30-year (3.3%) or greater chance of flooding, with existing flood risk management infrastructure operating effectively.
- Land which is designed to flood in more extreme events (such as a 1 in 1,000-year or 0.1% event), for example a flood attenuation scheme.

In the West Berkshire Level 1 SFRA, Flood Zone 3b has not been updated following the August 2022 change in PPG guidance, as no 1 in 30 year modelled flood extents were available from the Environment Agency hydraulic models within West Berkshire. The 1 in 20-year modelled flood extent was considered representative of the functional floodplain within West Berkshire, and was retained as Flood Zone 3b.

3.2.4 Climate Change (Flood Zone 3a (1 in 100-year event) plus climate change)

The Flood Map supplied by the Environment Agency does not provide any allowance or indication of the impact of climate change on the Flood Zones.

Updated government guidance on assessing the impact of climate change on flooding in line with the UKCP09 Climate Change Projections[27] was released in February 2016 and subsequently updated in July 2021[28]. The guidance provides a range of climate change allowances which are dependent on location (by river basin) and timescale of development (epoch). It also provides several bands (termed ‘central’, ‘higher central’ and ‘upper end’) to test depending on the vulnerability of the development and the Flood Zone within which it is located. For the purposes of strategic planning, the key epoch considered is 2070-2115 as this reflects the lifetime of residential development; and the key vulnerability is ‘more vulnerable’ as this represents a conservative classification incorporating all vulnerabilities.

Under the 2016 climate change guidance, the key allowances to consider for Flood Zone 3a were therefore the higher central and upper end (35% and 70% in the Thames river basin respectively) as shown in Table 3-3.

Due to the lower vulnerability of minerals and waste sites, the central allowance was suggested for the 'water compatible' development of sand and gravel extraction, whereas the central to higher central range of allowances were to be assessed for 'less vulnerable' development, such as ancillary

27 UK Climate Projections (UKCP09), Met Office (2015), Accessed online at: http://ukclimateprojections.metoffice.gov.uk/21678 on: 02/06/2017

28 Climate change allowances, Environment Agency (2020) Accessed online at: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances on 02/06/2017

buildings or waste treatment facilities. Extraction of other minerals, including chalk, clay and slate, are also classified as 'less vulnerable' developments.

However, hazardous waste and landfill are 'more vulnerable' development types, which required assessment of the upper end allowance. To ensure provision of flood risk information for any future, more sensitive development types, the higher central and upper climate change allowances were assessed for the MWLP.

It should be noted that Environment Agency guidance on climate change allowances was revised in July 2021, in line with the UK Climate Change Projections 2018 (UKCP18), which provide the latest source of information on how the UK climate is predicted to change over the rest of this century. While awaiting issue of the latest guidance, the 2016 allowances were applied within the SFRA, as the best available guidance at the time of preparation.

The Thames River Basin used in the 2016 guidance has since been replaced by three management catchments covering West Berkshire: Thames and South Chiltern, Kennet and tributaries, and Loddon and tributaries[29]. As shown in Table 3-2, the Loddon and tributaries Management Catchment has 1% – 24% lower recommended peak river flow allowances than the 2016 uplifts for the Thames Basin. The Kennet and tributaries Management Catchment also has 3% - 4% lower uplifts in the Central allowance category. However, greater differences are seen in the Higher and Upper allowances for the Kennet and tributaries and Thames and South Chiltern Management Catchments. Here, uplifts are 1% - 7% higher than in the 2016 allowances, particularly for the Upper scenario, and within the '2020s' and '2080s' epochs.

The latest climate change guidance recommends that both the Central and Higher allowances should be assessed within SFRAs and FRAs, which equates to uplifts of between 14% and 43% in West Berkshire, depending on the management catchment. Due to the late stage of the SFRA, the hydraulic models within the study area have not been re-run for the latest allowances. Instead, to maintain a precautionary approach, the 2016 Upper end allowance of 70% has been used to assess the impacts of climate change within the SFRA.

Further information on assessing the impact of climate change on flood risk is provided in Section 6.3 and Section 6.4.

Table 3-2: UKCP18 Climate change allowances (2021) used in comparison

Allowance category	Total potential change anticipated for the '2020s' (2015 to 2039)			Total potential change anticipated for the '2050s' (2040 to 2069)			Total potential change anticipated for the '2080s' (2070 to 2115)		
	T&SC	K&Ts	L&Ts	T&SC	K&Ts	L&Ts	T&SC	K&Ts	L&Ts
Upper	30% (+5%)	32% (+7%)	23% (-2%)	42% (+7%)	39% (+4%)	25% (-10%)	76% (+6%)	76% (+6%)	46% (-24%)
Higher	17% (+2%)	16% (+1%)	11% (-4%)	22% (-3%)	16% (-9%)	10% (-15%)	43% (+8%)	35% (0%)	23% (-12%)
Central	12% (+2%)	10% (0%)	7% (-3%)	14% (-1%)	8% (-7%)	4% (-11%)	31% (+6%)	21% (-4%)	14% (-11%)

T&SC = Thames and South Chiltern, K&Ts = Kennet and tributaries, L&Ts = Loddon and tributaries

Table 3-3: UKCP09 climate change allowances (2016) used in Level 1 SFRA

River basin district	Allowance category	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Thames	Upper end	25%	35%	70%
	Higher central	15%	25%	35%
	Central	10%	15%	25%

[29] Environment Agency (2022) Climate change allowances for peak river flow in England. Available at: Climate change allowances for peak river flow in England (data.gov.uk)

3.2.5 Hydraulic Modelling

Flood risk within the district has been assessed using results from computer models supplied by the Environment Agency and existing Environment Agency Flood Zone mapping.

Table 3-4 lists the models provided by the Environment Agency for analysis within the West Berkshire Level 1 SFRA. Several of the models are currently being updated, although the timescales for delivery of the updated model were beyond the programme of the SFRA. It was agreed with the Environment Agency in a meeting on 7 September 2017 that the Level 1 SFRA should progress with the available model data, rather than delay the assessment to receive updated model results.

Should a Level 2 SFRA be required, the most recent model data available should be reviewed and incorporated, where relevant.

Table 3-4: Summary of Environment Agency models used within the SFRA and indicative timescales for model updates.

Model	Year created	Model Type	Data source used in Flood Zone 3b	Data source used in Flood Zone 3a + CC	Planned updates
Foudry Brook (Silchester to M4)	2004	1D only	1 in 20 modelled outline	Flood Zone 2	None known.
Foudry Brook at Grazeley (Flood Map Challenge)	2017	1D-2D	1 in 20 modelled outline	Flood Zone 2	None known.
River Enborne (MRL to Kennet Confluence)	2007	1D only	1 in 20 modelled outline	1 in 100 + 70% modelled outline	None known.
River Kennet (Marlborough to Newbury)	2007	1D only	1 in 20 modelled outline	1 in 100 + 70% modelled outline	Early stages of updates – not available for use in Level 2 SFRA
River Kennet (Newbury to Tyle Mill)	2007	1D only	1 in 20 modelled outline	1 in 100 + 70% modelled outline	Early stages of updates – not available for use in Level 2 SFRA
River Kennet and Lambourn (Newbury)	2016	1D-2D	1 in 20 modelled outline	1 in 100 + 70% modelled outline	None known.
River Kennet (Tyle Mill to Thames Confluence)	2018	1D-2D	Flood Zone 3 (1 in 20-year modelled flood extent exceeds Flood Zone 3)	1 in 100 + 70% modelled outline	Updated in 2018, no additional updated known.

Model	Year created	Model Type	Data source used in Flood Zone 3b	Data source used in Flood Zone 3a + CC	Planned updates
Lambourn	2007	1D only	1 in 20 modelled outline	Flood Zone 2	Updated, but not yet published. Changes to Flood Zones around Eastbury.
Pang and Sulham Brook	2011	1D-2D	1 in 20 modelled outline	1 in 100 + 70% modelled outline	None known.
River Pang (Bucklebury)	2011	1D only	Flood Zone 3 (1 in 20-year extent not available)	Flood Zone 2	None known.
River Pang (Hampstead Norreys)	2010	1D-2D	1 in 20 modelled outline	1 in 100 + 70% modelled outline	None known.
River Pang (Hampstead Norreys) Sewage Treatment Works	2014	1D-2D	Flood Zone 3 (1 in 20-year extent not available)	1 in 100 + 70% modelled outline	None known.
River Thames (Sandford-Mapledurham)	2018	1D-2D	Flood Zone 3 (1 in 20-year extent not available)	1 in 100 + 70% modelled outline	None known.
River Thames (Mapledurham to Sonning)	2011	1D-2D	1 in 20 modelled outline	1 in 100 + 70% modelled outline	Updated, but not yet published

Note that new national and local models may have been developed since preparation of this SFRA. Users should always consult the latest available modelling and mapping.

3.2.6 Actual Flood Risk

If it has not been possible for all future development to be allocated within areas of low flood risk from all sources, Level 2 SFRA assessments are recommended at any sites identified as within Flood Zone 3b, 3a or 2, and therefore requiring application of the Exception Test.

Following update of the NPPF in July 2021, the Sequential Test must also consider risk of flooding from all sources, for example sites in Flood Zone 1 where there is a significant flood risk from other sources such as surface water and groundwater. The risk to a site is dependent on the vulnerability of proposed land use, and therefore the requirements for a Level 2 SFRA are specific to housing and employment, or mineral extraction sites.

Understanding the implications of development is accomplished by considering information on the “actual risk” of flooding. The assessment of actual risk takes account of the presence of flood defences and provides a picture of the safety of existing and proposed development. It should be understood that the standard of protection afforded by flood defences is not constant and it is presumed that the required minimum standards for new development are:

- Residential development should be protected against flooding with an annual probability of river flooding of 1% (1 in 100-year chance of flooding) taking into account climate change in any year.

The assessment of the actual risk should take the following issues into account:

- The level of protection afforded by existing defences might be less than the appropriate standards and hence may need to be improved if further growth is contemplated;
- The flood risk management policy for the defences will provide information on the level of future commitment to maintain existing standards of protection. If there is a conflict between the proposed level of commitment and the future needs to support growth, then it will be a priority for the Flood Risk Management Strategy to be reviewed;
- The standard of safety must be maintained for the intended lifetime of the development (assumed to be 100 years for residential development). Over time the effects of climate change will erode the present-day standard of protection afforded by defences. Commitment is needed to invest in the maintenance and upgrade of defences, if the present-day levels of protection are to be maintained, and where necessary land secured for affordable future flood risk management measures; and
- The assessment of actual risk can include consideration of the magnitude of the hazard posed by flooding. By understanding the depth, velocity, speed of onset and rate of rise of floodwater, it is possible to assess the level of hazard posed by flood events from the respective sources. This assessment will be needed in circumstances where consideration is given to the mitigation of the consequences of flooding or where it is proposed to place lower vulnerability development in areas that are at risk from inundation.
- The proposed development must not negatively impact on the integrity of any flood defence structure, and appropriate maintenance access must be retained.

For information on defences reference should be made to the Environment Agency's Asset Information Management System (AIMS) which contains details on the standard of protection of defences.

3.2.7 Residual Risk

The residual risk refers to the risks that remain in circumstances after measures have been taken to alleviate flooding. It is important that these risks are quantified to confirm that the consequences can be safely managed. The residual risk can be:

- The effects of a flood with a magnitude greater than that for which the defences or management measures have been designed to alleviate (the 'design flood'). This can result in overtopping of flood banks, failure of flood gates to cope with the level of flow or failure of pumping systems to cope with the incoming discharges; or
- Failure of the defences or flood risk management measures to perform their intended duty. This could be breach failure of flood embankments, failure of flood gates to operate in the intended manner or failure of pumping stations.

The assessment of residual risk demands that attention be given to the vulnerability of the receptors (including those who are less mobile or have a physical impairment) and the response to managing the resultant flood emergency. In this instance, attention should be paid to the characteristics of flood emergencies and the roles and responsibilities during such events. Additionally, in the cases of breach or overtopping events, consideration should be given to the structural safety of the dwellings or structures that could be adversely affected by significant high flows or flood depths.

3.3 How flood risk from other sources is assessed

Under paragraphs 161 and 162 of the NPPF, the Sequential Test should be applied when allocating development, to steer new development to areas with the lowest risk of flooding from any source', by, 'taking into account all sources of flood risk and the current and future impacts of climate change'. In addition, 'the sequential approach should be used in areas known to be at risk now or in the future from any form of flooding' (para. 162).

Evidence and maps presented in this SFRA on other sources of flooding (including surface water, ordinary watercourses, groundwater, sewers, canals and reservoirs) are derived from a range of sources of information, mostly publicly available. They are intended for use by planners and

developers, along with any other available evidence, to identify any risk of flooding from all sources for a particular site.

3.3.1 Surface Water

Flooding of land from surface water runoff is usually caused by intense rainfall and tends to occur in lower lying areas. It is exacerbated where the drainage system is unable to cope with the volume of water, due to exceedance, blockage or failure of the surface water drainage system.

Mapping of surface water flood risk in West Berkshire has been taken from the Risk of Flooding from Surface Water (RoFSW) map published by the Environment Agency. This information is based on a national scale map identifying those areas where surface water flooding poses a risk. Surface water flood risk is subdivided into the following four categories:

- High: An area has a change of flooding greater than the 1 in 30 (3.3%) each year;
- Medium: An area has a chance of flooding between 1 in 100 (1%) and 1 in 30 (3.3%) each year;
- Low: An area has a chance of flooding between 1 in 1000 (0.1%) and 1 in 100 (1%) each year;
- Very Low: An area has a chance of flooding of less than 1 in 1000 (0.1%) each year.

The RoFSW shows the flooding that takes place from the 'surface runoff' generated by rainwater which:

a) is on the surface of the ground, and

b) has not yet entered a watercourse, drainage system or public sewer.

The RoFSW predominantly follows topographical flow paths of existing watercourses or dry valleys with some isolated ponding located in low lying areas.

It should be noted that because of the broad-scale nature of surface water flooding, wherever possible, these mapped outlines should be used in conjunction with other sources of local flooding information to confirm the presence of a surface water risk.

The Environment Agency Risk of Flooding from Surface Water (RoFSW) mapping is provided in Appendix J. Surface water flood risk within the four Local Plan Spatial Areas is summarised in Sections 4.5 to 4.8.

3.3.2 Ordinary watercourses (not included in Flood Zone maps)

The location of small ordinary watercourses, which may not be included in the Flood Zones if they have a catchment area of less than 3km², can be found using the OS MasterMap Water Network Layer or OS Open Rivers layer. The OS Open Rivers layer has been used in this assessment. A good indication of potential flood risk from such watercourses can be gained from the RoFSW map. In addition, Section 19 Flood Investigation Reports undertaken by West Berkshire Council, in its role the Lead Local Flood Authority, can provide further details of flood risk from ordinary watercourses at a particular location.

3.3.3 Groundwater

The risk of groundwater flooding is dependent on local conditions at any given time. Groundwater levels rise during wet winter months, and fall again in the summer when effective rainfall is low, and extractions are higher. In very wet winters, rising groundwater levels may lead to the flooding of normally dry land, as well as reactivating flow in streams that only flow for part of the year.

Two datasets were used in assessing groundwater flood risk within West Berkshire.

Groundwater flooding is a significant risk in West Berkshire, and risk within the four Local Plan Spatial Areas is summarised in Sections 4.5 to 4.8. Two groundwater mapping datasets, the Jacobs 2014 groundwater emergence modelling (Appendix K) and JBA Groundwater Map (Appendix L) have been used to assess groundwater flood risk within the Level 1 SFRA, and are outlined below.

Jacobs Groundwater Mapping and Modelling

Groundwater modelling and mapping for West Berkshire was undertaken in 2015, following the severe groundwater flooding events of Winter 2014.

Emergence zones have been mapped, to identify areas where groundwater could be at or near the ground surface. The extents and depths of the resulting flooding on the ground surface have been

simulated for the 2014 event, and predicted for the 3.3% and 1% events. The full methodology for the dataset is available in the Journal of Flood Risk Management[30]. The Jacobs Groundwater emergence and flood depth mapping is provided in Appendix K.

JBA Groundwater Map

The JBA Groundwater Flood Map (Appendix Map 12) provides a detailed assessment of the risk of groundwater emergence in a 1 in 100-year event at a 5m resolution. The risk is scaled between 0 and 4, with 0 indicating no risk and 4 identifying groundwater levels either at or very near (within 0.025m of) the ground surface. The groundwater levels are compared against ground surface levels to determine the head difference in metres; with 0m suggesting artesian discharge of groundwater at the ground surface.

The JBA Groundwater Flood Map should be used in combination with other information, such as local data or historic data. It should not be used as sole evidence for any specific flood risk management, land use planning or other decisions at any scale. The data can however help to identify areas for further assessment at a local scale, where finer resolution datasets may exist or more data could be gathered. The JBA Groundwater Map is provided in Appendix L.

3.3.4 Reservoir

In England, reservoirs which retain 25,000m^3 or more of water are regulated under the Reservoirs Act 1975. The owners and operators of these reservoirs are required to register the features with the Environment Agency, and features identified as 'high-risk' are subsequently subject to high levels of inspection and supervision.

The Environment Agency Risk of Flooding from Reservoirs map (Appendix M) has been used to identify areas that may be at risk from failure or overtopping of reservoirs. The data was published following the Environment Agency's National Reservoir Inundation Mapping project in 2009, which mapped the risk of flooding from all large, raised reservoirs (storing over 25,000m^3 of water above ground level) in England. Layers showing depth, extent and speed of flooding are available, but no information is given on the likelihood of reservoir failure.

There are three reservoirs included in the mapping that may impact West Berkshire: Ewhurst Park Lake in Hampshire, Aldermaston Court Lake and Decoy Pond at Tadley.

In addition, the flood storage areas at Tull Way and Cold Ash are designated reservoirs. The flood risk from these features is not currently represented within the Risk of Flooding from Reservoirs mapping, however the residual risk from these features should be considered within the allocation of sites and site-specific Flood Risk Assessments.

There are also a number of privately-owned reservoirs in West Berkshire. Stringent operational requirements are in place[31] to ensure that reservoir owners maintain structures and produce an on-site reservoir flood plan to contain and reduce the impacts of a reservoir breach.

However, there is likely to be a higher risk associated with assets which are owned and managed by private individuals, rather than formal organisations.

3.3.5 Canal

Canals may pose a flood risk if they overtop or breach, but impacts will depend on the topography. There is a higher flood risk where the canal is raised by embankments (or perched) above a settlement.

The Kennet and Avon Canal is a 140km long navigable waterway, which follows the Rivers Avon and Kennet from Bristol to its confluence of the River Thames, east of Reading[32]. The canal interacts with the River Kennet at several locations within West Berkshire, including at the large towns of Hungerford, Newbury, Thatcham and Theale. At high flows, this allows the transfer of water from the River Kennet, into the Kennet and Avon Canal, raising the canal water levels. As a result, canal flooding in the Kennet catchment can occur in combination with fluvial flooding. The Kennet and Avon Canal is also perched in several locations, including Newbury, Thatcham, Aldermaston and Theale.

30 Morris, S.E, Cobby, D., Zaidman, M., Fisher, K. (2015) Modelling and mapping groundwater flooding at the ground surface in Chalk catchments. Journal of Flood Risk Management. DOI: 10.1111/jfr3.12201

31 Environment Agency (2014) Reservoirs: owner and operator requirements. Available at: https://www.gov.uk/guidance/reservoirs-owner-and-operator-requirements

32 Kennet and Avon Canal Trust (2017) The Trust and its Branches. Available at: https://katrust.org.uk/about-us/

The interaction of flows between the River Kennet and Kennet and Avon Canal is represented within the hydraulic models of the River Kennet to its confluence with the Thames Confluence, which form the basis of the Flood Zones. Therefore, the canal flood risk in the district is represented within the Flood Zones.

The Environment Agency is undertaking remodelling of the River Kennet, which includes a review of the operation of flow control structures on the watercourse by private owners.

3.3.6 Sewer

Sewer flooding incidents recorded in Thames Water's sewer flooding register were provided for the assessment. This is a register of flooding from the 'public' sewer system ('public' in this context meaning assets under the control of Water & Sewerage Companies in England & Wales). Properties at risk of flooding are recorded in a register which is made available to Ofwat.

Thames Water and Ofwat consider the register to be confidential and do not release the data in a resolution higher than ‘number of properties per 4 or 5-digit postcode’. Sewer flooding records provided by Thames Water are therefore not detailed enough to identify site-specific risks. However, Thames Water will comment on larger planning applications, and on Local Plans.

Local evidence of sewer flooding to existing properties on or near the site should be taken into account, with Section 19 Flood Investigation Reports providing a detailed source of information.

4 Understanding flood risk in West Berkshire

4.1 Topography, geology, soils and hydrology

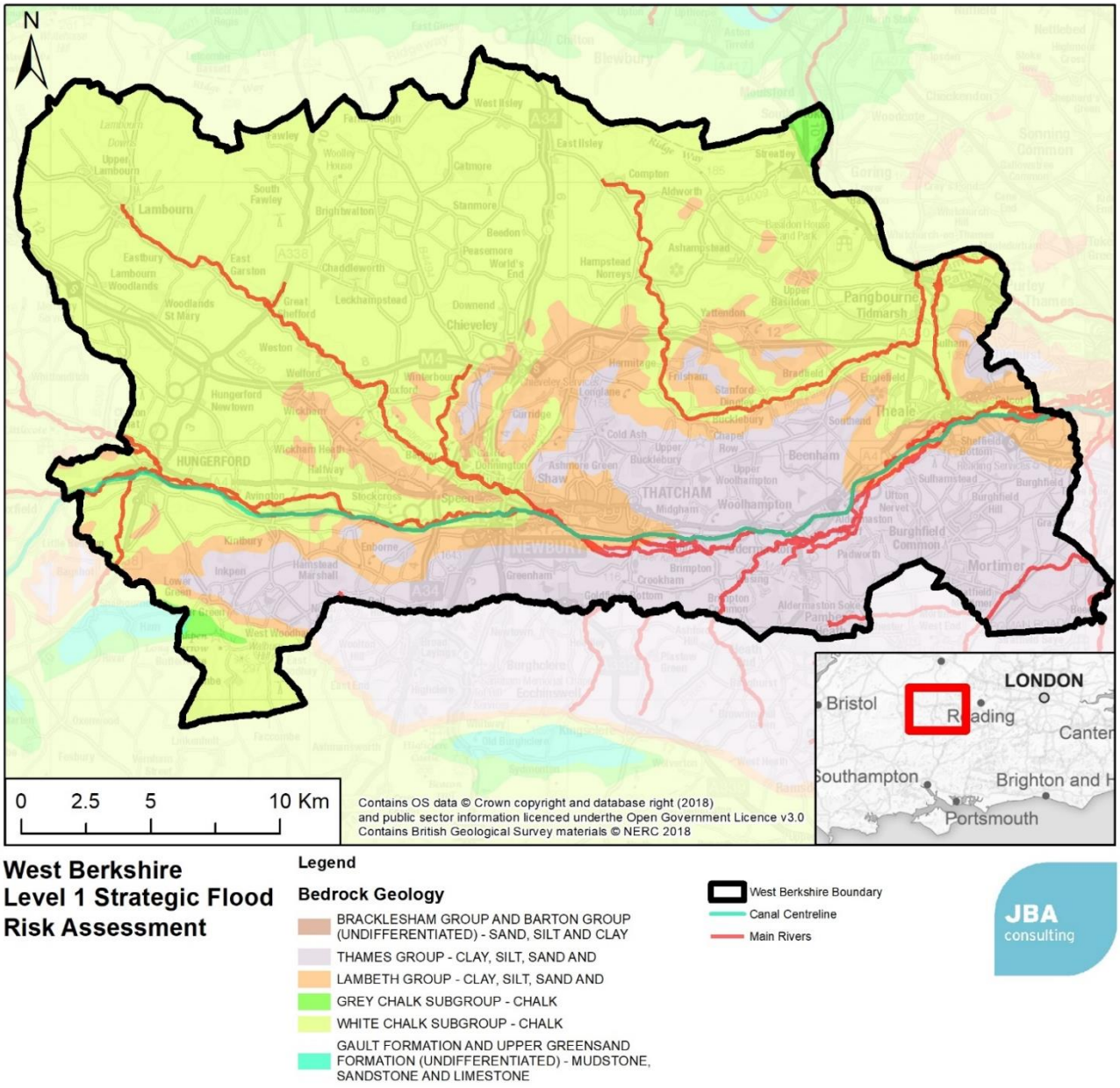
4.1.1 Topography

The topography of West Berkshire is characterised by the rolling hills of the North Wessex Downs in the north west of the district, and the low-lying floodplains of the River Kennet and Thames in the east. Topographic heights range from 215mAOD at Farnborough and 125mAOD at Lambourn on the Downs, to 55mAOD at Thatcham in the River Kennet valley.

4.1.2 Geology and soils

Chalk is the predominant bedrock geology in West Berkshire, underlying the north and west of the district (Figure 4-1). The area surrounding the valleys of the Rivers Kennet and Enborne, to the south and east, is underlain by the Thames and Lambeth Groups, sedimentary bedrock made up of clay, silt, sand and gravel.

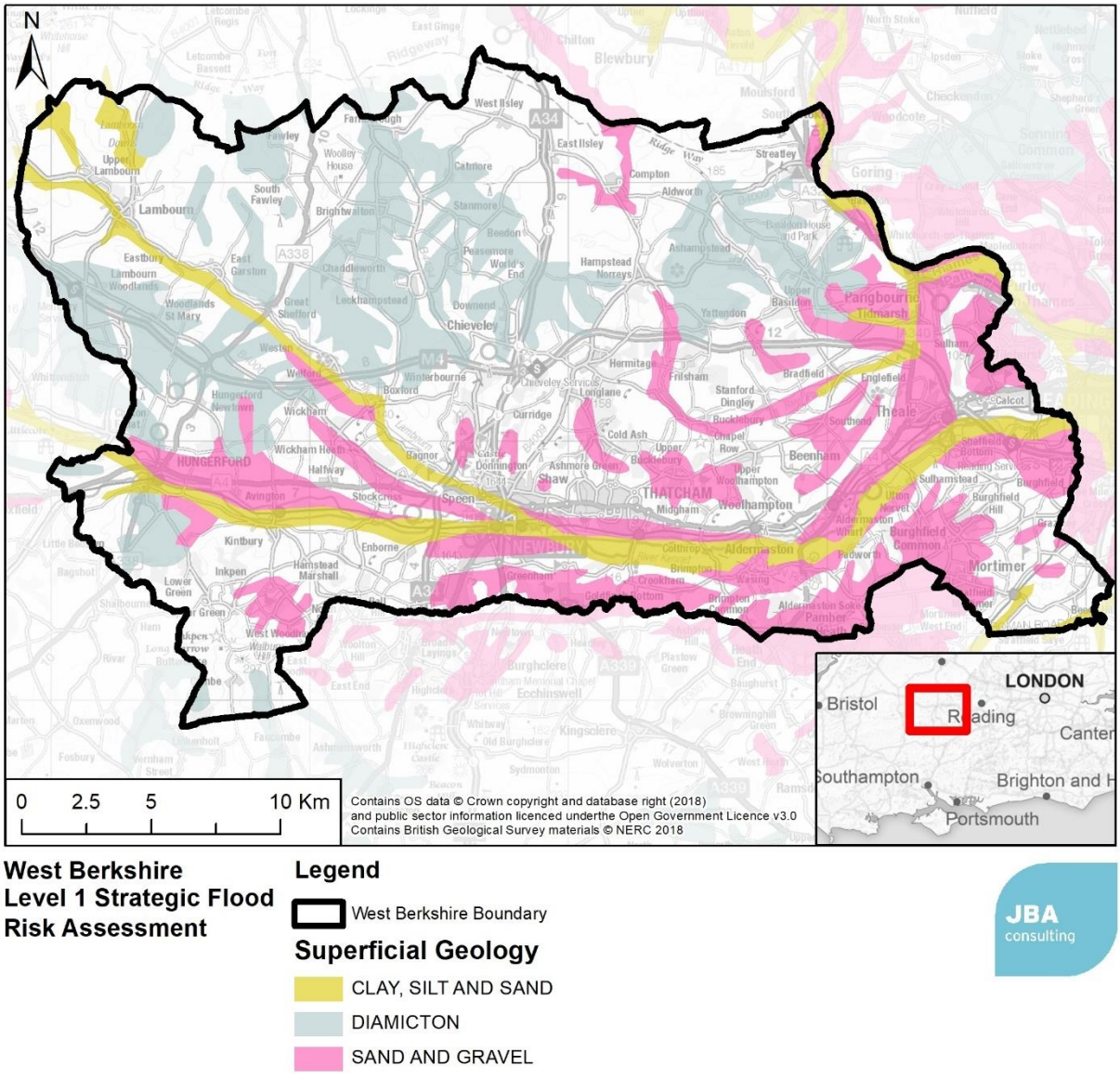
Figure 4-1: Bedrock geology of West Berkshire



The slopes of the North Wessex Downs are overlain by superficial deposits of clay-with-flints, formed by the weathering of rock during the last Ice Age (Figure 4-2). Alluvium and river terrace deposits of clay, silt, sand and gravel line the river valleys, and extensive sand and gravel deposits of unknown origin are located to the south and east, on the slopes of the Kennet and Pang valleys.

Shallow lime-rich soils overlie the chalk in the downland areas to the north, graduating through slightly acidic loamy and clayey soils with impeded drainage in the mid-to-lower slopes. Moving south through the district, soils become more permeable, seasonally wet and slightly acid, with base-rich loamy and clayey soils further south. More freely draining soils occur in smaller areas.

Figure 4-2: Superficial geology of West Berkshire



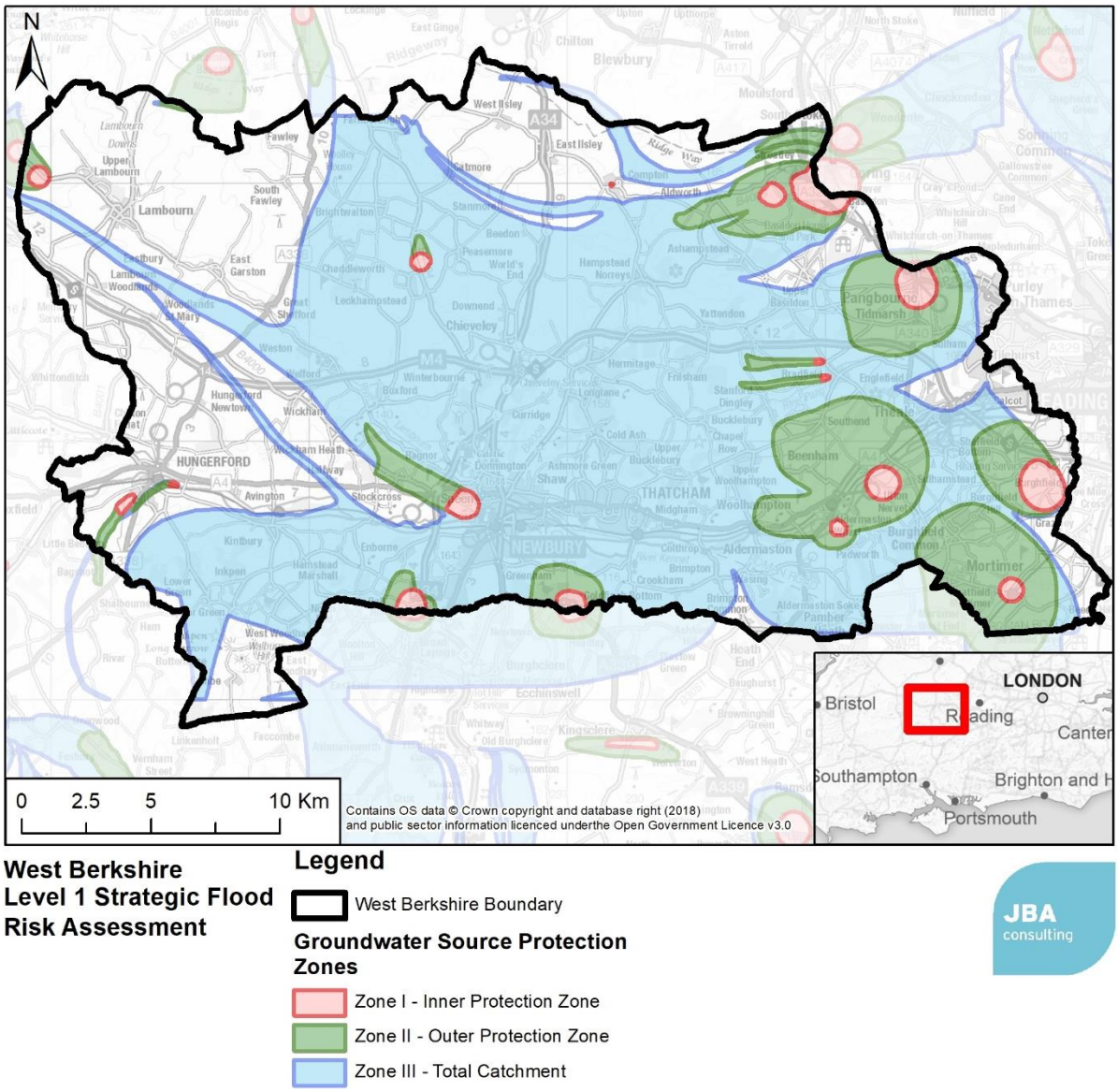
4.1.3 Hydrology

The district is reasonably dry by UK standards, with an average annual rainfall of 800-1000mm. The chalk bedrock is designated as a Principal Aquifer, which provides an important public water supply resource. In addition, the Rivers Pang and Lambourn are groundwater-fed chalk streams, which are fragile hydrological systems, supporting diverse, rare habitats. This is reflected in the designation of the River Lambourn as a Site of Special Scientific Interest (SSSI). As a result, large areas of the district are within Groundwater Source Protection Zones (SPZs), where the Environment Agency provide guidelines to protect groundwater from sources of pollution (Figure 4-3).

The hydrology of the district is modified by the West Berkshire Ground Water Scheme, which Thames Water operates on behalf of the Environment Agency. This system of 33 licensed groundwater abstraction boreholes, pumps water from the chalk aquifer and uses it to augment river

levels in the Lambourn and Kennet catchments. This helps to protect the environment, and also provide additional water to support public water supply downstream, in times of drought.

Figure 4-3: Groundwater Source Protection Zones in West Berkshire



Main Rivers

The principal watercourses in West Berkshire are outlined below. In addition to these Main Rivers, there are a number of smaller watercourses, ditch networks and unnamed land drains, which are classified as ordinary watercourses. A map of the watercourses within the district is provided in Figure 4-4.

The Environment Agency have permissive powers to manage Main Rivers, whereas West Berkshire Council, as Lead Local Flood Authority, have permissive powers to manage flood risk from ordinary watercourses. Riparian owners also have responsibility for maintaining and managing watercourses. Consents must be obtained from the relevant authority for any proposed works to a watercourse. This takes the form of Flood Risk Activity permits for Main Rivers, and Ordinary Watercourse consents for all other watercourses. Further details are provided in Section 6.8.

The River Kennet originates northwest of Marlborough and flows eastwards through the West Berkshire towns of Hungerford, Newbury and Thatcham, where it intermittently joins the Kennet and Avon Canal, before its confluence with the River Thames at Reading. The River Kennet is joined by a number of tributaries, also designated as main rivers, along its course, including the River Dun at Hungerford and the River Enborne north of Aldermaston.

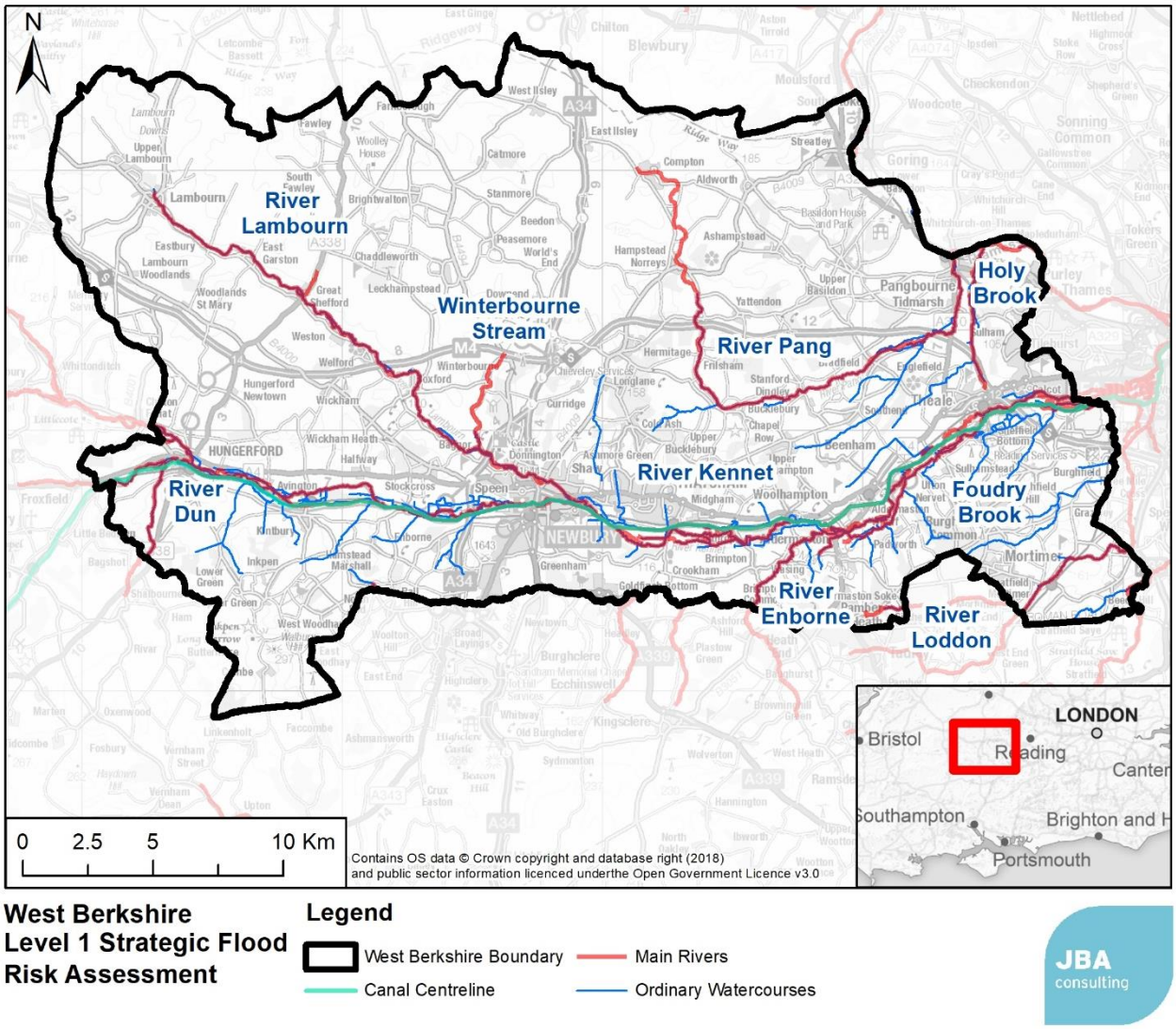
The River Lambourn is a groundwater-fed river which issues from the chalk bedrock of the North Wessex Downs at Lambourn. The watercourse flows through Eastbury, Great Shefford and Bagnor,

where it meets the Winterbourne Brook, before its confluence with the River Kennet in east Newbury.

The River Pang originates in Compton and flows in a south-easterly direction through Hampstead Norreys to Bucklebury, where it continues north-eastwards through Tidmarsh to its confluence with the River Thames at Pangbourne. The Sulham Brook flows northwards from Theale, parallel to the lower reaches of the River Pang, before joining the River Thames east of Pangbourne.

The Foudry Brook flows from Hampshire into the south-eastern corner of West Berkshire, and the River Thames forms part of the northeast border of West Berkshire, flowing through the town of Purley-on-Thames.

Figure 4-4: Watercourses within West Berkshire



4.2 Minerals and Waste in West Berkshire

4.2.1 Minerals Extraction

Sand and gravel, located in the Kennet Valley between Newbury and Reading, are the primary minerals extracted within West Berkshire. Sharp sand and gravel, used in concrete, has historically been extracted in the largest quantities, with soft (building) sand extracted in smaller quantities for use in construction applications, such as mortar and plaster, and as a component of asphalt.

The relationship between mineral extraction and flood risk is complex. The voids created through extraction of minerals in the floodplain can provide additional storage capacity for flood waters, reducing peak river flows downstream.

However, stockpiling of minerals and construction of ancillary buildings, such as processing plants, on the floodplain can reduce the storage capacity for water, and obstruct existing surface water drainage patterns. This may increase the flood risk to downstream and adjacent areas. In addition, mineral workings often involve interaction with groundwater, through excavation below the natural water table, and pumping of groundwater for use at the surface. This can interfere with the local groundwater flow regimes, impacting on wider groundwater flood risk and aquifer extraction for water supply.

4.2.2 Waste Management

The following types of waste arise in West Berkshire as they generally do in varying amounts in all local authority areas:

- Construction, Demolition and Excavation waste;
- Local Authority Collected Waste;
- Commercial and Industrial waste;
- Hazardous waste;
- Radioactive waste;
- Sewage sludge; and
- Equine waste.

All waste will require some type of management and it is acknowledged that waste crosses administrative boundaries. Therefore, it is logical that waste from other local authority areas will be managed in West Berkshire, and vice versa. The location of waste sites must consider all sources of flooding, as they are susceptible to the mobilisation and transfer of debris and pollutants into watercourses of lakes, and the leaching of contaminants into groundwater. As a result, flooding of a waste site can have considerable off-site impacts on the performance of flood risk management assets, such as culvert blockages, as well as the water quality of neighbouring water bodies.

The increase in impermeable areas through construction of waste facilities can also influence surface water flow paths, by increasing the rate and volume of runoff from the site.

4.3 Flood history

West Berkshire has experienced a number of severe flooding incidents, with British Hydrological Survey records dating back to 1757. Table 4-1 provides an overview of the significant flood events recorded in West Berkshire, with fluvial flood extents recorded by the Environment Agency, provided in Appendix E.

Table 4-1: Summary of significant flood events recorded in West Berkshire.

Event date	Mechanism	Areas worst affected	Source of information
March 1947	Significant flooding caused by snowmelt and rainfall running off frozen ground	River Kennet, River Loddon, Sulham Brook (Pangbourne), Lambourn	Middle Kennet Flood Mapping Report[33] Environment Agency Recorded Flood Outline
June 1971	Fluvial flooding, summer storm when groundwater levels were low.	River Kennet (Thatcham, Woolhampton, Newbury, Theale)	Lower Kennet Flood Study[34] Environment Agency Recorded Flood Outline
Winter 1979	Fluvial flooding, caused by exceedance of channel capacity (no raised defences)	Mid-to-lower reaches of River Lambourn (Donnington, Woodspeen), River Kennet (Hungerford, Newbury)	Environment Agency Recorded Flood Outline
Autumn 1992	Fluvial flooding, caused by exceedance of channel capacity (no raised defences)	River Lambourn (Lambourn, Woodspeen, Donnington) River Pang (Bucklebury, Pangbourne), River Enborne, River Kennet (Calcot)	Environment Agency Recorded Flood Outline
Winter 2000/2001	Exceptionally wet winter, high groundwater levels.	River Thames (Purley-on-Thames), Kennet (Newbury), Foudry Brook, Lambourn (Lambourn), Pang (Bucklebury, Pangbourne)	West Berkshire Flood Report Environment Agency Recorded Flood Outline
January 2003	Exceptionally wet winter, exceptionally high levels in Rivers Kennet, Pang and Thames, as well as high groundwater levels	River Thames (Purley-on-Thames), River Kennet (Aldermaston, Woolhampton, Theale), Lambourn.	Post-flood report (Environment Agency).
July 2007	Surface water flooding caused by heavy rainfall on saturated catchments.	Newbury, Thatcham, Bucklebury, Aldermaston, Pangbourne, Woolhampton.	Post-flood report (Environment Agency, West Berkshire Council).
Winter 2012/2013	Groundwater flooding, during exceptionally wet winter, high groundwater levels.	Lambourn Valley (Lambourn)	Local reports
Winter 2013/2014	Significant flood event caused by prolonged intense rainfall, and both high river and groundwater levels.	River Thames (Purley-on-Thames, Streatley), River Kennet (Newbury), River Lambourn (Eastbury, Lambourn, Shaw), River Pang (Tidmarsh and Pangbourne).	Post-flood report (West Berkshire)
September 2016	Surface water flooding from high intensity rainfall.	Newbury	Post-flood report (West Berkshire)

The impacts of recent events have been well-documented within detailed post-flood reports collated by both West Berkshire Council and the Environment Agency. The following sections have been informed by these flood reports. An overview of the numbers of properties affected by flood events by settlement is provided in Appendix C.

33 Halcrow (October 2007) Middle Kennet Flood Mapping (TH678) Volume II - Final Modelling Report. Report on behalf of Environment Agency Thames Region.

34 Jacobs (2007) Lower Kennet Flood Study: TH641. Final Hydraulic Modelling Report. Report on behalf of Environment Agency Thames Region.

4.3.1 Winter 2000/2001

The flooding of Winter 2000/2001 occurred after prolonged seasonal rainfall over the whole region, which equated to a 1 in 100-year rainfall event (1% Annual Exceedance Probability (AEP))[35] on the Berkshire Downs. Higher volumes of surface water runoff entered the watercourse, which led to river levels exceeding the capacity of the channels of the Rivers Thames, Kennet, Pang and Foudry Brook, which resulted in flooding to Pangbourne, Purley-on-Thames, Mortimer, Bucklebury and Newbury around Christmas 2000.

Groundwater levels rose earlier than the seasonal average, causing flooding along historically dry valleys in Lambourn and Compton, and existing bournes at Great Shefford. Ingress of heightened groundwater levels, surface water runoff and fluvial flood waters also caused the foul sewer system to surcharge, resulting in sewage flooding at Compton, Lambourn, Great Shefford and East Ilsley.

4.3.2 January 2003 Floods

The New Year Floods occurred on 1st January 2003 and flooded over 500 properties[36]. During December 2002 and January 2003, around double the average monthly rainfall was recorded over most of the Thames catchment. The heavy rain raised river levels to exceptionally high levels in the Rivers Kennet and Pang, above the levels of the 2000 floods. Many of the rivers within the West Thames Region experienced highest recorded flows, with the River Thames in Reading recording its third highest levels since 1882.

The middle reaches of the River Thames experienced the largest flood since 1947, with flood depths of 1.5m in places. The cause of the flooding to properties was largely due to river flows exceeding the channel capacity, causing overtopping onto the floodplain. High river levels also contributed to surface water flooding, as drainage systems were unable to discharge, and surcharged causing flooding. Groundwater levels were also elevated, which caused flooding to gardens, cellars and roads, as well as ingress into foul sewer networks, resulting in sewer flooding.

A significant concentration of properties flooded were in Purley-on-Thames, on the eastern edge of West Berkshire, where 145 properties were affected, 45 of which were internally flooded. In addition, significant areas of agricultural land were inundated in the River Thames and Kennet catchments.

4.3.3 July 2007 Floods

The July 2007 floods were the result of heavy rainfall falling on catchments saturated by the preceding wet summer months[37]. Surface water runoff generated by the intense rainfall was exacerbated in West Berkshire by blockages to culverts and surface water drainage systems[38]. In addition, rising water levels led to fluvial and groundwater flooding during the event.

The heavy rainfall caused localised flooding across West Berkshire, which lasted for several days. Flooding to 2,500 residential properties occurred, with schools, commercial properties and roads also affected. Key infrastructure was also impacted, with flooding and disruption of the railway line at Newbury and Aldermaston.

Thatcham was the worst affected settlement in the district, with surface water flowing off the steep hills surrounding the town and towards the River Kennet, bypassing surcharged culverts. Severe flooding also occurred at Pangbourne, where high river levels caused the River Pang to burst its banks; and at Newbury, where runoff from fields to the north overwhelmed the drainage system; and at Woolhampton, where runoff flowed down Woolhampton Hill and into residential properties, aided by substantial blockage of a culvert. Full details of the impacts to individual parishes within West Berkshire are provided in the **2007 Parish Flood Report** [39].

4.3.4 Winter 2013/2014 Floods

Winter 2013/2014 was the wettest in England in 250 years, with the Thames Valley receiving almost two and a half times the expected rainfall between December and February[40]. In total across the

35 Environment Agency, Thames Water, West Berkshire Council (2001) Flooding in West Berkshire: Action Plan for 2001/02.

36 Environment Agency (2003) New Year Floods 2003.

37 Marsh, T.J., Hannaford, J. (2007) The summer 2007 floods in England and Wales - a hydrological appraisal. Centre for Ecology & Hydrology. 32pp. Available at: https://www.ceh.ac.uk/sites/default/files/ceh_floodingappraisal.pdf

38 West Berkshire Council (2013) Local Flood Risk Management Strategy. Available at: http://info.westberks.gov.uk/index.aspx?articleid=30451

39 West Berkshire Council (2007) 2007 Parish Flood Report. Available on request.

40 Environment Agency (2014) Technical Flood Report - Winter Floods 2013/2014 West Thames Area. Available on request.

district over 1,400 properties were internally flooded by fluvial sources (main river) and a further 300 suffered groundwater flooding.

Heavy rainfall in December 2013 raised both river and groundwater levels, and further rainfall in January and February 2014 caused groundwater levels to continue rising, providing steady baseflows into the rivers.

An overview of the areas of West Berkshire affected by the event is provided below, with full details of the impacts in each parish available in the West Berkshire Council Winter 2014 Flood Investigation Report[41].

The worst affected areas of West Berkshire were in the valleys of the Rivers Kennet, Lambourn and Pang, where high groundwater and river levels were sustained throughout the event.

A total of 66 properties in West Berkshire were flooded from groundwater during February 2014, with Newbury, East and West Ilsley, East Garston and Great Shefford particularly affected. Varying groundwater flood mechanisms affected the settlements.

West Ilsley, located in the historic route of the River Pang, experienced groundwater emergence which caused internal flooding to properties and to the major access road of Main Street. East Ilsley was affected by overland flows off saturated ground in West Ilsley, and sewer flooding resulting from groundwater ingress into the sewer network. Similar groundwater and sewer flooding mechanisms impacted East Garston, with several properties suffering groundwater ingress into ground floors and cellars. Groundwater emergence in Newbury flowed from Newbury Cemetery and fields adjacent to the B4009, causing flooding to roads, residential properties and sheltered housing.

River Thames

Water levels of tributaries on the River Thames were raised, contributing to further flooding to the Thames floodplain. Purley-on-Thames was particularly affected, with 27 properties flooded over the storms following exceedance of capacity in the River Thames, and conveyance of groundwater through permeable floodplain sediments. Sewer flooding also affected the town, as fluvial and surface water flooding caused inundation of the foul sewer system[42].

The village of Streatley was affected by similar flooding mechanisms of out-of-bank flows from the River Thames, high groundwater levels and surcharging of sewer systems. A number of residential properties, a hotel and a church suffered internal flooding from the floodwaters, with damage also caused to large areas of agricultural land in the parish.

River Kennet, River Lambourn and River Pang

The Rivers Kennet, Lambourn and Pang are groundwater-fed chalk streams, which responded to the prolonged rainfall with a rise in groundwater levels, and consequently a rise river water levels. The banks of the watercourses were overtopped in mid-December 2013, following up to 100mm of rainfall across West Berkshire. Levels on the Kennet and Avon Canal also remained high throughout the event, contributing to flooding in Newbury and close to Reading.

Due to completion of the Newbury flood alleviation scheme three months earlier, 381 residential properties were protected from flooding from the River Kennet in Newbury[43]. However, the town experienced significant surface water flooding, particularly in the Northcroft Lane area, which was partially exacerbated by high river levels restricting drainage outfalls into the River Kennet.

Services were also threatened in the Kennet valley, with the Electricity Distribution Centre at Pingewood flooded in February 2014, when breaches in the Kennet and Avon Canal bank allowed floodwater to flow through private lakes towards the site[44]. Pumping and construction of a sandbag wall were required to prevent disruption to the distribution of electricity.

Water levels in the River Lambourn rose steadily from early January, causing overtopping of banks and internal property flooding at Eastbury, Lambourn and the Shaw area of Newbury in February 2014. Sections of the watercourse were heavily silted in Eastbury, which reduced the channel capacity, allowing the river to spill over onto the main access road.

41 West Berkshire Council (2014) Winter Floods and Storms Debrief. Available at: https://info.westberks.gov.uk/floodreports.

42 West Berkshire Council (2015) Winter Floods 2014 Flood Investigation Report. Available at: http://info.westberks.gov.uk/floodriskmanagement.

43 Environment Agency (2014) Technical Flood Report - Winter Floods 2013/2014 West Thames Area. Available on request.

44 Environment Agency (2003) New Year Floods 2003.

The River Pang breached its banks at several locations in early to mid-February 2014, causing flooding to Tidmarsh and Pangbourne, notably threatening Pangbourne Primary School and nearby properties. In Tidmarsh, further localised flooding to roads was caused by blockage to the drainage ditch network routing flows from the River Pang to Sulham Brook.

4.3.5 September 2016 surface water flood event

Following high intensity rainfall on 15 and 16 September 2016, Newbury experienced significant surface water flooding, affecting residential and commercial properties, as well as the road and rail network.

Flooding was dispersed across Newbury, with surface water runoff channelled along the road network, and conveyed downslope and ponded at low points in the topography, causing internal flooding of Newbury Train Station and properties in Mill Lane, Essex Street, Bartlemy Road and Donnington.

The surface water drainage system was functional, but overwhelmed by rainfall volumes causing highway drainage assets to be bypassed by overland flows. Ingress of surface water to foul sewer manholes also occurred, with sewer flooding experienced at Station Road and Bartlemy Road.

4.4 Defences, assets and structures

The Flood Zones do not take into account the effect of flood defences and assets on flood risk. Three broad scale 'national' GIS layers are provided alongside the Flood Map which define flood defences: Defences (recognised formal defences with a standard of protection of 1% or greater annual probability), Areas Benefiting from Defences (ABD) and Flood Storage Areas.

Raised defences line the River Kennet south of Woolhampton, north of Aldermaston, and in east Newbury, close to Hambridge Lane. The lower reaches of the River Lambourn are also defended in north east Newbury, between Shaw Road and London Road, and a series of embankments provide protection for the village of Bucklebury.

Appendix G provides an overview of the types and locations of flood defences within West Berkshire, as identified within The Environment Agency Spatial Flood Defences layer. It also includes the location of the culverts in the district which are registered on the Environment Agency Asset Information Management System (AIMS) database. These culverts are identified due to their potential to contribute to existing flood risk, through blockage, damage or the restricted capacity of the asset. In response to the impacts of severe flooding across West Berkshire in recent years, a number of flood alleviation schemes have been constructed by the Environment Agency and West Berkshire Council. A full list of completed and proposed schemes is outlined in Table 4-2 and Table 4-3, with further details of the key schemes provided in the below sections.

Additional hydraulic modelling has been undertaken for the majority of schemes, to understand the revised flood risk impacts following construction of the defences. The undefended scenarios used to produce the Environment Agency Flood Zones have been assessed as part of the Level 1 SFRA, however for potential development sites defended by the schemes, residual risk should be assessed within a Level 2 SFRA, where necessary.

4.4.1 Flood defence structures and raised defences

A summary of the existing flood defences in West Berkshire is provided in Table 4-2.

Further details of the larger schemes are provided below. Three flood alleviation schemes, Cold Ash, Tull Way and Dunstan Park, were designed and constructed in response to the 2007 surface water flooding in Thatcham, and delivered as part of the Thatcham Surface Water Management Plan. A further two flood alleviation schemes in the Bowling Green and Heath Lane areas of Thatcham were identified following publication of the Surface Water Management Plan, with planning applications for both schemes submitted in 2022.

Newbury Flood Alleviation Scheme (FAS)

The Newbury flood alleviation scheme was completed by the Environment Agency in October 2013, providing a 1 in 100-year standard of protection to approximately 380 residential and 70 commercial properties in Newbury Town Centre, as well as the major access routes of the A339 and A4 London Road[45]. The scheme comprises of flood defence measures at five locations within Newbury Town

45 Environment Agency (2015) Policy paper: Newbury Flood Risk Management Scheme. Available at: https://www.gov.uk/government/publications/newbury-flood-alleviation-scheme/newbury-flood-risk-management-scheme.

Centre, including construction of flood embankments in Northcroft Park and London Road, and flood walls and pathway raising at Northcroft Lane, Victoria Park, and Russell Road.

Updates to the Environment Agency hydraulic model at Newbury have been undertaken to incorporate the flood alleviation impacts of the scheme on the understanding of flood risk in the town.

Cold Ash Hill FAS

Completed in 2014, the Cold Ash Hill scheme involved the construction of four cascading detention basins, at Little Copse, north of Heath Land and west of Cold Ash Hill. The scheme manages surface water flood risk to north-central Thatcham, particularly around Northfield Road and Heath Lane.

Figure 4-5: Cold Ash Flood Alleviation Scheme (photo credit: West Berkshire Council)

Tull Way FAS

Completed in 2018, the Tull Way FAS is comprised of a surface water retaining bund, which allows the temporary storage of 40,000m^3 of flood water during a storm event. The scheme provides protection to over 250 properties south of Tull Way in Thatcham, up to a 1 in 100-year rainfall event.

Figure 4-6: Construction phases of Tull Way Flood Alleviation Scheme (photo credit: West Berkshire Council)

Dunstan Park FAS

Dunstan Park FAS is the third and final of three flood storage reservoirs in Thatcham, which include Tull Way and Cold Ash. The scheme comprises an attenuation basin and retaining embankment to the north of Floral Way in North Thatcham, which provides protection from surface water flooding to over 500 homes up to a 1 in 100-year plus 20% climate change allowance event. The scheme was completed in November 2020, and the spoil generated through excavation of the basin provided material for use in the South East Thatcham FAS.

South East Thatcham FAS

The South East Thatcham FAS includes a series of bunds, ranging from 0.5m to 1.5m in height, which provide protection for approximately 62 properties up to the 1 in 100-year storm event, with a 20% climate change allowance[46]. The scheme provided opportunities for landscaping of public parks at Dunstan Green and Siege Cross.

Surface water is diverted into attenuation areas by the re-profiling of Harts Hill Road, with swales constructed to accommodate exceedance flows. Flows are controlled by the use of culverts, realigned ditches and spillways. Construction of the South East Thatcham FAS was completed in November 2020.

Winterbourne FAS

Completed in 2016, the Winterbourne FAS involved realignment of the Winterbourne Stream, and the constructed of a 22,000m^3 flood storage to defend the village of Winterbourne (Table 4-3). A 300m long bund and control structures were created at the downstream end of the feature, to manage the storage and release of flows.

46 West Berkshire Council (2017) South East Thatcham Flood Alleviation Scheme. Available at: http://info.westberks.gov.uk/sethatchamfas.

Figure 4-7: Winterbourne Flood Alleviation Scheme (photo credit: West Berkshire Council)

Table 4-2: Existing Flood Alleviation Schemes in West Berkshire

Name	Standard of Protection	Number of Properties to benefit	Asset Owner
Aldermaston Primary School Property Level Resilience	N/A	1	Aldermaston Primary School
Boxford Property Level Resilience	N/A	5	Householders
Bucklebury FAS	1 in 100-year + 20% CC event	25	Environment Agency
Cold Ash FAS	1 in 100-year + 20% CC event	131	West Berkshire Council
Dunstan Park FAS	1 in 100-year + 20% CC event	512	West Berkshire Council
Eastbury FAS	1 in 48-year event	6	West Berkshire Council
Lower Padworth Property Level Resilience	N/A	26	Householders
Newbury FAS	1 in 100-year event	380 residential, 70 commercial	Environment Agency
River Pang and Sulham Brook FAS	1 in 75-year event	26	Environment Agency
South East Thatcham FAS	1 in 100-year + 20% CC event	61	West Berkshire Council
Stratfield Mortimer FAS	1 in 60-year event	12	Environment Agency
Tull Way FAS	1 in 100-year event	261	West Berkshire Council
Waller Drive Property Level Resilience	N/A	4	Householders
Winterbourne FAS	1 in 100-year event	12	West Berkshire Council

4.4.2 Future local flood alleviation schemes

Several of the future flood alleviation schemes detailed below have not yet received full planning approval. Therefore, there is a possibility that they may not be constructed. In addition, dates for completion of schemes and the numbers of properties benefitting from the defences are subject to change.

North and East Thatcham Flood Alleviation Schemes

In addition to the completed schemes at Tull Way, Dunstan Park, Cold Ash Hill, Dunstan Green and Siege Cross Park, planning applications were submitted in 2022 for three additional flood alleviation schemes in Thatcham, near to Bowling Green Road, Heath Lane and Siege Cross (off Floral Way). The schemes comprise of attenuation basins designed to capture and store flood water during storm events up to and including a 1 in 100-year plus 40% climate change event. The stored water is then released at a controlled rate into the existing sewer network, reducing the risk of the sewer system becoming overwhelmed and causing flooding throughout Thatcham.

Other potential schemes

Property Level Resilience (or Property Flood Resilience) measures, such as flood gates and airbrick covers, are planned for 50 properties in Lambourn. The Environment Agency is also assessing the possibility of a flood alleviation scheme in Pangbourne.

Table 4-3: Planned Flood Alleviation Schemes in West Berkshire between 2018 - 2022.

Name of scheme	Location	Stage of Project	Forecast Construction Start Date	Forecast Completion Date	Number of Properties to be defended by scheme
Great Shefford Flood Mitigation Scheme	Great Shefford	Planning Stages	2023	Beyond 2023	17
Hampstead Norreys Flood Alleviation Scheme	Hampstead Norreys	Construction	2022	Beyond 2022	15
Lambourn East Property Level Resilience	Lambourn East	Construction	2019 / 2020	2019 - 2022	26
Purley-on-Thames Property Level Resilience	Purley-on-Thames	Construction	Autumn 2018	2018 - 2022	21

4.4.3 Flood Information Service

The Environment Agency provides a Flood Information Service covering the main rivers within West Berkshire. This is a free service that residents can sign up to by phone, email or text message if their home or business is at risk of flooding.

Traditionally, the Environment Agency issues Flood Warnings to specific areas when flooding is expected, and more frequently Flood Alerts to larger areas, when flooding is possible.

There are 25 Flood Warning Areas in West Berkshire, covering the Rivers Kennet, Lambourn, Thames, Pang and Sulham Brook. Nine Fluvial Flood Alert Areas cover wider areas of the Rivers Enborne, Lambourn, Kennet, Thames, Pang, and Sulham Brook. Reflecting the high groundwater flood risk in West Berkshire, two Groundwater Flood Alert Areas are established, one in the Lambourn Valley catchment, and a second covering West Ilsley, East Ilsley, Compton, Chilton and West Hagbourne.

The locations of all Flood Alert Areas and Flood Warning Areas are shown in Appendix H.

4.5 Flood Risk in Spatial Area 1: Newbury and Thatcham

4.5.1 Newbury

Fluvial

The Kennet floodplain is constrained at Newbury by the topography of the North Wessex Downs to the north, and the urbanised town centre. The Environment Agency Flood Map for planning identifies central and eastern Newbury as being within Flood Zone 3. Commercial and residential areas west of the A339, from Park Way to Northcroft Park are covered by Flood Zone 3, as well as the residential streets from West Mills to Craven Road, south of the River Kennet. The majority of commercial land east of the A339 also lies in Flood Zone 3.

Much of north and east Newbury lies within Flood Zone 2. Where the River Lambourn enters Newbury at Donnington and Shaw, the Flood Zone incorporates the extents of historic flood events of Winter 1979 and Autumn 1992, covering the residential areas Shaw Road and Walton Way, as well as Newbury Business Park. The commercial development at Ham Marsh, south of the confluence between the River Kennet and Kennet and Avon Canal, is also identified as within Flood Zone 2.

Surface Water

Newbury has been affected by several surface water flood events, including July 2007, January/February 2014 and September 2016.

Northern Newbury has been particularly affected in recent years, with surface water flows generated on the steep slopes of the North Wessex Downs and flowing into the residential areas of Shaw Road, Cromwell Road, Wellington Close and Walton Way. Newbury Train Station, located in a topographic low point in the centre of the town is particularly affected by surface water flooding which, in combination with groundwater flooding, led to its closure during the flood events of 2007, 2014 and 2016.

Southern Newbury is affected by surface water runoff channelled down the road network, in particular the A343 Andover Road, Valley Road and the A339, where it ponds against the railway embankment. The RoFSW mapping identifies notable areas of surface water flood risk during the 1 in 30-year rainfall event and higher return periods, in the West Fields area of town, between Bartlemy Road and Enborne Road, as well as at the roundabout between the A339 and St. John's Road.

Groundwater

Newbury and Thatcham were not affected by groundwater emergence during the 2014 flood event, and therefore the available modelling does not cover the two towns. However, depth to groundwater mapping identifies that there is a risk of elevated groundwater levels in both towns in the superficial sand and gravel deposits alongside the River Kennet.

Groundwater levels at or within 0.025m of the ground surface during the 1 in 100-year event are identified in the incoming valleys to the north of Newbury, and east of the town centre, where the Rivers Lambourn and Kennet coalesce. Groundwater depths are estimated to be 0.025 - 0.5m below the ground surface in southern and northwest Newbury.

Canal

Newbury is also at risk of flooding from the Kennet and Avon Canal, which is perched above ground level at this location. This prevents out-of-bank flows from re-entering the canal, and causes flood waters to be retained on the ground surface.

4.5.2 Thatcham

Fluvial

The fluvial flood risk from main rivers at Thatcham is considerably lower, with the wide floodplain confined to the south by the railway embankment. The industrial park in Colthrop, east Thatcham, and rural roads to the south of the River Kennet, including Thatcham Town Football Club, are located within Flood Zone 3.

Flood Zone 2 incorporates the extents of the Summer 1971 and Winter 1979 fluvial flood events, including the area east of Station Road down to Thatcham train station, and isolated flood extents within the residential roads of Agricola Way and Wheelers Green Way.

Surface Water

Thatcham is at greatest risk from surface water flooding, with runoff conveyed rapidly through the town via culverted watercourses, drainage systems and the road network[47]. The most significant recent event occurred on 20 July 2007, where approximately 1,100 homes were flooded.

Two areas of the town particularly affected were south east Thatcham, covering the A4, Pipers Way and Station Road, and northwest Thatcham, including land north of Bath Road, Northfield Road and Henwick Lane/Gordon Road[48]. These areas were subsequently identified as Critical Drainage Areas within the 2008 Level 1 SFRA. The EA RoFSW identifies significant surface water flow paths generated in these catchments during the 1 in 30-year rainfall event and higher return periods. Following the course of former river valleys to the River Kennet, runoff drains through residential and commercial areas, restricted by culverted watercourses and the southern railway embankment.

Surface water flood risk to the town, and options for managing the risk, were investigated in detail within the 2010 Thatcham Surface Water Management Plan[49].

47 West Berkshire Council (2010) Thatcham Surface Water Management Plan - Work in Progress. Available at: http://info.westberks.gov.uk/CHttpHandler.ashx?id=40506&p=0.

48 West Berkshire Council (2015) West Berkshire Strategic Flood Risk Assessment (SFRA) Level 1: Updated to October 2015. Available at: http://info.westberks.gov.uk/CHttpHandler.ashx?id=41471&p=0

49 West Berkshire Council (2010) Thatcham Surface Water Management Plan - Work in Progress. Available at:

Groundwater

Groundwater levels in central and southern Thatcham are estimated to be at or close to the ground surface during the 1 in 100-year event, presenting a risk of flooding to both surface and subsurface assets. Isolated patches of lower groundwater levels, 0.5 - 5m below the ground surface, are located within central Thatcham, whereas no groundwater flood risk is identified in surrounding areas.

4.6 Flood Risk in Spatial Area 2: Eastern Area

4.6.1 Purley-on-Thames

Fluvial

Fluvial flood risk in Purley-on-Thames is confined to the northeast of the town, with the railway embankment appearing to provide a flood alleviation function. Flood Zone 3 extends from Purley Village to the end of Mapledurham Drive in the north, and River Gardens in the east. Residential areas closer to the railway embankment, including Primrose Close, St. Mary's Avenue, Thames Reach and Oak Tree Walk, are predominantly located within Flood Zone 2.

Surface Water

Significant surface water flow paths form on steep woodland to the west of the town during rainfall events of 1 in 30-years. The first originates southwest of Purley-on-Thames and flows through Vicarage Wood Way, Highworth Way and Meadowside, before continuing on Overdown Road, into Tilehurst. The roads of Dark Lane, Lower Elmstone Drive and Overdown Road are predicted to be affected by surface water flooding during the 1 in 30-year event.

A second flow path is formed west of Pryor Close, off Long Lane, and flows eastwards. It poses a surface water flood risk to the residential areas of Apple Close, Menpes Road and Skerritt Way, as well as the A329 Oxford Road, before reaching the River Thames.

Ponding of surface water is also predicted to affect lower-lying residential areas, north of the railway embankment, during the 1 in 30-year rainfall event and greater return periods.

Groundwater

Groundwater flood risk is high in the Eastern Area, with elevation of groundwater levels caused by confluence of the Rivers Kennet, Thames and Sulham Brook.

At Purley-on-Thames, groundwater flood risk is high north of the railway line, with groundwater estimated to lie at or very close to the ground surface from Purley Village to the end of Mapledurham Drive during the 1 in 100-year event. Flood risk is lower to the south, where groundwater levels are estimated at least 5m below the ground surface.

4.6.2 Calcot

Fluvial

Calcot is largely situated beyond the extent of fluvial flood risk. Flood Zone 2, incorporating the recorded outlines of flood events in Summer 1971, September 1992 and January 2003, covers the M4 and properties in Hawkesbury Drive, Mackay Close and Mill Lane, in the south of the town. Flood Zone 3 reaches within tens of metres of properties in south Calcot, however is confined to the undeveloped Kennet floodplain.

Surface Water

Calcot is located at the foot of steeply-sloping topography, and as a result several overland flow paths pose a risk of surface water flooding. RoFSW mapping indicates that several roads and residential areas are at risk from surface water during the 1 in 30-year rainfall event and higher return periods. Runoff originating on Bath Road in the east, and Bay Tree Rise and Starlands Drive to the north, flows through the suburb into the Holy Brook, affecting areas including Halpin Close, Calcot Infant School and Torcross Grange.

Although RoFSW mapping does not account for culverts or highway drainage systems, areas of surface water ponding are predicted north of the A4 Bath Road at Sandown Avenue and Calcot Row, during the 1 in 30-year rainfall event.

http://info.westberks.gov.uk/CHttpHandler.ashx?id=40506&p=0.

Groundwater

Elevated groundwater levels of between 0.025 to 5m below the ground surface are predicted at the southern edge of the Calcot during the 1 in 100-year event, close to the floodplain of the River Kennet. However, groundwater flood risk to the rest of the suburb is very low.

4.6.3 Theale

Fluvial

Much of southern and eastern Theale is located in Flood Zone 2. Theale was particularly affected in the flood events of Summer 1972 and January 2003, with historic extents included in Flood Zone 2 covering residential areas from Cavalier Close in the west to Woodfield Way in the east. Flood Zone 3 extends across the south of the town, incorporating commercial properties in Wigmore Lane, Arrowhead Drive and Arlington Business Park.

Surface Water

Surface water flood risk at Theale is dispersed into isolated areas of surface water ponding, reflecting the low-lying topography. Areas of more extensive ponding are predicted in RoFSW mapping south of Blossom Lane and Church Street, and north of M4 in central Theale, during the 1 in 30-year rainfall event and greater return periods.

Groundwater

Theale, located at the source of the Sulham Brook and the River Kennet floodplain, is at very high risk of groundwater flooding. Groundwater levels are expected to lie at or very near the ground surface across the town during the 1 in 100-year event, which may result in both subterranean flooding and groundwater emergence.

Canal

Theale is also affected by flooding from the Kennet and Avon Canal, where the waterbody interacts with the River Kennet. Under high flows on the River Kennet, water is transferred into the Kennet and Avon Canal, raising the canal water levels and leading to overtopping of the canal banks. This contributed to the flood events of February 2015, which affected the area between Theale and Reading.

4.7 Flood Risk in Spatial Area 3: East Kennet Valley

4.7.1 Aldermaston

Fluvial

Flood Zones 2 and 3 lie beyond Aldermaston village centre, where the A340 Basingstoke Road crosses the River Kennet and its tributaries. Isolated extents of Flood Zone 2, which incorporate the flood outline from January 2003, are located in the settlement, south of Fisherman's Lane and Wasing Lane.

Surface Water

Risk of surface water flooding is generally low in Aldermaston, although RoFSW mapping predicts extensive areas of surface water ponding south of Fisherman's Lane during the 1 in 30-year rainfall event. Isolated flooding is expected on A340 The Street, Wasing Lane and Maidas Way at 1 in 30 and 1 in 100-year return periods.

Groundwater

The risk of groundwater flooding is variable in the East Kennet Valley area, where settlements are located beyond the major fluvial floodplains, on geologies of varying permeability.

Groundwater flood risk is high across Aldermaston, with groundwater levels estimated to be at or very close to the ground surface during the 1 in 100-year event, and a risk of groundwater emergence.

4.7.2 Burghfield Common, Mortimer

Fluvial

Burghfield Common and Mortimer lie outside Flood Zones 2 and 3, however several ordinary watercourses flow through the settlements, with RoFSW providing the closest proxy to flood extent from these watercourses.

Surface Water

Surface water flood risk in Burghfield Common is predominantly confined to the channels of the ordinary watercourses which north-eastwards through the settlement. Overland flow paths originating at The Willink School and Leisure Centre are predicted to affect properties on Bluebell Drive and Alder Glade to the north, as well as Stable Close and Pineridge Rise during 1 in 30-year rainfall event. A further surface water pathway forms at Bunces Lane during the 1 in 100-year rainfall event, and affects the residential areas of Auclum Lane, Chervil Way and Tarragon Way.

Surface water risk is relatively low in Mortimer, with most areas of ponding expected to occur during the 1 in 1,000-year rainfall event. Locations identified as at risk of flooding during the 1 in 30-year rainfall event, such as Victoria Road and Croft Road, form the upper catchments of the ordinary watercourses which flow from the north and east of the village.

Groundwater

Burghfield Common is located in an area of sand and gravel deposits, with elevated groundwater levels of around 0.025 to 0.5m below the ground surface during the 1 in 100-year event leading to a risk of groundwater flooding to below ground assets. Groundwater flood risk is lower to the north and east of the town.

Mortimer, Woolhampton

Mortimer is at relatively low risk of groundwater flooding. Groundwater levels are estimated to be 0.5 to 5m below the ground surface during the 1 in 100-year event.

4.7.3 Woolhampton

Fluvial

Flood Zones 2 and 3 are located to the south of the A4 Bath Road in Woolhampton. Historic flood extents from Summer 1971 and January 2003 are incorporated within Flood Zone 2, covering properties on Angel Mead and Station Road. Station Road, and adjacent properties are located within Flood Zone 3, where the road crosses the River Kennet and its tributaries.

Surface Water

Surface water flood risk in Woolhampton is largely confined to the valleys of the incoming ordinary watercourses, Popleyhill Gully and Temple Gully. Flooding to A4 Bath Road and Station Road is expected during a 1 in 30-year rainfall event, and greater return periods, which may affect adjacent residential and commercial properties on Station Road and Woolhampton Hill.

Groundwater

Woolhampton is at relatively low risk of groundwater flooding. Groundwater levels are largely estimated to be 0.5 to 5m below the ground surface during the 1 in 100-year event, with isolated areas of 0.025 and 0.5m depths below the ground surface occurring in northeast Woolhampton, around Elstree and Woolhampton Schools.

4.8 Flood Risk in Spatial Area 4: North Wessex Downs Area of Outstanding Natural Beauty (AONB)

4.8.1 Hungerford

Fluvial

At Hungerford, fluvial flood risk is concentrated in the north of the town, in undeveloped areas of the River Kennet floodplain. Residential areas to the rear of Canal Walk, Charnham Street and Oxford Street are located within Flood Zone 3, whereas at the River Dun in west Hungerford, the Flood

Zone 3 extent is tightly confined in the valley. Flood Zone 2 incorporates the extent of the Winter 1979 flood event, including Kennet Way and Charnham Park in the north of the town.

Surface Water

At Hungerford, surface water flooding is generally confined to the floodplains of the Rivers Kennet and Dun. The exception is a flow path generated on Salisbury Road and Priory Road in the south of the town, which is predicted to cause flooding to the High Street and residential Hillside Road during the 1 in 30-year rainfall event. This flow path was identified as a Critical Drainage Area in the 2008 SFRA.

Groundwater

Groundwater flood risk in Hungerford is high within the floodplain of the River Kennet and incoming River Dun, however estimated depths to groundwater on JBA Groundwater mapping decrease south of the railway line to 0.05 - 5m below the ground surface during the 1 in 100-year event.

4.8.2 Lambourn

Fluvial

Lambourn is largely located outside the Flood Zones, with two small areas of Flood Zone 2 by the fire station on Newbury Road and south of Bockhampton Road, matching the extent of the Autumn 1992 flood event.

Surface Water

Wantage Road, Newbury Street and the dry valley of Farn Combe act as conduits for overland flows in Lambourn, channelling surface water into the town centre, during the 1 in 30-year rainfall event and higher return periods. Residential areas off Oxford Road and the High Street are predicted to be affected by surface water flooding during the 1 in 100-year rainfall event.

Groundwater

Groundwater emergence has been modelled over much of the North Wessex Downs AONB, which were particularly affected during the Winter 2014 floods. Jacobs 2014 Groundwater Modelling identifies the risk of groundwater emergence as generally concentrated within the valleys of the Rivers Kennet, Lambourn and Pang, as well as Winterbourne Brook. In the upper catchment, the JBA Groundwater map estimates groundwater to be 0.5 - 5m below the ground surface, rising to at or within 0.025m of the ground surface within the mid-to-lower river reaches.

At Lambourn, 2014 groundwater modelling indicates that groundwater emergence is expected to affect the entire town during the 1 in 30-year and 1 in 100-year events. Predicted flood depths of emerging groundwater range from 0 - 0.1m in the majority of the town, to 0.1 - 0.5m along Upper Lambourn Road and Wantage Road in the north, and a peak of 0.5 - 1m in the south, by Crowle Road and Francomes Field.

4.8.3 Pangbourne

Fluvial

Fluvial flood risk is high in Pangbourne, where the River Pang and Sulham Brook flow through the town, to join the River Thames. Coverage of Flood Zone 3 is largely confined to the road network, including the High Street, Purley Rise and Sulham Lane. However, large areas of the town are located within Flood Zone 2, covering residential areas between Kennedy Drive and Bourne Road in the east, and Courtlands Hill to Thames Avenue in the west. The extents of flood events from 1947, 1992, and 2003 incorporated within Flood Zone 2, indicate the transfer of water between the River Pang and Sulham Brook at high flows, through a network of connecting land drainage ditches.

Surface Water

Surface water flood risk is high in Pangbourne, with the east of the town designated as a Critical Drainage Area. RoFSW mapping highlights the flood risk from the ditch network at Moor, Alder and Decoy Copses, and several surface water flow paths drain into the town from the west, along Pangbourne Hill, Green Lane and to the rear of Cedar Drive. Areas of surface water ponding are predicted in residential areas south of Reading Road, such as The Moors, Horseshoe Park and Kennedy Drive during 1 in 100-year rainfall event.

Groundwater

Emergence modelling is not available at Pangbourne, however JBA Groundwater mapping identifies levels to be 0.05-0.5m below the ground surface during the 1 in 100-year event, rising to at or very near the ground in the east of the town, in the vicinity of the Sulham Brook. As a result, there is a risk of groundwater flooding to below ground assets throughout the town, with the potential for flooding of surface assets in the east.

4.8.4 Kintbury

Fluvial

Fluvial flood risk is concentrated in the north of Kintbury. Station Road is located in Flood Zone 2 and 3, where it crosses the River Kennet and its tributaries. Kintbury Train Station and the rear of properties on Mill Bank are classified as within Flood Zone 2. However, the majority of the town is located outside the extent of fluvial flood risk.

Surface Water

Two overland flow paths contribute to the surface water flood risk at Kintbury. Following a dry channel in the topography, a flow path forms at Inkpen Road in the south of the town during the 1 in 30-year rainfall event and greater return periods, and flows northwards through the residential areas of Lawrence Mead and Hop Gardens. At Newbury Street it converges with a second surface water flow path generated on the High Street, before flowing into the River Kennet at Station Road. Surface water flooding is expected to impact major access roads in the town, and some residential properties, during rainfall events with return periods of 1 in 30 to 1 in 1,000-years.

Groundwater

At Kintbury, JBA Groundwater mapping predicts groundwater levels to lie 0.025 - 0.5m below the ground surface in the town centre during the 1 in 100-year event, rising to at or very near the ground surface north of Newbury Street, with a risk of groundwater flooding occurring to above and below ground assets.

4.8.5 Bradfield Southend, Chieveley, and Hermitage

Fluvial

The three settlements lie outside Flood Zones 2 and 3. However, ordinary watercourses flow through the centre of Bradfield Southend and Hermitage, with RoFSW mapping providing a proxy for fluvial flood extent from these watercourses.

Surface Water

At Bradfield Southend, surface water flood risk is concentrated in a flow path which originates at Heath Road and flows to Mariners Lane, through residential areas, during rainfall events between a 1 in 30-year and 1 in 100-year return period. Isolated areas of surface water ponding are also predicted along the length of South End Road during the 1 in 100-year rainfall event.

Surface water flood risk is dispersed in Chieveley, with areas of ponding on the High Street as well as isolated spots in residential areas either side of the main road. Flow paths generated on East Lane and Oxford Road during the 1 in 30-year rainfall event and greater return periods are predicted to continue on to the A34, eventually ponding upstream of the M4. However, RoFSW mapping does not take into account culverts or highway drainage systems, which would be likely to convey surface water more effectively across the road network.

Hermitage is identified as a Critical Drainage Area, with much of the town affected by the 1 in 30-year flood risk event. RoFSW mapping appears to identify surface water flows following the natural course of the now culverted ordinary watercourse, along Marlston Road and the A4009 Newbury Road. Surface water flooding is predicted to affect Doctor's Lane and Briants Piece during the 1 in 30-year event. A long ridge of high topography at New Plantation appears to attenuate runoff flowing into Hermitage from steep slopes to the northeast, directing flows onto Marlston Road.

Groundwater

In the Winterbourne valley, 2014 modelled groundwater emergence is expected to extend to western Chieveley at shallow depths of 0 - 0.1m on the ground surface during 1 in 100-year event. Elsewhere in Chieveley, the JBA Groundwater mapping suggests the depth to groundwater is expected to be between 0.025 - 0.5m below the ground surface during the 1 in 100-year event.

There is low risk of groundwater flood risk at Bradfield Southend, where mapped groundwater levels are estimated as at least 5m below the ground surface during the 1 in 100-year event, and a very low risk at Hermitage.

4.8.6 Other settlements within the North Wessex Downs AONB

In addition to the areas of potential development, there are several other locations within the North Wessex Downs AONB Spatial Policy Area at risk of flooding.

The low-lying village of Bagnor is located at the confluence of the Winterbourne Stream and River Lambourn, and was subject to flooding from raised river levels on the Lambourn. Rehabilitation and operation of a downstream sluice has allowed control of river levels and management of the fluvial flood risk.

Fluvial flooding also affects several villages on the River Pang, where the watercourse passes through the residential centres of the settlements, becoming narrower and restricted by structures. The village of Hampstead Norreys has flooded several times in the past decade, affecting properties on Water Street, and the road itself. This has previously been mitigated by digging a temporary relief channel, to divert flows back into the river at Church Street.

Residential properties in the village of Bucklebury were severely flooded from the Pang during the 2007 flood event, and are subsequently defended by a flood alleviation scheme. At Stanford Dingley, properties were previously affected by flooding upstream of the River Pang crossing at Cock Lane. The relief channel used to divert flows away from properties has been formalised in a permanent flood alleviation scheme.

Great Shefford is an area of particular groundwater flood risk, due to emergence from the chalk geology, and flooding from the groundwater-fed ordinary watercourse flowing through the village. Opportunities to divert flows away from properties and into the River Lambourn, via a bypass channel, are currently being investigated.

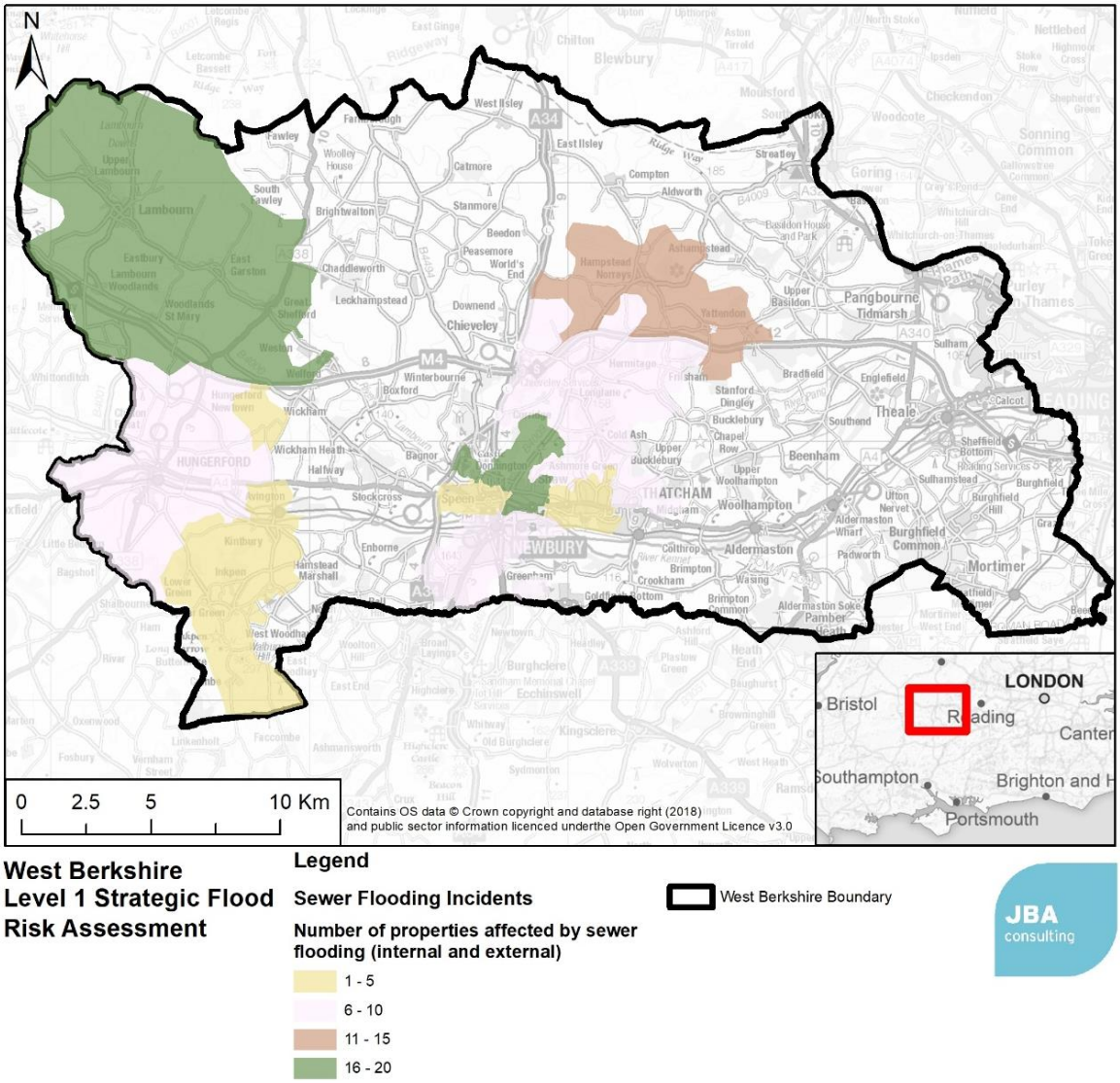
4.9 Flooding from sewers

Sewer flooding occurs when intense rainfall overloads the sewer system capacity (surface water, foul or combined), and/or when sewers cannot discharge properly to watercourses due to high water levels. Infiltration (entry of soil or groundwater into the sewer system via faults within the fabric of the sewerage system) is another cause of sewer flooding. Infiltration is often related to high groundwater levels, and may cause high flows for prolonged periods of time. Sewer flooding can also be caused when problems such as blockages, collapses or equipment failure occur in the sewerage system.

The majority of towns and large villages in the district, including Newbury, Thatcham, Purley-on-Thames and Lambourn have separate surface water and foul systems. However, more isolated villages tend to have foul systems only. Under Sewers for Adoption guidelines, most new surface water sewers are designed with capacity for a 1 in 30-year rainfall event. This means that, even where sewers are built to current specification, they are likely to be overwhelmed by larger magnitude events often considered when assessing river or surface water flooding (e.g. a 1 in 100-year event). Existing sewers can also become overloaded as new development adds to their catchment, or due to incremental increases in roofed and paved surfaces at the individual property scale (urban creep). Sewer flooding is therefore a problem that could occur in many locations across the study area.

Thames Water provided extracts from their Sewer Flooding Register for the purposes of the SFRA. These are water-company held registers of properties which have experienced sewer flooding due to hydraulic overload, or properties which are 'at risk' of sewer flooding more frequently than once in 20 years. In total, there are 64 recorded properties at risk of sewer flooding in West Berkshire. The records are summarised in Appendix B and Figure 4-8.

Figure 4-8: Location of postcodes included within the sewer flooding register.



5 The Sequential and Exception Tests

5.1 Introduction

The sequential and exception tests outlined in the NPPF and the Planning Practice Guidance are designed to ensure areas with little or no risk of flooding (from any source) are developed, in preference to areas at higher risk. The aims are to keep development outside areas at medium and high risk of flooding from all sources (for example, Flood Zones 2 and 3 for fluvial flood risk). This includes ordinary watercourses, surface water, reservoirs, groundwater and sewer flooding.

The flood risk management hierarchy underpins the risk-based approach and is the basis for making all decisions involving development and flood risk. When using the hierarchy, account should be taken of:

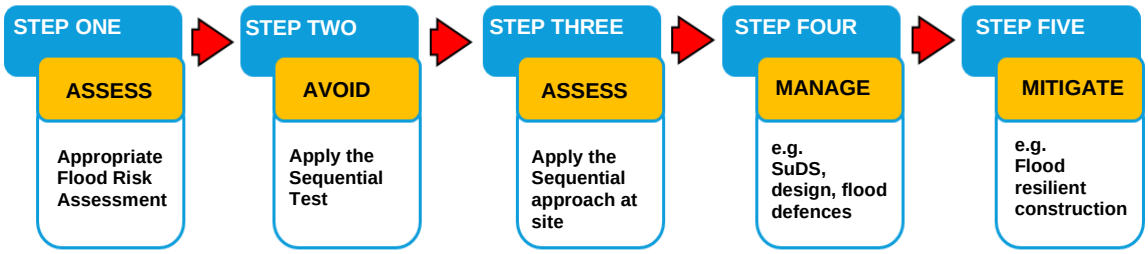
- the nature of the flood risk (the source of the flooding);
- the spatial distribution of the flood risk (the pathways and areas affected by flooding);
- climate change impacts; and
- the degree of vulnerability of different types of development (the receptors).

Developments should reflect the application of the Sequential Test using the maps produced for this SFRA. The information in this SFRA should be used as evidence and, where necessary, reference should also be made to relevant evidence in other documents referenced in this report. The Flood Zone maps and flood risk information on other sources of flooding contained in this SFRA should be used where appropriate to apply the Sequential Test.

Where other sustainability criteria outweigh flood risk issues, the decision-making process should be transparent. Information from this SFRA should be used to justify decisions to allocate land in areas at high risk of flooding.

The flood risk management hierarchy is summarised in Figure 5-1.

Figure 5-1: Flood Risk Management Hierarchy



5.2 Appropriate development in the Flood Zones

5.2.1 Vulnerability of development

Under the NPPF, development is classed as 'Essential Infrastructure', 'Less Vulnerable', 'More Vulnerable', 'Highly Vulnerable' or 'Water Compatible'. Annex 3 of the NPPF (shown in Table 5-1) and Table 2 of the Planning Practice Guidance provide further detail of the type of development considered incompatible with each Flood Zone, where development is not permitted, and where development is allowed only when the Exception Test is passed.

Table 5-1: Flood risk vulnerability classifications of development and land uses

Flood risk vulnerability classification	Examples of development and land uses
Essential infrastructure	• Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk; • Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood. • Wind turbines.
Highly vulnerable development	• Police and ambulance stations; fire stations and command centres; telecommunications installations required to be operational during flooding. • Emergency dispersal points. • Basement dwellings. • Caravans, mobile homes and park homes intended for permanent residential use. • Installations requiring hazardous substances consent. (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as 'Essential Infrastructure').
More vulnerable development	• Hospitals • Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels. • Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels. • Non–residential uses for health services, nurseries and educational establishments. • Landfill and sites used for waste management facilities for hazardous waste. • Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.
Less vulnerable development	• Police, ambulance and fire stations which are not required to be operational during flooding. • Buildings used for shops; financial, professional and other services; restaurants, cafes and hot food takeaways; offices; general industry, storage and distribution; non-residential institutions not included in the 'more vulnerable' class; and assembly and leisure. • Land and buildings used for agriculture and forestry.

Flood risk vulnerability classification	Examples of development and land uses
	• Waste treatment (except landfill and hazardous waste facilities). • Minerals working and processing (except for sand and gravel working). • Water treatment works which do not need to remain operational during times of flood. • Sewage treatment works, if adequate measures to control pollution and manage sewage during flooding events are in place.
Water-compatible development	• Flood control infrastructure. • Water transmission infrastructure and pumping stations. • Sewage transmission infrastructure and pumping stations. • Sand and gravel working. • Docks, marinas and wharves. • Navigation facilities. • Ministry of Defence defence installations. • Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. • Water-based recreation (excluding sleeping accommodation). • Lifeguard and coastguard stations. • Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. • Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.

Source: Table 2: Flood risk vulnerability classification, Paragraph 66, PPG.

5.2.2 Appropriate development in the Flood Zones

Table 5-2 provides a description of appropriate development within the Flood Zones. A fuller discussion of Flood Zones and their relation to planning policy can be found in the NPPF[50] and the Planning Policy Guidance[51].

50 Department for Levelling Up, Housing and Communities (2021) National Planning Policy Framework. Accessed online at: https://www.gov.uk/guidance/national-planning-policy-framework.
51 Planning Practice Guidance (2022) https://www.gov.uk/government/collections/planning-practice-guidance.

Table 5-2: Flood Zone descriptions[52]

Zone	Probability	Description
Zone 1	Low	All land uses are appropriate in this zone.
		For development proposals on sites meeting certain criteria (see Section 6), the vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off, should be incorporated in a Flood Risk Assessment (FRA).
		Developers and local authorities should seek opportunities to reduce the overall level of flood risk **from all sources** in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage systems.
Zone 2	Medium	Essential infrastructure, water compatible infrastructure, less vulnerable and more vulnerable land uses (as set out in Planning Practice Guidance) as appropriate in this zone. Highly vulnerable land uses are allowed as long as they pass the Exception Test.
		All developments (including minor developments[53] and change of use) in this zone require an FRA.
		Developers and local authorities should seek opportunities to reduce the overall level of flood risk from all sources of flooding in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage systems.
Zone 3a	High	Developers and the local authorities should seek to reduce the overall level flood risk, relocating development sequentially to areas of lower flood risk and attempting to restore the floodplain and make open space available for flood storage.
		Water compatible and less vulnerable land uses are permitted in this zone. Highly vulnerable land uses are not permitted. More vulnerable and essential infrastructure are only permitted if they pass the Exception Test.
		All developments (including minor developments and change of use) in this zone require an FRA.
		Developers and local authorities should seek opportunities to: Reduce the overall level of flood risk from all forms of flooding in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage systems. Relocate existing development to land in lower risk zones. Create space for flooding by restoring functional floodplain and flood flow pathways and by identifying, allocating and safeguarding open spaces for flood storage.
Zone 3a plus climate change	High	Water compatible and less vulnerable land uses are permitted in this zone. Highly vulnerable land uses are not permitted. More vulnerable and essential infrastructure are only permitted if they pass the Exception Test.
		All developments (including minor developments and change of use) in this zone require an FRA.
		Developers and local authorities should seek opportunities to: Reduce the overall level of flood risk from all forms of flooding in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage systems. Relocate existing development to land in lower risk zones. Create space for flooding by restoring functional floodplain and flood flow pathways and by identifying, allocating and safeguarding open spaces for flood storage.

52 Department of Communities and Local Government (2012) Paragraph 5 Table 1: Flood Zones. Technical Guidance to the National Planning Policy Framework. Accessed online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/6000/2115548.pdf .

53 The definition of a minor development in relation to flood risk includes extensions of a footprint of less than 250sq m, alterations to a development that doesn't increase the size of the building and householder development. Paragraph 46 https://www.gov.uk/guidance/flood-risk-and-coastal-change#minor-development-to-flood-risk

Zone	Probability	Description
Zone 3b	Functional Floodplain	Only water compatible development is permitted in this zone and should be designed to remain operational in times of flood, resulting in no loss of floodplain or blocking of water flow routes. Essential infrastructure must pass the Exception Test and must not increase flood risk elsewhere.
		All developments (including minor developments and change of use) in this zone require an FRA.
		Developers and local authorities should seek opportunities to: Reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage systems. Relocate existing development to land in lower risk zones.

The preference when allocating land is, whenever possible, to place all new development on land in Flood Zone 1 and away from other sources of flooding, taking into account the impacts of climate change. The following sections of this report (Sections 5.3 to 5.5) contain information on the Sequential and Exception Tests. Since the Flood Zones identify locations that are not reliant on flood defences, placing development within Flood Zone 1 means there is no future commitment to spending money on flood alleviation measures, therefore avoiding costly long-term expenditure that would become increasingly unsustainable as the effects of climate change increase.

5.3 Applying the Sequential Test and Exception Test in the preparation of a Local Plan

When preparing a Local Plan, the Local Planning Authority should demonstrate it has considered a range of site allocations, using Strategic Flood Risk Assessments to apply the Sequential and Exception Tests where necessary.

5.3.1 Sequential Test

The Sequential Test should be applied to the whole LPA area to increase the opportunities to allocate development in areas not at risk of flooding. The Planning Practice Guidance 'Applying the Sequential Test in the preparation of a Local Plan' describes the process.

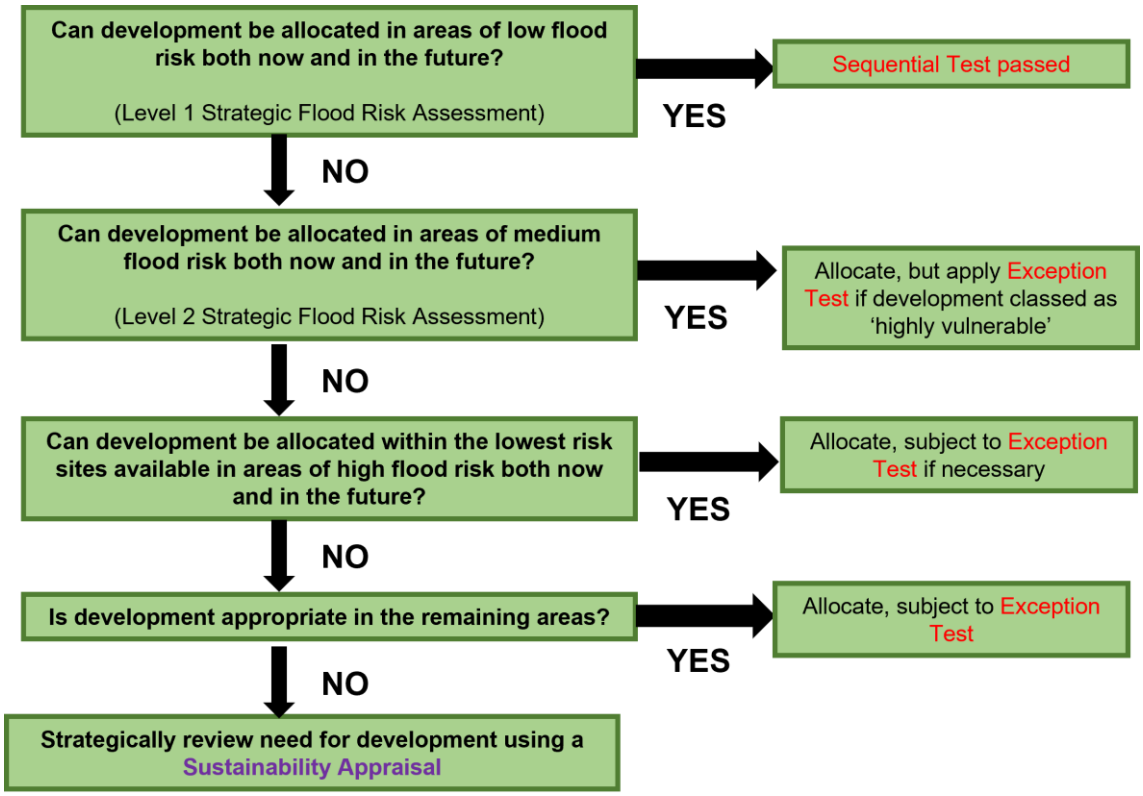
West Berkshire Council will carry out the Sequential Test for all sites that have come forward through the local plan process, taking into account all sources of flooding, and an appropriate allowance for climate change. The climate change allowances have been considered in the modelling of this study. The findings will be considered in balance with other criteria, outlined either within a Sequential Test document or as part of the Sustainability Appraisal process.

In July 2021, updates to the NPPF led to a change in the Sequential Test. Prior to the changes to the NPPF in July 2021, the requirement was set out as follows and only required consideration of river and sea flood risk when applying the Sequential Test: '*The aim of the Sequential Test is to steer new development to areas with the lowest risk of flooding'.* The Planning Practice Guidance advised that the exercise should be performed using the Flood Zones, which describe flood risk from rivers and sea.

Following publication of the revised NPPF in July 2021, the Sequential Test was amended as follows: *'The aim of the Sequential Test is to steer new development to areas with the lowest risk of flooding from any source'.*

The West Berkshire Level 1 SFRA was prepared under the version of the NPPF issued prior to July 2021. However, flood risk from all sources has been considered throughout the process, in screening sites for flood risk as part of the Level 1 SFRA and in selecting sites at highest flood risk to be assessed within the Level 2 SFRA. It is understood that all sources of flood risk have been taken into account in application of the Sequential Test and in selecting sites for allocation within the West Berkshire Local Plan Review.

Figure 5-2 Applying the Sequential Test in preparation of a Local Plan.



The first stage of the Sequential Test will identify all potential sites located in areas at low risk of flooding from all sources, in order that they can be taken forward for consideration for inclusion in the Local Plan at the Preferred Option Stage (Figure 5-2). In West Berkshire, for a site to be considered at low risk of flooding, it meets the following conditions, determined by the Council:

- Site is within Flood Zone 1
- Site is not within Flood Zone 3 plus climate change
- Less than 10% of the site is at risk from surface water flooding in the 1 in 1,000-year event
- Less than 10% of the site is within highest risk category in JBA Groundwater map (groundwater is <0.025m below the surface in the 1 in 100-year event) or the 1 in 100-year Jacobs groundwater emergence extent
- Less than 75% of the site is within the second highest risk category in JBA Groundwater map (groundwater is between 0.025m and 0.5m below the surface in the 1 in 100-year event)
- Site is not within an area highlighted on the Historic Flood Map
- Site is not at risk of reservoir flooding
- Site does not contain a Main River
- Site does not contain an Ordinary Watercourse

The above criteria take into account the potential to mitigate low levels of surface water and groundwater risk through appropriate design, and therefore are not likely to represent a significant constraint to development.

It is possible that all the necessary development required over the plan period cannot be accommodated by sites identified above as low risk from all sources (noting that the SA process may discount some low risk sites on other grounds), and additional sites may be required to enable delivery of the level of development set out in the Local Plan.

The next stage will be to undertake a Level 2 SFRA to provide further detail on the flood risk (including flood hazards and depths, actual flood risk and residual flood risk to sites), the potential for using sequential design of the site to move development away from flood risk, and provide evidence for the application of the Exception Test if required.

Whilst it is not mandatory to provide a Level 2 SFRA, where a Level 1 SFRA indicates that sites outside flood risk areas cannot accommodate the extent of development proposed, local authorities are advised to consider progressing to Level 2 in order to provide further detail and development solutions for prescribed sites and for the application of the Exception Test, if required.

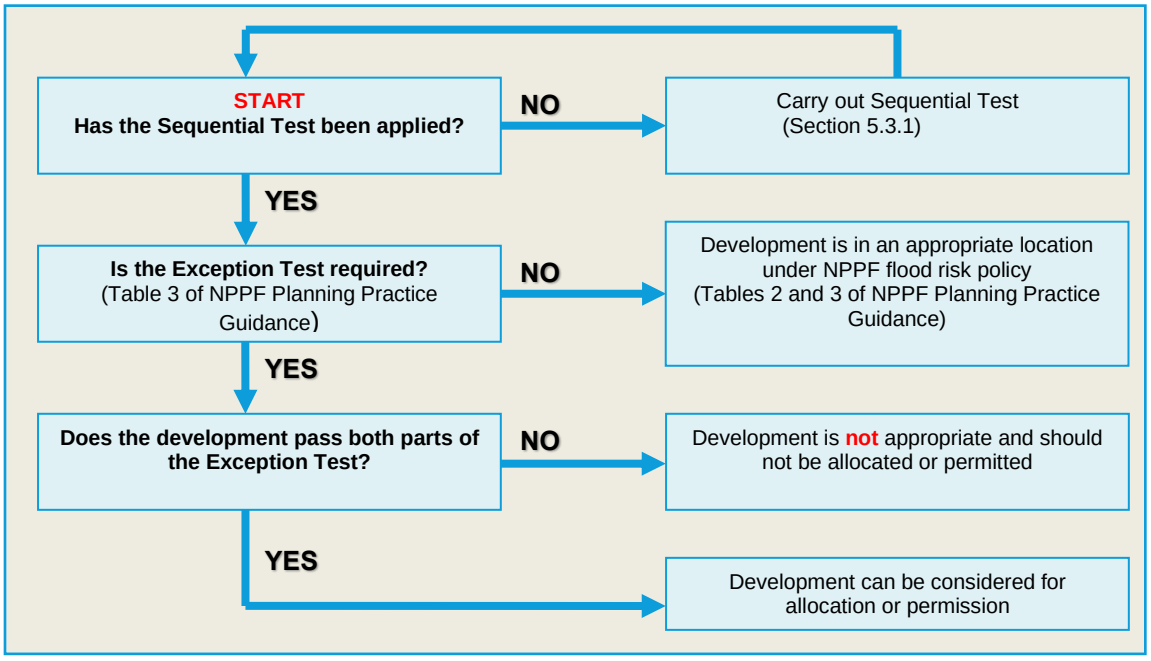
In West Berkshire, where several potential development sites are defended by recent flood alleviation schemes, the residual flood risk to these sites should be assessed within a Level 2 SFRA.

5.3.2 Exception Test

If, following an application of the Sequential Test, it is not possible for the development to be located in areas with a lower probability of flooding, the Exception Test must then be applied if required.

The guidance also explains how the Exception Test should be applied in the preparation of a Local Plan (Figure 5-3), as shown in Diagram 3 of the Planning Practice Guidance.

Figure 5-3: Applying the Exception Test in the preparation of a Local Plan



† Based on Diagram 3 of NPPF Planning Practice Guidance: Flood Risk and Coastal Change (paragraph 033, Reference ID: 7-033-20220825) August 2022

† In Flood Zone 3a essential infrastructure should be designed and constructed to remain operational and safe in times of flood.

" * " In Flood Zone 3b (functional floodplain) essential infrastructure that has to be there and has passed the Exception Test, and water-compatible uses, should be designed and constructed to: remain operational and safe for users in times of flood; result in no net loss of floodplain storage; not impede water flows and not increase flood risk elsewhere.

The requirements for the Exception Test depend on the proposed type/vulnerability of the development and the Flood Zone (or equivalent dataset showing areas at high flood risk from other sources), as set out in Table 2 of the Planning Practice Guidance.

Vulnerability classifications for different types of development are given in Annex 3 of the National Planning Policy Framework. The majority of the allocations to be made in West Berkshire are housing (More Vulnerable, but Highly Vulnerable for basement dwellings), with some employment (Less Vulnerable). Some developments may contain different elements of vulnerability and the highest vulnerability category should be used, unless the development is considered in its component parts.

It should be noted that at present, Table 2 of the Planning Practice Guidance does not suggest that the Exception Test is required to avoid flood risk from other sources. In the context of West Berkshire, it is important that the risks from other sources, particularly surface water and groundwater, are addressed.

The Exception Test should only be applied following the application of the Sequential Test. For the Exception Test to be passed:

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

Where required, West Berkshire Council will carry out the Exception Test for potential sites. The Sequential Test, the Exception Test if required and the SA processes will be iterative in nature and inform the site selection process within the Local Plan.

5.4 Applying the Sequential Test and Exception Test in the preparation of a Minerals and Waste Plan

Waste and mineral planning authorities need to take account of flood risk when allocating land for development. The Sequential Test, and where necessary the Exception Test, should be applied to the allocation of sites for waste management, mineral extraction and mineral processing.

Landfill and sites used for waste management facilities for hazardous waste are classified as 'more vulnerable' development, whereas waste treatment facilities are 'less vulnerable' development.

Minerals can only be worked where they naturally occur, and the NPPF recognises that there may not be alternative sites in areas of lower flood risk, particularly in the case of sand and gravel, which are deposited on fluvial floodplains. This is acknowledged in the classification of sand and gravel working as 'water-compatible' development, whereas other minerals working, and processing facilities are 'less vulnerable' development. Essential ancillary development required for sand and gravel extraction, such as residential accommodation, is also defined as 'water-compatible-development' however is subject to a specific flood warning and evacuation plan.

Under the NPPF, application of the Sequential Test is required for minerals and waste allocations. However, the Exception Test is not required for water compatible development uses, which includes the sand and gravel extraction sites within West Berkshire. The Exception Test will still be required for minerals and waste allocations which are not classified as water-compatible within Annex 3 of the NPPF (shown in Table 5-1).

Mineral working should not increase flood risk elsewhere. Extraction sites must be designed, worked and restored appropriately, with consideration to impacts on wider flood risk. Mineral workings are often large developments, and may provide opportunities for applying the sequential approach at the site level, with ancillary facilities such as offices and accommodation, located in areas of lowest flood risk.

The NPPF states that where sand and gravel extraction is proposed in the functional floodplain (Flood Zone 3b), it is required to be designed and constructed to:

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

It is recommended that development associated with extraction, such as stockpiles, should be accommodated outside the functional floodplain.

5.5 Applying the Sequential Test and the Exception Test to individual planning applications

The Local Plan will include sufficient allocation to meet the need for development over the plan period. However, in addition to these sites, planning applications may come forward in other locations. The Local Plan will need to include policies where proposals such as these can be properly assessed.

In these circumstances, the Local Plan should contain policies which set out how sites not identified in the Local Plan will require the Sequential Test to be applied on an individual site basis. The evidence presented within the SFRA Level 1 is intended to support the decision-making process.

Developers should use evidence provided in this SFRA to apply the Sequential Test as well as provide evidence to show that they have adequately considered other reasonably available sites. This should include other sites allocated within the West Berkshire Local Plan Review to 2036 (LPR)

and West Berkshire Minerals and Waste Local Plan (MWLP) as suitable for the proposed development.

When assessing sites not identified in the Local Plan, the following procedure should be followed:

1. Identify whether the Sequential Test is required. It is not needed for minor development or change of use (except for a change of use to a caravan, camping or chalet site, or to a mobile home or park home site), development sites which have been allocated through the Local Plan or for sites in areas at low flood risk as shown by the maps in this SFRA and set by criteria set out in section 5.3.1.
2. If the Sequential Test is required, the LPA should agree the area of search with the applicant. This should be guided by the requirement for the proposed development in a particular area.
3. Determine whether there are any other 'reasonably available' sites within areas at low flood risk, or whether the sequential approach can be used to move all of the development within the site boundary away from area of higher flood risk.
4. If there are found to be other reasonably available sites at a lower risk of flooding, then the development has failed the Sequential Test and planning permission should be refused. If there are no other reasonably available sites, then the development can be deemed as passing the Sequential Test and the Exception Test may be required as set out in Table 2 of the PPG.

The Council does not require the Sequential Test to be applied for minor development, changes of use or development sites which have been allocated through the Local Plan. However, applications for these development types should still meet all requirements for site-specific flood risk assessments, including consideration to the latest NPPF and PPG, Local Plan policies on flood risk, the West Berkshire SuDS SPD, and the requirements of the LFRMS.

6 Guidance for planners and developers: Flood risk

6.1 When is a flood risk assessment required?

The requirement for a FRA is set out in Paragraph 163 of the NPPF (footnote 50). The Flood Risk Assessment: Local Planning Authorities guidance[54] and Flood Risk Assessment for Planning Applications[55] guidance describe when a FRA is needed as part of a planning application, how to do one and how it is processed. In West Berkshire, a site-specific FRA is required in the following circumstances:

- All developments greater than 1Ha located in Flood Zone 1.
- All developments located within Flood Zone 2 or 3 or, 1 in 100-year flood extent plus climate change. This includes standing advice for minor developments such as non-residential extensions, alterations which do not increase the size of the building or householder developments. It also includes changes of use of an existing development.
- All developments where proposed development or a change of use in development type (e.g. conversion of commercial to residential) could be subject to other sources of flooding. This applies to those less than 1Ha in Flood Zone 1.
- All developments located in an area which has been highlighted as having critical drainage problems by the LLFA (e.g. the CDAs defined by the SFRA) or the Environment Agency.

Advice should be sought from the LPA (West Berkshire Council), the LLFA (West Berkshire Council) and/or the Environment Agency, as appropriate, at the pre-planning application stage to determine the need for a site-specific FRA. For example, a FRA is likely to be required for a site smaller than 1Ha in Flood Zone 1, which is at risk of flooding from other sources, such as surface water, groundwater or ordinary watercourses.

The Environment Agency charge a fee for this advice. West Berkshire Council also has a charging schedule for pre-application discussions, which can include flood risk matters.

54 Environment Agency (2017) Flood risk assessment: local planning authorities. Available at: https://www.gov.uk/guidance/flood-risk-assessment-local-planning-authorities.

55 Environment Agency (2017) Flood risk for planning applications. Available at: https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications.

6.2 Requirements for flood risk assessments

6.2.1 Requirements for development types

The aim of a FRA is to demonstrate that the development is protected to the 1 in 100-year (1% Annual Exceedance Probability (AEP)) event and is safe during the design flood event, including an allowance for climate change. The FRA must also demonstrate that the development does not increase flood risk elsewhere. This includes an assessment of mitigation measures required to safely manage flood risk.

FRAs should follow government guidance on development and flood risk, complying with the approach recommended by the NPPF (and its associated guidance) in appraising, managing and reducing the consequences of flooding both to and from a development site.

A FRA should first assess in detail the level of flood risk to the site, including but not limited to:

- The area liable to flooding from all sources of flood risk, including fluvial, surface water and drainage;
- The probability of flooding occurring now and over time;
- The extent and standard of existing flood defences and their effectiveness over time;
- The likely depth of flooding;
- The rates of flow likely to be involved;
- The likelihood of impacts to other areas, properties, habitats and protected species;
- The routes of safe access and egress from the site during flood events;
- The effects of climate change;
- The nature and currently expected lifetime of the development proposed.

Proposals for the design of the site should:

- Be performed in accordance with the requirements of the Sequential Test and, when necessary, the Exception Test;
- Not increase flood risk, either upstream or downstream, of the site, taking into account the impacts of climate change;
- Not increase surface water volumes or peak flow rates that would result in increased flood risk to the receiving catchments;
- Provide mitigation for the cumulative impacts of the development on flood risk elsewhere;
- Ensure that where development is necessary in areas of flood risk (after application of the Sequential and Exception Tests and the sequential approach), it is made safe from flooding for the lifetime of the development, taking into account the impact of climate change as stated in Paragraphs 161-162 of the NPPF;
- Use opportunities provided by new development to reduce flood risk and provide betterment within the site and elsewhere;
- Seek to use natural flood management such as increasing floodplain connectivity and enhancing natural flood storage to provide connectivity for the movement of flood water, habitats and protected species.
- Identify safe access and egress routes for the site.

In circumstances where FRAs are prepared for windfall sites, then they should include evidence that demonstrates that the proposals are in accordance with the policies set out in the Local Plan.

6.2.2 Additional requirements for minerals extraction

Sand and gravel mineral extraction involves excavation of the ground, often below the water table. Although sand and gravel working is water compatible in nature[56], extraction has the potential to be affected by flooding, as well as disrupting existing surface water and groundwater flow patterns.

56 National Planning Guidance (2022) Flood risk and coastal change: Flood Zone and flood risk tables. Table 2: Flood risk vulnerability classification (Paragraph: 079 Reference ID: 7-079-20220825). Available at: https://www.gov.uk/guidance/flood-risk-and-coastal-change#flood-zone-and-flood-risk-tables.

The presence of flood risk does not prevent the development of a site for sand or gravel extraction. However, consideration of extraction working practices and potential mitigation measures, should be detailed within the site-specific flood risk assessment for the development.

A FRA for a sand or gravel extraction site in West Berkshire must provide the following evidence:

- A detailed assessment of the hydrogeology of the site;
- Evidence that any sleeping accommodation is located outside Flood Zone 3b;
- Details of an appropriate flood warning system for the site;
- Consideration of the impacts of working practices on impeding surface water flow paths or disrupting groundwater regimes;
- Where minerals workings are below the water table, consideration of where groundwater is pumped to, and the potential impacts on the underlying aquifer or downstream river flows; and
- Details of appropriate mitigation measures in areas of known fluvial, groundwater or surface water flood risk, such as SuDS, and resilient groundwater pumps.

6.3 Assessing the impact of climate change

At all stages of the development process it is important to understand not only the current flood risk to a site but also the flood risk for the lifetime of the development, taking into account the future impact of predicted climate change.

Many areas currently situated within Flood Zone 2 may become part of Flood Zone 3a in the future, and similarly areas of Flood Zone 3a may become part of Flood Zone 3b due to the effects of climate change. The compatibility of the site with the proposed use may therefore change in the future.

In accordance with the Flood Risk Assessments: Climate change allowances guidance[57], FRAs are required to demonstrate that future implications of climate change have been considered, and that risks are managed where possible, for the lifetime of the proposed development. This may include for instance:

- Consideration of the vulnerability of the proposed development types or land use allocations to flooding in the future and directing the 'more vulnerable' land uses away from areas at higher risk due to climate change.
- Use of ‘built in’ resilience measures (e.g. raised floor levels).

The guidance provides a range of climate change allowances for river flows and rainfall intensities which are dependent on location (by river basin, or ‘management catchment’) and timescale of development (termed 'epoch'). Different allowances are given for different epochs, but it is envisaged that the '2070-2115' epoch will be appropriate for most developments (Table 6-1). A climate change outline for the 1 in 100-year event (Flood Zone 3a plus climate change) for the period up to 2115 has been provided in Appendix I.

The guidance also gives several categories (termed ‘central’, ‘higher central’ and ‘upper end’) to test depending on the vulnerability of the development and the Flood Zone within which it is located (summarised in Table 6-3). Under the 2016 climate change guidance, the key allowances to consider for Flood Zone 3a were therefore the higher central and upper end (35% and 70% in the Thames river basin respectively).

57 Environment Agency (2022) Flood risk assessments: climate change allowances. Available at: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances.

Table 6-1: UKCP09 climate change peak river flow allowances (2016) used in Level 1 SFRA

River basin	Allowance category	Total potential change anticipated for the '2080s' (2070 to 2115)
Thames	Upper end	70%
	Higher central	35%
	Central	25%

However, Environment Agency guidance on climate change allowances was revised in July 2021 and again in May 2022, in line with the UK Climate Change Projections 2018 (UKCP18), which provide the latest source of information on how the UK climate is predicted to change over the rest of this century. While awaiting issue of the latest guidance, the 2016 peak river flow allowances were applied within the SFRA, as the best available guidance at the time of preparation.

The Thames River Basin used in the 2016 guidance has since been replaced by three management catchments covering West Berkshire: Thames and South Chiltern, Kennet and tributaries, and Loddon and tributaries[58]. As shown in Table 6-2, the Loddon and tributaries Management Catchment has 1% – 24% lower recommended peak river flow allowances than the 2016 uplifts for the Thames Basin. The Kennet and tributaries Management Catchment also has 3% - 4% lower uplifts in the Central allowance category. However, greater differences are seen in the Higher and Upper allowances for the Kennet and tributaries and Thames and South Chiltern Management Catchments. Here, uplifts are 1% - 7% higher than in the 2016 allowances, particularly for the Upper scenario, and within the '2020s' and '2080s' epochs.

Table 6-3 identifies the peak river flow allowances recommended in climate change guidance for Flood Risk Assessments. The latest climate change guidance recommends that both the Central and Higher allowances should be assessed within SFRAs and FRAs, which equates to uplifts of between 14% and 43% in West Berkshire, depending on the management catchment. Due to the late stage of the SFRA, the hydraulic models within the study area have not been re-run for the latest allowances. Instead, to maintain a precautionary approach, the 2016 Upper end allowance of 70% has been used to assess the impacts of climate change within the SFRA.

Table 6-2: UKCP18 Climate change peak river flow allowances (2021) used in comparison

Allowance category	Total potential change anticipated for the '2020s' (2015 to 2039)			Total potential change anticipated for the '2050s' (2040 to 2069)			Total potential change anticipated for the '2080s' (2070 to 2115)		
	T&SC	K&Ts	L&Ts	T&SC	K&Ts	L&Ts	T&SC	K&Ts	L&Ts
Upper	30% (+5%)	32% (+7%)	23% (-2%)	42% (+7%)	39% (+4%)	25% (-10%)	76% (+6%)	76% (+6%)	46% (-24%)
Higher	17% (+2%)	16% (+1%)	11% (-4%)	22% (-3%)	16% (-9%)	10% (-15%)	43% (+8%)	35% (0%)	23% (-12%)
Central	12% (+2%)	10% (0%)	7% (-3%)	14% (-1%)	8% (-7%)	4% (-11%)	31% (+6%)	21% (-4%)	14% (-11%)

T&SC = Thames and South Chiltern, K&Ts = Kennet and tributaries, L&Ts = Loddon and tributaries

When carrying out a FRA, it may be necessary to carry out new or additional modelling to properly test these climate change allowances. It is advisable to contact the Environment Agency to establish what is expected for any particular site, and whether any new modelling is available. If a site is located within Flood Zone 1 and also close to Flood Zone 2, consideration may need to be given to whether the increased flood extents may impact the site.

Further information on assessing the impact of climate change on flood risk is provided in Section 6.3 and Section 6.4.

[58] Environment Agency (2022) Climate change allowances for peak river flow in England (data.gov.uk)

Table 6-3: Using peak river flow allowances in FRAs (2016 guidance, with 2021 updated guidance in brackets, where differs)

	Essential infrastructure	Highly vulnerable	More vulnerable	Less vulnerable	Water compatible
Flood Zone 1	Central	Central	Central	Central	None
Flood Zone 2	Higher central/upper end (2021 – higher central)	Higher central/upper end (2021 – central)	Central/higher central (2021 – central)	Central	None
Flood Zone 3a	Upper end (2021 – higher central)	Development not permitted	Higher central/upper end (2021 – central)	Central/higher central (2021 – central)	Central
Flood Zone 3b	Upper end (2021 – higher central)	Development not permitted	Development not permitted	Development not permitted	Central

In May 2022, the government released an update on the peak rainfall intensity climate change allowances. Within this update, more specific guidance was included on assessing the impact of climate change on rainfall intensity. Flood Risk Assessments and Strategic Flood Risk Assessments must now assess the Upper end allowance for both the 1% and 3.3% annual exceedance probability (AEP) events for the 2070s epoch (2061 to 2125).

Where previously, rainfall intensity climate change allowances were applied across the entirety of England, the updated guidance provided catchment-based climate change allowances. West Berkshire is covered by three management catchments – Loddon and tributaries, Kennet and tributaries and Thames and South Chiltern[59]. Table 6-4, Table 6-5 and Table 6-6 set out the rainfall intensity climate change allowances for each of these three catchments.

Table 6-4:Rainfall intensity allowances for Loddon and tributaries

Allowance category	3.3% annual exceedance rainfall event '2050s' (up to 2060)	3.3% annual exceedance rainfall event '2070s' (2061 to 2125)	1% annual exceedance rainfall event '2050s' (up to 2060)	1% annual exceedance rainfall event '2070s' (2061 to 2125)
Central	20%	25%	20%	25%
Upper end	35%	35%	40%	40%

Table 6-5: Rainfall intensity allowances for Kennet and tributaries

Allowance category	3.3% annual exceedance rainfall event '2050s' (up to 2060)	3.3% annual exceedance rainfall event '2070s' (2061 to 2125)	1% annual exceedance rainfall event '2050s' (up to 2060)	1% annual exceedance rainfall event '2070s' (2061 to 2125)
Central	20%	25%	20%	25%
Upper end	35%	35%	40%	40%

[59] Environment Agency (2022) Climate change allowances for peak rainfall in England (data.gov.uk)

Table 6-6: Rainfall intensity allowances for Thames and South Chiltern

Allowance category	3.3% annual exceedance rainfall event '2050s' (up to 2060)	3.3% annual exceedance rainfall event '2070s' (2061 to 2125)	1% annual exceedance rainfall event '2050s' (up to 2060)	1% annual exceedance rainfall event '2070s' (2061 to 2125)
Central	20%	25%	20%	25%
Upper end	35%	35%	40%	40%

6.4 The impact of climate change

6.4.1 Fluvial and coastal flooding

A climate change outline for the 1 in 100-year event (Flood Zone 3a plus climate change) for the period up to 2125 has been provided in Appendix I. The climate change allowance that has been applied to this study has produced a Flood Zone 3a + CC extent which combines both the 1 in 100-year plus 35% and 70% climate change modelled flood extents. This gives an indication of the potential impact of climate change on the viability of the site for the purposes of the Level 1 SFRA. Further detail on the choice of climate change scenario used for this SFRA is given in Section 3.2.5. As mentioned in Section 6.3, due to the late stage of the SFRA, and to maintain a precautionary approach, the 2016 allowances have been used to assess the impacts of climate change within the SFRA.

However, climate change affects the frequency, as well as the extent of flooding. For example, a storm which currently has a 1 in 50-year return period may increase to a 1 in 20-year return period.

The impact of an event with a given probability is also likely to become more severe. As water depths, velocities and flood hazard increase, so will the risk to people and property.

Although qualitative statements can be made as to whether extreme events are likely to increase or decrease over the UK in the future, there is still considerable uncertainty regarding the magnitude of the localised impact of these changes.

6.4.2 Surface water flooding

Climate change is predicted to increase rainfall intensity in the future by a range of between 20% and 40% in West Berkshire during a 1 in 100-year event (for the '2070s' epoch of 2061 to 2125). This will increase the likelihood and frequency of surface water flooding across the entire district; however it is likely to particularly affect impermeable urban areas that are already susceptible such as Thatcham, Newbury, Hungerford, and Pangbourne.

6.4.3 Groundwater flooding

The effect of climate change on groundwater flooding, and those watercourses where groundwater has a large influence on winter flood flows is more uncertain. Milder wetter winters may increase the frequency of groundwater flooding incidents in areas that are already susceptible, but warmer drier summers may counteract this effect by drawing down groundwater levels to a greater extent during the summer months.

6.5 Reducing flood risk through site layout and design

6.5.1 Sequential approach to site design

Flood risk should be considered at an early stage in deciding the layout and design of a site to provide an opportunity to reduce flood risk within the development. The NPPF states that a sequential, risk-based approach should be applied to try to locate more vulnerable land use away from all sources of flood risk.

In terms of fluvial risk, all built development should ideally be sited within Flood Zone 1, leaving higher risk Flood Zones as open space, preserving flow routes and flood storage. If this is not possible, then Table 2 of the PPG indicates appropriate and inappropriate development within each Flood Zone.

Following update to the NPPF in 2021, built development should also be located in areas at low risk of flooding from other sources. For example, areas at risk from surface water or locations at risk of groundwater emergence should also be protected from development to ensure flow routes are not blocked, preventing water from building up to potentially dangerous depths (see also Section 7). The RoFSW maps, groundwater monitoring and detailed surface water or groundwater modelling should be used to inform the site design at masterplanning stage. The Council promotes innovative and flexible design. Development proposals will be assessed and considered on a site by site basis.

In West Berkshire, watercourses, SuDS, and areas along known surface water flow routes within development sites, should be designated as Green Infrastructure, and used for recreation, amenity and environmental purposes. This allows the preservation of flow routes and flood storage, and at the same time, provides valuable social and environmental benefits contributing to other sustainability objectives. Landscaping should ensure safe access to higher ground from these areas, and avoid the creation of isolated islands as water levels rise. Details of ownership, maintenance and access to watercourses, over both the short term and long term, should be provided to support proposed development.

More flood-compatible development (e.g. vehicular parking, recreational space) may be located in higher risk areas. In assessing the acceptability of vehicular parking in areas of higher flood risk, account should be taken of the nature of parking, flood depths and hazard, including evacuation procedures and flood warning.

There is a requirement to have a buffer of at least 10 metres between the top of the bank (the point at which the bank meets the level of the surrounding land) of any Main River, and the built environment. The built environment includes formal landscaping, sport fields, footpaths, lighting and fencing, and the buffer should be managed for native biodiversity. If this buffer is not provided, the development is likely to be subject to an objection by the Environment Agency. The Council will ensure a similar buffer width is retained alongside ordinary watercourses, to allow sufficient space for access and maintenance.

6.5.2 Access and egress

Safe access and egress from the development must be provided during the 100-year plus climate change event, from any source of flooding. An emergency plan will be needed wherever emergency flood response is an important consideration in making a development safe.

6.6 Mitigation measures

In accordance with the Flood Risk Management Hierarchy Figure 5 1, mitigation measures should be considered as a last resort to address flood risk issues, where the Sequential and Exception Tests have demonstrated that development is necessary for wider sustainability benefits.

Consideration should first be given to minimising risk by planning sequentially across a site. Once risk has been minimised as far as possible, only then should mitigation measures be considered.

The minimum acceptable standard of protection against flooding for new residential property within flood risk areas is 1 in 100-year (1%) plus climate change annual probability for fluvial and surface water flooding. An allowance for climate change over the lifetime of the development must be made when assessing each of these scenarios. The measures chosen will depend on the nature of the flood risk.

6.6.1 Building design and raised floor levels

The raising of floor levels within a development avoids damage occurring to the interior, furnishings and electrics in times of a flood. Finished Floor Levels (FFL) are usually recommended in line with the Environment Agency's Guidance on Flood Risk, which requires a minimum FFL of 300mm above the modelled 1 in 100-year (1%) AEP fluvial water level with allowance for climate change. This additional height that the floor level is raised above the maximum water level is referred to as the “freeboard”. Additional freeboard may be required because of risks relating to blockages to the channel, culvert or bridge and should be considered as part of a FRA.

If residual surface water flood risk remains following the site drainage design (see also Section 7), the likely flow routes and depths across the site should be modelled. The site should be designed so that these flow routes are preserved and building design should provide resilience against this residual risk. FFLs should also be 300mm above the modelled 1 in 100-year (1%) AEP surface water level with allowance for climate change where available. If no surface water model is available, they should be 300mm above ground level.

When raising FFLs consideration must be given to ensuring that the development is still accessible to all.

Single storey buildings such as ground floor flats or bungalows are especially vulnerable to rapid rise of water. This risk can be reduced by use of multiple storey construction and raised areas that provide an escape route. However, access and egress would still be an issue, particularly when flood duration covers many days.

Similarly, the use of basements should be avoided. Habitable uses of basements within Flood Zone 3 and areas of high groundwater flood risk should not be permitted, whilst basement dwellings in Flood Zone 2 and areas at medium risk of groundwater flooding will be required to pass the Exception Test.

6.6.2 Development and raised defences

If development is proposed behind, or in an area benefitting from, defences, the Exception Test is likely to be required. Consideration should be given to the potential safety of the development, finished floor levels and the potential for safe access and egress in the event of rapid inundation of water due to a defence breach with little warning. Where the onset of rapid inundation would not allow sufficient time for safe access or egress, an internal place of safety must be identified.

Construction of localised raised floodwalls or embankments to protect new development is not acceptable, as a residual risk of flooding will remain. The Environment Agency do not support funding of any flood defences built to enable future development in areas at risk of flooding.

Compensatory storage must be provided where raised defences remove storage from the floodplain, and storage provided by raising buildings on stilts or voids should not be relied upon. However, it is preferable for schemes to involve an integrated flood risk management solution. It is not acceptable for new development to be enabled by temporary or demountable flood defences.

6.6.3 Modification of ground levels

Modifying ground levels to raise the land above the required flood level can reduce flood risk to a particular site, in circumstances where the land does not act as conveyance for flood waters. However, care must be taken at locations where raising ground levels could adversely affect existing communities, property or protected habitat.

There should be no interruption to flood flows or loss of flood storage as a result of any proposed development. Flood storage compensation may be appropriate for sites on the edge of the existing floodplain or within a flood cell.

Compensatory flood storage should be provided, and would normally be on a level for level, volume for volume basis on land that does not currently flood but is adjacent to the floodplain (in order for it to fill and drain). It should be in the vicinity of the site and within the red line of the planning application boundary.

Any proposal for modification of ground levels will need to be assessed as part of a detailed flood risk assessment and must demonstrate that there is no adverse impact on the hydrological and hydrogeological setting.

6.6.4 Developer contributions

In some cases, and following the application of the Sequential Test, it could potentially be necessary for the developer to make a contribution to the improvement of flood management provision that would benefit both proposed new development and the existing local community. Where development has a direct impact on flood risk, the Council may require developer contributions to be made, under Section 106 of the Town and Country Planning Act. Elsewhere, Community Infrastructure Levy funding may be made available for the provision of flood risk management infrastructure.

Where new development located downstream of a reservoir has implications for reservoir safety (such as costs of operation, maintenance and measures to reduce flood risk from the reservoir), developers are expected cover any additional costs incurred, under the NPPF ‘agent of change’ policy (paragraph 187).

The West Berkshire Local Flood Risk Management Strategy (LFRMS) outlines that any flood risk which is caused by, or increased by, new development should be resolved and funded by the developer.

6.6.5 Groundwater mitigation

Groundwater flooding has a complex, and very different flood mechanism to any other and for this reason many conventional flood defence and mitigation methods are not suitable. An available option to manage flood risk would be through building design (development form), ensuring FFLs are raised 300mm above the water levels caused by a 1 in 100-year plus climate change event. Site design would also need to preserve any flow routes followed by the groundwater overland to ensure flood risk is not increased downstream. Obstruction of sub-surface flows by buried services and basements should be avoided.

Infiltration SuDS can cause increased groundwater levels and subsequently may increase flood risk on or off the site. High groundwater levels would also cause them not to operate to their design capacity. Developers should provide evidence that this has been considered in the design and ensure that this will not be a significant risk. The depth of the proposed SuDS must be kept to a minimum and developers should make allowance for wide shallow SuDS such as wetlands and detention basins.

When redeveloping existing buildings, it may be acceptable to install pumps in basements as a resilience measure. However, for new development this is not considered an acceptable solution and basements should be avoided in high groundwater zones.

6.6.6 Sewer flooding mitigation

Where development is proposed within, or further up the network from, areas where sewer flooding has been recorded, it is recommended that Thames Water are consulted as early as possible in the planning process, as there may be network capacity issues which need to be dealt with.

When redeveloping existing buildings, the installation of some permanent or temporary flood-proofing and resilience measures could protect against both surface water and sewer flooding. Non-return valves prevent water entering the property from drains and sewers. Positively pumped devices can be installed within gravity sewers or drains within a property's private sewer upstream of the public sewerage system. These need to be carefully installed and must be regularly maintained, as the build-up of debris on the flaps can prevent closure and result in flooding to a property. Consideration must also be given to attenuation and flow ensuring that flows during the 100-year plus climate change storm event are retained within the site if any flap valves shut. This must be demonstrated with suitable modelling techniques.

6.7 Water Framework Directive and Natural Flood Risk Management

All new development close to rivers and culverts should consider the opportunity presented to improve and enhance the river environment and contribute to national, county and local biodiversity targets.

Requirements of the WFD should be accounted for in the site layout and design. Developments should look at opportunities for river restoration and enhancement, and projects which reconnect rivers with their floodplains. These ideas and plans should be incorporated into the development plans from an early stage. Options include, backwater creation, de-silting, de-culverting and naturalising the channel through in-channel habitat enhancements and removal of structures.

When designed properly, such measures can have benefits such as reducing the costs of maintaining hard engineering structures, reducing flood risk, improving water quality and increasing biodiversity. Social benefits are also gained by increasing green space and access to the river. Advice on river restoration, de-culverting and providing other environmental enhancements on development sites is available from the Environment Agency[60].

In West Berkshire, achievement of WFD requirements is variable. The River Pang is the only watercourse which has achieved an overall 'good' status. The Rivers Kennet and Lambourn, Enborne and Sulham Brook, as well as the waterbodies of Ameys Lake and Farnham Flint have a 'moderate' overall WFD status, whereas the Shalbourne and Foudry Brook are classified as 'poor' in status.

Natural Flood Risk Management (NFRM), also known as Working with Natural Processes (WWNP), is a means of managing the risk of flooding and erosion, through restoring the natural functions of

60 Environment Agency (2006). Building a better environment. A guide for developers http://www.environment-agency.gov.uk/static/documents/1_GETH1106BLNE-e-e(1).pdf

river catchments or coastlines[61]. NFM schemes also provide ecological and water quality benefits which can aid the achievement of Water Framework Directive targets.

A series of strategic maps indicating the relative suitability of areas in England for NFRM measures has been produced by the Environment Agency. The 'Mapping Areas of Potential for Working with Natural Processes' maps identify the potential for a range of options, including:

- floodplain reconnection;
- run-off attenuation features;
- gully blocking;
- woodland planting covering floodplain planting, riparian planting and wider catchment woodland; and
- broad land cover that could be used for targeting areas for soil structure improvement.

West Berkshire falls predominantly within the Kennet and Tributaries area; however the northeast portion of the administrative boundary lies within the Thames and South Chilterns area.

The mapping identifies high potential for planting of woodland within the floodplain (areas within Flood Zone 2) and riparian land of the Rivers Kennet, Lambourn and Pang valleys.

In areas along the River Kennet, Lambourn and River Pang, such as Colthrop, Bucklebury and, Bagnor, poor connectivity between the floodplain and the watercourse have been identified. The national NFM mapping suggests these watercourses as having a high to very high potential for floodplain reconnection, using methods such as daylighting culverts, creating floodplain spillways, and returning modified sections of watercourse to their former, often more sinuous, courses.

Steeper land on the North Wessex Downs and Kennet, Lambourn and Pang valleys at Lambourn Woodlands, Wickham Heath, Hermitage and Frilsham, is identified as providing high to very high potential for attenuation of surface water runoff during the 1 in 30-year (3.3%AEP) and 1 in 100-year (1%AEP) rainfall events.

A NFM scheme is currently being investigated in the Pang Valley, to reduce peak runoff rates in the catchment and manage flood risk to properties, while also improving the ecology and water quality within the catchment. The scheme will investigate the suitability of measures such as leaky dams, timber deflectors and river bank restoration, and will involve partnership working between the Pang Valley Flood Forum, West Berkshire Council and the Environment Agency.

6.8 Existing watercourses and assets

Permanent or temporary works within or adjacent to a watercourse require a consent from the relevant authority, under the Land Drainage Act 1991. A **Flood Risk Activity Permit**[62] must be obtained from the Environment Agency for any works carried out within the channel, banks or within 8m from the edge of a Main River. A Flood Risk Activity Permit may also be required for activities which affect flow or storage in the floodplain of a Main River (such as land raising), and where the potential impacts are not controlled by a planning permission. For works to all other watercourses, an Ordinary Watercourse Consent must be requested from West Berkshire Council.

Proposed developments which are adjacent to Environment Agency assets, including Main River channels, must demonstrate a minimum clearance of 10m from these assets to permit maintenance and renewal. The Council will ensure a similar buffer width is retained alongside ordinary watercourses, to allow sufficient space for access and maintenance.

The Environment Agency and West Berkshire Council have a presumption against allowing further culverting and building over culverts on Main Rivers. All new developments with culverts running through the site should seek to de-culvert rivers for flood risk management and conservation benefit. Existing watercourses and drainage channels should be retained, offering risk management authorities benefits in terms of maintenance, future upgrading, biodiversity and pollution prevention. The CIRIA (2010) Culvert Design and Operation Guide provides guidance in this area.

Where developers are riparian owners, they should also assess existing assets (e.g. bridges, culverts, river walls, embankments) and renew them to last the lifetime of the development.

61 Environment Agency (2014) Working with natural processes to reduce flood risk: research and development framework: summary (SC130004:S). Available at: https://www.gov.uk/government/publications/working-with-natural-processes-to-reduce-flood-risk-a-research-and-development-framework.

62 Environment Agency (2018) Flood risk activities: environmental permits. Available at: https://www.gov.uk/guidance/flood-risk-activities-environmental-permits

Enhancement opportunities should be sought when renewing assets, e.g. bioengineered river walls, raising bridge soffits to account for climate change. Any works should be designed to be maintenance free, but there is an obligation to the riparian owner to undertake maintenance when required.

The responsible parties for ownership and maintenance of all watercourses within a proposed development site must be specified. Both short and long-term maintenance requirements should be taken into account.

7 Guidance for planners and developers: Surface water runoff and drainage

7.1 Introduction

Sustainable Drainage Systems (SuDS) are management practices which enable surface water to be drained in a more sustainable manner and to mimic the local natural drainage. The inclusion of SuDS within developments is an opportunity to enhance ecological and amenity value, and promote Green Infrastructure, incorporating above ground facilities into the development landscape strategy.

7.2 Local SuDS design guidance

Requirements and design principles for managing surface water runoff and drainage in the district are outlined in detail within the West Berkshire Sustainable Drainage Systems Supplementary Planning Document (SuDS SPD), which underwent public consultation in June to July 2018[63]. The document was approved and adopted in December 2018. Checklists for the provision of information at outline or full planning application are available.

Surface water drainage strategies in West Berkshire should be assessed against the eight objectives of the SuDS SPD:

1. Replicate natural drainage and manage water quantity
2. Improve water quality
3. Promote and enhance biodiversity
4. Enhance the landscape
5. Engage and benefit the local community
6. Ensure that SuDS are adopted and maintained for the lifetime of the development
7. Adopt good practice in construction of SuDS
8. Promote SuDS retro-fitting

In West Berkshire, SuDS providing multiple benefits, including amenity and biodiversity, will be favoured over more engineered solutions, which solely deliver control of water quantity.

Thames Water advocates the use of SuDS in development, to limit the rate and volume of surface water as far as possible, and restrict surface water from entering the foul and combined sewer networks. SuDS are considered to be key in ensuring future capacity of the sewerage system, in response to the pressures of population growth and climate change.

7.2.1 SuDS suitability

SuDS must be integrated into the design of all new development. The effectiveness of SuDS within a site is defined by site characteristics including (but not limited to) topography, geology, soil permeability, water table and available area.

7.2.2 SuDS design

A clear and comprehensive understanding of the catchment hydrological processes (i.e. nature and capacity of the existing drainage system) is essential. The site drainage must be designed around the natural flow routes (both onsite, and entering the site) at the masterplanning stage, keeping water on the surface to provide maximum benefits and must not contribute to flooding off site.

There is considerable potential for infiltration SuDS in West Berkshire. However, it is imperative that site-specific infiltration testing, and if appropriate, groundwater monitoring, is undertaken.

7.2.3 Runoff rates and storage volumes

Section 4.1: 'Replicate natural drainage and manage water quantity' of the SuDS SPD outlines the requirements for runoff rates and volumes from sites in West Berkshire.

63 West Berkshire Council (2018) Sustainable Drainage Systems (SuDS) Supplementary Planning Document (SPD). Available at: https://info.westberks.gov.uk/sudsspd.

Guidance on designing runoff rates and storage volumes is in keeping with or an improvement on best practice (Defra Non-Statutory Technical Standards for Sustainable Drainage), with the following requirements for developments on greenfield and previously developed sites:

- The peak runoff rate and volume from the development for the 1 in 1-year and the 1 in 100-year events must not exceed the peak greenfield runoff rate for the same event.
- Flooding must not occur on any part of the site for a 1 in 30-year rainfall event.
- Flooding must not occur during a 1 in 100-year plus climate change rainfall event in any part of: a building (including a basement); or in any utility plant susceptible to water (e.g. pumping station or electricity substation) within the development.
- Rainfall in excess of a 1 in 100-year plus climate change rainfall event must be managed via exceedance routes that minimise the risks to people and property.

A climate change allowance of 40% is expected for storage volumes on all sites.

7.2.4 Discharge location

Also contained in Section 4.1: 'Replicate natural drainage and manage water quantity' of the SuDS SPD, West Berkshire guidance follows the discharge hierarchy of CIRIA SuDS Manual 2015.

It is the responsibility of a developer to make proper provision for surface water drainage to ground, water courses or surface water sewer. Infiltration is the preferred destination of surface water that is not re-used on site, or where not possible discharge to surface waters, followed by discharge to a surface water sewer. Discharge to a combined sewer is the least preferred option, and discharge to a foul sewer will not be accepted, as this is the major contributor to sewer flooding.

7.2.5 Water quality, biodiversity and amenity

Section 4.2: 'Improve water quality' of the SuDS SPD provides requirements for the SuDS 'management train' approach of designing components in series to allow interception, filtration and sedimentation of pollutants. Drainage systems should provide treatment for the 5mm interception rainfall event, or 'first flush' of pollutants.

As much of West Berkshire is designated within Groundwater Source Protection Zones, groundwater quality must be a key consideration in SuDS design.

SuDS in West Berkshire must also provide biodiversity benefits, through encouraging native species, and contributing to a network of green infrastructure across the district. Further standards are outlined in Section 4.3: 'Promote and encourage biodiversity' in the SuDS SPD, with Sections 4.4 and 4.6 providing guidance on enhancing the landscape and engaging communities.

7.3 Further guidance on SuDS

Further general guidance on SuDS can be found in the documents and websites below:

- West Berkshire Council - **S**ustainable Drainage Systems[64].
- CIRIA SuDS Manual - there are several CIRIA guides relating to SuDS, most notably the CIRIA SuDS Manual[65]
- Defra Non-statutory Technical Standards for Sustainable Drainage Systems[66]
- Susdrain website[67] - online community for delivering sustainable drainage.
- Local Authority SuDS Officer Organisation - Non-Statutory Technical Standards for Sustainable Drainage: Best Practice Guidance[68]
- BSI Standards Publication - BS8582 Code of practice for surface water management for development sites[69]

64 West Berkshire Council (2018) Sustainable Drainage Systems (SuDS) Supplementary Planning Document (SPD). Available at: https://info.westberks.gov.uk/sudsspd.

65 CIRIA (2015) The SuDS Manual (C753). http://www.ciria.org/Memberships/The_SuDs_Manual_C753_Chapters.aspx

66 Defra (March 2015) Non-statutory technical standards for sustainable drainage systems

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/415773/sustainable-drainage-technical-standards.pdf

67 Susdrain website http://www.susdrain.org/

68 Local Authority SuDS Officer Organisation - Non-Statutory Technical Standards for Sustainable Drainage: Best Practice Guidance http://www.lasoo.org.uk/?publications=non-statutory-technical-standards-for-sustainable-drainage

69 BSI Standards Publication (2013) Code of practice for surface water management for development sites. Available at: http://shop.bsigroup.com/en/ProductDetail/?pid=000000000030253266

- Institute of Civil Engineers - SuDS Route Maps: Guide to Effective Surface Water Management[70]
- Water UK – Sewerage Sector Guidance Appendix C: Design and Construction Guidance[71]

7.4 Wastewater

Developers should discuss public sewerage capacity with the water utility company (Thames Water) at the earliest possible stage. The development must improve the drainage infrastructure to reduce flood risk on site and regionally.

Major developments and those upstream of areas where sewer flooding is known to be a problem must carry out wastewater capacity checks and should liaise with the sewerage undertaker at an early stage. This is to prevent an increase in sewer flooding and/or spills from combined sewer overflows (CSOs) further down the wastewater system, as a result of the development.

The impact of an increased volume of foul water discharge on watercourses should also be considered for large sites, or where several sites are likely to be developed in the same Sewage Treatment Works (STW) catchment, particularly where the receiving STW discharges into the same watercourse as the surface water runoff from the site.

A Phase 2 Water Cycle Study has been carried out in West Berkshire, to provide information on wastewater capacity and the potential impacts of increased discharges of treated effluent on downstream flood risk, and aid the development of the LPR and emerging MWLP.

8 Assessment of flood risk in potential development areas

8.1 Introduction

As part of this Level 1 SFRA, all sites and development areas considered for allocation within the LPR and MWLP were assessed for suitability, based on flood risk. This ensures that all potential sites are assessed equally, regardless of their suitability on other planning grounds, and provides a solid evidence base to allow application of the Sequential Test.

At the time of preparing the Level 1 SFRA, the Council provided 29 potential minerals sites and one potential waste site for the MWLP. A further 249 potential housing and employment sites were provided for the LPR.

The flood risk to each of these sites, from all sources of flooding, was assessed by screening the site boundaries against the flood risk mapping from all sources, to determine the proportion of the site at risk.

The results of the assessment are provided in Appendix A. This spreadsheet has been designed to provide information on the risks posed to each development site, and to assist with the selection of sites within Local Plans.

The following flood risk information has been used in the assessment for each potential development area:

- % of site within each Flood Zone (3b, 3a, 3a plus climate change and 2).
- % of site within Risk of Flooding from Surface Water (3.3%, 1%, 0.1% probabilities).
- Historic flooding (based on the Environment Agency's Historic Flood Map).
- % within Risk of Flooding from Reservoirs maximum extent.
- % of site within JBA Groundwater flood map categories 3 (between 0.025m and 0.5m of ground surface) or 4 (within 0.025m of ground surface).
- Presence of watercourse mapped in Detailed River Network layer (watercourses under 3km² may not have Flood Zones).
- Presence of a canal within 100m of the site.

70 ICE (2018) SuDS Route Maps: Guide to Effective Surface Water Management. Available at: ICE-ACO-SuDS-Route-Map-Booklet-Feb2018.pdf.aspx

71 Water UK (2019) Sewerage Sector Guidance Appendix C. Available at: SSG-App-C-Des-Con-Guide-v-1.0-251019.pdf (water.org.uk)

8.2 Minerals sites flood risk summary

Flood risk from all sources was assessed for each of the potential sand and gravel extraction sites in West Berkshire. Although the proposed land use for these sites is classified as 'water-compatible development', this informs the sequential allocation of the sites, and the sequential layouts of the site. Both the total allocation site area (including landscaping and access points) and the indicative areas of mineral and waste development ('Developable Areas') were assessed. A total of 31 mineral and waste sites were assessed, which included 14 Developable Areas and 17 potential allocation sites. A summary of results for the potential allocation of sites is provided below, with results for the Developable Areas available in Appendix A.

The detailed assessment of fluvial flood risk to the 17 potential allocation sites suitable for development, found that 7 of these were at low risk from all sources. Of the sites at risk, 8 were within Flood Zone 2 and 8 were identified as being within Flood Zone 3 (either a or b). 7 sites were identified as within the Environment Agency's historic flood outline.

The sand and gravel mineral sites are classified as water-compatible development, and therefore under the NPPF are deemed appropriate within all the Flood Zones. However, the flood risk extents identified will still inform appropriate site layouts.

The assessment of surface water risk using the RoFSW identified that 8 sites were at risk from flooding in the 1 in 100-year event, but only one of these sites has more than 10% of the site area at risk.

The assessment of groundwater risk identified that 7 sites have more than 10% of their site area at risk within JBA Groundwater flood map categories 3 (between 0.025m and 0.5m below the ground surface) or 4 (within 0.025m of the ground surface).

There are four minerals sites in West Berkshire where more than 10% of the site is at risk of groundwater or surface water flooding, and where existing flow regimes may be disrupted by minerals extraction:

- AONB2: Land adjacent to the M4/A34 Chieveley Services
- AONB3: Gravel Pit Farm
- MW013: Manor Farm
- MW016: Waterside Farm

These sites do not require assessment within a Level 2 SFRA, and the risk identified does not prevent allocation of these sites within the MWLP. However, Section 6.2.2 identifies the level of detail required within site-specific FRAs to provide suitable mitigation measures for managing these flood risks.

8.3 HELAA sites flood risk summary

Flood risk from all sources was assessed for each of the sites promoted to the Council for its HELAA. This information is provided in Appendix A and gives more detailed information regarding the risks posed to each promoted site, along with maps covering all promoted sites within the district.

The detailed assessment of fluvial flood risk to the 289 promoted sites found that 153 of these were at very low risk of flooding from all sources. Of the sites at risk, 45 were within Flood Zone 2 and 39 were identified as being within Flood Zone 3 (either a or b) and of these sites. 32 sites were identified as within the Environment Agency's historic flood outline.

The assessment of surface water risk identified that 133 sites were at risk from the 1 in 100-year RoFSW outline, and 26 of these sites have an area of greater than 10% at risk.

The assessment of groundwater risk identified that 45 sites have an area of greater than 10% at risk within JBA Groundwater flood map categories 3 (between 0.025m and 0.5m below the ground surface) or 4 (within 0.025m of the ground surface).

8.4 Cumulative impact of development

When allocating land for development, consideration should be given to the potential cumulative impact on flood risk within a catchment. Development increases the impermeable area within a catchment, which if not properly managed, can cause loss of floodplain storage, increased volumes and velocities of surface water runoff, and result in heightened downstream flood risk. Whilst individual developments should only have a minimal impact on the hydrology and flood risk of an area, the cumulative effect of multiple developments may be more severe.

The cumulative impact should be considered throughout the planning process, from the allocation of sites within the Local Plan, to the planning application and development design stages. Once preferred options are identified, their cumulative impact can be considered in more detail within a Level 2 SFRA, where necessary. In addition, site-specific FRAs must consider the cumulative impact of the proposed development on flood risk within the wider catchment area.

In consultation with the Environment Agency, conditions set by the Council should support the implementation of SuDS and appropriate flood mitigation measures. As a minimum, development should have a neutral impact on flood risk, and where possible it should improve existing issues, to ensure that flood risk is not exacerbated either within, or outside of, the Council's administrative area.

9 Summary and conclusions

9.1 Summary

The 2022 West Berkshire SFRA has been produced to reflect recent changes in climate change allowance and data availability, to aid development of the LPR and emerging MWLP.

The SFRA provides general advice for planners and developers on:

- Sources of flood risk mapping and other evidence to inform the Sequential Test
- Flood risk from potential sources of flooding including Main River, ordinary watercourse, surface water, groundwater and sewer flooding sources within West Berkshire
- Requirements of a Flood Risk Assessment

9.2 Use of SFRA data

The SFRA has been developed using the best available information at the time of preparation. This relates both to the current risk of flooding from rivers, and the potential impacts of future climate change.

It is important to remember that information on flood risk is being updated continuously. This is particularly true now that the LLFA has taken responsibility for carrying out and recording Section 19 Flood Investigation Reports under the FWMA. The Environment Agency has a rolling programme of flood modelling and mapping studies, and updates to the Flood Map are made quarterly. Where new mapping studies are carried out this will also affect the definition of the functional floodplain (Flood Zone 3b) and Flood Zone 3a + climate change. It is important that the Environment Agency is consulted to determine whether updated information is available prior to commencing a detailed Flood Risk Assessment.

The SFRA should be periodically updated when new information on flood risk, flood warning or new planning guidance or legislation becomes available. New information on flood risk may be provided by West Berkshire District Council, Thames Water and the Environment Agency. It is recommended that the SFRA is reviewed internally on an annual basis, allowing a cycle of review, by checking with the above bodies for any new information to allow a periodic update.

9.3 Next steps

As the Council move forward with the LPR and MWLP, the most up-to-date information must be used in applying the Sequential Test. Both planners and developers should be aware of any future changes to advice in the consideration of climate change for planning FRAs.

The Flood and Water Management Act (2010) and the NPPF offer opportunities for a more integrated approach to flood risk management and development. As it is in the relatively early stages of developing its Local Plan, the Council has a real chance to approach planning for flood risk, sustainable drainage, green infrastructure, water quality, amenity, bio-diversity and habitat, and Water Framework Directive considerations in an integrated way.

Appendices

A Appendix A - Level 1 SFRA Site Summary Tables

B Appendix B - Sewer Flooding Records

Postcode Boundary	Internal flooding to property	External flooding to property	Total
GU236	0	2	2
HA30	0	0	0
HA87	0	0	0
KT246	0	0	0
N134	0	2	2
RG14	0	0	0
RG16	0	0	0
RG108	2	1	3
RG109	0	3	3
RG120	1	0	1
RG121	0	0	0
RG127	1	0	1
RG128	0	0	0
RG141	0	5	5
RG142	4	12	16
RG145	4	6	10
RG146	0	10	10
RG147	4	3	7
RG170	3	5	8
RG177	5	15	20
RG178	1	19	20
RG179	2	0	2
RG180	3	8	11
RG183	1	2	3
RG184	1	5	6
RG189	0	6	6
RG193	0	2	2
RG194	3	4	7
RG198	0	3	3
RG2 9	0	1	1
RG200	0	1	1
RG206	0	7	7
RG207	2	5	7
RG208	1	10	11
RG263	6	8	14
RG264	0	8	8
RG265	1	6	7
RG303	3	6	9
RG315	1	2	3
RG7 1	4	5	9
RG7 2	0	6	6
RG7 3	0	5	5
RG7 4	2	4	6
RG7 5	1	13	14
RG7 6	0	6	6
RG8 0	1	0	1
RG8 7	0	2	2
RG8 8	0	1	1
RG8 9	1	7	8
UB108	0	0	0

C Appendix C - Flood History

Settlement	Date of Flood Event	Number of internally flooded properties	Source of flooding
Thatcham	2007	1,107	Surface water
Winterbourne	2007	15	Surface water
Purley-on-Thames	2003	45	Main river
	2007	27	Main river
	2012	18	Main river
Pangbourne	2007	123	Surface water
	2013/14	1	Main river
		2	Groundwater
Stanford Dingley	2013/14	2	Main river
Theale	2013/14	1	Main river
Pingewood	2013/14	5	Main river
		1	Groundwater
		2	Source not identified
	2012	3	Groundwater
Burghfield	2013/14	10	Main river
Sulhampstead	2013/14	3	Main river
Aldermaston	2013/14	1	Main river
Woolhampton	2007	56	Surface water
	2013/14	1	Source not identified
Newbury	2007	151	Surface water
	2013/14	7	Main river
		23	Groundwater
		3	Surface water
		1	Source not identified
Shaw	2013/14	3	Main river
		3	Source not identified
Bagnor	2013/14	2	Main river
Lower Denford	2013/14	1	Main river
Great Shefford	2013/14	12	Main river
		11	Groundwater
East Garston	2013/14	2	Main river
		1	Source not identified
Eastbury	2013/14	7	Main river
	2012	2	Sewerage
		3	Source not identified
Lambourn	2007	46	Surface water
	2013/14	1	Main river
	2012	2	Surface water
		1	Sewerage
West Ilsley	2013/14	11	Groundwater
East Ilsley	2013/14	10	Groundwater
Compton	2013/14	5	Groundwater
Streatley	2013/14	2	Main river
		2	Groundwater
		7	Source not identified
Hampstead Norreys	2013/14	1	Groundwater
		1	Source not identified

D Appendix D - Watercourse Catchments

E Appendix E - Recorded Flood Outlines

F Appendix F - Flood Zones

G Appendix G - Defences, assets and structures

H Appendix H - Flood Warning Areas

I Appendix I - Impact of Climate Change on Flood Zones

J Appendix J - Risk of Flooding from Surface Water

K Appendix K - Jacobs Groundwater Emergence Mapping

L Appendix L - JBA Groundwater Mapping

M Appendix M - Reservoir Flood Risk

N Appendix N - Site Location Map

O Appendix O - Impact of Climate Change on Surface Water Flood Risk (1 in 30-year)

P Appendix P - Impact of Climate Change on Surface Water Flood Risk (1 in 100-year)

Offices at
Coleshill
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Limerick
Newcastle upon Tyne
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