Wokingham Borough Council Level 2 Strategic Flood Risk Assessment

Final Report

August 2023

Prepared for:
Wokingham Borough Council

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WOKINGHAM
BOROUGH COUNCIL

Document Status

Issue date	17/08/2023
Issued to	James McCabe (Wokingham Borough Council)
BIM reference	IDT-JBAU-XX-XX-RP-HM-0010
Revision	A1-C01
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Contract

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JBA Project Code	2022s0565

This report describes work commissioned by Wokingham Borough Council by an instruction dated 10 May 2022. The Client's representative for the contract was James McCabe of Wokingham Borough Council. Thomasin Sayers, Sarah Hambling, Rebecca Lee, Hannah Booth, Chloe Connett and Helen Dawson of JBA Consulting carried out this work.

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Acknowledgements

We would like to acknowledge the assistance of Wokingham Borough Council, the Environment Agency, Thames Water, South East Water and planners at the neighbouring authorities.

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List of Tables

Abbreviations

AEP	Annual Exceedance Probability
AIMS	Asset Information Management System
AStGWF	Areas Susceptible to Groundwater Flooding
CC	Climate Change
Defra	Department for Environment, Food and Rural Affairs
DWMP	Drainage and Wastewater Management Plan
EA	Environment Agency
EU	European Union
FMfP	Flood Map for Planning
FRA	Flood Risk Assessment
FRISM	Flood Risk Metrics
FRMP	Flood Risk Management Plan
FWA	Flood Warning Area
GIS	Geographic Information Systems
HELAA	Housing and Economic Land Availability Assessment
JBA	Jeremy Benn Associates
LiDAR	Light Detection and Ranging
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
LPU	Local Plan Update
mAOD	metres Above Ordnance Datum
NPPF	National Planning Policy Framework
NVZs	Nitrate Vulnerable Zones
PFRA	Preliminary Flood Risk Assessment
PPG	Planning Practice Guidance
RAG	Red-Amber-Green
RBD	River Basin District
RBMP	River Basin Management Plan
RMAs	Risk Management Authorities
RoFSW	Risk of Flooding from Surface Water
SFRA	Strategic Flood Risk Assessment
SoP	Standard of Protection
SuDS	Sustainable Drainage Systems
SWMP	Surface Water Management Plan

WBC	Wokingham Borough Council
WFD	Water Framework Directive

Definitions

1D model: one-dimensional hydraulic model

2D model: two-dimensional hydraulic model

Annual Exceedance Probability: the probability (expressed as a percentage) of a flood event occurring in any given year.

Brownfield: previously developed parcel of land

Climate Change: long term variations in global temperature and weather patterns caused by natural and human actions.

Cumecs: the cumec is a measure of flow rate. One cumec is shorthand for cubic metre per second (m^3/s).

Design flood: This is a flood event of a given annual flood probability, which is generally taken as: fluvial (river) flooding likely to occur with a 1% annual probability (a 1 in 100 chance each year), or tidal flooding with a 0.5% annual probability (1 in 200 chance each year), or surface water flooding likely to occur with a 1% annual probability (a 1 in 100 chance each year), plus an appropriate allowance for climate change, against which the suitability of a proposed development is assessed and mitigation measures, if any, are designed.

Dry island: Land which may not be at risk of flooding itself but is surrounded by flood risk and therefore may become cut off during a flood event.

Exception test: Set out in the NPPF, the exception test is a method used to demonstrate that flood risk to people and property will be managed appropriately, where alternative sites at a lower flood risk are not available. The exception test is applied following the sequential test.

Flood defence: Infrastructure used to protect an area against floods such as floodwalls and embankments; they are designed to a specific standard of protection (design standard).

Flood Map for Planning: The EA Flood Map for Planning (Rivers and Sea) (FMfP) is an online mapping portal which shows the Flood Zones in England. The FMfP shows river and sea flooding across different flood zones (Flood Zones 1, 2 and 3 (being split in to 3a and 3b)) and includes modelled and historic flood outlines. The FMfP does not however take in to account the presence of flood defences or the impacts of climate change.

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.

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.

Fluvial Flooding: Flooding resulting from water levels exceeding the bank level of a river (main river or ordinary watercourse).

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.

Green Infrastructure: a network of natural environmental components and green spaces that intersperse and connect the urban centres, suburbs, and urban fringe.

Greenfield: undeveloped parcel of land

Indicative Flood Risk Area: nationally identified flood risk areas based on the definition of 'significant' flood risk described by Defra and WAG.

Lead Local Flood Authority: the unitary authority for the area or if there is no unitary authority, the county council for the area.

Main river: a watercourse shown as such on the statutory main river map held by the Environment Agency. They are usually the larger rivers and streams. The Environment Agency has permissive powers (not duties) to carry out maintenance and improvement works on main rivers).

Major development: defined in the NPPF as a housing development where 10 or more homes will be provided, or the site has an area of 0.5 hectares or more, or as a non-residential development with additional floorspace of 1,000m² or more, or a site of 1 hectare or more, or as otherwise provide in the Town and Country Planning (Development Management Procedure) (England) Order 2015 available here.

Ordinary watercourse: any river, stream, ditch, drain, cut, dyke, sluice, sewer (other than a public sewer) and passage through which water flows but which does not form part of a main river. The local authority or internal drainage board has permissive powers (not duties) on ordinary watercourses.

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: see surface water flooding.

Resilience measures: Measures designed to reduce the impact of water that enters property and businesses; could include measures such as raising electrical appliances.

Resistance measures: Measures designed to keep flood water out of properties and businesses; could include flood guards for example.

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.

Riparian owner: A riparian landowner, in a water context, owns land or property, next to a river, stream or ditch.

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.

Risk Management Authority: The Environment Agency; a lead local flood authority; a district council in an area where there is no unitary authority; an internal drainage board; a water company and a highway authority.

Sequential test: Set out in the NPPF, the sequential test is a method used to steer new development to areas with the lowest probability of flooding.

Sewer flooding: Flooding caused by a blockage or overflowing in a sewer or urban drainage system.

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% AEP (1 in 100 year) standard of protection.

Stakeholder: A person or organisation affected by the problem or solution or interested in the problem or solution. They can be individuals or organisations, includes the public and communities.

Surface water flooding: Flooding as a result of 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.

Sustainable Drainage Systems: SuDS are methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques, such as grates, gullies and channels.

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. There are three key partners who must be involved and engaged in the SWMP study process: the Local Authority, the Environment Agency and the relevant Water and Sewerage Companies.

Toe Line: The level of the lowest part of a structure, generally forming the transition to the underlying ground.

Water Framework Directive: Under the WFD, all waterbodies have a target to achieve Good Ecological Status (GES) or Good Ecological Potential (GEP) by a set deadline. River Basin Management Plans (RBMPs) set out the ecological objectives for each water body and give deadlines by when objectives need to be met.

Windfall site: a site which becomes available for development unexpectedly and therefore not included as allocated land in a planning authority's local plan.

Executive Summary

Introduction and context

This report provides a comprehensive and robust evidence base on flood risk issues to support the review and update of Wokingham Borough Council's planning policies. The review process is known as the Local Plan Update (LPU). This report uses the best available information, including input from key stakeholders. This Level 2 Strategic Flood Risk Assessment (SFRA) for Wokingham Borough Council (WBC) was prepared to update previous targeted Level 2 SFRA work produced by Stantec and published in 2021. The SFRA assesses additional land promoted to WBC for potential development, changes to the proposed development sites within the borough, and changes in national planning policy and guidance, including the update to the National Planning Policy Framework (NPPF) in July 2021, the update to the Planning Practice Guidance (PPG) in August 2022, and the updates to the EA climate change guidance in July 2021 and May 2022.

SFRA objectives

The Government's PPG on Flood Risk and Coastal Change advocates a tiered approach to risk assessment involving Level 1 and Level 2 assessments.

The aim of the Level 2 assessment is to build on identified risks from the Level 1 assessment for proposed development sites, to provide a greater understanding of fluvial, surface water, groundwater, and reservoir related flooding risks to the site. From this, WBC and developers can make more informed decisions and pursue development in an effective and efficient manner. The Level 2 assessment also identifies sites for further risk analysis at the site-specific Flood Risk Assessment (FRA) stage.

Level 2 SFRA outputs

The Level 2 assessment includes detailed assessments of the proposed site options. The Level 2 assessment includes:

- An up-to-date SFRA, taking into account the most recent policy and legislation in the NPPF (2021) and PPG (2022).
- An assessment of all sources of flooding including fluvial flooding, surface water flooding, groundwater flooding, mapping of the functional floodplain and the potential increases in fluvial and surface water flood risk due to climate change, and how these may be mitigated.
- An assessment of existing flood warning and emergency planning procedures, including an assessment of safe access and egress during an extreme event.
- Advice and recommendations on the likely applicability of Sustainable Drainage Systems (SuDS) for managing surface water runoff.
- A comprehensive set of maps presenting flood risk from all sources that can be used as an evidence base for use in the emerging Local Plan.
- Advice on whether the sites are likely to pass the second part of the exception test and the sequential test with regards to flood risk and on the requirements for a site-specific FRA and outline specific measures or objectives that are required to manage flood risk.

As part of the Level 2 SFRA, detailed site summary tables have been produced for the proposed sites at significant flood risk, covering the above. To accompany each site summary table, there is a GeoPDF map, with all the mapped flood risk outputs.

Summary of Level 2 SFRA

All sites promoted to WBC (367 sites) were subject to an initial screening through JBA Consulting's FRISM software. The outputs of this screening can be found in Appendix G of the Level 1 SFRA (JBA Consulting, 2023). WBC then identified the sites assessed as potentially suitable for development through the latest Housing and Economic Land Availability Assessment (HELAA) including those proposed for allocation in the Local Plan Update Revised Growth Strategy (2021) consultation, from all sites promoted as well as newly promoted sites not yet subject to HELAA assessment.

This resulted in 58 sites / groups of combined sites being taken forward to a detailed screening exercise. This identified 27 sites / groups of combined sites as having significant risk of flooding on the site and a further 15 as having a less significant but still notable risk of surface water flooding, or causing access and egress issues. The sites at significant risk were further assessed in detailed site summary tables and the sites at lower but notable risk are assessed further within this report. This SFRA incorporates recent changes to national and local planning policy and considers the cumulative impacts of development across Wokingham Borough.

Detailed site summary tables setting out the flood risk analysis and NPPF requirements each site at significant risk of flooding, as well as guidance for site-specific FRAs, have been produced. A broadscale assessment of suitable SuDS has been provided, giving an indication where there may be constraints to certain types of SuDS techniques.

To accompany each site summary table, there is a GeoPDF map, with all the mapped flood risk outputs per site. This is displayed centrally, with easy-to-use ‘tick box’ layers down the right-hand side of the mapping, to allow easy navigation of the data.

The following points summarise the Level 2 assessment:

- **Fluvial flooding** - the main watercourses associated with fluvial risk to the sites within the Level 2 assessment are the River Thames, River Loddon, and the Emm Brook. There are also other smaller watercourses and drainage channels presenting a fluvial risk to sites across Wokingham Borough. The sites with the most significant area and severity of fluvial risk are 5CV001, 5WI004, 006 and 010, 5WI008, 5WK006, 5WW009, and the combined site of 5AR011, 5AR014, 5AR015, 5AR025, 5AR029, 5AR030, 5AR032, 5SH012, 5SH049, 5WI001, 5WI002, 5WI015, 5WI018 (referred hereafter as 5AR011 and combined sites).
- **Flood Warning Areas (FWAs)** - several proposed sites are located within existing EA FWAs. For proposed development within existing EA FWAs, developers should consult the EA to ensure that adequate flood warning procedures and evacuation processes are in place and that RMAs are not put under any additional burden.

- **Surface water flooding** - surface water tends to follow topographic flow routes, for example, along watercourses or isolated pockets of ponding where there are topographic depressions. The majority of sites with a detailed Level 2 summary table are at surface water risk. The degree of flood risk varies with some sites being only marginally affected along their boundaries, whilst other sites are more significantly affected within the site. The sites at most significant surface water risk are 5WI004, 006 and 010, 5WI008, 5WI014, 5WK006, 5WK029, 5WK042, 5WK045, 5WW009, 5WI009 and 019, and 5AR011 and combined sites.
- **Access and egress** - whilst not at significant flood risk within the site boundary, several sites have potential access and egress issues as a result of fluvial and surface water flooding of the surrounding roads. At these sites, consideration should be made as to how safe access and egress can be provided during flood events, both for people and emergency vehicles. Consideration should also be given to the nature of the risk, for example whether the flooding forms a flow path or bisects the site where access across the site from one side to another may be compromised.
- **Climate change** - fluvial and surface water climate change mapping indicates that flood extents are predicted to increase. As a result, the depths, velocities, and hazard of flooding may also increase. The significance of the increase will depend on the topography of the site and the climate change percentage allowance used; fluvial extents would be larger than Flood Zone 3, but maximum extents are likely to be similar to Flood Zone 2. Site-specific FRAs should confirm the impact of climate change using latest guidance. It is recommended that WBC work with other RMAs to review the long-term sustainability of existing and new development in these areas when developing climate change plans and strategies for the Borough.
- **Historic flooding** - 11 sites are shown to fall partially within the EA Historic Flood Map dataset, with the highest percentage coverage at sites 5WI008, 5WK006, and 5WO004. The EA Recorded Flood Outlines dataset and WBC recorded flooding incidences also show further historic flooding both on and surrounding several sites.
- **Sewer flooding** - several sites across Wokingham Borough have recorded sewer flooding incidents from Thames Water located in close proximity to the site. One site, 5AR011 and the collection of sites grouped as part of 5AR011, also has 48 recorded sewer flooding incidences within its site boundary.
- **Groundwater flooding** - a large number of sites across Wokingham Borough are shown by the Areas Susceptible to Groundwater flooding (AStGWF) map to have a high susceptibility to groundwater flooding with corresponding high ground water levels shown in the JBA emergence map. An appropriate assessment of the groundwater regime for a site should be carried out at the site-specific FRA stage.
- **Reservoirs** - there are 7 sites assessed within the site summary tables that are shown to be at risk of reservoir flooding during a 'Dry Day' scenario and 12 sites

in a 'Wet Day' scenario. The level and standard of inspection and maintenance required under the Reservoirs Act means that the risk of flooding from reservoirs is very low. However, there is a residual risk of a reservoir breach and this risk should be considered in any site-specific FRA (where relevant).

- **Main Rivers** - any sites located where there is Main River (including culverted reaches of Main River) will require an easement of 8m either side of the watercourse from the top of the bank. This may introduce constraints regarding what development will be possible and consideration will need to be given to access and maintenance at locations where there are culverts. Developers will be required to apply for appropriate permits so the activity being carried out over easements does not increase flood risk.
- **SuDS** - a strategic assessment was conducted of SuDS options using regional datasets. A detailed site-specific assessment of suitable SuDS techniques would need to be undertaken at site-specific level to understand which SuDS option would be best.

At the planning application stage, developers may need to undertake more detailed hydrological and hydraulic assessments of the watercourses so that the potential effects of proposals can be evaluated at site level. The modelling should verify flood extent (including latest climate change allowances), inform development zoning within the site, and prove, if required, whether the exception test can be passed.

For sites allocated within the Local Plan, the Local Planning Authority (LPA) should use the information in this SFRA to inform the exception test. At planning application stage, the developer must design the site adopting the sequential approach in line with the recommendations in national and local Planning Policy and supporting guidance and those set out in this SFRA.

For developments that have not been allocated in the Local Plan, developers must undertake the sequential test followed by the exception test (if required) and present this information to the LPA for approval. Developers will need to apply the exception test in the following instances:

- 'More vulnerable' development in Flood Zone 3a
- 'Essential infrastructure' in Flood Zone 3a or 3b
- 'Highly vulnerable' development in Flood Zone 2
- Any development where a higher risk of surface water has been identified (surface water Zone B) and the site does not clearly show that development can be achieved away from the flood risk.

'Highly vulnerable' development should not be permitted within Flood Zone 3a or Flood Zone 3b. 'More vulnerable' and 'Less vulnerable' development should not be permitted within Flood Zone 3b.

Flood risk issues are not always black and white. The significance of issues requires professional judgement, based on the location, topography and nature (including depth, velocity and hazard) of flooding, rather than simply whether part of a site is within a given

flood extent. This is determined as part of this Level 2 assessment for sites allocated within the Local Plan. The Level 1 SFRA can be used to scope the flooding issues that a site-specific FRA should investigate in more detail to inform the exception test for windfall sites.

It is recommended that as part of the early discussions relating to development proposals, developers discuss requirements relating to site-specific FRAs and drainage strategies with both the LPA and the Lead Local Flood Authority (LLFA), to identify any potential issues that may arise from the development proposals.

1 Introduction

1.1 Purpose of the Strategic Flood Risk Assessment

“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 EA and other relevant flood RMAs, such as lead local flood authorities and internal drainage boards.” (NPPF, paragraph 160).

In May 2022, Wokingham Borough Council (WBC) commissioned an addendum to their existing Level 2 SFRA for the Borough following the promotion of additional land for potential development and changes in the preferred spatial strategy for meeting development needs. The following are the current strategic development sites being delivered through the adopted Local Plan:

- North Wokingham
- South Wokingham
- Arborfield Garrison
- South of the M4 (Shinfield)

This 2023 SFRA will be used to inform decisions on the location of future development and the preparation of land use planning policies for the long-term management of flood risk, reflecting the implications of the August 2022 changes to the PPG. Annex 1 – Updates to the Planning Practice Guidance (25 August 2022) of the Level 1 SFRA report provides more information on the August 2022 changes.

As the data available for SFRAs and the relevant legislation is continually changing, an SFRA should be a live document and updated to reflect changes where applicable and practicable.

1.2 Levels of SFRA

The PPG identifies the following two levels of SFRA:

- A Level 1 assessment is required where flooding is not a significant constraint in relation to potential site allocations and where development pressures are low. The assessment should be of sufficient detail to enable application of the sequential test. The Level 1 SFRA for Wokingham Borough has been recently completed (JBA Consulting, 2023) and should be referred to alongside this Level 2 SFRA.
- A Level 2 assessment is required where land in Flood Zone 1 cannot appropriately accommodate all 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.

This report fulfils the requirements of a Level 2 SFRA. In accordance with the July 2021 changes to the NPPF, the Level 2 SFRA considers the risk of flooding from all sources now and in the future and the implications with respect to the implementation of development at the proposed allocation sites. This addresses the requirements that the exception test applies to flood risk from any source.

1.3 SFRA objectives

The objectives of this Level 2 SFRA are:

1. Provide individual flood risk analysis for site options using the latest available flood risk data, thereby assisting WBC in applying the exception test to their proposed site options through the emerging LPU.
2. Use available data to provide information and a comprehensive set of maps presenting flood risk from all sources for each site option.
3. Where the exception test is required, provide recommendations for making the site safe throughout its lifetime.
4. Take into account the most recent policy and legislation in the NPPF, PPG and LLFA SuDS guidance.
5. Update the catchments that are most sensitive to new development in flood risk terms and further review policy and recommendations for these catchments.

1.4 Consultation

SFRAs should be prepared in consultation with other risk management authorities (RMAs). The following parties (external to WBC) have been consulted during the preparation of this Level 2 SFRA:

- WBC LLFA
- EA
- Thames Water
- South East Water
- Neighbouring authorities to provide data on cross-boundary development implications:
  - Basingstoke and Deane Borough Council
  - Bracknell Forest Council
  - Buckinghamshire Council
  - Hart District Council
  - Reading Borough Council
  - South Oxfordshire District Council
  - West Berkshire Council

- Royal Borough of Windsor and Maidenhead

1.5 How to use this report

Table 1-1 below outlines the contents of this report and details how different users can apply this information.

Table 1-1: Outline of the contents of each section of this report

Section	Contents	How to use
1. Introduction	Outlines the purpose and objectives of the Level 2 SFRA	For general information and context.
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.	Users should refer to this section and the relevant sections of the Level 1 SFRA for any relevant policy which may underpin strategic or site-specific assessments.
3. Sources of information used in preparing the Level 2 SFRA	Summarises the data used in the Level 2 assessment and GeoPDF mapping.	Users should refer to this section in conjunction with the site summary tables and GeoPDF mapping to understand the data presented. Developers should refer to this section when understanding the requirements for a site-specific FRA.
4. Impact of Climate Change	Outlines the latest climate change guidance published by the EA and how this was applied to the SFRA. Sets out how developers should apply the guidance to inform site-specific FRAs.	This section should be used alongside the relevant sections of the Level 1 SFRA to understand the climate change allowances for a range of epochs and conditions, linked to the vulnerability of a development.
5. Level 2 Assessment Methodology	Summarises the sites taken forward to a Level 2 assessment and the outputs produced for each of these sites. Includes an assessment of flood risk at the 'amber sites' (those sites identified at a lower but still notable flood risk than those requiring a full Level 2 assessment).	This section should be used in conjunction with the site summary tables and GeoPDF mapping to understand the data presented. Developers of 'amber sites' should use this section to understand the flood risk and associated recommendations for their sites.

Section	Contents	How to use
6. Flood Risk Management Requirements for Developers	Identifies the scope of the assessments that must be submitted in FRAs supporting applications for new development. Refers to relevant sections in the L1 SFRA for mitigation guidance.	Developers should use this section alongside the relevant sections of the L1 SFRA to understand requirements for FRAs, what conditions/ guidance documents should be followed, and information on flood mitigation options.
7. Surface water management and SuDS	Refers to relevant sections in the L1 SFRA for information on SuDS and surface water management and provides an overview of SuDS suitability across the study area.	Developers should use this section to understand the suitability of SuDS across the study area and refer to the L1 SFRA for further information on types of SuDS, the hierarchy and management trains information.
8. Cumulative impact of development and strategic solutions	Provides a summary of the catchment level CIA (included in Appendix B).	Planners should use this section in conjunction with Appendix B to help develop policy recommendations for the sites specified. Developers should use this section in conjunction with Appendix B to understand the potential storage requirements and betterment opportunities for the sites assessed.
9. Summary of Level 2 assessment and recommendations	Summarises the results and conclusions of the Level 2 assessment, and signposts to the L1 SFRA for planning policy recommendations.	Developers and planners should use this section to see a summary of the Level 2 assessment and understand the key messages from the site summary tables. Developers should refer to the Level 1 SFRA recommendations when considering requirements for site-specific assessments.

Section	Contents	How to use
Appendix A: Site Summary Tables	Provides a detailed summary of flood risk for sites requiring a more detailed assessment, which considers flood risk, emergency planning, climate change, broadscale assessment of possible SuDS, exception test requirements and requirements for site-specific FRAs.	Planners should use this section to inform the application of the sequential and exception tests, as relevant. Developers should use these tables to understand flood risk, access and egress requirements, climate change, SuDS, and FRA requirements for site-specific assessments.
Appendix B: Level 2 Cumulative Impact Assessment (CIA)	Builds on recommendations from the Level 1 SFRA, identifying the cumulative impact of development in the site catchments and providing recommendations for storage and betterment for all potential development sites in the catchment.	Planners should use this section to help develop policy recommendations for the sites specified. Developers should use this section to understand the potential storage requirements and betterment opportunities for the sites assessed.
Appendix C Summary of flood risk at the 'amber' sites	Provides a summary of the surface water flood risk and additional considerations for sites identified at 'amber' flood risk during the site screening assessment. Provides static mapping of the surface water flood risk at and around each site.	Developers should use this appendix to understand the flood risk for site-specific assessments.
Appendix D: GeoPDF mapping and User Guide	Provides interactive PDF mapping for each Level 2 site assessed within a site summary table showing flood risk at and around the site. The associated User Guide provides details of the layers used within the interactive PDF mapping.	Planners and developers should use these maps in conjunction with the site summary tables to understand the nature and location of flood risk.

Hyperlinks to external guidance documents/websites are provided in blue through the SFRA.

1.6 SFRA study area

WBC is a Unitary Authority in Berkshire, Southeast England.

The main urban area in Wokingham Borough is the town of Wokingham. Other areas include Arborfield, Barkham, Charvil, Earley, Finchampstead, Hurst, Sonning, Remenham, Ruscombe, Shinfield, Twyford, Wargrave, Three Mile Cross, Winnersh, Spencer's Wood and Woodley.

Wokingham is bounded by eight other authorities:

- Basingstoke and Deane Borough
- Bracknell Forest
- Buckinghamshire
- Hart District
- Reading Borough
- South Oxfordshire District
- West Berkshire
- Royal Borough of Windsor and Maidenhead

The major watercourses which run through Wokingham Borough are the River Thames, its tributary the River Loddon, and the main tributaries of the River Loddon (Twyford Brook, the Emm Brook, Barkham Brook and the River Blackwater). Foudry Brook, a tributary of the River Kennet, also runs through the west side of the Borough.

For further details and mapping of the Wokingham study area see Section 1.5 of the Level 1 SFRA report.

2 The Planning Framework and Flood Risk Policy

This section of the Level 2 SFRA provides an overview of the planning framework, flood risk policy, and flood risk responsibilities. In preparing the subsequent sections of this SFRA, appropriate planning and policy amendments have been acknowledged and considered.

2.1 Roles and responsibilities for Flood Risk Management

RMAs are comprised of different organisations that have responsibilities for flood risk management. The RMAs in and around Wokingham Borough and their responsibilities are detailed in Section 2.1 of the Level 1 SFRA report.

2.2 Relevant legislation

The following legislation is relevant to development and flood risk in Wokingham Borough. Hyperlinks are provided to external documents:

- Flood Risk Regulations (2009) - these transpose the European Floods Directive (2000) into law and require the EA and LLFAs to produce PFRAs and identify nationally significant Flood Risk Areas.
- Town and Country Planning Act (1990), Water Industry Act (1991), Land Drainage Act (1991), Environment Act (1995), and Flood and Water Management Act (2010) – as amended and implanted via secondary legislation. These set out the roles and responsibilities for organisations that have a role in Flood Risk Management.
- The Land Drainage Act (1991, as amended) and Environmental Permitting Regulations (2018) also set out where developers will need to apply for additional permission (as well as planning permission) to undertake works to an ordinary watercourse or main river.
- The Water Environment Regulations (2017) – these transpose the European Water Framework Directive (WFD) (2000) into law and require the EA to produce River Basin Management Plans (RBMPs). These aim to improve/maintain the water quality of aquatic ecosystems, riparian ecosystems and wetlands so that they reach 'good' status.
- Other environmental legislation such as the Habitats Directive (1992), Environmental Impact Assessment Directive (2014), and Strategic Environmental Assessment Directive (2001) also apply as appropriate to strategic and site-specific developments to guard against environmental damage.

2.3 Relevant flood risk policy and strategy documents

This section highlights policies and other relevant documents for the WBC area. Hyperlinks are provided to external documents.

- Thames Catchment Flood Management Plan (2009) - the EA's overview of flood risk across the Thames river catchment and recommended ways of managing it.
- Thames River Basin District (RBD) RBMP (2022) - the EA's most recent review and update of the RBMPs took place in December 2022. RBMPs enable local communities to find more cost-effective ways to further improve water environments.
- Thames RBD Flood Risk Management Plan (FRMP) (2022) - the FRMP is a plan to manage significant flood risks within Thames RBD. The Thames FRMP identified two Flood Risk Areas covering Wokingham Borough for main rivers and the sea: Reading Rivers and Sea (RS) and Wokingham Rivers and Sea (RS).
- Thames draft Water Resources Management Plan (2024) and South East Water draft Water Resources Management Plan (2024) - sets out how the water companies intend to achieve a secure supply of water for their customers and a protected and enhanced environment.
- Thames Water Drainage and Wastewater Management Plan (DWMP) (2023) a 25 year plan that sets out how Thames Water will manage wastewater now and in the future to meet the challenges of a changing climate and growing population.
- Climate change guidance for flood risk assessment (2022) - the EA's guidance was last updated in 2022. New UK Climate Projections (UKCP18) were used to update peak river flow allowances, and these are now based on management catchments rather than RBDs. There has also been a change in how peak river flow allowances should be applied, with a greater focus placed on the 'central' allowance. In May 2022 peak rainfall allowances were updated and are now based on management catchments rather than the previous flat rates for the whole country.
- The Wokingham PFRA (2011) - a high-level screening exercise which provides an assessment of past flood risk based on historical data from WBC, the EA, Thames Water, local Parish Councils, Town Councils, and Residents Associations. the 2017 addendum to the PFRA is available on the Government website here.
- Wokingham Local Flood Risk Management Strategy (2015) - explains local flood risk sources in Wokingham Borough and how the council manage flood risk in an integrated and effective way.
- Wokingham Borough Council Water Cycle Study - Phase 1 Scoping Study (2019) - to assist WBC to select and develop growth proposals that minimise impacts on the environment, water quality, water resources, infrastructure, and flood risk and help to identify ways of mitigating such impacts.

- Wokingham Borough Council Water Cycle Study - Phase 2 (TBC) - provides a site-scale Red-Amber-Green (RAG) assessment for different aspects of the water cycle for potential development sites across the Borough. Once published this Water Cycle Study will be available to download from the Council's website.

Further details relating to these policies and documents can be found in Section 2.3 of the Level 1 SFRA report.

2.3.1 Thames River Basin District Flood Risk Management Plan

The Thames RBD FRMP (2022) is a plan to manage significant flood risks within the Thames RBD. Two Flood Risk Areas were identified covering Wokingham Borough for main rivers and the sea:

- Reading Rivers and Sea (RS)
- Wokingham Rivers and Sea (RS).

As part of the plan, objectives and measures have been set out for each Flood Risk Area. These measures have been created as part of a strategic six-year plan and will be reviewed annually. These measures describe short-term strategic actions. Further measures have also been developed for the wide geographic area of the Thames River Basin.

The measures and objectives for each area can be found on the EA's online Flood Plan Explorer, here. These measures should be reviewed and delivered as part of the planning process where possible.

2.3.2 Thames Water Drainage and Wastewater (DWMP) Management Plan

Water and sewerage companies have a statutory duty under the Environment Act to produce DWMPs. The first plans were published in 2023. DWMPs must cover a minimum period of 25 years, looking at current and future capacity, pressures, and risks to their networks, such as climate change and population growth.

DWMPs should detail how the companies will manage these pressures and risks through their business plans and how they will work with other RMAs or drainage asset owners.

Thames Water published their first DWMP in May 2023, which covers the period from 2025 through to 2050. The plan document is available on their website, here. Further information on the Thames Water DWMP is available on their website, here.

2.4 LLFAs, Surface Water and SuDS

The 2021 NPPF states that:

- ‘Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate’ (NPPF 2021, paragraph 169).

When considering planning applications, LPAs should consult the LLFA on the management of surface water to satisfy that:

- The proposed minimum standards of operation are appropriate.
- Through planning conditions or planning obligations there are clear arrangements for on-going maintenance over the development's lifetime.

Level 1 and Level 2 SFRAs have been prepared for WBC and should be referred to when assessing flood risk.

For proposed development in WBC, reference should be made to WBC's SuDS requirements for new developers which are set out in the Wokingham SuDS Strategy (2017) which can be downloaded from the Council's website here.

The 2021 NPPF states that:

- "All plans should apply a sequential, risk-based approach to the location of development" and should achieve this by "using opportunities provided by new development… to reduce causes and impacts of flooding." NPPF 2021, paragraph 161).

As such, WBC expects SuDS to be incorporated on minor development as well as major development and if possible, development in areas at material risk of flooding should be avoided. Masterplans should be designed to ensure that space is made for above ground SuDS features and that the requirements of existing surface water flow paths and storage volumes are appropriately accommodated. Underground tanks should only be used on sites as a last resort.

2.5 Updated Strategic Flood Risk Assessment Guidance

There was an update to the 'How to prepare a Strategic Flood Risk Assessment guidance' in March 2022, which requires further adjustment to the approaches to both Level 1 and Level 2 assessments. The Level 2 assessment is undertaken in accordance with the latest guidance. The latest guidance can be accessed on the Government website.

3 Sources of information used in preparing the Level 2 SFRA

This section outlines the datasets used in assessing the sites in the Level 2 SFRA.

3.1 Data used to inform the SFRA

Table 3-1 provides an overview of the supplied data used to inform the appraisal of flood risk for WBC.

Table 3-1: Overview of supplied data for WBC Level 2 SFRA

Source of flood risk	Data used	Data source
Historic (all sources)	Historic Flood Map and Recorded Flood Outlines datasets	EA
Historic (all sources)	Historic flooding incident reports	WBC
Fluvial (including climate change)	Blackwater (2007) 1D ISIS model (with 2017 climate change re-runs) Blackwater (2009) 1D-2D ISIS-TUFLOW model (with 2017 climate change re-runs) Foudry Brook (2017) 1D2D ISIS-TUFLOW model Kennet (2018) 1D-2D ESTRY-TUFLOW model Thames (Hurley to Teddington) (2019) 1D-2D ISIS-TUFLOW model Thames (Pangbourne to Sonning) (2019) 1D-2D Flood Modeller-TUFLOW Thames (Sonning to Hurley) (2019) 1D-2D Flood Modeller-TUFLOW Flood Map for Planning	EA
Fluvial (including climate change)	Emm Brook (2020) 1D-2D ESTRY-TUFLOW model	WBC
Fluvial (including climate change)	Arborfield (2023) 1D-2D ESTRY-TUFLOW model	Developed by JBA for WBC as part of this SFRA
Fluvial (including climate change)	Loddon Lower (2022) 1D2D ESTRY-TUFLOW model	EA 2009 rerun by JBA in 2022
Surface Water (including climate change)	Risk of Flooding from Surface Water dataset (3.3% AEP +35% and 1% AEP +40% climate change uplifts run by	EA and JBA

Source of flood risk	Data used	Data source
	JBA)	
Sewers	Internal and external historic drainage records	Thames Water
Groundwater	Areas Susceptible to Groundwater Flooding dataset	EA
Groundwater	JBA Groundwater emergence map	JBA
Reservoirs	National Inundation Reservoir Mapping (Long term flood risk map)	EA
Flood defences	AIMS Spatial Flood Defences dataset	EA
Cross-boundary impacts	Neighbouring authority sites and Local Plan information, to help assess cross-boundary impacts and for the CIA.	Planners at neighbouring authorities (see Section 1.6)
Other datasets	Source Protection Zones Aquifer Designation maps (Bedrock Geology and Superficial Deposits) Detailed River Network Flood Alert and Flood Warning Areas Groundwater Vulnerability Risk of Flooding from Rivers and Sea National Receptor Dataset	EA (via WBC)

3.2 Fluvial Flood Zones

3.2.1 Flood Zones 2 and 3a

Flood Zones 2 and 3a show the same extent as the Flood Map for Planning (FMfP) (which incorporates latest modelled data) other than for the watercourses listed below. In these instances, where additional detailed modelling was available that has not been incorporated into the FMfP, the modelled extent was used in preference:

- Blackwater (in the west of the area where the 2007 model extent is wider than the 2009 extent, only the 1% AEP output was available for Flood Zone 3a, so the Flood Zone 2 output remains the same as the FMfP).
- River Loddon (hydrology was updated as part of this SFRA)
- Arborfield (a new detailed hydraulic model was developed for the unnamed watercourse through Arborfield as part of this SFRA to inform the strategic development site)
- The Emm Brook (a detailed hydraulic model was provided by WSP for use within this SFRA)

The following provides additional information on the FMfP:

- Where flood outlines are not informed by detailed hydraulic modelling, the FMfP is based on generalised modelling to provide an indication of flood risk. Whilst the generalised modelling is generally accurate on a large scale, they are not provided for specific sites or for land where the catchment of the watercourse falls below 3km².
- For watercourses with smaller catchments, the EA's Risk of Flooding from Surface Water (RoFSW) map provides an indication of the floodplain of small watercourses and ditches. It is more accurate in upper to mid river valley locations than lower valley locations near the coast. This is because it does not represent the floodplain for small watercourses as well in largely flat areas.
- Even where more detailed models of Main Rivers have been used by the EA to inform the FMfP, they will be largely based on remotely detected ground model data and not topographic survey. In this area, FMfP does not include all modelled outputs, hence the Level 2 SFRA has derived its own Flood Zones based on latest available data.
- For this reason, the FMfP is not of a resolution to be used as application evidence to provide the details of possible flooding for 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.

3.2.2 Flood Zone 3b

Functional floodplain (Flood Zone 3b) is identified as land which would flood with an annual probability of 3.3% AEP (1 in 30 years), where detailed hydraulic modelling exists. The 3.3% AEP modelled flood extents have been used to represent Flood Zone 3b, where available. 3.3% AEP extents were available for the following models:

- Kennet
- Loddon
- Arborfield
- Thames (Hurley to Teddington)
- Thames (Pangbourne to Sonning)
- Thames (Sonning to Hurley)

For areas covered by detailed models, but with no 3.3% AEP output available, the 1% AEP outputs were used as a worst-case proxy. This was the case for the following models:

- Blackwater (2007)
- Blackwater (2009)
- Foudry Brook
- The Emm Brook

As this is quite a conservative approach, the 5% AEP outputs have also been considered to assess the sensitivity between the 1% AEP and 5% AEP and therefore indicate how accurate the conservative proxy of 1% AEP is to Flood Zone 3b.

Also for areas outside of the detailed model coverage, Flood Zone 3a (1% AEP) has been used as a conservative indication. Further work should be undertaken as part of a detailed site-specific FRA to define the extent of Flood Zone 3b where no detailed modelling exists.

3.3 Climate change

The Appendix D mapping included in this SFRA provides an assessment of climate change risk for fluvial and surface water flooding using modelled outputs with the latest climate change uplifts where available. Section 4 details how climate change has been represented within this Level 2 SFRA.

Developers should undertake detailed modelling of climate change allowances as part of a site-specific FRA, following the climate change guidance set out by the EA, available on the Government website here.

3.4 Surface water

Mapping of surface water flood risk in Wokingham Borough has been taken from the EA's RoFSW mapping. Surface water flood risk is subdivided into the following four categories:

- **High:** An area has a chance of flooding greater than 3.3% AEP (1 in 30) each year.
- **Medium:** An area has a chance of flooding between 1% AEP (1 in 100) and 3.3% AEP (1 in 30) each year.
- **Low:** An area has a chance of flooding between 0.1% AEP (1 in 1,000) and 1% AEP (1 in 100) each year.
- **Very Low:** An area has a chance of flooding of less than 0.1% AEP (1 in 1,000) each year.

The results should be used for high-level assessments such as SFRAs for local authorities. If a particular site is indicated in the EA mapping to be at risk from surface water flooding, a more detailed assessment may be required to illustrate the flood risk more accurately at a site-specific scale. Such an assessment should use the RoFSW in partnership with other sources of local flooding information to confirm the presence of a surface water risk at that particular location.

Detailed modelling using site survey will be necessary where there is a significant risk of surface water flooding. It is the intention that the EA will prepare updated and improved surface water mapping in the course of updating the National Flood Risk Assessment (NaFRA2). It is anticipated that this data will be available in 2024 and at that time it is recommended that the surface water risk assessment is reviewed. It is not anticipated that the updated mapping will fundamentally change the locations identified to be at risk from

surface water flooding, but the improved analysis techniques will reduce some of the uncertainties associated with the assessment.

3.5 Groundwater

In general, less is known about groundwater flooding than other sources and availability of data is limited. Groundwater flooding can be caused by:

- High water tables, influenced by the type of bedrock and superficial geology.
- Seasonal flows in dry valleys, which are particularly common in areas of chalk geology.
- Rebounding groundwater levels, where these have been historically lowered for industrial or mining purposes.
- Where there are long culverts that prevent water easily getting into watercourses.

Groundwater flooding is different to other types of flooding. It can last for days, weeks, or even months and is much harder to predict and warn for. Monitoring does occur in certain areas, for example where there are major aquifers or when mining stops.

Two datasets were used to assess potential areas that are likely to be at higher risk of groundwater flooding:

- The EA's AStGWF dataset, showing the degree to which areas are susceptible to groundwater flooding based on geological and hydrogeological conditions. It does not show the likelihood of groundwater flooding occurring, i.e., it is a hazard, not risk, based dataset.
- The JBA Groundwater Emergence map, showing the risk of groundwater flooding to both surface and subsurface assets, based on predicted groundwater levels.

In this SFRA, a three-stage approach has been adopted to assess the risk of groundwater flooding:

1. Firstly, the AStGWF dataset was used to identify grid squares that are most susceptible to groundwater flooding. Based on this dataset, any areas with greater than 50% susceptibility to groundwater flooding were taken forward for further analysis.
2. Of the areas identified in the above, the JBA Groundwater Emergence map was used to locate areas where this groundwater is most likely to emerge. For this assessment, areas where groundwater levels are predicted to be within 0.5m of the surface level were identified.
3. For locations that met both of the above parameters, a combination of the 0.1% AEP surface water extent from the EA's RoFSW map and EA 1m resolution LiDAR was used to identify where any groundwater emerging in these locations is most likely to flow and this is included in the site table. For 'amber' sites, the risk of groundwater flooding is noted where the above parameters are met.

The results of this assessment for each site are summarised in Appendix A. It should be noted that this assessment only identifies areas likely to be at risk of groundwater emergence and where this water might flow. It does not predict the likelihood of groundwater emerging or attempt to quantify the volumes of groundwater that might be expected to emerge in a given area. In high-risk areas, a site-specific risk assessment for groundwater flooding may be required to fully inform the likelihood of flooding.

3.6 River networks

Main Rivers are represented by the EA's Statutory Main River layer. Ordinary Watercourses are represented by the EA's Detailed River Network layer. Caution should be taken when using these layers to identify culverted watercourses which may appear as straight lines but, in reality, are not. Developers should check if a Flood Risk Activity Permit (FRAP) or any other permits or permissions will be needed prior to any activities being carried out to any main rivers.

Developers should be aware of the need to identify the route of, and flood risk associated with, culverts. CCTV condition survey will be required to establish the current condition of the culvert and hydraulic assessments will be necessary to establish culvert capacity of both culverts on site and those immediately offsite that could pose a risk to the site. The risk of flooding should be established using site survey, including the residual risk of culvert blockage.

3.7 Flood warning

Flood Warning Areas and Flood Alert Areas are represented by the EA's relevant GIS datasets. The sites affected by Flood Warning and Flood Alert Areas are detailed in the site summary tables in Appendix A.

3.8 Reservoirs

The risk of inundation as a result of a breach or failure of a number of reservoirs within the area has been identified from the EA’s Long Term Flood Risk Information website. Reservoir risk has been divided into 'Wet Day' and 'Dry Day' extents. The 'Wet Day' extent shows the individual flood extents for all large, raised reservoirs in the event that they were to fail and release the water held when local rivers had already overflowed their banks. The 'Dry Day' extent shows the individual flood extents for all large, raised reservoirs in the event that they were to fail and release the water held when local rivers are at normal levels. Further information can be found on the Defra data download website here.

3.9 Sewer flooding

Historical incidents of flooding are detailed by Thames Water through their records of flooding incidents relating to public foul, combined or surface water sewers from January

2000 until May 2022. Due to licencing and confidentiality restrictions, sewer data has not been represented on the mapping but is referred to within the site summary tables.

Modelling carried out by Thames Water in their Drainage and Wastewater Management Plan (DWMP) Catchment Strategic Plan (CSP) has been used to indicate areas which may require further investigation to determine capacity constraints within the network and identify any upgrades required to enable growth.

Thames Water has recognised that the Arborfield / Wokingham Wastewater Treatment Works will reach quality and/or flow exceedance over the coming Amps. Further investigation is required to understand what upgrades will be required.

3.10 Historic flooding

Historic flooding was assessed using the EA's Historic Flood Map and Recorded Flood Outlines mapping and a shapefile of historic flooding incidences provided by WBC.

3.11 Flood defences

Flood defences are represented by the EA's Asset Information Management System (AIMS) Spatial Defences dataset. Their current condition and Standard of Protection (SoP) are based on those recorded in the tabulated shapefile data. None of the sites being assessed are protected by formal flood defences but there is 'Natural high ground'; along both banks of the major watercourses and along some of the small drainage channels which will offer some protection from these watercourses.

3.12 Residual risk

The residual flood risk to sites is identified as where potential blockages or overtopping/ breach of defences could result in the inundation of a site, with the sudden release of water with little warning.

Potential culvert blockages that may affect a site were identified on OS Mapping and the EA's Detailed River Network layer to determine where watercourses flow into culverts or through structures (i.e. bridges) in the vicinity of the sites. Any potential locations were flagged in the site summary tables. These will need to be considered by the developer as part of a site-specific FRA.

Residual risk from breaches of flood defences, whilst rare, needs to be considered in FRAs. Considerations include the location of a breach, when it would occur and for how long, the depth of the breach (toe level), the loadings on the defence and the potential for multiple breaches. There are currently no national standards for breach assessments and there are various ways of assessing breaches using hydraulic modelling. Work is currently being undertaken by the EA to collate and standardise these methodologies. It is recommended that the EA are consulted if a development site is located near to a flood defence to

understand the level of assessment required and to agree the approach for the breach assessment, if required.

None of the sites which have been assessed in Wokingham Borough are protected by any formal flood defences. However, several sites are within close proximity to railway embankments which present a residual risk should they fail. Several sites assessed within Wokingham Borough are also in close proximity to culverts which run beneath footpaths, roads, and railway lines, and present a residual flood risk should they become blocked.

3.13 Depth, velocity, and hazard to people

The Level 2 assessment seeks to map the probable depth and velocity of flooding as well as the hazard to people and use this within the site summary tables.

Where detailed model outputs were available, the 1% AEP plus climate change depth, velocity and hazard data has been used. In the absence of detailed hydraulic models, flood depth, velocity, and hazard are not available as part of the FMfP dataset so have not been included as part of this Level 2 SFRA and may need to be considered further during a site-specific FRA.

It should be noted that the EA review of the Emm Brook model found that whilst this model was fit for purpose to update the Flood Map for Planning, the levels were not suitable for use in site-specific Flood Risk Assessments. Therefore, it is advised that the suitability of this modelling to inform any relevant sites is reviewed by the developer to determine if any further modelling work is needed.

The depth, hazard, and velocity of the 1% AEP plus climate change surface water flood event, produced by uplifting the EA RoFSW map, has been mapped and considered in this assessment.

Hazard to people has been calculated using the below formula as suggested in Defra's FD2321/TR2 "Flood Risk to People". The different hazard categories are shown in Table 3-2. Developers should also test the impact of climate change depths, velocities, and hazard on the site, at FRA stage.

Table 3-2: Defra's FD2321/TR2 "Flood Risks to People" classifications

Description of Flood Hazard Rating	Flood Hazard Rating	Classification Explanation
Very Low Hazard/ Caution	<0.75	"Flood zone with shallow flowing water or deep standing water"
Danger For Some (i.e. children)	0.75 - 1.25	"Danger: flood zone with deep or fast flowing water"
Danger For Most	1.25 - 2.00	"Danger: flood zone with deep fast flowing water"
Danger For All	>2.00	"Extreme danger: flood zone with deep fast flowing water"

As part of a site-specific FRA, developers will need to undertake more detailed hydrological and hydraulic assessments of the watercourses to verify flood depth, velocity and hazard based on the relevant 1% AEP plus climate change event, using the relevant climate change allowance based on the type of development and its associated vulnerability classification. Not all this information is known at the strategic scale and the level of resolution may not be appropriate to enable site scale assessment of proposed development schemes.

3.14 Note on SuDS suitability

The hydraulic and geological characteristics of each site were assessed to determine the factors that potentially constrain schemes for surface water management. This assessment is designed to inform the early-stage site planning process and is not intended to replace site-specific detailed drainage assessments.

The assessment is based on catchment characteristics and additional datasets such as JBA's Groundwater Emergence Mapping and British Geological Survey (BGS) Soil maps of England and Wales which allow for a basic assessment of the soil characteristics on a site-by-site basis. LiDAR data was used as a basis for determining the topography and average slope across each development site. Other datasets used include:

- Historic landfill sites
- Groundwater Source Protection Zones
- Detailed River Network
- Flood Zones derived as part of this Level 2 SFRA.

This data was then collated to provide an indication of particular groups of SuDS systems which might be suitable at a site. SuDS techniques were categorised into five main groups, as shown in Table 3-3. This assessment should not be used as a definitive guide as to which SuDS would be suitable but used as an indicative guide of general suitability. Further site-specific investigation should be conducted to determine what SuDS techniques could be used on a particular development, informed by detailed ground investigations.

Table 3-3: Summary of SuDS categories

SuDS Type	Technique
Source Controls	Green Roof, Rainwater Harvesting, Pervious Pavements, Rain Gardens
Infiltration	Infiltration Trench, Infiltration Basin, Soakaway
Detention	Pond, Wetland, Subsurface Storage, Shallow Wetland, Extended Detention Wetland, Pocket Wetland, Submerged Gravel Wetland, Wetland Channel, Detention Basin
Filtration	Surface Sand Filter, Sub-Surface Sand Filter, Perimeter Sand Filter, Bioretention, Filter Strip, Filter Trench
Conveyance	Dry Swale, Under-drained Swale, Wet Swale

The suitability of each SuDS type for the site options has been described in the summary tables, where applicable. The assessment of suitability is broadscale and indicative only; more detailed assessments should be carried out during the site planning stage to confirm the feasibility of different types of SuDS.

4 Impact of Climate Change

The sections below provide an overview of the approach taken to assess the impacts of climate change within this SFRA. For more detailed information about climate change please see Section 4 of the main Level 1 SFRA report.

4.1 Revised climate change guidance

The EA published updated climate change guidance for fluvial risk in July 2021 on how allowances for climate change should be included in both SFRA's and site-specific FRAs. The guidance adopts a risk-based approach considering the vulnerability of the development and considers risk allowances on a management catchment level, rather than a river basin level. The guidance was further updated in May 2022 to address the changes to the requirements for rainfall allowances.

Before undertaking a detailed FRA, developers should check the government website for the latest guidance.

4.2 Applying the climate change guidance

To apply the appropriate climate change guidance to a site, the following information is required:

- The vulnerability of the development – see Annex 3 in the NPPF.
- The likely lifetime of the development – in general 75 years is used for commercial development and 100 for residential, but this needs to be confirmed in an FRA. For development that will have an anticipated lifetime significantly beyond 100 years a higher allowance is required.
- The Management Catchment (assigned by the EA) that the site is located in.
    - Most of Wokingham Borough lies within the Loddon and tributaries Management Catchment.
    - The north of Wokingham Borough lies within the Thames and South Chilterns Management Catchment.
    - Small sections on the eastern boundary of Wokingham Borough lie within the Maidenhead and Sunbury Management Catchment.
    - Parts of the western side of Wokingham Borough lie within the Kennet and tributaries Management Catchment.

Developers should consider the following when deciding which allowances to use to address flood risk for a development or local plan allocation:

- Likely depth, speed, and extent of flooding for each allowance of climate change over time considering the allowances for the relevant epoch (2020s, 2050s and 2080s).
- The ‘built in’ resilience measures used, for example, raised floor levels.

- The capacity or space in the development to include additional resilience measures in the future, using a 'managed adaptive' approach.

Developers should refer to the EA guidance when considering which climate change allowances to use, available on the government website here.

4.3 Relevant allowances for Wokingham Borough

Table 4-1 shows the updated peak river flow allowances that apply in Wokingham Borough for fluvial flood risk for the Thames and South Chilterns, Loddon and tributaries, Maidenhead and Sunbury, and Kennet and tributaries Management Catchments. These allowances supersede the previous allowances by RBD. Where the previous climate allowances were within +/- 5% of the updated guidance, these were not re-run for the purposes of this SFRA.

Table 4-1: Peak river flow allowances for the Management Catchments which cover Wokingham Borough

Management Catchment	Allowance category	Total potential change anticipated for '2020s' (2015 to 2039)	Total potential change anticipated for '2050s' (2040 to 2069)	Total potential change anticipated for '2080s' (2070 to 2115)
Thames and South Chilterns	Upper end	30%	42%	76%
Thames and South Chilterns	Higher central	17%	22%	43%
Thames and South Chilterns	Central	12%	14%	31%
Loddon and tributaries	Upper end	23%	25%	46%
Loddon and tributaries	Higher central	11%	10%	23%
Loddon and tributaries	Central	7%	4%	14%
Maidenhead and Sunbury	Upper end	32%	45%	81%
Maidenhead and Sunbury	Higher central	19%	25%	47%

Management Catchment	Allowance category	Total potential change anticipated for '2020s' (2015 to 2039)	Total potential change anticipated for '2050s' (2040 to 2069)	Total potential change anticipated for '2080s' (2070 to 2115)
Maidenhead and Sunbury	Central	14%	17%	35%
Kennet and tributaries	Upper end	32%	39%	76%
Kennet and tributaries	Higher central	16%	16%	35%
Kennet and tributaries	Central	10%	8%	21%

Table 4-2 shows the updated rainfall intensity allowances that apply in Wokingham Borough for surface water flood risk for the different Management Catchments. These allowances supersede the previous country wide allowances. These allowances should be used for site-scale applications and for surface water flood mapping in small catchments (less than 5km²) and urbanised drainage catchments.

Table 4-2: Peak rainfall intensity allowances for small and urban catchments for the Management Catchments which cover Wokingham Borough

Management Catchment	Allowance category	Total potential change anticipated for '2050s' (2022 to 2060) 3.3% AEP	Total potential change anticipated for '2050s' (2022 to 2060) 1% AEP	Total potential change anticipated for '2070s' (2061 to 2125) 3.3% AEP	Total potential change anticipated for '2070s' (2061 to 2125) 1% AEP
Thames and South Chilterns	Upper end	35%	40%	35%	40%
Thames and South Chilterns	Central	20%	20%	25%	25%
Loddon and tributaries	Upper end	35%	40%	35%	40%
Loddon and tributaries	Central	20%	20%	25%	25%
Maidenhead and	Upper end	35%	40%	35%	40%

Management Catchment	Allowance category	Total potential change anticipated for '2050s' (2022 to 2060) 3.3% AEP	Total potential change anticipated for '2050s' (2022 to 2060) 1% AEP	Total potential change anticipated for '2070s' (2061 to 2125) 3.3% AEP	Total potential change anticipated for '2070s' (2061 to 2125) 1% AEP
Sunbury					
Maidenhead and Sunbury	Central	20%	20%	25%	25%
Kennet and tributaries	Upper end	35%	40%	35%	40%
Kennet and tributaries	Central	20%	20%	25%	25%

4.4 Representing climate change in the Level 2 SFRA

Fluvial climate change

Representation of climate change within the SFRA was discussed with the EA. Following the updated climate change allowances, where previous climate change runs were within +/- 5% these were used to represent climate change within the SFRA. This is due to the marginal change in allowance and subsequent results. As the Borough lies across four Management Catchments, the allowances are varied between watercourses.

As part of this study, the Loddon Lower model was re-run by JBA with updated hydrology and then re-run with the latest climate change uplifts. None of the other models provided were re-run as part of this SFRA.

The following models and allowances were used to represent the 2080s central climate change estimate (or 2070s central climate change estimate for peak rainfall intensity allowances):

- Blackwater 2007 – 1% AEP plus 15% climate change
- Blackwater 2009 – 1% AEP plus 15% climate change
- Foudry Brook – 1% AEP plus 20% climate change
- Kennet – 1% AEP plus 25% climate change
- Loddon Lower – 1% AEP plus 14% climate change
- Thames (Hurley to Teddington) – 1% AEP plus 35% climate change
- Thames (Pangbourne to Sonning) – 1% AEP plus 35% climate change
- Thames (Sonning to Hurley) – 1% AEP plus 35% climate change

The following models and allowances were used to represent the 2080s higher central climate change estimate:

- Blackwater 2007 – 1% AEP plus 25% climate change
- Blackwater 2009 – 1% AEP plus 25% climate change
- Kennet – 1% AEP plus 35% climate change
- Loddon Lower – 1% AEP plus 23% climate change
- Emm Brook – 1% AEP plus 25% climate change

The following models and allowances were used to represent the 2080s upper end ckunate change estimate:

- Loddon Lower - 1% AEP plus 46% climate change
- Thames (Hurley to Teddington) – 1% AEP plus 70% climate change
- Thames (Pangbourne to Sonning) – 1% AEP plus 70% climate change
- Thames (Sonning to Hurley) – 1% AEP plus 70% climate change

For the Thames models, the 70% estimates are slightly outside of the +/- 5% allowance for the upper end climate change (which is 76%). This model extent will be used as part of the site screening process to inform the sensitivity of sites to climate change in the absence of any suitable outputs for the higher central allowance.

The Arborfield model was developed as a direct rainfall model to best represent the flooding, therefore the peak rainfall intensity allowances have been used to represent central and upper end climate change for the 2070s period.

Surface water climate change

The 0.1% AEP surface water extent can be used as an indication of surface water risk, and the risk from smaller watercourses, which are too small to be covered by the EA's Flood Zones. Modelled Climate Change uplifts for the 3.3% and 1% AEP events were included as part of this SFRA and are presented in in Appendix A: GeoPDFs as 'Surface Water Extent plus Climate Change' for the following events and scenarios:

- 3.3% AEP plus 35% Climate Change
- 1% AEP plus 40% Climate Change

Developers

Developers will need to undertake a more detailed assessment of climate change as part of the planning application process when preparing FRAs, using the percentage increases which relate to the proposed lifetime and the vulnerability classification of the development. In areas where no modelling is present, this may require development of a 'detailed' hydraulic model, using channel topographic survey. Developers should consult the EA to provide further advice on how best to apply the new climate change guidance.

Where the peak river flow allowance is particularly high or the upper end is used, there should be an allowance for encroachment out of Flood Zone 2 and development in these areas should be avoided until proven at a site specific FRA stage.

4.5 Impact of climate change on groundwater flood risk

There is no technical modelling data available to assess climate change impacts on groundwater. It would depend on the flooding mechanism, historic evidence of known flooding and geological characteristics, for example prolonged rainfall in a chalk catchment. Flood risk could increase when groundwater is already high or emerged, causing additional overland flow paths or areas of still ponding.

A high likelihood of groundwater flooding may mean infiltration SuDS are not appropriate and groundwater monitoring may be recommended.

4.6 Impact of climate change on the functional floodplain

The potential impacts on Flood Zone 3b (3.3% AEP modelled extent) from climate change may need to be considered at site-specific assessment stage. Modelled flood extents can be compared to the Flood Zone 3a extent, and where no detailed modelling exists, Flood Zone 3a can be compared against Flood Zone 2, for an indication of areas most sensitive to climate change.

4.7 Impact of climate change on sewers

Surface water and fluvial flooding with climate change have the potential to impact on the sewerage system, so careful management of these is needed for development. Due to differing ages of settlements, there will be drainage systems consisting of different types of sewers. Increasing pressures from climate change, urban creep and infill development could impact on the performance of the sewerage system.

4.8 Adapting to climate change

The PPG climate change guidance contains information and guidance for how to identify suitable mitigation and adaptation measures in the planning process to address the impacts of climate change. Examples of adapting to climate change include:

- Considering future climate risks when allocating development sites so that the risks are understood over the development's lifetime.
- Considering the impact of and promoting design responses to flood risk and coastal change for the lifetime of the development.
- Considering availability of water and water infrastructure for the lifetime of the development and design responses to promote water efficiency and protect water quality.
- Promoting adaptation approaches in design policies for developments and the public realm, for example by building in flexibility to allow future adaptation if needed, such as setting new development back from watercourses.
- Identifying no or low-cost responses to climate risks that also deliver other benefits, such as green infrastructure that improves adaptation, biodiversity, and

amenity, for example by leaving areas shown to be at risk of flooding as public open space.

- Considering the SoP of defences and sites for future development, in relation to sensitivity to climate change. WBC and developers will need to work with RMAs and use the SFRA datasets to understand whether development is affordable or deliverable. Locating development in such areas of risk may not be a sustainable long-term option.
- It is recommended that the differences in flood extents from climate change are compared by WBC when proposing to allocate sites, to understand how much additional risk there could be, where this risk is in the site, whether the increase is marginal or activates new flow paths, whether it affects access/ egress and how much land could still be developable overall.
- Include the use of Natural Flood Management (NFM) techniques where possible to assist in the adaptation to climate change.

5 Level 2 Assessment Methodology

This section outlines how sites were screened against flood risk datasets to determine which sites required a Level 2 assessment. It also identifies other sites at lower risk with general recommendations for developers.

5.1 Site screening

As part of the screening process WBC identified the sites assessed as potentially suitable for development through the latest Housing and Economic Land Availability Assessment (HELAA) including those proposed for allocation in the Revised Growth Strategy (2021) consultation, from all sites promoted as well as newly promoted sites not yet subject to HELAA assessment.

WBC provided 58 sites / groups of combined sites to take forward to the Level 2 screening assessment. Table 5-1 details the combined sites which have been grouped together for this Level 2 assessment. Many of the proposed sites across Wokingham Borough are in close proximity and share boundaries, and therefore from a Local Plan site assessment point of view, would have similar suitability conclusions meaning they would be considered for allocation together. Any sites which adjoin and share flooding mechanisms/ drainage features, should be considered together at masterplanning stage to optimise flood risk management to and from each individual site.

It is important to identify opportunities to reduce the risk of flooding on and off the site(s) through the design of development and the value of compiling 'development guidelines' to understand the vision for site(s) and further information on how flood risk from all sources will be managed.

Table 5-1: Details of groups of sites which have been combined for the Level 2 assessment.

Level 2 Site Name	Sites included in group
5AR011 and combined sites	5AR011, 5AR014, 5AR015, 5AR025, 5AR029, 5AR030, 5AR032, 5SH012, 5SH049, 5WI001, 5WI002, 5WI015, 5WI018
5BA033, 032 and 034	5BA033, 5BA032, 5BA034
5HU009 and combined sites	5HU009, 5HU010, 5HU011, 5HU012, 5HU013, 5HU014, 5HU015, 5HU017, 5HU020, 5HU021, 5HU022 (minus the parcel north of the M4), 5HU023, 5HU041, 5HU047
5RU001	5RU001, 5RU002, 5RU003, 5RU004, 5RU005, 5RU006
5SH023 and 027	5SH023, 5SH027

Level 2 Site Name	Sites included in group
5SO008 and 005	5SO008, 5SO005
5WI004, 006 and 010	5WI004, 5WI006, 5WI010
5WI009 and 019	5WI009, 5WI019
5WI012 and 021	5WI012, 5WI021
5WK028 and combined sites	5WK028, 5WK032, 5WK034, 5WK039
5WW030	5WW030, 5WW017, 5WW026

These sites were screened against available flood risk information and spatial data to provide a summary of risk to each site, including:

- the proportion of the site in each Flood Zone derived from detailed hydraulic model outputs where available, and where detailed modelling was unavailable the information is taken from the EA's FMfP (see Section 3.2 for a summary of how the Flood Zones were derived for this SFRA).
- the proportion of the site affected by climate change within the central and higher central allowances for the 1% AEP event where available. See Section 4.4 for a summary of available climate change allowances for use within this assessment.
- whether the site is shown to be at risk from surface water flooding in the RoFSW mapping for the 3.3%, 1%, and 0.1% AEP events, and the 1% AEP event plus 40% climate change allowance.
- whether the site is within, or partially within, the reservoir 'Dry Day' or 'Wet Day' flood extents.
- whether the site is within, or partially within, the Environment Agency (EA) Historic Flood Map dataset.
- whether the site is within 20m of a watercourse shown within the EA Detailed River Network dataset.
- whether the AStGWF map shows the site to be susceptible to groundwater flooding.
- whether there are any recorded sewer flooding incidents from Thames Water within the site.

The screening was undertaken using JBA in-house software called “FRISM”. FRISM is an internal JBA GIS package that computes a range of flood risk metrics based on flood and receptor datasets.

The results of the screening provide a quick and efficient way of identifying sites that are likely to require a Level 2 Assessment, assisting WBC with sequential test decision-making so that flood risk is taken into account when considering allocation options.

The screening also provides an opportunity to identify sites which may show to be 100% in Flood Zone 1, but upon visual inspection in GIS, have an ordinary watercourse flowing through or adjacent to them but for which no Flood Zone information is currently available. Note: although there are no Flood Zone maps available for these watercourses, it does not mean the watercourse does not pose a risk, it just means no modelling has yet been undertaken to identify the risk. The Flood Zones are not provided for specific sites or land where the catchment of the watercourse falls below 3km². For this reason, the Flood Zones are not of a resolution to be used as application evidence to provide the details of possible flooding for individual properties or sites and for any sites with watercourses on, or adjacent to the site. The RoFSW has been used in these cases because this provides a reasonable representation of the floodplain of such watercourses to use for a strategic assessment.

5.2 Sites taken forward to a Level 2 assessment

Out of the 58 sites / groups of combined sites provided by WBC for the Level 2 screening assessment, 27 sites were carried forward to a Level 2 assessment.

Sites were screened against fluvial, surface water, groundwater, reservoir, and sewer flood risk using available data.

A RAG system was applied to the sites on the basis that: red sites needed a detailed Level 2 assessment, amber sites were grouped to provide standard advice for management of less significant surface water issues (recommendations are provided in Section 5.3 and Appendix C), and green sites that had no / negligible risk and required no further consideration.

Red sites were taken forward if they were at fluvial flood risk or if surface water risk was deemed significant. In order to assess whether a site was deemed to have significant surface water risk, professional judgment was used based on the extent and location of the surface water issues relative to the site and access and egress. For example, if there was an area of deep ponding, a prominent flow route bisecting a site, immediate constraints to site access at the boundary etc.

Amber sites with less significant surface water flood risk upon initial assessment highlighted in Section 5.3 were grouped to provide standard advice for development of the sites. This is due to the similarity of flooding mechanisms and the recommendations provided alongside. This approach was deemed suitable as the updated PPG requires the assessment of all sources of flooding to inform the sequential test. Detailed site tables were used where the assessment of flooding from multiple sources or significant risk was required.

Table 5-2 summarises the sites which have been taken forward to the Level 2 assessment on this basis.

Table 5-2: Sites carried forward to a Level 2 assessment.

Site Code	Location (Easting. Northing)	Primary reason for Level 2	% of site within Flood Zone 3b (some figures are indicative flood zone 3b)	% of site within Flood Zone 3a	% of site within Flood Zone 2	% of site within Flood Zone 1	% of site in RoFSW 3.3% AEP extent	% of site in RoFSW 1% AEP extent	% of site in RoFSW 1% AEP plus 40% CC extent	% of site in RoFSW 0.1% AEP extent
5AR011 and combined sites	475556, 168961	Fluvial, Surface Water, Sewer	29	32	35	65	6	11	26	29
5BA010	477595, 166325	Fluvial, Surface Water, Reservoir	2	2	6	94	3	5	10	12
5BA013	477021, 167000	Surface Water	0	0	0	100	2	3	8	9
5CV001	477392, 176503	Fluvial, Surface Water, Reservoir	13	18	28	72	1	2	5	5
5EA002	473224, 173758	Fluvial, Surface Water	<1	<1	1	99	2	4	6	7
5FI003	479059, 165812	Surface Water	0	0	0	100	1	3	9	12

Site Code	Location (Easting. Northing)	Primary reason for Level 2	% of site within Flood Zone 3b (some figures are indicative flood zone 3b)	% of site within Flood Zone 3a	% of site within Flood Zone 2	% of site within Flood Zone 1	% of site in RoFSW 3.3% AEP extent	% of site in RoFSW 1% AEP extent	% of site in RoFSW 1% AEP plus 40% CC extent	% of site in RoFSW 0.1% AEP extent
5FI032	477810, 165500	Surface Water	0	0	0	100	3	4	10	14
5HU006	479648, 173365	Groundwater	0	0	0	100	0	0	1	2
5HU009 and combined sites	481280, 171121	Fluvial and Surface Water	<1	<1	1	99	3	5	12	15
5HU030	479641, 174149	Surface Water	5	5	8	92	1	3	11	13
5HU054	480966, 171913	Surface Water	0	0	0	100	4	5	10	13
5RU001 - 006	479420, 177336	Fluvial, Surface Water	6	6	7	93	2	6	19	21
5SH023 and 027	473206, 167220	Fluvial, Surface Water	1	1	3	97	1	5	18	24
5SO008 and 005	476427, 174751	Surface Water	0	0	0	100	2	6	14	16

Site Code	Location (Easting. Northing)	Primary reason for Level 2	% of site within Flood Zone 3b (some figures are indicative flood zone 3b)	% of site within Flood Zone 3a	% of site within Flood Zone 2	% of site within Flood Zone 1	% of site in RoFSW 3.3% AEP extent	% of site in RoFSW 1% AEP extent	% of site in RoFSW 1% AEP plus 40% CC extent	% of site in RoFSW 0.1% AEP extent
5WI004, 006 and 010	479074, 170708	Fluvial, Surface Water	18	18	21	79	7	12	24	28
5WI008	477125, 171172	Fluvial and Surface Water	21	21	73	27	<1	13	47	55
5WI009 and 019	479572, 170320	Surface Water	0	0	0	100	<1	4	28	30
5WI011	476973, 169392	Surface Water	0	0	0	100	0	0	11	18
5WI012 and 021	478988, 170102	Surface Water	0	0	0	100	15	18	20	21
5WI014	477804, 169924	Surface Water	0	0	0	100	1	2	30	37
5WK006	481228, 167862	Fluvial and Surface Water	20	20	24	76	15	20	28	34
5WK029	480525, 168764	Surface Water	0	0	0	100	0	6	23	27

Site Code	Location (Easting. Northing)	Primary reason for Level 2	% of site within Flood Zone 3b (some figures are indicative flood zone 3b)	% of site within Flood Zone 3a	% of site within Flood Zone 2	% of site within Flood Zone 1	% of site in RoFSW 3.3% AEP extent	% of site in RoFSW 1% AEP extent	% of site in RoFSW 1% AEP plus 40% CC extent	% of site in RoFSW 0.1% AEP extent
5WK042	479808, 167633	Surface Water	0	0	0	100	1	4	35	37
5WK045	480908, 168024	Fluvial, Surface Water	0	0	25	75	2	6	29	36
5WO004	478080, 173365	Fluvial, Surface Water	7	7	7	93	0	2	2	2
5WW009	482325, 164976	Fluvial, Surface Water	0	32	54	46	5	10	40	42
5WW030, 017 and 026	483280, 167371	Surface Water	0	2	3	97	3	6	14	16

The Flood Zone values quoted show the percentage of the site at flood risk from that Flood Zone/event but also include the percentage of the site at flood risk at a higher risk zone. For example, if 50% of a site is in the Flood Zones, taking each Flood Zone individually, 50% would be in Flood Zone 2 but say only 30% might be in Flood Zone 3a and only 10% in Flood Zone 3b. Flood Zone 1 is the remaining area of the site outside of Flood Zone 2, so Flood Zone 2 + Flood Zone 1 will equal 100%.

5.3 Recommendations for 'amber' sites

The ‘amber’ sites identified are listed below:

- 5AR024
- 5CV002
- 5FI004
- 5FI028
- 5HU002
- 5HU052
- 5RU008
- 5SH031
- 5SO001
- 5SW019
- 5WK028 and combined sites
- 5WK046
- 5WK047
- 5WK053
- 5SH025

Appendix C (Summary of flood risk at the 'amber' sites) provides a more detailed overview of the flood risk at these sites and a figure of each site showing the RoFSW extents at and surrounding the site. These mostly pose a risk from surface water flooding. However, these sites were still assessed using mapping of flooding from all sources and any other flood risk issues to consider at the site are also included.

As the surface water risk to these sites is not significant, the exception test does not apply. However, the developer should still undertake a site-specific FRA at the planning stage and take particular consideration of the surface water flow routes/ areas at risk and how these will impact the site itself as well as access and egress. The nature of surface water risk has been identified for each site in Appendix C.

5.4 Site summary tables

As part of the Level 2 SFRA, detailed site summary tables have been produced for the sites listed above in Table 5-2. The summary tables can be found in Appendix A. Each summary table sets out the following information:

- Basic site information
- Location of the site in the catchment
- Area, type of site, current land use (greenfield/ brownfield), proposed site use
- Sources of flood risk
- Existing drainage features
- Fluvial – proportion of site at risk including description from mapping/modelling, utilising depth, hazard, and velocity information from detailed hydraulic models where available
- Surface Water – proportion of site at risk including description from RoFSW mapping using available depth, hazard, and velocity information
- Reservoir flood risk in both the 'Dry Day' and 'Wet Day' scenarios
- Flood history - historic incidents on or surrounding the site from the EA Recorded Flood Outline and Historic Flood Map datasets and historic incidences provided by WBC
- Flood risk management infrastructure
- Description of residual risk
- Emergency Planning
- Flood Warning and Alert Areas
- Access and egress
- Fluvial climate change - summary of available climate change allowances and increase in flood extent compared to the 1% AEP event (Flood Zone 3a)
- Surface water climate change - summary of available climate change allowances and increase in flood extent compared to the 1% AEP event
- Requirements for drainage control and impact mitigation
- Broadscale assessment of possible SuDS to provide indicative surface water drainage advice for each site assessed for the Level 2 SFRA.
- Groundwater Source Protection Zones
- Historic landfill sites
- NPPF Planning implications
- Exception test requirements
- Requirements and guidance for site-specific FRA (including consideration of opportunities for strategic flood risk solutions to reduce flood risk)
- Key messages – summarising considerations for the exception test to be passed
- Mapping information – description of data sources for the mapped outputs used within the assessment

6 Flood Risk Management Requirements for Developers

This section provides guidance on site-specific FRAs. These are carried out by (or on behalf of) developers to assess flood risk to and from a site. They are submitted with Planning Applications and should demonstrate how flood risk will be managed over the development's lifetime, considering climate change and the vulnerability of users.

This report provides a strategic assessment of flood risk in Wokingham Borough. Prior to any construction or development, site-specific assessments will need to be undertaken so all forms of flood risk, and any defences at a site, are considered in more detail. Developers should, where required, undertake more detailed hydrological and hydraulic assessments of the watercourse to verify flood extents (including latest climate change allowances), to inform the sequential approach within the site and prove, if required, whether the exception test can be satisfied.

A detailed FRA undertaken for a windfall site may find that the site is entirely inappropriate for development of a particular vulnerability, or even at all.

The EA advise that large development sites and associated new infrastructure may be able to deliver ways to reduce the risk of flooding (from all sources) on the site and also off the site where a stand-alone flood alleviation scheme is not viable. On these sites, early engagement with the EA is recommended. The EA also request that any development close to the edge of the floodplain is set back as much as possible leaving a development buffer, as a precautionary approach.

Developers should refer to the following sections of the Level 1 SFRA report for further information on the requirements for development.

- Section 8.1 - Principles for new developments
  - This section provides guidance for developers on applying the sequential and exception tests, consulting with statutory consultees, considering the risk from all sources of flooding, ensuring development seeks to reduce flooding and is safe for future users, enhancing the natural river environment and floodplain, and contributing to wider flood mitigation strategy within Wokingham Borough.
- Section 8.2 - Requirements for site-specific Flood Risk Assessments
  - When is an FRA required? (8.2.1)
  - Objectives of a site-specific FRA (8.2.2)
  - Site layout and design (8.2.3)
  - Modification of ground levels (8.2.4)
  - Raised floor levels (8.2.5)
  - Development and raised defences (8.2.6)
  - Developer contributions (8.2.7)

- Buffer strips (8.2.8)
- Making space for water (8.2.9)

6.1 Flood warning and emergency planning

Appendix D of the Level 1 SFRA details the EA Flood Warning's and Flood Alert's available within Wokingham Borough at the time of publication. This Level 2 assessment has identified several proposed sites located within existing EA FWAs. For proposed development within existing EA FWAs, developers should consult the EA to ensure that adequate flood warning procedures and evacuation processes are in place and that RMAs are not put under any additional burden.

Section 8.5 of the Level 1 SFRA report discusses NPPF requirements and what an emergency plan will need to consider and other relevant information on emergency planning. Further information is provided on WBC's 'Flooding and drainage' page here.

6.2 Reservoirs

This Level 2 SFRA identified 7 sites assessed within the site summary tables that are shown to be at risk of reservoir flooding during a 'Dry Day' scenario and 12 sites in a 'Wet Day' scenario. The level and standard of inspection and maintenance required under the Reservoirs Act means that the risk of flooding from reservoirs is very low. However, there is a residual risk of a reservoir breach, and this risk should be considered in any site-specific FRA (where relevant).

Section 8.4.3 of the Level 1 SFRA report details considerations that developers should follow when allocating development downstream of a reservoir.

6.3 Duration and onset of flooding

The duration and onset of flooding affecting a site depends on several factors:

- The position of the site within a river catchment, with those at the top of a catchment likely to flood sooner than those lower down. The duration of flooding tends to be longer for areas lower in river catchments.
- Reservoirs in upper catchments will provide some online flood storage that reduces the flood risk downstream and delays the onset of flooding. At the confluence of the larger watercourses and smaller tributaries, there may be different timings of peak flows, for example smaller tributaries would peak much earlier than watercourses with larger catchments.
- The principal source of flooding: where this is surface water, depending on the intensity and location of the rainfall, flooding could be experienced within 30 minutes of the heavy rainfall event e.g., a thunderstorm. Typically, the duration of flooding for areas at risk of surface water flooding, or from flash flooding from small watercourses, is short (hours rather than days).

- The preceding weather conditions prior to the flooding: wet weather lasting several weeks will lead to saturated ground. Rivers respond much quicker to rainfall in these conditions.
- Whether a site is defended, noting that if the defences were to fail, a site could be affected by very fast flowing and hazardous water within 15 minutes of a breach developing (depending on the size of the breach and the location of the site in relation to the breach), causing danger to life.
- Catchment geology: the permeability of a catchment affects its response time, for example chalk catchments take longer to respond than clay catchments.

Table 6-1 provides guidelines on the typical response time that may be expected for fluvial and surface water flooding. However, these are only broad guidelines, and it is recommended that a site-specific FRA refines this information based on more detailed modelling work where necessary.

Table 6-1: Guidelines on the duration of and onset of flooding

Principal source of flooding	Duration	Onset
Surface water	Up to 4 hours	Within 30 minutes
Fluvial	Between 4 and 24* hours	Within 2 to 8 hours

*Depending on where in the catchment a site is located, flooding could be rapid and flashy in the upper catchment (e.g. small tributaries), and slower responding and longer in duration in the lower catchment.

7 Surface Water Management and SuDS

This section provides guidance and advice on managing surface water runoff and flooding.

The Level 1 SFRA summarises guidance and advice on managing surface water runoff and flooding in Section 9. Below is a guide to what is included in sections not expanded on here, for reference alongside this Level 2 SFRA:

- Section 9.1 - Role of the LLFA and LPA in surface water management
- Section 9.2 - Sustainable Drainage Systems (SuDS)
- Section 9.3 - Sources of SuDS guidance
- Section 9.4 - Other surface water considerations covering Groundwater Vulnerability Zones, Groundwater Source Protection Zones, Nitrate Vulnerable Zones (NVZs) and Critical Drainage Areas

7.1 SuDS suitability across the study area

The permeability of the underlying soils can determine the infiltration capacity and percolation capacities. As such, a review of the soil characteristics has been undertaken using Soilscapes online soil maps of England and Wales which allow for a basic assessment of the soil characteristics and infiltration capacity. Soilscapes is not intended as a means for supporting detailed assessments, specific site investigations should be undertaken to determine the soil types across the study area. A high-level assessment of the suitability of SuDS is included in the site tables in Appendix A.

This strategic assessment should not be used as a definitive site guide as to which SuDS would be suitable but rather as an indicative guide of general suitability based solely on soil type. Several other factors can determine the suitability of SuDS techniques including land contamination, the depth and fluctuation of the water table, the gradient of local topography and primary source of runoff etc. When considering NVZs and if areas have pollutants, infiltration may only be suitable where treatment measures are provided, prior to any discharge to surface or groundwaters.

Further site-specific investigation should be conducted to determine what SuDS techniques could be utilised at a particular development. The result of this assessment does not remove the requirements for geotechnical investigation or detailed infiltration testing and does not substitute the results of site-specific assessments and investigations. The LLFA should be consulted at an early stage to ensure SuDS are implemented and designed in response to site characteristics and policy factors. WBC as LLFA have set out their requirements for developers in the Wokingham SuDS Strategy (2017) which can be downloaded from the Council's website here.

8 Cumulative impact of development, schemes, and strategic solutions

The cumulative impact of development should be considered at both the Local Plan making stage and the planning application and development design stages. Paragraph 160 of the NPPF (2021) states:

'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.'

As part of this Level 2 SFRA, a catchment-level Cumulative Impact Assessment (CIA) has been undertaken. This looks in more detail at catchments identified as high risk during the broadscale CIA. The broadscale CIA was originally undertaken as part of the Level 1 SFRA (see IDT-JBAU-XX-XX-RP-HM-0003-A1-C01-AppF_CIA) and then updated as part of this Level 2 SFRA to take account of changes to the development sites being taken forward for the Level 2 assessment.

Four catchments were identified as high risk:

- Emm Brook
- Barkham Brook
- Loddon (Swallowfield to River Thames confluence)
- Twyford Brook

In the catchment level assessment, a detailed analysis of these high risk catchments is undertaken. Other factors, such as the catchments' existing urban extent, topography, location within the wider river drainage network, and presence of EA FWAs are also considered to determine policy recommendations to address the specific risks within the catchment. Historic flooding incidents are also considered and presented as a hotspot 250m grid across the catchments to indicate areas potentially sensitive to flooding.

The full catchment-level CIA can be found in Appendix B.

9 Summary of Level 2 assessment and recommendations

9.1 Assessment methods

As part of the Level 2 SFRA 27 sites / groups of combined sites have been assessed with detailed site summary tables. Additional sites with some surface water issues identified have been grouped due to similarly applicable recommendations and are included in Section 5.3 and Appendix C of this report.

The summary tables set out the flood risk to each site, including Flood Zone coverage, and the modelled extents, depths, velocities, and hazard ratings of fluvial flooding (where hydraulic model data is available) and surface water flooding. Climate change mapping has also been used to indicate the impact which different climate change allowances may have on the sites (where appropriate model runs are available) or using Flood Zone 2 as an indication of climate change. Each table also sets out the NPPF requirements for the site as well as guidance for site-specific FRAs.

A broadscale assessment of suitable SuDS options has been provided giving an indication where there may be constraints to certain sets of SuDS techniques. This assessment is indicative and more detailed assessments should be carried out during the outline site planning stage by the developer to confirm the feasibility of different types of SuDS. It may be possible that those SuDS techniques highlighted as possibly not being suitable can be designed to overcome identified constraints.

Interactive mapping is shown in Appendix D and should be viewed alongside the detailed site summary tables in Appendix A. There are hydraulic model outputs available across large parts of the study area (see Section3.1), but where models are unavailable, the EA's Flood Zones from the FMfP have been used. Also, where the watercourses are smaller and not represented in the Flood Zones, the RoFSW mapping datasets have been used.

The Level 2 SFRA also identifies the need to consider the implications of allocating land that could potentially be affected by other sources of flooding, including groundwater and reservoir flood risk.

9.2 Considering the exception test for the proposed sites in Wokingham Borough

In principle, it is possible for the majority of sites assessed in the Level 2 SFRA to satisfy the flood risk element of the exception test, for example by:

- siting development away from the highest areas of risk into Flood Zone 1 (in the majority of sites assessed, the risk is either along a site boundary or the risk is posed by a flow path running through the site, so steering away from this is advised),

- considering safe access/ egress in the event of a flood (from all parts of the site, if say the site is severed by a flood flow path),
- using areas in Flood Zone 2 and 3a for the least vulnerable parts of the development in accordance with Table 2 (Flood risk vulnerability and flood zone 'incompatibility') in the PPG. No development at all should be permitted in Flood Zone 3b (aside from essential infrastructure, such as a bridge crossing the lowest points of a site),
- testing flood mitigation measures if these are to be implemented, to ensure that they will not displace water elsewhere (for example, if land is raised to permit development in one area, compensatory flood storage will be required in another),
- considering space for green infrastructure in the areas of highest flood risk where this is appropriate.
- No dry islands will be created as a result of development on sites reaching this stage.

Consideration should be given to the surface water risk within Wokingham Borough as this must also be addressed by the exception test. Care should be taken with use of the national EA RoFSW map as it does not account for culverts, structures, channel hydraulics, or sewer capacity, and therefore can provide an overestimated risk. It is recommended that developers investigate surface water risk in more detail at the planning application stage and may need to consider undertaking integrated modelling.

If larger sites are split in future into smaller land parcels for development, and some of those parcels are in areas of flood risk, the exception test may need to be re-applied by the developer at the planning application stage.

At planning application stage, the developer must design the site adopting the sequential approach in line with the recommendations in national and local Planning Policy and supporting guidance and those set out in this SFRA.

9.3 Planning policy recommendations

The planning policy recommendations in Section 10.1 of the Level 1 SFRA report (JBA, 2023) still stand for the site allocations and any windfall development that comes forward and should be referred to alongside this report.

9.4 Guidance for windfall sites and sites not assessed in Level 2 SFRA

- For sites not represented in the EA's Flood Zones, or where Flood Zones do exist, but no detailed hydraulic modelling is present, it is recommended that developers construct detailed hydraulic models at these sites as part of a site-specific FRA using channel, structure, and topographic survey, to confirm flood risk during the 1% AEP plus climate change 'design event'. Site-specific flood modelling will likely need to be developed in locations where it is necessary to

understand the effects of proposed development schemes on the existing flood flow paths and flood volume storage, in the present day and in the future.

- If a site's extent includes or borders an EA Main River (including a culverted reach of a Main River), an easement of 8m is required from both banks for access and maintenance. Any future development will require a flood risk permit1 for any activity within 8m of a Main River.
- If an ordinary watercourse is within or immediately adjacent to the site area, consultation with the LLFA (WBC) should be undertaken. If alterations or discharges are proposed to the watercourse, a land drainage consent will be required.
- Where necessary, blockages of nearby culverts may need to be simulated in a hydraulic model to confirm residual risk to the site.
- Surface water risk should be considered in terms of the proportion of the site at risk in the 3.3%, 1% and 0.1% AEP events (with an appropriate allowance for climate change), whether the risk is due to isolated minor ponding or deeper pooling of water, or whether the risk is due to a wider overland flow route.
- Surface water risk and mitigation should be considered as part of a detailed site-specific FRA and surface water drainage strategy.
- Access and egress should be considered at the site, but also in the vicinity of the site, for example, a site may have low surface water risk, but in the immediate locality, access/egress to and from the site could be restricted for vehicles and/ or people.
- If a site is located within 250m of a landfill site, there could be amenity, dirt, and contamination issues. Sites could be sensitive from the perspective of controlled waters and therefore any redevelopment must ensure there is no pollution risk to the water environment.

9.5 Use of SFRA data and future updates

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.

The SFRA should be a 'living document', and as a result should be 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 WBC, Thames Water, South East Water and the EA. Such information may be in the form of:

- New hydraulic modelling results
- Flood event information following a future flood event
- Policy/ legislation updates
- EA flood map updates

1 Flood risk activities: environmental permits - GOV.UK (www.gov.uk)

- New flood defence schemes, or alleviation schemes.

The EA regularly reviews their flood risk mapping, and it is important that they are approached to determine whether updated (more accurate) information is available prior to commencing a detailed FRA. The River Blackwater and its tributaries are currently programmed to be remodelled by the EA in 2024. The EA are also currently undertaking new nationalised modelling (NaFRA2) which is due to go live in August 2024, although these timescales are subject to change due to the complexities of this project.

It is recommended that the SFRA is reviewed in line with the EA's Flood Zone map updates to ensure latest data is still represented in the SFRA, allowing a cycle of review and a review of any updated data by checking with the above bodies for any new information.

A Site Summary Tables

B Level 2 Cumulative Impact Assessment (CIA)

C Summary of flood risk at the 'amber' sites

D GeoPDF Mapping and User Guide

D.1 Instructions for using GeoPDFs

To accompany each site summary table, there is an interactive GeoPDF map, with all the mapped flood risk outputs per site. GeoPDFs should be opened with Adobe. They display the mapping datasets relevant to this report for each site. Datasets shown in the legend can be switched on and off using the tick boxes.

The accompanying User Guide provides further details about the datasets used within the GeoPDF maps.

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