JBA consulting

South Oxfordshire and Vale of White Horse Level 2 Strategic Flood Risk Assessment - Main Report

Final Report

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Prepared for:

South Oxfordshire District Council and

Vale of White Horse District Council

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This report describes work commissioned by South Oxfordshire and Vale of White Horse District Councils. The Client's representative for the contract was Rebekah Goodwill of South Oxfordshire and Vale of White Horse District Councils. Mike Williamson of JBA Consulting carried out this work.

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Abbreviations

1D	One Dimensional (modelling)
2D	Two Dimensional (modelling)
AEP	Annual Exceedance Probability
DTM	Digital Terrain Model
EA	Environment Agency
FMfP	Flood Map for Planning
FRA	Flood Risk Assessment
HFM	Historic Flood Map
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
NaFRA2	National Flood Risk Assessment 2
NFM	Natural Flood Management
NPPF	National Planning Policy Framework
OS	Ordnance Survey
PPG	Planning Practice Guidance
RFO	Recorded Flood Outline
SFRA	Strategic Flood Risk Assessment

1 Introduction

A Level 2 Strategic Flood Risk Assessment (SFRA) is required by South Oxfordshire and Vale of White Horse district councils (the councils) as all identified potential development sites cannot be allocated outside areas of medium or high flood risk, as identified through the Level 1 SFRA, finalised September 2024.

The Level 1 SFRA entailed the flood risk screening of 64 potential development site allocations for inclusion in the Joint Local Plan. 19 of these sites were shown to be at medium or high flood risk yet considered important to the Joint Local Plan strategy. A Level 2 SFRA is therefore required to help determine whether these sites can be allocated in the Joint Local Plan.

Using the outputs from the Level 1 SFRA, the councils have performed the sequential test on all available sites using the administrative area of both districts as the search area. The outcomes of the sequential test found that there were no reasonably alternative sites, within the search area, at lower risk of flooding. Hence the necessity for a more detailed assessment of flood risk through this Level 2 SFRA.

This Level 2 SFRA has been prepared with full consideration of the latest government and Environment Agency (EA) guidance on flood risk and planning policy, namely:

- National Planning Policy Framework[1] (NPPF) 2023,
- Flood Risk and Coastal Change Planning Practice Guidance[2] (FRCC-PPG) 2022,
- How to Prepare a Strategic Flood Risk Assessment[3] guidance 2024,
- Strategic Flood Risk Assessment Good Practice Guide[4] 2021,
- Flood Risk Assessments: Climate Change Allowances[5] 2022.

The council have consulted the Environment Agency (EA), the Lead Local Flood Authority (LLFA) and other key stakeholders throughout the Level 2 SFRA process with full transparency provided between all parties.

At the time of writing, this Level 2 SFRA has assessed and considered flood risk in the Joint Local Plan area at a specific point in time. This Level 2 SFRA has been developed using the most up-to-date data and information available at the time of publication. The Level 2 SFRA has been future proofed as far as possible though the reader should always confirm with the source organisation (the councils) that the latest information is being used when decisions concerning development and flood risk are being considered.

[1] National Planning Policy Framework | UK Government | 2023
[2] Flood Risk and Coastal Change Planning Practice Guidance | UK Government | 2022
[3] How to Prepare a Strategic Flood Risk Assessment | Environment Agency | 2024
[4] Strategic Flood Risk Assessment Good Practice Guide | Association of Directors of Environment, Economy, Planning & Transport | 2021
[5] Flood Risk Assessments: Climate Change Allowances | Environment Agency | 2022

This SFRA uses the EA's Flood Map for Planning (FMfP) version accessed in June 2024 to assess fluvial risk, and the Risk of Flooding from Surface Water (RoFSW) dataset to assess surface water flood risk, also accessed in June 2024.

At the time of writing, the EA is planning to publish a new National Flood Risk Assessment (NaFRA2) in early 2025. NaFRA2 will provide a single picture of current and future flood risk from rivers, the sea and surface water, using both existing detailed local information and improved national data and surface water flood risk will be incorporated into the FMfP.

The EA is therefore pausing updates to the flood zones of the FMfP until Spring 2025. During this period, where new flood zone information becomes available in the study area, a comment will appear on the current FMfP service stating - "*Our understanding of flood risk from rivers and the sea has changed since this information was published*". Any new information must be used instead of the flood zones published on the FMfP service, when preparing or updating the SFRA, when requesting planning application flood risk assessments (FRA), and when applying the sequential and exception tests.

The NPPF (December 2023) is also, at the time of writing, undergoing a reform with the advent of the new Labour Government. A consultation period is ongoing, at the time of writing, with draft reforms to the NPPF due late 2024 / early 2025.

The FRCC-PPG (August 2022), alongside the NPPF, is referred to throughout this SFRA, being the current primary development and flood risk policy and guidance available at the time of the finalisation of this SFRA.

The EA's SFRA guidance states a review of a SFRA should be carried out when there are changes to:

- The predicted impacts of climate change on flood risk,
- Detailed flood modelling - such as from the EA or LLFA,
- The spatial development strategy or relevant local development documents,
- Local flood management schemes,
- Flood risk management plans,
- Local flood risk management strategies, and
- National planning policy or guidance.

The SFRA should also be reviewed after a significant flood event. It is in any authority's interest to keep the SFRA as up to date as possible.

Ideally, the SFRA should be kept as a 'live' entity and continually updated when new information becomes available. The EA requests for reports and maps to be published online and be easily updateable, when required.

2 Level 2 SFRA requirements

The aim of a Level 2 assessment is to build on the findings of the Level 1 SFRA, focussing on identified sites or communities at high and medium flood risk that are considered important to Local Plan development. This allows the SFRA process to be time efficient using detailed modelling techniques only where they are required in the Level 2 assessment. These locations usually include significant development and / or regeneration areas that are at medium or high risk of flooding from main rivers, ordinary watercourses, or surface water whilst also accounting for the impacts of climate change. Flood risk data such as modelled flood extents, depths, and hazards are used to assess the suitability of these areas for development. Appropriate mitigation techniques and achievable site layouts can then be informed.

This detailed information should support further application of the sequential test, the sequential approach to development management, inform on whether sites can pass the exception test, where applicable, and allow for flood risk indicators to be produced for use in the Sustainability Appraisal of the Joint Local Plan.

EA guidance[3] states a Level 2 SFRA should:

- *Be detailed enough for the LPA to identify which potential site allocations have the least risk of flooding,*
- *Contain the information needed to apply the exception test, if relevant,*
- *Enable the LPA to decide if development can be made safe without increasing flood risk elsewhere.*

It should enable the LPA to:

- *Apply the sequential approach by identifying the severity and variation in risk within medium and high flood risk areas,*
- *Establish whether proposed allocations or windfall sites, on which your local plan will rely, are capable of being made safe throughout their lifetime without increasing flood risk elsewhere,*
- *Apply the exception test, where relevant*.

A site-specific FRA will be required at the planning application stage which will assess risk to each site in greater detail than this Level 2 SFRA. The Level 2 SFRA is a strategic assessment that is not intended to replace the requirement of a site-specific FRA.

2.1 Objectives

In accordance with the latest national policy and guidance, the requirements of the councils, and with consideration of the limitations stated in Chapter 6, the key objectives of this Level 2 SFRA are to:

- Assess present day flood risk from all sources (fluvial, surface water, groundwater, canals, and reservoirs),

- Document potential residual risk from potential defence breaches and culvert blockages (no modelling),
- Assess detailed modelled outputs including flood depths, velocities, and hazards, where information is available,
- Assess existing flood warnings and advise on required emergency planning procedures and safety of site access and escape routes in times of flood,
- Account for the potential cumulative impacts of development based on the cumulative impacts assessment carried out for the Level 1 SFRA,
- Provide site-specific advice on mitigation options i.e. developable / non-developable areas; blue / green infrastructure and open spaces; maintenance of fluvial and / or surface water flow routes; land raising and compensatory storage; and advice on minimum finished floor levels; SuDS,
- Assess any catchment-wide or strategic solutions, e.g. upstream opportunity areas for flood management (storage solutions) to mitigate against the risk of flooding downstream and elsewhere using Natural Flood Management (NFM) and Working with Natural Processes (WwNP) datasets,
- Demonstrate whether the second part of the Exception Test (part b) can be passed for the potential development site allocations, where applicable,
- Provide recommendations for additional and future works required following on from or to supplement the Level 2 SFRA i.e. further fluvial or surface water modelling including for climate change, modelling of site layout / design options including provisions for safe access and escape routes, development optioneering (land raising, compensatory storage, flow routes / rates), drainage strategies, site-specific FRA requirements.

3 Available data and information

The data and information described in this chapter has been used in the Level 2 SFRA to assess the risk to each site.

3.1 EA flood models

Table 3-1 lists the EA hydraulic river models covering the Level 2 sites within the study area. Additional modelling beyond the available outputs noted in Table 3-1 has not been carried out for this assessment for the reasons stated.

Table 3-1 EA river models

Model	Return periods available	Climate change availability
River Thames - Thames (Sandford to Pangbourne) 2018	2-year, 5-year, 10-year, 20-year, 30-year, 50-year, 75-year, 100-year, 200-year, 1000-year	100-year + 25%, 100-year + 35%, 100-year + 70%
Northfield & Littlemore Brooks 2011	5-year, 20-year, 100-year, 1000-year	100-year +20%
Didcot Valley Park 2019	100-year, 1000-year	None
Moor Ditch (Didcot to Thames Confluence) 2007	20-year, 100-year, 1000-year	100-year +20%
Stert (A34 to Thames Confluence) 2012	5-year, 20-year, 100-year, 1000-year	100-year +20%
Letcombe Brook 2009	5-year, 20-year, 100-year, 1000-year	100-year +20%

3.2 EA Open Data (June 2024)

Additional to the EA modelling information, the following datasets available from the EA's Open Data have been considered in the Level 2 SFRA:

- Most recent LIDAR digital terrain model (DTM) data
- FMfP Flood Zones 2 and 3
- Flood Storage Areas
- Risk of Flooding from Surface Water extents, depths, and hazards for 3.3%, 1% and 0.1% Annual Exceedance Probability (AEP) events
- Reduction in Risk of Flooding from Rivers and Sea
- Spatial Flood Defences
- Historic Flood Map
- Recorded Flood Outlines
- Flood Warning Areas
- Flood Alert Areas

- Reservoir Flood Map
- Working with Natural Processes:
  - Riparian Woodland Potential
  - Wider Catchment Woodland Potential
  - Floodplain Woodland Potential
  - Floodplain Reconnection Potential
  - Runoff Attenuation Features 3.3% AEP
  - Runoff Attenuation Features 1% AEP

3.3 Other datasets

Other datasets and information used include:

- JBA 5m Groundwater Flood Map (already available under licence from JBA Risk Management from the Level 1 SFRA)
- LLFA historic flood incident register
- Sewer flooding - Thames Water flood incident register
- Canal & River Trust - historic overtopping and breach events
- Functional floodplain dataset - existing functional floodplain delineated through the Level 1 SFRA
- OS Open Data base mapping.

4 Methodology

This chapter presents the methodology used in each stage of the Level 2 SFRA. The site-specific reports (Appendix A) contain further information.

4.1 Accounting for climate change

A precautionary proxy approach has been applied to assessing the impacts of climate change on both fluvial and surface water flood risk to each site. This entails using the available 1% AEP event results and Flood Zone 3a as a precautionary proxy for the 3.3% AEP event plus climate change scenario (future functional floodplain) and using the available 0.1% AEP event results and Flood Zone 2 as a precautionary proxy for the 1% AEP event plus climate change scenario. Joint Local Plan policy (Section 5) details the requirements for development to be directed to the areas with the lowest risk of flooding from any source, taking into account the impacts of climate change.

4.2 1D flood mapping

Upon review of the EA's flood models, it is apparent that modelled flood depth and hazard information are not available for the Didcot Valley Park 2019 model and the Moor Ditch (Didcot to Thames Confluence) 2007 model. We have therefore, for both models, manually produced depth and hazard information through a simple 1D mapping process involving the projection of existing modelled 1D flood depths within the river channel across a 2D LIDAR digital elevation model terrain surface.

4.3 Residual risk modelling

Potential residual risk from structure blockages and raised defence breaches have not been modelled, due to the reasons already stated. Where a site is identified to be at potential residual risk, recommendations for further work are provided. It is recommended that any update to this Level 2 SFRA and/or any site-specific FRA should include for defence breach or structure blockage modelling to allow for an up-to-date assessment of residual risk.

For sites potentially at residual risk, the FRCC-PPG includes the following information:

- Areas of residual risk should be included in the sequential approach to risk avoidance when sequential testing or through development management.
- Where avoidance is not shown to be feasible through appropriate sequential testing, flood resistance and resilience measures should be in place, including for finished floor levels to be place above the design flood level plus a minimum of 300mm.
- Adequate flood warning and emergency plans should be available to site users. Residual risks will need to be safely managed to ensure people are not exposed to hazardous flooding. This includes the ability of residents and site users to safely access and escape a building during the design flood and to evacuate before an extreme flood event which is defined as the 0.1% AEP event with an

allowance for climate change (note it was not possible to model this event for this SFRA).

- The likelihood of defences keeping pace with climate change should be considered e.g. is funding available and what are the funding options (e.g. Community Infrastructure Levy, planning obligations / S106 agreements, or Partnership Funding). This should inform the nature of residual risk to be considered.
- Local planning authorities should use information on identified residual risk to state in strategic policies their preferred mitigation strategy for ensuring development will be safe throughout its lifetime in relation to urban form, risk management and where flood mitigation measures are likely to have wider sustainable design implications.
- A site-specific FRA will be required for all sites at residual risk. The FRAs would need to show that appropriate evacuation procedures and flood response infrastructure are in place to manage the residual risk associated with an extreme flood event.

4.4 Assessing flood risk from reservoirs

The EA's SFRA guidance[3] requests for the assessment of risk from reservoir dam failure using the EA's Reservoir Flood Map (RFM). The RFM shows the credible worst-case scenarios from dam failure in a dry day scenario. Para 046 of the FRCC-PPG states the following in relation to the risk of flooding from a reservoir:

The local planning authority will need to evaluate the potential damage to buildings or loss of life in the event of dam failure, compared to other risks, when considering development downstream of a reservoir. Local planning authorities are also advised to consult with the owners/operators of raised reservoirs, to establish constraints upon safe development.

Local planning authorities should also consider any implications for reservoir safety and reservoir owners and operators caused by new development located downstream of a reservoir, such as the cost of measures to improve the design of the dam to reduce flood risk, the operation of the reservoir, and general maintenance costs, by consulting with reservoir owners and operators on plan and development proposals. Local authorities, as category 1 responders, can access more information about reservoir risk and reservoir owners using the Resilience Direct system. Developers should be expected to cover any additional costs incurred, as required by the National Planning Policy Framework's 'agent of change' policy (paragraph 187). This could be through Community Infrastructure Levy or section 106 obligations for example.

Applications will need to include any evidence local planning authorities need to understand the impact of individual developments on reservoirs. In doing so, they need to refer to relevant guidance in the Institution of Civil Engineers publication Floods and Reservoir Safety (4th edition) and the Environment Agency's Guide to risk assessment for reservoir safety management. It may be necessary to seek expert advice, such as from an All

Reservoirs Panel Engineer, from the government accredited list under How to appoint a panel engineer.

Consideration should also be given to the potential impacts of development on the operation of reservoirs. This is particularly important where impacts could affect the management of flood risk or the supply of water.

Only site AS2 (Land adjacent to Culham Campus) is shown to be at risk from reservoir flooding according to the RFM. The LPA may wish to follow the above guidance for this site. However, this is for wider consideration within the local planning authority and emergency planning teams outside of the Level 2 SFRA.

4.5 Assessing flood risk from groundwater

Susceptibility of areas to groundwater flooding have been appraised using JBA's national 5m resolution Groundwater Flood Map. See the site-specific reports in Appendix A for groundwater flood risk to each potential site allocation.

4.6 Assessing flood risk from sewers

Information suitable for inclusion in the Level 2 assessment was not available.

4.7 Assessing historic flood risk

The EA's Historic Flood Map (HFM) and Recorded Flood Outlines (RFO) datasets have been considered. The LPA have also provided information on historic flood incidents within the vicinity of the sites.

4.8 Access and escape and emergency planning

EA Flood Warning Areas and Flood Alert Areas have been mapped and reviewed against the potential site allocations along with access and escape routes for each site and any evacuation routes which are modelled to stay dry or experience non-hazardous to life flooding. Liaison with emergency planners and the local resilience forum may be required at the site-specific FRA stage. See Appendix A site reports.

4.9 Cumulative impacts

Cumulative impacts of development and land use change were assessed in the Level 1 SFRA. A joined-up approach should be adopted between developers at the site-specific FRA stage for any clusters of sites to ensure possible flood risk mitigation at one site does not increase risk to a neighbouring or downstream site as a result of loss of floodplain storage, the deflection or constriction of flood flow routes, or through inadequate management of surface water. Para 049 of the FRCC-PPG states that site-specific flood risk assessments should assess cumulative impacts and demonstrate how mitigation measures have addressed them.

The site reports in Appendix A recommend for any clusters of sites at significant risk to be combined into a wider drainage strategy and masterplanning process.

4.10 Working with Natural Processes

The national Working with Natural Processes (WwNP) mapping dataset has been assessed as to whether there is any potential for WwNP techniques, such as flood storage, that could benefit potential site allocations. See Appendix A site reports for any potential areas.

5 Joint Local Plan Policy

The Joint Local Plan policy relating to development and flood risk, which applies to all sites assessed as part of this Level 2 SFRA, is outlined below.

Policy CE6 - Flood risk

1) The risk and impact of flooding must be minimised by:

   a) directing development to areas with the lowest risk of flooding from any source, taking into account current and future impacts of climate change;

   b) ensuring development does not increase the risk of flooding elsewhere;

   c) ensuring development is safe for its lifetime; and

   d) taking opportunities provided by development and improvements in green and other infrastructure to reduce the causes and impacts of flooding, making as much use as possible of natural flood management techniques that also deliver wider environmental benefits.

2) Development in areas at risk of flooding must pass the Sequential Test and where necessary the Exception Test, where they are required by national planning policy and guidance. Regard should be had to the Joint Local Plan Strategic Flood Risk Assessment (or any future update) in applying the tests.

3) A site-specific Flood Risk Assessment (FRA) must be provided for all development in Flood Zones 2 and 3. In Flood Zone 1 a FRA must accompany all proposals involving:

   a) sites of 1 hectare or more;

   b) land identified in the Strategic Flood Risk Assessment as being at increased flood risk in future; or

   c) land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use.

   FRAs must consider all sources of flood risk and the impacts of climate change. FRAs must also consider the cumulative impact of development on flood risk as set out in the Joint Local Plan Strategic Flood Risk Assessment (or any future update). It should be demonstrated that flood risk downstream will not be made worse by development. Measures that contribute to a reduction in flood risk downstream are encouraged.

4) Where flood risk is a consideration and relevant tests have been passed development must:

   a) firstly, seek to minimise flood risk through design, with site layouts that locate the most vulnerable elements of development

in areas of lowest flood risk (or on upper storeys) as far as possible and by raising finished floor and/or ground levels where appropriate.

b) then, where appropriate, investigate opportunities to control the risk of flooding in discussion with the council, Environment Agency and Oxfordshire County Council (as Lead Local Flood Authority). Consideration should be given to natural flood management techniques.

c) then use flood resistance and resilience measures to address any residual risk. Passive measures should be prioritised over active measures.

d) then consider any further flood management measures required. Safe access and escape routes must be provided. Consideration must also be given to whether adequate flood warning will be available to people using the development.

5) Planning permission will not be granted for development in the functional flood plain (Flood Zone 3b) except where it is for water-compatible uses or essential infrastructure (as defined in national planning policy and guidance) or where it is on brownfield land and includes a high standard of flood resistance and resilience measures designed to decrease risk compared with the existing situation. All of the following criteria must also be met:

a) development will not lead to a net increase in the built footprint and where possible will reduce the built footprint;

b) development will not result in a reduction in flood storage and where possible will increase flood storage;

c) development will not increase the risk of flooding elsewhere; and

d) any future occupants of the development will not be put at risk and safe access and escape routes will be provided.

Policy CE8 - Water quality, wastewater infrastructure and drainage

Protecting and enhancing water quality

1) Development must protect and enhance water quality, including through:

   a) the use of green infrastructure, including sustainable drainage systems (SuDS);

   b) utilising natural means of water quality improvements where possible, with mechanical water quality improvement devices only being used in situations where insufficient water quality improvement can be achieved through natural means;

   c) maximising water efficiency; and

   d) identifying and implementing opportunities to remedy historical water contamination issues, where appropriate.

2) Where a development includes the creation or extension of roads, the potential water quality issues associated with road runoff must be considered and appropriate mitigation provided to address impacts.

3) Where development may have an adverse impact on water quality, evidence must be provided that identifies potential impacts (including for human health, the natural environment and amenity) and suitable mitigation. Engagement should be undertaken with the Environment Agency to agree the scope and content of the evidence required. Mitigation must be in place before any environmental effects occur. Where appropriate, water quality monitoring should be undertaken and submitted to the council to ensure that mitigation is effective.

Meeting legal requirements

4) Development, individually or cumulatively, must not prevent the future attainment of "good" status under the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017.

5) Where there are impact pathways on habitats of national or international importance, development must not prevent a protected waterbody achieving the objectives set out in the Common Standards Monitoring Guidance (or any future standards/guidance that may supersede this).

Wastewater infrastructure

6) There must be adequate wastewater treatment capacity to serve development.

7) Applications for major development must be supported by a Sewage Capacity Assessment.

8) Where wastewater infrastructure capacity constraints are identified, development must not commence until the delivery of sufficient new and/or upgraded wastewater infrastructure has been agreed and programmed (between the developer and Thames Water or other utility provider). Development must not be occupied until the necessary wastewater treatment infrastructure upgrades have been completed. A phased approach may be required to ensure alignment between development and infrastructure delivery. The council will apply Grampian conditions, where appropriate, to ensure that adequate sewerage capacity is in place before new homes are occupied in order to protect water quality.

Drainage

9) All development will be required to provide a Drainage Strategy.

10) Development will be expected to incorporate sustainable drainage systems (SuDS) that:

a) are well designed;

b) are appropriate to their location (for example, infiltration SuDS are unlikely to be appropriate in areas of contamination, even following remediation);

c) are multifunctional, providing a range of benefits for people and nature, including protecting and enhancing water quality (including groundwater quality), managing flood risk and supporting biodiversity;

d) attenuate run-off rates to greenfield run-off rates. Higher rates would need to be justified and the risks quantified. Development on brownfield land should reduce run-off rates to as close to greenfield rates as possible; and

e) reduce the amount of water discharging to the wider wastewater infrastructure network at source, with opportunities taken to disconnect flows where possible. (For example, by using features such as water butts, swales and rain gardens, rather than direct network connections from gullies and rainwater pipes.)

11) Major development must comply with the latest local standards and guidance for surface water drainage produced by the Lead Local Flood Authority (Oxfordshire County Council).*

12) No new surface water connections are to be connected to a foul sewer. For brownfield sites, where existing connections are proven, the drainage strategy should seek to either remove these if feasible or attenuate existing flows to as close to the QBar greenfield rate as feasible or to a rate acceptable to Thames Water whichever is the lower.

13) In the case of extensions to buildings, changes of use and refurbishments, developments are encouraged to take the opportunity to upgrade the drainage of the existing building as well as the extension, by disconnecting roof drainage from the surface water sewer network and incorporating soakaways, water butts and greywater recycling schemes.

14) All development will be required to demonstrate suitable arrangements for future maintenance and management of drainage schemes. All below ground drainage serving more than one property should be designed to adoptable standards and offered to an OFWAT approved statutory water authority for adoption.

15) In areas where high groundwater could potentially affect the drainage system, specific measures should be incorporated in any new network provided to reduce the risk of groundwater affecting the drainage system.

**Current local standards can be found at Oxfordshire County Council (December 2021) Local Standards and Guidance for Surface Water Drainage on Major Development in Oxfordshire. V1.2: www.oxfordshirefloodtoolkit.com/wp-content/uploads/2022/01/LOCAL-STANDARDS-AND-GUIDANCE-FOR-SURFACE-WATER-DRAINAGE-ON-MAJOR-DEVELOPMENT-IN-OXFORDSHIRE-Jan-22-2.pdf*

6 Limitations

This Level 2 SFRA has been prepared under several limitations associated with the availability and quality of data. These limitations have been subject to consultation with council officers whereby alternative approaches have been agreed to enable the Level 2 SFRA to be prepared using available existing information. Consultation has also been undertaken with the EA, who have approved the use of alternative approaches. The timescales of the Local Plan programme meant it was not possible to update EA flood models with the latest information. The limitations include the following:

- The latest available EA flood models provided for use in the Level 2 SFRA are not up to date with the latest hydrology, therefore they may not be fully representative of current hydrological conditions. Model survey and digital terrain model data may also not be based on the latest information. The councils' Joint Local Plan budget and programme would not allow for any updates to the EA models. The EA models used in the assessment are listed in Table 3-1.
- As shown in Table 3-1, the latest climate change allowances for peak flows are also not represented in the models. As with the Level 1 SFRA, a precautionary proxy approach has therefore been applied to assessing the impacts of climate change on both fluvial and surface water flood risk to each site. This entails using the available 1% annual exceedance probability (AEP) event results and Flood Zone 3a as a precautionary proxy for the 3.3% AEP event plus climate change scenario and using the available 0.1% AEP event results and Flood Zone 2 as a precautionary proxy for the 1% AEP event plus climate change scenario. It is recommended that any update to this Level 2 SFRA and/or any site-specific FRA should include for the most up to date climate change allowances to allow for an up-to-date assessment of future flood risk.
- Several sites being assessed are at risk of flooding from rivers though an EA model is not available for a more detailed review of risk.
- Upon review of the EA's flood models, it is apparent that modelled flood depth and hazard information are not available for the Didcot Valley Park 2019 model and the Moor Ditch (Didcot to Thames Confluence) 2007 model. Modelled flood depth and hazard information is required to inform flood risk and potential developability of sites in a Level 2 SFRA. Depth and hazard information in these areas have therefore been produced using a simple 1D mapping process. This involves projecting existing modelled 1D flood depths within the river channel across a 2D LIDAR digital elevation model terrain surface. This method assumes uniformity across each cross-section and does not account for the detailed variations in topography and flow behaviour that occur laterally. Consequently, extrapolated flood extents may not be robustly predicted, leading to the formulation of isolated patches of flooding with no connectivity to the modelled watercourse. Small-scale topographical features, such as depressions and minor

elevations, may not be adequately resolved in the model, resulting in misrepresentations of where water might pool or flow.

- Residual flood risks from flood risk management infrastructure should be assessed through the Level 2 SFRA. However, due to the accelerated timetable for the Joint Local Plan, updating the available EA models to represent any residual risk scenarios was not possible.

Any future SFRA update should look to include updates to the EA models with the latest information that is available at the time, including up to date hydrology inputs, channel and bank survey, LIDAR terrain data, and using the latest modelling software to update and run the models. The latest climate change allowances should be modelled and used to update the SFRA. Any SFRA update should also use any detailed culvert information available from the LLFA to more robustly define the functional floodplain and any residual risk modelling of culvert blockage scenarios.

Joint Local Plan policies (Section 5) in relation to development and flood risk refer to directing development to the areas at the lowest risk of flooding from any source. Therefore, in the absence of an update to the SFRA ahead of any planning application for allocated sites, the site-specific FRA should address all these limitations to the satisfaction of the LPA, the EA, and the LLFA, where required.

7 Level 2 sites screening assessments

19 individual detailed Level 2 site screening reports have been produced detailing the site-specific assessments carried out through this Level 2 SFRA. Table 7-1 summarises the outcomes from the Level 2 assessment at each site.

7.1 Summary of Level 2 outcomes

Table 7-1 Level 2 site assessment outcomes

Site reference	Site name	How has main risk been identified?	Summary of Level 2 assessment	Main barriers to development	Further work / next steps
AS1	Land at Berinsfield Garden Village	No model available for River Thame therefore limited assessment	Based on current information and the use of proxies to represent the impacts of climate change, this site should be able to pass the exception test. However, all the recommendations suggested in this Level 2 SFRA should be considered at the site-specific FRA stage or before any site design planning. In the absence of updated modelled information, further detailed modelling of the River Thame should be required. An updated model should be used as part of a site-specific FRA to provide an up-to-date assessment of flood risk to this site and the surrounding area. Were this site to be allocated based on current information, the LPA must make it clear that this site cannot be developed until the required information detailed in this SFRA on existing and future flood risk from the River Thame and the unnamed watercourse is fully ascertained.	Absence of detailed river modelling. Groundwater conditions.	Updated modelling of the River Thame Site-specific FRA to inform development

Site reference	Site name	How has main risk been identified?	Summary of Level 2 assessment	Main barriers to development	Further work / next steps
AS2	Land adjacent to Culham Campus	River Thames - Thames (Sandford to Pangbourne) 2018	Based on current information and the use of proxies to represent the impacts of climate change, this site should be able to pass the exception test. However, all the recommendations suggested in this Level 2 SFRA should be considered at the site-specific FRA stage or before any site design planning. Updated climate change modelling of the River Thames should be used to update this Level 2 SFRA at the earliest opportunity to provide an up-to-date strategic assessment of flood risk to this site and the surrounding areas. It would be acceptable to use updated modelling to suitably assess risk through a site-specific FRA, as well as/instead of a Level 2 SFRA update. Were this site to be allocated based on current information, the LPA must make it clear that this site cannot be developed until the required information detailed in this SFRA on flood risk from the River Thames is fully ascertained.	Fluvial risk from the River Thames and absence of detailed modelling of climate change. Groundwater conditions.	Updated modelling of River Thames Site-specific FRA to inform development
AS3	Land South of Grenoble Road, Edge of Oxford	Northfield & Littlemore Brooks 2011	Based on current information and the use of proxies to represent the impacts of climate change, this site should be able to pass the exception test. However, all the recommendations suggested in this Level 2	Fluvial risk from Northfield Brook and Littlemore Brook and absence of detailed modelling of climate change.	Updated modelling of Northfield Brook and Littlemore

Site reference	Site name	How has main risk been identified?	Summary of Level 2 assessment	Main barriers to development	Further work / next steps
			SFRA should be considered at the site-specific FRA stage or before any site design planning. Updated climate change modelling of Northfield Brook and Littlemore Brook should be used to update this Level 2 SFRA at the earliest opportunity to provide an up-to-date strategic assessment of flood risk to this site and the surrounding areas. It would be acceptable to use updated modelling to suitably assess risk through a site-specific FRA, as well as/instead of a Level 2 SFRA update. Were this site to be allocated based on current information, the LPA must make it clear that this site cannot be developed until the required information detailed in this SFRA on flood risk from Northfield Brook and Littlemore Brook is fully ascertained.	Surface water flood risk. Groundwater conditions.	Brook. Surface water climate change modelling

Site reference	Site name	How has main risk been identified?	Summary of Level 2 assessment	Main barriers to development	Further work / next steps
AS4	Land at Northfield, Edge of Oxford	Northfield & Littlemore Brooks 2011	Based on current information and the use of proxies to represent the impacts of climate change, this site should be able to pass the exception test. However, all the recommendations suggested in this Level 2 SFRA should be considered at the site-specific FRA stage or before any site design planning. Updated climate change modelling of Northfield Brook should be used to update this Level 2 SFRA at the earliest opportunity to provide an up-to-date strategic assessment of flood risk to this site and the surrounding areas. It would be acceptable to use updated modelling to suitably assess risk through a site-specific FRA, as well as/instead of a Level 2 SFRA update. Were this site to be allocated based on current information, the LPA must make it clear that this site cannot be developed until the required information detailed in this SFRA on flood risk from Northfield Brook is fully ascertained.	Fluvial risk from Northfield Brook and absence of detailed modelling of climate change. Surface water flood risk. Groundwater conditions. Potential residual risk from Northfield Brook culvert.	Updated modelling of Northfield Brook including residual risk from culvert. Surface water climate change modelling
AS5	Land at Bayswater Brook, Edge of Oxford	No model available for Bayswater Brook	The exception test is not required for this site as it is not located within Flood Zone 3a. In the absence of updated modelled information, further detailed modelling of Bayswater Brook should be required to inform	Fluvial risk from Bayswater Brook and absence of detailed modelling of climate change.	Ste-specific FRA to inform development, including updated

Site reference	Site name	How has main risk been identified?	Summary of Level 2 assessment	Main barriers to development	Further work / next steps
			whether this site can be made safe for its lifetime. An updated model should be used as part of a site-specific FRA to provide an up-to-date assessment of flood risk to this site and the surrounding area. Were this site to be allocated based on current information, the LPA must make it clear that this site cannot be developed until the required information detailed in this SFRA on existing and future flood risk from Bayswater Brook is fully ascertained.	Surface water flood risk. Groundwater conditions.	modelling of Bayswater Brook
AS6	Rich's Sidings and Broadway, Didcot	N/A	The exception test is not required for this site as it is not located within Flood Zone 3a. Based on current information, this site could be allocated if development avoids the short surface water flow path along the eastern boundary of the site. Were this site to be allocated based on current information, the LPA must make it clear that this site cannot be developed until the required information detailed in this SFRA on future surface water flood risk is fully ascertained.	Surface water flood risk to surrounding roads	Site-specific FRA to inform development
AS7	Didcot Gateway, Didcot	N/A	The exception test is not required for this site as it is not located within Flood Zone 3a. Surface water risk should be attenuated onsite and included in site design and layout. Were this site to be allocated based on current information, the LPA must make it	Surface water flood risk	Site-specific FRA to inform development

Site reference	Site name	How has main risk been identified?	Summary of Level 2 assessment	Main barriers to development	Further work / next steps
			clear that this site cannot be developed until the required information detailed in this SFRA on future surface water flood risk is fully ascertained.		
AS8	North West of Grove, Grove	N/A	The exception test is not required for this site as it is not located within Flood Zone 3a. Surface water risk should be attenuated onsite and included in site design and layout. Were this site to be allocated based on current information, the LPA must make it clear that this site cannot be developed until the required information detailed in this SFRA on future surface water flood risk is fully ascertained.	Surface water flood risk. Groundwater conditions.	Site-specific FRA to inform development
AS9	North West of Valley Park, Didcot	Didcot Valley Park 2019 / Moor Ditch (Didcot to Thames Confluence) 2007. No modelled depths or hazards provided within the EA model share therefore derived through 1D mapping approach	The site is not required to pass the exception test as it is not located within Flood Zone 3a, and it is expected that vulnerable development will avoid the area of functional floodplain. Updated modelling of the unnamed drain included in the model should be used to update this Level 2 SFRA at the earliest opportunity to provide an up-to-date strategic assessment of flood risk to this site and the surrounding areas. It would be acceptable to use updated modelling to suitably assess risk through a site-specific FRA, as well as/instead of a Level 2 SFRA update.	Fluvial risk from unnamed drain and absence of detailed modelling of climate change.	Updated modelling of unnamed drain

Site reference	Site name	How has main risk been identified?	Summary of Level 2 assessment	Main barriers to development	Further work / next steps
			Were this site to be allocated based on current information, the LPA must make it clear that this site cannot be developed until the required information detailed in this SFRA on future flood risk from the unnamed watercourse is fully ascertained.		
AS10	Land at Dalton Barracks Garden Village, Shippon	No model available for Sandford Brook therefore limited assessment	The exception test is not required for this site as it is not located within Flood Zone 3a, and it is expected that vulnerable development will avoid the area of functional floodplain. In the absence of updated modelled information, further detailed modelling of Sandford Brook should be required to inform whether this site can be made safe for its lifetime. An updated model should be used as part of a site-specific FRA to provide an up-to-date assessment of flood risk to this site and the surrounding area. Were this site to be allocated based on current information, the LPA must make it clear that this site cannot be developed until the required information detailed in this SFRA on existing and future flood risk from Sandford Brook is fully ascertained.	Absence of detailed river modelling. Groundwater conditions.	Updated modelling of Sandford Brook Site-specific FRA to inform development
AS11	Culham Campus	N/A	The exception test is not required for this site as it is proposed for less vulnerable uses. Site wholly in Flood Zone 1. Development design and layout should include for the surface water flow path through the east of	Surface water flood risk. Groundwater conditions.	Site-specific FRA to inform development

Site reference	Site name	How has main risk been identified?	Summary of Level 2 assessment	Main barriers to development	Further work / next steps
			the site. A detailed drainage strategy will be required for any new development, given the large area of the site. Were this site to be allocated based on current information, the LPA must make it clear that this site cannot be developed until the required information detailed in this SFRA on future flood risk from surface water is fully ascertained.		
AS12	Harwell Campus	N/A	The exception test is not required for this site as it is proposed for less vulnerable uses. It should be appropriate for this site to be allocated, given the very low fluvial and surface water flood risk to the site. However, were this site to be allocated based on current information, the LPA must make it clear that this site cannot be developed until the required information detailed in this SFRA on future flood risk from surface water is fully ascertained.	Surface water flood risk	Site-specific FRA to inform development
AS16	Vauxhall Barracks, Didcot	N/A	The exception test is not required for this site as it is not located within Flood Zone 3a. It should be appropriate for this site to be allocated, given the very low fluvial and surface water flood risk to the site. However, were this site to be allocated based on current information, the LPA must make it clear that this site cannot be developed until the required information detailed in this SFRA on	Surface water flood risk.	Site-specific FRA to inform development

Site reference	Site name	How has main risk been identified?	Summary of Level 2 assessment	Main barriers to development	Further work / next steps
			future flood risk from surface water is fully ascertained.		
HOU2v	North-West of Abingdon-on-Thames	Stert (A34 to Thames Confluence) 2012	Note that the north eastern parcel of the site already has planning permission and is built out. The south western parcel remains available for development. Based on current information and the use of proxies to represent the impacts of climate change, this site should be able to pass the exception test. However, all the recommendations suggested in this Level 2 SFRA should be considered at the site-specific FRA stage or before any site design planning. Updated modelling of the River Stert should be used to update this Level 2 SFRA at the earliest opportunity to provide an up-to-date strategic assessment of flood risk to this site and the surrounding areas. It would be acceptable to use updated modelling to suitably assess risk through a site-specific FRA, as well as/instead of a Level 2 SFRA update. Were this site to be allocated based on current information, the LPA must make it clear that this site cannot be developed until the required information detailed in this SFRA on flood risk from the River Stert is fully ascertained.	Fluvial risk from River Stert and absence of detailed modelling of climate change. Groundwater conditions. Potential residual risk from River Stert culvert.	Updated modelling of River Stert and modelling of residual risk. Site-specific FRA to inform development.

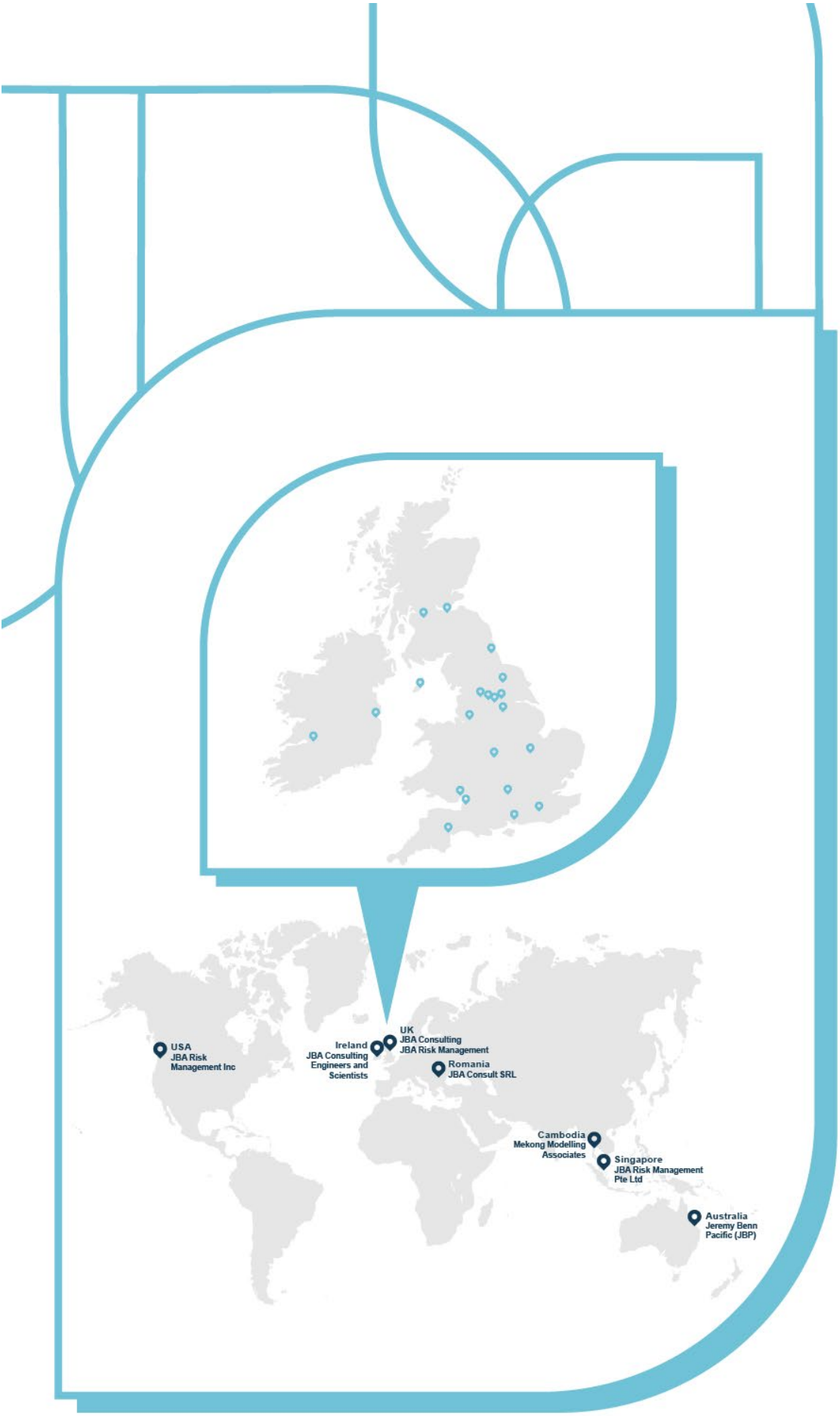
Site reference	Site name	How has main risk been identified?	Summary of Level 2 assessment	Main barriers to development	Further work / next steps
JT1a	Southmead Industrial Estate, Didcot	Moor Ditch (Didcot to Thames Confluence) 2007. No modelled depths or hazards provided within the EA model share therefore derived through 1D mapping approach	The exception test is not required for this site as it is proposed for less vulnerable uses. Updated modelling of Moor Ditch should be used to update this Level 2 SFRA at the earliest opportunity to provide an up-to-date strategic assessment of flood risk to this site and the surrounding areas. It would be acceptable to use updated modelling to suitably assess risk through a site-specific FRA, as well as/instead of a Level 2 SFRA update. Were this site to be allocated based on current information, the LPA must make it clear that this site cannot be developed until the required information detailed in this SFRA on flood risk from Moor Ditch is fully ascertained.	Fluvial risk from Moor Ditch and absence of detailed modelling of climate change. Groundwater conditions	Updated modelling of Moor Ditch. Site-specific FRA to inform development.
JT1e	Monument Business Park, Chalgrove	N/A	The exception test is not required for this site as it is proposed for less vulnerable uses. This site could be allocated if development avoids the area at modelled surface water flood risk in the high and medium risk events. However, were this site to be allocated based on current information, the LPA must make it clear that this site cannot be developed until the required information detailed in this SFRA on future flood risk from surface water is fully ascertained.	Surface water flood risk. Groundwater conditions.	Site-specific FRA to inform development.

Site reference	Site name	How has main risk been identified?	Summary of Level 2 assessment	Main barriers to development	Further work / next steps
JT1f	Abingdon Science Park	River Thames - Thames (Sandford to Pangbourne) 2018 No model available for Radley Park Ditch therefore limited assessment of risk from this watercourse	The exception test is not required for this site as it is proposed for less vulnerable uses. Updated climate change modelling of the River Thames and Radley Park Ditch should be used to update this Level 2 SFRA at the earliest opportunity to provide an up-to-date strategic assessment of flood risk to this site and the surrounding areas. It would be acceptable to use updated modelling to suitably assess risk through a site-specific FRA, as well as/instead of a Level 2 SFRA update. Were this site to be allocated based on current information, the LPA must make it clear that this site cannot be developed until the required information detailed in this SFRA on flood risk from the River Thames and Radley Park Ditch is fully ascertained.	Fluvial risk from the River Thames and absence of detailed modelling of climate change. Absence of detailed modelling for Radley Park Ditch. Potential residual risk from Radley Park Ditch culvert blockage and defence breach.	Detailed modelling of Radley Park Ditch. Site-specific FRA to inform development.
JT1i	Former Esso Research Centre	N/A	The exception test is not required for this site as it is proposed for less vulnerable uses. It should be appropriate for this site to be allocated, given the very low fluvial and surface water flood risk to the site. However, were this site to be allocated based on current information, the LPA must make it clear that this site cannot be developed until the required information detailed in this SFRA on future flood risk from surface water is fully ascertained.	Surface water flood risk	Site-specific FRA to inform development.

Site reference	Site name	How has main risk been identified?	Summary of Level 2 assessment	Main barriers to development	Further work / next steps
JT1k	South of Park Road, Faringdon	N/A	The exception test is not required for this site as it is proposed for less vulnerable uses. It should be appropriate for this site to be allocated, given the very low fluvial and surface water flood risk to the site. However, were this site to be allocated based on current information, the LPA must make it clear that this site cannot be developed until the required information detailed in this SFRA on future flood risk from surface water is fully ascertained.	Surface water flood risk. Groundwater conditions.	Site-specific FRA to inform development.

A Appendix A - Level 2 SFRA site screening reports

Contains 19 individual Level 2 SFRA site-screening reports.



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