Solihull Metropolitan Borough Council Level 2 Strategic Flood Risk Assessment

Final Report

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Solihull Metropolitan Borough Council

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Purpose

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Executive Summary

Introduction and Context

This Level 2 Strategic Flood Risk Assessment (SFRA) document undertakes a Level 2 assessment of site options identified by Solihull Metropolitan Borough Council. It builds upon the Level 1 SFRA completed in April 2017.

This Level 2 SFRA involves the assessment of 12 proposed development sites. In addition, since the previous SFRA was published, there have been updates to national and local planning policy, including the release of updated SFRA guidance in August 2019. This 2020 Level 2 SFRA has updated information on flood data, flood risk policy and recommendations for the cumulative impact of development. The policy recommendations for the River Cole and River Blythe catchments cover all proposed developments in those catchments.

SFRA Objectives

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

- **Level One:** where flooding is not a major issue in relation to potential development sites and where development pressures are low. The assessment should be sufficiently detailed to allow application of the Sequential Test.
- **Level Two**: where land outside Flood Zones 2 and 3 cannot appropriately accommodate all the necessary development creating the need to apply the NPPF's Exception Test. In these circumstances, the assessment should consider the detailed nature of the flood characteristics within a Flood Zone and assessment of other sources of flooding.

Level 2 SFRA Outputs

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

- An assessment of all sources of flooding including fluvial flooding, surface water flooding, groundwater flooding, mapping of the functional floodplain and the potential increase in fluvial flood risk due to climate change.
- Reporting on current conditions of flood defence infrastructure, where applicable.
- 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 for managing surface water runoff.
- Advice on whether the sites are likely to pass the second part of the Exception Test with regards to flood risk and on the requirements for a site-specific FRA.

As part of the Level 2 SFRA, detailed site summary tables have been produced for the proposed sites, covering the above. To accompany each site summary table, there is an Interactive Geo-PDF map, with all the mapped flood risk outputs.

Summary of the Level 2 SFRA

Solihull Metropolitan Borough Council (SMBC) initially provided a list of 24 sites for review. These sites were screened against the following flood risk datasets to assess how many should be carried forward for Level 2 assessment:

- Fluvial flood zones
- The 100 year fluvial event with an allowance for climate change
- The Risk of Flooding from Surface Water map
- The proximity to a Main River or other watercourse

Of the 12 sites assessed in the Level 2 SFRA:

- 2 sites required no additional flood modelling
- 2 sites required strategic modelling to understand fluvial flood risk
- 6 sites required strategic modelling with the inclusion of surveyed structures to understand fluvial flood risk
- 2 sites required detailed modelling or a hydrological assessment to understand fluvial flood risk

Each site specific summary table produced sets out the flood risk to each site based on a range of flood risk datasets and the strategic or detailed flood modelling completed as part of this study. Each table 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 types of SuDS techniques.

To accompany each site summary table, there is an Interactive 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 and bottom of the mapping, to allow easy navigation of the data.

The following points summarise the Level 2 assessment:

- The majority of the sites assessed as part of this Level 2 SFRA are at fluvial flood risk. The degree of flood risk varies, with some sites being only marginally affected along their boundaries, and other sites being more significantly affected within the site. Sites significantly affected by fluvial flooding will require more detailed investigations to inform a sequential approach to site layouts, SuDS possibilities, safe access and egress etc, as part of a site specific Flood Risk Assessment taken forward by a developer.
- The majority of sites at fluvial risk are also at risk from surface water flooding, with areas of ponding in the higher return period events across some sites and the access roads surrounding them. Surface water tends to follow topographic flow routes, for example along the watercourses or isolated pockets of ponding where there are topographic depressions. Site 17 – Moat Lane for example is at very low fluvial flood risk but has a significant surface water flow path running through the site. The impact of surface water flooding at sites such as this will need more detailed investigations undertaken as part of a site specific Flood Risk Assessment at a later stage.
- The strategic and detailed modelling completed as part of this SFRA made allowances for the impact of climate change. For the 1 in 100 year event, the 2080s period was used, and all three allowance categories were modelled (20%, 30% & 50%). Modelling indicates that flood extents will increase as a result of climate change and therefore, the depths, velocities and hazard of flooding are also seen to increase. The increases seen are more significant on some sites compared to others. Site-specific FRAs should confirm the impact of climate change using latest guidance.
- Structures and culvert locations have been identified where the structure upstream, downstream or within the site could have an impact on flood risk. A 2016 study using JScreen, a culvert blockage modelling software, has been used to look at the impact of culvert blockages on flood risk across sites. Specific survey and modelling has also been undertaken as part of the assessment where was it identified that this would add value.

This impact of blockages on flood risk needs to be considered further as part of a site-specific FRA.

- For some sites, there is the potential for safe access and egress to be impacted by fluvial or surface water flooding. Consideration should be made to these sites as to how safe access and egress can be provided during flood events, both to people and emergency vehicles.
- 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.
- Sites which have areas designated by the Environment Agency as being a historic landfill site will require site ground investigations to determine the extent of the contamination and the impact this may have on SuDS. No Level 2 sites are located in a Groundwater Source Protection Zone.
- The Cumulative Impact Assessment (CIA), which includes Site 4 and 26 in the River Cole catchment and Site 12 in the River Blythe catchment is currently underway. The results of this assessment will be added to the draft report once completed and the report will be re-issued for comment.

At the planning application stage and as part of a Flood Risk Assessment, developers will need to undertake detailed hydrological and hydraulic assessments of watercourses to verify flood extent, depth, velocity and hazard (including considering the 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 should use the information in this SFRA to inform the Exception Test. At planning application stage, the Developer must design the site such that is appropriate flood resistant and resilient 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 Exception Test and present this information to the Local Planning Authority for approval. The Level 1 SFRA can be used to scope the flooding issues that a site-specific FRA should look into 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 Flood Risk Assessment and drainage strategies with both the Local Planning Authority and the LLFA, to identify any potential issues that may arise from the development proposals.

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Abbreviations and Glossary of Terms

Term	Definition
1D model	One-dimensional hydraulic model
2D model	Two-dimensional hydraulic model
AStGWf	Areas Susceptible to Groundwater flooding
Brownfield	Previously developed parcel of land
CC	Climate change - Long term variations in global temperature and weather patterns caused by natural and human actions.
DTM	Digital Terrain Model
EA	Environment Agency
Exception Test	Set out in the NPPF, the Exception Test is 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 as floodwalls and embankments; they are designed to a specific standard of protection (design standard).
Flood Map for Planning	The Environment Agency Flood Map for Planning (Rivers and Sea) is an online mapping portal which shows the Flood Zones in England. The Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences and do not account for the possible 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).
FWA	Flood Warning Area
Fluvial Flooding	Flooding resulting from water levels exceeding the bank level of a River
FRA	Flood Risk Assessment - A site-specific assessment of all forms of flood risk to the site and the impact of development of the site to flood risk in the area.
Greenfield	Undeveloped parcel of land
Ha	Hectare
IH124	A hydrology methodology produced by the Institute of Hydrology to assess the runoff from small catchments.
JBA	Jeremy Benn Associates
Jflow	2D generalised hydrodynamic modelling software.
LIDAR	Light Detection and Ranging
LLFA	Lead Local Flood Authority - Local Authority responsible for taking the lead on local flood risk management
m AOD	metres Above Ordnance Datum
NPPF	National Planning Policy Framework
NPPG	National Planning Practice Guidance
NRD	National Receptor Database
Ordinary Watercourse	All watercourses that are not designated Main River. Local Authorities or, where they exist, IDBs have similar permissive powers as the Environment Agency in relation to flood defence work. However, the riparian owner has the responsibility for maintenance.
Pluvial flooding	Flooding as a result of high intensity rainfall when water is ponding or flowing over the ground surface (surface runoff) before it enters the underground drainage network or watercourse or cannot enter it because the network is full to capacity.
ReFH	Revitalised Flood Hydrograph
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.
RoFSW	Risk of Flooding from Surface Water (formerly known as the Updated Flood Map for Surface Water (uFMfSW))
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.

Term	Definition
SFRA	Strategic Flood Risk Assessment
SPZ	(Groundwater) Source Protection Zone
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.
SuDS	Sustainable Drainage Systems - Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques
Surface water flooding	Flooding 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, thus causing what is known as pluvial flooding.
URBEXT	Urban extent catchment descriptor, describing the level of urbanisation in a catchment.

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 Environment Agency and other relevant flood risk management* ***authorities, such as lead local flood authorities and internal drainage boards.".***
>
> (National Planning Policy Framework, paragraph 156)

This Strategic Flood Risk Assessment (SFRA) 2020 document provides a Level 2 assessment of strategic sites identified for potential allocation within Solihull.

1.2 Levels of SFRA

The Planning Practice Guidance[1] (PPG) advocates a tiered approach to risk assessment and identifies the following two levels of SFRA:

- Level 1: where flooding is not a major issue 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.
- Level 2: where land outside Flood Zones 2 and 3 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.

1.3 SFRA Objectives

The objectives of the Level 2 SFRA are to:

1. Undertake site specific flood risk analysis for the site identified using the latest available flood risk data, thereby assisting the Council in applying the Exception Test to its proposed site options in preparation of its Local Plan.
2. Using available data, 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 most recent policy and legislation in the NPPF, PPG and LLFA SuDS guidance.
5. Following Environment Agency recommendations, undertake strategic analysis of the River Cole and River Blythe catchments in the form of a cumulative impact assessment.

[1] Planning Practice Guidance – Flood Risk and Coastal Change - Paragraph: 012 Reference ID: 7-012-20140306

1.4 Context of the Level 2 Assessment

The Solihull Metropolitan Borough Council Level 1 SFRA was undertaken by JBA Consulting and published in April 2017. This report appraised flood risk from all sources in the Solihull Metropolitan Borough.

The current Solihull Local Plan was adopted in December 2013 and covers the period 2011 to 2028. The Council is currently undertaking a Local Plan Review (LPR). The SMBC Local Development Scheme (LDS), sets out the programme for reviewing the Solihull Local Plan (SLP), which is currently the principal statutory development plan document for the Borough.

JBA Consulting were provided with a list of preferred sites from SMBC, which were screened against flood risk information to provide a summary of flood risk to each site. In total, 12 sites were identified as requiring Level 2 assessment.

1.5 Consultation

SFRAs should be prepared in consultation with other Risk Management Authorities (RMAs). The following parties, external to SMBC, have been consulting during the preparation of the Level 2 SFRA:

- Environment Agency
- Severn Trent Water
- Canal and Rivers Trust

1.6 How to Use this Report

Table 1-1 SFRA User Guide

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 for any relevant policy which may underpin strategic or site-specific assessments.
3. Planning policy for flood risk management	Provides an overview of both national and existing Local Plan policy on flood risk management	Users should use this section to understand and follow the steps required for the Sequential and Exception Tests.
4. Impact of climate change	Outlines the latest climate change guidance published by the Environment Agency and how this was applied to the SFRA Sets out how developers should apply the guidance to inform site specific Flood Risk Assessments	This section should be used to understand the climate change allowances for a range of epochs and conditions, linked to the vulnerability of a development.
5. Sources of information used in preparing the Level 2 SFRA	Summarises the data used in the Level 2 assessments and GeoPDF mapping	Users should refer to this section in conjunction with the summary tables and GeoPDF mapping to understand the data presented. Developers should refer back to this section when understanding requirements for a site-specific FRA.
6. Level 2 Assessment Methodology	Summarises the sites requiring Level 2 assessment and the outputs produced for each of these sites.	This section should be used in conjunction with the site summary tables and GeoPDF mapping to understand the data presented.

7. 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 to understand requirements for FRAs and what conditions/ guidance documents should be followed. Developers should also refer to the L1 SFRA for further information on flood mitigation options.
8. Surface water management and SuDS	An overview of any specific local standards and guidance for Sustainable Drainage Systems (SuDS) from the Lead Local Flood Authority. Refers back to relevant sections in the L1 SFRA for information on SuDS and surface water management.	Developers should use this section to understand what national, regional and local SuDS standards are applicable. Hyperlinks are provided. Developers should also refer to the L1 SFRA for further information on types of SuDS, the hierarchy and management trains information.
9. Cumulative impact of development and strategic solutions	Makes policy recommendations regarding the cumulative impact of development on flood risk for the River Cole and River Blythe catchments	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.
10. 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 provide an overview of the Level 2 assessment. Planners should use this section to identify which potential site allocations have the least risk of flooding. Developers should refer to the Level 1 SFRA recommendations when considering requirements for site-specific assessments.
Appendix A: Level 2 Assessment - Site Summary Tables	Provides a detailed summary of flood risk for sites requiring a more detailed assessment. The section 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: Interactive Mapping	Provides interactive PDF mapping for each Level 2 assessed site showing flood risk at and around the site.	Planners and developers should use these maps in conjunction with the site summary tables to understand the nature and location of flood risk.
Appendix C: Strategic Modelling Report	Provides technical information on the 8 strategic models completed as part of this SFRA.	For technical background information.
Appendix D: Site 4 Modelling Report	Provides technical information on the detailed model developed for Site 4 – West of Dickens Heath	For technical background information.
Appendix E: Site 12 Hydrology Technical Note	Technical note summarising the hydrological analysis of the existing model covering Site 12 – South of Dog Kennel Lane and recommendations for future hydrology updates	For technical background information.

Advice to users has been highlighted in amber boxes throughout the document.

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

1.7 SFRA Study Area

The Solihull Metropolitan Borough covers an area of approximately 180km^2 and has a population of approximately 216,374[2].

Solihull is located on the southern edge of the West Midlands. The borough is bound by the City of Birmingham and the Black Country to the west, and Coventry to the east. To the north, there is rural North Warwickshire and to the south, Bromsgrove, Stratford and Warwick.

The main river in the north of the borough is the River Cole and its tributaries:

- Kingshurst Brook
- Low Brook
- Hatchford Brook

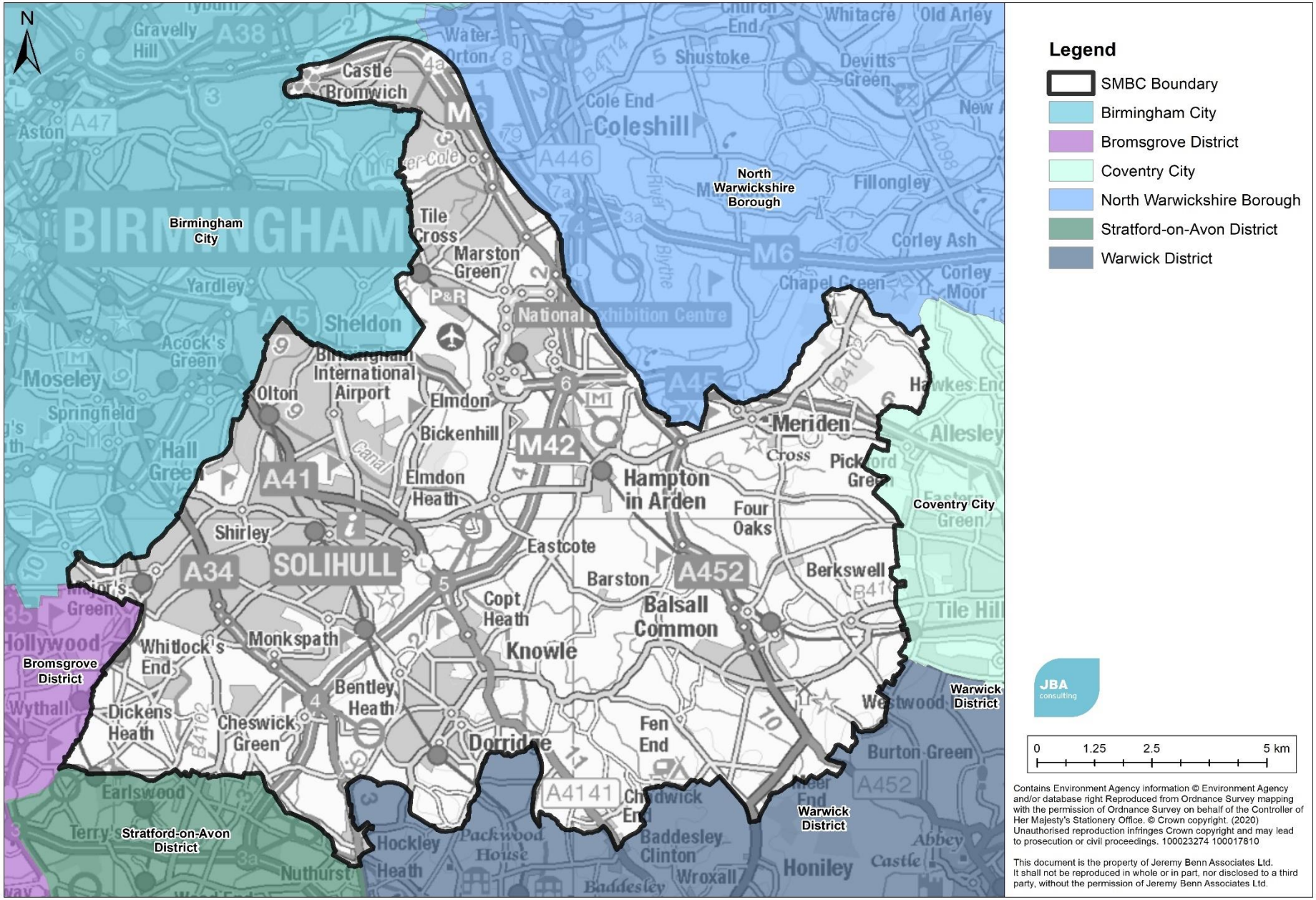
The main river in the south of the borough the River Blythe and its tributaries:

- Hollywell Brook
- Shadow Brook
- Purnell's Brook
- Alder Brook
- Mount Brook

Both the River Cole and the River Blythe feed into the River Tame to the north east of the SMBC boundary. An overview of the study area is shown in Figure 1-1.

2 Office for National Statistics. Estimates of the population for the UK, England and Wales, Scotland and Northern Ireland. Mid-2019: April 2020 Local Authority District Codes. https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/datasets/populationestimatesforukenglandandwalesscotlandandnorthernireland

Figure 1-1 Study Area



2 The Planning Framework and Flood Risk Policy

2.1 Introduction

The overarching aim of development and flood risk planning policy in the UK is to ensure that the potential risk of flooding is taken into account at every stage of the planning process. This section of the Level 2 SFRA provides an overview of the planning framework, flood risk policy and flood risk responsibilities, given the changes since the previous SFRA publications. In preparing the subsequent sections of this SFRA, appropriate planning and policy amendments have been acknowledged and taken into account.

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

2.2 Roles and Responsibilities for Flood Risk Management

There are a number of different organisations in and around Solihull that have responsibilities for flood risk management, known as Risk Management Authorities (RMAs). These are shown on Table 2 1, with a summary of their responsibilities.

It is important to note that land and property owners are responsible for the maintenance of watercourses either on or next to their properties. Property owners are also responsible for the protection of their properties from flooding. More information can be found in the Environment Agency publication Owning a Watercourse (2018).

When it comes to undertaking works to reduce flood risk, the Environment Agency and SMBC as LLFA do have powers, but limited resources must be prioritised and targeted to where they can have the greatest effect.

Table 2-1 Roles and Responsibilities for Flood Risk Management

Risk Management Authority	Strategic Level	Operational Level	Planning Role
Environment Agency	• Strategic overview for all sources of flooding • National Strategy • Reporting and general supervision	• Main rivers • Reservoirs	• Statutory consultee for development in Flood Zones 2 and 3
Solihull Metropolitan Borough Council - Lead Local Flood Authority (LLFA)	• Preliminary Flood Risk Assessment • Local Flood Risk Management Strategy	• Surface Water • Groundwater • Ordinary Watercourses (consenting and enforcement) • Ordinary watercourses (works)	• Statutory consultee for all major developments
Solihull Metropolitan Borough Council - Local Planning Authority (LPA)	• Local Plans as Local Planning Authorities	• Determination of Planning Applications as Local Planning Authorities • Managing open spaces under Council ownership	• As left

Risk Management Authority	Strategic Level	Operational Level	Planning Role
Water Companies: Severn Trent Water	• Asset Management Plans supported by Periodic Reviews (business cases) • Develop Drainage and Wastewater management plans	• Public sewers	• Non-statutory consultee
Highways Authorities: Highways Agency - motorways and trunk roads Solihull Metropolitan Borough Council – Other adopted roads	• Highway drainage policy and planning	• Highway drainage	• Internal planning consultee regarding highways and design standards and options

2.3 Relevant Legislation

The following legislation is relevant to development and flood risk in the Solihull Metropolitan Borough:

- Flood Risk Regulations (2009) transpose the EU Floods Directive (2000) into UK law and require the Environment Agency and LLFAs to produce Preliminary Flood Risk Assessments (PFRAs) and identify where there are nationally significant Flood Risk Areas. For the Flood Risk Areas, detailed flood maps and a Flood Risk Management Plan are produced. This is a six-year cycle of work and the second cycle started in 2017.
- Town and County Planning Act (1990), Water Industry Act (1991), Land Drainage Act (1991), Environment Act (2005) 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 FRM role.
- Land Drainage Act (1991) and Environmental Permitting Regulations (2016) define where developers need to apply for additional permission (and Planning Permission) to undertake works to an ordinary watercourse or Main River.
- Water Environment Regulations (2017) transpose the European Water Framework Directive (2000) into law, requiring the Environment Agency to produce River Basin Management Plans (RBMPs). These aim to ensure that the water quality of aquatic ecosystems, riparian ecosystems and wetlands 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.
- Note that secondary UK legislation implementing EU Directives such as the Flood Risk Regulations and Water Environment Regulations are subject to repeal/ amendment following the UK exit from the EU. At the time of publishing this report the UK is in the transition period following EU exit and the references here were correct.

2.4 Relevant Flood Risk Policy and Strategy Documents

Table 2-2 summarises some of the relevant national, regional and local flood risk policy and strategy documents and how these apply to development and flood risk. There are hyperlinks to the documents in the table. These documents may:

- Provide useful and specific local information to inform flood risk assessments within the local area.
- Set the strategic policy and direction for Flood Risk Management (FRM) and drainage – they may contain policies and action plans that set out what future mitigation and climate change adaptation plans may affect a development site. A developer should seek to contribute in all instances to the strategic vision for FRM and drainage in Solihull.
- Provide guidance and/ or standards that informs how a developer should assess flood risk and/ or design flood mitigation and SuDS.

Table 2-2 National, Regional and Local Flood Risk Guidance, Policy and Strategy Documents

	Document, lead author and date	Information	Policy and Measures	Development Design Requirements	Next Update Due
National	Flood and Coastal Management Strategy (Environment Agency) 2020	No	Yes	No	Due to be reviewed in 2026
	National Planning Policy Framework and Guidance (MCHLG) 2018/2015	No	No	Yes	
	Building Regulations Part H (MCHLG) 2010	No	No	Yes	-
Regional	River Trent Catchment Flood Management Plan (Environment Agency) 2010	Yes	Yes	No	-
	Humber River Basin District River Basin Management Plan (Environment Agency) 2015	No	Yes	No	2021
	Climate Change Guidance for Flood Risk Assessment (Environment Agency) 2020	No	No	Yes	2021
Local	Solihull Level 1 Strategic Flood Risk Assessment (JBA Consulting) 2017	Yes	No	No	
	Solihull Local Plan Policy P11 - Water Management (SMBC) 2013	Yes	Yes	Yes	-
	SMBC Preliminary Flood Risk Assessment (2011) and Update (2017) (SMBC)	Yes	No	No	-
	SMBC Local Flood Risk Management Strategy (WSP) 2015	Yes	Yes	No	2021
	A Guide to SuDS and Drainage in Solihull (SMBC)	Yes	Yes	Yes	2021

2.5 Relevant Flood Risk Management Studies and Documents

2.5.1 The National Flood and Coastal Erosion Risk Management Strategy for England (2011 and 2020)

The National Flood and Coastal Erosion Risk Management Strategy (FCERM) for England provides the overarching framework for future action by all risk management authorities to tackle flooding and coastal erosion in England. The new Strategy has been in preparation since 2018. The Environment Agency brought together a wide range of stakeholders to develop the strategy collaboratively. The Strategy is much more ambitious than the previous one from 2011 and looks ahead to 2100 and the action needed to address the challenge of climate change.

The Strategy has been split into 3 high level ambitions: climate resilient places, today's growth and infrastructure resilient in tomorrow's climate and a nation ready to respond and adapt to flooding and coastal change. Measures include updating the national river, coastal and surface water flood risk mapping and the understanding of long term investment needs for flood and coastal infrastructure, trialling new and innovative funding models, flood resilience pilot studies, developing an adaptive approach to the impacts of climate change, seeking nature based solutions towards flooding and erosion issues, integrating natural flood management into the new Environmental Land Management scheme, considering long term adaptive approaches in Local Plans, maximising the opportunities for flood and coastal resilience as part of contributing to environmental net gain for development proposals, investing in flood risk infrastructure that supports sustainable growth, aligning long term strategic planning cycles for flood and coastal work between stakeholders, mainstreaming property flood resilience measures and 'building back better' after flooding, consistent approaches to asset management and record keeping, updating guidance on managing high risk reservoirs in light of climate change, critical infrastructure resilience, education, skills and capacity building, research, innovation and sharing of best practise, supporting communities to plan for flood events, develop world leading ways of reducing the carbon and environmental impact from the construction and operation of flood and coastal defences, development of digital tools to communicate flood risk and transforming the flood warning service and increasing flood response and recovery support.

The Strategy was laid before parliament in July 2020 for formal adoption and published alongside a New National Policy Statement for Flood and Coastal Erosion Risk Management. The statement sets out five key commitments which will accelerate progress to better protect and better prepare the country for the coming years:

1. Upgrading and expanding flood defences and infrastructure across the country,
2. Managing the flow of water to both reduce flood risk and manage drought,
3. Harnessing the power of nature to not only reduce flood risk, but deliver benefits for the environment, nature, and communities,
4. Better preparing communities for when flooding and erosion does occur, and
5. Ensuring every area of England has a comprehensive local plan for dealing with flooding and coastal erosion.

2.6 LLFAs, Surface Water and SuDS

The 2019 NPPF states that: 'Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate' (Para 165). When considering planning applications, local planning authorities should consult the LLFA on the management of surface water in order to satisfy that:

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

SMBC's SuDS requirements for new developers are set out in the Guide to SuDS and Drainage in Solihull document.

The 2019 NPPF states that flood risk should be managed "using opportunities provided by new development to reduce causes and impacts of flooding." As such, SMBC expects SuDS to be incorporated on minor development as well as major development. Masterplans should be designed to ensure that space is made for above ground SuDS features. Underground tanks should only be used on sites as a last resort.

2.7 Surface Water Management Plans

Surface Water Management Plans (SWMPs) outline the preferred surface water management strategy in a given location. SWMPs are undertaken, when required, by LLFAs in consultation with key local partners who are responsible for surface water management and drainage in their area. SWMPs establish a long-term action plan to manage surface water in an area and are intended to influence future capital investment, drainage maintenance, public engagement and understanding, land-use planning, emergency planning and future developments. The risk assessment phases of a SWMP has been undertaken by SMBC, which will be used to inform prioritisation of future flood management actions in the Borough.

2.8 Updated Strategic Flood Risk Assessment Guidance

There was an update to the **'How to prepare a Strategic Flood Risk Assessment guidance'** in August 2019, which had some key additions to both Level 1 and Level 2 assessments. The Level 2 assessment is undertaken in accordance with this guidance.

3 Planning Policy for Flood Risk Management

3.1 National Planning Policy Framework and Guidance

The revised National Planning Policy Framework (NPPF) was published in February 2019, replacing the 2012 version. The NPPF sets out Government's planning policies for England. It must be taken into account in the preparation of local plans and is a material consideration in planning decisions. The NPPF defines Flood Zones, how these should be used to allocate land and flood risk assessment requirements. The NPPF states that:

"Strategic policies should be informed by a strategic flood risk assessment and should manage flood risk from all sources. They should consider cumulative impacts in, or affecting, local areas susceptible to flooding, and take account of advice from the Environment Agency and other relevant flood risk management authorities, such as lead local flood authorities and internal drainage boards"

Planning Practice Guidance on flood risk was published in March 2014 and sets out how the policy should be implemented. Diagram 1 in the NPPG sets out how flood risk should be considered in the preparation of Local Plans.

3.2 The Risk Based Approach

The NPPF takes a risk-based approach to development in flood risk areas.

3.3 The Flood Zones

The definition of the Flood Zones is provided below. The Flood Zones do not consider defences. This is important for planning long term developments as long-term policy and funding for maintaining flood defences over the lifetime of a development may change over time.

The Flood Zones do not consider surface water, sewer or groundwater flooding or the impacts of canal or reservoir failure. They do not consider climate change. Hence there could still be a risk of flooding from other sources and that the level of flood risk will change over time during the lifetime of a development.

Table 3-1 Fluvial Flood Zone Summary

Zone	Probability	Description
Zone 1	Low	This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).
		All land uses are appropriate in this zone.
		For development proposals on sites comprising one hectare or above the vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off, should be incorporated in a flood risk assessment.
Zone 2	Medium	This zone comprises land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (0.1% - 1%) or between 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.1% – 0.5%) in any year.
		Essential infrastructure, water compatible infrastructure, less vulnerable and more vulnerable land uses (as set out by NPPF) as appropriate in this zone. Highly vulnerable land uses are allowed as long as they pass the Exception Test.
		All developments in this zone require an FRA.

Zone	Probability	Description
Zone 3a	High	This zone comprises land assessed as having a greater than 1 in 100 annual probability of river flooding (>1.0%) or a greater than 1 in 200 annual probability of flooding from the sea (>0.5%) in any year Developers and the local authorities should seek to reduce the overall level flood risk, relocating development sequentially to areas of lower flood risk and attempting to restore the floodplain and make open space available for flood storage.
		Water compatible and less vulnerable land uses are permitted in this zone. Highly vulnerable land uses are not permitted. More vulnerable and essential infrastructure are only permitted if they pass the Exception Test.
		All developments in this zone require an FRA.
Zone 3b	Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. SFRAs should identify this Flood Zone in discussion with the LPA and the Environment Agency. The identification of functional floodplain should take account of local circumstances.
		Only water compatible and essential infrastructure are permitted in this zone and should be designed to remain operational in times of flood, resulting in no loss of floodplain or blocking of water flow routes. Infrastructure must also not increase flood risk elsewhere.
		All developments in this zone require an FRA.

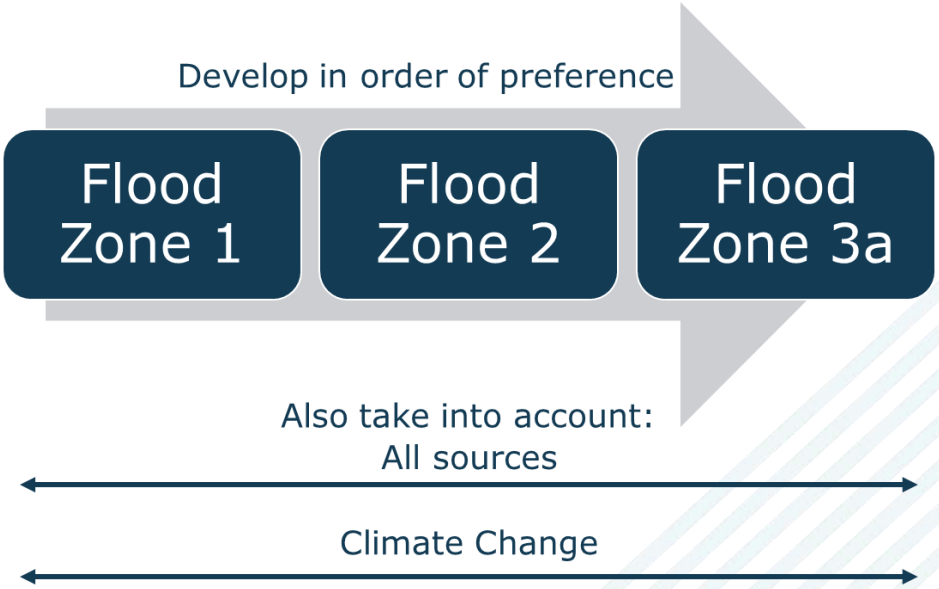
3.4 The Sequential Test

Firstly, land at the lowest risk of flooding and from all sources should be considered for development. A test is applied called the 'Sequential Test' to do this. Figure 3-1 summarises the Sequential Test. The LPA will apply the Sequential Test to strategic allocations. For all other developments, developers must supply evidence to the LPA, with a Planning Application, that the development has passed the test.

The LPA should work with the Environment Agency to define a suitable area of search for the consideration of alternative sides in the Sequential Test. The Sequential Test can be undertaken as part of a Local Plan Sustainability Appraisal. Alternatively, it can be demonstrated through a free-standing document, or as part of Strategic Housing Land or Employment Land Availability Assessments.

Whether any further work is needed to decide if the land is suitable for development will depend on both the vulnerability of the development and the Flood Zone it is proposed for. Table 2 of the NPPG defines the vulnerability of different development types to flooding. Table 3 of the NPPG shows whether, having applied the Sequential Test first, that vulnerability of development is suitable for that Flood Zone and where further work is needed.

Figure 3-1: The Sequential Test

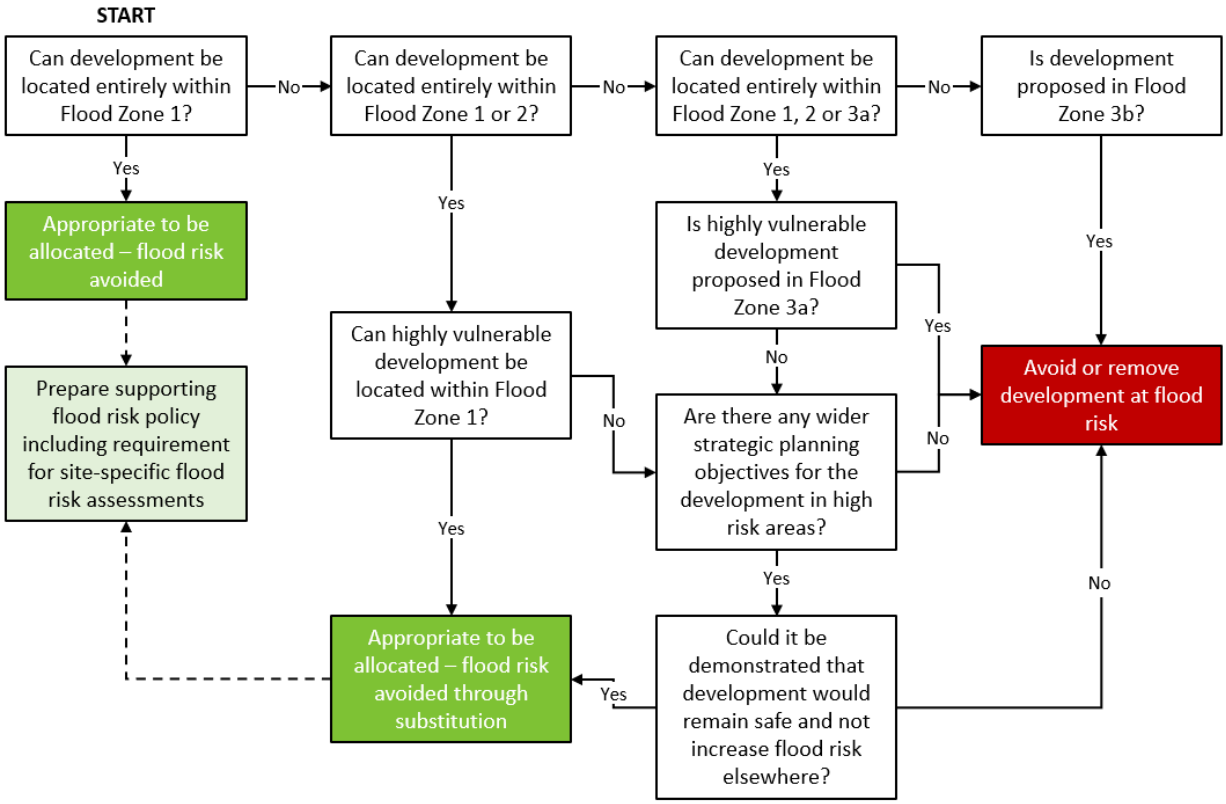


The figure above illustrates the Sequential and Exception Tests as a process flow diagram using the information contained in this SFRA to assess potential development sites against the EA's Flood Map for Planning flood zones and development vulnerability compatibilities.

This is a stepwise process, but a challenging one, as a number of the criteria used are qualitative and based on experienced judgement. The process must be documented, and evidence used to support decisions recorded.

In addition, the risk of flooding from outer sources and the impact of climate change must be considered when considering which sites are suitable to allocate.

Figure 3-2: Local Plan Sequential Approach to Site Allocation



3.5 The Exception Test

It will not always be possible for all new development to be allocated on land that is not at risk from flooding. To further inform whether land should be allocated, or Planning Permission granted, a greater understanding of the scale and nature of the flood risks is required. In these instances, the Exception Test will be required.

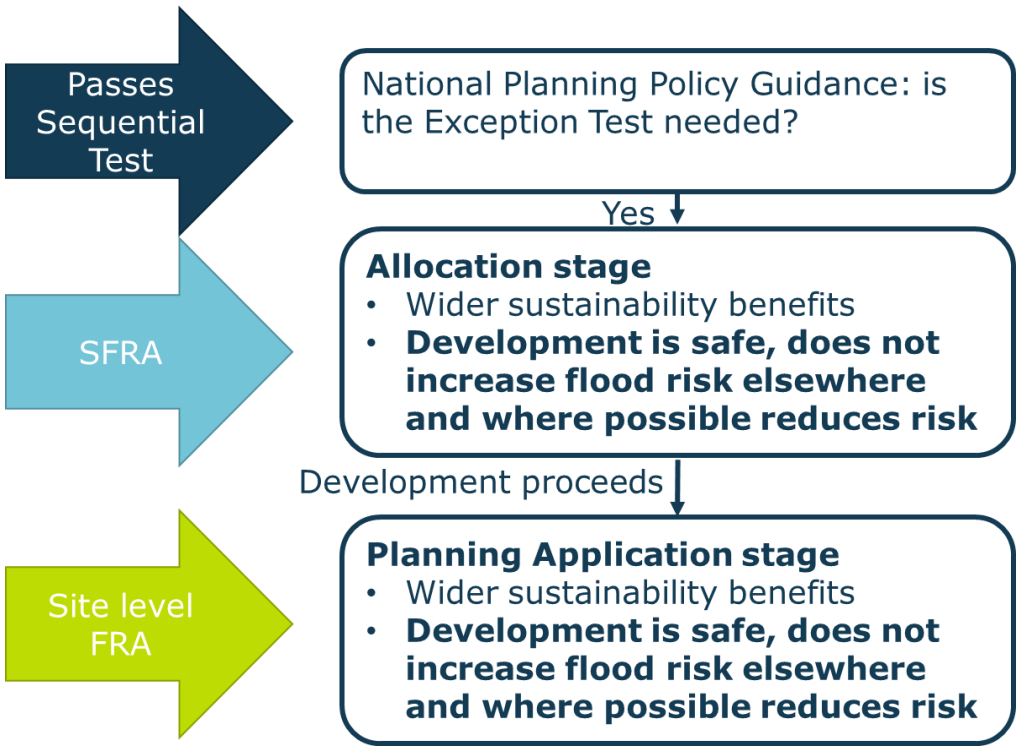
The Exception Test should only be applied following the application of the Sequential Test. It applies in the following instances:

- More vulnerable in Flood Zone 3a
- Essential infrastructure in Flood Zone 3a or 3b
- Highly vulnerable in Flood Zone 2 (this is NOT permitted in Flood Zone 3a or 3b)

The figure below summarises the Exception Test. For sites allocated within the Local Plan, the Local Planning Authority should use the information in this SFRA to inform the Exception Test. At planning application stage, the Developer must design the site such that is appropriate flood resistant and resilient in line with the recommendations in National and Local Planning Policy and supporting guidance and those set out in this SFRA. This should demonstrate that the site will still pass the flood risk element of the Exception Test based on the detailed site level analysis.

For developments that have not been allocated in the Local Plan, developers must undertake the Exception Test and present this information to the Local Planning Authority for approval. The Level 1 SFRA can be used to scope the flooding issues that a site-specific FRA should look into in more detail to inform the Exception Test for windfall sites.

Figure 3-3: The Exception Test



There are two parts to demonstrating a development passes the Exception Test:

1 *Demonstrating that the development would provide wider sustainability benefits to the* community *that outweigh the flood risk*

Local planning authorities will need to consider what criteria they will use to assess whether this part of the Exception Test has been satisfied and give advice to enable applicants to provide evidence to demonstrate that it has been passed. If the application fails to prove this, the Local Planning Authority should consider whether the use of planning conditions and / or planning obligations could allow it to pass. If this is not possible, this part of the Exception Test has not been passed and planning permission should be refused.

At the stage of allocating development sites, Local Planning Authorities should consider wider sustainability objectives, such as those set out in Local Plan Sustainability Appraisals. These generally consider matters such as biodiversity, green infrastructure, historic environment, climate change adaptation, flood risk, green energy, pollution, health, transport etc.

The Local Planning Authority should consider the sustainability issues the development will address and how doing so will outweigh the flood risk concerns for the site, e.g. by facilitating wider regeneration of an area, providing community facilities, infrastructure that benefits the wider area etc.

2 *Demonstrating that the development will be safe for its lifetime taking account of the* vulnerability *of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.*

A Level 2 SFRA is likely to be needed to inform the Exception Test in these circumstances for strategic allocations. At Planning Application stage, a site-specific Flood Risk assessment will be needed. Both would need to consider the actual and residual risk and how this will be managed over the lifetime of the development.

3.6 Making a Site Safe from Flood Risk over its Lifetime

Local Planning Authorities will need to consider the actual and residual risk of flooding and how this will be managed over the lifetime of the development:

- The actual risk is the risk to the site considering existing flood mitigation measures. The fluvial 1% chance flood in any year event is a key event to consider because the National Planning Policy Guidance refers to this as the 'design flood' against which the suitability of a proposed development should be assessed and mitigation measures, if any, are designed.
- Safe access and egress should be available during the design flood event. Firstly, this should seek to avoid areas of a site at flood risk. If that is not possible then access routes should be located above the design flood event levels. Where that is not possible, access through shallow and slow flowing water that poses a low flood hazard may be acceptable.
- Residual risk is the risk that remains after the effects of flood defences have been taken into account and/ or from a more severe flood event than the design event. The residual risk can be:
- The effects of an extreme 0.1% chance flood in any year event. Where there are defences this could cause them to overtop, which may lead to failure if this causes them to erode, and/ or
- Structural failure of any flood defences, such as breaches in embankments or walls.

Flood resistance and resilience measures should be considered to manage any residual flood risk by keeping water out of properties and seeking to reduce the damage it does, should water enter a property. Emergency plans should also account for residual risk, e.g. through the provision of flood warnings and a flood evacuation plan where appropriate.

In line with the NPPF, the impacts of climate change over the lifetime of the development should be considered when considering actual and residual flood risk.

3.7 The Sequential Test and Exception Test and Individual Planning Applications

3.7.1 The Sequential Test

Developers are required to apply the Sequential Test to all development sites, unless the site is:

- A strategic allocation and the test has already been carried out by the LPA, or
- A change of use (except to a more vulnerable use), or
- A minor development (householder development, small non-residential extensions with a footprint of less than 250m^2), or
- A development in flood zone 1 unless there are other flooding issues in the area of the development (i.e. surface water, ground water, sewer flooding).

The SFRA contains information on all sources of flooding and taking into account the impact of climate change. This should be considered when a developer undertakes the Sequential Test, including the consideration of reasonably available sites at lower flood risk.

Local circumstances must be used to define the area of application of the Sequential Test (within which it is appropriate to identify reasonably available alternatives). The criteria used to determine the appropriate search area relate to the catchment area for the type of development being proposed. For some sites this may be clear e.g. school catchments, in other cases it may be identified by other Local Plan policies. For some sites e.g. regional distribution sites, it may be suitable to widen the search area beyond LPA administrative boundaries.

The sources of information on reasonably available sites may include:

- Site allocations in Local Plans
- Site with Planning Permission but not yet built out
- Strategic Housing and Economic Land Availability Assessments (SHELAAs)/ five-year land supply/ annual monitoring reports
- Locally listed sites for sale

It may be that a number of smaller sites or part of a larger site at lower flood risk form a suitable alternative to a development site at high flood.

Ownership or landowner agreement in itself is not acceptable as a reason not to consider alternatives.

3.7.2 The Exception Test

If, following application of the Sequential Test it is not possible for the development to be located in areas with a lower probability of flooding the Exception Test must then be applied if required (as set out in Table 3 of the NPPG). Developers are required to apply the Exception Test to all applicable sites.

The applicant will need to provide information that the application can pass both parts of the Exception test:

- *Demonstrating that the development would provide wider sustainability benefits to the* community *that outweigh the flood risk*

  Applicants should refer to wider sustainability objectives in Local Plan Sustainability Appraisals. These generally consider matters such as biodiversity, green infrastructure, historic environment, climate change adaptation, flood risk, green energy, pollution, health, transport etc.

  Applicants should detail the suitability issues the development will address and how doing out will outweigh the flood risk concerns for the site e.g. by facilitating wider regeneration of an area, providing community facilities, infrastructure that benefits the wider area etc.

- Demonstrating *that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.*

  The site-specific Flood Risk Assessment should demonstrate that the site will be safe, and the people will not be exposed to hazardous flooding from any source. The FRA should consider actual and residual risk and how this will be managed over the lifetime of the development, including:

  - The design of any flood defence infrastructure;
  - Access and egress;
  - Operation and maintenance;
  - Design of the development to manage and reduce flood risk wherever possible;
  - Resident awareness;
  - Flood warning and evacuation procedures, including whether the developer would increase the pressure on emergency services to rescue people during a flood event; and
  - Any funding arrangements required for implementing measures.

4 The Impact of Climate Change

4.1 Introduction

The Climate Change Act 2008 creates a legal requirement for the UK to put in place measures to adapt to climate change and to reduce carbon emissions by at least 80% below 1990 levels by 2050.

The NPPF sets out how the planning system should help minimise vulnerability and provide resilience to the impacts of climate change. NPPF and NPPG describe how FRAs should demonstrate how flood risk will be managed over the lifetime of the development, taking climate change into account. The Climate Change Act 2008 creates a legal requirement for the UK to put in place measures to adapt to climate change and to reduce carbon emissions by at least 80% below 1990 levels by 2050.

Climate change modelling for the watercourses in Solihull was undertaken as part of the Level 1 SFRA. Existing Environment Agency models and generalised 2D models (JFlow) where no detailed model existed were run for the 2080s period for all three allowance categories.

4.2 Revised Climate Change Guidance

The Environment Agency published updated climate change guidance in July 2020 on how allowances for climate change should be included in both strategic and site specific FRAs. The guidance adopts a risk-based approach considering the vulnerability of the development. Whilst the guidance was updated in 2020, fluvial allowances are still to be updated from those in the original 2016 guidance.

In 2018, the government published new UK Climate Projections (UKCP18). The Environment Agency are currently using these to further update their climate change guidance for new developments with regards to updated fluvial and rainfall allowances. Developers should check on the government website for the latest guidance before undertaking a detailed Flood Risk Assessment. At the time of writing this report, this was likely to be due in late 2020, but is not yet released.

Note that the method in the SFRA was based on the Environment Agency climate change guidance update from December 2019. In late July 2020 the Environment Agency updated their guidance to say that the sensitivity of significant urban extensions and new settlements to the extreme H++ scenario should be considered in SFRAs. Due to this late change the H++ scenario has not been considered for the urban extensions in this SFRA. The Council are advised to use the Upper End allowances to consider sensitivity to flood risk when allocating sites. Within each site specific summary table, sensitivity to climate change has been assessed and recommendations for future site specific assessments made. Associated interactive mapping also shows how climate change could impact the flood extents and depths across each site. The council are also advised to encourage developers to account for the H++ scenario for the 100 year design event when master planning and ensure a development is resilient to flooding in the extreme 1000 year event with the H++ scenario.

4.3 Applying the Climate Change Guidance

To apply the climate change guidance, the following information needs to be known:

- The vulnerability of the development – see the NPPG
- The likely lifetime of the development – in general 60 years is used for commercial development and 100 for residential, but this needs to be confirmed in a FRA
- The River Basin that the site is in – Solihull is situated in the Humber River Basin District.
- Likely depth, speed and extent of flooding for each climate change allowance 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

4.3.1 Relevant Allowances for Solihull

Table 4-1 shows the peak river flow allowances and Table 4-2 shows the peak rainfall intensity allowances that apply to Solihull.

Table 4-1 Peak River Flow Allowances by River Basin District

River Basin District	Allowance category	Total potential change anticipated **for '2020s' (2015** to 39)	Total potential change anticipated for **'2050s' (2040** to 2069)	Total potential change anticipated for **'2080s' (2070 to** 2115)
Humber	Extreme (H++)	20%	35%	65%
	Upper end	20%	30%	50%
	Higher central	15%	20%	30%
	Central	10%	15%	20%

Table 4-2 Peak Rainfall Intensity Allowance in Small and Urban Catchments

Applies across all of England	Total potential change anticipated for 2010 to 2039	Total potential change anticipated for 2040 to 2059	Total potential change anticipated for 2060 to 2115
Upper end	10%	20%	40%
Central	5%	10%	20%

4.4 Representing Climate Change in a Level 2 SFRA

For this Level 2 SFRA, the Level 1 climate change modelling was used where this aligned with sites being assessed. Where strategic and detailed models were produced as part of the Level 2 study, climate change allowances were also modelled, and impacts assessed. Three scenarios were previously modelled to reflect the three climate change allowances for the '2080s' timeframe in the Humber River Basin District, therefore the 100-year plus 20%, 30% and 50% defended scenario.

The 1,000-year surface water extent was also used as an indication of surface water risk with allowance for climate change.

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.

Climate change mapping has been provided in Appendix B: GeoPDFs. In summary, the climate change outputs on the GeoPDF maps for the SFRA will be from either:

- Broadscale 2D modelling completed as part of the Level 1 SFRA using JFlow
- Strategic modelling completed as part of the Level 2 SFRA
- Detailed modelling complete as part of the Level 2 SFRA.

The site tables in Appendix A details what datasets have been used to inform the assessment of each site.

It is recommended that the impact of climate change on a proposed site is considered as part of a detailed Flood Risk Assessment, using the percentage increases which relate to the proposed lifetime and the vulnerability classification of the development as described in this Chapter. The Environment Agency should be consulted to provide further advice for developers on how best to apply the new climate change guidance.

4.5 Adapting to Climate Change

The NPPG sections on climate change contain information and guidance for how to identify suitable mitigation and adaptation measure 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 to ensure 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; and
- 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.

5 Sources of Information used in Preparing the Level 2 SFRA

5.1 Data Used to Inform the SFRA

This chapter discusses all the datasets used in the Level 2 SFRA to assess the sites against flood risk. Several different sets of data may have been used to inform the extent, depth, hazard and velocity for each site.

Table 5-1 Overview of data used for the Solihull L2 SFRA

Zone	Data Description	Data Source
Historic (All Sources)	Historic Flood Map and Recorded Outlines Hydraulic Modelling Reports, where provided	SMBC Environment Agency
	Solihull L1 SFRA - 2017	SMBC JBA Consulting
	Historic flood incidents/records	SMBC Severn Trent Water Canals and River Trust
Fluvial	Flood Map for Planning Risk of Flooding from Rivers and Sea	Environment Agency
	Solihull L1 SFRA – Broadscale JFlow Modelling Solihull L2 SFRA Strategic and Detailed Modelling JScreen Culvert Blockage Assessments	SMBC
	Blythe Valley – Hydraulic Modelling Report and Model – November 2016	WSP
	Birmingham International Airport Proposed Runway Extension – Flood Risk Assessment – December 2007	Scott Wilson (Public Information)
	HS2 – Phase 2a Environmental Statement Volume 5: Water and Flood Risk[3]	Arup ERM (Public Information)
Surface Water	Risk of Flooding from Surface Water dataset	Environment Agency
	Meriden Surface Water Mapping Study – May 2020	JBA Consulting
Groundwater	Areas Susceptible to Groundwater Flooding dataset Bedrock geology/superficial deposits dataset	Environment Agency
Sewer	At Risk Register Historic flooding records	Severn Trent Water
Reservoir	National Inundation Reservoir Mapping	Environment Agency
Canal	Dataset of flood incidents	Canal and River Trust

3 HS2 Phase 2a Environmental Statement – Volume 5 – Water and Flood Risk: https://www.gov.uk/government/publications/hs2-phase-2a-environmental-statement-volume-5-water-and-flood-risk

5.2 Flood Zones

The data used to prepare the fluvial mapping for this study is based on the results from hydraulic models, either provided by the Environment Agency or prepared for the purposes of this SFRA.

5.2.1 No Modelling Required

As part of the Level 1 SFRA, broadscale 2D modelling was completed for watercourses within the study area using JFlow. Two sites utilised the broadscale modelling for this Level 2 assessment:

- Site 17: Moat Lane, Vulcan Road
- Site 19: UK Central Hub / HS2 Interchange

This broadscale modelling dataset has not been incorporated into the Environment Agency's Flood for Planning and as a result, flood extents vary between the two datasets.

Site 17 did not progress to detailed modelling as the risk to this site is purely surface water. To further the understanding of risk on this site would involve detailed modelling on interactions between surface water and sewers which was is more appropriate for site specific Flood Risk Assessment once site topographic data is available.

No further modelling was undertaken for Site 19 because it was deemed appropriate to use existing datasets to assess the risk at this strategic level.

5.2.2 Strategic Modelling

For several of the sites, flood risk had not previously been assessed relating to nearby watercourses and there were no existing Environment Agency flood zones associated with these watercourses. As part of this study, survey was collected across 8 of the Level 2 sites, including the survey of structures where they could impact flood risk. As part of the Level 1 study, strategic modelling was undertaken for the following sites to better understand fluvial flood risk:

- Site 1 – Barrett's Farm, Balsall Common
- Site 6 – Meriden Road, Hampton-in-Arden
- Site 8 – Hampton Road, Knowle
- Site 9 – Station Road, Knowle
- Site 10 – Birmingham Road, Meriden
- Site 18 – Sharman's Cross Road, Solihull
- Site 20 – Damson Parkway, Bickenhill
- Site 26 – Whitlock's End Farm, South of Shirley

The Strategic Modelling Report in Appendix C provides additional detail on the strategic modelling undertaken.

5.2.3 Detailed Modelling

Detailed modelling has been undertaken for Site 4 - West of Dickens Heath using survey data collected as part of this study. Additional detail on the detailed 1D-2D model developed can be found in Appendix D.

It was initially recommended that the hydrology (inflows) in the existing WSP model of the River Blythe would be updated to better understand fluvial flood risk at Site 12 - South of Dog Kennel Lane. Having undertaken an in depth investigation into the existing hydraulic model and any associated hydrological reporting, it was found that until there is a longer record of gauge data on the watercourses surrounding the site, any update to the hydrology would be as uncertain as the existing flows within the model.

A technical note can be found in Appendix E summarising the investigation into the hydrology of the existing model. This technical note also makes recommendations for a review of the hydrology used in the River Blythe model covering Site 4 once additional gauge data is available.

5.3 Climate Change

The mapping provides a strategic assessment of climate change risk; 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 Environment Agency.

This would include the Central (100-year +20%), Higher Central (100-year +30%) and Upper End (100-year +50%) climate change allowances for the 2080s epoch, for the Humber basin's 2080s epoch. The sensitivity to the extreme H++ scenario should be assessed for significant urban extensions.

5.4 Surface Water

Mapping of surface water flood risk in Solihull has been taken from the Environment Agency's Risk of Flooding from Surface Water (RoFfSW) mapping, which is a slightly more detailed resolution than that published online by the Environment Agency. Surface water flood risk is subdivided into the following four categories:

- High: A chance of flooding greater than 1 in 30 (3.3%) each year.
- Medium: A chance of flooding between 1 in 100 (0.1%) & 1 in 30 (3.3%) each year.
- Low: A chance of flooding between 1 in 1,000 (0.1%) & 1 in 100 (1%) each year.
- Very Low: A chance of flooding of less than 1 in 1,000 (0.1%) each year.

In May 2020, surface water modelling was undertaken for three areas in Solihull in line with the 2019 Environment Agency requirements for updating the National Risk of Flooding from Surface Water map. An existing surface water model for Meriden was updated as part of this study and outputs have been used to better understand surface water flood risk at Site 10.

The results should be used for high level assessments such as SFRAs for local authorities. If a particular site is indicated in the Environment Agency mapping to be at risk from surface water flooding, a more detailed assessment should be required to more accurately illustrate the flood risk 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 based on site survey will be necessary where there is a significant risk of surface water flooding.

5.5 Groundwater

Mapping of groundwater flood risk has been based on the Areas Susceptible to Groundwater (AStGWF) dataset. The AStGWF dataset is a strategic-scale map showing groundwater flood areas on a 1km square grid. It shows the proportion of each 1km grid square, where geological and hydrogeological conditions indicate that groundwater might emerge. It does not show the likelihood of groundwater flooding occurring and does not take account of the chance of flooding from groundwater rebound.

This dataset covers a large area of land, and only isolated locations within the overall susceptible area are actually likely to suffer the consequences of groundwater flooding.

The AStGWF data is indicative and should only be used in combination with other information, for example local data or historical data. It should not be used as sole evidence for specific flood risk management, land use planning or other decisions at any scale. The data can help to identify areas for assessment at a local scale where finer resolution datasets exist.

5.6 River Networks

Main Rivers are represented by the Environment Agency's Statutory Main River layer. Ordinary Watercourses are represented by the Environment Agency'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 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 survey, including the residual risk of culvert blockage.

5.7 Flood Warnings

Flood Warning and Flood Alert Areas are represented by the EA's GIS datasets.

5.8 Reservoirs

The risk of inundation as a result of reservoir breach or failure of a number of reservoirs within the area has been identified from the Environment Agency's Long Term Flood Risk Information website.

5.9 Sewer Flooding

Historical incidents of flooding are detailed by Severn Trent Water in their sewer flooding register. The sewer flooding register records incidents of flooding relating to public foul, combined or surface water sewers and displays which properties suffered flooding. This data was used to describe any sewer flooding in the Level 2 summary tables. Due to licencing and confidentiality restrictions, sewer data has not been represented on the mapping.

5.10 Historic Flooding

Historic flooding was assessed using the Environment Agency's Historic Flood Map and Recorded Flood Outlines datasets. In addition, historic flooding records have been supplied by SMBC as LLFA and the Canal and Rivers Trust.

5.11 Flood Defences

Flood defences are represented by Environment Agency's Asset Information Management System (AIMS) Spatial Defences data set. Their current condition and standard of protection are based on those recorded in the tabulated shapefile data. None of the sites being assessed are formally protected by a flood defence.

5.12 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 Environment Agency'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 Flood Risk Assessment.

Residual risk from breaches to flood defences, whilst rare, needs to be considered in Flood Risk Assessments. 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 Environment Agency to collate and standardise these methodologies. It is recommended that the Environment Agency 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.

5.13 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 during the defended fluvial and surface water 100-year event. The 100-year flood event has been investigated in further detail because the Level 2 assessment helps inform the Exception Test and usually flood mitigation measures and access/ egress requirements focus on flood events lower than the 1,000-year event (e.g. the 100-year or 100-year plus climate change events). Any development should be designed such that it is resilient to the extreme 1000 year plus climate change event and this should be considered for a site specific Flood Risk Assessment.

Depth velocity and hazard information was derived from 2D generalised modelling, or detail modelling where this exists.

The depth, hazard and velocity of the 100-year surface water flood event has also 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 5-2.

Table 5-2 **Defra's FD2321/TR2 "Flood Risks to People"** Classifications

Description of Flood Hazard Rating	Flood Hazard Rating	Classification Explanation
Very Low Hazard	<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 may need to undertake more detailed hydrological and hydraulic assessments of the watercourses to verify flood depth, velocity and hazard based on the relevant 100-year plus climate change event as part of a site-specific FRA, using the relevant climate change allowance based on the type of development and its associated vulnerability classification. Not all information is known at the strategic scale.

5.14 Note of SuDS Suitability

The hydraulic and geological characteristics of each site were assessed to determine the constraining factors 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 the AStGWF map 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 were used to determine other factors and 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 Figure 5-3. 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 5-3 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. Solihull Metropolitan Borough Council as LLFA should be consulted at an early stage to ensure SuDS are implemented and designed in response to site characteristics and policy factors.

6 Level 2 Assessment Methodology

6.1 Site Screening

Solihull Metropolitan Borough Council supplied JBA with site options. In total, 24 sites were screened against a suite of available flood risk information and spatial data to provide a summary of risk to each site.

The screening has helped to identify where a site required a Level 2 assessment, and where a site may not require a Level 2 assessment but where the implications and recommendations for flood risk to the site could be considered as part of this SFRA.

The site screening assessed the following:

- The proportion of the site in each Flood Zone
- Whether the site is shown to be at risk in the Risk of Flooding from Surface Water map, and the proportion of the site in each surface water category
- Whether the site is within 100m of a Main River or watercourse identified in the Environment Agency's Detailed River Network (DRN) layer.
- LiDAR availability for 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, giving a clear spatial picture of flood risk. The site boundaries were queried using FRISM against the flood risk information including Flood Zones, surface water and historic flood map.

The results of the screening provide a quick and efficient way of identifying sites that are likely to require a Level 2 Assessment, assisting Solihull Metropolitan Borough Council 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 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 3km^2. 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 Risk of Flooding from Surface Water has been used in these cases because this provides a reasonable representation of the floodplain of such watercourses to use for a strategic assessment.

6.2 Sites Taken Forward to Level 2 Assessment

Out of the 24 sites screened, 12 sites were carried forward for Level 2 assessment.

A Red-Amber-Green system was applied to the sites on the basis, that: red sites needed a Level 2, amber sites did not need a Level 2 due to less significant flood risk, but still needed flagging in this report (recommendations provided in section 6.3), and green sites that had no/ negligible risk.

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, potential for highly vulnerable types of development to occupy a site etc.

Table 6-1 summarises the sites which have been taken forward to Level 2 assessment.

Table 6-1 Sites Carried Forward to a Level 2 Assessment

Site Code	Site Name	Reason for Level 2	Updated Flood Zones % *				Risk of flooding from surface water %		
			FZ3b	FZ3a	FZ2	FZ1	30yr	100yr	1,000yr
Site 19	UK Central Hub/HS2 Interchange	Fluvial	2.8	3.9	4.7	95.3	2.0	3.0	7.0
Site 17	Moat Lane, Vulcan Road	Surface Water	0.0	0.0	0.0	100.0	10.6	14.3	28.4
Site 9	South of Knowle	Fluvial & Surface Water	3.0	3.1	3.5	96.5	1.1	3.1	11.6
Site 20	Land Damson Parkway	Fluvial & Surface Water	3.2	4.3	6.1	93.9	1.1	2.1	7.0
Site 1	Barretts Farm	Fluvial & Surface Water	11.3	12.0	13.0	87.0	3.0	5.4	13.6
Site 6	Meriden Road	Fluvial	1.8	1.88	1.88	98.2	0.3	1.3	3.1
Site 8	Hampton Road Northern Site	Fluvial & Surface Water	0.4	0.5	5.6	94.4	0.2	0.8	5.6
Site 8	Hampton Road Southern Site		0.0	0.0	0.0	100.0	0.0	0.1	31.5
Site 10	West of Meriden	Fluvial & Surface Water	0.1	1.3	1.9	98.1	1.2	1.5	2.4
Site 18	Sharman's Cross Road	Fluvial & Surface Water	19.5	22.4	26.1	73.9	0.4	0.9	6.5
Site 26	South of Shirley	Fluvial & Surface Water	1.3	1.3	1.3	98.7	0.1	0.7	1.9
Site 12	South of Dog Kennel Lane	Fluvial & Surface Water	0.0	0.0	0.0	100.0	0.6	1.0	3.2
Site 4	West of Dickens Heath Northern Site	Surface Water	0.0	0.0	0.0	100.0	1.2	1.9	5.3
Site 4	West of Dickens Heath Southern Site	Fluvial & Surface Water	0.3	0.4	0.5	99.5	0.3	0.4	3.5

**Flood Zones updated using latest modelling data; hence these may differ from the EA's Flood Map for Planning Flood Zones.*

'Unmodelled' fluvial risk relates to there being the presence of watercourses on OS mapping, but the catchments are smaller than those represented in the EA's Flood Zones.

The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including 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. This would be displayed as stated above, i.e. the total % of that particular Flood Zone in that site. 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%.

6.3 Recommendations for Site Not Taken Forward to Level 2

The 'amber' sites identified as having some lower level flood risk, but not requiring a Level 2 assessment, are shown in Table 6-2.

Table 6-2 Sites at Lower Flood Risk

Site Code	Site Name	Nature of low flood risk/ considerations for the developer
Site 25	Land south of School Road	Low risk identified on the site, but Stratford upon Avon canal runs along the south-western boundary which may pose some flood risk to the site.
Site 16	East of Solihull	Surface water risk associated with unnamed water course running along the north-western boundary. Majority of the site unaffected and access remains possible.
Site 8	Hampton Road Southern Site	Assessed as lower risk but has been included in the Site 8 Tables with the northern site identified as requiring Level 2 Assessment

Some recommendations are stated below for consideration at the site-specific Flood Risk Assessment stage:

- For sites not represented in the Environment Agency'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.
- Where detailed Environment Agency models exist, it is recommended the developer embeds site survey, such as topography into the model domain to refine the understanding of flood risk to the site as well as test options to mitigate flood risk. The developer may also need to review the model hydrology and run additional climate change scenarios based on the latest EA guidance.
- Risk of flooding from canals should be considered using datasets from the Canal and River Trust.
- Where relevant, blockages of nearby culverts will 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 30-year, 100-year or 1,000-year events, 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 Flood Risk Assessment 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.

6.4 Site Summary Tables

As part of the Level 2 SFRA, detailed site summary tables have been produced for the sites listed above. The summary tables can be found in Appendix A.

Each table sets out the following information:

- Basic site information
- 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
  - Surface Water – proportion of site at risk including description from RoFfSW mapping
  - Reservoir
  - Canal
- Flood History
- Flood risk management infrastructure
  - Defences – type, Standard of Protection and condition (if known), and description
  - Description of residual risk (blockage scenarios)
- Emergency Planning
  - Flood Warning and Flood Alert Areas
  - Access and egress
- Climate change
  - Summary of climate change allowances and increase in flood extent compared to Flood Zones
  - Description of implications to the site
- 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 Zone
  - Historic Landfill Site
- 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)
- Mapping information – description of data sources for the following mapped outputs:
  - Flood Zones
  - Climate change
  - Surface water
  - Fluvial depth, velocity and hazard mapping
  - Surface water depth velocity and hazard mapping

6.5 Interactive Geo-PDF mapping

To accompany each site summary table, there is an Interactive Geo-PDF 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 and bottom of the mapping, to allow navigation of the data. The Level 2 Geo-PDF mapping as well as the Borough-wide Geo-PDF maps from the Level 1 SFRA identify communities, features, structures and properties affected by flood risk.

Flood risk information in the Geo-PDFs include:

- Site boundary and Council boundary
- Title bar showing area, grid reference, site name, proposed development use (e.g. residential/employment) and percentage Flood Zone coverage
- Flood Zones 2, 3a and 3b (functional floodplain)
- Modelled 100-year fluvial depth, velocity and hazard rating
- Risk of Flooding from Rivers and Sea
- Surface water 100-year depth, velocity and hazard rating
- Climate change extents
- Flood risk from surface water dataset (30-years, 100-years and 1,000-years)
- Areas Susceptible to Groundwater Flooding
- Flood Warning and Flood Alert Areas
- Historic Landfill
- Defences (embankments and walls)
- Main Rivers/Ordinary watercourses

7 Flood Risk Management Requirements for Developers

7.1 Introduction

The report provides a strategic assessment of flood risk in Solihull. 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 watercourses to verify flood extent (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 Flood Risk Assessment (FRA) may show that a site is not appropriate for development of a particular vulnerability or even at all. However, a detailed Flood Risk Assessment undertaken for a windfall site4 may find that the site is entirely inappropriate for development of a particular vulnerability, or even at all. The Sequential and Exception Tests in the NPPF apply to all developments and an FRA should not be seen as an alternative to proving these tests have been met.

7.2 Principles for New Developments

Apply the Sequential and Exception Tests

Developers must provide evidence that the Sequential Test has been passed for windfall developments. If the Exception Test is needed, they must also provide evidence that all parts of the Test can be met for all developments, based on the findings of a detailed Flood Risk Assessment.

Developers should also apply the sequential approach to locating development within the site. The following questions should be considered:

- Can risk be avoided through substituting less vulnerable uses or by amending the site layout?
- Can it be demonstrated that less vulnerable uses for the site have been considered and reasonably discounted? and
- Can layout be varied to reduce the number of people or flood risk vulnerability or building units located in higher risk parts of the site?

Consult with the statutory consultees at an early stage to understand their requirements

Developers should consult with the Environment Agency, Solihull Metropolitan Borough Council as LLFA and Severn Trent Water as the water and sewerage companies, at an early stage to discuss flood risk including requirements for site-specific FRAs, detailed hydraulic modelling and drainage assessment and design.

Consider the risk from all sources of flooding and that they are using the most up to date flood risk data and guidance

The SFRA can be used by developers to scope out what further detailed work is likely to be needed to inform a site-specific Flood Risk Assessment. At a site level, Developers will need to check before commencing on a more detailed Flood Risk Assessment that they are using the latest available datasets. Developers should apply the 2020 Environment Agency climate change guidance and ensure the development has taken into account climate change adaptation measures.

4 'Windfall sites' is used to refer to those sites which become available for development unexpectedly and are therefore not included as allocated land in a planning authority's development plan.

Ensure that development does not increase flood risk elsewhere and in line with the NPPF, seeks to reduce the causes and impacts of flooding

The Level 1 SFRA sets out these requirements for taking a sustainable approach to surface water management. Developers should also ensure mitigation measures do not increase flood risk elsewhere and that floodplain compensation is provided where necessary.

Ensure the development is safe for future users

Consideration should first be given to minimising risk by planning sequentially across a site. Once risk has been minimised as far as possible, only then should mitigation measures be considered. Developers should consider both the actual and residual risk of flooding to the site.

Further flood mitigation measures may be needed for any developments in an area protected by flood defences, where the condition of those defences is 'fair' or 'poor', and where the standard of protection is not of the required standard.

Enhance the natural river corridor and floodplain environment through new development

Developments should demonstrate opportunities to create, enhance and link green assets. This can provide multiple benefits across several disciplines including flood risk and biodiversity/ ecology and may provide opportunities to use the land for an amenity and recreational purposes. Development that may adversely affect green infrastructure assets should not be permitted. Where possible, developers should identify and work with partners to explore all avenues for improving the wider river corridor environment.

Consider and contribute to wider flood mitigation strategy and measures in Solihull and apply the relevant local planning policy

Wherever possible, developments should seek to help reduce flood risk in the wider area e.g. by contributing to a wider community scheme or strategy for strategic measures, such as defences or natural flood management or by contributing in kind by mitigating wider flood risk on a development site. Developers must demonstrate in an FRA how they are contributing towards this vision.

7.3 Requirements for Site-Specific Flood Risk Assessments

7.3.1 When is a FRA Required?

Site-specific FRAs are required in the following circumstances:

- Proposals of 1 hectare or greater in Flood Zone 1.
- Proposals for new development (including minor development such as non-residential extensions, alterations which do not increase the size of the building or householder developments and change of use) in Flood Zones 2 and 3.
- Proposals for new development (including minor development and change of use) in an area within Flood Zone 1 which has critical drainage problems (as notified to the LPA by the Environment Agency).
- Where proposed development or a change of use to a more vulnerable class may be subject to other sources of flooding.

An FRA may also be required for some specific situations:

- If the site may be at risk from the breach of a local defence (even if the site is actually in Flood Zone 1)
- Where evidence of historical or recent flood events have been passed to the LPA
- In an area of significant surface water flood risk.

7.3.2 Objectives of Site-Specific FRAs

Site-specific FRAs should be proportionate to the degree of flood risk, as well as appropriate to the scale, nature and location of the development. Site-specific FRAs should establish:

- whether a proposed development will be at risk of flooding, from all sources, both now and in the future, taking into account climate change;
- whether a proposed development will increase flood risk elsewhere;
- whether the measures proposed to deal with the effects and risks are appropriate;
- the evidence, if necessary, for the local planning authority to apply the Sequential Test; and
- whether, if applicable, the development will be safe and pass the Exception Test.

FRAs should follow the approach recommended by the NPPF (and associated guidance) and guidance provided by the Environment Agency and Solihull Metropolitan Borough Council. Guidance and advice for developers on the preparation of site-specific FRAs include:

- Standing Advice on Flood Risk (Environment Agency);
- Flood Risk Assessment for Planning Applications (Environment Agency);
- FRA Guidance Note (Environment Agency SHWG area);
- Site-specific Flood Risk Assessment: CHECKLIST (NPPF PPG, Defra).

Guidance for local planning authorities for reviewing flood risk assessments submitted as part of planning applications has been published by Defra in 2015 – Flood Risk Assessment: Local Planning Authorities.

7.4 Local Requirements for Mitigation Measures

The Level 1 SFRA provides details on the following mitigation measures in Section 7.3 of the SFRA Report and should be referred to alongside this report:

- Layout and Design (7.3.1)
- Making Space for Water (7.3.2)
- Raised Floor Levels (7.3.3)
- Development and Raised Defences (7.3.4)
- Modification of Ground Levels (7.3.5)
- Developer Contributions (7.3.6)

7.4.1 Flood Storage Compensation

For any development (both major and minor), that results in built volume below the design flood level (100-year plus climate change flood level), mitigation shall be required for loss in floodplain storage volume.

7.4.2 Resistant and Resilient Measures

The consideration of resistance and resilience measures should not be used to justify development in inappropriate locations.

Having applied planning policy, there will be instances where developments, such as those that are water compatible and essential infrastructure are permitted in high flood risk areas. The above measures should be considered before resistance and resilience measures are replied on. The effectiveness of these forms of measures are often dependant on the availability of a reliable forecasting and warning system and the use of back up pumping to evacuate water from a property as quickly as possible. The proposals must include details of how the temporary measures will be erected and decommissioned, responsibility for maintenance and the cost of replacement when they deteriorate. The following measures are available:

Permanent Barriers: Permanent barriers can include built up doorsteps, rendered brick walls and toughened glass barriers.

Temporary Barriers: Temporary barriers consist of moveable flood defences which can be fitted into doorways and/or windows. The permanent fixings required to install these temporary defences should be discrete and keep architectural impact to a minimum. On a smaller scale, temporary snap on covers for airbricks and air vents can also be fitted to prevent the entrance of flood water.

Community Resistance Measures: These include demountable defences that can be deployed by local communities to reduce the risk of water ingress to a number of properties. The methods require the deployment of inflatable (usually with water) or temporary quick assembly barriers in conjunction with pumps to collect water that seeps through the systems during a flood.

Resilience Measures: These measures aim to ensure no permanent damage is caused, the structural integrity of the building is not compromised and the clean up after the flood is easier. Interior design measures to reduce damage caused by flooding can include electrical circuitry installed at a higher level and water-resistant materials for floors, walls and fixtures.

7.5 Reducing Flood Risk from other Sources

Section 7.6 of the Level 1 SFRA Report discusses how to reduce flood risk from other sources, such as groundwater, surface water and sewer flooding.

7.6 Duration and Onset of Flooding

The duration and onset of flooding affecting a site depends on a number of 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 in lower 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).
- Catchment geology. Chalk catchments talk longer to respond than typical clay catchments for example.

The position of the Council area in an upper/ mid catchment location has been taken into account to develop the following guidelines for the duration and onset of flooding.

It is recommended that a site-specific Flood Risk Assessment refines this information, based on more detailed modelling work where necessary.

7.6.1 Flood Warning and Emergency Planning

Emergency planning covers three phases: before, during and after a flood. Measures involve developing and maintaining arrangements to reduce, control or mitigate the impact and consequences of flooding and to improve the ability of people and property to absorb, respond to and recover from flooding. National Planning Policy takes this into account by seeking to avoid inappropriate development in areas of flood risk and considering the vulnerability of new developments to flooding.

The NPPF (paragraph 163) requires site level Flood Risk Assessments to demonstrate that:

"d) any residual risk can be safely managed; and

e) safe access and escape routes are included where appropriate, as part of an agreed emergency plan."

Certain sites will need emergency plans:

- Sites with vulnerable users, such as hospitals and care homes.
- Camping and caravan sites.
- Sites with transient occupants e.g. hostels and hotels.
- Developments at a high residual risk of flooding from any source e.g. immediately downstream of a reservoir or behind raised flood defences.
- Situations where occupants cannot be evacuated (e.g. prisons) or where it is safer to remain "in-situ" and / or move to a higher floor or safe refuge area (e.g. at risk of a breach).

Emergency Plans will need to consider:

- The characteristics of the flooding e.g. onset, depth, velocity, hazard, flood borne debris.
- The vulnerability of site occupants.
- Structural safety.
- The impact of the flooding on essential services e.g. electricity, drinking water.
- Flood warning systems and how users will be encouraged to sign up for them.
- Safe access and egress for users and emergency services.
- How to manage the consequences of events that are un-foreseen or for which no warnings can be provided e.g. managing the residual risk of a breach.
- A safe place of refuge where safe access and egress and advance warning may not be possible, having discussed and agreed this first with emergency planners. Proposed new development that places an additional burden on the existing response capacity of the Councils will not normally be appropriate.

The Environment Agency and the Association of Directors of Environment, Economy, Planning and Transport (ADEPT) have produced joint guidance on flood risk emergency plans for new development aimed at local authority planners to help identify when they should be asking for planning applications to be supported by flood risk emergency plans, and what should be included in them. It encourages local planning authorities to produce their own guidelines and set up local consultation arrangements to ensure emergency plans are fit-for-purpose and receive proper scrutiny. It also provides a framework for them to appraise emergency plans in the absence of such local arrangements.

8 Surface Water Management and SuDS

8.1 Role of the LLFA and Local Planning Authority in surface water management

In April 2015, Solihull Metropolitan Borough Council was made a statutory consultee on the management of surface water and, as a result, provides technical advice on surface water drainage strategies and designs put forward for major development proposals.

When considering planning applications, SMBC will provide advice to the Planning Department on the management of surface water. As LPA, SMBC should satisfy themselves that the development's proposed minimum standards of operation are appropriate and ensure through the use of planning conditions or planning obligations, that there are clear arrangements for on-going maintenance over the lifetime of the development.

It is essential that developers consider sustainable drainage at an early stage of the development process – ideally at the master-planning stage. This will assist with the delivery of well designed, appropriate and effective SuDS.

8.2 Sustainable Drainage Systems

Sustainable Drainage Systems (SuDS) are designed to maximise the opportunities and benefits that can be secured from surface water management practices.

SuDS provide a means of dealing with the quantity and quality of surface water and can also provide amenity and biodiversity benefits. Given the flexible nature of SuDS they can be used in most situations within new developments as well as being retrofitted into existing developments. SuDS can also be designed to fit into most spaces. For example, permeable paving could be used in parking spaces or rainwater gardens as part of traffic calming measures.

It is a requirement for all new major development proposals to ensure that sustainable drainage systems for management of runoff are put in place. Likewise, minor developments should also ensure sustainable systems for runoff management are provided. The developer is responsible for ensuring the design, construction and future/ongoing maintenance of such a scheme is carefully and clearly defined, and a clear and comprehensive understanding of the existing catchment hydrological processes and current drainage arrangements is essential.

8.3 Sources of SuDS Guidance

8.3.1 C753 CIRIA SuDS Manual (2015)

The C753 CIRIA SuDS Manual (2015) provides guidance on planning, design, construction and maintenance of SuDS. The manual is divided into five sections ranging from a high-level overview of SuDS, progressing to more detailed guidance with progression through the document.

8.3.2 Non-statutory Technical Guidance, Defra (March 2015)

Non-Statutory Technical guidance provides non-statutory standards on the design and performance of SuDS. It outlines peak flow control, volume control, structural integrity, flood risk management and maintenance and construction considerations.

8.3.3 A Guide to SuDS and Drainage in Solihull

The Guide to SuDS and Drainage in Solihull provides guidance for developers and relevant professionals on the SuDS requirements within the study area. The guide sets out the planning, design and maintenance requirements for SuDS schemes with the aim of producing benefits for the environment and communities whilst enabling developers to achieve compliance with LLFA SuDS requirements to gain SuDS approval.

The document is intended to be complementary to the National Standard for SuDS (2015) and The SuDS Manual (CIRIA C753).

8.4 Other Surface Water Considerations

8.4.1 Groundwater Vulnerability Zones

The Environment Agency have published new groundwater vulnerability maps in 2015. These maps provide a separate assessment of the vulnerability of groundwater in overlying superficial rocks and those that comprise of the underlying bedrock. The map shows the vulnerability of groundwater at a location based on the hydrological, hydro-ecological and soil propertied within a one-kilometre grid square.

The groundwater vulnerability maps should be considered when designing SuDS. Depending on the height of the water table at the location of the proposed development site, restrictions may be placed on the types of SuDS appropriate to certain areas. Groundwater vulnerability maps can be found on **Defra's interactive mapping.**

8.4.2 Groundwater Source Protection Zones (GSPZ)

The Environment Agency also defines Groundwater Source Protection Zones (SPZs) near groundwater abstraction points. These protect areas of groundwater used for drinking water. The Groundwater SPZ requires attenuated storage of runoff to prevent infiltration and contamination. Groundwater Source Protection Zones can be viewed on the Defra website.

There is a Source Protection Zone covering a small area of eastern Solihull. However, none of the Level 2 assessment sites fall within this area.

8.4.3 Nitrate Vulnerable Zones

Nitrate Vulnerable Zones (NVZs) are areas designated as being at risk from agricultural nitrate pollution. Nitrate levels in waterbodies are affected by surface water runoff from surrounding agricultural land entering receiving waterbodies. The level of nitrate contamination will potentially influence the choice of SuDS and should be assessed as part of the design process. The NVZ coverage can be viewed on the **Environment Agency's** online maps.

The entirety of the Solihull study area is contained within a Nitrate Vulnerable Zone.

9 Cumulative Impact of Development and Strategic Solutions

The Environment Agency has recommended that for some catchments, a strategic approach to flood alleviation should be assessed as part of the Level 2 SFRA. Sites 4 and 26, both located in the River Cole catchment and Site 12, located in the River Blythe catchments have been identified as requiring a Cumulative Impact Assessment (CIA).

The Cumulative Impact Assessment is included within Appendix F.

10 Summary of Level 2 Assessment

10.1 Assessment Methods

As part of the Level 2 SFRA, detailed site summary tables have been produced for the 12 sites identified as being at high risk. As part of the site screening assessment, these sites were found to be at risk from fluvial and/or surface water flooding.

The summary tables in Appendix A summarise flood risk to each site based on a range of flood risk datasets and the strategic or detailed modelling completed as part of this study. Climate change mapping has also been produced, either through the broadscale 2D modelling completed in the Level 1 SFRA or as part of the strategic and detailed modelling completed for the Level 2 SFRA. Each table sets out the NPPF requirements for the site as well as guidance for site-specific FRAs. The tables consider requirements for passing the Exception Test where this is relevant and possible. A broadscale assessment of suitable SuDS options 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 an Interactive GeoPDF map, with all the mapped flood risk outputs per site. This includes fluvial flood zone extents, depths and velocities as well as hazard mapping where modelling has been completed. Interactive mapping in Appendix B, should be viewed alongside the detailed site summary tables.

10.2 Summary of Key Site Issues

The following points summarise the Level 2 assessment:

- The majority of the sites assessed as part of this Level 2 SFRA are at fluvial flood risk. The degree of flood risk varies, with some sites being only marginally affected along their boundaries, and other sites being more significantly affected within the site. Sites significantly affected by fluvial flooding will require more detailed investigations to inform a sequential approach to site layouts, SuDS possibilities, safe access and egress etc, as part of a site specific Flood Risk Assessment taken forward by a developer.
- The majority of sites at fluvial risk are also at risk from surface water flooding, with areas of ponding in the higher return period events across some sites and the access roads surrounding them. Surface water tends to follow topographic flow routes, for example along the watercourses or isolated pockets of ponding where there are topographic depressions. Site 17 – Moat Lane for example is at very low fluvial flood risk but has a large surface water flow path running through the site. The impact of surface water flooding sites such as this will need more detailed investigations undertaken as part of a site specific Flood Risk Assessment at a later stage.
- The strategic and detailed modelling completed as part of this SFRA made allowances for the impact of climate change. For the 1 in 100 year event, the 2080s period was used, and all three allowance categories were modelled (20%, 30% & 50%). Modelling indicates that flood extents will increase as a result of climate change and therefore, the depths, velocities and hazard of flooding are also seen to increase. The increases seen are more significant on some sites compared to others. Site-specific FRAs should confirm the impact of climate change using latest guidance.
- Structures and culvert locations have been identified where the structure upstream, downstream or within the site could have an impact on flood risk. A 2016 study using JScreen, a culvert blockage modelling software, has been used to look at the impact of culvert blockages on flood risk across sites. Specific survey and modelling has also been undertaken as part of the assessment where was it identified that this would add value. This impact of blockages on flood risk needs to be considered further as part of a site-specific FRA.

- For some sites, there is the potential for safe access and egress to be impacted by fluvial or surface water flooding. Consideration should be made to these sites as to how safe access and egress can be provided during flood events, both to people and emergency vehicles.
- 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.
- Sites which have areas designated by the Environment Agency as being a historic landfill site will require site ground investigations to determine the extent of the contamination and the impact this may have on SuDS. No Level 2 sites are located in a Groundwater Source Protection Zone.
- The Cumulative Impact Assessment (CIA), which includes Site 4 and 26 in the River Cole catchment and Site 12 in the River Blythe catchment is currently underway. The results of this assessment will be added to the draft report once completed and the report will be re-issued for comment.

At the planning application stage and as part of a Flood Risk Assessment, developers will need to undertake detailed hydrological and hydraulic assessments of watercourses to verify flood extent, depth, velocity and hazard (including considering the 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 should use the information in this SFRA to inform the Exception Test. At planning application stage, the Developer must design the site such that is appropriate flood resistant and resilient 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 Exception Test and present this information to the Local Planning Authority for approval. The Level 1 SFRA can be used to scope the flooding issues that a site-specific FRA should look into 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 Flood Risk Assessment and drainage strategies with both the Local Planning Authority and the LLFA, to identify any potential issues that may arise from the development proposals.

10.3 Considering the Exception Test for the Proposed Sites

In principle, it is possible for all sites assessed in the Level 2 SFRA to pass 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 along a site boundary, 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 for the least vulnerable parts of the development in accordance with Table 2 in the NPPF. Residential development should not be permitted in Flood Zone 3 and 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 on one area, compensatory flood storage will be required in another),
- Considering space for green infrastructure in the areas of highest flood risk.

If the strategic 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.

Site 17 – Moat Lane, Vulcan Road, was identified to be at very low fluvial flood risk but high surface water flood risk. As a result of the significant surface water flow path through the site:

- 10.6% of the site would be affected during the 30 year event
- 14.3% of the site would be affected during the 100 year event
- 28.4% of the site would be affected during the 1000 year event.

Due to the uncertainties identified in the Level 2 SFRA at the strategic scale, it is recommended further assessment is undertaken for this site to provide an evidence base when assessing space for development and overall viability. Additional integrated surface water modelling will be required to gain a better understanding of flood risk in this location.

10.4 Planning Policy Recommendations

The planning policy recommendations found in Chapter 11 of the Level 1 SFRA still stand for the site allocations and any windfall development that comes forward. Recommendations made in the Level 1 SFRA cover:

- Site specific flood risk assessments
- Sequential and exception tests
- Windfall sites
- Drainage strategies and SuDS
- Cumulative impact of development and cross boundary issues
- Residual risk
- Safe access and egress
- Future flood management

Further site-specific recommendations have been made in the Level 2 regarding Cumulative Impact Assessment. These are made in Chapter 9.

10.5 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 Solihull Metropolitan Borough Council, the Canal and Rivers Trust, Severn Trent Water and the Environment Agency. Such information may be in the form of:

- New hydraulic modelling results
- Flood event information following a future flood event
- Policy/ legislation updates
- Environment Agency flood map updates
- New flood alleviation schemes.

The Environment Agency 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 Flood Risk Assessment. It is recommended that the SFRA is reviewed in line with the Environment Agency'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.

Appendices

A Level 2 Assessment – Site Summary Tables

B Level 2 Assessment – Interactive Mapping

C Strategic Modelling Report

D Site 4 Modelling Report

E Site 12 Hydrology Technical Note

F Cumulative Impact Assessment

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