Partnership for South Hampshire Level 1 Strategic Flood Risk Assessment

PART 1 Main Report

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Quality information

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Acronymns

Acronym	Definition
AEP	Annual exceedance probability
BGS	British Geological Survey
CFMP	Catchment flood management plan
CMP	Catchment Management Plan
FCERM	Flood and coastal erosion risk management
FRA	Flood Risk Assessment
GIS	Geographical information system
HCC	Hampshire County Council
LFRMS	Local flood risk management strategy
LiDAR	Light detection and ranging
LLFA	Lead local flood authority
LPA	Local planning authority
NPPF	National planning policy framework
PCC	Portsmouth City Council
PFRA	Preliminary flood risk assessment
PfSH	Partnership for South Hampshire
PPG	Planning practice guidance
RMA	Risk management authority
SCC	Southampton City Council
SFRA	Strategic flood risk assessment
SuDS	Sustainable drainage systems
RBD	River basin district
RFCC	Regional flood and coastal committee
WWNP	Working with natural processes

1. Introduction

1.1 Background

1.1.1 AECOM has been commissioned by Portsmouth City Council (PCC) on behalf of ten planning authorities in South Hampshire (the 'Partnership for South Hampshire' (PfSH)) to prepare an updated Strategic Flood Risk Assessment (SFRA). The PfSH SFRA covers the administrative areas of Portsmouth City, Havant Borough, Gosport Borough, Fareham Borough, Eastleigh Borough, Southampton City, Winchester City, Test Valley Borough, New Forest District and New Forest National Park Authority, shown in Figure 1-1.

1.1.2 An SFRA is a study carried out to assess the risk to an area from all sources of flooding, now and in the future, taking into account the impacts of climate change, as well as assessing the cumulative impact that land use changes and development in the area will have on the flood risk. It identifies opportunities to reduce the causes and impacts of flooding and gathers information on the land that is likely to be needed for flood risk management infrastructure. It also informs policies for change of use and reducing the causes and impacts of flooding.

1.1.3 The PfSH SFRA has been prepared in line with the requirements of the National Planning Policy Framework[1] (NPPF), supporting Planning Practice Guidance[2] (PPG) and Environment Agency guidance 'How to prepare a Strategic Flood Risk Assessment'[3].

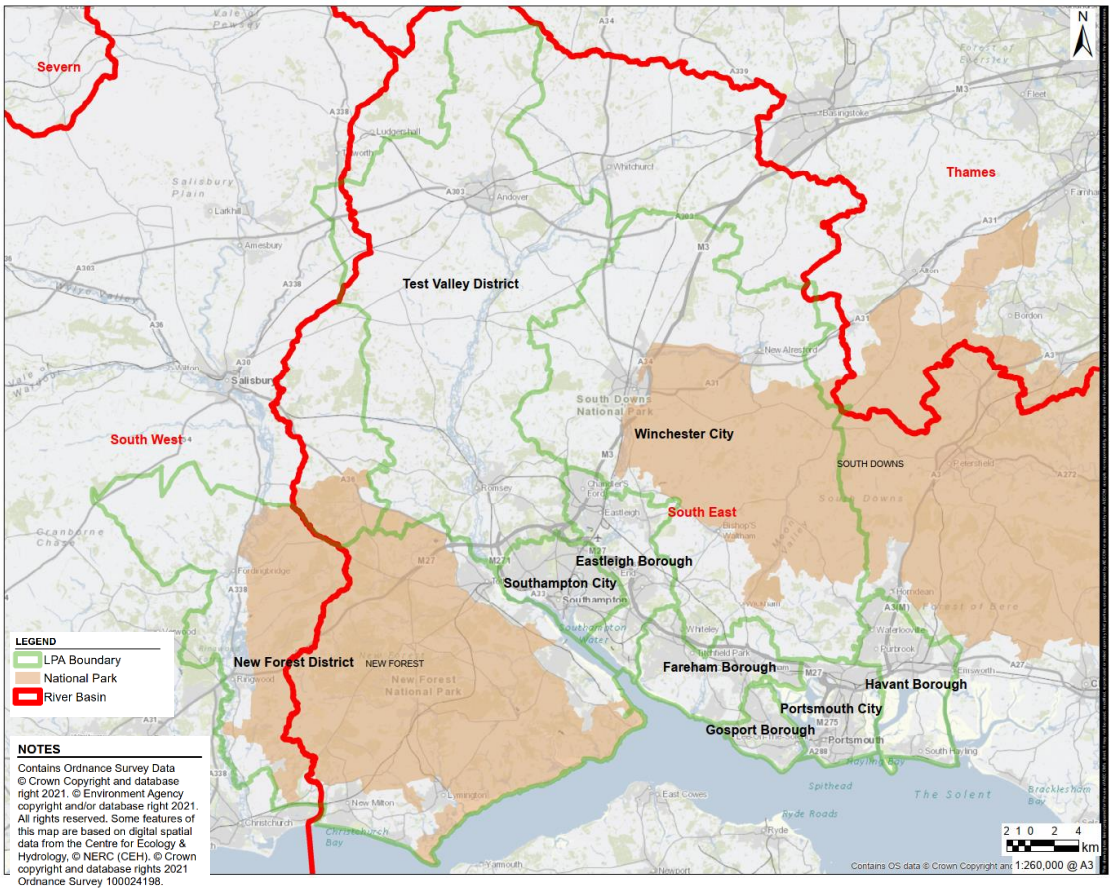

Figure 1-1 PfSH SFRA Study Area

[1] DLUHC, Updated December 2023, National Planning Policy Framework https://www.gov.uk/government/publications/national-planning-policy-framework--2
[2] DLUHC, Updated August 2022, Planning Practice Guidance https://www.gov.uk/guidance/flood-risk-and-coastal-change
[3] Defra, Environment Agency, March 2022. https://www.gov.uk/guidance/local-planning-authorities-strategic-flood-risk-assessment

1.1.4 The Environment Agency encourage planning authorities to work together to prepare SFRAs, particularly where LPAs share a river catchment or coastal area, or where the causes of flooding and solutions to address flood risk lie across LPA boundaries. For the PfSH, there are a number of benefits for collaborating between the LPAs and New Forest NPA to update the SFRA:

- The planning authorities of Portsmouth City, Havant Borough, Gosport Borough, Fareham Borough, Eastleigh Borough, Southampton City, New Forest District and New Forest NPA share the Solent coastline and the shared challenges of coastal erosion and/or tidal flooding.
- There are a number of river catchments that cross planning authority boundaries, including the Test, Itchen, Hamble, Monks Brook, Meon and Wallington River. Collaboration between the planning authorities enables the risk from these watercourses to be considered with a catchment approach.
- The planning authorities are part of the Partnership for South Hampshire and have an established track record of collaborative working across the region on housing and green environment work elements.

1.2 Stakeholders

1.2.1 Table 1-1 identifies the stakeholders that have been involved in the preparation of this SFRA and their roles and responsibilities with respect to flood risk management.

Table 1-1 Stakeholders

STAKEHOLDER	ROLE / RESPONSIBILITY
Local Planning Authorities: Portsmouth City, Havant Borough, Gosport Borough, Fareham Borough, Eastleigh Borough, Southampton City, Winchester City, Test Valley Borough, New Forest District and New Forest National Park Authority	Responsible for preparing Local Plans including flood risk policies and development allocations. Local Drainage Authorities under the Land Drainage Act. Risk Management Authorities (RMAs) under the Flood and Water Management Act. Category 1 responders under the Civil Contingencies Act.
Partnership for South Hampshire	Partnership of 12 local authorities around the Solent which aim to improve the environmental, cultural, and economic performance of the South Hampshire area. Areas of work include housing and energy and green environment, which are informed by flood risk.
Coastal Partners	Partnership between Havant, Portsmouth, Gosport and Fareham, and Chichester Councils who manage 176km of Hampshire's coastline and lead on coastal issues, such as managing flooding and erosion risk, planning design and managing construction of new coastal defence schemes, and inspecting, managing and maintaining existing coastal assets whilst planning for the future.
Lead Local Flood Authorities, Hampshire County Council, Wiltshire Council, Portsmouth City Council, Southampton City Council	Lead RMA for the management of local sources of flooding (surface water, groundwater, ordinary watercourses). Responsibility to develop a LFRMS, investigate flood incidents, maintain a register and record of flood risk management structures and features, regulate works in ordinary watercourses, establish a sustainable drainage adoption body for the approval of new SuDS, and approve drainage arrangements for new developments.
Environment Agency	Lead RMA for the management of river and coastal flooding.
Southern Water and Wessex Water	Responsible for public water supply and sewerage systems. Statutory consultee for Sustainable Drainage solutions that connect to the public network. Required to co-operate and share flood risk information with the LLFA.
Wessex Rivers Trust	Environmental charity dedicated to the conservation of chalk streams in Wessex. Informing policy and delivering catchment-wide environmental initiatives. Works across five main catchments: East Hampshire, Test & Itchen, Hampshire Avon and Dorset Stour.
Test and Itchen Catchment Partnership	Partnership hosted by the Hampshire & Isle of Wight Wildlife Trust and the Wessex Rivers Trust. Its role is to offer stakeholders a point of contact and a place to set out actions to improve the management and health of the Test and Itchen river catchment.
Southern Regional Flood and Coastal Committee (RFCC) and Wessex RFCC.	Involved in allocating government funding for flood defence and mitigation schemes.

1.3 Objectives

1.3.1 The objectives of the SFRA are as follows:

- Assess all potential sources of flooding based on readily available datasets,
- Update existing coastal and river models with new climate change allowances where required,
- Assess the risk of tidal flooding for defended and undefended scenarios, to understand the risk in the future should the level of protection afforded by defences not be maintained,
- Identify existing flood risk management measures as well as areas that need to be adapted to climate change, and areas that need to be safeguarded for future flood risk management features and structures,
- Consider the potential cumulative impact of development and land use change on the risk of flooding in the study area,
- Identify opportunities to reduce the causes and impacts of flooding,
- Provide recommendations for the sustainability appraisal in the preparation of the Local Plan,
- Provide recommendations for the emergency planning capabilities in relation to flood risk,
- Provide guidance for applying the sequential test in the preparation of Local Plans,
- Provide recommendations of how to address flood risk in development, including flood risk from sources other than rivers and the sea.

1.4 Approach to Flood Risk Management

1.4.1 The NPPF and associated PPG for Flood Risk and Coastal Change emphasise the active role LPAs should take to ensure that flood risk is assessed and managed effectively and sustainably throughout all stages of the planning process. The main steps to be followed when addressing flood risk are:

- Assess the risk,
- Avoid,
- Control,
- Mitigate, and,
- Manage residual risks.

1.4.2 This has implications for LPAs and developers as described below.

Assess flood risk

1.4.3 The NPPF states that Local Plans should be supported by a SFRA, and LPAs should use the findings to inform strategic land use planning. Figure 1-2 illustrates how flood risk should be taken into account in the preparation of the Local Plan by the LPAs. Where appropriate, for sites in areas at risk of flooding, developers must undertake a site-specific Flood Risk Assessment (FRA) to accompany planning applications (or prior approval for certain types of permitted development, or Technical Details Consent).

1.4.4 Assessments of flood risk identify sources of uncertainty and how these are accounted for in a mitigation strategy.

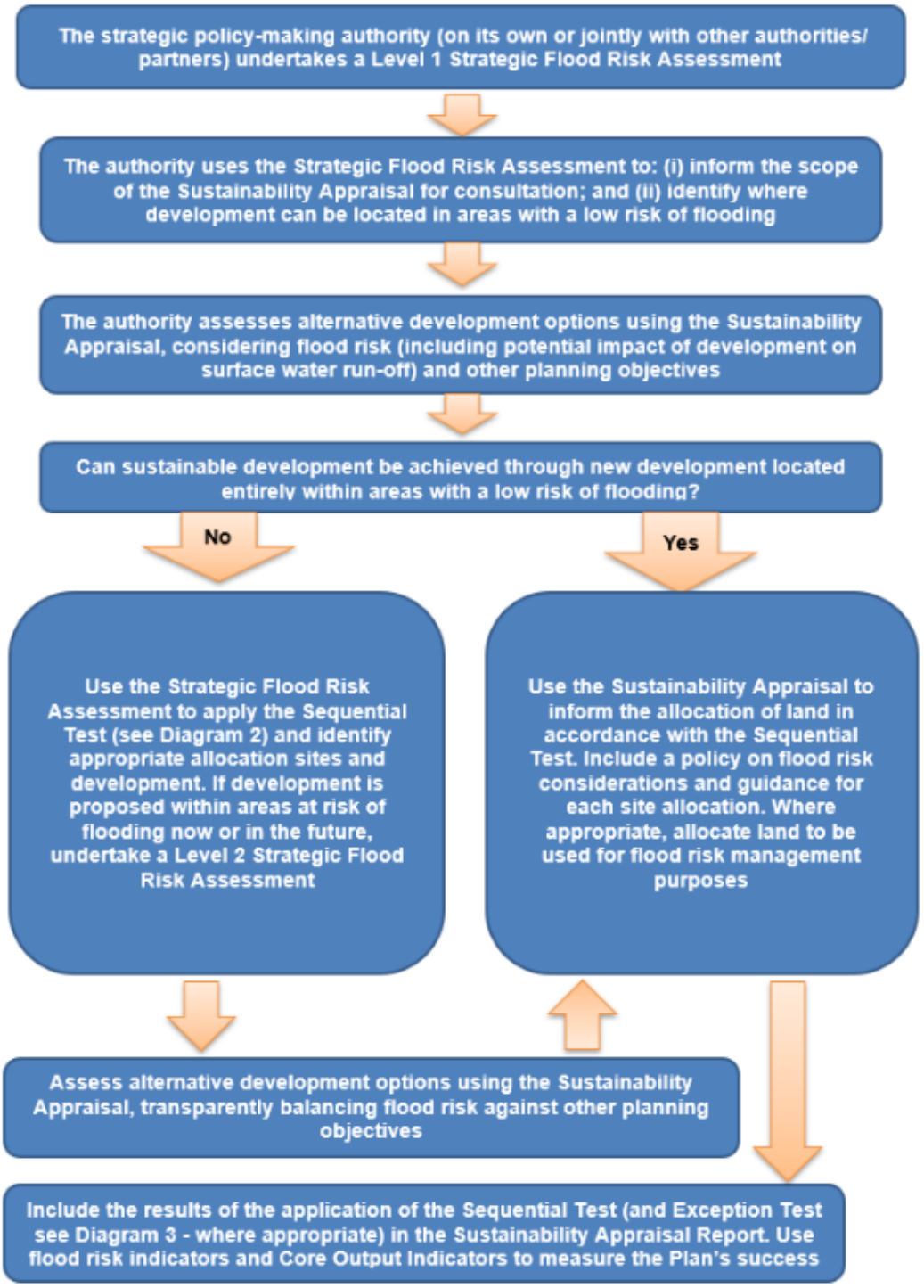

Figure 1-2 Taking flood risk into account in the preparation of a Local Plan (Planning Practice Guidance for Flood Risk and Coastal Change)

Avoid flood risk

1.4.5 LPAs should apply the sequential approach to site selection so that development is, as far as reasonably possible, located where the risk of flooding from all sources is lowest, taking account of climate change and the vulnerability of future users to flood risk. In plan-making this involves applying the Sequential Test, and where necessary the Exception Test to Local Plans, as described in Figure 1-2. In decision-taking this involves applying the Sequential Test and if necessary, the Exception Test for specific development proposals.

1.4.6 Within individual application sites, the most vulnerable aspects of development must be located in areas of lowest flood risk, including measures to avoid flood risk vertically, unless there are overriding reasons to prefer a different location.

1.4.7 Where the sequential and the exception tests have been applied as necessary and not met, development should not be allowed.

1.4.8 Guidance on application of the Sequential Test is provided in Section 4.

Control flood risk

1.4.9 LPAs and developers can investigate measures to control the risk of flooding affecting the site. Early discussions with relevant flood risk management authorities, reference to SFRAs and any programme of flood and coastal erosion risk management schemes will help to identify such opportunities.

1.4.10 LPAs and developers should seek flood risk management opportunities (e.g., safeguarding land), and to reduce the causes and impacts of flooding (e.g., through the use of sustainable drainage systems).

Mitigate flood risk

1.4.11 Where alternative sites in areas at lower risk of flooding are not available, it may be necessary to locate development in areas at risk of flooding. In these cases, LPAs and developers must ensure that development is appropriately flood resilient and resistant, safe for its users for the lifetime of the development and will not increase flood risk overall. Passive flood resilience and resistance measures should be prioritised over active measures as they are likely to be more effective and more reliable.

Manage flood risk

1.4.12 LPAs and developers should consider further management measures to deal with any residual risk remaining after avoidance, control and mitigation have been utilised. Residual risks will need to be safely managed to ensure people are not exposed to hazardous flooding. LPAs and developers should provide safe access and escape routes and consider whether adequate flood warning would be available to people using the development.

1.5 User Guide

1.5.1 It is anticipated that the SFRA will have a variety of end users, including LPA officers, developers, planning consultants, neighbourhood planning bodies, Lead Local Flood Authorities, emergency planners and local resilience forums. This guide sets out where to access relevant information within the SFRA reports.

Table 1-2 SFRA User Guide

PART 1 MAIN REPORT	CONTENT
1 Introduction	Explains the need for the study and the objectives. Provides a user guide and identifies who has been consulted. Identifies when the SFRA may need to be updated in the future.
2 Legislation and Policy Framework	Provides an overview of the latest legislation and national and regional policies in relation to flood risk and coastal change.
3 Datasets and Methodologies	Identifies the datasets used to inform the SFRA and describes the approaches taken to use and update data as part of the SFRA.
4 Applying the Sequential Test	Describes how the sequential test should be applied using the SFRA.
5 Preparing Flood Risk Assessments	Describes how site specific FRAs should be prepared.
Appendix A: GIS Floodplain Analysis Methodology	Records the methodology applied for the GIS floodplain analysis to determine those areas that may be sensitive to changes in flood level in the future.
Appendix B: Coastal Modelling Technical Notes	East Solent Flood Inundation Model Re-Simulations Technical Note (Hayling Island, Portsea Island, Gosport to Warsash) Southampton Water Model Re-Simulation Technical Note

LPA SPECIFIC REPORTS	CONTENT
PART 2 TEST VALLEY BOROUGH **PART 3 WINCHESTER CITY** **PART 4 HAVANT BOROUGH** **PART 5 PORTSMOUTH CITY** **PART 6 GOSPORT** **PART 7 FAREHAM BOROUGH** **PART 8 EASTLEIGH BOROUGH** **PART 9 SOUTHAMPTON CITY** **PART 10 NEW FOREST DISTRICT AND NATIONAL PARK AUTHORITY**	For each LPA, mapping of the flood risk datasets is provided as well as a report covering the following topics: 1 Introduction 2 Local policy and plans 3 Sources of flood risk and expected effects of climate change 4 Cumulative impacts of development and land use change 5 Current control, mitigation and management measures 6 Opportunities to reduce the causes and impacts of flooding 7 Recommendations of how to address flood risk in development

1.6 Future monitoring and update

1.6.1 This SFRA should be reviewed when there are changes to:

- The predicted impacts of climate change on flood risk,
- Detailed flood modelling - such as from the Environment Agency or Lead Local Flood Authority,
- Local Plans, spatial development strategies or relevant local development documents,
- Local flood management schemes,
- Flood Risk Management Plans,
- Shoreline Management Plans,
- Local Flood Risk Management Strategies, and,
- National planning policy or guidance.

1.6.2 The SFRA may also need to be reviewed after a significant flood event.

2. Legislation and Policy Framework

This Section provides a high level overview of the national and regional planning context for coastal change and flood risk management in the PfSH SFRA study area. A summary of the local context is provided in Parts 2 – 10 for each of the LPA areas.

2.1 National

National Planning Policy Framework

2.1.1 The NPPF[4] sets out the government's planning policies for England and provides guidance for LPAs to implement localised plans to deliver sustainable development in the face of the challenges presented by climate change, flooding, and coastal change.

2.1.2 The NPPF states that Local Plans should be supported by SFRAs and should develop policies to manage flood risk from all sources, taking account of advice from the Environment Agency and other relevant risk management bodies such as Lead Local Flood Authorities and internal drainage boards.

2.1.3 The NPPF presents the Sequential and Exception Tests as the decision making tools LPAs should use to direct development to areas with the lowest probability of flooding wherever possible. This SFRA provides the basis for applying these tests. Guidance for applying these tests can be found in Section 4.

Planning Practice Guidance 'Flood Risk and Coastal Change'

2.1.4 The Planning Practice Guidance[5] is a living document that supports the NPPF and is subject to periodic updates. It describes the planning approach to development within areas at risk of flooding from all sources, and it provides information on how flood risk should be taken into account in the preparation of local plans and what SFRAs should include. Where relevant, specific PPG paragraphs are referenced throughout this SFRA in the relevant sections.

Flood and Water Management Act 2010

2.1.5 The Flood and Water Management Act (FWMA)[6] aims to provide sustainable and consistent management of flooding in England and Wales. It defines the roles of risk management authorities (RMA) as the bodies with flood risk related responsibilities. RMAs include the Environment Agency, Internal Drainage Boards, Water and Sewerage Companies and Lead Local Flood Authorities (LLFAs). Within the PfSH study area, Hampshire County Council, Portsmouth City Council and Southampton City Council are LLFAs and have the following responsibilities:

- Developing and implementing a Local Flood Risk Management Strategy,
- Investigating and recording key local flood incidents,
- Maintaining a flood risk asset register,
- Coordinating the management of flooding from local sources (surface water, groundwater, and ordinary watercourses),
- Regulating works on Ordinary Watercourses, and,
- Sharing of information about flood risk.

[4] DLUHC, Updated December 2023, National Planning Policy Framework https://www.gov.uk/government/publications/national-planning-policy-framework--2
[5] DLUHC, Updated August 2022, Planning Practice Guidance https://www.gov.uk/guidance/flood-risk-and-coastal-change
[6] Flood Management Water Act, Updated 2010, https://www.legislation.gov.uk/ukpga/2010/29/contents

Flood Risk Regulations 2009

2.1.6 The Flood Risk Regulations (FRR)[7] set out duties for LLFAs and the Environment Agency to produce Preliminary Flood Risk Assessments (PFRAs), flood risk maps showing flooding extents and hazards, and Flood Risk Management Plans for Flood Risk Areas (FRAs). These reports are further described in Section 2.2. These FRR requirements are completed on a six-year cycle and achieve the country's legal obligations of the European Union (EU) Floods Directive 2007.

2.2 Regional

South Marine Plan

2.2.1 The South Marine Plan[8] introduces a strategic approach to planning within the inshore and offshore waters between Folkstone, Kent and the river Dart in Devon. Through its vision, the South Marine Plan will safeguard environments, encourage growth in local sectors and protect and enhance essential natural defences against climate change and flooding.

2.2.2 Implementation of the plan's objectives will help decision makers to optimise the marine area's natural capital, realising greater protection of vulnerable habitats and species and natural defences against climate change and flooding, as well as improving the well-being of coastal communities and supporting a stronger marine economy.

Shoreline Management Plans

2.2.3 Shoreline Management Plans (SMPs)[9] form part of Defra's strategy for flood and coastal defence. They provide a large-scale assessment of risks associated with coastal change and present the policy framework to address these risks in a sustainable manner. The SMP policies defined by Defra are:

- Hold the line – maintain or upgrade the level of protection provided by defences,
- Advance the line – build new defences seaward of the existing defence line,
- Managed realignment – allowing retreat of the shoreline, with management to control or limit the movement, and
- No active intervention – a decision not to invest in providing or maintaining defences.

2.2.4 The following SMPs are relevant to the study area:

- North Solent (2010) from Selsey Bill to Hurst Spit, and,
- Poole and Christchurch Bays (2011) from Hurst Spit to Durlston Head.

2.2.5 In coastal areas, LPAs will need to collaborate with the Marine Management Organisation to ensure that plans and policies across the land/sea boundary are coordinated. Furthermore, LPAs are strongly encouraged to adopt the principles set out in the Coastal Concordat for England to coordinate the consenting process for coastal development.

River Basin Flood Risk Management Plans

2.2.6 The Flood Risk Regulations 2009 set out a statutory process for flood risk planning over a 6-year cycle. The Environment Agency and those LLFAs with a surface water Flood Risk Area (FRA) within their administrative area must produce a Flood Risk Management Plan (FRMP), to set out how the risk in that FRA will be managed.

2.2.7 There are no *surface water* FRAs in the PfSH study area. There are two *rivers and sea* FRAs:

- Southampton FRA
- Portsmouth FRA

[7] Flood Risk Regulations, Updated 2009, https://www.legislation.gov.uk/uksi/2009/3042/contents/made
[8] MMO, Updated July 2018, South Marine Plan https://www.gov.uk/government/publications/the-south-marine-plans-documents
[9] Environment Agency, Updated March 2019, Shoreline Management Plans https://www.gov.uk/government/publications/shoreline-management-plans-smps

2.2.8 The South East FRMP[10] sets out how to manage significant flood risk in these nationally identified FRAs. Further details are provided in relation to the Southampton and Portsmouth FRAs in SFRA Part 5 (Portsmouth) and SFRA Part 9 (Southampton).

River Basin Management Plans

2.2.9 Alongside flood risk management planning, the Environment Agency works with others to protect and improve the quality of the water environment. It does this through river basin management.

2.2.10 River Basin Management Plans (RBMPs) are prepared in accordance with the Water Framework Directive and assess the pressure facing the water environment in river basin districts. The study area is located chiefly within the South East RBD[11], with the western edge located in the South West RBD[12].

2.2.11 The Environment Agency aims to co-ordinate the FRMPs and the RBMPs so that all organisations can do more for the environment. Many of the FRMP measures have the potential to contribute to RBMP objectives, for example through Natural Flood Management, SuDS, incorporating ecological enhancements into measures, or naturalisation of channels through the removal of structures.

Catchment Flood Management Plans

2.2.12 Catchment Flood Management Plans (CFMPs) are high-level strategic plans providing an overview of flood risk across each river catchment[13]. The Environment Agency use CFMPs to work with other decision makers to identify and agree long-term policies for sustainable flood risk management.

2.2.13 In the South East river basin district, the following CFMPs are relevant to the study area:

- New Forest Catchment Flood Management Plan (2009),
- Test and Itchen Catchment Flood Management Plan (2009), and,
- South East Hampshire Catchment Flood Management Plan (2009).

2.2.14 In the South West river basin district, the following CFMPs are relevant to the study area:

- Hampshire Avon Catchment Flood Management Plan (2012), and,
- Dorset Stour Catchment Flood Management Plan (2009).

[10] South East Flood Risk Management Plan 2021-2027. December 2022 https://www.gov.uk/government/publications/south-east-river-basin-district-flood-risk-management-plan
[11] South East River Basin District River Basin Management Plan Updated 2022 https://www.gov.uk/guidance/south-east-river-basin-district-river-basin-management-plan-updated-2022
[12] South West River Basin District River Basin Management Plan Updated 2022 https://www.gov.uk/guidance/south-west-river-basin-district-river-basin-management-plan-updated-2022
[13] Environment Agency, December 2009, Catchment Flood Management Plans https://www.gov.uk/government/collections/catchment-flood-management-plans

3. Datasets

SFRAs rely on a large number of datasets and information from a range of stakeholder organisations. This section describes the datasets that have been obtained and the methods that have been applied to assess the risk from all sources of flooding across the study area.

3.1 Assessing Risk of Flooding from Rivers

3.1.1 Flooding from rivers occurs when water levels rise higher than bank levels, causing floodwater to spill across adjacent land (floodplain). The main reasons for water levels rising in rivers are:

- Intense or prolonged rainfall causing runoff rates and flows to increase in rivers, exceeding the capacity of the channel. This can be exacerbated by wet conditions and where there is significant groundwater base flow.
- Constrictions in the river channel causing flood water to back up.
- Constrictions preventing discharge at the outlet of the river e.g., locked flood gates.

Datasets

3.1.2 The datasets described in Table 3-1 have been used in the assessment of flooding from rivers.

Table 3-1 Datasets for river flooding

Dataset	Notes	Data Source
Detailed River Network	A consistent standardised GIS shapefile representing the river network. Identifies the watercourse centreline, and numerous parameters e.g., type (primary river, secondary, culvert, canal), surface or below ground, main river status, name, width, flow direction.	Environment Agency
OS Open Rivers	GIS shapefile which provides a high level view of watercourses. Contains over 144,000 km of water bodies and watercourses map data. These include freshwater rivers, tidal estuaries, and canals.	Ordnance Survey free download https://www.ordnancesurvey.co.uk/business-government/products/open-map-rivers
Catchment boundaries	GIS shapefiles obtained from the Catchment Data Explorer have been used to identify the river basin districts, management catchments and water body catchments in the PfSH SFRA project area.	Environment Agency Catchment Data Explorer https://environment.data.gov.uk/catchment-planning
Flood Zone 2 and Flood Zone 3a	GIS shapefiles which identify the probability of river and sea flooding, including the future impacts of climate change, ignoring the presence of defences as mapped on the Environment Agency Flood Map for Planning (rivers and sea). Flood Zone 1: Land having a less than 1 in 1,000 annual probability of river or sea flooding. (All land outside Flood Zones 2 and 3). Flood Zone 2: Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding. Flood Zone 3a: Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding.	Defra Data Services Platform https://environment.data.gov.uk/dataset/86ec354f-d465-11e4-b09e-f0def148f590 https://environment.data.gov.uk/dataset/87446770-d465-11e4-b97a-f0def148f590
Defences	Contains the locations of flood defences currently owned, managed or inspected by the Environment Agency, including structures, buildings, earth banks, stone and concrete walls, and sheet-piling that is used to prevent or control the extent of flooding.	Environment Agency
Flood Storage Areas	Contains flood storage areas, including balancing reservoirs, storage basins and balancing ponds whose purpose is to attenuate an incoming flood peak or to delay the timing of the peak.	Defra Data Services Platform https://environment.data.gov.uk/dataset/86ca7c80-d465-11e4-afe1-f0def148f590

Dataset	Notes	Data Source
Reduction in Risk of Flooding from Rivers and Sea due to Defences	Reduction in Risk of Flooding from Rivers and Sea due to Defences is a spatial dataset that indicates where areas have reduced flood risk from rivers and sea due to the presence of flood defences. The dataset has been created to help initiate conversations about the impact our flood defences have on the risk of flooding from the rivers and sea, and as a prompt to find out more about the flood defences in a particular area of interest. It does not replace any local, more detailed information.	Defra Data Services Platform https://environment.data.gov.uk/dataset/7b5cf457-6853-4b50-a812-b041d9da003a
Recorded Flood Outlines	Contains all records of historic flooding from rivers, the sea, groundwater, and surface water since 1946. Takes account of the presence of defences, structures and other infrastructure that existed at the time of flooding. A companion dataset Historic Flood Map contains a subset of these Recorded Flood Outlines which satisfy certain criteria.	Defra Data Services Platform https://environment.data.gov.uk/dataset/8c75e700-d465-11e4-8b5b-f0def148f590

Hydraulic models

3.1.3 A number of hydraulic river models were provided by the Environment Agency at the start of the project. The models were checked for completeness, date of preparation and the hydrological methods used. Outputs from the models have been used to define Flood Zone 3b functional floodplain and to map the impacts of climate change on floodplain extents in the future, as described in the following subsections.

3.1.4 Where necessary and appropriate models were re-run for the latest climate change allowances as part of this SFRA. In some cases, updates to the hydrological analysis informing the model have been updated. Table 3-3 summarises the models that have been received, how they have been used in the SFRA and any updates that have been undertaken as part of the SFRA. Full details of re-simulations are documented in separate standalone Technical Notes.

Functional floodplain

3.1.5 The SFRA should identify areas of Flood Zone 3b functional floodplain, which is defined as land where water has to flow or be stored in times of flooding. This is identified by the normal form of the river channel and land that would flood with an annual probability of 1 in 30 (3.3%) or greater in any year, with existing flood risk management features and structures operating effectively. It is also identified by land that is designed to flood (such as a flood attenuation scheme), even if it would only flood in more extreme events (such as 0.1% annual probability of flooding).

3.1.6 Where the 3.3% annual exceedance probability (AEP) flood extent is available from received hydraulic models, it has been used to delineate Flood Zone 3b functional floodplain. As noted in Table 3-3, where the received hydraulic models did not include a 3.3% annual exceedance probability (AEP) flood extent, alternative approaches have been adopted. In some cases, this involves using the 4% AEP (1 in 25 year) 5% AEP (1 in 20 year), or the 2% AEP (1 in 50 year) flood extent.

3.1.7 Where a suitable flood extent is not available to identify the functional floodplain, the extent of Flood Zone 3a should be used as a surrogate for Flood Zone 3b to ensure the risk isn't underestimated. The Environment Agency guidance 'How to prepare a strategic flood risk assessment' [3] encourages the use of site specific flood risk assessments to determine whether a site is affected by functional floodplain. If sites are proposed for development in such areas in any of the LPA's Local Plans, it may be necessary to undertake additional assessment to map the location of the functional floodplain as part of a Level 2 SFRA.

Impact of climate change on peak river flow

3.1.8 Climate change is expected to increase the frequency, extent, and impact of flooding, reflected in peak river flows. Wetter winters and more intense rainfall may increase fluvial flooding and surface water runoff and there may be increased storm intensity in summer. Rising river levels may also increase flood risk.

3.1.9 LPAs are required to make allowances for climate change in Local Plans to help minimise vulnerability and provide resilience to flooding. Current guidance on the climate change allowances that should be

applied are set out by the Environment Agency[14]. Peak river flow allowances show the anticipated changes to peak flow by management catchment. Management catchments are sub-catchments of river basin districts. The range of allowances is based on percentiles. A percentile describes the proportion of possible scenarios that fall below an allowance level. The 50th percentile is the point at which half of the possible scenarios for peak flows fall below it, and half fall above it. The:

- *central* allowance is based on the 50th percentile
- *higher central* allowance is based on the 70th percentile
- *upper end* allowance is based on the 95th percentile

3.1.10 An allowance based on the 50th percentile is exceeded by 50% of the projections in the range. At the 70th percentile it is exceeded by 30%. At the 95th percentile it is exceeded by 5%.

3.1.11 These allowances (increases) are provided, in the form of figures for the total potential change anticipated, for three climate change periods:

- The '2020s' (2015 to 2039)
- The '2050s' (2040 to 2069)
- The '2080s' (2070 to 2125)

3.1.12 The time period that should be used in an assessment depends upon the expected lifetime of the proposed development. Residential development should be considered for a minimum of 100 years, whilst the lifetime of a non-residential development depends upon the characteristics of that development.

3.1.13 The guidance states that for *SFRAs* LPAs should assess both the *central* and *higher central* allowances.

3.1.14 When designing safe access, escape routes and places of refuge, the central allowance should be used for all development types except for essential infrastructure. For essential infrastructure the higher central allowance should be used.

3.1.15 The management catchments in the PfSH SFRA project area include:

- East Hampshire (South East river basin district)
- Test and Itchen (South East river basin district)
- New Forest (South East river basin district)
- Avon Hampshire (South West river basin district)

3.1.16 Table 3-2 presents the peak river flow allowances for these management catchments.

[14] Flood risk assessments: climate change allowances https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances First published February 2016. Last updated May 2022.

Table 3-2 Peak river flow allowances by management catchment (based on 1981 to 2000 baseline)

Management catchment	River basin district	Allowance category	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2125)
East Hampshire	South east	Upper end	37%	51%	88%
		Higher central	24%	30%	51%
		Central	19%	22%	37%
New Forest	South east	Upper end	29%	51%	86%
		Higher central	16%	30%	50%
		Central	11%	22%	35%
Test and Itchen	South east	Upper end	45%	61%	127%
		Higher central	24%	28%	56%
		Central	16%	17%	35%
Avon Hampshire	South west	Upper end	33%	52%	102%
		Higher central	19%	27%	56%
		Central	12%	16%	38%

3.1.17 Table 3-3 summarises the models that have been received, to inform this SFRA, how they have been used in the SFRA, and additional model simulations that have been undertaken as part of the SFRA.

*Table 3-3 River models in PfSH study area**

Hydraulic Model	LPA	Type and Date of Received Model	Model Information	Flood Zone 3b Functional Floodplain	Approach undertaken within this SFRA to map the risk in the future as a result of climate change
River Anton (including Pillhill Brook)	Test Valley BC	1D-2D model (FMP-TUFLOW), August 2014, JBA.	2 models (lower and upper catchment)	3.3% AEP (1 in 30 year) extent available to map Flood Zone 3b functional floodplain.	Hydrology checked and confirmed suitable. Model re-run by AECOM for 1% AEP plus central (35%) and higher central (56%) allowances.
Kimpton (Mullens Brook)	Test Valley BC	1D-2D model (FMP-TUFLOW), September 2016, Environment Agency.	Small area modelled in Kimpton village. Mullens Brook flows through Kimpton to confluence with Pillhill Brook at Mullens Pond.	No suitable AEP event to map the functional floodplain available.	Hydrology checked and confirmed suitable. Model re-run by AECOM for 1% AEP plus central (35%) and higher central (56%) allowances.
Romsey	Test Valley BC	1D-2D model (FMP-TUFLOW), September 2018, Royal Haskoning DHV.	Flood alleviation scheme model. Do Nothing and Do Something scenarios modelled.	2% AEP (1 in 50 year) extent used to map Flood Zone 3b functional floodplain.	Hydrology checked and confirmed suitable. Model re-run by AECOM for the Do Something scenario for the 1% AEP plus central (35%) and higher central (56%) allowances.
River Bourne (Tidworth & Shipton Bellinger)	Test Valley BC	TUFLOW, 2005, Capita Symonds.	Steady state TUFLOW modelling.	2% AEP (1 in 50 year) extent used to map Flood Zone 3b functional floodplain.	Hydrology updated. Model re-run for 1% AEP plus central (38%) and higher central (56%) allowances.
Tadburn Lake Stream	Test Valley BC	FMP 1D, December 2004, Atkins.		2% AEP (1 in 50 year) extent used to map Flood Zone 3b functional floodplain.	Due to the age of this model, it has not been re-run for the SFRA. The available 1% AEP and 0.1% AEP flood extents have been mapped in this SFRA provide an indication of the impact of climate change. GIS Floodplain Analysis also undertaken to provide indication of areas that could be susceptible to flooding if flood levels were to increase (refer to next section).
Tanners Brook	Test Valley BC Southampton CC	FMP, February 2010, Royal Haskoning.		No suitable AEP event to map the functional floodplain available.	Due to the age of this model, it has not been re-run for the SFRA. The available 1% AEP and 1% AEP plus 20% climate change allowance flood extents have been mapped in this SFRA provide an indication of the impact of climate change. GIS Floodplain Analysis undertaken to provide indication of areas that could be susceptible to flooding if flood levels were to increase (refer to next section).
Monks Brook	Test Valley BC Eastleigh BC	FMP, August 2008, Halcrow Group Ltd.		4% AEP extent used to map Flood Zone 3b functional floodplain	No additional work undertaken. The Environment Agency are developing a new model for the Monks Brook. The available 1% AEP and 1% AEP plus 20% climate change allowance flood extents have been mapped in this SFRA provide an indication of the impact of climate change. GIS Floodplain Analysis also undertaken to provide indication of areas that could be susceptible to flooding if flood levels were to increase (refer to next section).

Hydraulic Model	LPA	Type and Date of Received Model	Model Information	Flood Zone 3b Functional Floodplain	Approach undertaken within this SFRA to map the risk in the future as a result of climate change
Monks Brook (upstream sections)	Eastleigh BC	FMP-TUFLOW, May 2018, Jacobs	*Model focused on Chandlers Ford Area. Atkins developed FMP TUFLOW model in 2016 to evaluate risk for Monks Brook Flood Alleviation Scheme. The model was based entirely on LiDAR data and site observations, hence is subject to significant uncertainty.* *Review by Jacobs 2018: although the Atkins model contains significant data gaps and uncertainties, it was considered appropriate to adopt for this study. More rigorous modelling will be required for any future stages of work.*	2% AEP (1 in 50 year) extent available to map Flood Zone 3b functional floodplain	Due to the age of this model and the fact that the Environment Agency are developing a new model for the Monks Brook this model has not been re-run for the SFRA. The available 0.5% AEP and 0.1% AEP flood extents have been mapped in this SFRA to provide an indication of the impact of climate change. GIS Floodplain Analysis also undertaken to provide indication of areas that could be susceptible to flooding if flood levels were to increase (refer to next section).
Itchen	Winchester CC Eastleigh BC Southampton CC	FMP-TUFLOW, JFLOW, May 2019, JBA	Model split into 3. JFLOW for upstream catchment, FMP-TUFLOW between Easton and Woodmill.	3.3% AEP extent used to map Flood Zone 3b functional floodplain.	Environment Agency are planning to update CC scenarios. Therefore, no additional work undertaken for the SFRA; the existing available climate change allowances have been mapped (35%, 45% and 105%).
Itchen tributaries	Bow Lake (Winchester CC) Colden Common Stream (Winchester CC) Hatch Green Brook (Eastleigh BC) Moorgreen Brook (Eastleigh BC) Otterbourne Stream (Winchester CC) Townhill Stream (Eastleigh BC)	FMP-TUFLOW, May 2019, JBA	Separate models for each tributary. Model has been run for the following climate change allowances 35%, 45% and 105%.	3.3% AEP extent us to map Flood Zone 3b functional floodplain.	Environment Agency are planning to update CC scenarios. Therefore, no additional work undertaken for the SFRA; the existing available climate change allowances have been mapped (35%, 45% and 105%).
River Meon	Winchester CC Fareham BC	FMP-TUFLOW, August 2009, Halcrow Group Ltd	Comprises 8 models, each are short sections of river at key locations identified by Environment Agency. Two sections are in the SFRA study area: Titchfield (Fareham BC) and Wickham (Winchester CC).	Wickham: Winchester CC have selected to use the 1.3% AEP (1 in 75 year) flood extent through Wickham as this is a built-up area that has experienced flooding issues in the past and therefore a conservative approach is justified. Titchfield: Fareham BC have selected to use the 5% AEP (1 in 20 year) flood extent. Given its location, there is very minimal chance of any development being allocated here in any emerging Local Plan. The area is covered by a variety of nature conservation designations including parts within a SPA and Ramsar as well as the whole valley being classes as an Area of Special Landscape Quality.	Due to the age of this model, it has not been re-run for the SFRA. The available 1% AEP, 1% AEP plus 20% climate change allowance and 0.1% AEP flood extents have been mapped in this SFRA provide an indication of the impact of climate change. GIS Floodplain Analysis also undertaken to provide indication of areas that could be susceptible to flooding if flood levels were to increase (refer to next section).

Hydraulic Model	LPA	Type and Date of Received Model	Model Information	Flood Zone 3b Functional Floodplain	Approach undertaken within this SFRA to map the risk in the future as a result of climate change
River Wallington	Winchester CC Fareham BC	FMP-TUFLOW, April 2011, Hyder Consulting.	This is more detailed than JFLOW modelling. However, there is low confidence in the extents at the moment.	2% AEP extent (1 in 50 year) used to map Flood Zone 3b functional floodplain for River Wallington and its tributaries upstream of North Fareham.	Due to the age of this model, it has not been re-run for the SFRA. The available 1% AEP, 1% AEP plus 20% climate change allowance and 0.1% AEP flood extents have been mapped in this SFRA provide an indication of the impact of climate change. GIS Floodplain Analysis also undertaken to provide indication of areas that could be susceptible to flooding if flood levels were to increase (refer to next section).
River Wallington	Fareham BC	FMP-TUFLOW, November 2018, JBA.		3.3% AEP extent used to map Flood Zone 3b functional floodplain for lower part of the River Wallington from North Fareham through Wallington to the A27 roundabout.	Hydrology checked and confirmed suitable. Model re-run by AECOM for 1% AEP plus central (37%) and higher central (51%) allowances.
Hermitage Stream and Lavant Stream	Havant BC	Infoworks RS, March 2008, Atkins.	Separate sub-model of Park Lane Stream build in RS for the Warren Dam.	No suitable AEP event to map the functional floodplain available.	Due to the age of this model, it has not been re-run for the SFRA. The available 1% AEP, 1% AEP plus 20% climate change allowance and 0.1% AEP flood extents have been mapped in this SFRA provide an indication of the impact of climate change. GIS Floodplain Analysis also undertaken to provide indication of areas that could be susceptible to flooding if flood levels were to increase (refer to next section).
Hampshire Avon: Fordingbridge	New Forest DC and NPA	FMP-TUFLOW, 2018, JBA		5% AEP extent used to map Flood Zone 3b functional floodplain.	Hydrology checked and confirmed suitable. Model re-run by AECOM for 1% AEP plus central (38%) and higher central (56%) allowances.
Ringwood Ordinary Watercourses	New Forest DC and NPA	FMP-TUFLOW, 2018, JBA		5% AEP extent used to map Flood Zone 3b functional floodplain.	Hydrology checked and confirmed suitable. Model re-run by AECOM for 1% AEP plus central (38%) and higher central (56%) allowances.
Bransgore	New Forest DC and NPA	FMP-TUFLOW, 2018, JBA		5% AEP extent used to map Flood Zone 3b functional floodplain.	Hydrology checked and confirmed suitable. Model re-run by AECOM for 1% AEP plus central (38%) and higher central (56%) allowances.
Hampshire Avon: Ringwood	New Forest DC and NPA	FMP-TUFLOW, 2011, JBA		2% AEP extent (1 in 50 year) used to map Flood Zone 3b functional floodplain.	This model has not been re-run for the SFRA. The available 1% AEP, 0.5% AEP and 0.1% AEP flood extents have been mapped in this SFRA to provide an indication of the impact of climate change. GIS Floodplain Analysis also undertaken to provide indication of areas that could be susceptible to flooding if flood levels were to increase (refer to next section).
River Mude	New Forest DC and NPA	2009		5% AEP extent used to map Flood Zone 3b functional floodplain.	Due to the age of this model, it has not been re-run for the SFRA. The available 1% AEP, 1% AEP plus 20% climate change allowance and 0.1% AEP flood extents have been mapped in this SFRA provide an indication of the impact of climate change. GIS Floodplain Analysis also undertaken to provide indication of areas that could be susceptible to flooding if flood levels were to increase (refer to next section).

Hydraulic Model	LPA	Type and Date of Received Model	Model Information	Flood Zone 3b Functional Floodplain	Approach undertaken within this SFRA to map the risk in the future as a result of climate change
Avon Water, Bartley Water, Danes Water, Dark Water and Walkford Brook	New Forest DC and NPA	HEC-RAS 2020, Capita AECOM	1D models of watercourses in New Forest. Outputs available for 10%, 3.3%, 1% and 0.1%. Climate change runs available for 35%, 45% and 105%.	3.3% AEP extent used to map Flood Zone 3b functional floodplain.	Current outputs deemed suitable for the SFRA. In the New Forest management catchment (in which these watercourses are located), the central and higher central allowances are 35% and 50% respectively. The modelled outputs for 1% AEP plus 35% and plus 45% are therefore suitable indications of the likely impacts of climate change.
Calmore Canal, Testwood Stream and the Bartley Water Tributary	New Forest DC and NPA	InfoWorks Integrated Catchment Model, March 2022, JBA Consulting	Detailed 1D-2D linked fluvial and integrated hydraulic models for the Calmore and Totton study area. Represents rivers, sewers, and surface water. The model was built to update flood risk mapping and flood warning systems, and to rest flood alleviation options.	5% AEP extent used to map Flood Zone 3b functional floodplain.	The available climate change allowances have been mapped for the 1% AEP flood event: 35%, 45% and 105%.

* Watercourses not listed in this table that have Flood Zones 2 and 3 associated with them on the Flood Map for Planning (rivers and sea) are derived from national generalised modelling (JFLOW). Detailed hydraulic models containing extents for Flood Zone 3b or including the impacts of climate change are not available for these watercourses.

GIS Floodplain Analysis

3.1.18 Some of the watercourses in the study area have only been modelled using national generalised modelling (JFLOW). In these cases, Flood Zone 2 and Flood Zone 3 extents are available, but there are no extents for Flood Zone 3b functional floodplain or consideration of the how the extent of flooding could change in the future as a result of the impacts of climate change.

3.1.19 Where significant development is proposed, there is a case for hydraulic modelling to be carried out to determine the risk of from these watercourses. For example, the Environment Agency are currently developing new hydraulic models for the River Test and the Monks Brook. The Environment Agency are also updating the Itchen and Itchen tributary models with the latest climate change allowances as part of their ongoing programme of modelling.

3.1.20 In other areas, full hydraulic modelling cannot be justified at this stage, but more information would be valuable for LPAs to enable them to understand those areas of the floodplain that may be sensitive to changes in flood level. To facilitate this understanding, the scope of the SFRA has been extended to include GIS analysis of the extents of Flood Zone 2 and 3 and local LIDAR topographic survey.

3.1.21 The GIS floodplain analysis involved recreating the Environment Agency Flood Zone 3 flood extents in ArcGIS Pro by extracting elevation points along the boundary of the Flood Zone 3 flood extent from DTM LiDAR data and interpolating a new water surface. Additional water depths of 300 and 600mm were added on to this water surface to provide an indication of those areas of floodplain that could become flooded if the water level were to increase. This mapping does not show the expected impacts of specific climate change predictions, rather it highlights areas which could be sensitive to an increase in flood level. It also identifies areas of floodplain which comprise a more well defined valley and are therefore less sensitive to changes in flood level.

3.1.22 This is considered a suitable level of information to inform the application of the Sequential Test by the LPAs. However, if the LPAs are considering development within the extents of Flood Zone 2 and 3 associated with these watercourses detailed modelling should be undertaken.

3.1.23 Further details are provided in the Technical Note in Appendix B.

3.2 Assessing Risk of Flooding from Surface Water

3.2.1 Overland flow and surface water flooding typically arise following periods of intense rainfall, often of short duration, that is unable to soak into the ground or enter drainage systems. It can run quickly off land and result in localised flooding. The PPG states that an SFRA should identify areas at risk from surface water flooding and drainage issues, taking account of climate change and of the surface water flood risk published by the Environment Agency as well other available information.

Hampshire County Council records

3.2.2 As the LLFA for most of the LPA administrative areas, Hampshire County Council have a duty to lead on the management of surface water flood risk. To inform the SFRA, HCC have provided GIS shapefiles of recorded highway flooding incidents and locations of flood investigations.

Risk of flooding from Surface Water mapping

3.2.3 The Environment Agency has undertaken modelling of surface water flood risk at a national scale and produced mapping identifying those areas at risk of surface water flooding during three annual probability events: 1 in 30 year (3.33% annual probability), 1 in 100 year (1% annual probability) and 1 in 1,000 year (0.1% annual probability). The extents of the latest version of the mapping have been made available for the Level 1 SFRA as GIS layers. This mapping is referred to as 'Risk of Flooding from Surface Water' (RoFSW) and is also available online on the Long Term Flood Risk Map[15].

3.2.4 The RoFSW mapping provides all relevant stakeholders, such as the Environment Agency, LPAs, and the public access to information on surface water flood risk which is consistent across England and Wales. The modelling helps the Environment Agency take a strategic overview of flooding and assists

[15] Environment Agency Long Term Flood Risk Map https://flood-warning-information.service.gov.uk/long-term-flood-risk

LLFAs in their duties relating to management of surface water flood risk. For the purposes of this SFRA, the mapping allows an improved understanding of areas within the study area which may have a surface water flood risk.

3.2.5 It should be noted that this national mapping has the following limitations:

- Use of a single drainage rate for all urban areas,
- It does not show the susceptibility of individual properties to surface water flooding,
- The mapping has significant limitations for use in flat catchments,
- No explicit modelling of the interaction between the surface water network, the sewer systems and watercourses,
- In a number of areas, modelling has not been validated due to a lack of surface water flood records, and
- As with all models, the ROFSW mapping is affected by a lack of, or inaccuracies, in available data.

Impact of climate change on peak rainfall intensity

3.2.6 Climate change is predicted to result in wetter winters and increased summer storm intensity in the future. This will lead to an increased volume of water entering land and urban drainage systems, consequently resulting in surface water flooding.

3.2.7 LPAs are obliged to make allowances for climate change in Local Plans to help minimise vulnerability and provide resilience to flooding. Current guidance on the climate change allowances that should be applied are set out by the Environment Agency[16]. Table 3-4 shows anticipated changes in peak rainfall intensity in small catchments (less than 5km^2), or urbanised drainage catchments[17].

Table 3-4 Peak rainfall intensity allowance in small catchments (less than 5km^2) or urban drainage catchments (based on a 1981 to 2000 baseline)

Management catchment	River basin district	AEP	Epoch 2050s (2022-2060) or 2070s (2051-2125)	Central Allowance	Upper End Allowance
East Hampshire	South east	3.33%	‘2050s’	20%	35%
		3.33%	‘2070s’	25%	40%
		1%	‘2050s’	20%	40%
		1%	‘2070s’	25%	45%
New Forest	South east	3.33%	‘2050s’	20%	35%
		3.33%	‘2070s’	25%	40%
		1%	‘2050s’	20%	40%
		1%	‘2070s’	25%	45%
Test and Itchen	South east	3.33%	‘2050s’	20%	35%
		3.33%	‘2070s’	25%	40%
		1%	‘2050s’	20%	40%
		1%	‘2070s’	25%	45%
Avon Hampshire	South west	3.33%	‘2050s’	20%	35%
		3.33%	‘2070s’	25%	40%
		1%	‘2050s’	25%	40%
		1%	‘2070s’	25%	45%

[16] Flood risk assessments: climate change allowances https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances First published February 2016. Last updated May 2022.
[17] For large rural drainage catchments use the peak river flow allowances described in Table 3-2.

3.2.8 The guidance encourages the use of the upper end allowances for the 2070s epoch when preparing SFRAs.

3.2.9 Climate change must be considered in evaluating the flood risk from all sources, including surface water. The RoFSW does not include a specific scenario to determine the impact of climate change on the risk of surface water flooding and it is not within the scope of this SFRA to undertaken widespread surface water modelling to apply all the allowances within the guidance. However, a range of three annual probability events have been modelled within the RoFSW, 3.3%, 1% and 0.1%, and therefore it is possible to use with caution the 0.1% outline as a substitute dataset to provide an indication of the implications of climate change.

3.3 Assessing Risk of Flooding from Groundwater

3.3.1 Groundwater flooding usually occurs in low lying areas underlain by permeable rock and aquifers that allow groundwater to rise to the surface through the permeable subsoil following long periods of wet weather. Low lying areas may be more susceptible to groundwater flooding because the water table is usually at a much shallower depth and groundwater paths tend to travel from high to low ground.

3.3.2 There are many mechanisms associated with groundwater flooding which are linked to high groundwater levels and can be broadly classified as:

- Direct contribution to channel flow – where the river channel intersects the water table and groundwater enters the streambed increasing water levels and causing flooding,
- Springs erupting at the surface,
- Exceptionally large flows from perennial springs or large flows from intermittent or dormant springs,
- Rise of typically high groundwater levels to extreme levels in response to prolonged extreme rainfall.

3.3.3 The main impacts of groundwater flooding are:

- Flooding of basements of buildings below ground level – in the mildest case this may involve seepage of small volumes of water through walls, temporary loss of services etc. In more extreme cases larger volumes may lead to the catastrophic loss of stored items and failure of structural integrity,
- Overflowing of sewers and drains – surcharging of drainage networks can lead to overland flows causing significant but localised damage to property. Sewer surcharging can lead to inundation of property by polluted water. Note: it is complex to separate this flooding from other sources, notably surface water, or sewer flooding,
- Flooding of buried services or other assets below ground level – prolonged inundation of buried services can lead to interruption and disruption of supply,
- Inundation of roads, commercial, residential and amenity areas – inundation of grassed areas can be inconvenient; however, the inundation of hard-standing areas can lead to structural damage and the disruption of commercial activity. Inundation of agricultural land for long durations can have financial consequences,
- Flooding of ground floors of buildings above ground level – can be disruptive and may result in structural damage. In addition, typically a groundwater flood event will have a long duration (when compared to other flood sources) which adds to the disruptive nature of the flood event.

Areas Susceptible to Groundwater Flooding

3.3.4 ‘Areas Susceptible to Groundwater Flooding’ is a national dataset produced by the Environment Agency which shows the proportion of 1km squares where geological and hydrogeological conditions show that groundwater might emerge. It does not show the likelihood of groundwater flooding occurring but provides a useful tool to identify where further studies may be useful.

Susceptibility to Groundwater Flooding

3.3.5 The BGS has produced the first national dataset on the susceptibility of groundwater flooding. Based on geological and hydrogeological information, the digital data can be used to identify areas where geological conditions could enable groundwater flooding to occur and where groundwater may come close to the ground surface. Note, it is a susceptibility set, it does not indicate hazard or risk, i.e., it does not provide any information on the depth to which groundwater flooding occurs or the likelihood of the occurrence of an event of a particular magnitude.

3.3.6 The 'Susceptibility to Groundwater Flooding' dataset is divided into three classes – High, Medium, and Low risk as follows:

- High – areas with the potential for groundwater flooding to occur at the surface
- Medium – areas which may experience groundwater flooding of property situated below the ground surface i.e., basements
- Low – areas with limited potential for groundwater flooding to occur.

3.3.7 The BGS state that the dataset is suitable for use for regional or national planning purposes where the groundwater flooding information will be used along with a range of other relevant information to inform land-use planning decisions. It might also be used in conjunction with a large number of other factors, e.g., records of previous incidence of groundwater flooding, rainfall, property type, and land drainage information, to establish relative, but not absolute, risk of groundwater flooding at a resolution of greater than a few hundred metres. The susceptibility data should not be used on its own to make planning decisions at any scale, and, in particular, should not be used to inform planning decisions at the site scale. The susceptibility data cannot be used on its own to indicate risk of groundwater flooding.

3.3.8 The Susceptibility to Groundwater Flooding dataset provided by the BGS can be used to identify areas where geological conditions could enable groundwater flooding to occur and where groundwater may come close to the ground surface.

Impact of Climate Change on Groundwater Flood Risk

3.3.9 Climate change must be considered in evaluating the flood risk from all sources, including groundwater. Groundwater flooding occurs primarily as a response to extended periods of rain during late autumn and early winter[18]. With climate change bringing wetter winters, an increased risk of groundwater flooding may be seen. However, the complex relationship between rainfall, recharge, groundwater storage and flow make the response to climate change uncertain. For this reason, the effect of climate change on groundwater flood risk has not been evaluated.

3.4 Assessing risk of flooding from Sewers

3.4.1 During heavy rainfall, flooding from the sewer system may occur if:

- The rainfall event exceeds the capacity of the sewer system/drainage system: Sewer systems are typically designed and constructed to accommodate rainfall events with an annual probability of 3.3% (1 in 30 chance each year) or greater. Therefore, rainfall events with an annual probability less than 3.3% would be expected to result in surcharging of some of the sewer system. While sewerage undertakers recognise the impact that more extreme rainfall events may have, it is not cost beneficial to construct sewers that could accommodate every extreme rainfall event.
- The system becomes blocked by debris or sediment: Over time there is potential that road gullies and drains become blocked from fallen leaves, build-up of sediment and debris (e.g., litter).
- The system surcharges due to high water levels in receiving watercourses: There is potential for surface water outlets to become submerged due to high river levels. Once storage capacity within the sewer system itself is exceeded, the water will overflow into streets and potentially into houses.

[18] Hampshire County Council, October 2013, Hampshire Groundwater Management Plan https://www.hants.gov.uk/landplanningandenvironment/environment/flooding/strategies/groundwater-management-plan

Historic records

3.4.2 Water companies are required to maintain a register of properties which are at risk of flooding due to hydraulic overloading of the sewers (the sewer pipe is too small, or at too shallow a gradient).

3.4.3 Within the context of strategic planning, identification of these locations of previous flooding can inform LPAs of areas where further development may have a significant impact on the existing sewer system, and where Southern Water may be required to invest in measures to improve capacity to support the proposed development. However, it should be noted that the incidents may have been addressed through Southern Water's ongoing asset management programme and may no longer reflect an area where incapacity is a problem or where flooding is likely to occur.

Climate Change

3.4.4 Climate change is anticipated to increase the potential risk from sewer flooding as summer storms become more intense and winter storms more prolonged. This combination is likely to increase the pressure on the existing efficiency of sewer systems, thereby reducing their design standard and leading to more frequent localised flooding incidents. Any sewer flooding that may occur could be exacerbated as a result of surface water runoff during extreme rainfall events.

3.4.5 Water Companies continue to monitor the risk of sewer flooding and put plans in place to manage the risk, as required, based on their business plan and priorities. The LPAs can work with Southern Water to identify flooding hotspots and locations of known sewer capacity issues where risk could be exacerbated. Water companies prioritise investment for potential flood alleviation schemes depending on the severity and frequency of flooding, but this can only be identified where affected property owners report the incident to the water company.

3.5 Assessing Risk of Flooding from Reservoirs

3.5.1 The failure of a reservoir has the potential to cause catastrophic damage due to the sudden release of large volumes of water. The PPG obliges LPAs to identify any impounded reservoirs and evaluate how they might modify the existing flood risk in the event of a flood in the catchment it is located within, and / or whether emergency draw-down of the reservoir will add to the extent of flooding. Furthermore, the PPG obliges LPAs to evaluate the potential damage to buildings or loss of life in the event of dam failure, compared to other risks, when considering development downstream of a reservoir.

3.5.2 Areas at risk of reservoir flooding are included on the Environment Agency's Long Term Flood Risk Map[19]. This dataset shows the individual flood extents for all large, raised reservoirs in the event that they were to fail and release the water held.

3.5.3 Two extents are provided; one for a "dry day"[20], when river levels are normal, and one for a "wet day"[21] when local rivers had already overflowed their banks.

3.5.4 The data represents a prediction of a credible worst case scenario, however it's unlikely that any actual flood would be this large. The data gives no indication of likelihood or probability of reservoir flooding. Flood extents are not included for smaller reservoirs or for reservoirs commissioned after the reservoir modelling programme began in October 2016.

[19] Environment Agency Long Term Flood Risk Map https://www.gov.uk/check-long-term-flood-risk
[20] Defra Data Services Platform Reservoir Flood Extents – Dry Day (National) https://environment.data.gov.uk/dataset/c66ee97f-49d2-454e-9a19-d48a47bd22ad
[21] Defra Data Services Platform Reservoir Flood Extents – Wet Day (National) https://environment.data.gov.uk/dataset/d81646cf-37e5-4e71-bbcf-b7d5b9ca3a1c

3.6 Assessing Risk of Flooding from the Sea

Datasets

3.6.1 Some of the datasets described in Table 3-1 have been used in the assessment of flooding from sea, including 'Flood Zones', 'Defences' and 'Reduction in Risk of Flooding from Rivers and Sea due to Defences'.

Coastal modelling

3.6.2 The Environment Agency have supplied the following coastal models for the study area:

- East Solent Study (including 3 inundation models for Hayling Island, Portsea Island, and Gosport to Warsash)[22]
- Southampton Water Coastal Modelling Study[23]
- New Forest Coastal Modelling Study[24]

3.6.3 These models simulate the impact of a combination of extreme sea levels and wave overtopping. Simulations are included for defended scenarios including the presence of flood defences, and undefended scenarios.

3.6.4 No changes were required for the New Forest Coastal Model to inform the SFRA. For the East Solent models and the Southampton Water model it was necessary to update the tidal boundaries are re-run these for new epochs to tie in with the new plan periods for the LPAs. Some modifications were also required to flood defence crest levels on Portsea Island.

Impact of climate change on sea levels

3.6.5 LPAs are required to make allowances for climate change in Local Plans to help minimise vulnerability and provide resilience to flooding. Current guidance on the climate change allowances that should be applied are set out by the Environment Agency[25].

3.6.6 There are a range of allowances for each river basin district and epoch for sea level rise. The allowances for the south west and south east river basin district are included in Table 3-5.

3.6.7 The guidance states that LPAs should assess both the *higher central* and the *upper end* allowances for SFRAs.

Table 3-5 Sea level allowances by river basin district for each epoch in mm for each year (based on 1981 to 2000 baseline) – the total sea level rise for each epoch is in brackets

Area of England	Allowance	2000 to 2035 (mm)	2036 to 2065 (mm)	2066 to 2095 (mm)	2096 to 2125 (mm)	Cumulative rise 2000 to 2125 (metres)
South east	Higher central	5.7 (200)	8.7 (261)	11.6 (348)	13.1 (393)	1.20
South east	Upper end	6.9 (242)	11.3 (339)	15.8 (474)	18.2 (546)	1.60
South west	Higher central	5.8 (203)	8.8 (264)	11.7 (351)	13.1 (393)	1.21
South west	Upper end	7 (245)	11.4 (342)	16 (480)	18.4 (552)	1.62

3.6.8 AECOM have obtained the latest Coastal Flood Boundary (CFB) dataset and calculated the revised extreme still water levels using UKCP18 climate change projections for RCP 8.5 at 70th (higher central) and 95th (upper end) percentiles for the follow epochs:

- 2022 (present day scenario)

[22] JBA Consulting, 2015, East Solent Study.
[23] JBA Consulting, 2014, Southampton Water Coastal Modelling Study.
[24] JBA Consulting, 2022, New Forest Coastal Modelling Study.
[25] Flood Risk Assessments Climate Change Allowances https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances First published February 2016. Last updated May 2022.

- 2055 (to provide consistency with the Shoreline Management Plan)
- 2122 (100 year for residential development and to inform plan making)

3.6.9 Full details are provided in the Technical Notes[26] included in Appendix B.

3.6.10 The models have been run and maximum depth and maximum hazard rating mapping produced to inform the SFRAs for each LPA. Maximum water level grids have been supplied to the LPAs as ASCII grid files.

3.7 Assessing the cumulative impact of development

3.7.1 The NPPF states that strategic policies should be informed by a strategic flood risk assessment, and should consider cumulative impacts in, or affecting, local areas susceptible to flooding (paragraph 166).

3.7.2 When allocating land for development consideration should be given to the potential cumulative impact on flood risk within a catchment. Development typically increases the impermeable area within a catchment, which, if not effectively managed, can cause increased rates and volumes of surface water runoff and changes to floodplain storage, thereby resulting in increased flood risk further downstream. Whilst individual development with appropriate site mitigation measures should not result in measurable local effects with respect to hydrology and flood risk, the cumulative effect of multiple development may be more severe at downstream locations in the catchment. Locations where there are existing flood risk issues will be particularly sensitive to cumulative effects.

3.7.3 The cumulative impact should be considered throughout the planning process, from the allocation of sites within the Local Plan, to the planning application and development design stages.

3.7.4 As part of this SFRA an assessment of the study area has been undertaken to identify those catchments where there is greater potential for cumulative effects on flood risk.

3.7.5 Catchments were identified across the study area using the river water body catchments and surface water management catchments from the Catchment Data Explorer. Minor adjustments were made to combine catchments where these were very small. This resulted in the identification of 81 catchments across the project study area.

3.7.6 For each catchment, consideration has been made of the:

i. The size and nature (rural or urban) of the catchment.

ii. The risk of flooding in the catchment from rivers, the sea, surface water and groundwater. This is based upon data provided by HCC from the Hampshire Catchment Prioritisation Tool[27] and considers the number of properties calculated to be at risk of flooding from rivers, the sea, surface water, groundwater according to available mapping datasets and as well as historic records of flooding. A rating of high, medium, and low was assigned to each catchment based on the data provided.

iii. The scale of potential future development in the catchment. This is based upon a high level review of potential development sites and growth locations provided by LPAs as well as information publicly available on the LPA websites.

3.7.7 Based on a qualitative assessment of these three criteria, a red, amber, green rating has been assigned to each catchment to highlight those catchments where there is a higher, medium, and lower potential for cumulative effects on flood risk. In those areas with a medium or higher potential for cumulative impact on flood risk, it is recommended that LPAs consider area specific policies or guidance for new development to help reduce the cumulative impact, and where possible, identify opportunities for new development to provide cumulative betterment with respect to flood risk. Further detail of these types of measures are included in Sections 6 and 7 of each LPA Report.

[26] AECOM, March 2022, East Solent Flood Inundation Model re-Simulations Technical Note.
AECOM, March 2022, Southampton Water Flood Inundation Model Re-Simulations Technical Note.
[27] Atkins, January 2017, Hampshire Catchment Prioritisation Tool.

3.8 Assessing cross boundary considerations

3.8.1 Many of the catchments within the PfSH SFRA project area cross borders between LPA administrative areas. Watercourses and overland flowpaths pass from one LPA to a neighbouring one. Therefore, future development in one LPA has the potential to affect flood risk to existing development and surrounding areas in another LPA area. It is important that LPAs work together and take a catchment approach to consider the wider impacts of any proposed development.

3.8.2 Within the SFRA for each LPA, (Parts 2 – 10) a review of the catchments and watercourses has been undertaken to determine where runoff from one LPA naturally flows into another. This will help identify which LPAs will need to work together to discuss the opportunities to reduce the causes and impacts of flooding.

3.9 Avoiding flood risks

3.9.1 The LFAs should use the datasets identified in section 3.1 to 3.8 of this document to apply the sequential approach to site selection so that development is, as far as reasonably possible, located where the risk of flooding from all sources is lowest, taking account of climate change and the vulnerability of future users to flood risk. Further information on the application of the Sequential Test is provided in Section 4.

3.10 Controlling and mitigating flood risks

Defences

3.10.1 Data provided by the Environment Agency from their Asset Information Management System (AIMS) has been used to identify flood risk management measures already in place with the study area.

3.10.2 The following project area wide datasets have been obtained to help identify opportunities to reduce the causes and impacts of flooding across the PfSH SFRA project area. Locally specific opportunities are identified in SFRA Parts 2 – 10.

Programme of FCERM Schemes

3.10.3 The Environment Agency manage an investment programme to reduce flood risk and coastal erosion in England. The current 6 year flood and coastal erosion risk management investment programme runs from 1 April 2021 to 31 March 2027. Completed and planned capital schemes are shown on the online map[28] and details are provided within SFRA Parts 2 – 10 for each LPA.

3.10.4 Coastal Partners is a partnership between five local councils (Fareham BC, Gosport BC, Portsmouth CC, Havant BC, and Chichester DC) formed in 2012, which aims to deliver a comprehensive, shared coastal management service for 246km of coastline. Capital schemes undertaken by Coastal Partners in the study area include the extension of a revetment at Nore Barn Woods, a new Beach Management Plan for Eastoke Peninsula, the North Portsea Island Scheme, and the Hill Head Coastal Protection Project. Further details about these capital schemes are provided within SFRA Parts 4-7.

Working with Natural Processes

3.10.5 There are a number of opportunities available to reduce the causes and impacts of flooding through Working with Natural Processes (WWNP)[29]. This involves implementing measures that help to protect, restore, and emulate the natural functions of catchments, floodplains, rivers, and the coast. WWNP takes many forms and can be applied in urban and rural areas, and on rivers, estuaries, and coasts.

3.10.6 As part of a research project undertaken by the Environment Agency and Flood and Coastal risk Management Research and Development Programme, a series of spatial datasets have been generated

[28] Programme of flood and coastal erosion risk management (FCERM) schemes https://www.gov.uk/government/publications/programme-of-flood-and-coastal-erosion-risk-management-schemes
[29] Environment Agency and Flood and Coastal Risk Management R&D Programme, Published February 2021, Working with Natural Processes to Reduce Flood Risk https://www.gov.uk/flood-and-coastal-erosion-risk-management-research-reports/working-with-natural-processes-to-reduce-flood-risk?web=1&wdLOR=c56AD7DAC-BB7B-471B-94B4-B5C5B91DEEE4

for these natural processes[30], identifying their best estimate of locations in the country where the methods can be applied.

Table 3-6 Description of WWNP datasets

Natural Process	Benefits	Most Effective Conditions	Notes
Floodplain Woodland Planting Potential	Slows floodwaters and increases water depth on the floodplain. Reduces flood peaks, delays flood peak timing and desynchronises flood peaks. Enhances sediment deposition on the floodplain.	Middle and lower river reaches of middle to large catchments.	Based upon Flood Zone 2. Information is largely based on modelled data and open constraints data and is indicative rather than specific.
Riparian Woodland Planting Potential (woodlands on land immediately adjoining a watercourse)	Slows flood flows. Reduces sediment delivery to the watercourse. Reduces bankside erosion. Creates below ground storage.	At the reach scale in middle and upper catchments.	Based upon a 50m buffer of available OS Open Data river networks. Information is largely based on open data and is indicative rather than specific.
Wider Catchment Woodland	Intercepts, slows, stores and filters water. Reduces flood peaks, flood flows and frequency.	Small events on small catchments – extent of reduction decreases as flood magnitude increases.	Based upon the 1:50k BGS geology survey and relies upon identifying drift and bedrock geologies that are characteristic of slowly permeable soils. Information is largely based on the 100m gridded version of BGS data and open constraints data and is indicative rather than specific.
Floodplain Reconnection Potential (reconnecting watercourses and floodplains)	Encourages more regular floodplain inundation and flood water storage Decreases the magnitude of flood peaks and reduces downstream flood depths.	High frequency, low return period floods.	Designed to support signposting of areas where there is currently poor connectivity such that flood waters are constrained to the channel and flood waves may therefore propagate downstream rapidly Based upon the Risk of Flooding from Rivers and Seas probability maps and identifies areas of low and very low probability that are close to a watercourse, but do not contain residential property or key services (may contain non-residential property – important to consider).
Runoff Attenuation Features (3.3% and 1% AEP) (includes swales, ponds, and sediments traps)	Delays and flattens the hydrograph and reduces peak flow locally for small flood events.	A cluster of features working as a network throughout the landscape.	Based upon the Risk of Flooding from Surface Water datasets and identifies areas of high flow accumulations for the 1% and 3.3% AEP surface water maps. The areas of ponding or accumulation are between 100 and 5000 metres squared and have been tagged where they fall on an area of slope steeper than 6% as gully blocking opportunities

3.10.7 Defra have produced a Woodland Constraints dataset which refines potential locations for WWNP, taking into account roads, rail, urban areas, existing woodland, peat, and water bodies.

3.10.8 As well as reducing the causes and impacts of flooding, WWNP has a number of environmental, social, and cultural benefits, including water quality, habitat, climate regulations, health access, air quality, aesthetic quality, and cultural activity.

[30] Working with Natural Processes datasets
https://environment.data.gov.uk/searchresults;query=wwnp;searchtype=All;page=1;pagesize=20;orderby=Relevancy

3.10.9 Although WWNP methods have very promising benefits, they are relatively new concepts, and more research is required to gain a greater understanding of their impacts in different conditions and representation in models.

3.10.10 The WWNP data does not provide information on design, which may need to consider issues such as drain-down between flood events. It is important to note that land ownership and change to flood risk have not been considered. Locations identified may have more recent building or land use than available data indicates.

Southern Water Drainage and Wastewater Management Plan (DWMP)

3.10.11 Water and sewerage companies must produce Drainage and Wastewater Management Plans (DWMPs) covering a minimum of 25 years, setting out how they intend to improve and maintain a robust and resilient drainage and wastewater system in the face of risks to the network such as climate change and population growth. Companies will need to produce final plans in 2023 and the production of plans will be made statutory through the Environment Act.

3.10.12 Southern Water has developed 11 DWMPs across their entire operational region[32]. The DWMPs relevant to the PfSH SFRA study area are: East Hampshire catchment, Test and Itchen catchment, New Forest catchment, and the eastern part of the Arun and Western Streams catchment. These are described in more detail for each LPA in Parts 2-10.

3.10.13 The following points were extracted from the regional DWMP, detailing how Southern Water will assess and manage issues related to flood risk and drainage across its system over the next 25 years:

- Submission and review of Infiltration Reduction Plans in order to measure and reduce the rate of groundwater infiltration into Southern Water's sewer systems, as these have the potential to cause internal flooding.
- Investment of £35 million between 2020 and 2025 to create smarter sewer networks and install 20,000 sewer level monitors, so pre-emptive actions and maintenance can be undertaken to reduce the number of flooding incidents by approximately 60 per annum.
- Tree root ingress surveys, and clearance, and conditions, in order to reduce the number of floods by 30 incidents per annum.
- Southern Water will undertake modelling to better understand and demonstrate the risk of sewer flooding across their network during both the 1 in 30 year storm and the 1 in 50 year storm.
- Southern Water will conduct a network-wide risk assessment in collaboration with LLFAs, internal drainage boards, other councils, and the Environment Agency, to identify the locations where the management of surface water flood needs to be improved, with a particular focus on the adoption of sustainable measures such as rainwater separation as opposed to traditional practices such as increasing the flow capacity of pipes.

3.11 Managing residual risks

Flood Warning Areas

3.11.1 The Environment Agency provide a flood warning service for many areas at risk of flooding from rivers and the sea[33]. In some parts of England, the Environment Agency may be able to provide warnings when flooding from groundwater is possible.

3.11.2 Flood warnings are issued to homes and businesses when flooding is expected. Upon receipt of a flood warning, occupants should take immediate action.

[32] Southern Water, Drainage and Wastewater Management Plans https://www.southernwater.co.uk/dwmp
[33] Environment Agency, March 2022 Flood Alerts and Warnings https://check-for-flooding.service.gov.uk/alerts-and-warnings

3.11.3 Flood alerts are issued when flooding is possible. Flood alerts cover larger areas than flood warnings and are issued more frequently. Upon receipt of a flood alert, occupants should be prepared for flooding and to take action.

3.11.4 If a flood alert for groundwater is available this does not mean that a particular property is definitely at risk. It is very difficult to predict the exact location of flooding from groundwater as it is often related to local geology.

3.11.5 GIS layers of the Flood Warning Areas[34] have been obtained from the Defra Data Services Platform for inclusion within the SFRA.

[34] Defra Data Services Platform Flood Warning Areas https://environment.data.gov.uk/dataset/87e5d78f-d465-11e4-9343-f0def148f590

4. Applying the Sequential Test

4.1 Sequential Test

4.1.1 The Sequential Test is a decision making tool designed to ensure that areas at little or no risk of flooding from all sources are developed in preference to areas at higher risk[39]. Avoiding flood risk through the sequential test is the most effective way of addressing flood risk because it places the least reliance on measures like flood defences, flood warnings and property level resilience features.

4.1.2 Where it is not possible to locate development in low-risk areas, the Sequential Test should go on to compare reasonably available sites within medium risk areas and only where there are no reasonably available sites in low and medium risk areas, within high-risk areas. The definition of 'reasonably available sites' is defined within the PPG as sites in a suitable location for the type of development with a reasonable prospect that the site is available to be developed at the point in time envisaged for the development.

Sequential Test for a Local Plan

4.1.3 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 assessment.

4.1.4 Figure 4-1, reproduced from Diagram 2 of the PPG, sets out the process of applying the Sequential Test in the preparation of a Local Plan.

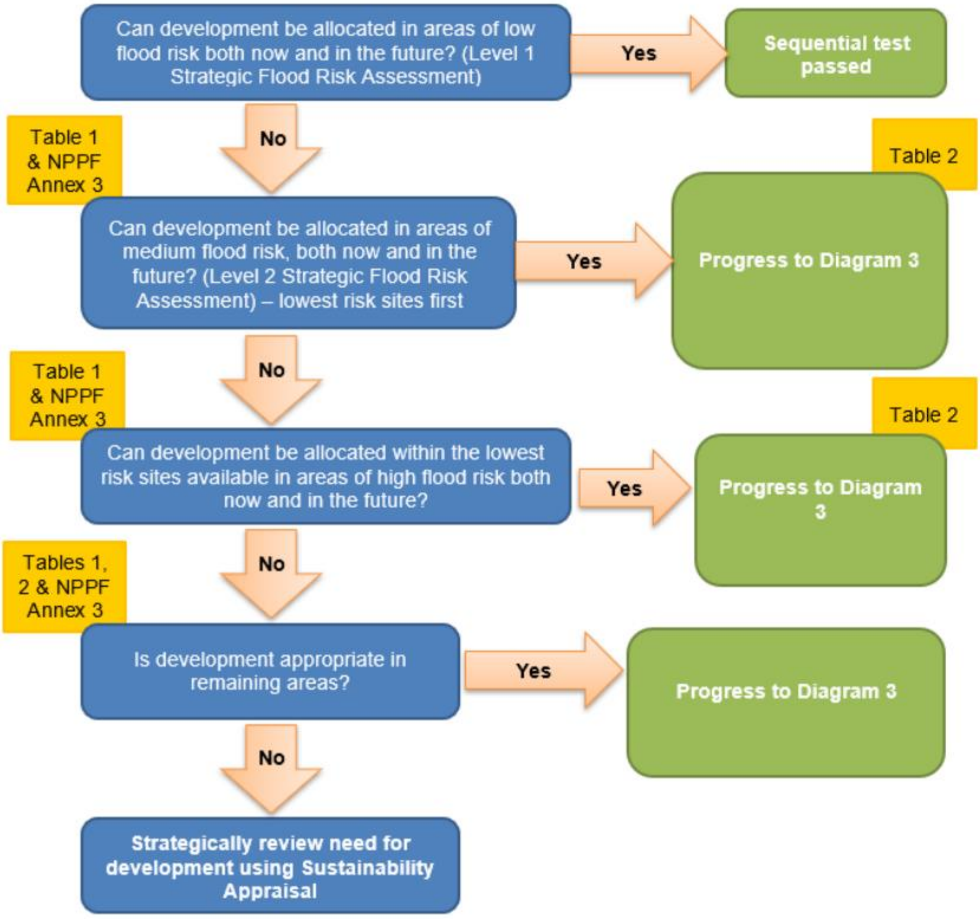

Figure 4-1 Applying the sequential test in the preparation of a Local Plan (PPG Diagram 2)

4.1.5 Data within this SFRA should be used to assess the risk of flooding to potential site allocations from all sources and apply the Sequential Test. An example approach for scoring and ranking sites is provided in

[39] https://www.gov.uk/guidance/flood-risk-and-coastal-change#the-sequential-approach-to-the-location-of-development

Table 4-1. A score from 1-4 is assigned for each source of flooding, resulting in an overall score for each site between 5 and 20.

4.1.6 This is just one example, and the approach will need to be tailored for each LPA giving due consideration to the particular flood risk issues in their administrative area. For example, in areas where the risk of flooding is predominantly the risk of tidal flooding, lots of the sites are likely to score 3 for flooding from the sea. Therefore, in order to apply a sequential approach between those sites, further analysis of the sites using the different modelled scenarios and resulting hazard ratings would enable those sites with lower hazard rating to be identified as preferential over those sites with a greater hazard rating.

Table 4-1 Example flood risk scoring system

Source	Very High (Score 4)	High (Score 3)	Medium (Score 2)	Low (Score 1)
Rivers	>20% in Flood Zone 3b Functional Floodplain (at risk in 3.3% AEP event)	>20% in Flood Zone 3a (at risk in 1% AEP flood event)	>20% in Flood Zone 2 (at risk in 0.1% AEP flood event)	>80% Flood Zone 1 (not at risk in 0.1% AEP flood event)
Sea	>20% in Flood Zone 3b Functional Floodplain (at risk in 3.3% AEP flood extent)	>20% in Flood Zone 3a (at risk in 0.5% AEP flood extent) including an allowance for climate change	>20% in Flood Zone 2 (at risk in 0.1% AEP flood extent)	>80% Flood Zone 1 (not at risk in the 0.1% AEP flood extent)
Surface Water / Sewer	>50% at risk in 3.3% AEP event.	>50 % at risk in 1% AEP event.	>50% at risk in 0.1% AEP event.	>50% not at risk in 0.1% AEP event.
Groundwater	Site investigations confirm groundwater at surface.	BGS mapping identifies potential for groundwater flooding at surface.	BGS mapping identifies potential for groundwater flooding below ground.	BGS mapping identifies limited potential for groundwater flooding to occur OR not considered to be at susceptible to groundwater flooding.
Artificial Sources	>75% at residual risk of reservoir flooding during dry day scenario.	50%<>75% at residual risk of reservoir flooding during dry day scenario.	25%<>50% at residual risk of reservoir flooding during dry day scenario.	<25% at residual risk of reservoir flooding during dry day scenario.

Planning applications

4.1.7 With regards to planning applications, the Sequential Test must be applied for all major and non-major developments in areas at risk of flooding. The Sequential Test will not be required where:

- The site has been allocated for development and subject to the test at the plan-making stage (assuming the proposed development is consistent with the use for which the site was allocated and provided there no significant changes to the known level of flood risk to the site, either now or in the future which could impact the outcome of the test).
- The application is for a development type that is exempt from the test, as specified in footnote 60 of the National Planning Policy Framework, which includes householder development, small non-residential extensions (with a footprint of less than 250m^2) and changes of use; except for changes of use to a caravan, camping or chalet site, or to a mobile home or park home site, where the sequential and exception tests should be applied as appropriate.
- The site is in an area at low risk from all sources of flooding, unless the Strategic Flood Risk Assessment, or other information, indicates there may be a risk of flooding in the future.

4.1.8 **Recommendation:** It is recommended that each of the LPAs prepares concise guidance on the application of the Sequential Test to assist developers and save time at the application stage. The guidance should identify:

- Areas in the LPA where the Sequential Test is considered to be passed and further assessment at planning application stage is not required. (For example, if the Local Plan identifies key areas where future housing and development growth will be focused, the LPA may consider (in

agreement with the Environment Agency) that development in these areas cannot be located in an area of lower risk elsewhere, and therefore development within these areas is considered to pass the Sequential Test).

- Appropriate areas of search for common development types.
- An up to date register of 'reasonably available' sites, clearly ranked in flood risk preference. This could be part of the housing and/or economic land availability assessments or as a separate document. The data within this SFRA should be used to identify the risk of flooding to each site.

4.2 Exception Test

4.2.1 It may be concluded that there are no reasonable available alternative sites in areas of lower risk suitable for the proposed development to which the development could be steered and the Sequential Test is therefore passed. Based on the flood zone and the vulnerability classification of the proposed development (as defined in NPPF Annex 3) the Exception Test may be required. Table 4-2 (reproduced from PPG Table 2) identifies when the Exception Test is required and Figure 4-2 sets out how it should be applied in relation to the preparation of Local Plans.

Table 4-2 Flood Risk Vulnerability and Flood Zone 'Incompatibility' (PPG Table 2)

Flood Risk Vulnerability Classification		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone	1	✓	✓	✓	✓	✓
	2	✓	✓	Exception Test Required	✓	✓
	3a †	Exception Test Required †	✓	✗	Exception Test Required	✓
	3b *	Exception Test Required *	✓*	✗	✗	✗

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

Table 4-3 Flood zones (PPG Table 1)

Flood Zone	Definition
Zone 1 Low Probability	Land having a less than 0.1% annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map for Planning – all land outside Zones 2, 3a and 3b)
Zone 2 Medium Probability	Land having between a 1% and 0.1% annual probability of river flooding; or land having between a 0.5% and 0.1% annual probability of sea flooding. (Land shown in light blue on the Flood Map)
Zone 3a High Probability	Land having a 1% or greater annual probability of river flooding; or Land having a 0.5% or greater annual probability of sea. (Land shown in dark blue on the Flood Map)
Zone 3b The Functional Floodplain	This zone comprises land where water from rivers or the sea has to flow or be stored in times of flood. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. Functional floodplain will normally comprise: • land having a 3.3% or greater annual probability of flooding, with any existing flood risk management infrastructure operating effectively; or • land that is designed to flood (such as a flood attenuation scheme), even if it would only flood in more extreme events (such as 0.1% annual probability of flooding). Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. (Not separately distinguished from Zone 3a on the Flood Map)

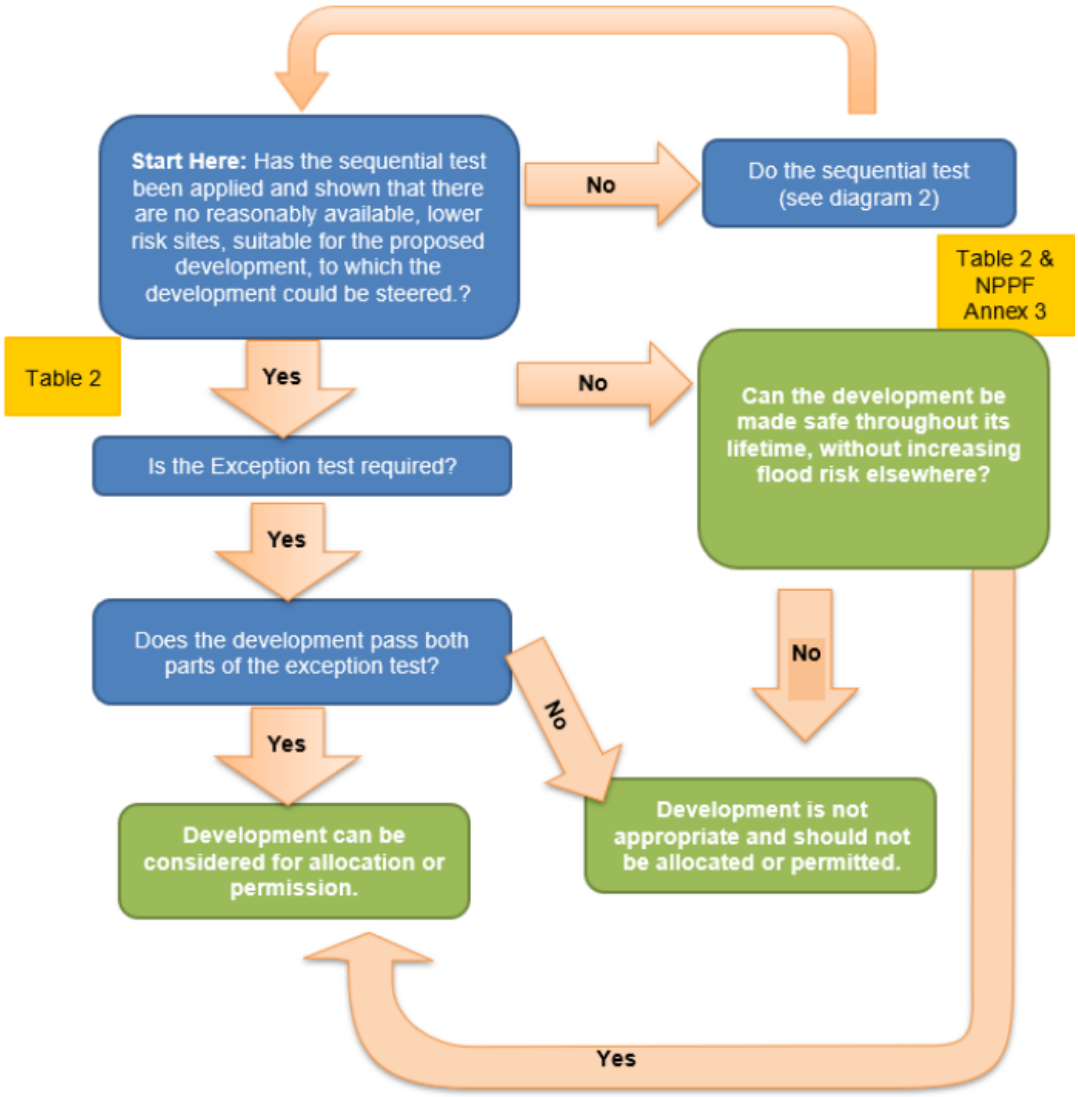

Figure 4-2 Applying the exception test in the preparation of a Local Plan (PPG Diagram 3)

4.2.2 As set out in paragraph 170 of the NPPF, for the Exception Test to be passed, it must be demonstrated that:

(a) the development would provide wider sustainability benefits to the community that outweigh the flood risk; and

(b) 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. If the risk of flooding is not reduced overall, the SFRA must also demonstrate why measures to reduce flood risk overall have not been secured, for example if such measures cannot be identified or are unfeasible.

4.2.3 Both elements of the exception test should be satisfied for development to be allocated or permitted.

Sustainability benefits

4.2.4 Each LPA should consider what criteria will be used to assess the sustainability benefits of a proposed development under part (a) of the exception test. This is typically an assessment of the proposed development against the objectives in the LPA's Sustainability Appraisal.

Safe development

4.2.5 In order to address part (b), a site specific FRA should be prepared for the proposed development that demonstrates how the site will be safe. Consideration should be made of the following as appropriate:

- Applying a sequential approach within the site layout
- Development design to manage and reduce flooding
- Access and egress
- Design of flood defence infrastructure
- Operation and maintenance
- Flood warning and evacuation procedures
- Funding or maintenance arrangements for implementing measures

4.2.6 When determining whether a proposed development will remain safe for its lifetime, Paragraph 5 of the 'Planning and Flood Risk' section of the PPG indicates that the LPA should take the following into consideration:

- The characteristics of a possible flood event, including any residual risks from flood management infrastructure.
- The safety of people within a building if it floods and also the safety of people around a building and in adjacent areas, including people who are less mobile or who have a physical impairment. This includes the ability of residents and users to safely access and exit a building during a design flood and to evacuate before an extreme flood (0.1% AEP of flooding with allowance for climate change).
- The structural safety of buildings.
- The impact of a flood on the essential services provided to or from a development.
- Where flood risk management infrastructure form part of the strategy for addressing flood risk, the LPA should consider the consequences of flood risk management infrastructure failing or its design standard being exceeded, and the likelihood of defences keeping pace with climate change. The LPA should also consider how this infrastructure will be operated, funded and maintained, and ensure there is space for future maintenance or new flood risk management infrastructure that is likely to be needed.

4.2.7 The lifetime of a proposed development should be judged based on the characteristics of the development. In the case of residential developments, a minimum lifetime of 100 years should be taken when selecting climate change allowances. For other types of development, the applicant should assess how long they anticipate the development to be in place and justify the lifetime of the development, with a minimal 75 year lifetime used.

Impact of development on flood risk elsewhere

4.2.8 When allocating land for development, or assessing planning applications, consideration must be given to the potential for development to impact flood risk elsewhere. The increase in impermeable surfaces and resulting increase in runoff increases the chances of surface water flooding if suitable mitigation measures, such as SuDS, are not put in place. Additionally, the increase in runoff may result in more flow entering watercourses, increasing the risk of fluvial flooding downstream.

4.2.9 Consideration must also be given to the potential impact of the loss of floodplain as a result of development. The effect of the loss of floodplain storage should be assessed both at the development and elsewhere within the catchment and, if required, the scale and scope of appropriate mitigation should be identified.

4.2.10 Whilst the increase in runoff, or loss in floodplain storage, from individual developments may only have a minimal impact on flood risk, the cumulative effect of multiple developments may be more severe without appropriate mitigation measures. This must be considered at the planning application and development design stages and the appropriate mitigation measures undertaken, within an appropriate FRA, to ensure flood risk is not exacerbated, and in many cases the development should be used to improve the flood risk. Maintenance and upkeep for mitigation measures, such as SuDS, must be set out as part of a drainage strategy and management funding for the lifetime of the development must be agreed.

Opportunities to reduce the causes and impacts of flooding

4.2.11 When allocating land for development, or assessing planning applications, opportunities should be sought to reduce the causes and impacts of flooding. This may be achieved by:

- building new or improved flood defences
- contributing to funding for new or improved defences
- area-wide sustainable drainage systems to remove surface water from combined sewers
- natural flood management
- changes to land management
- surface water storage areas
- removal of culverts or other restrictions on flow
- river restoration, such as removing canalisation and re-introducing meanders
- removing permitted development rights in sensitive areas

5. Preparing Flood Risk Assessments

This section identifies when a Flood Risk Assessment is required, the varying levels of detail and where to obtain pre-application advice. Detailed information on how to prepare a flood risk assessment as part of a planning application can be found online at https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications

5.1 Requirement for an FRA

5.1.1 The NPPF states that a site-specific FRA is required in the following circumstances:

- Proposals for new development (including minor development and change of use) in Flood Zones 2 and 3.
- Proposals in Flood Zone 1 with a site area of 1 hectare or more.
- 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).
- Proposals in an area within Flood Zone 1, which was identified in a SFRA as being at increased flood risk in future.
- Where proposed development or a change of use increases the vulnerability classification and where the SFRA shows it is at risk from other sources of flooding.

5.1.2 The PPG states that site-specific FRAs should be proportionate to the degree of flood risk, the scale and nature of the development, its vulnerability classification, and the status of the site in relation to the Sequential and Exception Tests. Site-specific FRAs should also make optimum use of readily available information, for example the mapping presented within this SFRA and available on the Environment Agency website, although in some cases additional modelling or detailed calculations will need to be undertaken. Flood risk assessments need to include the information set out in the flood risk assessment checklist in the PPG.

5.1.3 As a result, the scope of each site-specific FRA will vary considerably. Table 5-1 presents the different levels of site-specific FRA as defined in the CIRIA publication C624[40] and identifies typical sources of information that can be used. The list is not exhaustive, and the level of detail could vary depending on the location, scale, and nature of the proposed works. Sufficient information must be included to enable the Council and where appropriate, consultees, to determine that the proposal will be safe for its lifetime, not increase flood risk elsewhere and where possible, reduce flood risk overall. Failure to provide sufficient information is likely to result in applications being refused.

Table 5-1 Levels of site specific FRA

Description
Level 1 Screening study to identify whether there are any flooding or surface water management issues related to a development site that may warrant further consideration. This should be based on readily available existing information. The screening study will ascertain whether an FRA Level 2 or 3 is required. Typical sources of information include: • Strategic Flood Risk Assessment • Flood Map for Planning (Rivers and Sea) • Environment Agency Standing Advice • PPG Tables 1, 2 and 3
Level 2 Scoping study to be undertaken if the Level 1 FRA indicates that the site may lie within an area that is at risk of flooding, or the site may increase flood risk due to increased run-off. This study should confirm the sources of flooding which may affect the site. The study should include: • An appraisal of the availability and adequacy of existing information, • A qualitative appraisal of the flood risk posed to the site, and potential impact of the development on flood risk elsewhere, and, • An appraisal of the scope of possible measures to reduce flood risk to acceptable levels.

[40] CIRIA (2004) Development and flood risk – guidance for the construction industry C624.

The scoping study may identify that sufficient quantitative information is already available to complete an FRA appropriate to the scale and nature of the development.

Typical sources of information include those listed above, plus:

- Local policy statements or guidance.
- Catchment Flood Management Plans.
- PFRA, LFRMS and (in Hampshire CC) Catchment Management Plans.
- Data request from the Environment Agency to obtain result of existing hydraulic modelling studies relevant to the site and outputs such as maximum flood level, depth and velocity.
- Consultation with Environment Agency/Lead Local Flood Authority/sewerage undertakers and other flood risk consultees to gain information and to identify in broad terms, what issues related to flood risk need to be considered including other sources of flooding.
- Historic maps.
- Interviews with local people and community groups.
- Walkover survey to assess potential sources of flooding, likely routes for floodwaters, the key features on the site including flood defences, their condition.
- Site survey to determine general ground levels across the site, levels of any formal or informal flood defences

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Level 3 Detailed study to be undertaken if a Level 2 FRA concludes that further quantitative analysis is required to assess flood risk issues related to the development site. The study should include:

- Quantitative appraisal of the potential flood risk to the development
- Quantitative appraisal of the potential impact of the development site on flood risk elsewhere, and
- Quantitative demonstration of the effectiveness of any proposed mitigations measures.

Typical sources of information include those listed above, plus:

- Detailed topographical survey.
- Detailed hydrographic survey.
- Site-specific hydrological and hydraulic modelling studies which should include the effects of the proposed development.
- Monitoring to assist with model calibration/verification.
- Continued consultation with the LPA, Environment Agency, and other flood risk consultees.

5.2 Pre-application Advice

5.2.1 At all stages, the LPA, and where necessary the Environment Agency, Lead Local Flood Authority and/or the Statutory Water Undertaker may need to be consulted to ensure the FRA provides the necessary information to fulfil the requirements for planning applications.

5.2.2 The Environment Agency, the LLFAs and each LPA offer pre-application advice services which should be used to discuss particular requirements for specific applications.

- Environment Agency https://www.gov.uk/government/publications/pre-planning-application-enquiry-form-preliminary-opinion
- The following government guidance sets out when LPAs should consult with the Environment Agency on planning applications https://www.gov.uk/flood-risk-assessment-local-planning-authorities.
- Hampshire County Council (LLFA) https://www.hants.gov.uk/landplanningandenvironment/environment/flooding/planning
- Southampton City Council (LLFA) https://www.southampton.gov.uk/environmental-issues/flood-risk-management/suds/
- Portsmouth City Council (LLFA) https://www.portsmouth.gov.uk/services/development-and-planning/planning-applications/pre-application-planning-advice/

5.2.3 Should proposed works not require planning permission the Environment Agency can be consulted regarding permission to do work on or near a river, or a flood or sea defence by contacting enquiries@environment-agency.gov.uk.

Appendix A GIS Floodplain Analysis Technical Note

Appendix B Coastal Modelling Technical Notes

B.1 East Solent Flood Inundation Model Re-Simulation Technical Note

B.2 Southampton Water Model Re-Simulation Technical Note