Level 1 Strategic Flood Risk Assessment

Spelthorne Borough Council

Revised Draft Report

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Quality information

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Executive Summary

A considerable proportion of the Borough of Spelthorne is at risk of flooding from rivers, surface water and groundwater sources. The River Thames and its tributaries the River Ash and River Colne are dominant features in the Borough and flooding from these watercourses had occurred a number of times in the last 100 years, most recently in the winter of 2013 – 2014, during which many homes and business were affected. Parts of the Borough are also at risk of surface water flooding and groundwater emergence.

The Environment Agency and partners are currently working on the development of the River Thames Scheme (TES) between Datchet and Teddington, which will involve the construction of a new flood channel alongside the River Thames to reduce flood risk to 15,000 properties in communities in Datchet, Wraysbury, Egham, Staines, Chertsey, Shepperton, Weybridge, Sunbury, Molesey, Thames Ditton, Kingston and Teddington.

As the Local Planning Authority (LPA) Spelthorne Borough Council (BC) has the responsibility, in accordance with the National Planning Policy Framework (NPPF) Flood Risk and Coastal Change[1], to ensure that flood risk is understood and managed effectively through all stages of the planning process. As such, Spelthorne BC is required to undertake a Strategic Flood Risk Assessment (SFRA) to form part of the evidence base for the preparation of their Local Plan.

The aim of the Level 1 Strategic Flood Risk Assessment (SFRA) is to identify the spatial variation in flood risk across the Borough of Spelthorne from all sources, including rivers, surface water, groundwater, sewers and other artificial sources, thereby facilitating a borough-wide comparison of future development sites with respect to flood risk considerations and the application of the Sequential Test.

AECOM was commissioned in 2018 to review and update the SFRA which was originally prepared in 2006[2]. A further update is now required (2021), as new modelling outputs for a number of the fluvial watercourses in the Borough are available.

The Level 1 SFRA has been prepared in consultation with the Environment Agency and Surrey County Council who are the Lead Local Flood Authority (LLFA). The Environment Agency are the risk management authority (RMA) with responsibility for taking the lead in the management of flood risk from the main rivers in the study area and have made key flood risk mapping datasets available for the Level 1 SFRA. SCC, as the LLFA, takes the lead in the management of flood risk from surface water, groundwater and ordinary watercourses, and has prepared a series of Flood Investigation Reports for significant flood events in the Borough.

The Level 1 SFRA provides an overview of the risk of flooding from all sources across Spelthorne Borough and should be used to assist in the development of policies, strategic planning decisions, the application of the Sequential Test, development management and emergency planning.

In the future, climate change is anticipated to have an impact on all sources of flood risk within the Borough. It is important that planning decisions recognise the potential risk that increased runoff poses to property and plan development accordingly to 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.

1 National Planning Policy Framework, 2019. National Planning Policy Framework - GOV.UK (www.gov.uk)
2 Spelthorne Borough Council (2006) Strategic Flood Risk Assessment. https://www.spelthorne.gov.uk/media/3478/Strategic-Flood-Risk-Assessment-part-1/pdf/Strategic_Flood_Risk_Assessment.pdf

1 Introduction and User Guide

1.1 Introduction

In its role as the Local Planning Authority (LPA), Spelthorne Borough Council (BC) is currently preparing documents that will form part of the new Local Plan and set out a vision and framework for development in the Borough.

The National Planning Policy Framework (NPPF) and accompanying Planning Practice Guidance (PPG)[3] emphasise the responsibilities for LPAs to ensure that flood risk is understood and managed effectively using a risk-based approach through all stages of the planning process. As such, LPAs are required to undertake a Strategic Flood Risk Assessment (SFRA) to support the preparation of their Local Plan.

AECOM has been commissioned by the Spelthorne BC to review and revise their existing SFRA which was originally prepared in 2006[4]. This update collates the most up to date flood risk information for use by the Council as an evidence base to inform the updated Local Plan and subsequent planning documents. The SFRA has been completed in collaboration with Spelthorne BC, Surrey County Council (SCC), the Environment Agency and Thames Water. This will enable stringent decision making by Strategic Planning and Development Management officers on a day-to-day basis.

1.2 Approach to Flood Risk Management

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, avoided, and managed effectively and sustainably throughout all stages of the planning process. The overall approach for the consideration of flood risk set out in Section 1 of the PPG can be summarised as follows:

This has implications for LPAs and developers as described below.

Assess flood risk

The NPPF outlines that Local Plans should be supported by a SFRA and LPAs should use the findings to inform strategic land use planning. Figure 1-1 illustrates how flood risk should be taken into account in the preparation of the Local Plan by Spelthorne BC.

For sites in areas at risk of flooding, or with an area of 1 hectare or greater, developers must undertake a site-specific Flood Risk Assessment (FRA) to accompany planning applications (or prior approval for certain types of permitted development).

Avoid flood risk

Spelthorne BC 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 1-1.

In decision-taking this involves applying the Sequential Test and if necessary, the Exception Test for specific development proposals.

3 Planning Practice Guidance: Flood Risk and Coastal Change, 2016 Planning practice guidance - GOV.UK (www.gov.uk)
4 Spelthorne Borough Council (2006) Strategic Flood Risk Assessment. https://www.spelthorne.gov.uk/media/3478/Strategic-Flood-Risk-Assessment-part-1/pdf/Strategic_Flood_Risk_Assessment.pdf

Manage and mitigate flood risk

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, Spelthorne BC 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. Spelthorne BC 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).

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

1.3 Purpose of the SFRA

The purpose of this SFRA is to collate and present the most up to date flood risk information for use by Spelthorne BC to inform the preparation of their Local Plan and prudent decision-making by Development Management officers on a day-to-day basis.

In order to achieve this, the SFRA will:

- Refine information on the areas that may flood taking into account all sources of flooding and the impacts of climate change;
- Inform the Sustainability Appraisal process, so that flood risk is fully taken into account;
- Inform the application of the Sequential and, if necessary, Exception Tests in the allocation of future development sites, as required by the NPPF, and planning application process;
- Identify the requirements for site-specific Flood Risk Assessments;
- Inform the preparation of flood risk policy and guidance;
- Determine the acceptability of flood risk in relation to emergency planning capability; and,
- Consider opportunities to reduce flood risk to existing communities and developments through better management of surface water, provision for conveyance and storage for flood water.

1.4 Flood Risk Policy and Guidance

There is an established body of policy and guidance documents which are of particular importance when considering development and flood risk. These are identified in Table 1-1 along with links for where these documents can be found for further detail.

Table 1-1 Flood Risk Policy and Guidance Documents

National Legislative and Policy Documents

Flood and Water Management Act (2010)	Provides for a more comprehensive management of flood risk, designating roles and responsibilities for different Risk Management Authorities. Designates Surrey County Council as the Lead Local Flood Authority, with duties and responsibilities for managing local flood risk (defined as flooding from surface water, groundwater and ordinary watercourses).	https://www.legislation.gov.uk/ukpga/2010/29/contents
Flood Risk Regulations (2009)	The Flood Risk Regulations transpose the EU Floods Directive into law in England. It aims to provide a consistent approach to flood risk across Europe.	http://www.legislation.gov.uk/uksi/2009/3042/contents/made
National Planning Policy Framework (Section 14, para. 155-165)	The NPPF[2] was originally published by the UK's DCLG in March 2012, consolidating over two dozen previously issued documents called Planning Policy Statements (PPS) and Planning Policy Guidance Notes (PPG) for use in England. The latest update to the NPPF was published in February 2019.	https://www.gov.uk/government/publications/national-planning-policy-framework--2
National Flood and Coastal Erosion Risk Management Strategy for England (2011)	The National FCERM Strategy sets out the long-term objectives for managing flood and coastal erosion risks and the measures proposed to achieve them. It provides a framework for the work of all flood and coastal erosion risk management authorities.	https://www.gov.uk/government/publications/national-flood-and-coastal-erosion-risk-management-strategy-for-england

Regional Flood Risk Policy

Thames Catchment Flood Management Plan (2009)	Role of the CFMP is to establish flood risk management policies which will deliver sustainable flood risk management for the long term (an Environment Agency Document).	https://www.gov.uk/government/collections/catchment-flood-management-plans

Guidance Documents

Planning Policy Guidance – Flood Risk and Coastal Change	Describes the planning approach to development within areas at risk of flooding from all sources	http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/

National Legislative and Policy Documents

Environment Agency Standing Advice	Guidance on information to be included within robust site specific FRAs.	https://www.gov.uk/guidance/flood-risk-assessment-standing-advice
Flood Risk Assessments: Climate Change Allowances (2016) – Revised July 2020.	The guidance provides climate change allowance to consider in flood risk assessments in order to demonstrate how flood risks will managed over the design life of the development.	https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

Local Documents and Strategies

Spelthorne BC Core Strategy and Policies DPD (adopted 2009); Allocations DPD (2009)	The Core Strategy sets out the existing policies for development within the Borough including policy guidance on flood risk.	https://www.spelthorne.gov.uk/article/2887/Planning-Policy
Spelthorne BC Local Plan Preferred Options Consultation Documents – Policies, Site Allocations, Sustainability Appraisal (Nov 2019)	These documents set out the preferred options for the emerging Local Plan for consultation. The documents include policies, site allocations and sustainability appraisal.	https://spelthorne.gov.uk/article/19901/Preferred-Options-Consultation-documents
SCC Preliminary Flood Risk Assessment (PFRA) (2017)	In accordance with the Flood Risk Regulations 2009, SCC provided a PFRA to provide a high level overview of flood risk from local sources for provision to the Environment Agency, ultimately reporting to Europe. The report was prepared in 2011 and subsequently updated in 2017.	https://www.surreycc.gov.uk/people-and-community/emergency-planning-and-community-safety/flooding-advice/more-about-flooding/the-preliminary-flood-risk-assessment
Surrey County Council Local Flood Risk Management Strategy (LFRMS) (2017)	As LLFA, SCC has developed a LFRMS to understand and manage flood risk within the Borough and is responsible for delivering the LFRMS and monitoring progress on the LFRMS action plans.	https://www.surreycc.gov.uk/people-and-community/emergency-planning-and-community-safety/flooding-advice/more-about-flooding/surrey-local-flood-risk-management-strategy
Multi-Agency Flood Plan	Describes the management structures and actions of local responders in response to a flooding event in Spelthorne BC.	*Internal document.*

1.5 User Guide

It is anticipated that this SFRA will have a number of end users with slightly different requirements; this Section describes how to use the SFRA and how to navigate the report and mapping deliverables. The SFRA Report is set out as follows:

- Section 3 Methodology
- Section 3 Strategic Assessment of Flood Risk
- Section 4 Avoiding Flood Risk – Guidance on Applying the Sequential Test
- Section 5 Measures for Managing and Mitigating Flood Risk
- Section 6 Guidance on the preparation of site specific FRAs
- Section 7 Recommendations for Policy and Practice
- Appendix A Data Register
- Appendix B Mapping
- Appendix C Surface Water Note (2006)

Strategic Planning and Policy

The main purpose of the SFRA for Spelthorne BC, as explained in the NPPF, is to provide a strategic overview of flood risk within the Borough in order to enable effective risk-based strategic planning for the future, through the preparation of the Local Plan. Section 3 presents the information that should be used by Spelthorne BC to inform their knowledge of flood risk from all sources throughout the Borough.

As part of this SFRA, a number of policy options have been developed for the Borough and presented in Section 7. These should be taken forward to inform the planning application of the Sequential and Exception Test during the process of allocating development within the Borough.

Applying the Sequential Test

The NPPF sets strict tests to protect people and property from flooding which all LPAs are expected to follow. The aim of the Sequential Test, under the NPPF, is to steer new development to areas with the lowest probability of flooding. Section provides the data required to undertake the Sequential Test and Section 4 provides specific guidance on applying both the Sequential and, where appropriate, Exception Tests.

Emergency Planning

Spelthorne BC is a Category One Responder under the Civil Contingencies Act 2004[5] and therefore has a responsibility, along with other organisations, to develop emergency plans to help reduce, control or ease the effects of an emergency. Spelthorne BC has set out its response plan in the Spelthorne BC Emergency Plan[6].

The Emergency Plan sets out generic plans for any emergency event. However, the complex nature of flooding, and its subsequent impacts, often requires a comprehensive and sustained response from a wide range of organisations. As such, Surrey County Council (SCC) has formed a Local Resilience Forum (LRF)[7] to allow all responding parties to work together in a coordinated response to a flood event.

The SFRA deliverables should be used by Spelthorne BC's Emergency Planning team as a useful source of up to date information about flood risk. The SFRA should be reviewed by the team, such that the findings can be incorporated into their understanding of flood risk.

Preparing Site Specific FRAs

The SFRA can provide a useful starting point to the preparation of site specific Flood Risk Assessments (FRAs) for individual development sites as follows;

- Section 3 provides an overview of the key issues within the Borough in relation to flood risk;
- Section 4 provides guidance on the application of the Sequential Test for sites that have not yet been tested by the LPA, as well as details on when the Exception Test is required, and how to apply it;
- Section 5 provides detail of measures that may need to be implemented to manage and mitigate flood risk; and,
- Section 6 provides specific guidance for preparing site specific FRAs in accordance with the checklist presented in the Planning Practice Guidance.

Assessing Planning Applications

Planning and development officers who are reviewing site specific FRAs as part of the planning application process should consult Section 3 of the SFRA to provide background for flood risk in the area relating to the planning application. Section 6 can also be used by those assessing applications as a checklist for issues that need to be addressed as part of site specific FRAs.

1.6 Living Document

This SFRA has been developed building heavily upon existing knowledge with respect to flood risk within the Borough. The Environment Agency review and update the Flood Map for Planning (Rivers and Sea)[8] on a quarterly basis and a rolling programme of detailed flood risk mapping is underway. The Environment Agency have recently updated the modelling for the Lower Thames between Hurley and Teddington and this has been incorporated into this version of the SFRA.

New information may influence future development control decisions within these areas. Therefore it is important that the SFRA is adopted as a 'living' document and is reviewed regularly in light of emerging policy directives, flood risk datasets and an improving understanding of flood risk within the Borough.

[5] HSMO (2004) Civil Contingencies Act. Available from: http://www.legislation.gov.uk/ukpga/2004/36/contents
[6] Spelthorne Borough Council (2016) Emergency Plan. Available from: https://www.spelthorne.gov.uk/CHttpHandler.ashx?id=1095&p=0
[7] Surrey County Council (2017) Local Resilience Forum. Available from: https://www.surreycc.gov.uk/__data/assets/pdf_file/0007/87253/Surrey-Major-Incident-Protocol-V12.5-Public-Facing.pdf
[8] Environment Agency (2018) Flood Map for Planning https://flood-map-for-planning.service.gov.uk/

2 Methodology

2.1 Consultation

Under the Localism Act 2011[9], there is now a legal duty on LPAs to co-operate with one another, County Councils and other Prescribed Bodies to maximise the effectiveness within which certain activities are undertaken as far as they relate to a 'strategic matter'.

In complying with the duty to cooperate, Government Guidance recommends that LPAs 'scope' the strategic matters of Local Plan documents at the beginning of the preparation process taking account of each matters 'functional geography' and identify those LPAs and Prescribed Bodies that need to be constructively and actively engaged.

The Council prepared and consulted on a Scoping Statement[10]as part of the background work required to prepare the Spelthorne Local Plan. Flood risk is identified as a strategic matter and specific engagement activities are proposed with a number of adjoining LPAs and Prescribed Bodies, both in relation to the preparation of the SFRA and the Local Plan.

As part of the SFRA, a number of organisations were contacted, invited to attend an inception meeting, and requested to provide data to inform the SFRA. A summary of the roles of each organization, and their involvement through the SFRA project, is provided in Table 2-1.

Table 2-1 SFRA Stakeholder Organisations and Roles

Stakeholder Organisation	Role with respect to Spelthorne BC SFRA
Spelthorne BC	As a LPA Spelthorne BC has a responsibility to consider flood risk in their strategic land use planning and the development of their Local Plan. The NPPF requires LPAs to undertake a SFRA and to use their findings, and those of other studies, to inform strategic land use planning including the application of the Sequential Test which seeks to steer development towards areas of lowest flood risk prior to consideration of areas of greater risk. Spelthorne BC is also required to consider flood risk and, when necessary, apply the Sequential and Exception Tests when assessing applications for development. During the preparation of the SFRA, Spelthorne BC has provided access to available datasets held by the Council regarding flood risk across the Borough. The SFRA will be used by the Spelthorne BC's Emergency Planning team to ensure that the findings are incorporated into their understanding of flood risk and the preparation of their Multi-Agency Flood Plan (MAFP).
Environment Agency	The Environment Agency is responsible for managing the risk of flooding from Main Rivers and the sea and has a responsibility to provide a strategic overview for all flooding sources and coastal erosion. The Environment Agency has a role to provide technical advice to LPAs and developers on how best to avoid, manage and reduce the adverse impacts of flooding. Part of this role involves advising on the preparation of spatial plans, sustainability appraisals and evidence base documents, including SFRAs as well as providing advice on higher risk planning applications. The Environment Agency undertakes systematic modelling and mapping of fluvial flood risk associated with all Main Rivers in the study area, as well as supporting Lead Local Flood Authorities (LLFA) with the management of surface water flooding by mapping surface water flood risk across England. The Environment Agency has supplied available datasets for use within the SFRA. The Environment Agency will be involved in reviewing the draft SFRA project deliverables.

[9] HMSO (2011) Localism Act Available from: http://www.legislation.gov.uk/ukpga/2011/20/contents/enacted
[10] Spelthorne Borough Council (2016) Spelthorne Local Plan Duty to Cooperate Scoping Statement Available from: https://www.spelthorne.gov.uk/media/12229/Duty-to-Cooperate-Scoping-Statement/pdf/Duty_to_Cooperate_Scoping_Statement1.pdf

Stakeholder Organisation	Role with respect to Spelthorne BC SFRA
Surrey County Council (SCC)	As the LLFA, under the Flood and Water Management Act (FWMA) SCC has a duty to take the lead in the coordination of local flood risk management, specifically defined as flooding from surface water, groundwater and ordinary watercourses and to this end has prepared the Local Flood Risk Management Strategy (LFRMS) for Surrey . SCC is responsible for regulation and enforcement on ordinary watercourses and is a statutory consultee for future sustainable drainage systems (SuDS) for major developments in the county, following changes to the Town and Country Planning (Development Management Procedures) (England) Order 2015. SCC is the Highways Authority and therefore has responsibilities for the effectual drainage of surface water from adopted roads insofar as ensuring that drains, including kerbs, road gullies and ditches and the pipe network which connect to the sewers, are maintained. As such, SCC is a key stakeholder in the preparation of the SFRA. SCC has provided current datasets in relation to the assessment of local sources of flooding (surface water, groundwater and ordinary watercourses), has been consulted on the draft project deliverables and will be involved in the implementation of any policy outcomes with respect to sustainable drainage or ordinary watercourse management.
Thames Water Utilities Ltd	Thames Water Utilities Ltd (TWUL) is responsible for surface water drainage from development via adopted sewers and for maintaining public sewers into which much of the highway drainage connects. In relation to the SFRA, the main role that TWUL will play is providing data regarding past sewer flooding.
British Geological Survey	BGS hold a number of datasets that have informed the SFRA, including superficial and bedrock geology and suitability of infiltration SuDS.
Neighbouring LPAs and other consultees	The following LPAs adjoin Spelthorne BC and will be consulted on the draft report; the London boroughs of Hillingdon, Hounslow and Richmond, the Berkshire Authorities of Windsor and Maidenhead and Slough and the Surrey authorities of Runnymede and Elmbridge.

2.2 Data Collection and Mapping

The large quantity of information and datasets have been made available by the stakeholder organisations and used to inform the assessment of flood risk from each of the sources presented in Section 3 and Appendix B. Descriptions of the datasets that have been used, along with details of their appropriate use or limitations, are included in Section 3, and a data register is included in **Appendix A Data Register**.

3 Strategic Assessment of Flood Risk

3.1 Overview

Under Section 10 of the NPPF, the risk of flooding from all sources must be considered as part of a SFRA, including flooding from the sea, rivers, land, groundwater, sewers and artificial sources. The study area is not located within an area at risk of tidal flooding, and thus flood risk from this source will not be considered further as part of this SFRA. This Section provides a strategic assessment of the flood risk across the Borough from each source. Reference should be made to the supporting mapping in Appendix B.

Local Area

The Borough of Spelthorne is located in North West Surrey, just south of London Heathrow Airport. It is surrounded by the London boroughs of Richmond, Hillingdon and Hounslow to the north, the Berkshire authorities of Windsor and Maidenhead and Slough to the west and the Surrey authorities of Runnymede and Elmbridge to the south and east respectively. The River Thames forms the southern boundary of the Borough.

Spelthorne covers an area of approximately 51.18 km^2, of which 65% is designated as Green Belt land. The earliest settlements within the Borough were situated on relatively high ground; therefore the susceptibility of flooding was generally low. However, with urban expansion, particularly in the inter war period, housing developments have extended into lower lying areas. According to the 2011 census, the majority of the population is distributed in the larger centres of Ashford, Shepperton, Staines-upon-Thames and Sunbury[11]. Future development pressure within the Borough of Spelthorne is relatively limited as a result of the extensive protective greenbelt area. In addition to this much of the existing housing is in a reasonably good condition, thus the need for regeneration is limited. However, some intensification of residential areas is anticipated to meet the current housing target of circa. 600 houses per year over a 15 year period.

Topography

Light Detection and Ranging (LiDAR) topographic survey data[12], presented in Appendix B Figure 1, indicates that the Borough of Spelthorne is very flat, and low lying. The highest point of the Borough is approximately 24m Above Ordnance Datum (AOD) near Oaks Road, with the lowest point, 7.5m AOD, being located in Lower Sunbury. The flat topography exacerbates the likely susceptibility of many areas of the Borough to flood risk, both from river and surface water flooding.

Appendix B Figure 1 Study Area Topography and Waterbodies.

Geology

Datasets have been obtained from the British Geological Survey (BGS) website to provide a high level identification of the superficial deposits and bedrock geology across the Borough. This is is displayed in Appendix B Figures 2 and 3.

Appendix B Figure 2 Bedrock Geology and Figure 3 Superficial Geology.

Bedrock is the consolidated rock underlying the ground surface. Superficial deposits refer to the more geologically recent deposits (typically of Quaternary age) that may be present above the bedrock such as floodplain deposits, beach sands and glacial drift. Underlying geology can influence the presence and nature of groundwater in an area, and therefore potential groundwater flood risk. The geology can also impact on the potential for infiltration based drainage systems.

In general, Eocene clays and sands dominate the surface exposures down to a depth of approximately 120m, with these clays and sands having been overlain more recently by Quaternary deposits of river gravels and sand.

The primary solid deposits are the London Clay Formation and the Woolwich Formation, which is part of the Lambeth Group. These solid deposits overlie the Upper Chalk at depth. Throughout much of the Borough superficial

[11] Spelthorne Borough Council (2015) Duty to Cooperate Framework. Available from: https://www.spelthorne.gov.uk/media/13031/DtC-Framework-Final-Version-25-May-2015/pdf/Duty_to_Cooperate_Framework2.pdf

[12] Light Detection and Ranging (LiDAR) is an airborne mapping technique, which uses a laser to measure the distance between the aircraft and the ground. Up to 100,000 measurements per second are made of the ground, allowing highly detailed terrain models to be generated at spatial resolutions of between 25 cm and 2 m. The data covering Spelthorne has a spatial resolution of 1m. The Environment Agency's LiDAR data archive contains digital elevation data derived from surveys carried out since 1998.

deposits, of varying thicknesses, overlie the solid deposits. Eastern and north-eastern areas of the Borough are overlain predominantly by Quaternary drift deposits of the Kempton Park Gravels, the southern region of the Borough is characterised by the Shepperton Gravel Formation and the northern aspects of the Borough are characterised by Taplow Gravels.

Hydrogeology

Aquifers are defined as layers of permeable rock or unconsolidated material (sand, gravel, silt etc.) capable of storing and transporting large quantities of water. The understanding of the behaviour and location of aquifers is important as they can provide an indication of the potential for groundwater flooding.

The Environment Agency describes the London Clay Formation, at depth, as being Unproductive Strata rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow. The underlying Upper Chalk formation, however, is a Principal Aquifer, which at depth is afforded protection from contamination within the superficial deposits due to significant deposits of the London Clay between the two strata.

The superficial deposits located across much of the Borough (Appendix B Figure 3) are highly permeable in nature and are classified by the Environment Agency as a Principal Aquifer and described as *layers of rock or drift deposits that have a high intergranular and / or fracture permeability – meaning they usually provide a high level of water storage. They may support water supply and / or river base flow on a strategic scale.* The majority of the soils across the Borough are classified as having Intermediate to High leaching potential which can readily transmit liquid discharges and therefore potentially transmit a wide range of pollutants[13].

Main Rivers

The Environment Agency dataset 'Detailed River Network' dataset has been used to identify watercourses in the study area, along with their designation (i.e. Main River or Ordinary Watercourse).

Appendix B Figure 1 Topography and Waterbodies.

The River Thames forms the southern boundary of the Borough of Spelthorne. It is along this boundary that many of the key population centers are located and thus a considerable proportion of the Borough is affected by flooding from the River Thames.

The River Colne system, including the River Ash, also poses a risk, albeit affecting fewer properties, within the Borough. These rivers, however, are far more susceptible to flash flooding as a result of localized intense rainfall, with storms of this nature expected to become increasingly common, as a result of changing climate patterns, the potential risk these fluvial systems pose to properties is likely to increase in the future. It is therefore necessary that development is planned accordingly in order that future sustainability can be assured.

Ordinary Watercourses

The Environment Agency dataset 'Detailed River Network' dataset has been used to identify Ordinary Watercourses in the study area.

Appendix B Figure 1 Topography and Waterbodies.

As well as Main Rivers there are a number of smaller Ordinary Watercourses[14] in the Borough, which form tributaries of the Main Rivers. These are smaller streams, ditches and drainage channels, the majority of which are open channel. Additional surface waters which pass through the Borough include the River Wraysbury, Stanwell Moor Ditch, Hithermoor Stream and Bonehead Ditch which form part of the River Colne network; Sweeps Ditch, Engine River, Docket Eddy which feed into the River Thames and Felthamhill Brook and Portlane Brook which flow around the northern side of Sunbury to meet the River Thames.

[13] Spelthorne Borough Council (2017) Contaminated Land Inspection Strategy. Available from: https://www.spelthorne.gov.uk/media/17039/Contaminated-Land-Inspection-Strategy-2017/pdf/CL_Strategy_2017_FINAL.pdf

[14] This includes "all rivers and streams and all ditches, drains, cuts, culverts, dikes, sluices (other than public sewers within the meaning of the Water Industry Act 1991) and passages, through which water flows" according to the Land Drainage Act 1991.

3.2 Flooding from Rivers

Flood Map for Planning

Flooding from rivers occurs when water levels rise higher than bank levels causing floodwater to spill across adjacent land (floodplain). The risk of flooding is a function of the probability that a flood will occur and the consequence to the community or receptor as a direct result of flooding.

The NPPF seeks to assess the probability of flooding from rivers by categorising areas within the fluvial floodplain into zones of low, medium and high probability, as defined in Table 3-1 and presented on the Flood Map for Planning (Rivers and Sea) available on the Environment Agency website. GIS layers of these Flood Zones have been provided by the Environment Agency via their online Partner Catalogue.

Appendix B Figures 4A-4D Flood Map for Planning.

Table 3-1 Fluvial Flood Zones (extracted from the PPG, 2014)

Flood Zone	Flood Zone Definition for River Flooding	Probability of Flooding
Flood Zone 1	Land having a less than 1 in 1,000 chance of river flooding each year (0.1% AEP). Shown as clear on the Flood Map – all land outside Flood Zones 2 and 3.	Low
Flood Zone 2	Land having between a 1 in 100 and 1 in 1,000 chance of river flooding each year (between 1% and 0.1% AEP).	Medium
Flood Zone 3a	Land having a 1 in 100 or greater chance of river flooding each year (greater than 1% AEP).	High
Flood Zone 3b	Land where water has to flow or be stored in times of flood, or land purposely designed to be flooded in an extreme flood event (flood storage area). Flood Zone 3b is defined by the LPA, in this instance the 1 in 20 annual probability has been used to define Flood Zone 3b. Not separately distinguished from Flood Zone 3a on the Flood Map for Planning (Rivers and Sea).	Functional Floodplain

A large proportion of the Borough is located in areas of Flood Zone 2 and 3 that have a Medium and High probability of flooding from rivers as shown in Appendix B Figures 4A-4D. The floodplain of the Lower Thames affects all but the northern region of the Borough.

The major towns and villages of Ashford, Shepperton, Staines-upon-Thames and Sunbury are all, at least in part, located in regions of Flood Zone 2 and 3, Medium to High probability of flooding.

Ashford

- Located in the centre of the Borough, the south west portion of this town lies within a region of predominantly Flood Zone 2 (Medium probability), with narrow bands of Flood Zone 3a (High probability) along the A308 and Ashford Road (from the Lower Thames).

Shepperton

- Shepperton lies to the south of the Borough and comprises areas of Flood Zone 2 and 3 (Medium to High probability of flooding from rivers) due to its close proximity to the River Thames and River Ash. The southern part of Shepperton, including the High Street, is located in Flood Zone 1, Low probability of river flooding. Given the surrounding areas of Flood Zone 2 and 3, there is the potential for 'dry islands' to form. There are records of flooding events having occurred throughout the area of Shepperton (Appendix B Figure 4C), primarily along the major roads, for example Russell Road and Ferry Lane.

Staines-Upon Thames

- The part of Staines-upon-Thames which lies within the Borough of Spelthorne is situated in a region of Flood Zone 2 and 3 (Medium to High probability), as a result of being located on the banks of the River Thames. There are several small pockets of land which lie in areas of Flood Zone 1 (Low probability) dispersed throughout this area of higher flood risk, which could potentially lead to the formation of 'dry islands' during certain flood events. Of the four primary towns, Staines-upon-Thames is that with the greatest risk from fluvial flooding.

Sunbury

- The northern part of Sunbury is partially located within Flood Zone 2, Medium probability of flooding from rivers. The southern part of Sunbury is designated Food Zone 1, Low probability of flooding from rivers.

Hydraulic Modelling

As part of the Environment Agency's national programme of coastal and fluvial modelling studies, hydraulic models have been developed for the Main Rivers in the study area, including the River Thames, River Ash, Sweep's Ditch, Pool End Ditch and River Colne. The outputs from these models for the undefended scenarios inform the delineation of Flood Zones 2 and 3 presented in the Flood Map for Planning. However, there are additional modelled outputs that are of importance for strategic planning. Details of the modelling studies and available outputs are included in Table 3-2.

Table 3-2 Summary of Modelling Studies

Watercourse	Modelling Study
Lower Thames (between Hurley and Teddington), Sweep's Ditch, Pool End Ditch.	Lower Thames, Jubilee River and River Ash Modelling Study, JBA Consulting, July 2020. A 1D-2D model was developed to provide high resolution floodplain mapping of the Lower Thames catchment between Marlow and Hammersmith as well as enabling the impact of the proposed River Thames Scheme (RTS) updates to be tested and the economic impacts to be quantified in more detail. Flood maps have been developed for events where the River Thames represents the main source of flooding (Thames dominated) and conversely when the tributaries are the key source of flooding (Tributary dominated). The following outputs are available: • Defended scenarios for the following AEP events: 50%, 20%, 10%, 5%, 3.33%, 2.5%, 2%, 1.33%, 1%, 0.5%, 0.1%. • Climate change scenarios: 15%, 25%, 35% and 70% increase in peak flows applied to the 1% AEP modelled event. • Undefended scenarios for the 1% and 0.1% AEP events (to inform the development of Flood Zones 3 and 2 respectively on the Flood Map for Planning (Rivers and Sea)).
River Ash	River Ash Modelling Update, JBA Consulting 2019. This project forms part of the wider-arching Lower Thames, Jubilee River and River Modelling study, examining river flood risk along two particular tributaries of the River Thames: • The River Ash, a tributary of the River Colne in Staines-Upon-Thames, and • Staines Aqueduct, a man-made channel mainly used for water supply purposes by Thames Water. The following outputs are available: • Defended scenarios for the following AEP events: 50%, 20%, 10%, 5%, 3.33%, 2.5%, 2%, 1.33%, 1%, 0.5%, 0.1%. • Climate change scenarios: 15%, 25%, 35% and 70% increase in peak flows applied to the 1% AEP modelled event. • Undefended scenarios for the 1% and 0.1% AEP events (to inform the development of Flood Zones 3 and 2 respectively on the Flood Map for Planning (Rivers and Sea)).
River Colne	Lower Colne Modelling and Mapping Study, Mott MacDonald, April 2012. • Defended scenarios for the following AEP events: 50%, 20%, 10%, 5%, 2%, 1% and 0.1%. • Climate change scenarios: 20% increase in peak flows applied to the 1% AEP modelled event. • Undefended scenarios for the 1% and 0.1% AEP events (to inform the development of Flood Zones 3 and 2 respectively on the Flood Map for Planning (Rivers and Sea)).

Appendix B Figures 5A-5D – River Thames (Thames dominated) Modelled Outlines.

Appendix B Figures 6A-6D – River Thames (Tributary dominated) Modelled Outlines.

Appendix B Figures 7A-7B – River Ash Modelled Outlines.

Appendix B Figures 8A-8B – River Colne Modelled Outlines.

Flood Zone 3b Functional Floodplain

The Functional Floodplain is defined in the NPPF as 'land where water has to flow or be stored in times of flood'. The Functional Floodplain (also referred to as Flood Zone 3b), is not separately distinguished from Flood Zone 3a on the Flood Map for Planning. Rather the SFRA is the place where LPAs should identify areas of Functional Floodplain in discussion with the Environment Agency.

The PPG states that the identification of Functional Floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. However, land which would naturally flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood (such as a flood attenuation scheme) in an extreme (0.1% annual probability) flood, should provide a starting point for consideration. The guidance goes on to say that 'areas which would naturally flood with an annual probability of 1 in 20 or greater but are prevented from doing so by existing infrastructure or solid buildings will not normally be defined as functional floodplain'.

For the purpose of the SFRA, the 1 in 20 year modelled flood extents from the Lower Thames, River Ash and Lower Colne models have been mapped to delineate Flood Zone 3b Functional Floodplain.

However, it is noted that within the 1 in 20 year (5% AEP) extent, existing infrastructure or solid buildings that resist water ingress are not included within the definition of Flood Zone 3b Functional Floodplain and the associated planning requirements do not apply.

Climate Change

A considerable amount of research is being carried out worldwide in an endeavour to quantify the impacts that climate change is likely to have on flooding in future years. Climate change may increase peak rainfall intensity and river flow, which could result in more frequent and severe flood events. Climate change is perceived to represent an increasing risk to low lying areas of England, and it is anticipated that the frequency and severity of flooding will change measurably within our lifetime.

The Environment Agency's online guidance 'Flood risk assessments: climate change allowances'[15] sets out the climate change allowances for peak river flows for each management catchment and provides advice on applying climate change projections when preparing flood risk assessments. The allowances for the management catchment of relevance to Spelthorne Borough are set out in Table 3-3.

Table 3-3 Peak river flow allowances for management catchments in Spelthorne (use 1961 to 1990 baseline)

Management Catchment	Allowance category	Total potential change anticipated for '2020s' (2015 to 2039)	Total potential change anticipated for '2050s' (2040 to 2069)	Total potential change anticipated for '2080s' (2070 to 2115)
London Management	Upper end (95th)	26%	30%	54%
	Higher central (70th)	14%	14%	27%
	Central (50th)	10%	7%	17%
Colne Management	Upper end (95th)	30%	38%	72%
	Higher central (70th)	16%	16%	35%
	Central (50th)	10%	8%	21%
Maidenhead and Sunbury Management	Upper end (95th)	32%	45%	81%
	Higher central (70th)	19%	25%	47%
	Central (50th)	14%	17%	35%

In order to determine which range of allowance should be assessed for a proposed development or plan, the flood zone and vulnerability classification should be considered, as set out below.

In Flood Zone 2 or 3a

- essential infrastructure – use the higher central allowance
- highly vulnerable – use the central allowance
- more vulnerable – use the central allowance
- less vulnerable – use the central allowance

[15] Environment Agency (published 2016 and updated October 2021) Flood risk assessments: climate change allowances. https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

- water compatible – use the central allowance

In Flood Zone 3b

- essential infrastructure – use the higher central allowance
- highly vulnerable – development should not be permitted
- more vulnerable – development should not be permitted
- less vulnerable – development should not be permitted
- water compatible – use the central allowance

The lifetime of the development should also be considered when determining which future climate change allowance time period should be used. 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 allowance percentages. 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. Otherwise, a 75 year lifetime should be used.

For the purposes of strategic planning, the '2070 to 2115' allowances in Table 3-3 should be used.

As noted in Table 3-2, as part of the modelling study which covered the River Thames, River Ash, Sweep's Ditch and Pool End Ditch, simulations have been run for the 1% AEP event including 15%, 25%, 35% and 70% climate change allowances.

For the hydraulic modelling of the River Colne (including River Ash) (Mott MacDonald, 2012), a 20% increase has been applied to the 1 in 100 year event. Modelling results for the full suite of new allowances, as set out in Table 3-3, are not currently available. It is not currently within the scope of this SFRA to re-run the River Colne model to account for the new climate change allowances. It is therefore proposed to use the 1 in 1000 year outline as a proxy for the climate change outline within this Level 1 SFRA and this has been mapped in **Appendix B Figures 8A-8B.**

Historic Flooding

The Borough has a history of significant flooding events, specifically from the River Thames, with major events occurring in 1894, six between 1900 and 1929, 1947, 1959, 1974 and 2003[16]. A summary of these events is displayed in Table 3-4.

Table 3-4 River Thames Historic Flood Events

River Thames Flood Event	Approximate Flood Magnitude	Approximate River Thames Flow at Staines (m^3/s)
November 1894	1 in 100	600
February 1900/04	1 in 20	445
January 1915	1 in 20	440
January 1925	1 in 17	425
January 1928	1 in 15	410
December 1929	1 in 18	430
March 1947	1 in 60	535
January 1959	1 in 6	360
November 1974	1 in 4	350
January 2003	1 in 14	390

In addition to the events in Table 3-4, further significant flood events have occurred in 2009, 2012 and most recently the winter months of 2013-2014.

[16] Jacobs 2006 Spelthorne BC Level 1 Strategic Flood Risk Assessment.

SCC prepared a Flood Investigation Report[17] for the flooding experienced during the winter 2013-14. The report concluded that the River Thames was the primary source of fluvial flooding within the Borough of Spelthorne which was brought about by the exceptional and unprecedented rainfall that fell over these months. This flooding affected the areas of Shepperton, Littleton and Laleham and Sunbury, resulting in the internal flooding of approximately 130 properties within these areas.

During this event, there was also significant fluvial flooding associated with the River Ash. In February 2014 the level of the upstream section of the River Ash rose dramatically over a short time period in the vicinity of Leacroft and Priory Green, until it began to overtop its banks. This resulted in the fluvial flooding of Leacroft, Leacroft Close, Raleigh Court, Manor Place, Chesnut Manor Close and Priory Green. In some instances, properties were subject to internal flooding. The elevated level of the River Ash lasted for a number of days before receding.

The Environment Agency has provided a GIS layer of the Recorded Flood Outlines dataset (also referred to as the Historic Flood Map) which shows the extent of fluvial flooding that has been experienced and the date. This data is mapped in Appendix B Figure 9A and a description of the areas affected is included in Table 3-5. Figure 9B shows solely the extent of the Winter 2013-2014 flooding for ease of reference.

Appendix B Figure 9A – 9B Recorded Flood Outlines.

Table 3-5 Recorded Flood Outlines (Environment Agency dataset)

Recorded Flood Outline	Approximate Location Affected
1947 March	River Thames – Flooding the majority of the land located between Fordbridge Road and the River Thames. River Ash – Flooding of land adjacent to the River Ash, with the area impacted increasing moving downstream, beginning at Round Copse. River Colne and Bonehead Ditch – Area of land between King George VI and Wraysbury Reservoir impacted due to the channel capacity having been exceeded and the absence of raised flood defences. Wraysbury River – Flooding of the land adjacent to the river, along the stretch of the river between the M25 and the railway line.
1968 September	River Thames – Flooding of the majority of the land west and south-west of Shepperton, with a notable area of land not having been impacted, that within approximately 200m of Halliford Mere Lake. An area of land east of Lower Halliford, surrounding Ash Estates, adjacent to the River Thames was also impacted by this fluvial flooding. River Ash – Similar fluvial flooding extent as that of the 1947 flooding incident.
1988 May	River Thames – Small localised areas of flooding along the Thames in the south of the borough, impacting land within approximately 200m of the river. Four notable areas of flooding. 1. Crossing the M3, west of Thames Side. 2. South of Bridge Road and west of Chertsey Meads. 3. The area surrounding Pharaoh's Island, south of Towpath. 4. Between the B376 and Thames Meadow.
1990 February	River Thames – Similar localised flooding as that experienced in 1988, with the addition of further flooding of Hamhaugh and Lock Island, an area of land protruding approximately 300m east from Dockett Eddy Lane, an area of land east of Sandhills Meadow and a small region east of Fordbridge Road.
1993 October	River Ash – A small area south of the river, approximately 50m wide, between Stainash Crescent and Glebe Road. River Colne and Bonehead Ditch – Regions of flooding throughout Staines Moor, Lower Mill Farm, west of Hithermoor Lake and along Hithermoor Road in Stanwell.
2000 December	River Colne – Area in the south of Staines Moor and Stanwell (specifically along Leylands Lane, Horton Road and Hithermoor Road). Wraysbury River – Between Staines By-Pass and Moor Lane in addition to a small area around Church Lammas, north of Wraysbury Road. River Ash – Area west of Ashford Road and south of Round Copse. Sweep's Ditch – Area of land no more than 100m west of the ditch, south of the B376. River Thames – Similar locations as those impacted by the 1968 floods.
2003 January	River Colne and Bonehead Ditch – Similar areas affected as those in the 2000 flooding incident. River Thames – An extensive area of land impacted north of the river, largely to the south and west of Shepperton, in addition to more localised regions such as areas around Riverside Close, Sandhills Meadow, Ash Estates, Thames Meadow and Nettlefold Place. Sweep's Ditch – Area of land up to 100m west of the ditch, south of the B376.

[17] SCC Flood Investigation Report for Winter 2013/14 Flooding 11-Spelthorne-S19-Report.pdf (surreycc.gov.uk)

Recorded Flood Outline	Approximate Location Affected
	River Ash – Notable regions of localised flooding around Littleton, specifically adjacent to New Road and south of Round Copse.
2009 February	Two small regions of flooding associated with Main Rivers around Stanwell Moor. The northernmost region is located at the intersection between Horton Road and Spout Lane North, with the other located adjacent to the Main River, north of Horton Road.
2009 November	Wraysbury River – Another relatively small flooding incident, this time impacting land adjacent to Wraysbury River, south of the M25 within Staines Moor.
2012 December	Three small localised regions associated with a Main River which flows towards Wrasbury River. These are located around Church Lammas, between the River Thames and Moor Lane.
2013 December – 2014 February	The Winter 2013/14 floods resulted in extensive flooding throughout the Borough. River Thames – The majority of the land between the river and the B375 was subject to fluvial flooding from the Thames. Further flooding associated with the Thames during this event occurred between the M3 and Shepperton Green, the area surrounding Ash Estates and a region around Pavilion Bungalow. River Ash – Notable flooding along this stretch of the river occurred around Round Copse, Littleton Education Facility, west of the M3, in a large area of Staines-upon-Thames (specifically along Staines By-Pass, Priory Green, Greenlands Road, Birch Green and Church Lammas. Sweeps' Ditch – Large area centred on Laleham Road. Flooding associated with the Wraysbury River, River Colne and Bonehead Ditch is similar to that experienced in previous flooding incidents, with additional flooding occurring around Runnymede Farm.

Flood Defences

Flood defences are typically raised structures that alter natural flow patterns and prevent floodwater from entering property in times of flooding. They are generally categorised as either 'formal' or 'informal' defences. A 'formal' flood defence is a structure that is maintained by its respective owner, regardless of whether it is owned by the Environment Agency. An 'informal' flood defence is a structure that has often not been specifically built to retain floodwater and is not maintained for this specific purpose. Boundary walls and industrial buildings situated immediately adjacent to rivers often act as informal flood defences.

The Environment Agency Asset Information Management System (AIMS) contains details of flood defence assets associated with Main Rivers. This information is presented in **Appendix B Figures 4A-4D.**

Formal raised flood defences have been identified in consultation with the Environment Agency. The defences identified are located mainly on the lower reaches of the Lower Colne system, north of Staines. The main formal raised defences are as follows:

- Raised banks along the Colne Brook – west of Wraysbury Reservoir;
- Raised defence (referred to as Cambridge kennels defence) along the Wraysbury River;
- Raised defences on the Wraysbury River between Pound Mill and Hale Street Bridge;
- Raised defences along both sides of the Staines Bypass Channel linking the Wraysbury River with County Ditch/River Thames;
- Raised defence south of the A30 along Thames Water aqueduct;
- Raised defences at the River Ash offtake from the River Colne;
- Raised defences along the River Colne between the A30 and the railway line, through to the Two Rivers Retail Park.

Although these raised defences may be formally maintained, it is important to reiterate that the risk of flooding can never be fully removed. There will always be a residual risk of flooding, due to (for example) a more extreme event, changing climatic conditions, a structural failure of the constructed flood defence system or flooding behind the defences due to local runoff or groundwater. It is incumbent on both the Council and developers to ensure that the level and integrity of defence provided within developing areas can be assured for the lifetime of the development.

No informal raised flood defences in the form of boundary walls and/or existing buildings, providing protection from flooding, have been identified in the Spelthorne Borough. It is recognised however that infrastructure, including for example road and/or rail embankments, may alter the flow of floodwater throughout the Borough. For the purposes

of the SFRA process, these have not been assessed as 'informal' defences. This is because the height and breadth of the embankments are such that the likelihood of a sudden catastrophic failure of the structure (i.e. potentially posing a risk to life) is virtually negligible.

Flood Risk Management Strategies

A Catchment Flood Management Plan (CFMP) is a high-level strategic planning document that provides an overview of the main sources of flood risk and how these can be managed in a sustainable framework for the next 50 to 100 years. The Environment Agency engages stakeholders within the catchment to produce policies in terms of sustainable flood management solutions whilst also considering local land use changes and effects of climate change. CFMPs were consolidated into Flood Risk Management Plans (FRMPs) in 2015.

The CFMPs are used to inform and support planning policies, statutory land use plans and implementation of the Water Framework Directive, so that future development in the catchment is sustainable in terms of flood risk. The approach that the Environment Agency would like to see taken to flood risk management within the Study Area is outlined in the Thames CFMP (2009)[18]. The CFMP aims to identify flood risk management policies for the catchment and sets out the preferred plan for sustainable flood risk management in the Thames region over the next 50 to 100 years.

The preferred policy for the Spelthorne BC study area in the CMFP is Policy 4: **Take further action to sustain the current level of flood risk into the future, responding to the potential increases in risk from urban development, land use change and climate change.**

Building upon the flood risk management measures set out in the CFMP, the Environment Agency has provided details of the proposed River Thames Scheme between Datchet and Teddington which will impact flood risk affected communities in Spelthorne.

River Thames Scheme: The Environment Agency is currently working on the development of the River Thames Scheme between Datchet and Teddington, which is a proposed scheme to reduce flood risk in communities near Heathrow including Datchet, Wraysbury, Egham, Staines, Chertsey, Shepperton, Sunbury, Kingston and Teddington.

The scheme comprises large scale engineering work to construct three new sections of flood channel totalling 17km, improvements to three of the existing Thames weirs, installation of property level products for up to 1,200 homes to improve resistance to flooding, and improved flood incident response plans.

The proposed scheme is estimated to cost in the region of £256 million (present value cost at 2009 prices) and is expected to qualify for a central government grant of approximately £136million. The remaining funding of approximately £120million needs to be secured from other sources, including local enterprise partnerships and businesses. The Thames Regional Flood and Coastal Committee are currently funding much of the development stages of the scheme. This has established the delivery programme and enabled progress on several projects as part of the scheme. The River Thames Scheme can only be delivered if the full funding is secured.

All communities between Datchet and Teddington will benefit from the River Thames Scheme. This includes the communities downstream of the flood channel, as the weir modifications will reduce water levels between Walton Bridge and Teddington. The degree of benefit will vary along this 40 kilometre length of the river. As the flood risk cannot be eliminated completely, some households benefiting from the scheme are also being offered property level products. These products will help to make homes more resistant to flooding. Overall the River Thames Scheme will significantly reduce the likelihood of flooding for the 15,000 properties at a time when climate change is predicted to increase flood risk.

Modifications to Sunbury weir and Desborough Cut will fully mitigate the increase in flow due to the channel operation, and also provide some small scale reduction in the water levels in flood conditions after the channels are built and in operation. Once the scheme is completed, the additional gates proposed at Sunbury weir and the widened Desborough Cut will allow greater flow (up to 4%) through them and reduce the upriver water levels. The capacity improvements to the weirs and Desborough Cut will result in an overall small reduction in flood water levels all the way through the lower reaches of the River Thames, from Walton Bridge to Teddington.

As part of the scheme the Environment Agency has identified approximately 1600 properties that would remain with a flood risk of 1 in 40 years or greater, once the flood channel has been constructed. Properties that remain

[18] Environment Agency (2009) Thames Catchment Flood Management Plan. Available from: https://www.gov.uk/government/publications/thames-catchment-flood-management-plan

at this higher risk of flooding may be offered Property Level Products to help make their homes more resistant to flooding.

Temporary Defences

The Environment Agency has provided details of three temporary defence systems in place in Spelthorne:

Staines-upon-Thames: Barriers run along towpath to the west of Thames Side and follow river back around with the curve of the river to penton Hook Road. A further alignment runs south along the towpath from penton hook lock and hooks around Balmoral Grange. There is a final deployment which crosses the fields to the south east of Staines football club. Within the whole deployment there is 1720m barriers needed and will protect approximately 300 properties for a 1 in 30 year event.

Littleton lakes: The deployment runs south along Thames side starting near Laleham Abby to Chertsey Lock. The total length is 1400m. It will protect more than 50 residential properties (to its design capability).

Shepperton Mead Farm: This temporary defence system starts on Chertsey road to the east of Dockett Eddy Road and loops around the south of the group of properties and re-joins Chertsey Road to the west. It uses 820m of barrier and protects around 20 properties (to its design capability).

Residual Risk

It is important to recognise that the risk of flooding from the rivers in Spelthorne can never be fully mitigated, and there will always be a residual risk of flooding that will remain after measures have been implemented to protect an area or a particular site from flooding. This residual risk is associated with a number of potential risk factors including (but not limited to):

- A flooding event that exceeds that for which the flood risk management measures have been designed e.g. flood levels above the designed finished floor levels;
- The structural deterioration of flood defence structures (including informal structures acting as a flood defence) over time; and/or,
- General uncertainties inherent in the prediction of flooding.

The modelling of flood flows and flood levels is not an exact science; therefore there are inherent uncertainties in the prediction of flood levels used in the assessment of flood risk. Whilst the NPPF Flood Zones provide a relatively robust depiction of flood risk for specific conditions, all modelling requires the making of core assumptions and the use of empirical estimations relating to (for example) rainfall distribution and catchment response.

Steps should be taken to manage these residual risks through the use of flood warning and evacuation procedures, as described in Section 5.

3.3 Flooding from Surface Water

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 off land quickly and result in localised flooding. This occurs most commonly in urban areas where water is unable to enter the ground due to the presence of impermeable surfaces.

Risk of Flooding from Surface Water (RoFSW)

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 exceedance probability events: 1 in 30 year (3.33% AEP) (High Risk), 1 in 100 year (1% AEP) (Medium Risk) and 1 in 1,000 year (0.1% AEP) (Low Risk). The latest version of the mapping is referred to as the Risk of Flooding from Surface Water (RoFSW) and the extents have been made available to Spelthorne BC as GIS layers.

Appendix B Figures 11A-11D Risk of Flooding from Surface Water.

The RoFSW provides all relevant stakeholders access to information on surface water flood risk which is consistent across England and Wales. The modelling will help the Environment Agency to take a strategic overview of flooding and assist SCC in their duties relating to management of surface water flood risk. For the purposes of this SFRA, the mapping allows Spelthorne BC an improved understanding of areas within the Borough which may have a surface water flood risk.

The modelling represents a significant improvement on previous mapping, namely the Flood Map for Surface Water (FMfSW) (2010) and the Areas Susceptible to Surface Water Flooding (AStSWF) (2009), for example:

- Increased model resolution to 2m grid;
- Representation of buildings and flow routes along roads and manual editing of the model for structural features such as flyovers;
- Use of a range of storm scenarios; and
- Incorporation of appropriate local mapping, knowledge and flood incident records.

However, 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 is affected by a lack of, or inaccuracies, in available data.

The RoFSW mapping for the Spelthorne BC study area, presented in **Appendix B Figures 11A-D,** illustrates that the risk of surface water flooding is widespread throughout the Borough, primarily along, but not exclusively limited to, road networks. It should be noted that these maps are based on topography and their accuracy is not as robust as fluvial flood maps. They can, however, be used to identify general flow routes.

Historic Records

In their role as the LLFA, SCC has duties to record and investigate flood incidents relating to local sources of flooding, namely flooding from surface water, groundwater and ordinary watercourses. SCC has provided a number of GIS layers to inform the SFRA that relate to past flood events. These datasets are presented spatially in Appendix A Figures 11A-11D A summary of each dataset as provided below:

- **Internal property flooding**: road locations along which internal property flooding has been reported to SCC.
- **External property flooding**: road locations along which external property flooding has been reported to SCC.
- **Historical Flooding Incidents**: indicative road location along which a flood event has occurred that has been investigated by SCC and a Section 19 Flood Investigation Report has been prepared.
- **SCC Wetspots**: 'Wetspot' is a term used by SCC as the LLFA to describe the location of a surface water flooding incident that has been reported. The wetspot database is continually updated to produce a comprehensive map and record of all the identified wetspots in Surrey. Information from Surrey risk management authorities informs the database. SCC currently prioritises capital works at wetspots throughout the county based on a number of factors. These factors include safety, internal property flooding, social impact and duration of flooding. Details of these specific factors have not been supplied for the purposes of the SFRA.

SCC publish Flood Investigation Reports for significant flood events in the County. Reference has been made to FIRs detailing incidents in Spelthorne to inform this SFRA.

Using the RoFSW mapping and historic flood records, the risk of surface water flooding has been considered across the Borough and summarised below:

Staines-upon-Thames

- There are some drainage issues which have been identified in this area, however, these are very localised in nature, and in some instances are maintenance related. These localised drainage issues correspond to the heterogeneity of surface water flood risk throughout this area, as illustrated by the RoFSW mapping (Appendix B Figures 11A and B). The highest risk of surface water flooding in this region is primarily located along road networks, most notably the A308, Knowle Green, Moor Lane and Waters Drive. The

SCC Flood Investigation Report[19] for flooding in Spelthorne notes that Knightsbridge Crescent is highly susceptible to surface water flooding, with major incidents being reported in 2003 and January-February 2014. The January 2014 incident occurred following a period of extended rainfall (275% compared to an average winter) which resulted in rising groundwater levels and surface water to build-up and begin to flood parts of Knightsbridge Crescent, including the edge of some properties. During this time period surface water flooding was also reported along Wheatsheaf Lane. SCC has also noted 18 wetspots within the Staines area.

Ashford

- Similarly to Staines, there are some localised drainage issues in this area which have the potential to result in low to medium risk surface water ponding in some areas of this region, for example in the land between Fordbridge Road and the A308, and the open land south of Village way as shown in the RoFSW mapping (Appendix B Figure 11B). There is also a high risk of surface water flow pathways forming along many roads within the region, for example along Elgin Avenue, Metcalf Road and Fordbridge Road. SCC has noted 10 wetspots within the Ashford area.

Shepperton

- The RoFSW mapping (Appendix B Figure 11C) indicates that part of this region is at risk from surface water flooding, primarily along major and minor roads, most notably Church Road. The SCC Flood Investigation Report notes that Shepperton was impacted by surface water flooding which arose from the extended period of rainfall between January and February 2014. During this time the underlying clay soils became saturated from the excessive rainfall and overflowing fluvial flood waters, meaning that further rainfall could not infiltrate into the ground, resulting in it flowing as surface water flow. This surface water flooding exacerbated that flooding from the River Thames around Shepperton Lock and Littleton Lane. SCC has noted 12 wetspots within the Shepperton area.

Sunbury

- The RoFSW mapping (Appendix B Figure 11D) illustrates that a large area of Sunbury is at risk from surface water flooding, with ponding being more prevalent, relative to the three other key areas. Key areas at risk of surface water ponding occur along Nursery Road and around Gaflac Sports Ground. Notable high risk surface water flow pathways are located along Hawkewood Road, Wosely Road and Staines Road West. SCC has noted 24 wetspots within the Sunbury area.

Further information on site specific incidents of surface water flooding was recorded during the preparation of the previous SFRA by a member of the Highways and Drainage Department of Spelthorne BC. This has been retained in this SFRA and can be found in **Appendix C Surface Water Conditions**.

Climate Change

The RoFSW mapping does not include a specific scenario to determine the impact of climate change on the risk of surface water flooding. However a range of three annual probability events have been undertaken, 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.

3.4 Flooding from Groundwater

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.

There are many mechanisms of 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;
- Inundation of drainage infrastructure – where the infrastructure has eroded over time; and,

[19] https://www.surreycc.gov.uk/__data/assets/pdf_file/0020/71930/11-Spelthorne-S19-Report.pdf

- Inundation of low lying property (basements).

The main impacts of groundwater flooding are:

- Flooding of basements of buildings below ground level – this can range from seepage of small volumes of water through walls and temporary loss of services to larger volumes of water, catastrophic loss of belongings and failure of structural integrity.;
- Overflowing of sewers and drains – surcharging of drainage networks can lead to overland flows causing localised damage to property. Sewer surcharging can lead to inundation of property by polluted water. However it is difficult to differentiate between groundwater flooding and other sources (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 hard-standing areas can lead to structural damage and the disruption of commercial activity; and,
- Flooding of ground floors of buildings above ground level – can result in structural damage. In addition, a groundwater flood event will typically have a long duration (compared to other flood sources), adding to the disruptive nature of the flood event.

Areas Susceptible to Groundwater Flooding (AStGWF)

The Environment Agency dataset 'Areas Susceptible to Groundwater Flooding' has been provided for the study area. This dataset indicates where groundwater may emerge due to certain geological and hydrogeological conditions. This information is shown as a proportion of 1km grid squares where there is potential for groundwater emergence. The data does not show where flooding is likely to occur, but instead should be used at a strategic level to indicate areas for further investigation. This is due to the coarse nature of the dataset, being based largely on underlying geology, which in itself is a broad-scale dataset.

Appendix B Figure 12 Areas Susceptible to Groundwater Flooding.

According to the Environment Agency's 'Areas Susceptible to Groundwater Flooding' (AStGWF) map (Appendix B Figure 12), a large proportion of the land within and around the perimeter of the Borough is highly susceptible (>=75%) to groundwater flooding

In broad terms, there is a low (>=25% <50%) to medium potential (<50%) for the central region of Spelthorne to be flooded through groundwater mechanisms. However, there is a band of land dissecting the Borough, between the south of Staines-upon-Thames and Chattern Hill which is highly susceptible (>=75%) to groundwater flooding.

The BGS' 'Susceptibility to Groundwater Flooding' map, presented in the Surrey Local Flood Risk Management Strategy (LFRMS) Report[20], also illustrates that there is the potential for groundwater flooding to occur throughout the majority of the Borough, with this mapping also indicting that the majority of this flooding will occur at the surface, rather than below ground level. This mapping also again suggests that, predominantly, the central and lower regions of the Borough (i.e. west of Shepperton) are situated in regions with limited potential for groundwater flooding to occur, if at all.

As shown in Appendix B Figure 2, the Thames Group formation makes up the bedrock geology for the majority of the Borough. This is a sedimentary bedrock of clay, silt and sand material, having formed approximately 48 to 56 million years ago in the Palaeogene Period. In contrast to the homogeneity of the bedrock, the composition of the overlying superficial deposits varies spatially throughout the Borough, contributing to the spatial differences in groundwater flooding susceptibility.

South of Staines Reservoir is predominantly made up of Kempton Park Gravel Member superficial deposits. These formed up to 2 million years ago in the Quaternary Period when this environment was dominated by rivers. Intertwined throughout this region of Kempton Park Gravel lies small areas of Langley Silt Member deposits. There is a correlation between areas overlain by Kempton Park Gravel and the locations susceptible to groundwater flooding. This may be a result of the higher permeability of gravel, compared to silt, sand and clay material. In the very south of the Borough, between Lateham Road and the River Thames, the superficial deposits are dominated by Shepperton Gravel. Shepperton Gravel Member's lithology is described as gravel with clay and sand, this

[20] https://www.surreycc.gov.uk/__data/assets/pdf_file/0005/136724/Surrey-Local-Flood-Risk-Management-Strategy-FINAL_v2.pdf

addition of more clay and sand material, when compared to Kempton Park Gravel, may suggest why the susceptibility to groundwater flooding in this area is lower than that of regions overlain by Kempton Park Gravel.

Therefore, the presence of this permeable superficial geology in direct link with the River Thames, and other watercourses in the Borough, creates pathways for groundwater and the potential for groundwater flooding to occur in Spelthorne, which is exacerbated when water levels in the watercourses are raised.

Groundwater flooding has been observed at a number of locations throughout Spelthorne, primarily in the towns of Staines-upon-Thames, Shepperton and Sunbury. It has been suggested that previous development within these areas have altered the natural groundwater drainage regime. The construction of reservoirs and backfilling of gravel pits with materials of different permeability to those present originally, could have altered groundwater storage flow paths.

Where flood defences have been constructed to mitigate the risk of fluvial flooding, a residual risk of groundwater flooding may remain. Groundwater can move through floodplain gravels, driven by high water levels in the river, ultimately flooding land behind flood defences. These fluvial flood defences may also impede the natural flow of groundwater into the river, thereby resulting in a backing up of groundwater behind these defences, exacerbating the risk of groundwater flooding

SCC's Flood Investigation Report for Spelthorne indicates that, following the extensive rainfall in January and February 2014, groundwater flooding was widespread throughout the Borough during this time. Rising groundwater levels, coupled with the build-up of surface water, resulted in flooding along Wheatsheaf Lane, Staines-upon-Thames. This flooding was exacerbated by the fact that the ground floor level of many of these properties was lower than that of the road. Fluvial and groundwater flooding was reported along Chertsey Bridge Road, Shepperton, and the surrounding area, resulting in extensive road and internal property flooding. Chertsey Bridge Road was temporarily closed, with Thames Side, Littleton Lane, Sheep Walk, Dockett Eddy Lane, Ferry Lane and Russel Road also closed.

In the summer of 2014 groundwater levels remained above normal levels in the north and western monitoring locations of the Borough. As a result of this, the groundwater fed Littleton north and south levels remained high. Boreholes in the east of the Borough, however, indicated that groundwater levels had returned to normal levels, this indicates that there may be barriers to groundwater flow between the east and west areas, as well as a likely barrier to groundwater flow out to the River Thames.

These barriers are likely to have been put in place in order to enable dry working of the gravels. Being near the river they would always be flooded and have been more difficult to work. The western boreholes and lake margins are also where a more claylike geology is present, so there may be natural barriers marking the edges of the economically recoverable gravels.

3.5 Flooding from Sewers

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

1. The rainfall event exceeds the capacity of the sewer system/drainage system:
    - Sewer systems are typically designed and constructed to accommodate rainfall events with a 1 in 30 years (3.33% AEP) or less. Therefore, rainfall events with a return period of frequency greater than 3.3% AEP would be expected to result in surcharging of some of the sewer system. While Thames Water are concerned about the frequency of extreme rainfall events, it is not economically viable to build sewers that could cope with every extreme rainfall event.
2. 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.
3. The system surcharges due to high water levels in receiving watercourses:
    - Where the local area is served by 'combined' sewers i.e. containing both foul and storm water, if rainfall entering the sewer exceeds the capacity of the combined sewer and storm overflows are blocked by high water levels in receiving watercourses, surcharging and surface flooding may again occur but in this instance, floodwaters will contain untreated sewage.

The majority of Spelthorne BC is served by a Thames Water combined surface and foul water sewer system, which is typically designed and constructed to accommodate rainfall events with a 1 in 30 year (3.33% AEP) event or less. Therefore, rainfall events with a return period of frequency greater than 3.3% AEP would be expected to result in surcharging of some of the sewer system.

Thames Water has provided an extract from their register of flooded properties for the study area. This shows properties that have been affected by sewer flooding (as reported to Thames Water) within the last 20 years. Due to data protection requirements, this data has not been provided at the individual property level; rather the register comprises the number of properties within 4 digit postcode areas that have experienced flooding, either internally or externally, over the last 20 years. It should be noted that it is likely that there have also been unreported sewer flooding incidents in this area over this time period.

Thames Water Sewer Flood records, presented in Table 3-6 and Appendix B Figure 13 indicate that 62 reported sewer flooding incidents, both internal and external, have occurred in Spelthorne over the last 20 years. The majority of the internal flooding events have taken place in the village of Stanwell (TW197) and Shepperton (TW170 and TW179), whilst the reported external events were located in the south of Staines-upon-Thames (TW182), Egham Hythe (TW181) and Shepperton (TW170).

Table 3-6 Sewer flooding incidents reported to Thames Water in Spelthorne within the last 20 years

Local Authority	Register Type						
Spelthorne	Internal flooding to property			External flooding property/areas			
Post code area	AI (2 in 10)	BI (1 in 10)	CI (1 in 20)	AE (2 in 10)	BE (1 in 10)	CE (1 in 20)	Grand Total
KT168	0	0	0	0	1	0	1
TW12	0	0	0	0	0	0	0
TW121	0	0	1	0	0	0	1
TW123	0	0	0	0	0	0	0
TW134	0	0	1	0	0	0	1
TW140	0	0	2	0	0	0	2
TW166	0	0	0	0	0	1	1
TW170	0	0	4	0	0	7	11
TW178	0	0	0	0	0	3	3
TW179	0	0	2	1	2	1	6
TW181	0	0	2	0	0	6	8
TW182	0	0	2	0	4	5	11
TW183	0	0	0	0	0	0	0
TW196	0	0	0	0	0	0	0
TW197	0	0	14	0	2	1	17
Grand Total	0	0	28	1	9	24	62

I = Internal property flooding
E = External property flooding
A = 2 or more incident in the last 10 years
B = 1 incident in the last 10 years
C = 1 incident more than 10 years ago but less than 20 years ago

In Staines-upon-Thames, specifically Laleham Road, as reported in SCC Flood Investigation Report, a sewer flooding incident occurred between January and February 2014. During this time the sewerage system was inundated within extensive precipitation, resulting in the surcharging of the combined foul sewer network within this area. In addition to this, during the same precipitation event, the rising groundwater and increasing volume of surface water flooding present resulted in some sewer overflow in parts of Parkside Place, Staines-upon-Thames.

3.6 Flooding from Artificial Sources

An artificial source is any water body which is not covered under other categories and typically includes canals, lakes and reservoirs. The failure of a reservoir or artificial source has the potential to cause catastrophic damage due to the sudden release of large volumes of water. The PPG encourages LPAs to identify any reservoirs and evaluate how they might modify the existing flood risk in the event of a flood in the catchment is located within, and/or whether emergency draw-down of the reservoir will add to the extent of flooding.

Within Spelthorne Borough, the artificial waterbodies include:

- Wraysbury Reservoir;
- King George VI Reservoir;
- Staines Reservoir; and,
- Queen Mary Reservoir

The Environment Agency dataset 'Risk of Flooding from Reservoirs'[21] identifies areas that could be flooded if a large reservoir were to fail and release the stored water. The mapping illustrates that almost the entirety of Borough is at risk of flooding from reservoirs, with regions within approximately 1km from a reservoir having the potential to be inundated by over 2m of water. There are two notable small areas of land which are identified to not be at risk of flooding from reservoirs. The first is located west of Upper Halliford, and the second is in the north of the Borough around Lower Mill Farm. These areas are however situated on higher, steeper ground (Appendix B Figure 1).

Reservoirs in the UK have an extremely good safety record. The Environment Agency is the regulatory authority for the Reservoirs Act 1975 in England and Wales. All large reservoirs must be inspected and supervised by reservoir panel engineers on an annual basis.

Thames Water is responsible for water supply infrastructure located within the Spelthorne Borough which could cause flooding, should any of the infrastructures fail. This infrastructure includes the large water supply reservoirs located within, and around, the Borough. Thames Water provided assurance that the water supply reservoirs are actively managed and that all required safety standards are met. Thames Water confirmed that there is a Reservoir Surveillance Management Process that is externally accredited via the ISO 9000 accreditation. This includes the appointment of a Supervising Panel Engineer and regular inspections of all reservoirs to the requirements of the Reservoirs Act by suitably qualified engineers. In addition to the statutory requirement, Thames Water state that it undertakes inspections of the reservoirs by trained individuals at a frequency agreed by the Supervising Panel Engineer. On this basis the possible risk of failure of these reservoirs is considered to be minimal.

[21] https://flood-warning-information.service.gov.uk/long-term-flood-risk/map

4 Avoiding Flood Risk – Applying the Sequential and Exception Tests

4.1 Overview

This Section guides the application of the Sequential Test and Exception Test in the Plan-making and planning application processes. Not all development will be required to undergo these tests, as described below, but may still be required to undertake a site specific FRA, guidance about which is included in Section 6.

The sequential approach is a decision-making tool designed to ensure that sites at little or no risk of flooding are developed in preference to sites at higher risk. This will help avoid the development of sites that are inappropriate on flood risk grounds. The subsequent application of the Exception Test where required will ensure that new developments in flood risk areas will only occur where flood risk is clearly outweighed by other sustainability drivers.

The sequential approach can be applied at all levels and scales of the planning process, both between and within Flood Zones. All opportunities to locate new developments (except Water Compatible) in reasonably available areas of little or no flood risk should be explored, prior to any decision to locate them in areas of higher risk.

4.2 Applying the Sequential Test for the Local Plan

Figure 4-1 illustrates the approach for applying the Sequential Test that Spelthorne BC should adopt in the allocation of sites as part of the preparation of the Local Plan. The Sequential Test should be undertaken by Spelthorne BC and accurately documented to ensure decision processes are consistent and transparent.

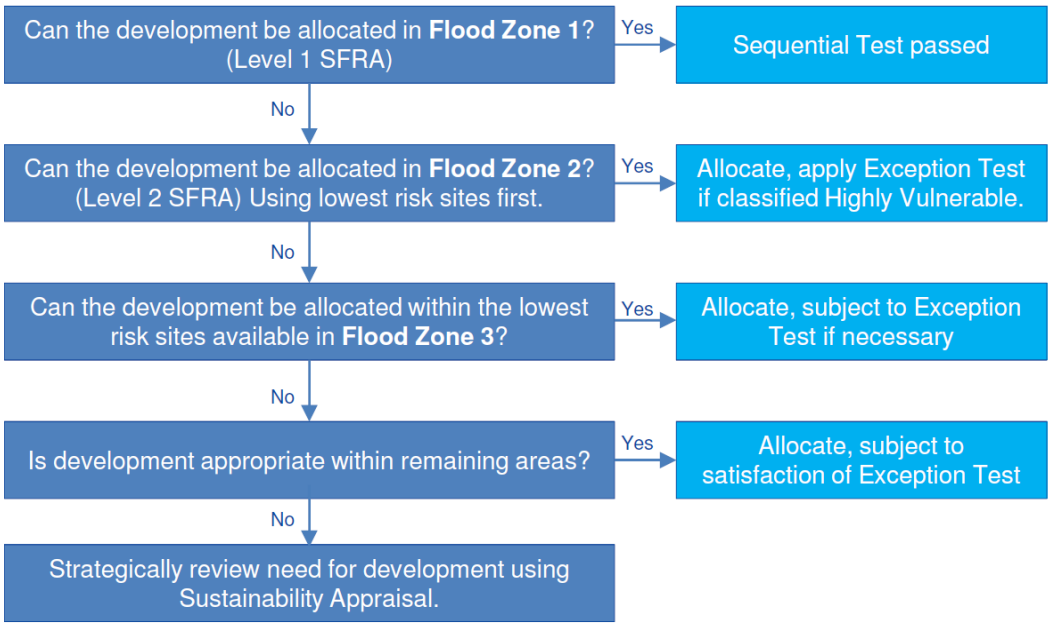

Figure 4-1 Application of Sequential Test for Local Plan preparation (Planning and Practice Guidance for Flood Risk and Coastal Change)

The Sequential Test requires an understanding of the Flood Zones in the study area and the vulnerability classification of the proposed developments. Flood Zone definitions are provided in Table 3-1 and mapped in the figures in Appendix B (and the Flood Map for Planning (Rivers and Sea) on the Environment Agency website). Flood risk vulnerability classifications, as defined in the PPG are presented in Table 4-1.

NPPF acknowledges that some areas will (also) be at risk of flooding from sources other than fluvial. All sources must be considered when planning for new development including flooding from land or surface water runoff; groundwater; sewers; and artificial sources.

If a location is recorded as having experienced repeated flooding from the same source this should be acknowledged within the Sequential Test.

Table 4-1 Flood Risk Vulnerability Classification (PPG)

Vulnerability Classification	Development Uses
Essential Infrastructure	Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk. Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood. Wind turbines.
Highly Vulnerable	Police stations, ambulance stations and fire stations and command centres and telecommunications installations required to be operational during flooding. Emergency dispersal points. Basement dwellings. Caravans, mobile homes and park homes intended for permanent residential use. Installations requiring hazardous substances consent. (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as “essential infrastructure”).
More Vulnerable	Hospitals. Residential institutions such as residential care homes, children’s homes, social services homes, prisons and hostels. Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels. Non–residential uses for health services, nurseries and educational establishments. Landfill and sites used for waste management facilities for hazardous waste. Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.
Less Vulnerable	Police, ambulance and fire stations which are not required to be operational during flooding. Buildings used for shops, financial, professional and other services, restaurants and cafes, hot food takeaways, offices, general industry, storage and distribution, non–residential institutions not included in “more vulnerable”, and assembly and leisure. Land and buildings used for agriculture and forestry. Waste treatment (except landfill and hazardous waste facilities). Minerals working and processing (except for sand and gravel working). Water treatment works which do not need to remain operational during times of flood. Sewage treatment works (if adequate measures to control pollution and manage sewage during flooding events are in place).
Water-Compatible Development	Flood control infrastructure. Water transmission infrastructure and pumping stations. Sewage transmission infrastructure and pumping stations. Sand and gravel working. Docks, marinas and wharves. Navigation facilities. MOD defence installations. Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. Water-based recreation (excluding sleeping accommodation). Lifeguard and coastguard stations. Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.

The NPPF indicates suitability of a development based on its vulnerability and location within a fluvial flood zone as set out in Table 4-2. However, the vulnerability classification of types of development is still relevant in

considering flood risk from other sources. For example, a basement dwelling will still be more vulnerable to surface water flooding than an office development.

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

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	✓	×	×	×

✓ – Development is appropriate × – Development should not be permitted

The recommended steps in undertaking the Sequential Test are detailed below. This is based on the Flood Zone and the Flood Risk Vulnerability compatability.

Recommended Stages for LPA Application of the Sequential Test

The information required to address many of these steps is provided in the accompanying maps presented in Appendix B. When preparing a Local Plan a database of the potential allocation sites across Spelthorne should be generated and information for each site populated using the GIS layers presented in the maps. This database can be used by Spelthorne BC when applying the steps below.

1. Assign potential developments with a vulnerability classification (Table 4-1). Where development is mixed, the development should be assigned the highest vulnerability class of the developments proposed.
2. The location and identification of potential development should be recorded.
3. The Flood Zone classification of potential development sites should be determined based on a review of the Flood Map for Planning (Rivers and Sea). Where a site is defined within more than one Flood Zone, all zones should be noted, preferably using percentages.
4. The design life of the development should be considered with respect to climate change:
    - 100 years – up to 2121 for residential developments; and
    - 75 years – up to 2096 for commercial / industrial developments, or other time horizon specific to the non-residential use proposed.
5. Identify existing flood defences serving the potential development sites. However, it should be noted that for the purposes of the Sequential Test, Flood Zones ignoring defences should be used.
6. Highly Vulnerable developments to be accommodated within the Borough should be located on those sites identified as being within Flood Zone 1. If these cannot be located in Flood Zone 1, because the identified sites are unsuitable or there are insufficient sites in Flood Zone 1, sites in Flood Zone 2 can then be considered. If sites in Flood Zone 2 are inadequate then additional sites in Flood Zones 1 or 2 may need to be identified to accommodate development or opportunities sought to locate the development outside the Borough.
7. Once all Highly Vulnerable developments have been allocated to a development site, consideration can be given to those development types defined as More Vulnerable. In the first instance More Vulnerable development should be located on sites in Flood Zone 1. Where these sites are unsuitable or there are insufficient sites remaining, sites in Flood Zone 2 can be considered. If there are insufficient sites in Flood Zone 1 or 2 to accommodate More Vulnerable development, sites in Flood Zone 3a can be considered. More Vulnerable developments in Flood Zone 3a will require application of the Exception Test.

8. Once all More Vulnerable developments have been allocated to a development site, consideration can be given to those development types defined as Less Vulnerable. In the first instance Less Vulnerable development should be located on sites in Flood Zone 1, continuing sequentially with Flood Zone 2, then 3a. Less Vulnerable development types are not appropriate in Flood Zone 3b – Functional Floodplain.
9. Essential Infrastructure should be preferentially located in the lowest flood risk zones, however this type of development may be located in Flood Zones 3a and 3b, provided the Exception Test is satisfied.
10. Water Compatible development has the least constraints with respect to flood risk and it is considered appropriate to allocate these sites last. The sequential approach should still be followed in the selection of sites; however it is appreciated that Water Compatible development by nature often relies on access and proximity to water bodies.
11. On completion of the Sequential Test, consideration may need to be given to the risks posed to a site within a Flood Zone in more detail in a Level 2 SFRA. By undertaking the Exception Test, this more detailed study should consider the detailed nature of flood hazard to allow a sequential approach to site allocation within a Flood Zone. Consideration of flood hazard within a flood zone would include:
    - Flood risk management measures,
    - The rate of flooding,
    - Flood water depth,
    - Flood water velocity.

Where the development is Highly Vulnerable, More Vulnerable, less Vulnerable or Essential Infrastructure and a site is found to be impacted by a recurrent flood source (other than tidal or fluvial), the site and food sources should be investigated further regardless of any requirement of the Exception Test.

Windfall Sites

Windfall sites are those which have not been specifically identified as available in the Local Plan process. They comprise sites that have unexpectedly become available. In cases where development needs cannot be fully met through the provision of site allocations, a realistic allowance for windfall development should be assumed, based on past trends. It is recommended that the acceptability of windfall applications in flood risk areas should be considered at the strategic level through a policy setting out broad locations and quantities of windfall development that would be acceptable or not in Sequential Test terms.

4.3 Applying the Sequential Test for Planning Applications

It is necessary to undertake a sequential test for a planning application if both of the following apply:

- The proposed development is in Flood Zone 2 or 3.
- A sequential test hasn't already been done for a development of the type you plan to carry out on your proposed site.

The Environment Agency publication 'Demonstrating the flood risk Sequential Test for Planning Applications[22]' sets out the procedure for applying the sequential test to individual applications as follows:

- Identify the geographical area of search over which the test is to be applied; this could be the Borough area, or a specific catchment if this is appropriate and justification is provided (e.g. school catchment area or the need for affordable housing within a specific area).
- Identify the source of 'reasonably available' alternative sites; usually drawn from evidence base / background documents produced to inform the Local Plan.

[22] Environment Agency (2012) Demonstrating the flood risk Sequential Test for Planning Applications, Version 3.1. Available from: https://www.gov.uk/guidance/flood-risk-assessment-the-sequential-test-for-applicants

- State the method used for comparing flood risk between sites; for example the Environment Agency Flood Map for Planning, the SFRA mapping, site-specific FRAs if appropriate, other mapping of flood sources.
- Apply the Sequential Test; systematically consider each of the available sites, indicate whether the flood risk is higher or lower than the application site, state whether the alternative option being considered is allocated in the Local Plan, identify the capacity of each alternative site, and detail any constraints to the delivery of the alternative site(s).
- Conclude whether there are any reasonably available sites in areas with a lower probability of flooding that would be appropriate to the type of development or land use proposed.
- Where necessary, as indicated by Table 4-2, apply the Exception Test.
- Apply the Sequential approach to locating development within the site.

It should be noted that it is for Spelthorne BC, taking advice from the Environment Agency as appropriate, to consider the extent to which Sequential Test considerations have been satisfied, taking into account the particular circumstances in any given case. The developer should justify with evidence what area of search has been used when making the application.

Ultimately, after applying the Sequential Test, Spelthorne BC needs to be satisfied in all cases that the proposed development would be safe and not lead to increased flood risk elsewhere. This needs to be demonstrated within a FRA and is necessary regardless of whether the Exception Test is required.

Sequential Test Exemptions

It should be noted that the Sequential Test does not need to be applied in the following circumstances:

- Individual developments proposed on sites which have been allocated in development plans through the Sequential Test.
- Minor development, which is defined in the NPPF as:
  - Minor non-residential extensions: industrial / commercial / leisure etc. extensions with a footprint <250m^2.
  - Alterations: development that does not increase the size of buildings e.g. alterations to external appearance.
  - Householder development: for example; sheds, garages, games rooms etc. within the curtilage of the existing dwelling, in additional to physical extensions to the existing dwelling itself. This definition excludes any proposed development that would create a separate dwelling within the curtilage of the existing dwelling e.g. subdivision of houses into flats.
- Change of Use applications, unless it is for a change of use of land to a caravan, camping or chalet site, or to a mobile home site or park home site.
- Development proposals in Flood Zone 1 (land with a low probability of flooding from rivers or the sea) unless the SFRA, or other more recent information, indicates there may be flooding issues now or in the future (for example, through the impact of climate change).
- Redevelopment of existing properties (e.g. replacement dwellings), provided they do not increase the number of dwellings in an area of flood risk (i.e. replacing a single dwelling within an apartment block).

4.4 Exception Test

The purpose of the Exception Test is to ensure that, following the application of the Sequential Test, new development is only permitted in Flood Zone 2 and 3 where flood risk is clearly outweighed by other sustainability factors and where the development will be safe during its lifetime, considering climate change.

For the Exception Test to be passed:

- Part 1 - It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by the SFRA where one has been prepared; and

- Part 2 - A site-specific Flood Risk Assessment must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

Both elements of the test will have to be passed for development to be allocated or permitted.

In order to satisfy part (a) of the Exception Test, the objectives of the Sustainability Appraisal (SA) can be used to assess each potential development site. The Spelthorne BC SA[23] includes a series of Sustainability Objectives which allow quantification of the sustainable development of a potential development site.

When determining planning applications, Spelthorne BC should ensure flood risk is not increased elsewhere. In order to consider development to be appropriate in an area at risk of flooding, it should be informed by a site-specific FRA, follow the Sequential Test, and if required the Exception Test, before demonstrating the following:

- Within the site, the most vulnerable development is located in areas of lowest flood risk unless there are overriding reasons to prefer a different location;
- Development is appropriately flood resilient and resistant, including safe access and escape routes where required, and that any residual risk can be safely managed, including any emergency planning carried out by the resident and/or owner; and it gives priority to the use of sustainable drainage systems.

There are a number of ways a new development can be made safe:

- Avoiding flood risk by not developing in areas at risk from floods;
- Substituting higher vulnerability land uses for lower vulnerability uses in higher flood risk locations and locating higher vulnerability uses in areas of lower risk on a strategic scale, or on a site basis;
- Providing adequate flood risk management infrastructure which will be maintained for the lifetime of the development; and
- Mitigating the potential impacts of flooding through design and resilient construction.

Further guidance is provided in Sections 5 and 6.

[23] Spelthorne Borough Council (February 2021) Spelthorne Local Plan Preferred Options Consultation Sustainability Appraisal Final Report. Available from: https://www.spelthorne.gov.uk/article/19901/Preferred-Options-Consultation-documents

5 Managing and Mitigating Flood Risk

5.1 Overview

The NPPF appreciates that it may not always be possible to avoid locating development in areas at risk of flooding. This Section provides guidance on the range of measures that could be considered in order to manage and mitigate flood risk. These measures should be considered when preparing a site-specific FRA as described in Section 6.

It is essential that the development control process influencing the design of future development within the Borough carefully mitigates the potential impact that climate change may have upon the risk of flooding. As a result mitigation measures should be designed with an allowance for climate change over the lifetime of the proposed development as follows:

- 100 years for residential developments; and,
- 75 years for commercial / industrial developments, or other time horizon specific to the non-residential use proposed

5.2 Development Layout and Sequential Approach

A sequential approach to site planning should be applied within new development sites.

Flood risk should be considered at an early stage in deciding the layout and design of a site to provide an opportunity to reduce flood risk within the development. Most large development proposals include a variety of land uses of varying vulnerability to flooding. The sequential approach should be applied within development sites to locate the most vulnerable elements of a development in the lowest risk areas (considering all sources of flooding) e.g. residential elements should be restricted to areas at lower probability of flooding whereas parking, open space or proposed landscaped areas can be placed on lower ground with a higher probability of flooding.

5.3 Finished Floor Levels

All More Vulnerable and Highly Vulnerable development within Flood Zones 2 and 3 should set Finished Floor Levels 300mm above the known or modelled 1 in 100 annual probability (1% AEP) flood level including an allowance for climate change.

Where developing in Flood Zone 2 and 3 is unavoidable, the recommended method of mitigating flood risk to people, particularly with More Vulnerable (residential) and Highly Vulnerable land uses, is to ensure internal floor levels are raised a freeboard level above the design flood level.

In certain situations (e.g. for proposed extensions to buildings with a lower floor level or conversion of existing historical structures with limited existing ceiling levels), it could prove impractical to raise the internal ground floor levels to sufficiently meet the general requirements. In these cases, the Environment Agency and/or Spelthorne BC should be approached to discuss options for a reduction in the minimum internal ground floor levels provided flood resistance measures be implemented up to an agreed level. There are also circumstances where flood resilience measures should be considered first. These are described further below. For both Less and More Vulnerable developments where internal access to higher floors is required, the associated plans showing the access routes and floor levels should be included within any site-specific FRA.

Table 5-1 provides an overview of the requirements for finished floor levels for development in Spelthorne.

Table 5-1 Requirements for Finished Floor Levels in Spelthorne BC

Development Type	Flood Zone 3	Flood Zone 2
Minor development (i.e. non-residential extensions with a floor space <250m^2 and householder developments)	Provide evidence to Spelthorne BC that EITHER, Floor levels within the proposed development will be set no lower than existing levels AND, flood proofing of the proposed development has been incorporated where appropriate. Details of flood proofing / resilience and resistance techniques to be included in accordance with 'Improving the flood performance of new buildings' CLG (2007). OR, Floor levels within the extension will be set 300mm above the known or modelled 1 in 100 annual probability river flood (1%) in any year including climate change. This flood level is the extent of the Flood Zones. Applicants should provide a plan showing floor levels relative to flood levels. All levels should be stated in relation to Ordnance Datum.	Provide evidence to Spelthorne BC that, Floor levels within the proposed development will be set no lower than existing levels AND, flood proofing of the proposed development has been incorporated where appropriate. Details of flood proofing / resilience and resistance techniques to be included in accordance with 'Improving the flood performance of new buildings' CLG (2007).
New residential development (More Vulnerable)	Where appropriate, subject to there being no other planning constraints (e.g. restrictions on building heights), finished floor levels should be set a minimum of 300mm above the 1% annual probability flood level (1 in 100 year) including climate change. The design flood level should be derived for the immediate vicinity of the site (i.e. relative to the extent of a site along a watercourse as flood levels are likely to vary with increasing distance downstream) as part of a site-specific FRA. Sleeping accommodation should be restricted to the first floor or above to offer the required 'safe places'. Internal ground floors below this level could however be occupied by Less Vulnerable commercial premises, garages or non-sleeping residential rooms (e.g. kitchen, study, lounge) (i.e. applying a sequential approach within a building).	
New non-residential development (e.g. Less Vulnerable)	Finished floor levels may not need to be raised. For example, Less Vulnerable developments can be designed to be floodable instead of raising floor levels, and this may be beneficial to help minimise the impact of the development on the displacement of floodwater and the risk of flooding to the surrounding area. However, it is strongly recommended that internal access is provided to upper floors (first floor or a mezzanine level) to provide safe refuge in a flood event. Such refuges will have to be permanent and accessible to all occupants and users of the site and a FWEP should be prepared to document the actions to take in the event of a flood.	
Basements	Basements, basement extensions, conversions of basements to a higher vulnerability classification or self-contained units are not be permitted in Flood Zone 3b. Self-contained residential basements and bedrooms at basement level are not permitted in Flood Zone 3a. Internal access to a higher floor situated 300mm above the 1% annual probability flood level (1 in 100 year) including climate change must be provided for all other basements, basement extensions and conversions.	All basements, basement extensions and conversions must have internal access to a higher floor situated 300mm above the 1% annual probability flood level (1 in 100 year) including climate change.

5.4 Flood Resistance 'Water Exclusion Strategy'

There is a range of flood resistance and resilience construction techniques that can be implemented in new developments to mitigate potential flood damage. The Department for Communities and Local Government (CLG) have published a document 'Improving the Flood Performance of New Buildings, Flood Resilient Construction'[24],

[24] CLG (2007) Improving the Flood Performance of New Buildings, Flood Resilient Construction. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/7730/flood_performance.pdf

the aim of which is to provide guidance to developers and designers on how to improve the resistance and resilience of new properties to flooding through the use of suitable materials and construction details. Figure 5-1 provides a summary of the Water Exclusion Strategy (flood resistance measures) and Water Entry Strategy (flood resilience measures) which can be adopted depending on the depth of floodwater that could be experienced.

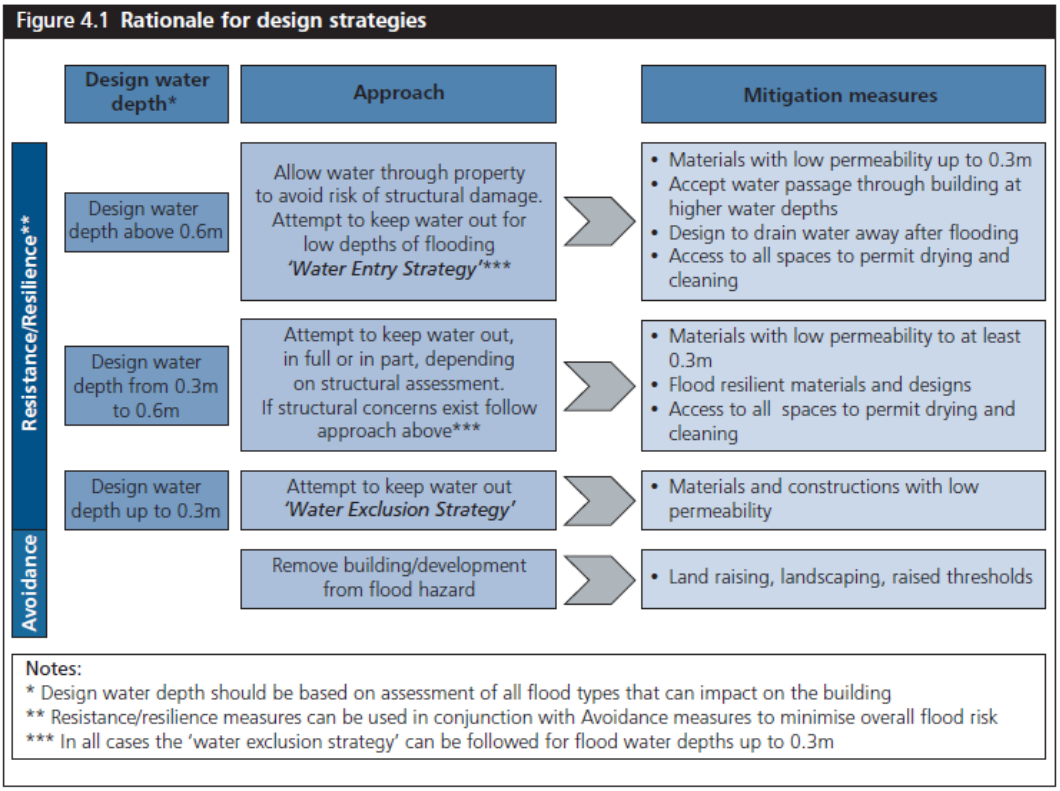

Figure 5-1 Flood Resistant / Resilient Design Strategies, Improving Flood Performance, CLG 2007

Resistance measures are aimed at preventing water ingress into a building (Water Exclusion Strategy); they are designed to minimise the impact of floodwaters directly affecting buildings and to give occupants more time to relocate ground floor contents. These measures will probably only be effective for short duration, low depth flooding, i.e. less than 0.3m, although these measures should be adopted where depths are between 0.3m and 0.6m and there are no structural concerns

In areas at risk of flooding of low depths (<0.3m), implement flood resistance measures such as:

- Using materials and construction with permeability;
- Land raising;
- Landscaping e.g. creation of low earth bunds (subject to this not increasing flood risk to neighbouring properties);
- Raising thresholds and finished floor levels e.g. porches with higher thresholds than main entrance;
- Flood gates with waterproof seals; and,
- Sump and pump for floodwater to remove waste faster than it enters.

There are a range of property flood protection devices available on the market, designed specifically to resist the passage of floodwater. These include removable flood barriers and gates designed to fit openings, vent covers and stoppers designed to fit WCs. These measures can be appropriate for preventing water entry associated with fluvial flooding as well as surface water and sewer flooding. The efficacy of such devices relies on their being deployed before a flood event occurs. It should also be borne in mind that devises such as air vent covers, if left in place by occupants as a precautionary measure, may compromise safe ventilation of the building in accordance with Building Regulations.

5.5 Flood Resilience 'Water Entry Strategy'

For flood depths greater than 0.6m, it is likely that structural damage could occur in traditional masonry construction due to excessive water pressures. In these circumstances, the strategy should be to allow water into the building, but to implement careful design in order to minimise damage and allow rapid re-occupancy. This is referred to as the Water Entry Strategy. These measures are appropriate for uses where temporary disruption is acceptable and suitable flood warning is received.

Materials should be used which allow the passage of water whilst retaining their structural integrity and they should also have good drying and cleaning properties. Alternatively sacrificial materials can be included for internal and external finishes; for example the use of gypsum plasterboard which can be removed and replaced following a flood event. Flood resilient fittings should be used to at least 0.1m above the design flood level. Resilience measures are either an integral part of the building fabric or are features inside a building that will limit the damage caused by floodwaters.

In areas at risk of frequent or prolonged flooding, implement flood resilience measures such as:

- Use materials with either, good drying and cleaning properties, or, sacrificial materials that can easily be replaced post-flood.
- Design for water to drain away after flooding.
- Design access to all spaces to permit drying and cleaning.
- Raise the level of electrical wiring, appliances and utility metres.
- Coat walls with internal cement based renders; apply tanking on the inside of all internal walls.
- Ground supported floors with concrete slabs coated with impermeable membrane.
- Tank basements, cellars or ground floors with water resistant membranes.
- Use plastic water resistant internal doors.

Further specific advice regarding suitable materials and construction techniques for floors, walls, doors and windows and fittings can be found in 'Improving the Flood Performance of New Buildings, Flood Resilient Construction'[25].

Structures such as (bus, bike) shelters, park benches and refuse bins (and associated storage areas) located in areas with a high flood risk should be flood resilient and be firmly attached to the ground and designed in such a way as to prevent entrainment of debris which in turn could increase flood risk and/or breakaway posing a danger to life during high flows.

5.6 Safe Access and Egress

Safe access and egress is required to enable the evacuation of people from the development, provide the emergency services with access to the development during times of flood and enable flood defence authorities to carry out any necessary duties during periods of flood.

A safe access/egress route should allow occupants to safely enter and exit the buildings and be able to reach land outside the flooded area (e.g. within Flood Zone 1) using public rights of way without the intervention of emergency services or others during design flood conditions, including climate change allowances. This is of particular importance when contemplating development on sites located on dry islands.

'Dry Islands'

The extensive area of floodplain within Spelthorne is relatively flat; however, there are certain areas of slightly higher ground which are less prone to flooding than the land around them. During times of flood it is possible that all the land surrounding these areas becomes flooded, resulting in this higher area becoming a 'dry island'. During prolonged periods of flooding it may prove difficult to provide resources and emergency services to those living in these areas. In order to reduce the flood risk, these 'dry islands' should be treated the same as for the level of flood

[25] CLG (2007) Improving the Flood Performance of New Buildings, Flood Resilient Construction. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/7730/flood_performance.pdf

risk in the area surrounding them, regardless of their size. When contemplating development, it is important to study the wider area of the flood map to ensure that there is a dry route to a point outside the floodplain.

Guidance prepared by the Environment Agency[26] uses a calculation of flood hazard to determine safety in relation to flood risk. Flood hazard is a function of the flood depth and flow velocity at a particular point in the floodplain along with a suitable debris factor to account for the hazard posed by any material entrained by the floodwater. The derivation of flood hazard is based on the methodology in Flood Risks to People FD2320, the use of which, for the purpose of planning and development control, is clarified in the abovementioned publication.

Table 5-2 Hazard to People Rating *(HR=d x (v +0.5)+DF)* (Table 13.1 FD2320/TR2)

Flood Hazard (HR)	Description
Less than 0.75	Very low hazard – Caution
0.75 to 1.25	Dangerous for some – includes children, the elderly and the infirm
1.25 to 2.0	Dangerous for most – includes the general public
More than 2.0	Dangerous for all – includes the emergency services

For developments located in areas at risk of fluvial flooding safe access / egress must be provided for new development as follows in order of preference:

- Safe dry route for people and vehicles.
- Safe dry route for people.
- If a dry route for people is not possible, a route for people where the flood hazard (in terms of depth and velocity of flooding) is low and should not cause risk to people.
- If a dry route for vehicles is not possible, a route for vehicles where the flood hazard (in terms of depth and velocity of flooding) is low to permit access for emergency vehicles. However the public should not drive vehicles in floodwater.

In all these cases, a 'dry' access/egress is a route located above the 1% annual probability flood level (1 in 100 year) including an allowance for climate change.

In exceptional circumstances, dry access above the 1% annual probability (1 in 100 year) flood level including climate change may not be achievable. In these circumstances the Environment Agency and Spelthorne BC should be consulted to ensure that the safety of the site occupants can be satisfactorily managed. This will be informed by the type of development, the number of occupants and their vulnerability and the flood hazard along the proposed egress route. For example, this may entail the designation of a safe place of refuge on an upper floor of a building, from which the occupants can be rescued by emergency services. It should be noted that sole reliance on a safe place of refuge is a last resort, and all other possible means to evacuate the site should be considered first. Provision of a safe place of refuge will not guarantee that an application will be granted.

5.7 Flood Compensation Storage

All new development within Flood Zone 3 must not result in a net loss of flood storage capacity. Where possible, opportunities should be sought to achieve an increase in the provision of floodplain storage.

Where proposed development results in a change in building footprint, the developer must ensure that it does not impact upon the ability of the floodplain to store water and should seek opportunities to provide a betterment with respect to floodplain storage.

Similarly, where ground levels are elevated to raise the development out of the floodplain, compensatory floodplain storage within areas that currently lie outside the floodplain must be provided to ensure that the total volume of the floodplain storage is not reduced.

As depicted in Figure 5-2, floodplain compensation must be provided on a level for level, volume for volume basis on land which does not already flood and is within the site boundary. Where land is not within the site boundary, it

[26] Environment Agency (2008) Supplementary note on Flood hazard ratings and thresholds for development planning and control purpose. Clarification of Table 13.1 FD2320/TR2 and Figure 3.2 FD2321/TR1. Available from: http://evidence.environment-agency.gov.uk/FCERM/Libraries/FCERM_Project_Documents/FD2321_7400_PR_pdf.sflb.ashx

must be in the immediate vicinity, in the applicant's ownership and linked to the site. Floodplain compensation must be considered in the context of the 1% annual probability (1 in 100 year) flood level including an allowance for climate change. When designing a scheme flood water must be able to flow in and out and must not pond. An FRA must demonstrate that there is no loss of flood storage capacity and include details of an appropriate maintenance regime to ensure mitigation continues to function for the life of the development. Guidance on how to address floodplain compensation is provided in Appendix A3 of the CIRIA Publication C624[27].

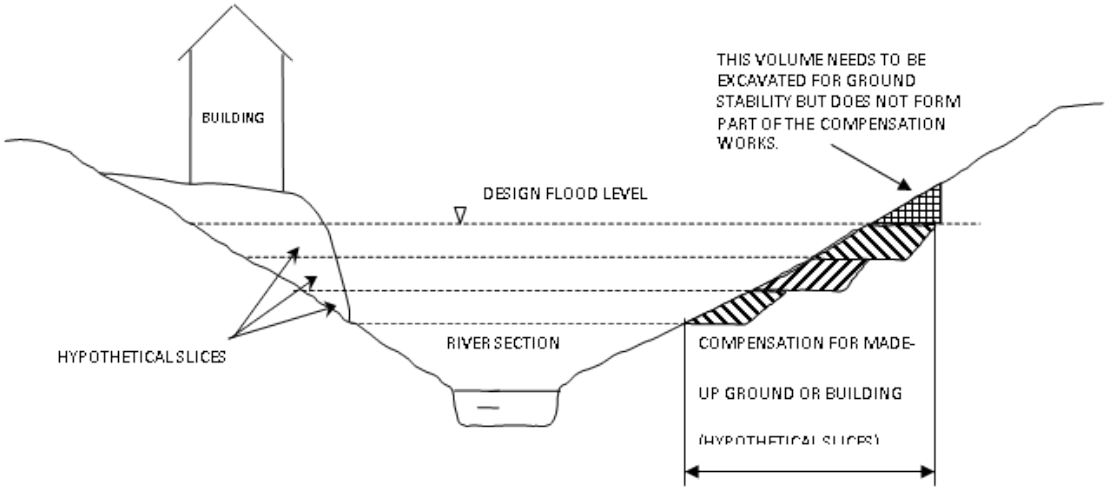

Figure 5-2 Example of Floodplain Compensation Storage (Environment Agency 2009)

The requirement for no loss of floodplain storage means that it is not possible to modify ground levels on sites which lie completely within the floodplain (when viewed in isolation), as there is no land available for lowering to bring it into the floodplain. It is possible to provide off-site compensation within the local area e.g. on a neighbouring or adjacent site, or indirect compensation, by lowering land already within the floodplain, however, this would be subject to detailed investigations and agreement with the Environment Agency to demonstrate (using an appropriate flood model where necessary) that the proposals would improve and not worsen the existing flooding situation or could be used in combination with other measures to limit the impact on floodplain storage

The use of under-floor voids with adequate openings beneath the raised finished floor levels can be considered for development in Flood Zone 2 and 3. They are generally considered to provide indirect compensation or mitigation, but not true compensation for loss of floodplain storage. The use of under-floor voids will typically require a legal agreement or planning condition and maintenance plan for them to remain open for the lifetime of the development and agreement that Spelthorne BC will enforce. Sole reliance on the use of under-floor voids to address the loss of floodplain storage capacity is generally not acceptable on undeveloped sites or for individual properties.

Should it not be possible to achieve all the level for level compensation required, the Environment Agency may consider that the remainder be provided through the use of under-floor voids instead. The amount of level for level compensation would need to be maximised and any under-floor voids would need to be appropriately designed and kept clear to enable them to function effectively.

Ideally, void openings should be a minimum of 1m long and open from existing ground levels to at least the 1% annual probability (1 in 100 year) plus climate change flood level. By setting finished floor levels at 300mm above the design flood level, there is usually enough space provision for voids below. There should be a minimum of 1m of open void length per 5m length of wall. Void openings should be provided along all external walls of the proposed extension. If security is an issue, 10mm diameter vertical bars set at 100mm centres can be incorporated into the void openings. The Environment Agency is likely to seek confirmation from Spelthorne BC that the voids be maintained in a free and open condition for the lifetime of the development.

Where car parks are specified as areas for the temporary storage of surface water and fluvial floodwaters, flood depths should not exceed 300mm given that vehicles may be moved by water of greater depths. Where greater depths are expected, car parks should be designed to prevent the vehicles from floating out of the car park. Signs

[27] CIRIA (2004) CIRIA Report 624: Development and Flood Risk - Guidance for the Construction Industry.

should be in place to notify drivers of the susceptibility of flooding and flood warning should be available to provide sufficient time for car owners to move their vehicles if necessary.

5.8 Flood Routing

All new development in Flood Zones 2 and 3 should not adversely affect flood routing and thereby increase flood risk elsewhere.

Opportunities should be sought within the site design to make space for water, such as:

- Removing boundary walls or replacing with other boundary treatments such as hedges, fences (with gaps).
- Considering alternatives to solid wooden gates or ensuring that there is a gap beneath the gates to allow the passage of floodwater.
- On uneven or sloping sites, consider lowering ground levels to extend the floodplain without creating ponds. The area of lowered ground must remain connected to the floodplain to allow water to flow back to river when levels recede.
- Create under-croft car parks or consider reducing ground floor footprint and creating an open area under the building to allow flood water storage.
- Where proposals entail floodable garages or outbuildings, consider designing a proportion of the external walls to be committed to free flow of floodwater.

In order to demonstrate that 'flood risk is not increased elsewhere', development in the floodplain will need to prove that flood routing is not adversely affected by the development, for example giving rise to backwater affects or diverting floodwaters onto other properties.

Potential overland flow paths should be determined and appropriate solutions proposed to minimise the impact of the development, for example by configuring road and building layouts to preserve existing flow paths and improve flood routing, whilst ensuring that flows are not diverted towards other properties elsewhere.

Careful consideration should be given to the use of fences and landscaping walls so as to prevent causing obstruction to flow routes and increasing the risk of flooding to the site or neighbouring areas.

5.9 Riverside Development

Retain an 8 metre wide undeveloped buffer strip alongside Main Rivers and explore opportunities for riverside restoration. Retain a 5 metre wide buffer strip alongside Ordinary Watercourses. New development within 8m of a Main River or Ordinary Watercourse will require consent from either the Environment Agency or SCC(as LLFA) respectively.

The Environment Agency is likely to seek an 8 metre wide undeveloped buffer strip alongside main fluvial rivers for maintenance purposes and would also ask developers to explore opportunities for riverside restoration as part of any development. SCC would seek a 5 metre wide undeveloped buffer strip to be retained alongside Ordinary Watercourses.

Under Section 109 of the Water Resources Act 1991 and/or Environment Agency Byelaws, any works within 8 metres of any statutory Main River (both open channels and culverted sections) requires Environment Agency consent. Whilst Flood Defence Consents are dealt with outside of the planning process, since requirements of the consenting process in relation to flood risk, biodiversity and pollution may result in changes to development proposals or construction methods, the Environment Agency aims to advise on such issues as part of its statutory consultee role in the planning process. Should proposed works not require planning permission the Environment Agency can be consulted regarding permission to do work on or near a river, floor or sea defence by contacting enquiries@environment-agency.gov.uk.

Responsibility for the consenting of works by third parties on Ordinary watercourses under Section 23 of the Land Drainage Act 1991 (as amended by the Flood and Water Management Act 2010) lies with the LLFA. SCC is responsible for the consenting of works to ordinary watercourses and has powers to enforce un-consented and non-compliant works. This includes any works (including temporary) that affect flow within the channel (such as in

channel structures or diversion of watercourses). Enquiries and applications for ordinary watercourse consent should be sent to suds@surreycc.gov.uk. Further information can be found on the SCC website[28].

Consent will be refused if the works would result in an increase in flood risk, a prevention of operational access to the watercourse and/ or an unacceptable risk to nature conservation[29].

5.10 Surface Water Management

All major developments (10 or more dwellings and 100m^2 floorspace) and other development should not result in an increase in surface water runoff. Surface run-off rates should be reduced back to greenfield and meet the requirements set out below.

Sustainable Drainage Systems (SuDS) should be used to reduce and manage surface water run-off to and from proposed developments as near to source as possible in accordance with the requirements of the Technical Standards and supporting guidance published by DCLG and Department for the Environment, Food and Rural Affairs (Defra)[30]. In line with the Spelthorne Core Strategy, SuDS must be implemented for sites in Flood Zone 2 and 3. SuDS must be considered for sites in Flood Zone 1.

SuDS are typically softer engineering solutions inspired by natural drainage processes such as ponds and swales which manage water as close to its source as possible. Wherever possible, a SuDS technique should seek to contribute to each of the three goals identified below. Where possible SuDS solutions for a site should seek to:

- Reduce flood risk (to the site and neighbouring areas);
- Reduce pollution; and,
- Provide landscape and wildlife benefits.

Suitable surface water management measures should be incorporated into new development designs in order to reduce and manage surface water flood risk to, and posed by, the proposed development. This should ideally be achieved by incorporating (SuDS).

Generally the aim should be to discharge surface water run-off as high up the following hierarchy of drainage options as reasonably practicable as per The Building Regulations 2010 Drainage and Waste Disposal Approved Document H[31]:

- Into the ground (infiltration)
- To a surface water body
- To a surface water sewer, highway drain, or another drainage system
- To a combined sewer

SuDS techniques can be used to reduce the rate and volume and improve the water quality of surface water discharges from sites to the receiving environment (i.e. natural watercourse or public sewer etc.). The SuDS Manual[32] identified several processes that can be used to manage and control runoff from developed areas. Each option can provide opportunities for storm water control, flood risk management, water conservation and groundwater recharge.

- **Infiltration**: the soaking of water into the ground. This is the most desirable solution as it mimics the natural hydrological process. The rate of infiltration will vary with soil type and condition, the antecedent conditions and with time. The process can be used to recharge groundwater sources and feed baseflows of local watercourses, but where groundwater sources are vulnerable or there is risk of contamination, infiltration techniques are not suitable.

[28] https://www.surreycc.gov.uk/people-and-community/emergency-planning-and-community-safety/flooding-advice/more-about-flooding/ordinary-watercourse-consents
[29] Surrey County Council (2017) Surrey County Council Local Flood Risk Management Strategy. https://www.surreycc.gov.uk/people-and-community/emergency-planning-and-community-safety/flooding-advice/more-about-flooding/surrey-local-flood-risk-management-strategy
[30] Sustainable drainage systems: non-statutory technical standards. Available from: https://www.gov.uk/government/publications/sustainable-drainage-systems-non-statutory-technical-standards
[31] Drainage and waste disposal: Approved document H. Building Regulations in England for foul water drainage and disposal. Available from: Drainage and waste disposal: Approved Document H - GOV.UK (www.gov.uk)
[32] CIRIA C697 SuDS Manual. Available from: http://www.ciria.org/Resources/Free_publications/the_suds_manual.aspx

- **Detention/Attenuation**: the slowing down of surface flows before their transfer downstream, usually achieved by creating a storage volume and a constrained outlet. In general, though the storage will enable a reduction in the peak rate of runoff, the total volume will remain the same, just occurring over a longer duration.
- **Conveyance**: the transfer of surface runoff from one place to another, e.g. through open channels, pipes and trenches.
- **Water Harvesting**: the direct capture and use of runoff on site, e.g. for domestic use (flushing toilets) or irrigation of urban landscapes. The ability of these systems to perform a flood risk management function will be dependent on their scale, and whether there will be a suitable amount of storage always available in the event of a flood.

As part of any SuDS scheme, consideration should be given to the long-term maintenance of the SuDS to ensure that it remains functional for the lifetime of the development. Table 5-3 has been reproduced from the SuDS Manual, CIRIA C697 and outlines typical SuDS techniques.

The application of SuDS is not limited to a single technique per site. Often a successful SuDS solution will utilise a combination of techniques, providing flood risk, pollution and landscape/wildlife benefits. In addition, SuDS can be employed on a strategic scale, for example with a number of sites contributing to large scale jointly funded and managed SuDS. It should be noted, each development site must offset its own increase in runoff and attenuation cannot be "traded" between developments.

Table 5-3 Typical SuDS Components (Y: primary process, * some opportunities subject to design)

Technique	Description	Conveyance	Detention	Infiltration	Harvesting
Pervious Surfaces	Pervious surfaces allow rainwater to infiltrate through the surface into an underlying storage layer, where water is stored before infiltration to the ground, reuse, or release to surface water.		Y	Y	*
Filter Drains	Linear drains/trenches filled with a permeable material, often with perforated pipe in the base of the trench. Surface water from the edge of paved areas flows into the trenches, is filtered and conveyed to other parts of the site.	Y	Y		
Filter Strips	Vegetated strips of gently sloping ground designed to drain water evenly from impermeable areas and filter out silt and particulates.	*	*	*	
Swales	Shallow vegetated channels that conduct and/or retain water and can permit infiltration when unlined.	Y	Y	*	
Ponds	Depressions used for storing and treating water.		Y	*	Y
Wetlands	As ponds, but the runoff flows slowly but continuously through aquatic vegetation that attenuates and filters the flow. Shallower than ponds. Based on geology these measures can also incorporate some degree of infiltration.	*	Y	*	Y
Detention Basin	Dry depressions designed to store water for a specified retention time.		Y		
Soakaways	Sub-surface structures that store and dispose of water via infiltration.			Y	
Infiltration Trenches	As filter drains but allowing infiltration through trench base and sides.	*	Y	Y	
Infiltration Basins	Depressions that store and dispose of water via infiltration.		Y	Y	
Green Roofs	Green roofs are systems which cover a building's roof with vegetation. They are laid over a drainage layer, with other layers providing protection, waterproofing and insulation. It is noted that the use of brown/green roofs should be for betterment purposes and not to be counted towards the provision of on-site storage for surface water. This is because the hydraulic performance during extreme events is similar to a standard roof (CIRIA C697).		Y		
Rainwater Harvesting	Storage and use of rainwater for non-potable uses within a building, e.g. toilet flushing. It is noted that storage in these types of systems is not usually considered to count towards the provision of on-site storage for surface water balancing because, given the sporadic nature of the use of	*	*	*	Y

harvested water, it cannot be guaranteed that the tanks are available to provide sufficient attenuation for the storm event.

Suitability for Infiltration SuDS

The use of infiltration techniques is highly dependent on the underlying ground conditions. As part of this SFRA, an assessment of the suitability of using infiltration SuDS techniques across the Borough has been undertaken using the detailed BGS Infiltration SuDS Map.

Appendix B Figure 14 presents the Infiltration SuDS Map, which shows the following areas:

Highly compatible: The subsurface is likely to be suitable for free-draining infiltration SuDS.

Probably compatible for infiltration SuDS: The subsurface is probably suitable for infiltration SuDS, although design may be influenced by the ground conditions.

Opportunities for bespoke infiltration SuDS: The subsurface is potentially suitable for infiltration SuDS although the design will be influenced by the ground conditions.

Very significant constraints are indicated: There is a very significant potential for one or more geohazards associated with infiltration.

The coverage across the Borough is quite patchy, but the dataset identifies that in parts of Shepperton and Sunbury there may be opportunities for the use of infiltration SuDS. Over the large majority of the urbanised areas of the Borough the dataset identifies constraints for the use of infiltration SuDS.

Detention measures are not constrained by geology, though in areas of permeable geology, there will also be a degree of infiltration of runoff taking place.

Technical Standards and supporting guidance

A set of non-statutory Technical Standards have been published, to be used in conjunction with supporting guidance in the PPG, which set the requirements for the design, construction, maintenance and operation of sustainable drainage systems (SuDS).

The Technical Standards that are of chief concern in relation to the consideration of flood risk to and from development relating to peak flow control and volume control are presented below:

Peak flow control

S2 For greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event should never exceed the peak greenfield runoff rate for the same event.

S3 For developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event must be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event.

Volume control

S4 Where reasonably practicable, for greenfield development, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event should never exceed the greenfield runoff volume for the same event.

S5 Where reasonably practicable, for developments which have been previously developed, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event must be constrained to a value as close as is reasonably practicable to the greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for that event.

S6 Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with S4 or S5 above, the runoff volume must be discharged at a rate that does not adversely affect flood risk.

Flood risk within the development

S7 The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 1 in 30 year rainfall event.

S8 The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur during a 1 in 100 year rainfall event in any part of: a building (including a basement); or in any utility plant susceptible to water (e.g. pumping station or electricity substation) within the development.

S9 The design of the site must ensure that, so far as is reasonably practicable, flows resulting from rainfall in excess of a 1 in 100 year rainfall event are managed in exceedance routes that minimise the risks to people and property.

As of 6 April 2015, all major development should include provision for SuDS and, as the LLFA, SCC is a statutory consultee on surface water management drainage issues for all such major developments. In partnership with the 11 LPAs in Surrey, SCC has set out clear advice and guidance documents on their website[33]. This includes a 'Surface Water Drainage Summary Pro-forma' which should be completed in full and accompany the submitted drainage statement and supporting evidence. This must be cross-referenced within an FRA where appropriate.

Applicants are strongly encouraged to discuss their proposals with SCC at the pre-application stage. A request can be made via suds@surreycc.gov.uk.

For smaller schemes located within Flood Zones 2 and 3, SuDS will need to be addressed as part of an FRA and will be assessed by Spelthorne BC.

5.11Flood Warning and Evacuation Plans

Evacuation is where flood alerts and warnings provided by the Environment Agency enable timely actions by residents or occupants to allow evacuation to take place unaided, i.e. without the deployment of trained personnel to help people from their homes, businesses and other premises. Rescue by the emergency services is likely to be required where flooding has occurred and prior evacuation has not been possible.

For all developments (excluding minor developments and change of use) proposed in Flood Zone 2 or 3, a Flood Warning and Evacuation Plan should be prepared to demonstrate what actions site users will take before, during and after a flood event to ensure their safety, and to demonstrate their development will not impact on the ability of the local authority and the emergency services to safeguard the current population.

For sites in Flood Zone 1 that are located on 'dry islands', it may also be necessary to prepare a Flood Warning and Evacuation Plan to determine potential egress routes away from the site through areas that may be at risk of flooding during the 1% annual probability (1 in 100 year) flood event including an allowance for climate change.

The Environment Agency has a tool on their website to create a Personal Flood Plan[34]. The Plan comprises a checklist of things to do before, during and after a flood and a place to record important contact details. Where proposed development comprises non-residential extension <250m^2 and householder development (minor development), it is recommended that the use of this tool to create a Personal Flood Plan will be appropriate.

Flood Warning and Evacuation Plans should include:

- How flood warning is to be provided, such as:
  - Availability of existing flood warning systems;
  - Where available, rate of onset of flooding and available flood warning time; and,
  - How flood warning is given.
- What will be done to protect the development and contents, such as:
  - How easily damaged items (including parked cars) or valuable items (important documents) will be relocated;

[33]SCC SuDS Planning Advice https://www.surreycc.gov.uk/people-and-community/emergency-planning-and-community-safety/flooding-advice/more-about-flooding/suds-planning-advice
[34] Environment Agency Tool 'Make a Flood Plan'. Available from: https://www.gov.uk/government/publications/personal-flood-plan

  - How services can be switched off (gas, electricity, water supplies);
  - The use of flood protection products (e.g. flood boards, airbrick covers);
  - The availability of staff/occupants/users to respond to a flood warning, including preparing for evacuation, deploying flood barriers across doors etc.; and,
  - The time taken to respond to a flood warning.
- Ensuring safe occupancy and access to and from the development, such as:
  - Occupant awareness of the likely frequency and duration of flood events, and the potential need to evacuate;
  - Safe access route to and from the development;
  - If necessary, the ability to maintain key services during an event;
  - Vulnerability of occupants, and whether rescue by emergency services will be necessary and feasible; and,
  - Expected time taken to re-establish normal use following a flood event (clean-up times, time to re-establish services etc.)

There is no statutory requirement for the Environment Agency or the emergency services to approve evacuation plans. Spelthorne BC is accountable via planning condition or agreement to ensure that plans are suitable. This should be done in consultation with emergency planning staff.

5.12Flood Warning Areas

The Environment Agency operates a free Flood Warning Service[35] for many areas at risk of flooding from rivers and the sea. In some parts of England the Environment Agency may also be able to tell when flooding from groundwater is possible. The Environment Agency has provided a GIS layer of Flood Warning Areas in Spelthorne.

Appendix B Figure 10 Environment Agency Flood Warning Areas.

There are 14 flood warning areas within the Borough, as shown in Appendix B Figure 10 and Table 5-4. The Environment Agency issues flood warnings to residents and businesses that have registered for the service in these specific areas when flooding is expected.

Table 5-4 Environment Agency Flood Warning Areas in Spelthorne

Flood Warning Area Name	Description
River Colne and Frays River at West Drayton and Stanwell Moor	The River Colne and Frays River at West Drayton and Stanwell Moor including Longford and Poyle
River Ash at Ashford and Staines	The River Ash at Ashford and Staines, including Birch Green, Knowle Green, Littleton and Shepperton
River Thames at Chertsey	River Thames at Chertsey including Chertsey Lock, Abbeychase, Chertsey Bridge Road, Thames Close, Hazelbank Road, Mead Lane and Bridge Wharf
River Thames at Hamm Court	River Thames at Hamm Court including Shepperton Lock, Hamhaugh Island, Hamm Court Estate and Dorney Grove
River Thames at Laleham	River Thames at Laleham and Penton Hook including Penton Park, Laleham Reach and Laleham Abbey, Staines Road, The Broadway and Thames Side
River Thames at Shepperton and Lower Halliford	River Thames at Shepperton and Lower Halliford including St. Nicholas Drive, Thamesmead School and Bishop Duppas Park areas
River Thames at Shepperton Green	River Thames in the Shepperton Green village area
River Thames at Staines and Egham	River Thames at Staines and Egham including Bell Weir and Penton Hook Locks, Runnymede, Hythe End, Pooley Green, Thorpe Lea and east Egham
River Thames at Sunbury	River Thames in the Sunbury town area, including Longwood Business Park, Halliford Road areas of Upper Halliford and Sunbury, Lower Hampton Road park, Kenton Court Meadow and Kempton Park Racecourse areas

[35]Environment Agency Flood Warning Service http://apps.environment-agency.gov.uk/wiyby/37835.aspx

Properties closest to the River Thames from Shepperton Lock to Beasley's Ait	The River Thames from Shepperton Lock to Beasley's Ait, including Sandhills Meadow, Thames Meadow, Penny Lane and Felix Lane areas
Properties closest to the River Thames between Littleton Lane (Shepperton Green) and Shepperton Lock	River Thames at the Littleton Lane, Chertsey Road and Pool End areas of Shepperton Green as well as Dockett Eddy, Dockett Point and Pharaoh's Island.
Properties closest to the River Thames between Runnymede Pleasure Grounds, Staines and Penton Hook	River Thames between Runnymede Pleasure Grounds, Staines and Penton Hook, including Hythe End Road, Bell Weir Lock, Holm Island, Church Island, Truss Island and Penton Hook Lock areas of Staines
Properties closest to the River Thames at Sunbury	River Thames at Sunbury from Wheatley's Eyot to Sunbury Court Island including Wheatley's Eyot, Sunbury Lock Ait, Sunbury Ait, Sunbury Court Island and properties on The Creek, Parke Road, Thames Street and Lower Hampton Road
Colne Brook at Colnbrook	The Colne Brook at Colnbrook including Horton and Wraysbury

Spelthorne BC has designated emergency rest centres across the Borough. Details of these centres have not been provided within the SFRA due to data sensitivity. It is advised that Spelthorne BC use the findings of the SFRA to inform the next planned review of the Multi-Agency Flood Plan as required.

6 Preparing Site Specific FRAs

6.1 What is a Flood Risk Assessment?

A site-specific FRA is a report suitable for submission with a planning application which provides an assessment of flood risk to and from a proposed development, and demonstrates how the proposed development will be made safe, will not increase flood risk elsewhere and where possible will reduce flood risk overall in accordance with paragraph 163 of the NPPF and supporting PPG. An FRA must be prepared by a suitably qualified and experienced person and must contain all the information needed to allow Spelthorne BC to satisfy itself that the requirements have been met.

6.2 When is a Flood Risk Assessment required?

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 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 of 1 hectare or greater in Flood Zone 1.
- Where proposed development or a change of use to a more vulnerable class may be subject to other sources of flooding.

6.3 How detailed should an FRA be?

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 (Table 4-1) 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. For example, where the development is an extension to an existing house (for which planning permission is required) which would not significantly increase the number of people present in an area at risk of flooding, Spelthorne BC would generally need a less detailed assessment to be able to reach an informed decision on the planning application. For a new development comprising a greater number of houses in a similar location, or one where the flood risk is greater Spelthorne BC may require a more detailed assessment, for example, the preparation of site-specific hydraulic modelling to determine the flood risk to and from the site pre and post-development, and the effectiveness of any management and mitigation measures incorporated within the design.

As a result, the scope of each site-specific FRA will vary considerably. Table 6-1 presents the different levels of site-specific FRA as defined in the CIRIA publication C624[36] and identifies typical sources of information that can be used. 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 will result in applications being refused.

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

Table 6-1 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 a FRA Level 2 or 3 is required.

Typical sources of information include:

- Spelthorne BC SFRA
- Flood Map for Planning (Rivers and Sea)
- Environment Agency Standing Advice
- NPPF 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.

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

Typical **sources of information** include those listed above, plus:

- Local policy statements or guidance.
- Lower Thames Catchment Flood Management Plan.
- Surrey County Council PFRA and LFRMS.
- Data request from the EA to obtain result of existing hydraulic modelling studies relevant to the site and outputs such as maximum flood level, depth and velocity.
- Consultation with EA/SCC/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

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.

Environment Agency Data Requests

The Environment Agency offers a series of 'products' for obtaining flood risk information suitable for informing the preparation of site-specific FRAs as described on their website https://www.gov.uk/planning-applications-assessing-flood-risk.

- **Products 1 – 4** relate to mapped deliverables including flood level and flood depth information and the presence of flood defences local to the proposed development site;
- **Product 5** contains the reports for hydraulic modelling of the Main Rivers;
- **Product 6** contains the model output data so the applicant can interrogate the data to inform the FRA.
- **Product 7** comprises the hydraulic model itself.

Products 1 – 6 can be used to inform a Level 2 FRA. In some cases, it may be appropriate to obtain Product 7 and to use as the basis for developing a site-specific model for a proposed development as part of a Level 3 FRA. This

can be requested via either their National Customer Contact Centre via enquiries@environment-agency.gov.uk or the Customer and Engagement Team via KSLEnquiries@environment-agency.gov.uk.

Modelling of Ordinary Watercourses

It should be noted that the scope of modelling studies undertaken by the Environment Agency typically cover flooding associated with Main Rivers, and therefore Ordinary Watercourses that form tributaries to the Main Rivers may not always be included in the model. Where a proposed development site is in close proximity to an Ordinary Watercourse and either no modelling exists, or the available modelling is considered to provide very conservative estimates of flood extents (due to the use of national generalised JFLOW modelling), applicants may need to prepare a simple hydraulic model to enable more accurate assessment of the probability of flooding associated with the watercourse and to inform the site-specific FRA. This should be carried out in line with industry standards and in agreement with the Environment Agency and SCC (as the LLFA).

6.4 What needs to be addressed in a Flood Risk Assessment?

The PPG states that the objectives of a site specific flood risk assessment are to establish:

- Whether a proposed development is likely to be affected by current or future flooding from any source;
- Whether it will increase flood risk elsewhere;
- Whether the measures proposed to deal with these effects and risks are appropriate;
- The evidence for the local planning authority to apply (if necessary) the Sequential Test, and;
- Whether the development will be safe and pass the Exception Test, if applicable.

6.5 Flood Risk Assessment Checklist

Table 6-2 provides a checklist for site-specific FRAs including the likely information that will need to be provided along with references to sources of relevant information. As described earlier in this Section, the exact level of detail required under each heading will vary according to the scale of development and the nature of the flood risk. It is expected that this Checklist is completed for all planning applications. This will be a validation requirement once the Council has updated its validation checklist and proposals that are submitted without the completed Checklist will be regarded as invalid.

Table 6-2 Site specific FRA Checklist (developed from guidance in PPG)

What to include in the FRA		*Source(s) of Information*
1. Site Description		
Site address	-	-
Site description	-	
Location plan	*Including geographical features, street names, catchment areas, watercourses and other bodies of water*	*OS Mapping* *SFRA Appendix B*
Site plan	*Plan of site showing development proposals and any structures which may influence local hydraulics e.g. bridges, pipes/ducts crossing watercourses, culverts, screens, embankments, walls, outfalls and condition of channel*	*OS Mapping* *Site Survey*
Topography	*Include general description of the topography local to the site. Where necessary, site survey may be required to confirm site levels (in relation to Ordnance datum).* *Plans showing existing and proposed levels.*	*SFRA Appendix B* *Site Survey*
Geology	*General description of geology local to the site.*	*SFRA Appendix B* *Ground Investigation Report*
Watercourses	*Identify Main Rivers and Ordinary Watercourses local to the site.*	*SFRA Appendix B*

Status	*Is the development in accordance with the Council's Spatial Strategy?*	*See advice from Spelthorne BC if necessary.*
2. Assessing Flood Risk		
The level of assessment will depend on the degree of flood risk and the scale, nature and location of the proposed development. Not all of the prompts listed below will be relevant for every application.		
Flooding from Rivers	*Provide a plan of the site and Flood Zones.* *Identify any historic flooding that has affected the site, including dates and depths where possible.* *How is the site likely to be affected by climate change?* *Determine flood levels on the site for the 1% annual probability (1 in 100 chance each year) flood event including an allowance for climate change.* *Determine flood hazard on the site (in terms of flood depth and velocity).* *Undertake new hydraulic modelling to determine the flood level, depth, velocity, hazard, rate of onset of flooding on the site.*	*SFRA Appendix B* *Environment Agency Flood Map for Planning (Rivers and Sea).* *Environment Agency Products 1-7.* *New hydraulic model (where EA data not available)*
Flooding from Land	*Identify any historic flooding that has affected the site.* *Review the local topography and conduce a site walkover to determine low points at risk of surface water flooding.* *Review the Risk of Flooding from Surface Water mapping.* *Where necessary, undertake modelling to assess surface water flood risk.*	*SFRA Appendix B* *Topographic survey.* *Site walkover.* *Risk of Flooding from Surface Water mapping (EA website).*
Flooding from Groundwater	*Desk based assessment based on high level BGS mapping in the SFRA.* *Ground survey investigations.* *Identify any historic flooding that has affected the site.*	*SFRA Appendix B* *Ground Investigation Report*
Flooding from Sewers	*Identify any historic flooding that has affected the site.*	*SFRA Appendix B* *Where appropriate an asset location survey can be provided by Thames Water Utilities Ltd* *http://www.thameswater-propertysearches.co.uk/*
Reservoirs, canals and other artificial sources	*Identify any historic flooding that has affected the site.* *Review the Risk of Flooding from Reservoirs mapping.*	*Risk of Flooding from Reservoirs mapping (EA website)*
3. Proposed Development		
Current use	*Identify the current use of the site.*	-
Proposed use	*Will the proposals increase the number of occupants / site users on the site such that it may affect the degree of flood risk to these people?*	-
Vulnerability Classification	*Determine the vulnerability classification of the development. Is the vulnerability classification appropriate within the Flood Zone?*	*SFRA Table 4-1* *SFRA Table 4-2*
4. Avoiding Flood Risk		
Sequential Test	*Determine whether the Sequential Test is required.* *Consult Spelthorne BC to determine if the site has been included in the Sequential Test.* *If required, present the relevant information to Spelthorne BC to enable their determination of the Sequential Test for the site on an individual basis.*	*SFRA Section 4*
Exception Test	*Determine whether the Exception Test is necessary.*	*SFRA Table 4-2* *Refer to Spelthorne BC sustainability objectives*

	Where the Exception Test is necessary, present details of: *Part 1) how the proposed development contributes to the achievement of wider sustainability objectives as set out in the Spelthorne BC Sustainability Appraisal Report.* *(Details of how part 2) can be satisfied are addressed in the following part 5 'Managing and Mitigating Flood Risk'.)*	
5. Managing and Mitigating Flood Risk		
Section 6 of the SFRA presents measures to manage and mitigate flood risk and when they should be implemented. Where appropriate, the following should be demonstrated within the FRA to address the following questions: *How will the site/building be protected from flooding, including the potential impacts of climate change, over the development's lifetime?* *How will you ensure that the proposed development and the measures to protect your site from flooding will not increase flood risk elsewhere?* *Are there any opportunities offered by the development to reduce flood risk elsewhere?* *What flood-related risks will remain after you have implemented the measures to protect the site from flooding (i.e. residual risk) and how and by whom will these be managed over the lifetime of the development (e.g. flood warning and evacuation procedures)?*		
Development Layout and Sequential Approach	*Plan showing how sensitive land uses have been placed in areas within the site that are at least risk of flooding.*	*SFRA Section 5*
Finished Floor Levels	*Plans showing finished floor levels in the proposed development in relation to Ordnance Datum taking account of indicated flood depths.*	*SFRA Section 5*
Flood Resistance	*Details of flood resistance measures that have been incorporated into the design. Include design drawings where appropriate.*	-
Flood Resilience	*Details of flood resilience measures that have been incorporated into the design. Include design drawings where appropriate.*	-
Safe Access / Egress	*Provide a figure showing proposed safe route of escape away from the site and/or details of safe refuge. Include details of signage that will be included on site.* *Where necessary this will involve mapping of flood hazard associated with river flooding. This may be available from Environment Agency modelling or may need to be prepared as part of hydraulic modelling specific for the proposed development site.*	*SFRA Section 5*
Floodplain Compensation Storage	*Provide calculations or results of a hydraulic modelling study to demonstrate that the proposed development provides compensatory flood storage and either will not increase flood risk to neighbouring areas or will result in an overall improvement. This should be located and designed to achieve level for level and volume for volume compensation, should be provided on land that is in hydrological continuity with the site within the applicant's ownership and subject to appropriate maintenance regimes for its lifetime. Include cross sectional drawings clearly showing existing and proposed site levels.*	*SFRA Section 5*
Flow Routing	*Provide evidence that proposed development will not impact flood flows to the extent that the risk to surrounding areas is increased. Where necessary this may require modelling.*	
Riverside Development Buffer Zone	*Provide plans showing how a buffer zone of relevant width will be retained adjacent to any Main River or Ordinary Watercourse in accordance with requirements of the Environment Agency or SCC.*	*SCC guidance on OW consent.* *https://www.surreycc.gov.uk/people-and-community/emergency-planning-and-community-safety/flooding-advice/more-about-flooding/ordinary-watercourse-consents*
Surface Water Management	*Completion of SuDS Proforma for all major development proposals in Flood Zones 1, 2 or 3.*	*SFRA Section 5*

	Details of the following within FRA for all other developments located within Flood Zones 2 and 3: *Calculations (and plans) showing areas of the site that are permeable and impermeable pre and post-development.* *Calculations of pre and post-development runoff rates and volumes including consideration of climate change over the lifetime of the development.* *Details of the methods that will be used to manage surface water (e.g. permeable paving, swales, wetlands, rainwater harvesting).* *Where appropriate, reference the supporting Outline or Detailed Drainage Strategy for the site.* *Information on proposed management arrangements*	*SCC SuDS planning advice https://www.surreycc.gov.uk/people-and-community/emergency-planning-and-community-safety/flooding-advice/more-about-flooding/suds-planning-advice*
Flood Warning and Evacuation Plan	*Where appropriate reference the Flood Warning and Evacuation Plan or Personal Flood Plan that has been prepared for the proposed development (or will be prepared by site owners).*	*SFRA Section 5*

6.6 Pre-application Advice

At all stages, Spelthorne BC, and where necessary the Environment Agency, SCC 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.

The Environment Agency, SCC and Spelthorne BC each offer pre-application advice services which should be used to discuss particular requirements for specific applications.

- Spelthorne Borough Council https://www.spelthorne.gov.uk/article/2843/Pre-application-advice
- Surrey County Council suds@surreycc.gov.uk
- Environment Agency https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications#contact

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.

Abbreviations and Glossary of Terms

Abbreviations

ACRONYM	DEFINITION
AOD	Above Ordnance Datum
AIMS	Asset Information Management System
BC	Borough Council
BGS	British Geological Survey
CFMP	Catchment Flood Management Plan
FCERM	Flood and Coastal Erosion Risk Management
FRA	Flood Risk Assessment
FWMA	Flood and Water Management Act 2010
GIS	Geographical Information System
LFRMS	Local Flood Risk Management Strategy
LiDAR	Light Detection and Ranging
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
LRF	Local Resilience Forum
PPG	Planning Practice Guidance
NPPF	National Planning Policy Framework
RoFSW	Risk of Flooding from Surface Water
SCC	Surrey County Council
SFRA	Strategic Flood Risk Assessment
SuDS	Sustainable Drainage Systems

Glossary of Terms

GLOSSARY	DEFINITION
1D Hydraulic Model	Hydraulic model which computes flow in a single dimension, suitable for representing systems with a defined flow direction such as river channels, pipes and culverts.
2D Hydraulic Model	Hydraulic model which computes flow in multiple dimensions, suitable for representing systems without a defined flow direction including topographic surfaces such as floodplains
Asset Information Management System (AIMS)	Environment Agency database of assets associated with Main Rivers including defences, structures and channel types. Information regarding location, standard of service, dimensions and condition.
Aquifer	A source of groundwater comprising water bearing rock, sand or gravel capable of yielding significant quantities of water.
Attenuation	In the context of this report - the storing of water to reduce peak discharge of water.
Catchment Flood Management Plan	A high-level plan through which the Environment Agency works with their key decision makers within a river catchment to identify and agree policies to secure the long-term sustainable management of flood risk.
Climate Change	Long term variations in global temperature and weather patterns caused by natural and human actions.
Culvert	A channel or pipe that carries water below the level of the ground.
Design flood	A flood event of a given annual probability against which the suitability of a proposed development is assessed and mitigation measures, if any, are designed. The design event is generally taken as; fluvial flooding likely to occur with a 1% annual probability (1 in 100 chance each year), or tidal flooding with a 0.5% annual probability (1 in 200 chance each year).
Exception Test	The exception test should be applied following the application of the sequential test. Conditions need to be met before the exception test can be applied.
Flood Defence	Infrastructure used to protect an area against floods, such as floodwalls and embankments; they are designed to a specific standard of protection (design standard).
Flood Resilience	Measures that minimise water ingress and promotes fast drying and easy cleaning, to prevent any permanent damage.
Flood Resistant	Measures to prevent flood water entering a building or damaging its fabric. This has the same meaning as flood proof.
Flood Risk	The level of flood risk is the product of the frequency or likelihood of the flood events and their consequences (such as loss, damage, harm, distress and disruption).
Flood Zone	Flood Zones show the probability of flooding, ignoring the presence of existing defences
Fluvial	Relating to the actions, processes and behaviour of a watercourse (river or stream).
Freeboard	Height of flood defence crest level (or building level) above designed water level
Functional Floodplain	Land where water has to flow or be stored in times of flood.
Groundwater	Water that is in the ground, this is usually referring to water in the saturated zone below the water table.
Lead Local Flood Authority (LLFA)	As defined by the Flood and Water Management Act, in relation to an area in England, this means the unitary authority or where there is no unitary authority, the county council for the area, in this case Surrey County Council (SCC).
Light Detection and Ranging (LiDAR)	Airborne ground survey mapping technique, which uses a laser to measure the distance between the aircraft and the ground.
Local Planning Authority (LPA)	Body that is responsible for controlling planning and development through the planning system.
Main River	Watercourse defined on a ‘Main River Map’ designated by Defra. The Environment Agency has permissive powers to carry out flood defence works, maintenance and operational activities for Main Rivers only.
Mitigation measure	An element of development design which may be used to manage flood risk or avoid an increase in flood risk elsewhere.

GLOSSARY	DEFINITION
Ordinary Watercourse	A watercourse that does not form part of a Main River. This includes “all rivers and streams and all ditches, drains, cuts, culverts, dikes, sluices (other than public sewers within the meaning of the Water Industry Act 1991) and passages, through which water flows” according to the Land Drainage Act 1991.
Residual Flood Risk	The remaining flood risk after risk reduction measures have been taken into account.
Risk	Risk is a factor of the probability or likelihood of an event occurring multiplied by consequence: Risk = Probability x Consequence. It is also referred to in this report in a more general sense.
Sequential Test	Aims to steer vulnerable development to areas of lowest flood risk.
Sewer Flooding	Flooding caused by a blockage or overflowing in a sewer or urban drainage system.
Surface Water	Flooding caused when intense rainfall exceeds the capacity of the drainage systems or when, during prolonged periods of wet weather, the soil is so saturated such that it cannot accept any more water.
Sustainable drainage systems (SuDS)	Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques.
Topographic survey	A survey of ground levels.

Appendix A Data Register

Appendix B Figures

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Figure 2	Bedrock Geology
Figure 3	Superficial Geology
Figure 4A-4D	Flood Map for Planning (Rivers and Sea)
Figure 5A-5D	River Thames – Modelled Flood Outlines
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Figure 11A-11D	Risk of Flooding from Surface Water Map
Figure 12	Areas Susceptible to Groundwater Flooding
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Figure 14	Infiltration SuDS Suitability Map

Appendix C Surface Water Conditions Report