Sevenoaks District Council – Level 1 Strategic Flood Risk Assessment

Final Report

August 2022

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Revision History

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S3-P01 – Apr 2022	Draft Report	Claire Pamberi (Sevenoaks District Council)
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Contract

This report describes work commissioned by Claire Pamberi, on behalf of Sevenoaks District Council, in an email dated 22 July 2021. Sevenoaks District Council's representatives for the contract were Claire Pamberi and Naiomi Sargant. Abigail Betts, Dan Griffin and Peter Rook of JBA Consulting carried out this work.

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Purpose

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JBA Consulting has no liability regarding the use of this report except to Sevenoaks District Council.

Acknowledgements

JBA would like to acknowledge Sevenoaks District Council, the Environment Agency, Kent County Council, Thames Water and Southern Water for their assistance in producing this SFRA.

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Executive summary

Introduction

This Level 1 Strategic Flood Risk Assessment (SFRA) 2022 is an update to the 2017 document is published as part of the evidence base for the emerging Local Plan. The report has updated the content that was included in the previous SFRA to provide appropriate supporting evidence for the resubmission of the Local Plan

SFRA objectives

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

- Level 1: where flooding is not a major issue and where development pressures are low. The assessment should be sufficiently detailed to allow application of the Sequential Test.
- Level 2: where land outside Flood Zones 2 and 3 cannot appropriately accommodate all the necessary development (see outputs from the Level 1 SFRA) creating the need to apply the NPPF's Exception Test. In these circumstances the assessment should consider the detailed nature of the flood characteristics within a Flood Zone and assessment of other sources of flooding. Following changes made to the NPPF in July 2021 the Exception Test is also applied at locations where proposed development affects a surface water flood zone and so included in a Level 2 assessment.

The objective of this SFRA update is to provide a Level 1 assessment.

Summary of the Level 1 SFRA

Historic flooding

Sevenoaks has experienced a number of recorded flood incidents across the River Darent, Eden and Medway. Data from the EA and the local authority indicate flooding was often due to channel capacities being exceeded during intense storms, with no raised defences to prevent floodwater overspills. In other cases, flooding was a result of the local drainage network and surface water sources more generally. Data for these reported events spans from 1958 to 2013.

When looking at the River Darent in specific, areas commonly affected by flooding include Eysnford, Shoreham, Chipstead, Farningham, Otford, Sundridge, Brasted and Westerham. While work performed in 1968 aimed to improve channel and floodplain conveyance, problems still remain and the Darent has continued to flood, most notably in 1969, 1971, 1972, 1976, 2003 and 2013.

The River Eden and Medway also have a history of flooding. Most notably, Edenbridge, Penshurst and Hilden Brook have all suffered from historic flooding. While interventions have been implemented to reduce risk at Edenbridge in particular, frequent episodes of flooding have still been experienced.

Fluvial flooding

The River Darent, Eden and Medway are the main watercourses within the Local Plan area identified to be contributing to fluvial flood risk.

Flood Zone mapping of the fluvial flood risk in the Local Plan area has been prepared as part of the Level 1 SFRA and can be found in Appendix A. The key settlements identified to be at risk from fluvial flooding include Dunton Green, which is located close to the Darent. Further south, Flood Zone Mapping indicates a high level of fluvial flood risk is to be expected around the River Eden, most notably around Edenbridge, Hever and Penshurst.

This therefore reflects where the majority of Sevenoaks' historic flooding has been experienced.

Surface water flooding

Flooding from surface water runoff (or 'pluvial' flooding) is caused by intense short periods of rainfall and usually affects lower lying areas, often where the natural (or artificial) drainage system is unable to cope with the volume of water. Surface water flooding problems are inextricably linked to issues of poor drainage or drainage blockage by debris, and sewer flooding.

The Risk of Flooding from Surface Water dataset shows that surface water predominantly follows topological flow paths of existing watercourses, dry valleys or roads, with some areas of ponding upslope of topographic features including railway lines and roads. To support this, Sevenoaks has experienced a number of events that have historically been attributed to surface water. The mapped areas of greatest risk also seem to agree with the preceding observation as the high risk areas closely mirror the locations at greatest risk to fluvial flooding. The most notable locations include Edenbridge, Hever and Penshurst, as well as Chipstead.

Groundwater flooding

The JBA Groundwater Flood Map identifies the majority of Sevenoaks is considered to be at 'no risk' or have a 'low likelihood'. Localised areas of higher risk primarily follow the River Darent in the north of Sevenoaks and along the River Eden to the south. This higher risk area very closely follows the river and is effectively the river floodplain where development and housing is generally limited. It should be noted that as this groundwater flood risk information is based on a national dataset there may be localised differences in the predictions. Planners and developers should consult the LLFA to find out if they hold any relevant local information.

Reservoir flood risk

Outlines from the Risk of Flooding from Reservoirs dataset (informed from the National Reservoir Inundation Mapping) shows worst case inundation extents of eleven reservoirs impacting the Local Plan area. Areas at risk of flooding from reservoirs include Farningham, Eynsford, Shoreham, Otford, Dunton Green, Chipstead, Edenbridge, Hever and Penshurst.

Sewer flooding

Sevenoaks falls within both Southern Water and Thames Water's administrative area. Sewer flooding (SIRF) data was requested as part of this study, although this data was only provided by Southern Water. This indicates that there have been at least 49 sewer flooding incidents since 2011 in the district, although the spatial distribution and further details of these events are not known.

Flood defences

A high-level review of flood defences was carried out for this SFRA, involving an interrogation of existing information on asset condition and standard of protection. There are a number of flood defences in the district, predominantly along the River Medway and River Darent.

The Leigh Flood Storage Area (FSA) plays an important role in managing flood risk in the district. The Leigh FSA is an online storage reservoir which was constructed in 1982 on the River Medway to reduce the risk of flooding in Tonbridge in the neighbouring borough. The FSA consists of an impounding embankment with an outflow through three radial gates. Proposed improvement plans involve raising the maximum water level that can be accommodated within the Leigh Flood Storage Area by 1m, to increase the storage provided by the FSA by as much as 30%. It is anticipated that the construction work for this will be

completed by Autumn 2023. As these works are not implemented the effect of the improvements on flood risk is not be included in the SFRA.

Recommendations

Recommendations for Local Plan policy

This report addresses Level 1 SFRA requirements. Following the application of the Sequential Test, where sites cannot be appropriately accommodated in Flood Zone 1, Sevenoaks District Council may need to apply the NPPF's Exception Test. In these circumstances, a Level 2 SFRA may be required, to consider the detailed nature of the flood characteristics within a Flood Zone and assessment of other sources of flooding.

If a Level 2 Assessment is required, any updates to the Environment Agency's climate change allowances will be considered when preparing more detailed assessments of hazards and actual risks.

Development management recommendations

This SFRA has made the following recommendations for developers and with regard to development management in Sevenoaks to:

- Reduce flood risk through appropriate site allocations and site design;
- Promote the use of SuDS to mimic natural drainage routes to improve water quality;
- Reduce surface water runoff from new developments and agricultural land;
- Enhance and restore river corridors and habitat;
- Mitigate against risk and improve emergency planning and flood awareness.

Technical recommendations

The SFRA has also made a number of technical recommendations, particularly with regard to hydraulic modelling. The Environment Agency regularly reviews its flood risk mapping, and it is important that they are approached to determine whether updated (more accurate) information is available prior to commencing a site-specific FRA.

This SFRA is based on the best available data at the time of publication and no climate change modelling has been undertaken for this study. Updated allowances for peak rainfall intensity are expected to be published by the Environment Agency later in 2022.

Use of SFRA data and future updates

SFRAs are high level strategic documents and, as such, do not go into specific detail on an individual site-specific basis. This SFRA has been developed using the best available information, as could be obtained at the time of preparation. This relates both to the current risk of flooding from a range of sources, and the potential impacts of future climate change. Other datasets used to inform this SFRA may also be periodically updated and following the publication of this SFRA, new information on flood risk may be available from Risk Management Authorities. It is recommended that the SFRA is reviewed internally, in line with the Environment Agency's Flood Zone map updates so that the latest data is still represented in the SFRA, allowing a cycle of review and a review of any updated data by checking for any new information available from RMAs including the Environment Agency

A full user guide to SFRA data is provided in Appendix D.

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Abbreviations

Term	Definition
AEP	Annual Exceedance Probability
BGS	British Geological Survey
Brownfield	Previously developed parcel of land
CC	Climate change - Long term variations in global temperature and weather patterns caused by natural and human actions.
CFMP	Catchment Flood Management Plan- A high-level planning strategy 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.
CIRIA	Construction Industry Research and Information Association
Defra	Department for Environment, Food and Rural Affairs
Designated Feature	A form of legal protection or status reserved for certain key structures or features that are privately owned and maintained, but which make a contribution to the flood or coastal erosion risk management of people and property at a particular location.
DG5 Register	A water-company held register of properties which have experienced sewer flooding due to hydraulic overload, or properties which are 'at risk' of sewer flooding more frequently than once in 20 years.
EA	Environment Agency
EU	European Union
FEH	Flood Estimation Handbook
Flood defence	Infrastructure used to protect an area against floods as floodwalls and embankments; they are designed to a specific standard of protection (design standard).
Flood Risk Area	An area determined as having a significant risk of flooding in accordance with guidance published by Defra and WAG (Welsh Assembly Government).
Flood Risk Regulations	Transposition of the EU Floods Directive into UK law. The EU Floods Directive is a piece of European Community (EC) legislation to specifically address flood risk by prescribing a common framework for its measurement and management.
Flood and Water Management Act	Part of the UK Government's response to Sir Michael Pitt's Report on the Summer 2007 floods, the aim of which is to clarify the legislative framework for managing surface water flood risk in England.
Fluvial Flooding	Flooding resulting from water levels exceeding the bank level of a main river
FRA	Flood Risk Assessment - A site-specific assessment of all forms of flood risk to the site and the impact of development of the site to flood risk in the area.
FRMP	Flood Risk Management Plan
FWMA	Flood and Water Management Act
GI	Green Infrastructure – a network of natural environmental components and green spaces that intersperse and connect the urban centres,

Term	Definition
	suburbs and urban fringe
Greenfield	Undeveloped parcel of land
Ha	Hectare
Indicative Flood Risk Area	Nationally identified flood risk areas, based on the definition of 'significant' flood risk described by Defra.
JBA	Jeremy Benn Associates
LFRMS	Local Food Risk Management Strategy
LLFA	Lead Local Flood Authority - Local Authority responsible for taking the lead on local flood risk management
LPA	Local Planning Authority
mAOD	metres Above Ordnance Datum
Main River	A watercourse shown as such on the Main River Map, and for which the Environment Agency has responsibilities and powers
NFM	Natural Flood Management
NPPF	National Planning Policy Framework
Ordinary Watercourse	All watercourses that are not designated Main River. Local Authorities or, where they exist, IDBs have similar permissive powers as the Environment Agency in relation to flood defence work. However, the riparian owner has the responsibility of maintenance.
OS NGR	Ordnance Survey National Grid Reference
PFRA	Preliminary Flood Risk Assessment
Pluvial flooding	Flooding as a result of high intensity rainfall when water is ponding or flowing over the ground surface (surface runoff) before it enters the underground drainage network or watercourse, or cannot enter it because the network is full to capacity.
PPG	National Planning Policy Guidance
Resilience Measures	Measures designed to reduce the impact of water that enters property and businesses; could include measures such as raising electrical appliances.
Resistance Measures	Measures designed to keep flood water out of properties and businesses; could include flood guards for example.
Risk	In flood risk management, risk is defined as a product of the probability or likelihood of a flood occurring, and the consequence of the flood.
Return Period	Is an estimate of the interval of time between events of a certain intensity or size, in this instance it refers to flood events. It is a statistical measurement denoting the average recurrence interval over an extended period of time.
RoFSW	Risk of Flooding from Surface Water
SDC	Sevenoaks District Council
Sewer flooding	Flooding caused by a blockage or overflowing in a sewer or urban drainage system.
SHLAA	Strategic Housing Land Availability Assessment - The Strategic Housing Land Availability Assessment (SHLAA) is a technical piece of evidence to

Term	Definition
	support local plans and Sites & Policies Development Plan Documents (DPDs). Its purpose is to demonstrate that there is a supply of housing land in the district which is suitable and deliverable.
SFRA	Strategic Flood Risk Assessment
SoP	Standard of Protection - Defences are provided to reduce the risk of flooding from a river and within the flood and defence field standards are usually described in terms of a flood event return period. For example, a flood embankment could be described as providing a 1 in 100-year standard of protection.
Stakeholder	A person or organisation affected by the problem or solution, or interested in the problem or solution. They can be individuals or organisations, includes the public and communities.
SuDS	Sustainable Drainage Systems - Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques
Surface water flooding	Flooding as a result of surface water runoff because of high intensity rainfall when water is ponding or flowing over the ground surface before it enters the underground drainage network or watercourse, or cannot enter it because the network is full to capacity, thus causing what is known as pluvial flooding.
SWMP	Surface Water Management Plan - The SWMP plan should outline the preferred surface water management strategy and identify the actions, timescales and responsibilities of each partner. It is the principal output from the SWMP study.
WFD	Water Framework Directive

1 Introduction

1.1 Purpose of the Strategic Flood Risk Assessment

This Level 1 Strategic Flood Risk Assessment (SFRA) 2022 that updates the 2017 document is published as part of the evidence base for the emerging Local Plan. The report has updated the content that was included in the previous SFRA and to provide appropriate supporting evidence for the resubmission of the Local Plan.

The 2022 SFRA update will be used in decision making, to inform the process for location of land for future development and the preparation of sustainable policies for the long-term management of flood risk.

The key objectives of the review performed during the preparation of the 2022 SFRA are:

1. To take into account the latest flood risk policy.
2. Take into account the latest flood risk information and available data.
3. To provide specific flood risk analyses for sites identified by the Council as part of their Local Plan preparation.
4. To provide a comprehensive mapping to support the Local Plan.

1.2 SFRA objectives

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

- Level 1: where flooding is not a major issue and where development pressures are low. The assessment should be sufficiently detailed to allow application of the Sequential Test.
- Level 2: where land outside Flood Zones 2 and 3 cannot appropriately accommodate all the necessary development (see outputs from the Level 1 SFRA) creating the need to apply the NPPF's Exception Test. In these circumstances the assessment should consider the detailed nature of the flood characteristics within a Flood Zone and assessment of other sources of flooding. Following changes made to the NPPF in July 2021 the Exception Test is also applied at locations where proposed development affects a surface water flood zone and so included in a Level 2 assessment.

The objective of this SFRA update is to provide a Level 1 assessment.

1.3 SFRA outputs

To meet the objectives, the following outputs have been prepared:

- Appraisal of all potential sources of flooding, including Main River, Ordinary Watercourse, surface water and groundwater.
- Updated review of historical flooding incidents.
- Mapping of location and extent of functional floodplain.
- Reporting on the standard of protection provided by existing flood risk management infrastructure.
- An assessment of the potential increase in flood risk due to climate change.
- Areas at risk from other sources of flooding, for example surface water or reservoirs.
- An assessment of existing flood warning and emergency planning procedures, including an assessment of safe access and egress during an extreme event.

- Recommendations of the criteria that should be used to assess future development proposals and the development of a Sequential Test and sequential approach to flood risk.

1.4 Approach

1.4.1 General assessment of flood risk

The flood risk management hierarchy underpins the risk-based approach and is the basis for making all decisions involving development and flood risk. When using the hierarchy, account should be taken of:

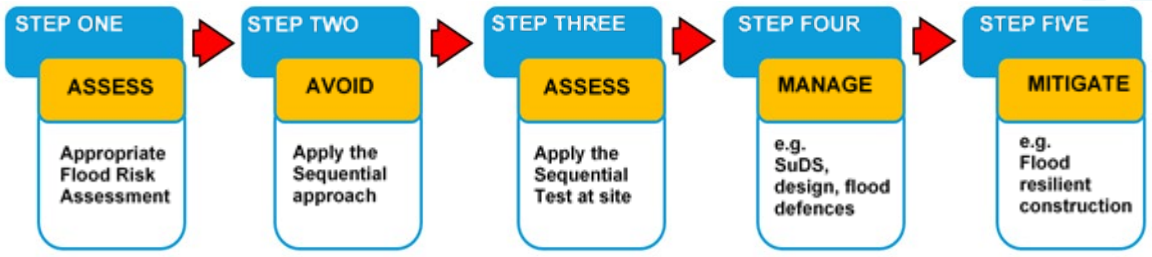
- the nature of the flood risk (the source of the flooding);
- the spatial distribution of the flood risk (the pathways and areas affected by flooding);
- climate change impacts; and
- the degree of vulnerability of different types of development (the receptors).

Development locations should reflect the application of the Sequential Test using the maps produced for this SFRA. The information in this SFRA should be used as evidence and, where necessary, reference should also be made to relevant evidence in other documents referenced in this report. The Flood Zone maps and flood risk information on other sources of flooding contained in this SFRA should be used where appropriate to apply the Sequential Test.

Where other sustainability criteria outweigh flood risk issues, the decision-making process should be transparent. Information from this SFRA should be used to support decisions to allocate land in areas at high risk of flooding.

The flood risk management hierarchy is summarised in Figure 1-1.

Figure 1-1: Flood risk management hierarchy



1.4.2 Technical assessment of flood hazards

Flood risk within the Sevenoaks District has been assessed using results from hydraulic models supplied by the Environment Agency and existing Environment Agency Flood Zone mapping. The following models inform the flood risk information within the district:

Environment Agency fluvial (river) models

- River Darent (2009)
- River Medway (2015), including latest climate change modelling (2016)
- National Flood Zone modelling

Environment Agency surface water (rainfall) models

- Risk of Flooding from Surface Water (2013)
- Risk of Flooding from Surface Water climate change (2021)

1.5 Consultation

The following parties (external to Sevenoaks District Council) have been consulted during the preparation of this version of the SFRA:

- Environment Agency
- Kent County Council (as Lead Local Flood Authority)
- Southern Water
- Thames Water

1.6 Use of SFRA data

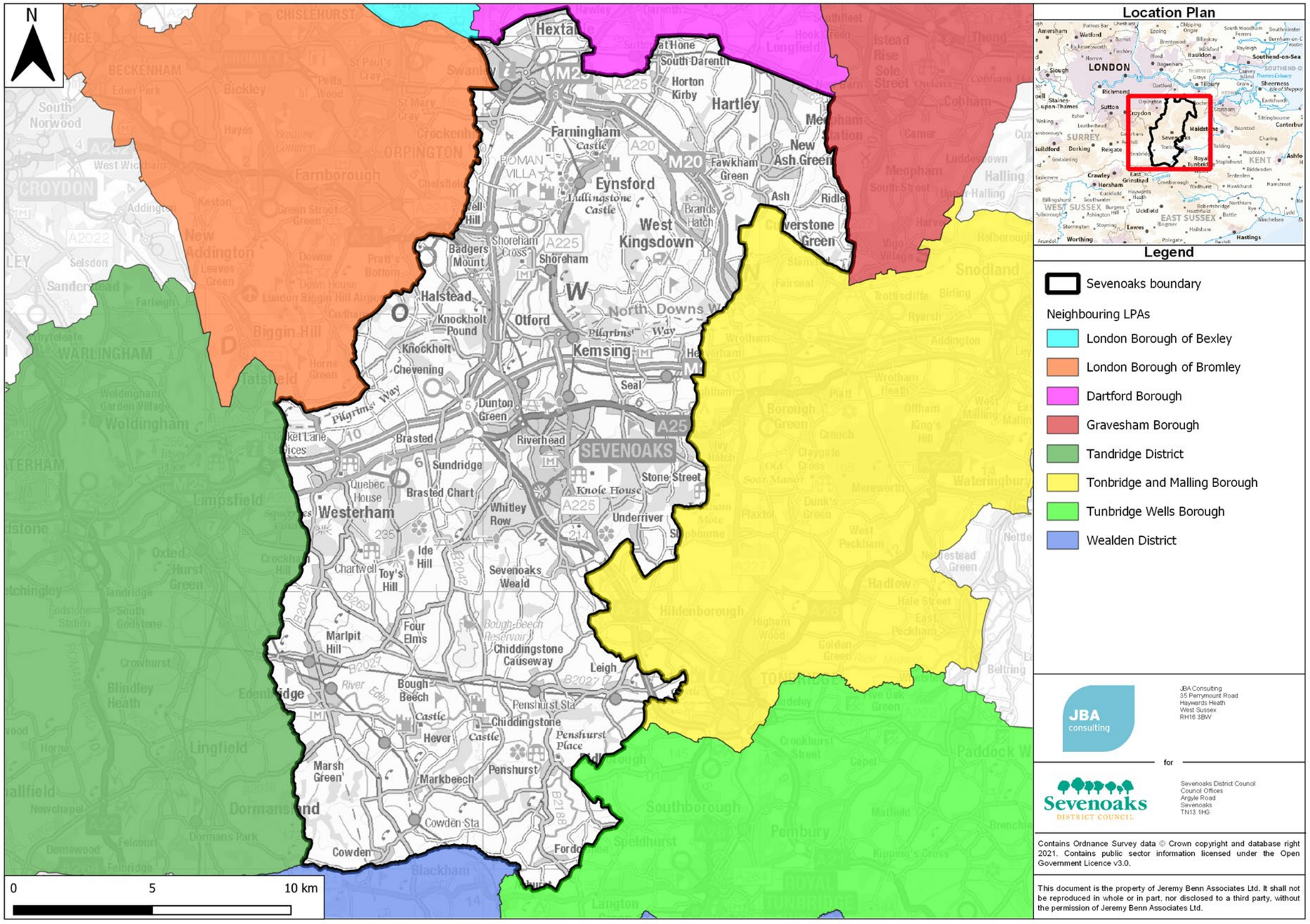
Level 1 SFRAs are high-level strategic documents and do not go into detail on an individual site-specific basis. The primary purpose is to provide an evidence base to inform the Local Plan and any future flood risk policies.

Developers will still be required to undertake site-specific Flood Risk Assessments to support Planning Applications. Developers will be able to use the information in the SFRA to scope out the sources of flood risk that will need to be explored in more detail at site level.

Appendix D contains a guide to using the technical data presented within this SFRA, further explaining how SFRA data should be used, including reference to relevant sections of the SFRA, how to consider different sources of flood risk and recommendations and advice for Sequential and Exception Tests.

On the date of publication, the SFRA contains the latest available flood risk information. Over time, new information will become available to inform planning decisions, such as updated hydraulic models (which then update the Flood Map for Planning), flood event information, new defence schemes and updates to policy and legislation. Developers should check the online Flood Map for Planning in the first instance to identify any major changes to the Flood Zones.

Figure 1-2: Sevenoaks District and neighbouring authorities



2 The Planning System and Flood Risk Policy

2.1 Introduction

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

2.2 Floods Directive (2007) and Flood Risk Regulations (2009)

The **Flood Risk Regulations**[1] translated the **EU Floods Directive**[2] into UK law. The EU required Member States to complete an assessment of flood risk (known as a Preliminary Flood Risk Assessment (PFRA)) and then use this information to identify areas where there is a significant risk of flooding. The threshold for designating significant Flood Risk Areas is defined by DEFRA. For these Flood Risk Areas, States must then undertake Flood Risk and Hazard Mapping and produce Flood Risk Management Plans.

The Flood Risk Regulations as pertain to English and Welsh legislation direct the Environment Agency to do this work for river, sea and reservoir flooding. LLFAs must do this work for surface water, Ordinary Watercourses and groundwater flooding. This is a six-year cycle of work and the second cycle started in 2017. In the instance of this SFRA, the LLFA is Kent County Council (KCC).

The **Kent PFRA**[3]**(2011)** provided information on significant past and future flood risk from localised flooding in Kent, including Sevenoaks District.

In 2011 indicative Flood Risk Areas were identified nationally by LLFA's. The exercise was repeated in 2018 and a further national study prepared to identify potential areas of significant flood risk ("Flood Risk Areas") – **'Review of preliminary flood risk assessments (Flood Risk Regulations 2009): guidance for lead local flood authorities in England – 25th Jan 2017'**. However, there were no indicative Flood Risk Areas identified within Kent.

2.2.1 Flood and Water Management Act (2010)

The **Flood and Water Management Act**[4] (FWMA) was passed in April 2010. It aims to improve both flood risk management and the way we manage our water resources and implements some of Sir Michael Pitt's recommendations following his review of the 2007 floods. The FWMA received Royal Assent in April 2010.

The FWMA has created clearer roles and responsibilities and helped to define a more risk-based approach to dealing with flooding. This included the creation of a lead role for LAs, as LLFAs, assigned to manage local flood risk (from surface water, ground water and ordinary watercourses) and to provide a strategic overview role of all flood risk for the EA.

The content and implications of the FWMA provide considerable opportunities for improved and integrated land use planning and flood risk management by LAs and other key partners. The integration and synergy of strategies and plans at national, regional and

1 Flood Risk Regulations. UK Government. (2009). https://www.legislation.gov.uk/uksi/2009/3042/contents/made

2 EU Floods Directive. European Commission. (2007) https://ec.europa.eu/environment/water/flood_risk/

3 Kent PFRA. (2011) https://www.kent.gov.uk/about-the-council/strategies-and-policies/environment-waste-and-planning-policies/flooding-and-drainage-policies/preliminary-flood-risk-assesment

4 Flood and Water Management Act. UK Government. (2010) https://www.legislation.gov.uk/ukpga/2010/29/pdfs/ukpga_20100029_en.pdf

local scales, is increasingly important to protect vulnerable communities and deliver sustainable regeneration and growth.

Kent County Council as LLFA has developed a **Local Flood Risk Management Strategy**[5] under the Act, in consultation with local partners. This is discussed further in Section 2.8. This Strategy acts as the basis and discharge of duty for Flood Risk Management co-ordinated by Kent County Council. The latest version of the strategy was published in 2017.

Local authorities are responsible for flood management relating to 'Ordinary Watercourses' (i.e. smaller ditches, brooks), with the Environment Agency responsible for 'Main Rivers'. The Upper Medway Internal Drainage board have responsibility for certain ordinary watercourses and land drainage in the southern part of the district. The internal drainage board should be consulted on development proposals which affect the land or watercourses in their jurisdiction.

When considering planning applications, Local Planning Authorities should consult LLFAs on the management of surface water in order to satisfy that:

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

The FWMA will also update the Reservoirs Act 1975 by reducing the capacity of reservoir regulation from 25,000m^3 to 10,000m^3. Phase 1 of this intention has been implemented in 2013 requiring large, raised reservoirs to be registered to allow the Environment Agency to categorise whether they are 'high risk' or 'not high risk'.

2.2.2 Water Framework Directive (2000) & Water Environmental Regulations (2017)

The purpose of the **Water Framework Directive**[6] (WFD), which was transposed into English Law by the **Water Environment Regulations**[7] (first published in 2003 and updated in 2017), is to deliver improvements across Europe in the management of water quality and water resources. This is enforced through a series of plans called River Basin Management Plans (RBMP) (see section 2.3.3), which were last published in 2015 and are currently being updated.

2.2.3 Environmental permitting

The **Environmental Permitting Regulations**[8] (2016, amended 2018) set out where developers will need to apply for additional permission (as well as Planning Permission) to undertake works to an Ordinary Watercourse (pollution related works only) or Main River. This includes flood risk activities, for example:

- on or within 8 metres of a main river (16 metres if tidal);
- on or within 8 metres of a flood defence structure or culvert (16 metres if tidal);
- on or within 16 metres of a sea defence;
- involving quarrying or excavation within 16 metres of any main river, flood defence (including a remote defence) or culvert; and

5 Kent Local Flood Risk Management Strategy: https://www.kent.gov.uk/__data/assets/pdf_file/0010/79453/Local-Flood-Risk-Management-Strategy-2017-2023.pdf

6 Water Framework Directive. European Commission. (2000) https://ec.europa.eu/environment/water/water-framework/index_en.html

7 Water Environment Regulations. UK Government. (2003) https://www.legislation.gov.uk/uksi/2003/3242/contents/made

8 Environmental Permitting Regulations. UK Government. (2016) https://www.legislation.gov.uk/uksi/2018/110/contents/made

- in a floodplain more than 8 metres from the riverbank, culvert or flood defence structure (16 metres if it is a tidal main river) and you do not already have planning permission.

Environmental permits may also be required from the Environment Agency to discharge runoff, trade effluent or sewage into a main river. They may also be required in relation to groundwater activities, where there may be a risk of groundwater contamination.

An Ordinary Watercourse consent may be required where work is carried out which could affect the flow of water within a watercourse which is not main river. These should be acquired from **Kent County Council**[9].

2.2.4 Land Drainage Act (1991)

Under the **Land Drainage Act (1991)**[10] Internal Drainage Boards were also given the power to implement their own Byelaws. The act also outlines riparian responsibilities to maintain the flow of water and sets out Local Authority powers to regulate works that may alter the flow of water in a watercourse.

2.2.5 Byelaws

Land Drainage Byelaws outline legal obligations and responsibilities when undertaking works on or close to a watercourse, for the purpose of preventing flooding, or mitigating any damage caused by flooding.

Under the Land Drainage Act, Internal Drainage Boards were also given the power to implement their own Byelaws. The **Upper Medway Internal Drainage Board Byelaws**[11] have effect within Sevenoaks. These Byelaws have effect on any activity within the Internal Drainage Board District that affect the flow of water and flood risk. The Byelaws are stated to be considered necessary for the following purposes:

- Securing the effectiveness of flood risk management work within the meaning of section 14A of the Land Drainage Act.
- Regulating the effects on the environment of a drainage system
- Securing the efficient working of the drainage system

Compliance with the relevant Byelaws and standards must be demonstrated by any developer planning works within the two IDB's drainage district and watershed (or catchment) within the Local Plan area. The byelaws that are most relevant to flood risk management are Byelaws 3 and 10:

- Byelaw 3 - Control of Introduction of Water and Increase of in Flow or Volume or Water;
- Byelaw 10 - No Obstructions within 8 Metres of the Edge of the Watercourse.

2.2.6 Additional legislation

Additional legislation relevant to development and flood risk in Sevenoaks include:

9Land drainage. Kent County Council https://www.kent.gov.uk/environment-waste-and-planning/flooding-and-drainage/sustainable-drainage-systems/owning-and-maintaining-a-watercourse

10 Land Drainage Act. UK Government. (1991). https://www.legislation.gov.uk/ukpga/1991/59/contents

11 Upper Medway Internal Drainage Board Byelaws. https://www.medwayidb.co.uk/wp-content/uploads/2018/12/Upper-Medway-Byelaws.pdf/

- The **Town and Country Planning Act**[12] (1990) and the **Water Industry Act**[13] (1991). These set out the roles and responsibilities for organisations that have a role in Flood Risk Management (FRM).
- Other environmental legislation such as the **Habitats Directive**[14] (1992), **Environmental Impact Assessment Directive**[15] (2014) and **Strategic Environmental Assessment Directive**[16] (2001) also apply as appropriate to strategic and site-specific developments to guard against environmental damage.

It should be noted that the some of the environmental directives listed are from European Union (EU) legislation, due to the UK leaving the EU these may be subject to change in the future.

2.3 Relevant national, regional and local policy documents

Error! Reference source not found. summarises key national, regional and local flood risk policy and strategy documents and how these apply to development and flood risk. Hyperlinks are provided to external documents.

These documents may:

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

12 Town and Country Planning Act. UK Government. (1990) https://www.legislation.gov.uk/ukpga/1990/8/contents

13 Water Industry Act. UK Government. (1991) https://www.legislation.gov.uk/ukpga/1991/56/contents

14 Habitats Directive. European Commission. (1992) https://ec.europa.eu/environment/nature/legislation/habitatsdirective/index_en.htm

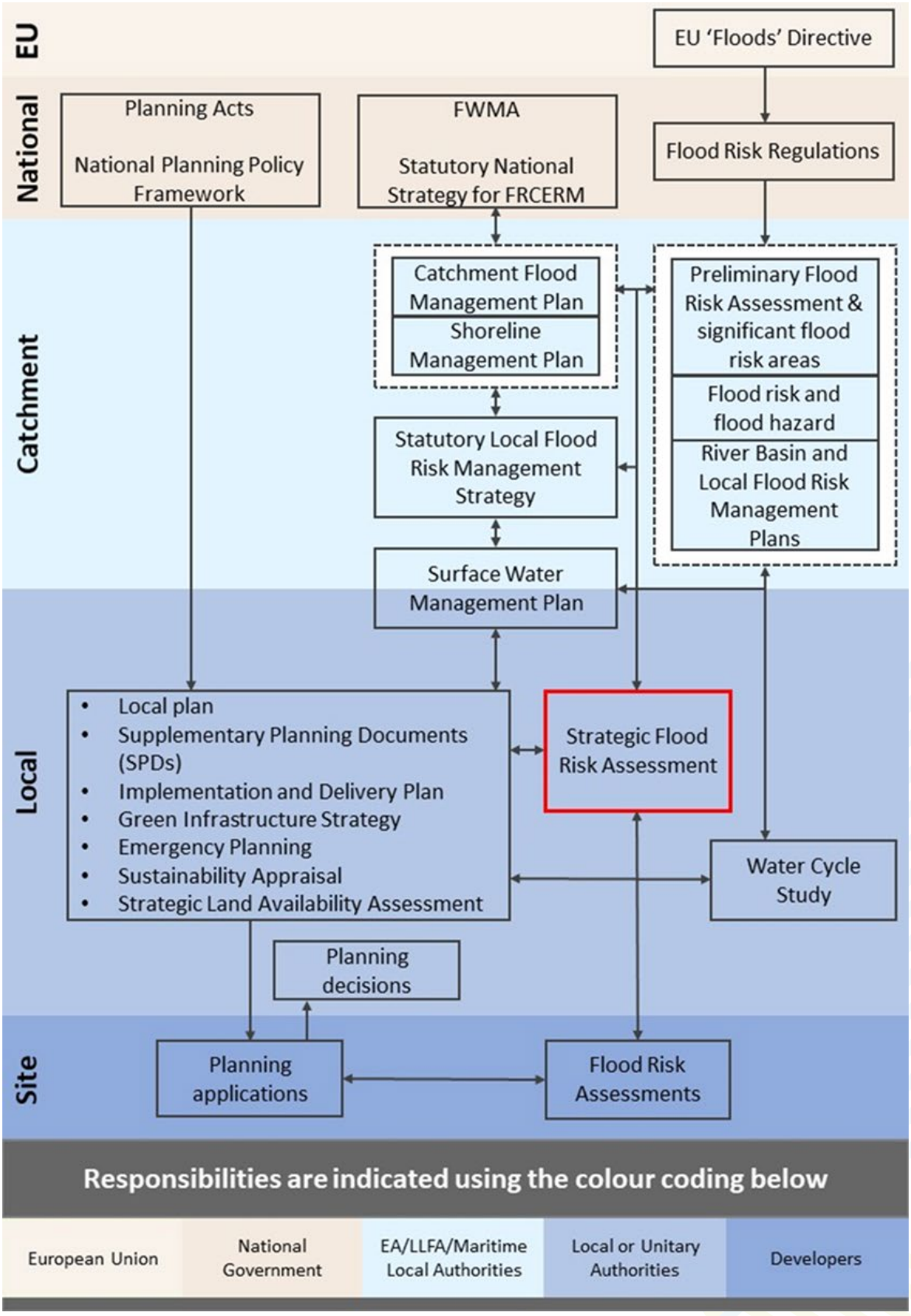
15 Environmental Impact Assessment Directive. European Commission. (2014) https://ec.europa.eu/environment/eia/eia-legalcontext.htm

16Strategic Environmental Assessment Directive. European Commission. (2001) https://ec.europa.eu/environment/eia/sea-legalcontext.htm

Table 2-1: summary of legislation

Document, lead author, and date		Relevant direct legislation	Information	Policy and measures	Development design requirements	Next update due
National	**National Flood and Coastal Erosion Risk Management Strategy** (Environment Agency) 2020	Flood and Water Management Act (2010)	No	Yes	No	2026
	Natural Flood Management Plans (Environment Agency)	N/A	Yes	No	No	-
	National Planning Policy Framework (MHCLG) 2019	Planning and Compulsory Purchase Act 2004 as amended & The Town and Country Planning (Local Planning) (England) Regulations 2012 as amended	No	Yes	Yes	-
	National Planning Practice Guidance (MHCLG) 2019		Yes	No	Yes	-
Regional	**Thames River Basin District Management Plan** (Environment Agency) 2009	WFD (Section 2.2.2)	No	Yes	No	2022
	Thames River Basin District Flood Risk Management Plan (Environment Agency) 2015	Flood Risk Regulations (section 2.2)	No	Yes	No	2022
	River Medway Catchment Flood Management Plan and **North Kent Rivers Catchment Flood Management Plan** (Environment Agency) 2012, 2009	N/A	Yes	Yes	No	-
	Climate change guidance for development and flood risk (Environment Agency) 2020	N/A	No	No	Yes	
Local	**Kent Local Flood Risk Management Strategy 2017 – 2023** (Kent County Council) 2017	FWMA	Yes	No	Yes	
	Drainage and Planning Policy (Kent County Council)	N/A	Yes	No	Yes	

Figure 2-1: Strategic planning links and key documents for flood risk



2.4 National Flood and Coastal Erosion Risk Management Strategy (2020)

The **National Flood and Coastal Erosion Risk Management Strategy**[17] (FCERM) for England provides the overarching framework for future action by all risk management authorities to tackle flooding and coastal erosion in England. The new Strategy has been in preparation since 2018. The Environment Agency brought together a wide range of stakeholders to develop the strategy collaboratively. The Strategy is much more ambitious than the previous one from 2011 and looks ahead to 2100 and the action needed to address the challenge of climate change.

The Strategy has been split into 3 high level ambitions: climate resilient places; today's growth and infrastructure resilient in tomorrow's climate; and a nation ready to respond and adapt to flooding and coastal change. The strategy outlines strategic objectives relating to these ambitions, with specific measures to achieve these.

The Strategy was laid before parliament in July 2020 for formal adoption and published alongside a **New National Policy Statement for Flood and Coastal Erosion Risk Management**[18]. The statement sets out five key commitments which will accelerate progress to better protect and better prepare the country for the coming years:

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

2.5 Surface Water Management Plans

Surface Water Management Plans (SWMPs) outline the preferred surface water management strategy in a given location. SWMPs are undertaken, when required, by LLFAs in consultation with key local partners who are responsible for surface water management and drainage in their area. They are produced to understand the flood risks that arise from local flooding, which is defined by the Flood and Water Management Act 2010 as flooding from surface runoff, groundwater, and Ordinary Watercourses. SWMPs establish a long-term action plan to manage surface water in a particular area and are intended to influence future capital investment, drainage maintenance, public engagement and understanding, land-use planning, emergency planning and future developments. The action plan from SWMPs should be reviewed and updated as a minimum every six years.

Kent County Council published the **Sevenoaks Stage 1 SWMP**[19] in 2014.

2.6 Catchment Flood Management Plans

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

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17 National Flood and Coastal Erosion Risk Management Strategy. Environment Agency. (2020). https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/920944/023_15482_Environment_agency_digitalAW_Strategy.pdf

18 New National Policy Statement for Flood and Coastal Erosion Risk Management https://www.gov.uk/government/publications/flood-and-coastal-erosion-risk-management-policy-statement

19 Sevenoaks Stage 1 SWMP (2014): https://www.kent.gov.uk/about-the-council/strategies-and-policies/environment-waste-and-planning-policies/flooding-and-drainage-policies/surface-water-management-plans/sevenoaks-surface-water-management-plan

There are six pre-defined national policies provided in the CFMP guidance and these are applied to specific locations through the identification of 'Policy Units'. These policies are intended to cover the full range of long-term flood risk management options that can be applied to different locations in the catchment.

The six national policies are:

- No active intervention (including flood warning and maintenance). Continue to monitor and advise
- Reducing existing flood risk management actions (accepting that flood risk will increase over time)
- Continue with existing or alternative actions to manage flood risk at the current level (accepting that flood risk will increase over time from this baseline)
- Take further action to sustain the current level of flood risk (responding to the potential increases in risk from urban development, land use change and climate change)
- Take action to reduce flood risk (now and/or in the future)
- Take action with others to store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits, locally or elsewhere in the catchment.

Sevenoaks falls within both the **North Kent Rivers CFMP**[20] and the **Medway CFMP**[21].

2.7 River Basin Management Plans

River Basin Management Plans (RBMPs) are prepared under the Water Framework Directive (WFD) and assess the pressure facing the water environment in River Basin Districts. The Sevenoaks area falls within the **Thames River Basin Management Plan**[22].

The plan provides a summary of programmes of measures that help prevent deterioration to protect and improve the beneficial use of the water environment in the river basin district. An assessment of whether deterioration has occurred from the 2015 classification baseline was performed in 2021. Updated plans are in the process of preparation.

Measures are presented for each significant water management issue in the river basin district which are:

- Physical modifications
- Managing pollution from wastewater
- Managing pollution from towns, cities and transport
- Changes to natural flow and levels of water
- Managing invasive non-native species
- Managing pollution from rural areas

2.8 Kent County Council Local Flood Risk Management Strategy

Local Flood Risk Management Strategies set out how Lead Local Flood Authorities such as Kent County Council will manage local flood risk i.e. from surface water runoff,

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20 North Kent Rivers CFMP:
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/293893/North_Kent_rivers_Catchment_Flood_Management_Plan.pdf

21 Medway CFMP:
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/293890/Medway_Catchment_Flood_Management_Plan.pdf

22 Thames RBMP: https://www.gov.uk/government/publications/thames-river-basin-management-plan

groundwater and ordinary watercourses, for which they have a responsibility as LLFA and the work that other Risk Management Authorities are doing to manage flood risk in Kent.

The Local Flood Risk Management Strategy 2017– 2023[23] sets out the LLFA's plan for managing local flood risk.

2.9 Risk Areas for Local Planning Authorities in England

The Association of British Insurers (ABI) and the National Flood Forum have published guidance for Local Authorities with regards to planning in flood risk areas[24]. The guidance aims to assist Local Authorities in England in producing local plans and dealing with planning applications in flood risk areas. The guidance complements the National Planning Policy Framework. The key recommendations from the guidance are:

- Ensure strong relationships with technical experts on flood risk.
- Consider flooding from all sources, taking account of climate change.
- Take potential impacts on drainage infrastructure seriously.
- Ensure that flood risk is mitigated to acceptable levels for proposed developments.
- Make sure Local Plans take account of all relevant costs and are regularly reviewed.

23Kent County Council Local Flood Risk Management Plan 2017-2023. https://www.kent.gov.uk/__data/assets/pdf_file/0010/79453/Local-Flood-Risk-Management-Strategy-2017-2023.pdf

24 Guidance on Insurance and Planning in Flood Risk Areas for Local Planning Authorities in England (Association of British Insurers and National Flood Forum, April 2012)

3 Roles and Responsibilities for Flood Risk Management

3.1 Environment Agency

The Environment Agency is responsible for protecting and enhancing the environment and contributing to the government's aim of achieving sustainable development in England and Wales. In terms of flood risk, the Environment Agency has a strategic overview of all sources of flooding and coastal erosion. Examples of this strategic overview role include:

- Setting the direction for managing the risks through strategic plans;
- Providing evidence and advice to inform Government policy and support others;
- Working collaboratively to support the development of risk management skills and capacity; and
- Providing a framework to support local delivery.

The Agency also has operational responsibility for managing the risk of flooding from main rivers, reservoirs, estuaries and the sea.

The Environment Agency has powers to carry out flood and coastal risk management work and to regulate the actions of other flood risk management authorities on the coast. These powers are permissive, which means they are not a duty.

The Environment Agency also has powers to regulate and consent works. The environmental permitting rules must be followed works are performed:

- on or near a main river
- on or near a flood defence structure
- in a flood plain
- on or near a sea defence

Further details on Environment Agency permits can be found on the **Environment Agency's Flood risk activities: environmental permits**[25] website.

3.2 Sevenoaks District Council

Sevenoaks Council the Local Planning Authority (LPA) for the SFRA study area. This role is discussed separately below.

3.2.1 Lead Local Flood Authority

The Lead Local Flood Authority (LLFA) for the area is Kent County Council.

As the Lead Local Flood Authority (LLFA), Kent County Council's duties and powers include:

- Developing a Local Flood Risk Management Strategy (LFRMS): LLFAs must develop, maintain, apply and monitor a LFRMS to outline how they will manage flood risk, identify areas vulnerable to flooding and target resources where they are needed most.
- Investigating flooding: When appropriate and necessary LLFAs must investigate and report on flooding incidents (Section 19 investigations).
- Register of Flood Risk Features: LLFAs must establish and maintain a register of structures or features which, in their opinion, are likely to have a significant effect on flood risk in the LLFA area.

25 Flood risk activities environmental permits. Environment Agency. https://www.gov.uk/guidance/flood-risk-activities-environmental-permits

- Designation of Features: LLFAs may exercise powers, as all RMAs can, to designate structures and features that affect flood risk, requiring the owner to seek consent from the authority to alter, remove or replace it.
- Consenting: When appropriate, LLFAs will perform consenting of works on ordinary watercourses. Further details can be found on the Kent County Council land drainage website[26].
- Regulation: The LLFA has enforcement powers under the Land Drainage Act 1991 and FWMA 2010.

3.2.2 Local Planning Authority

As a Local Planning Authority, Sevenoaks District Council assess, consult on and determine whether development proposals are acceptable, ensuring that flooding and other similar risks are effectively managed.

The Council will consult relevant statutory consultees as part of planning application assessments and may, in some cases, also contact non-statutory consultees, such as Southern Water, that have an interest in the planning application.

3.3 Water and wastewater providers

Southern Water and Thames Water are the sewerage undertakers for the SFRA study area (Figure 3-1). They have the responsibility to maintain surface, foul and combined public sewers to ensure the area is effectually drained. When flows (foul or surface water) are proposed to enter public sewers, Southern Water will assess whether the public system has the capacity to accept these flows as part of their pre-application service. If there is not available capacity, they will provide a solution that identifies the necessary mitigation. Southern Water and Thames Water can also comment on the available capacity of foul and surface water sewers as part of the planning application process although this is not a statutory role.

For further details about developer services and relevant application forms please see **Southern Water's Developer Services website**[27].

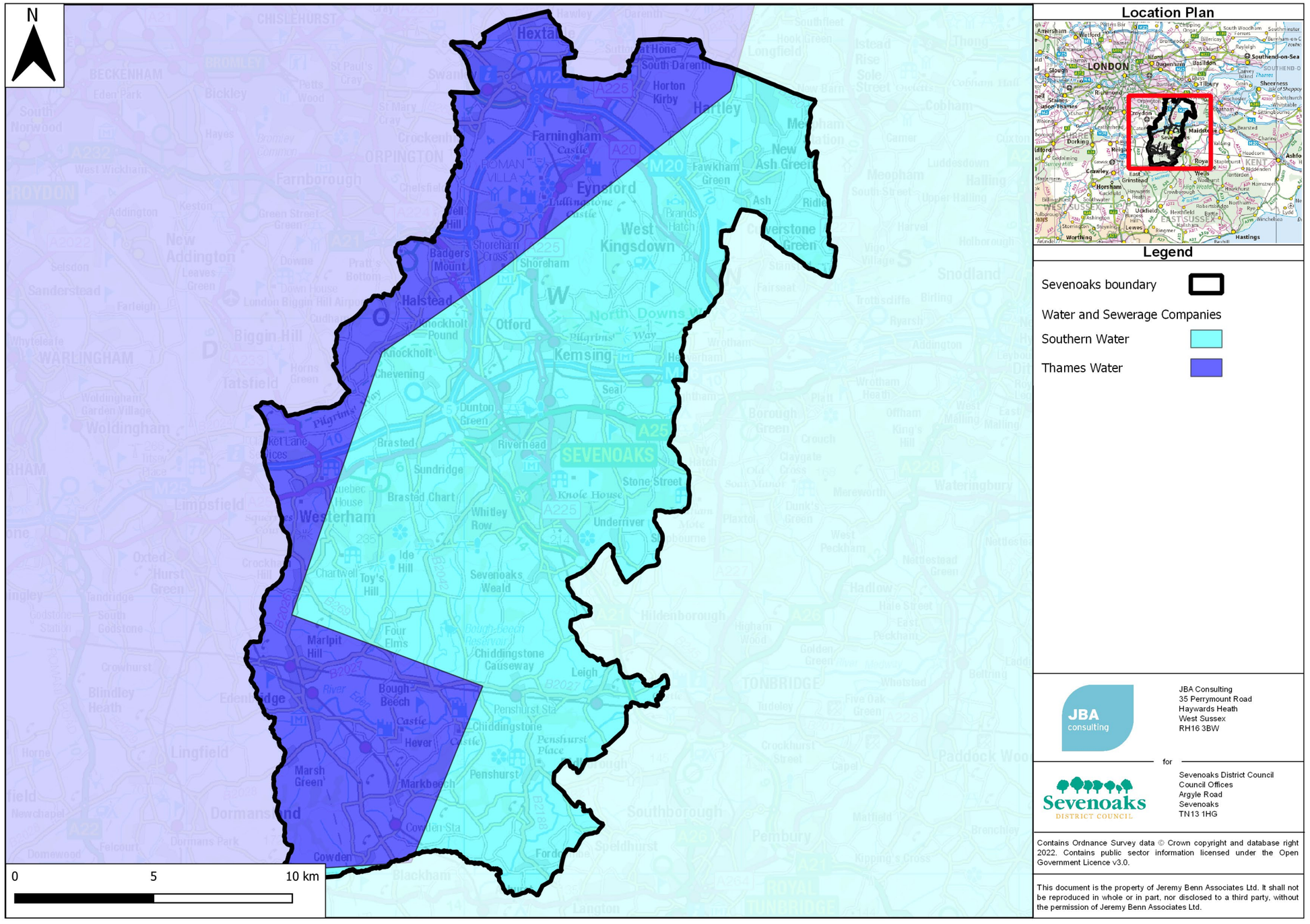
3.4 Upper Medway Internal Drainage Board (IDB)

Under the Land Drainage Act 1991 the Upper Medway IDB exercises general powers of supervision over all matters relating to water level management within their district. Key watercourses are adopted by the Board for maintenance purposes. The Board also has responsibility for the operation and maintenance of assets used to manage water levels.

26 Kent County Council Land Drainage (2021). https://www.kent.gov.uk/environment-waste-and-planning/flooding-and-drainage/sustainable-drainage-systems/owning-and-maintaining-a-watercourse

27 Developer Services. Wessex Water. https://www.southernwater.co.uk/developing

Figure 3-1: Water and Sewerage Company boundaries in Sevenoaks District



4 How Flood Risk is Assessed

4.1 Definitions

4.1.1 Flood

Section 1 (subsection 1) of the Flood and Water Management Act (FWMA) (2010)[28] defines a flood as:

'any case where land not normally covered by water becomes covered by water'

Section 1 (subsection 2) states that 'it does not matter for the purposes of subsection (1)' whether a flood is caused by

a) heavy rainfall;
b) a river overflowing or its banks being breached;
c) a dam overflowing or being breached;
d) tidal waters;
e) groundwater; or
f) anything else (including any combination of factors).

Note: Sources of flooding under this definition do not include excess surface water from any part of a sewerage system, unless caused by an increase in the volume of rainwater entering or affecting the system, or a flood caused by a burst water main.

4.1.2 Flood risk

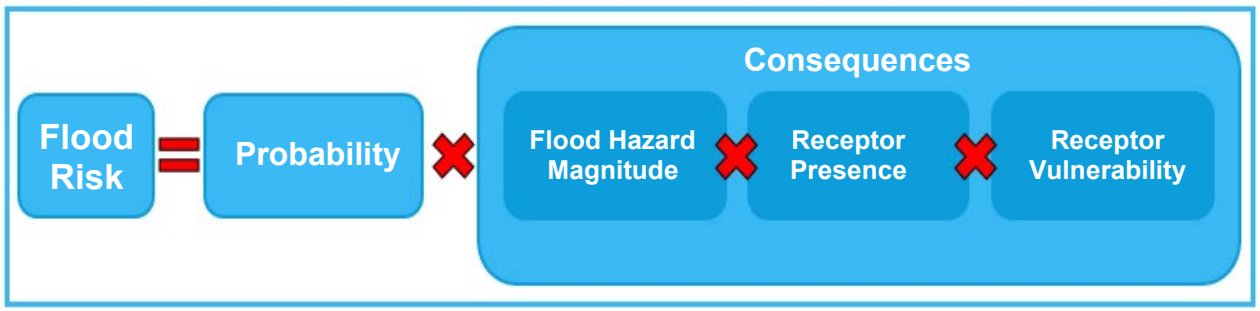
Section 3 (subsection 1) of the FWMA defines the risk of a potentially harmful event (such as flooding) as:

'a risk in respect of an occurrence is assessed and expressed (as for insurance and scientific purposes) as a combination of the probability of the occurrence with its potential consequences.'

Thus, it is possible to summarise flood risk as:

Flood Risk = (Probability of a flood) x (Scale of the consequences)

On that basis it is useful to express the definition as follows:



Using this definition it can be seen that:

Increasing the probability or chance of a flood being experienced increases the flood risk: In situations where the probability of a flood being experienced increases gradually over time, for example due to the effects of climate change, then the severity of

28 Flood and Water Management Act (2010): http://www.legislation.gov.uk/ukpga/2010/29/pdfs/ukpga_20100029_en.pdf

the flood risk will increase (flooding becomes more frequent or has increased effect). For the purposes of applying the National Planning Policy Framework, "flood risk" is a combination of the probability and the potential consequences of flooding from all sources – including from rivers and the sea, directly from rainfall on the ground surface and rising groundwater, overwhelmed sewers and drainage systems, and from reservoirs, canals and lakes and other artificial sources.

The potential scale of the consequences in a given location can increase the flood risk:

- Flood Hazard Magnitude: If the direct hazard posed by the depth of flooding, velocity of flow, the speed of onset, rate of risk in flood water or duration of inundation is increased, then the consequences of flooding, and therefore risk, is increased.
- Receptor Presence: The consequences of a flood will be increased if there are more receptors affected, for example with an increase in extent or frequency of flooding. Additionally, if there is new development that increases the probability of flooding (for example, increase in volume of runoff due to increased impermeable surfaces) or increased density of infrastructure then consequences will also be increased.
- Receptor Vulnerability: If the vulnerability of the people, property or infrastructure is increased then the consequences are increased. For example, old or young people are potentially more vulnerable in the event of a flood.

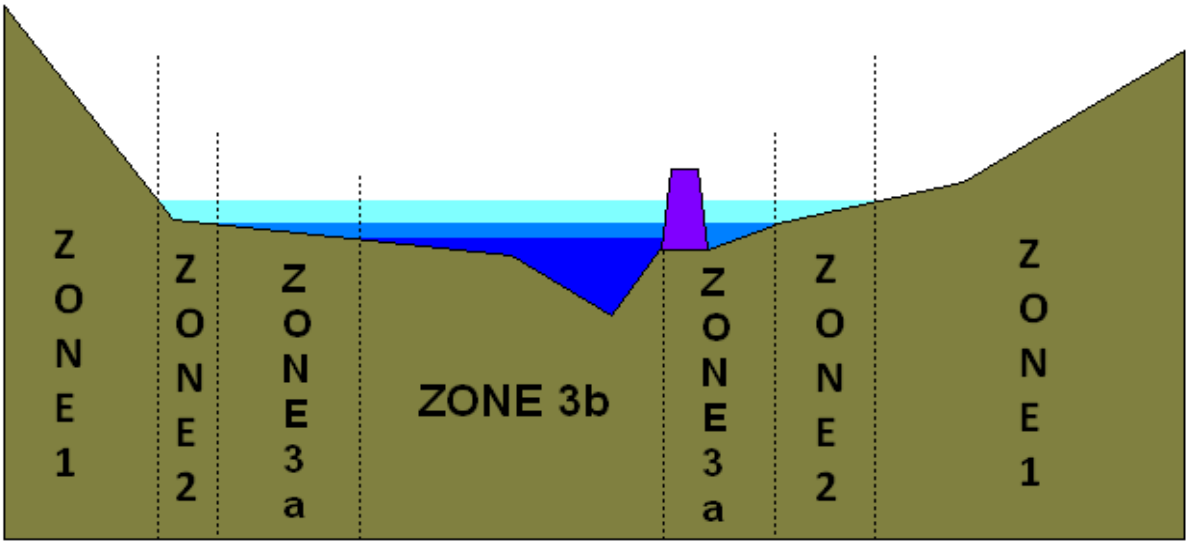
4.1.3 Flood zones – river and sea flooding

The SFRA includes maps that show the Flood Zones. These zones describe the land that would flood if there were no defences present. A concept diagram showing the classification of Flood Zones graphically is included Figure 3-1. The Government's Planning Practice Guidance identifies the following **Flood Zones**[29]. These apply to both Main River and Ordinary Watercourses.

The preference when allocating land is, whenever possible, to place all new development on land in Zone 1. Since the Flood Zones identify locations that are not reliant on flood defences, placing development on Zone 1 land means there is no future commitment to spending money on flood banks or flood alleviation measures. It also does not commit future generations to costly long-term expenditure that would become increasingly unsustainable as the effects of climate change increase.

29 Planning Practice Guidance Flood Zones (accessed March 2022): https://www.gov.uk/guidance/flood-risk-and-coastal-change

Figure 4-1: Concept of flood zones



The Flood Zones are:

- Flood Zone 1: Low probability: less than a 0.1% chance of river and sea flooding in any given year
- Flood Zone 2: Medium probability: between a 1% and 0.1% chance of river flooding in any given year or 0.5% and 0.1% chance of sea flooding in any given year
- Flood Zone 3a: High probability: greater or equal to a 1% chance of river flooding in any given year or greater than a 0.5% chance of sea flooding in any given year. Excludes Flood Zone 3b.
- Flood Zone 3b: Functional Floodplain: land where water has to flow or be stored in times of flood. SFRAs identify this Flood Zone in discussion with the LPA and the Environment Agency. The identification of functional floodplain takes account of local circumstances. Only water compatible and essential infrastructure are permitted in this zone and should be designed to remain operational in times of flood, resulting in no loss of floodplain or blocking of water flow routes. Flood Zone 3b is primarily based on the defended 5% AEP flood extent.

Excluding Flood Zone 3b, the Flood Zones do not take into account defences. This is important for planning long term developments as long-term policy and funding for maintaining flood defences over the lifetime of a development may change over time.

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

4.1.4 Flood Zone – surface water (other sources of flooding)

This SFRA has considered the July 2021 changes to the sequential test requiring a sequential approach for of all sources of flood risk. In the absence of an update to PPG or formal guidance, an approach to the sequential test for SDC has been developed in consultation and agreement with the LPA and Kent County Council (as LLFA). This proposed approach is outlined in Figure 5-2.

Surface water flood risk has been addressed through the inclusion of two surface water flood zones, these are defined as follows:

- Surface Water Flood Zone A – land at <0.1% annual probability of flooding from surface water;

- Surface Water Flood Zone B – land at 0.1% or greater annual probability of flooding from surface water.

The Risk of Flooding from Surface Water mapping (Appendix A3) has been used as a basis for this and it is considered that the 0.1% AEP event is a sufficiently conservative approach, this may be superseded by detailed modelling where it is available. This approach has been agreed with Kent County Council as LLFA.

Mapping available for groundwater, reservoir and sewer flood risks is not sufficiently detailed to allow for the adoption of a sequential approach for these sources of flood risk. However, sites will be screened sequentially against a variety of data sources in the Level 2 SFRA to understand 'actual' groundwater flood risk.

4.1.5 Actual flood risk

If it has not been possible for all future development to be situated in Zone 1 then a more detailed assessment is needed to understand the implications of locating proposed development in Zones 2 or 3. This is accomplished by considering information on the "actual risk" of flooding. The assessment of actual risk takes account of the presence of flood defences and provides a picture of the safety of existing and proposed development. It should be understood that the standard of protection afforded by flood defences is not constant and it is presumed that the required minimum standards for new development are:

- residential development should be protected against flooding with an annual probability of river flooding of 1% (1 in 100-year chance of flooding) in any year; and
- residential development should be protected against flooding with an annual probability of tidal (sea) flooding of 0.5% (1 in 200-year chance of flooding) in any year.

The assessment of the actual risk should take the following issues into account:

- The level of protection afforded by existing defences might be less than the appropriate standards and hence may need to be improved if further growth is contemplated.
- The flood risk management policy for the defences will provide information on the level of future commitment to maintain existing standards of protection. If there is a conflict between the proposed level of commitment and the future needs to support growth, then it will be a priority for the Flood Risk Management Strategy to be reviewed.
- The standard of safety must be maintained for the intended lifetime of the development (assumed to be 100 years for residential development). Over time the effects of climate change will erode the present day standard of protection afforded by defences and so commitment is needed to invest in the maintenance and upgrade of defences if the present day levels of protection are to be maintained and where necessary land secured that is required for affordable future flood risk management measures.
- The assessment of actual risk can include consideration of the magnitude of the hazard posed by flooding. By understanding the depth, velocity, speed of onset, rate of rise and duration of floodwater events it is possible to assess the level of hazard posed by flooding from the respective sources. This assessment will be needed in circumstances where consideration is given to the mitigation of the consequences of flooding or where it is proposed to place lower vulnerability development in areas that are at risk from inundation.

For information on defences reference should be made to the Environment Agency's Asset Information Management System (AIMS) which contains details on the standard of protection of defences.

4.1.6 Residual risk

The residual risk refers to the risks that remain in circumstances after measures have been taken to alleviate flooding (such as flood defences). It is important that these risks are quantified to confirm that the consequences can be safely managed. The residual risk can be:

- The effects of a flood with a magnitude greater than that for which the defences or management measures have been designed to alleviate (the 'design flood'). This can result in overtopping of flood banks, failure of flood gates to cope with the level of flow or failure of pumping systems to cope with the incoming discharges.
- Failure of the defences or flood risk management measures to perform their intended duty. This could be breach failure of flood embankments, failure of flood gates to operate in the intended manner, failure of pumping stations or blockage of culverts.

The assessment of residual risk demands that attention be given to the vulnerability of the receptors and the response to managing the resultant flood emergency. In this instance, attention should be paid to the characteristics of flood emergencies and the roles and responsibilities during such events. Additionally, in the cases of breach or overtopping events, consideration should be given to the structural safety of the dwellings or structures that could be adversely affected by significant high flows or flood depths.

4.2 Possible responses to flooding

4.2.1 Assess

The first response to flooding must be to understand the nature and frequency of the risk. The assessment of risk is not just performed as a "one off" during the process, but rather the assessment of risk should be performed during all subsequent stages of responding to flooding.

4.2.2 Avoid

The sequential approach requires that the first requirement is to avoid the hazard. If it is possible to place all new growth in areas at a low probability of flooding, then the flood risk management considerations will include provisions sot that proposed development does not increase the probability of flooding to others. This can be achieved by implementing Sustainable Drainage Systems (SuDS) and other measures to control and manage run-off.

In some circumstances it might be possible to include measures within proposed growth areas that reduce the probability of flooding to others and assist existing communities to adapt to the effects of climate change. In such circumstances the growth proposals should include features that can deliver the necessary levels of mitigation so that the standards of protection and probability of flooding are not reduced by the effects of climate change. In Sevenoaks District, consideration should be given not only to the peak flows generated by new development but also to the volumes generated during longer duration storm events.

4.2.3 Substitute control and mitigate

These responses all involve management of the flood risk and thus require an understanding of the consequences (the magnitude of the flood hazard and the vulnerability of the receptor).

There are opportunities to reduce the flood risk by lowering the vulnerability of the proposed development. For instance, changing existing residential land to commercial uses

will reduce the risk provided that the residential land can then be located on land in a lower risk flood zone.

Flood risk management responses in circumstances where there is a need to consider growth or regeneration in areas that are affected by a medium or high probability will include:

- Strategic measures to maintain or improve the standard of flood protection so that the growth can be implemented safely for the lifetime of the development (this must include firm commitments to invest in infrastructure that can adapt to the increased chance and severity of flooding presented by climate change).
- Design and implement measures so that the proposed development includes features that enables the infrastructure to adapt to the increased probability and severity of flooding so that new communities are safe and the risk to others is not increased (preferably reduced).
- Flood resilient measures that reduce the consequences of flooding to infrastructure so that the magnitude of the consequences is reduced. Such measures would need to be considered alongside improved flood warning, evacuation and welfare procedures so that occupants affected by flooding could be safe for the duration of a flood event and rapidly return to properties after an event had been experienced.

4.3 Cumulative impacts

When allocating land for development, consideration must be given to the potential cumulative impact of development on flood risk. The loss of the natural storage and infiltration capacity of undeveloped land, potential loss of surface water storage capacity, the increase in impermeable surfaces and resulting rise in runoff increases the chances of surface water flooding if suitable mitigation measures, such as SuDS, are not put in place. Additionally, the increase in runoff may result in more flow entering watercourses, increasing the risk of fluvial flooding at locations further downstream that are potentially sensitive to increases in the volume or flow of flood water.

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

Whilst the increase in runoff, or loss in floodplain storage, from individual developments may only have a minimal impact on flood risk, the cumulative effect of multiple developments may be more severe without appropriate mitigation measures.

For windfall sites which have not yet been allocated, the NPPF requires that the cumulative impact of development should be considered at the application stage and the appropriate mitigation measures undertaken to ensure flood risk is not exacerbated, and in many cases the development should be used to improve the flood risk.

5 The Sequential Risk-based Approach

5.1 The National Planning Policy Framework

The **revised National Planning Policy Framework**[30] (NPPF) was originally published in 2012 (and most recently amended in July 2021), replacing the previous versions published in June 2019, July 2018 and March 2012. The NPPF sets out Government's planning policies for England. It must be taken into account in the preparation of local plans and is a material consideration in planning decisions. The NPPF defines Flood Zones, how these should be used to allocate land and flood risk assessment requirements. The NPPF states that:

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

National Planning Practice Guidance[31] (NPPG) on flood risk was published in March 2014 (and has since been revised / updated) and sets out how the policy should be implemented. **Diagram 1 in the NPPG**[32] sets out how flood risk should be considered in the preparation of Local Plans.

5.2 The sequential risk-based approach

Firstly, land at the lowest risk of flooding from all sources should be considered for development. A test is applied called the 'Sequential Test' to do this. Figure 5-1 summarises the Sequential Test. The LPA will apply the Sequential Test to strategic allocations. For all other developments in Flood Zones 2 and 3 (or in Flood Zone 1 on land with other flooding/drainage issues), developers must supply evidence to the LPA, with a Planning Application, that the development has passed the test.

The LPA should work with the Environment Agency to define a suitable area of search for the consideration of alternative sites in the Sequential Test. A local planning authority should demonstrate through evidence that it has considered a range of options in the site allocation process, using the Strategic Flood Risk Assessment to apply the Sequential Test and the Exception Test where necessary. This can be undertaken directly or, ideally, as part of the sustainability appraisal. Where other sustainability criteria outweigh flood risk issues, the decision-making process should be transparent with reasoned justifications for any decision to allocate land in areas at high flood risk in the sustainability appraisal report. The Sequential Test can also be demonstrated in a free-standing document, or as part of the Housing and Economic Land Availability Assessment (HELAA).

Whether any further work is needed to decide if the land is suitable for development will depend on both the vulnerability of the development and the Flood Zone it is proposed for. **Table 2 of the NPPG**[33] defines the vulnerability of different development types to flooding. **Table 3 of the NPPG**[34] shows whether, having applied the Sequential Test first, the vulnerability of development is suitable for that Flood Zone and where further work is needed.

30 National Planning Policy Framework. UK Government. (2021) https://www.gov.uk/government/collections/revised-national-planning-policy-framework

31 National Planning Practice Guidance. UK Government. (2021) (https://www.gov.uk/government/collections/planning-practice-guidance

32Flood Risk and coastal change. UK Government. (2014). https://www.gov.uk/guidance/flood-risk-and-coastal-change#flood-risk-in-local-plans

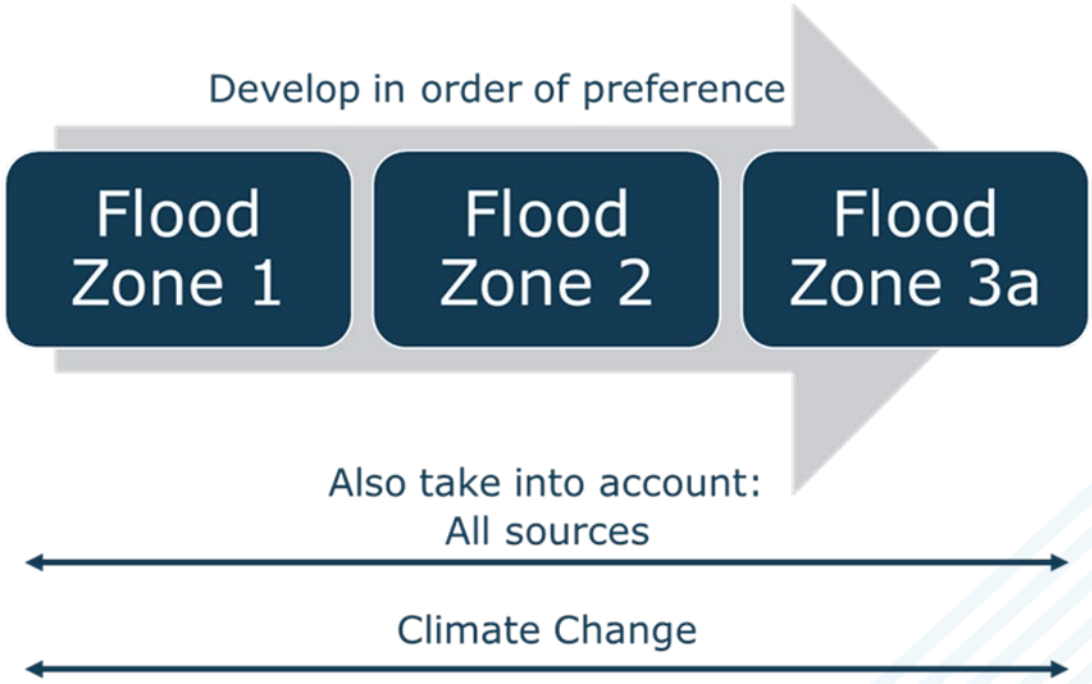
33 Flood Risk and coastal change. UK Government. (2014). https://www.gov.uk/guidance/flood-risk-and-coastal-change#Table-2-Flood-Risk-Vulnerability-Classification

34 Flood Risk and coastal change. UK Government. (2014). https://www.gov.uk/guidance/flood-risk-and-coastal-change#Table-3-Flood-risk-vulnerability

Figure 5-2 illustrates the Sequential and Exception Tests as a process flow diagram using the information contained in this SFRA to assess potential development sites against flood zones and development vulnerability compatibilities.

This is a stepwise process, but a challenging one, as a number of the criteria used are qualitative and based on experienced judgement. The process must be documented, and evidence used to support decisions recorded. In addition, the risk of flooding from other sources and the impact of climate change must be considered when assessing which sites are suitable to allocate. The SFRA guide to using technical data in Appendix D shows where the Sequential and Exception Tests may be of concern with the datasets, recommending what development might be appropriate in what situations.

Figure 5-1 - the Sequential Test



5.3 Application of the sequential test and exception tests for a Local Plan

5.3.1 The sequential test in Sevenoaks

When preparing a Local Plan, the Local Planning Authority should demonstrate it has considered a range of site allocations, using Strategic Flood Risk Assessments to apply the Sequential and Exception Tests where necessary.

The Sequential Test should be applied to the whole Local Planning Authority area to increase the likelihood of allocating development in areas not at risk of flooding. The Sequential Test can be undertaken as part of a Local Plan Sustainability Appraisal. Alternatively, it can be demonstrated through a free-standing document, or as part of strategic housing land or employment land availability assessments. NPPF Planning Practice Guidance for Flood Risk and Coastal Change describes how the Sequential Test should be applied in the preparation of a Local Plan.

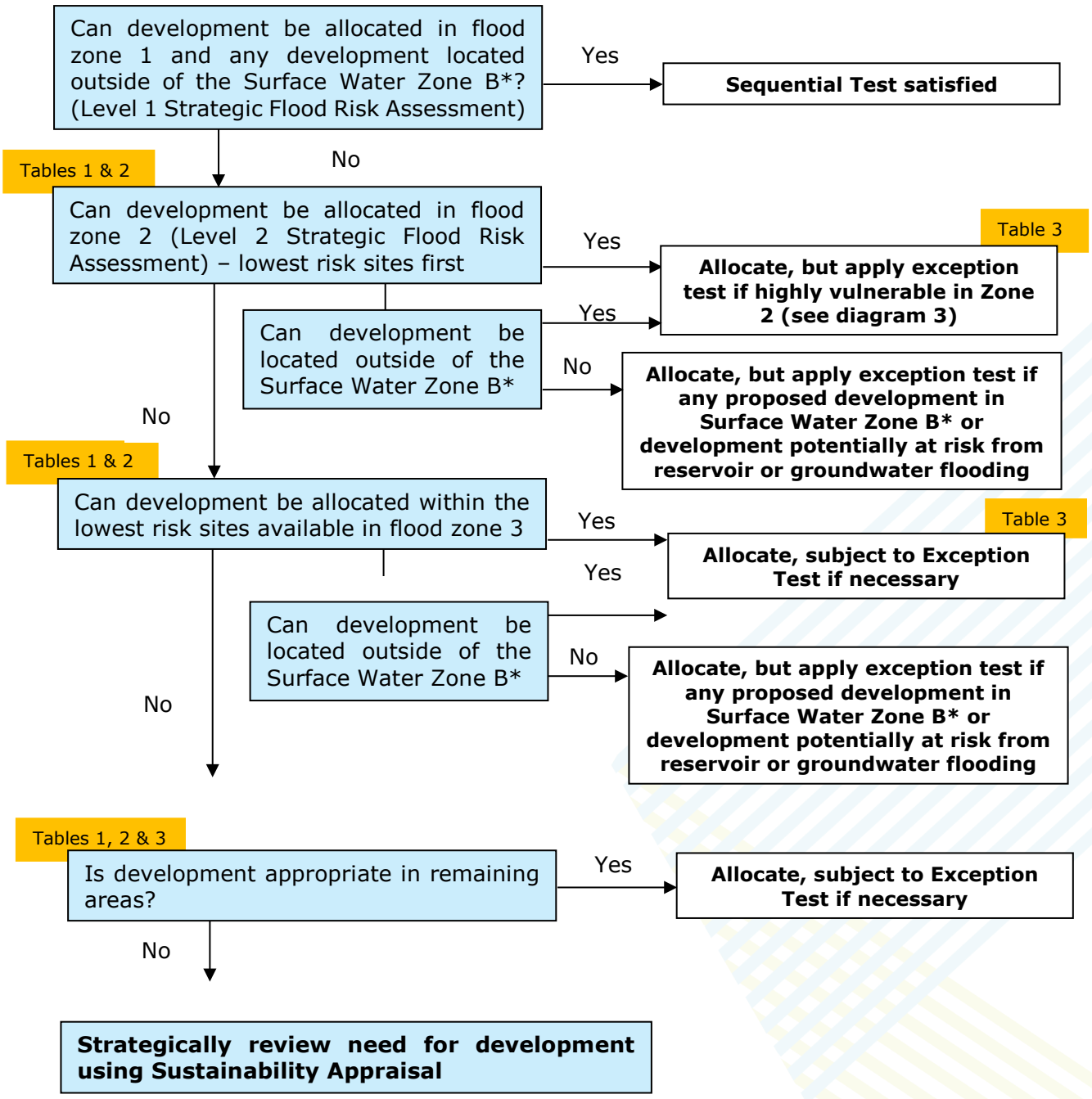
This SFRA has considered the July 2021 changes to the sequential test requiring a sequential approach for of all sources of flood risk. In the absence of an update to PPG or formal guidance, an approach to the sequential test for SDC has been developed in consultation and agreement with the LPA and Kent County Council (as LLFA). This proposed approach is outlined in Figure 5-2.

Surface water flood risk has been addressed through the inclusion of two surface water flood zones, these are defined as follows:

- Surface Water Flood Zone A – land at <0.1% annual probability of flooding from surface water;
- Surface Water Flood Zone B – land at 0.1% or greater annual probability of flooding from surface water.

The Risk of Flooding from Surface Water mapping (Appendix A3) has been used as a basis for this and it is considered that the 0.1% AEP event is a sufficiently conservative approach, this may be superseded by detailed modelling where it is available. This approach has been agreed with Kent County Council as LLFA.

Figure 5-2: Local Plan sequential approach for site allocation



Existing groundwater flood mapping is not considered sufficient to inform a sequential approach, as it shows risk of emergence and does not quantify volumes or flows. Any site potentially at risk of groundwater flooding should be screened as part of the L2 SFRA based on a hydrogeological understanding of 'actual' groundwater flood risk. This approach also applies to sites potentially at risk of reservoir flooding.

It is considered that the data quality of sewer flood risk is insufficient to adopt a sequential approach to development although these risks will be considered, where appropriate to inform the exception test.

5.3.2 The exception test

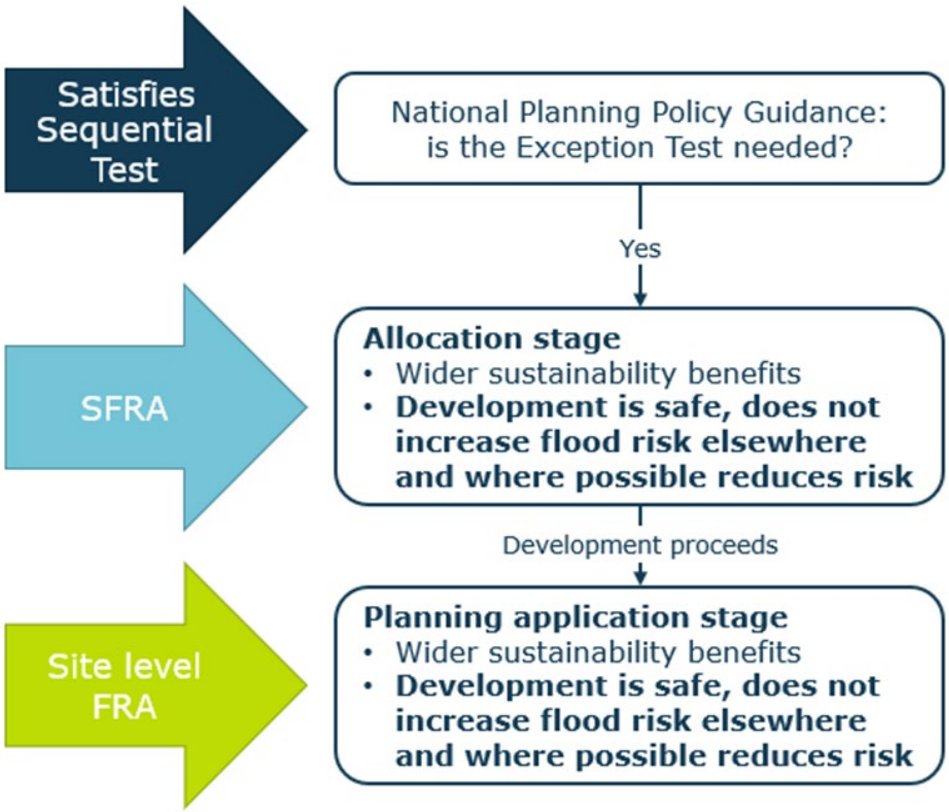
It will not always be possible for all new development to be allocated on land that is not at risk from flooding. To further inform whether land should be allocated, or Planning Permission granted, a greater understanding of the scale and nature of the flood risks is required. In these instances, the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

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

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

Figure 4-3 summarises the Exception Test. An LPA should apply the Exception Test to strategic allocations. For all developments, developers must supply evidence to the LPA, with a Planning Application, that the development has passed the test. This is because when a site-specific Flood Risk Assessment is done, more information on the exact measures that can manage the risk is available.

Figure 5-3: the Exception Test



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

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

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

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

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

5.4 Application of the sequential and exception tests to individual planning applications

Sevenoaks District Council are responsible for considering the extent to which Sequential Test considerations have been satisfied. The Environment Agency may be invited by Sevenoaks District Council to provide comment in respect of the accuracy of the data the test is based on.

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

- a strategic allocation and the test has already been carried out by the LPA
- a change of use (except to a more vulnerable use)
- a minor development (householder development, small non-residential extensions with a footprint of less than 250m2); or
- a development in flood zone 1 unless there are other flooding issues in the area of the development (i.e. surface water, ground water, sewer flooding).

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

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

The sources of information on reasonably available sites may include:

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

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

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

The SFRA guide to using technical data in Appendix D shows where the Sequential and Exception Test may be required for the datasets assessed in the SFRA, and how to interpret different levels of concern with the datasets, recommending what development might be appropriate in what situations.

It should also be noted that for "small catchments" (typically less than 3 square kilometres) or the upper extremity of larger catchments the nationally available flood mapping might not have been prepared. This potentially gives the incorrect impression that a site is in Zone 1, when in fact it might be affected by flood risk from an adjacent watercourse. In such circumstances an initial assessment should be performed to identify the extent of the flood zones to understand the implications with respect to applying the Sequential Test.

5.5 Cross boundary considerations

Situations may occur where a development site is situated across Local Authority boundaries, or where the development in one district or borough may impact flood risk elsewhere. Sevenoaks District Council should consider the impacts of development on flood risk elsewhere even if the impact of this is not within their area. In situations where cross-boundary developments are proposed, Sevenoaks District Council should work closely with other Local Planning Authorities to satisfy the requirements of policies in their respective Local Plans, in consultation with statutory consultees such as the Environment Agency and Lead Local Flood Authority.

The study area is characterised by extensive locations where the proportion of paved areas is relatively high (urban and commercial areas) that can potentially generate substantive surface runoff volumes and flows.

A potentially influential characteristic of Sevenoaks study area is the possible effect of the Leigh Flood Storage Area on flows in the River Medway, although measurable effects of such storage will naturally dissipate as the distance from the storage area increases.

6 Climate Change

6.1 Climate change, the NPPF and PPG

The updated NPPF (July 2021) sets out how the planning system should help minimise vulnerability and provide resilience to the impacts of climate change. NPPF and NPPG describe how FRAs should demonstrate how flood risk will be managed over the lifetime of the development, taking climate change into account.

The updated 2021 NPPF also states that the '*All plans should apply a sequential, risk-based approach to the location of development – taking into account all sources of flood risk and the current and future impacts of climate change – so as to avoid, where possible, flood risk to people and property*' (para 161).

The Environment Agency published **updated climate change guidance**[35] on 06 October 2021 (further updated in February 2019, December 2019, July 2020 and July 2021), which supports the NPPF and must now be considered in all new developments and planning applications. The document contains guidance on how climate change should be accounted for when considering development, specifically how allowances for climate change should be included with FRAs. The Environment Agency can give a free preliminary opinion to applicants on their proposals at pre-application stage. The Environment Agency charge for more detailed pre-application planning advice.

6.2 Climate change guidance and allowances

Making an allowance for climate change helps reduce the vulnerability of the development and provides resilience to flooding in the future.

Due to the complexity of projecting the effects of climate change, there are uncertainties attributed to climate change allowances. As a result, the guidance presents a range of possibilities to reflect the potential variation in the impact of climate change over three time scales (epochs).

The **UK Climate Predictions 2018**[36] (UKCP18) were published on 26 November 2018. The UKCP18 projections replace the UKCP09 projections (as were used to inform the previous SFRA) and are the official source of information on how the climate of the UK may change over the rest of this century. The Environment Agency has already updated the climate change allowances for sea level rise to take account of the UKCP18 projections and the most recent updates for peak river levels rainfall intensity were issued on the 6th October 2021.

Any further changes which impact on this SFRA (Rainfall allowances) are expected by the middle of 2022. If a Level 2 SFRA is required, any further changes to the climate change allowances will be considered at that stage.

35 Flood Risk Assessments: climate change allowances. Environment Agency (2016, last updated 2020) https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

36 UK Climate Predictions: Headline Findings. Met Office. (2019) https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp-headline-findings-v2.pdf

6.3 Peak river flows

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

The **peak river flow allowances**[37] provided in the guidance show the anticipated changes to peak flow for each management catchment within a river basin district that a watercourse is located within.

For each management catchment, guidance on uplift in peak flows are normally provided for three climate change allowance categories, Central, Higher Central and Upper End which are based on the 50th, 70th and 95th percentiles respectively. The allowance category to be used is based on the vulnerability classification of the development and the Flood Zones within which it is located.

Table 6-1: Guidance on the use of peak river flow allowances based on flood zone and vulnerability classification

Vulnerability classification	Flood Zone 2 or Flood Zone 3a	Flood Zone 3b
Essential Infrastructure	Higher Central	Higher Central
Highly Vulnerable	Central (development should not be permitted in FZ3a)	Development should not be permitted
More Vulnerable	Central	Development should not be permitted
Less Vulnerable	Central	Development should not be permitted
Water Compatible	Central	Central

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

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

- The '2020s' (2015 to 2039)
- The '2050s' (2040 to 2069)
- The '2080s' (2070 to 2115)

The time period used in the assessment depends upon the expected lifetime of the proposed development. Residential development should be considered for a minimum of 100 years, whilst the lifetime of a non-residential development depends upon the characteristics of that development. Further information on what is considered to be the lifetime of development is provided in the **NPPG**.

Land within the Sevenoaks area is located within the Thames River Basin District, with areas of the district falling within both the Darent and Cray and Medway management catchments, as indicated by mapping **published by the Environment Agency**[38]. The allowances for these catchments are provided in **Error! Reference source not found.** and **Error! Reference source not found.**.

37 Flood Risk Assessments - climate change allowances (2021): https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#Select-the-peak-river-flow-allowances-to-use-for-your-assessment

38 Climate change allowances for peak river flow in England: https://environment.maps.arcgis.com/apps/webappviewer/index.html?id=363522b846b842a4a905829a8d8b3d0c

Current guidance is that Strategic Flood Risk Assessments should assess both the central and higher central allowances.

Table 6-2: Peak river flow allowances for the Darent and Cray 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)
Upper end	21%	23%	41%
Higher central	11%	8%	18%
Central	6%	3%	10%

Table 6-3: Peak river flow allowances for the Medway 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)
Upper end	29%	37%	62%
Higher central	19%	21%	37%
Central	14%	15%	27%

Developers will also need to use these allowances to assess off-site impacts and calculate floodplain storage compensation depends on land uses in affected areas. The central allowance should be used in most cases, with the higher central allowance used when the affected area contains essential infrastructure. This guidance also applies with consideration to safe access, escape route and places of refuge.

Developers should also consider likely future land uses shown by local plan allocations or unimplemented extant planning permissions. The Environment Agency will want to see evidence from the developer to prove they have done this.

6.4 Peak rainfall intensity allowance

Climate change is predicted to result in wetter winters and increased summer storm intensity in the future. This increased rainfall intensity will affect land and urban drainage systems, resulting in surface water flooding, due to the increased volume of water entering the systems. **Error! Reference source not found.** shows anticipated changes in extreme rainfall intensity in small catchments (FEH hydrological catchments with an area of less than 5km^2) and urbanised drainage catchments (where underground sewer networks are likely to have a significant impact on hydrological flows in the catchment).

These allowances should be used for small catchments and urbanised drainage sites. For Flood Risk Assessments, the upper end allowances for both the 3.3% and 1% AEP events should be assessed to understand the range of impact.

For catchments, larger than 5km^2, the guidance suggests the peak river flow allowances should be used.

Table 6-4: Peak rainfall intensity allowance for the Darent and Cray management catchment

Epoch	3.3% AEP – Central allowance	3.3% AEP – Upper end allowance	1% AEP – Central allowance	1% AEP – Upper end allowance
2050s	20%	35%	20%	45%
2070s	20%	35%	25%	40%

Table 6-5: Peak rainfall intensity allowance for the Medway management catchment

Epoch	3.3% AEP – Central allowance	3.3% AEP – Upper end allowance	1% AEP – Central allowance	1% AEP – Upper end allowance
2050s	20%	35%	20%	45%
2070s	20%	35%	20%	40%

The updated guidance states that for the upper end allowance during the 1% AEP event there should be no increase in flood risk elsewhere and that development must be safe from surface water flooding. The guidance acknowledges that in some locations the allowance for the 2050s epoch is higher than that for the 2070s epoch, this is evident in Sevenoaks. In these instances, the higher of the two allowances (45%) should be used.

The RoFSW mapping has been updated with these allowances and can be found in Appendix A4.

6.5 Sea level rise allowance

Climate change is predicted to result in higher sea levels caused by melting ice sheets and more extreme storm events which will create higher storm surges and the Environment Agency has published sea level rise allowances for this. However, Sevenoaks District is not a coastal authority, all rivers within the district are of fluvial influence only and predicted to remain so under changes in the climate. Therefore, climate change implications of tidal flood risk to the district have not been considered further as part of this SFRA.

6.6 Groundwater

The effect of climate change on groundwater flooding problems, and those watercourses where groundwater has a large influence on winter flood flows, is much more uncertain. Milder wetter winters may increase the frequency of groundwater flooding incidents in areas that are already susceptible, but warmer drier summers may counteract this effect by drawing down groundwater levels to a greater extent during the summer months. The effect of climate change on groundwater levels for sites in areas where groundwater is known to be an issue should be considered at the planning application stage.

6.6.1 The impact of climate change within Sevenoaks District

The **UKCP18**[39] climate projections provide a number of future projections for different variables across the UK.

South East England

With an increase in global temperature between 2 – 4 degrees, the UKCP18 allowances estimate that[40]:

- Increased mean summer temperature of between 2° - 7°C by 2099.
- Increased mean winter temperatures of up to 2ºC or a decrease of up to -1ºC by 2099.
- Summer rainfall could decrease by over 80% or it could increase up to 10% by 2099.
- Winter rainfall could decrease by up to 10% or it could increase over 30% by 2099.

Whilst changes in trends and mean values is important, the more influential effect of climate change with respect to flood risk and drought is to increase the chance of occurrence and severity of more extreme wet and dry events.

6.6.2 Adapting to climate change

The **NPPG Climate Change guidance**[41] contains information for how to identify suitable mitigation and adaptation measures in the planning process to address the impacts of climate change. Examples of adapting to climate change include:

- Considering future climate risks when allocating development sites to ensure risks are understood over the development's lifetime
- Considering the impact of and promoting design responses to flood risk and coastal change for the lifetime of the development
- Considering availability of water and water infrastructure for the lifetime of the development and design responses to promote water efficiency and protect water quality
- Promoting adaptation approaches in design policies for developments and the public realm for example by building in flexibility to allow future adaptation if needed, such as setting new development back from watercourses

39 UKCP18 Climate Projections. Met office (2018). https://www.metoffice.gov.uk/research/approach/collaboration/ukcp/index

40 UKCP18 Overview Report: https://www.metoffice.gov.uk/pub/data/weather/uk/ukcp18/science-reports/UKCP18-Overview-report.pdf

41 Climate change guidance. Ministry of Housing, Communities, and Local Government. (2014, updated 2019) https://www.gov.uk/guidance/climate-change

7 Sources of Information

7.1 Historic flooding

The historic flood risk in the Local Plan areas has been assessed using point information of recorded incidents provided by Kent County Council, the Environment Agency's recorded flood outline dataset and Southern and Thames Water's Sewer Incident Report Form (SIRF) dataset.

This has been supplemented with other information from the Kent County Council's PFRA and LFRMS, Environment Agency Flood Investigation reports and news reports. The key considerations from these sources are outlined in Section 8. Historic flood mapping for Sevenoaks District can be found in Appendix A. Guidance on how this information should be used to inform the Sequential and Exception Tests can be found in Appendix D.

7.2 Flood zone mapping – river and sea flood risk

Flood Zones 2, 3a and 3b have been compiled for Sevenoaks District as part of this SFRA. Flood Zones are based on the undefended scenario with the exception of Flood Zone 3b, which includes the presence of defences on the basis that land behind existing defences is not functional floodplain. The Flood Zones presented in this SFRA should be used for the basis for decision making in the Sevenoaks District Council Local Plan review. This will in some circumstances update the existing Environment Agency Flood Zones.

Flood zone mapping is only available where hydraulic modelling has been undertaken and therefore there are some areas (typically watercourses with a catchment area of less than 3km^2) where the fluvial flood risk has not been mapped and so are shown to be in Flood Zone 1. In these areas detailed modelling may be required to accurately determine the flood zones (refer also to para 4.4.1).

The following categories have been used to define each Flood Zone:

- Flood Zone 1: Comprised of land having a less than 1 in 1,000 annual probability of river or sea flooding in any year (<0.1% AEP)
- Flood Zone 2: Comprised of land having between a 1 in 100 (1% AEP) and 1 in 1,000 annual probability of river flooding or 1 in 200 (0.5% AEP) and 1 in 1,000 (0.1% AEP) annual probability of sea flooding.
- Flood Zone 3a: This zone comprises land assessed as having a greater than 1 in 100 (>1% AEP) annual probability of river flooding or Land having a 1 in 200 or greater annual probability of sea flooding.
- Flood Zone 3b: This zone comprises land where water has to flow or be stored in times of flood (the functional floodplain).

Flood Zone 3b, unlike other Zones, does show flood risk that takes account of the presence of existing flood risk management features and flood defences, as land afforded this standard of protection is not appropriately included as functional flood plain. The mapping in the SFRA identifies this Flood Zone as land which would flood.

Where the 5% Annual Exceedance Probability (AEP) outputs are not available, a precautionary approach has been taken using the 1% AEP undefended scenario (Flood Zone 3a). If a proposed development is shown to be within this area, further investigation should be undertaken as part of a detailed site-specific FRA to define and confirm the extent of Flood Zone 3b.

If existing development or infrastructure is shown in Flood Zone 3b, additional consideration should be given to whether the specific location is appropriate for designation as 'Functional' with respect to the storage or flow of water in time of flood.

Care should be taken when interpreting how Flood Zone 3b is predicted to change as a consequence of climate change. At such locations there may be a possible need to account

for potential changes in the standard of protection provided by flood risk management features. In areas where no detailed modelling is available, a precautionary approach has been taken to the identification of Flood Zone 3b, where an 'Indicative Flood Zone 3b' has been designated based on the best available data.

Flood Zone mapping for Sevenoaks District can be found in Appendix A. Guidance on how this information should be used to inform the Sequential and Exception Tests can be found in Appendix D. displays the datasets used within the creation of Flood Zones for the study area.

7.2.1 Fluvial models used in this SFRA

Error! Reference source not found. lists the flood risk modelling used to inform the SFRA.

Table 7-1: Fluvial flood risk modelling used to inform this SFRA

Model name	Year	Software
Daren and Cray Model	2018	Flood Modeller-TUFLOW
Flood Map for Planning (national generalised mapping)	2004	JFLOW

7.3 Flood zone mapping – surface water flood risk

7.4 Surface water flood risk

Flooding from surface water runoff (or 'pluvial' flooding) is caused by intense short periods of rainfall. It often occurs where the natural (or artificial) drainage system is unable to cope with the volume of water. Surface water flooding problems are inextricably linked to issues of poor drainage (or drainage blockage by debris) and sewer flooding.

Mapping of surface water flood risk in the Local Plan area has been taken from **the Risk of Flooding from Surface Water**[42] (RoFSW) published online by the Environment Agency. These maps are intended to provide a consistent standard of assessment for surface water flood risk across England and Wales in order to help LLFAs, the Environment Agency and any potential developers to focus their management of surface water flood risk. The different surface water risk categories used in the RoFSW mapping are defined in **Error! Reference source not found.**.

The RoFSW is derived primarily from identifying topographical flow paths of existing watercourses or dry valleys that contain some isolated ponding locations in low lying areas. They provide a map which displays different levels of surface water flood risk depending on the annual probability of the land in question being inundated by surface water. The RoFSW mapping is generally based on national modelling and therefore should be used as an indication of flood risk only. As a result, more detailed site-specific surface water modelling may be required. It is recommended that developers consult Kent County Council as the LLFA at the earliest opportunity.

As outlined in Chapter 5, surface water flood zones have been defined for the purposes of the sequential test and agreed with KCC.

- Surface Water Flood Zone A – land at <0.1% annual probability of flooding from surface water;
- Surface Water Flood Zone B – land at 0.1% or greater annual probability of flooding from surface water.

42 Risk of flooding from surface water. Environment Agency. (2013)
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/297429/LIT_8986_eff63d.pdf

The Risk of Flooding from Surface Water mapping (Appendix A3) has been used as a basis for this and it is considered that the 0.1% AEP event is a sufficiently conservative approach, this may be superseded by detailed modelling where it is available. This approach has been agreed with Kent County Council as LLFA.

Table 7-2: Surface water risk categories used in the RoFSW mapping

Category	Definition
High	Flooding occurring as a result of rainfall with a greater than 1 in 30 chance in any given year (3.3% AEP)
Medium	Flooding occurring as a result of rainfall of between 1 in 100 (1% AEP) and 1 in 30 (3.3% AEP) chance in any given year.
Low	Flooding occurring as a result of rainfall of between 1 in 1,000 (0.1% AEP) and 1 in 100 (1% AEP) chance in any given year.
Very low	Flooding occurring as a result of rainfall with less than 1 in 1,000 (0.1% AEP) chance in any given year.

Although the RoFSW offers improvement on previously available datasets, the results should not be used to understand flood risk for individual properties. The results should be used for high level assessments such as SFRAs for local authorities. If a particular site is indicated in the Environment Agency mapping to be at risk from surface water flooding, a more detailed assessment should be considered to more accurately illustrate the flood risk at a site-specific scale. Such an assessment will use the RoFSW in partnership with other sources of local flooding information, to confirm the presence of a surface water risk at that particular location.

The RoFSW map for Sevenoaks District can be found in Appendix A. Guidance on how this information should be used to inform the Sequential and Exception Tests can be found in Appendix D.

7.4.1 Critical Drainage Areas

Critical drainage areas are defined by the Town and Country Planning (General Development Procedure Amendment No. 2, England) Order 2006 as "*an area within Flood Zone 1 which has critical drainage problems and which has been notified [to] the local planning authority by the Environment Agency*". These can cover wide areas within both rural and urban environments and are typically where man made drainage infrastructure has been identified as at critical risk of failure, resulting in flooding. An absence of critical drainage areas does not mean there are no areas with potential drainage problems.

No formal critical drainage areas have been identified within Sevenoaks District by the Environment Agency

7.5 Groundwater flood risk

JBA has developed a range of Groundwater Flood Map products at the national scale. The 5m resolution JBA Groundwater map has been used within the SFRA. The modelling involves simulating groundwater levels for a range of return periods (including 75, 100 and 200-years). Groundwater levels are then compared to ground surface levels to determine the head difference in metres. The JBA Groundwater Map categorises the head difference (m) into five feature classes based on the 100-year model outputs which are outlined in **Error! Reference source not found.**.

Table 7-3: JBA Groundwater flood risk map categories

Flood depth range during a 1% AEP flood event	Groundwater flood risk
Groundwater levels are either at or very near (within 0.025m of) the ground surface.	Within this zone there is a risk of groundwater flooding to both surface and subsurface assets. Groundwater may emerge at significant rates and has the capacity to flow overland and/or pond within any topographic low spots.
Groundwater levels are between 0.025m and 0.5m below the ground surface.	Within this zone there is a risk of groundwater flooding to both surface and subsurface assets. There is the possibility of groundwater emerging at the surface locally.
Groundwater levels are between 0.5m and 5m below the ground surface.	There is a risk of flooding to subsurface assets but surface manifestation of groundwater is unlikely.
Groundwater levels are at least 5m below the ground surface.	Flooding from groundwater is not likely.
No Risk	This zone is deemed as having a negligible risk from groundwater flooding due to the nature of the local geological deposits.

It is important to note that the modelled groundwater levels are not predictions of typical groundwater levels. Rather they are flood levels i.e. groundwater levels that might be expected after a winter recharge season with 1% AEP, so would represent an extreme scenario.

It should be noted that as the JBA Groundwater Flood Map is based on national modelling it should only be used for general broad-scale assessment of the groundwater flood hazard in an area and it is not explicitly designed for the assessment of flood hazard at the scale of a single property. In high risk areas a site-specific risk assessment for groundwater flooding is recommended to fully inform the likelihood of flooding. Kent County Council should be consulted at the earliest opportunity to understand local groundwater issues around development sites and developers should prioritise groundwater monitoring to further understand local impacts.

The JBA Groundwater Map for the Local Plan areas can be found in Appendix A. Guidance on how this information should be used to inform the Sequential and Exception Tests can be found in Appendix D.

7.6 Reservoir flood risk

The risk of inundation due to reservoir breach or failure of reservoirs within the area has been assessed using the Risk of Flooding from Reservoirs mapping that can be found in Appendix A. These show two different scenarios a "dry-day" scenario predicts the flooding that would occur if the reservoir failed when rivers are at normal levels. The "wet day" scenario predicts how much worse the flooding might be if a river is already experiencing an extreme natural flood. More than one reservoir could affect a location at the same time.

Guidance on how this information should be used to inform the Sequential and Exception Tests can be found in Appendix D.

7.7 Sewer flooding

Historical incidents of flooding are detailed by Thames Water and Southern Water through their Sewer Incident Report Form (SIRF). This database records incidents of flooding relating to public foul, combined or surface water sewers and displays properties that both

internal and external flooding. Much of this data has been redacted so it is not possible to understand the spatial distribution of sewer flooding incidents in Sevenoaks. The database covers reported incidents of sewer flooding in the last 26 years. The SIRF for the Local Plan area can be found in **Error! Reference source not found.**.

Table 7-4: SIRF data from Southern Water

Year	Number of incidents
2011	6
2012	11
2013	10
2014	7
2015	1
2016	1
2017	1
2018	1
2019	3
2020	3
2021	6
Sum	**49**

It should be noted that there are large gaps in this data. Much of Sevenoaks falls within Thames Water's administrative area and SIRF data was not provided.

8 Understanding Flood Risk in Sevenoaks District

8.1 Topography and geology

8.1.1 Introduction and location

Sevenoaks District covers an area of approximately 370km^2 and has a population of approximately 120,750[43]. There are 26 wards in the district, the largest of which is Sevenoaks Town and St John's with a population of approximately 7335[44]. Other sizeable wards include Swanley White Oak, Ash and New Ash Green, Brasted, Chevening and Sundridge, and Fawkham and West Kingsdown.

8.1.2 Topography

The topography that characterises the district is displayed in **Error! Reference source not found.**. The topography primarily comprises higher elevations and steeper slopes which form the North Downs in the north section of the district and the High Weald in the south section of the district. The highest elevations reach approximately 247 metres Above Ordnance Datum (m AOD) at The Chart near Weardale. Elevations decrease in a north and south-east direction due to the presence of several river valleys in the district. For example, elevations reach approximately 20m AOD near South Darenth and Leigh, both of which are located in separate river valleys. There are three main watercourses within the district boundary; the River Darent which originates from higher elevations in the north, and the Rivers Eden and Medway which occupy the lower elevations in the south.

8.1.3 Geology and soils

The geology of the catchment can be an important influencing factor in the way that water runs off the ground surface. This is primarily due to variations in the permeability of the surface material and bedrock stratigraphy. Sevenoaks District primarily consists of three main geologies; the Wealden Group, the Lower Greensand Group and the White Chalk Sub-group all of which were formed 146 to 66 million years ago in the Cretaceous period.

The Wealden Group is located in the southern section of the district (south of Chartwell) and consists of sandstone, mudstone and siltstone. Bands of the Lower Greensand Group and the Gault Formation and Upper Greensand Formation (undifferentiated) are located across the centre of the district between Chartwell and Kemsing, both of which consist of mudstone, sandstone and limestone. Due to the limestone composition and the greater permeability of the Greensand Group bedrock, central areas may be less responsive to rainfall compared to southern areas of the district. As a result, flood volumes are likely to be slightly more critical in the southern areas characterised by the less permeable Wealden Group.

North of Kemsing, the district is primarily underlain by White and Grey Chalk Subgroups (chalk) interspersed with small Thanet Sand Formation (sand, silt and clay), Thames Group and Lambeth Group (clay, silt, sand and gravel) deposits. The permeable chalk formations indicate that the majority of this area is likely to have a slower response to rainfall and flood volumes are likely to be less critical. However, areas of mixed geologies will exhibit different catchment responses depending on the local geology. For example, areas dominated by sand, silt and clay (e.g. Swanley) will have a quicker catchment response compared to areas dominated by chalk.

Superficial (at the surface) deposits in Sevenoaks District are located on the North Downs as well as the floodplains of the Rivers Eden, Medway and Darent. Clay-with-Flints Formation (diamicton) characterise the North Downs, whereas Alluvium (clay, silt and

43Office for National Statistics, (June 2013), Ward level population estimates (Mid-2019)

44Office for National Statistics, (June 2013), Ward level population estimates (Mid-2019)

sand) and River Terrace Deposits (undifferentiated – sand and gravel) characterise the floodplains and areas surrounding the three main rivers in the district.

Figure 8-1: Topography of Sevenoaks

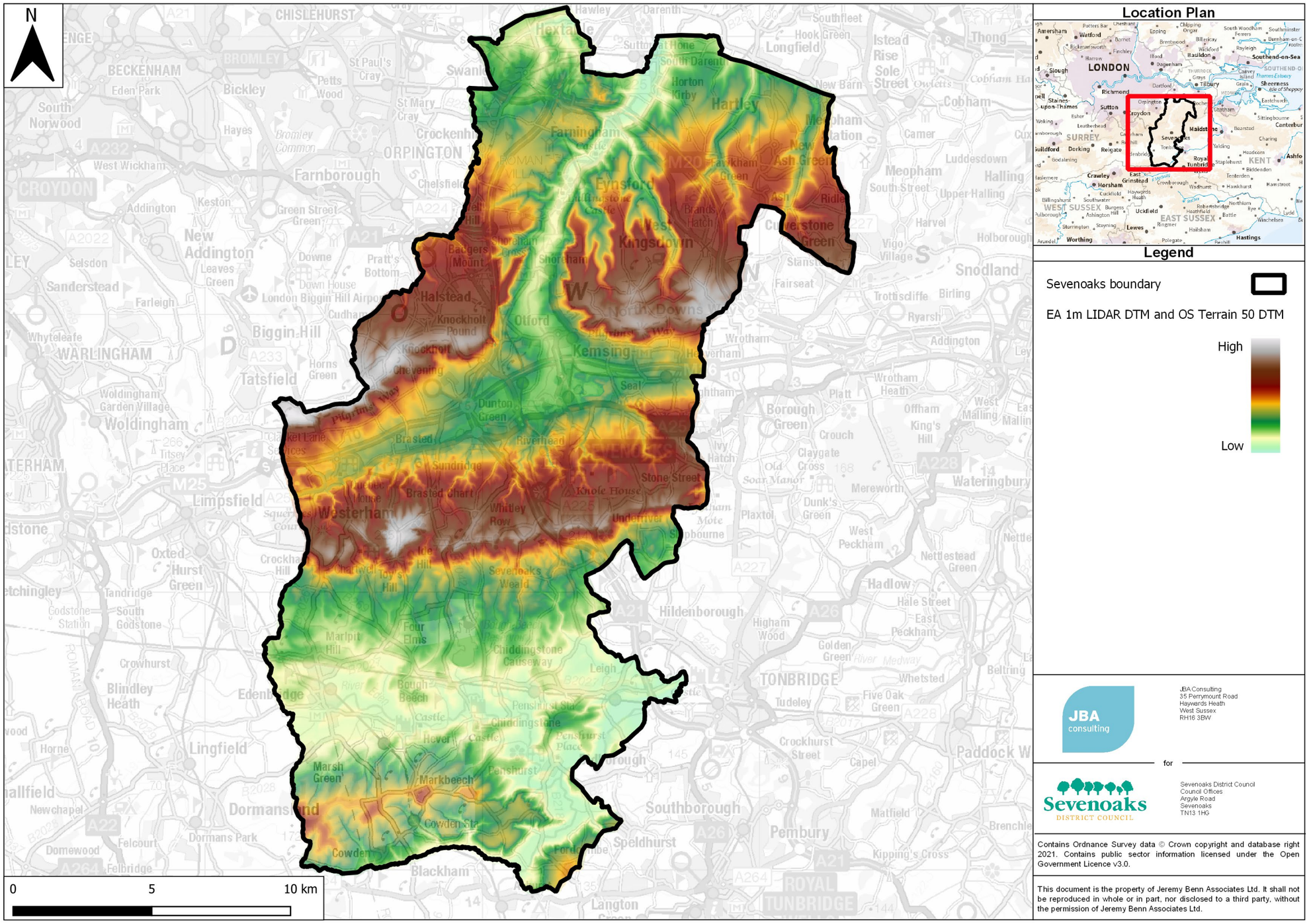


Figure 8-2: Bedrock geology of Sevenoaks

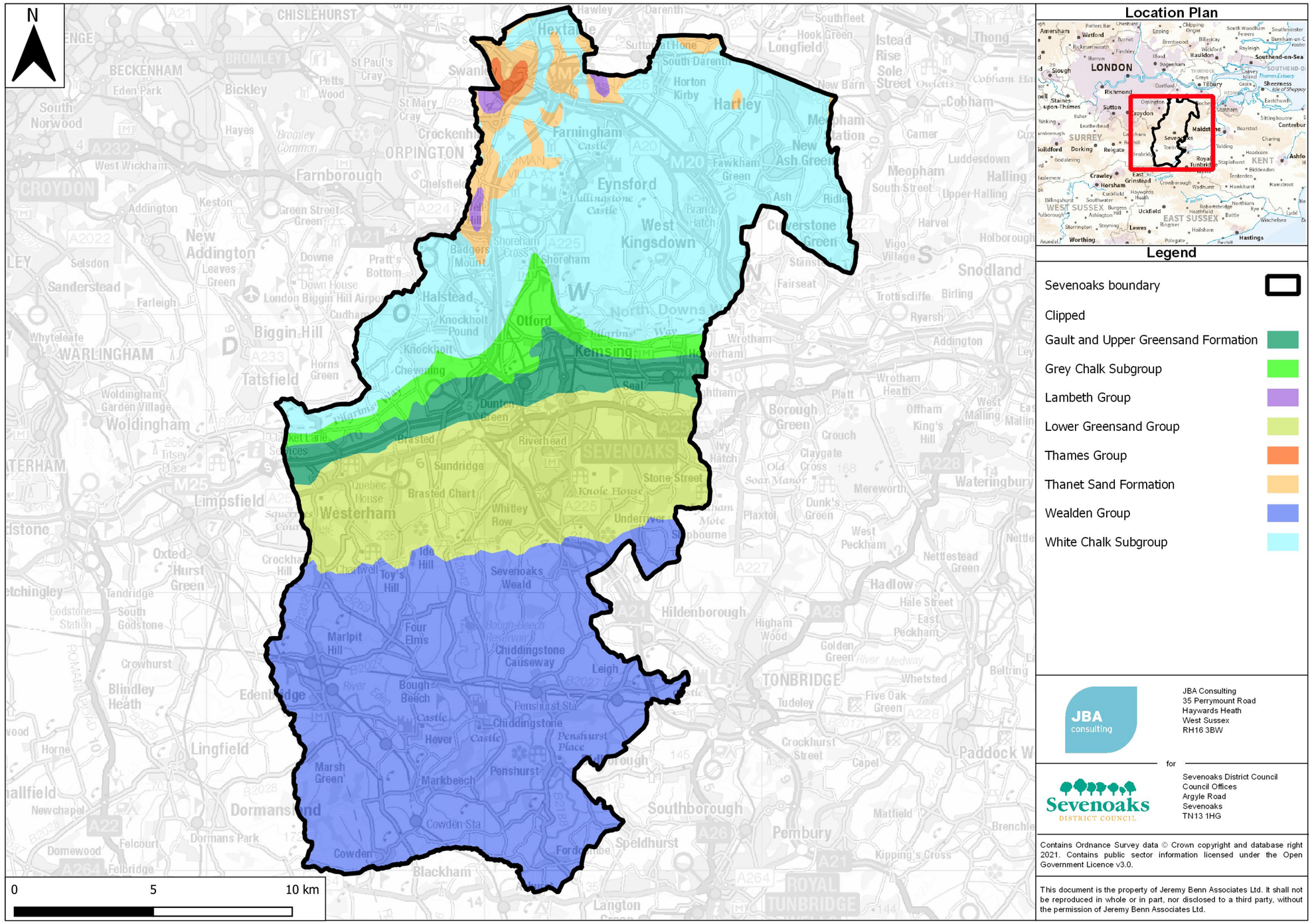
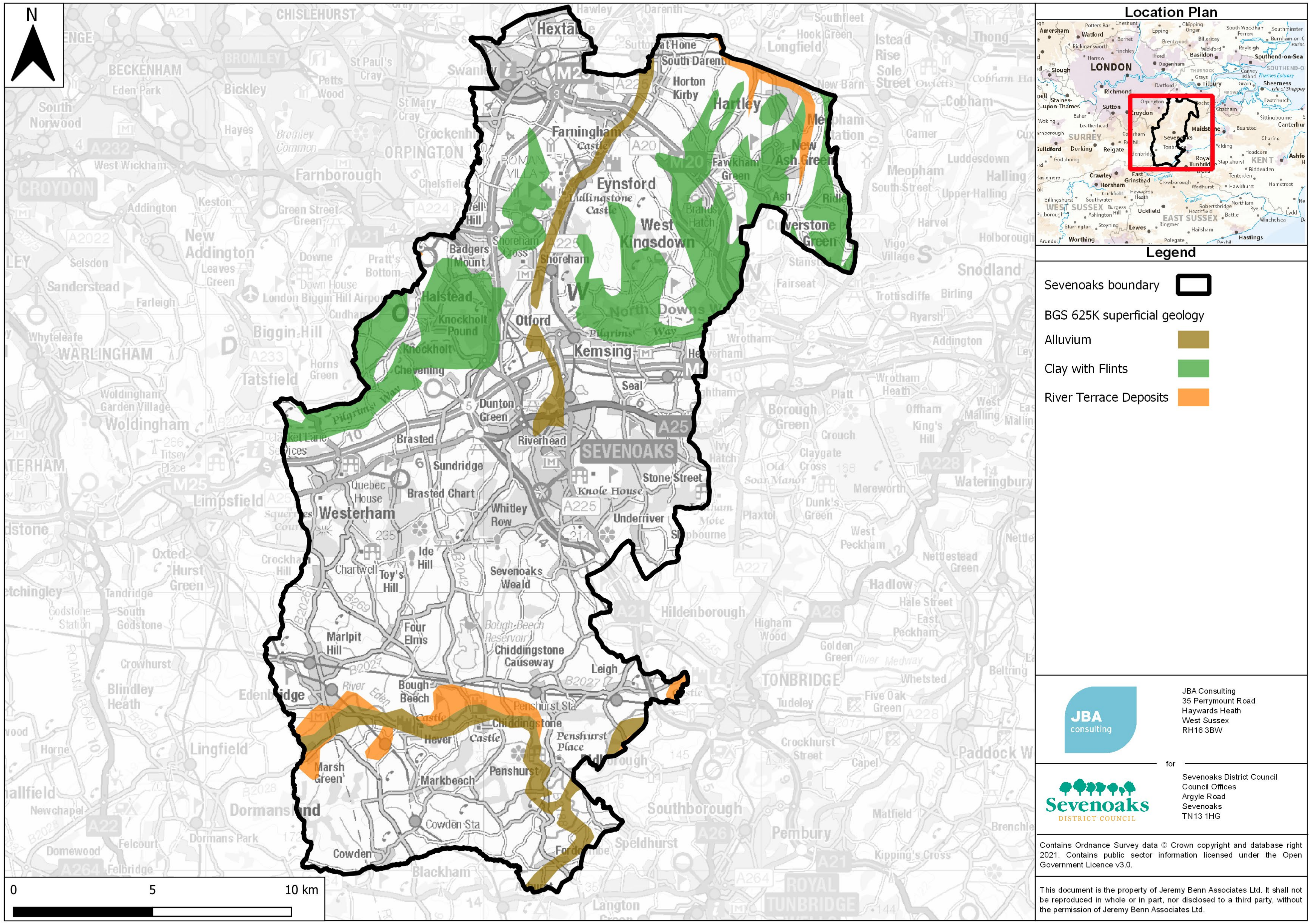


Figure 8-3: Superficial geology of Sevenoaks



8.2 Historical flooding

Sevenoaks District has a history of documented flood events with the main source being from 'fluvial' (river/ordinary watercourse) sources.

The events of 1968, 2000 and 2002/2003 caused widespread flooding across the district after heavy rainfall over a prolonged period. Since this time, significant flooding occurred within the district during Winter 2013/14, which included notable flooding from the River Medway.

Historic flood records provided by the Environment Agency, Sevenoaks District Council and Kent County Council identify the flood events known to have occurred between 1958 and 2016. The following locations and surrounding areas are noted to have been affected by at least one historical flood event during this period:

The following historic flooding incidents are notable in Sevenoaks;

- Flooding during the winter of 2013/14;
- **Ightham flooding**[45] – June 2016;
- Swanley flooding[46] – June 2019.

8.3 Fluvial flood risk

8.3.1 Watercourses

Watercourses flowing through Sevenoaks District include the:

- River Darent
- River Eden
- River Medway
- Honeypot Stream
- Watercress Stream
- Hilden Brook

The two principal watercourses within the district are the River Darent, tributaries of which include the Honeypot Stream and the Watercress Stream, and the River Eden which is a major tributary of the River Medway. Tributaries to these watercourses include primarily smaller Ordinary Watercourses and unnamed drains. A description of these watercourses is provided in **Error! Reference source not found.**.

The River Darent catchment (at Hawkey NGR 55200 72000) receives approximately 729mm of rain on average per year[47]. The adjoining catchments of the Honeypot Stream (downstream extent: NGR 55660 158250) and the Watercress Stream (downstream extent: NGR 552700 158100) receive similar levels of average rainfall per year.

The River Eden catchment (downstream extent: NGR 552750 143400) receives approximately 742mm of rain on average per year[48], which is similar to the levels received by the River Medway Catchment at Allington Lock: NGR 574850 158150.

45 Ightham Section 19 Investigation: https://www.kent.gov.uk/__data/assets/pdf_file/0008/79442/Igtham-S.19-Flood-Report-Final.pdf

46 West Kingsdown Section 19: https://www.kent.gov.uk/__data/assets/pdf_file/0005/105278/Section-19-Flood-Investigation-West-Kingsdown.pdf

47 SAAR value extracted from the FEH CD-ROM v3.0 © NERC (CEH). © Crown copyright. © AA. (2009)

48 SAAR value extracted from the FEH CD-ROM v3.0 © NERC (CEH). © Crown copyright. © AA. (2009)

8.3.1.1 River Darent

As Sevenoaks District is located inland, the River Darent is of fluvial influence within the district boundary. However, north of the District boundary the river is of tidal/estuarine influence north of Dartford and this section of the river is known as Dartford Creek.

There is a long history of flooding from the River Darent and areas commonly affected by flooding from the river include Eysnford, Shoreham, Chipstead, Farningham, Otford, Sundridge, Brasted and Westerham[49]. Historical records show that flooding along the River Darent is primarily caused by intense storms and high rainfall in conjunction with an impervious catchment (e.g. already saturated by rain)[50]. For example, the storms and prolonged rainfall in September 1968 was considered to cause a flood event with a return period greater than 1 in 100 years[51]. As a result, agricultural land, roads, bridges and properties between Westerham and Farningham were extensively flooded and damaged[52].

The event triggered subsequent work on the River Darent to improve channel and floodplain conveyance, and reduce the risk of flooding. For example, the Darent channel was realigned and enhanced at Westerham and flood relief channels were constructed to divert floodwaters to a storage lake at Chipstead. However, some problems still remain at Brasted and Shoreham, and the River Darent has flooded multiple times post-1968. Recorded events include 1969, 1971, 1972, 1976, and 2003[53]. The most recent event to affect the district occurred in the winter of 2013/2014 when extreme winter weather and exceptionally heavy rainfall caused the River Darent to continually rise, exceed its channel capacity and inundate properties at Brasted, Sundridge, Westerham, Swanley and Sevenoaks[54,55].

Fluvial flood risk within Sevenoaks District also arises from the Upper Darent and its tributaries. Areas surrounding the River Darent from its source, as well as the Honeypot and Watercress Streams are susceptible to flooding from a combination of high river flows, insufficient watercourse capacities, unmaintained watercourses, blocked culverts, trash screens and bridges, and problems with the operation of sluices[56].

8.3.1.2 Rivers Eden and Medway

The River Eden is one of four main tributaries of the heavily managed River Medway and is of fluvial influence only within Sevenoaks District. The main areas at risk of flooding are concentrated in Edenbridge and the areas surrounding the river's confluence with the River Medway (e.g. Penshurst).

The most severe flood event from the River Eden occurred in 1958 before any flood defences were built to protect Edenbridge and the surrounding communities[57]. Following a series of severe storms and heavy rainfall, the River Eden exceeded its channel capacity and caused widespread flooding damage to Edenbridge High Street. Despite the river being dredged in the 1960's and the subsequent construction of flood walls, earth embankments and channel improvements to offer further flood protection, Edenbridge has regularly been

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49 Kent County Council: Sevenoaks Stage 1 Surface Water Management Plan (2013)

50 Environment Agency: North Kent Rivers Catchment Flood Management Plan (December, 2009)

51 Sevenoaks District Council, Strategic Flood Risk Assessment for Local Development Framework, (April, 2008)

52 National Rivers Authority, River Darent Catchment Management Plan Consultation Report, (July, 1994)

53 Kent County Council: Sevenoaks Stage 1 Surface Water Management Plan (2013)

54 BBC News: Floodwater pumped from homes in west Kent (January 2014)

55 KentOnline: Met Office flood warnings will remain in Kent as overnight rain sparks levels to rise, with people in Dartford, Otford and Darenth on alert (January 2014)

56 Environment Agency: North Kent Rivers Catchment Flood Management Plan (December, 2009)

57 http://www.edenbridgetown.com/stories_events/2009/flood_history.php

affected by a number of flood events[58]. This includes the widespread flooding following the winter storms of 2013/2014 when the River Eden burst its banks and caused structural damage to properties[59] and regular inundation of the highways in Edenbridge and Penshurst[60]. It is noted that the regular flooding in and around Edenbridge may be due to the fact that the headwaters of the river come together upstream of the town before being constricted by bridge crossings and the inability of the local infrastructure and to convey flows in extreme events through the urban area[6162].

Fluvial flood risk also arises from the River Medway in the south of the district and its confluence with the River Eden near Penshurst, as well as the Hilden Brook which joins the River Medway outside the district boundary. It is notable that the Leigh Flood Storage Area protects Tonbridge by providing major attenuation of floodwaters during high flows by impounding a large area of agricultural land adjacent to Leigh within Sevenoaks District.

8.3.1.3 Ordinary Watercourses

The Sevenoaks SWMP states that ordinary watercourses have also repeatedly flooded in the district. For example, an ordinary watercourse north of Marlpit and south of Four Elms reportedly flooded in 1958 and 1960, and properties have been recorded to be affected in the past along Coppings Road and Hartfield Road, within Kippington and throughout Sevenoaks. These incidents have occurred due to the known issues with unmaintained watercourses and riparian owners not being aware of their duty to maintain the watercourse[63]. Issues include blocked trash screens and culverts, and high water levels are known to have had a knock-on effect on highway drainage.

In addition to flood risk shown by the flood risk mapping, there are a number of small watercourses and field drains which may pose a risk to development. Generalised Flood Zone mapping (where more detailed modelling investigations are not available) is only available for watercourses with a catchment greater than 3km^2. Therefore, whilst these smaller watercourses may not be shown as having flood risk on the flood risk mapping, it does not necessarily mean that there is no flood risk. As part of a site-specific flood risk assessment it will be necessary to assess the risk from these smaller watercourses where these may influence the site.

Given the widespread flooding recorded historically within the district (particularly along the floodplains of the River Darent, Eden and Medway, particular areas (e.g. roads, settlements) of the district susceptible to fluvial flooding have not been identified specifically as they are so numerous. It should be noted that defences are present within the district which act to reduce flooding. This may be particularly important when considering the functional floodplain (Flood Zone 3b) for development proposals. Further details on defences in Sevenoaks District are presented in section 6.

The delineation of the fluvial Flood Zones and the areas of Sevenoaks District which are within fluvial Zones are shown in Appendix A. Consideration of how climate change may influence the predicted Flood Zones in the future is indicated within mapping of Appendix A.

An important consideration when assessing fluvial flood risk is the probability of a failure of river defence occurring or being exceeded. Risk of defence failure is reduced by the positive actions of the defence owners in maintaining the defences, but there remains a

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58 Environment Agency: River Medway Catchment Flood Management Plan (December, 2009)

59 Kent and Sussex Courier: Edenbridge community pulls together in face of floods (December, 2013)

60 SWIMS Event Summary Report for Kent & Medway Winter 2013-2014 Full Report

61 Environment Agency: River Medway Catchment Flood Management Plan (December, 2009)

62 Kent County Council: Sevenoaks Stage 1 Surface Water Management Plan (2013)

63 Environment Agency: "Living on the Edge" report, 5th edition (2014). Available: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/454562/LIT_7114.pdf

residual risk of breach or exceedance by an event that is greater than the design capacity. The necessity for assessment of the 'residual' risk of defence failure (e.g. breach) should be considered on a site by site basis.

Table 8-1: Watercourses in Sevenoaks District

Watercourse name	Classification	Description
River Darent	Main River	The River Darent is a Kentish tributary of the River Thames. The river rises from its source in Westerham as several spring-fed reaches, all of which flow east towards their confluence near Dunsdale Lodge (NGR: TQ 45370, 54379). From there, the river flows as one main channel in a north-east direction through the northern edge of Sevenoaks, through Chipstead, Longford and the Sevenoaks Wild Fowl Reserve. Approximately 0.17km west of the A225 near Greatness, the River Darent reaches its confluence with the Honeypot and Watercress Streams (NGR: TQ 52680, 58179). The River Darent then flows in a northern direction through Otford, Shoreham, Eynsford, Farningham and Horton Kirby. The river eventually reaches South Darenth at the northern boundary of the district (NGR: TQ 56277, 70027) before flowing towards and through Dartford and joining the River Thames.
River Eden	Main River	The River Eden rises from its source in Titsey and flows south through Oxsted as several Ordinary Watercourses before becoming a designated Main River at Caterfield Bridge, approximately 2.13km west of the district boundary (NGR: TQ 40078, 47997). From this point, the river flows south-east into the district and through Edenbridge, joins with a second branch of the river (NGR: TQ 45375, 46389). The river then flows east towards Chiddingstone, and subsequently south through the district towards Penshurst where it joins the River Medway (NGR: TQ 52820, 43447).
River Medway	Main River	The River Medway is 113km in length and rises from its spring-fed source in Turners Hill, West Sussex. From its source, the river flows north-east through mainly agricultural land before entering the district boundary approximately 1.37km south-west of Fordcombe (NGR: TQ 51260 39782). The river then flows in a northern direction towards Penshurst where it joins its confluence with the River Eden (NGR: TQ 52820, 43447). From here, the river flows in a north-east direction towards Leigh where it passes through 3 steel radial gates which form the Leigh Flood Storage Area. The river then flows in an eastern direction across the Tonbridge By-pass and into the Tonbridge and Malling Borough (NGR: TQ 57001 46081).
Honeypot Stream	Main River	The Honeypot Stream is a small tributary of the River Darent. The stream is formed of several Ordinary Watercourses, all of which flow in a western direction and converge at Noah's Ark (NGR: TQ 55520 57716). The stream continues to flow in a western direction parallel to the M26, before flowing underneath the Otford Road (A225) and reaching its confluence with the Watercress Stream and the River Darent approximately 0.15km west of Bartram Farm (NGR: TQ. 52679 58181).
Watercress Stream	Main River	The Watercress Stream is a small tributary of the River Darent. The stream rises from its source near Millpond Wood in Greatness and flows northwest along Millane and Watercress Drive (NGR: TQ 53573 56690). The stream continues to flow through Greatness beneath the railway line and the Otford Road (A225) before reaching its confluence with the Honeypot Stream and the River Darent approximately 0.15km west of Bartram Farm (NGR: TQ. 52679 58181).
Hilden Brook	Main River	The Hilden Brook flows south from its source in Underriver (NGR: TQ 55524, 52375) for approximately 2.11km before reaching the district boundary adjacent to Mill Lane (NGR: TQ 56367 56861). At this point, the river flows into the Tonbridge and Malling Borough towards Watts Cross before reaching its confluence with the River Medway.
NOTE: This table is based on information extracted from the Environment Agency's Statutory (Sealed) Main Rivers database. Ordinary Watercourses within the district are not included within this table.		

8.4 Tidal flood risk

Tidal flood risk can be assessed using Extreme Still Water Sea Levels (ESWSL). An ESWSL is the level the sea is expected to reach during a storm event for a particular magnitude tidal flood event as a result of the combination of tides and surges. As these levels are based on 'still' water, the effect of short-term fluctuations in sea level associated with wind and swell waves are not included in these predictions, but should be considered at locations where wind and wave effects are influential.

Given that the reach of the rivers within the district are of fluvial influence only, the tidal flood risk to the district has not been assessed as part of this SFRA.

8.5 Surface water flooding

Flooding from surface water runoff (or 'pluvial' flooding) is caused by intense short periods of rainfall and usually affects lower lying areas, often where the natural (or artificial) drainage system is unable to cope with the volume of water. Surface water flooding problems are inextricably linked to issues of poor drainage or drainage blockage by debris, and sewer flooding.

The Risk of Flooding from Surface Water (RoFSW) mapping predominantly follows topographical flow paths of existing watercourses or dry valleys with some isolated ponding located in low lying areas. RoFSW mapping throughout the district is provided in Appendix A.

Surface water flood records provided by a variety of data sources are shown in Appendix A. It should be noted that information provided by KCC highways covers a period from 2008 to 2013. There are limited records of older events from other key partners but the majority of records were provided by KCC. Therefore, based on the data provided, there are at least 192 records of surface water flooding in total and 117 records of surface water flooding across the district since 2008.

The historical records of flooding are well dispersed throughout the district. However, clusters of recorded flood events are located around Edenbridge and Sevenoaks. The Sevenoaks SWMP states that for the most part surface water flooding could be attributed to heavy rainfall overloading carriageways and drains/gullies. Surface water flooding is particularly common north-west of Knole Park in Sevenoaks.

There are other instances of surface water flooding that have been caused by blocked drains/gullies or high levels within receiving watercourses impeding free discharge from surface water drains and gullies. Examples of where high-water levels in local watercourses have affected highway drainage include Hartfield Road in Edenbridge and Coppings Road near Leigh. It is understood that there have also been a number of surface water flooding incidents in Swanley.

8.6 Groundwater flooding

Groundwater flooding is the term used to describe flooding caused by unusually high groundwater levels. It occurs as excess water emerges at the ground surface or within manmade underground structures such as basements. Groundwater flooding tends to be more persistent than surface water flooding, in some cases lasting for weeks or months, and it can result in significant damage to property.

The Sevenoaks SWMP and historical flood records provided by Kent County Council indicate that Brasted, Eynsford, Bradbourne Lakes, Sevenoaks, Kemsing and Brittains Lane are vulnerable to or have experienced groundwater flooding in the past. Specifically, it has been observed that the Bradbourne Lakes are spring-fed, meaning that groundwater is typically high and the area is at risk of groundwater flooding[64]. Furthermore, there are

64 Sevenoaks District Council, (April, 2008), Strategic Flood Risk Assessment for Local Development Framework (Table 2: Sources of Flooding)

several locations in Sevenoaks where the aquifer cap is missing, which results in groundwater infiltration when full[65]. Waterlogged gardens have been recorded in these areas but there are no records of any serious property flooding.

The Sevenoaks SWMP also notes that it is difficult to ascertain if the source of flood event in other areas of the district is from groundwater. This is because it may be a result of a combination of sources, or a culverted watercourse being mistaken for a spring or underground stream[66].

As a result, developers planning to build within any groundwater emergence zones should investigate whether groundwater flooding is likely to be a problem locally.

8.7 Reservoir flood risk

Reservoirs with an impounded volume greater than 25,000 cubic metres are governed by the Reservoir Act 1975 and are listed on a register held by the Environment Agency. The level and standard of inspection and maintenance required under the Act means that the risk of flooding from reservoirs is relatively low. Legislation under the Flood and Water Management Act requires the Environment Agency to designate the risk of flooding from these reservoirs. Reservoir flood mapping is provided in Appendix A and shows the risk of flooding during normal conditions (dry day scenario) and when a breach coincides with a severe fluvial flood event (wet day scenario).

Table 8-2: Reservoirs which may impact Sevenoaks District in the event of failure

Reservoir	Location (grid reference)	Reservoir owner	Environment Agency area	Local authority
Within Sevenoaks District boundary				
Knockholt No. 2	546603, 158437	Thames Water Ltd	Kent and South London	Kent County Council
Coombe Bank Lake	547643, 155556	Gilberts Estate		
Farningham Hill No.2	553561, 167362	Thames Water Ltd		
Bough Beech	549168, 147292	Sutton & East Surrey Water Company		
Hever Castle Lake	548849, 145550	Hever Castle Ltd		
Outside of Sevenoaks District boundary				
Weirwood	540713, 135333	Southern Water Services Ltd	Kent and South London	East Sussex County Council
Main Lake, Eridge Park	556134, 135014	The Nevill Estate Co. Ltd		
Buckhurst Park Lake	549797, 135106	Trustees of the Buckhurst Park Fund		
Wilderness Lake	539626, 140274	Isfield & District Angling Club		Surrey County Council
Leigh Place Pond	536138, 150804	Leigh Holdings Inc		
Bay Pond	535318, 151505	Surrey Wildlife Trust		
Wiremill Lake	536875, 141941	Wiremill Waterski Club		

65 Sevenoaks District Council, (April, 2008), Strategic Flood Risk Assessment for Local Development Framework (Table 2: Sources of Flooding)

66 Kent County Council, (October, 2013), Sevenoaks Stage 1 Surface Water Management Plan

8.8 Sewer flooding

Sewer flooding occurs when intense rainfall overloads the sewer system capacity (surface water, foul or combined), and / or when sewers cannot discharge properly to watercourses due to high water levels. Sewer flooding can also be caused when problems such as blockages, collapses or equipment (such as pumps) failure occur in the sewerage system. Surface water inundation of manhole openings and entry of groundwater may cause high flows for prolonged periods of time. Since 1980, the Sewers for Adoption guidelines (now replaced by the Design Construction Guidance) have meant that most new surface water sewers have been designed to have capacity for a rainfall event with a 1 in 30 chance of occurring in any given year (3.33% AEP), although until recently this did not apply to smaller private systems.

Consequently, even where sewers are built to current specifications, they can still be overwhelmed by larger events of the magnitude often considered when looking at river or surface water flooding (e.g. a 1 in 100 chance of occurring in any given year (1% AEP)). Existing sewers can also become overloaded as new development adds to their catchment, even with restrictions in place on permitted discharge, or due to incremental increases in roofed and paved surfaces at the individual property scale (urban creep). Sewer flooding is therefore a problem that could occur in many locations across the study area.

9 Flood Defences

A high-level review of flood defences was carried out for this SFRA, involving an interrogation of existing information on asset condition and standard of protection.

Defences are any assets that provide flood defences or coastal protection functions. An assessment of the Environment Agency Spatial Flood Defence dataset has been carried out. Flood defences which potentially provide a standard of protection from a 50% AEP event or more have been considered. The datasets include manmade and natural defences which may arise for instance due to the presence of naturally high ground adjacent to a settlement have been considered. The defences and their locations are summarised in the following sections.

9.1 Defence standard of protection and residual risk

One of the aims of this SFRA is to outline the present risk of flooding across the Sevenoaks Local Plan area including consideration of the effect of flood risk management measures (including flood banks and defences). The modelling that informs the understanding of flood risk within the Local Plan area is typically of a catchment wide nature, suitable for preparing evidence on possible site options for development. In cases where a specific site risk assessment is required, detailed studies should seek to refine the results used to provide a strategic understanding of flood risk from all sources. Developers should consider the standard of protection provided by defences when preparing detailed Flood Risk Assessments.

Standard of Protection

Flood defences are designed to give a specific standard of protection, reducing the risk of flooding to people and property in flood prone areas. For example, a flood defence with a 1% AEP standard of protection means that the flood risk in the defended area is reduced to a 1% chance of flooding in any given year. Although flood defences are designed to a standard of protection it should be noted that, over time, the actual standard of protection provided by the defence may decrease, for example due to deterioration in condition or increases in flood risk due to the increased magnitude of the flood hazard caused by climate change effects (e.g. rise in frequency and intensity of extreme weather over time). For raised flood defences (bunds or banks), a standard of protection can be straight forward to define. However, sometimes it is not possible to define the standard of protection for Flood Storage Areas as there are a number of factors that determine the protection that they can provide e.g. outflow rates, number of watercourses that flow into the Flood Storage Area.

For the purpose of this study, the standard of protection has been derived from the Environment Agency Spatial Flood Defence Dataset.

9.2 Defence condition

Formal structural defences are given a rating by the Environment Agency based on a grading system for their condition[67]. A summary of the grading system used by the Environment Agency for condition is provided in **Error! Reference source not found.Error! Reference source not found.**.

67 Condition Assessment Manual, Environment Agency (2012)

Table 9-1: Defence asset condition rating

Grade	Rating	Description
1	Very Good	Cosmetic defects that will have no effect on performance.
2	Good	Minor defects that will not reduce the overall performance of the asset.
3	Fair	Defects that could reduce the performance of the asset.
4	Poor	Defects that would significantly reduce the performance of the asset. Further investigation required.
5	Very Poor	Severe defects resulting in complete performance failure.

The condition of existing flood defences and whether they are planned to be maintained and/or improved in the future must be considered with respect to the safety and sustainability of development over its intended life and also with respect to the financial and economic commitment to the long-term provision of appropriate standards of protection. In some cases, the relevant strategy may suggest that it is not appropriate to maintain the condition of the assets, which may prove influential for the development over its intended life. In addition, detailed FRAs undertaken by developers (if a defence is influential to the proposed development) will need to thoroughly explore the condition of defences, especially where these defences are informal and demonstrate a wide variation of condition grades. It is important that all of these assets are maintained to a good condition and their function remains unimpaired in accordance with the policy and strategy for Flood Risk Management.

9.3 Defences in Sevenoaks District

Mapping showing the condition and design standards of existing flood defences in Sevenoaks District can be found in Appendix A, this information is derived from the Environment Agency's Spatial Flood Defences dataset.

9.3.1 Raised defences

Edenbridge

Within Edenbridge, raised flood defences are set back from the channel of the River Eden to protect certain areas from river flooding. Several raised embankments and a wall are located on either side of the River Eden notably adjacent to the gardens properties on Cobbetts Way, Mont St Aignan Way, Hever Road and Church Street. The wall has a condition grade of 'Good' while raised embankments have a condition grade of 'Fair'. Therefore, defects may be present on the embankments that could reduce the performance of these flood defences

Local sources state that the raised embankment adjacent to Cobbetts Way was damaged during December 2013 when efforts to raise barrier and protect the surrounding properties from the rising water levels in the channel undermined the defence[68]. During the winter, sandbags were provided by the EA to temporarily line, protect and strengthen the defence and works to repair the defence were scheduled at the beginning of May 2014. The embankment required approximately £45,000 of repair work from the EA's recovery budget[69].

68 Kent Live, (April 2014), Edenbridge flood defence barrier to be repaired

69 Kent Live, (February, 2015), Is flooding solution a bridge too far for Edenbridge?

Brasted

There are a number of raised flood defences within Brasted located along the banks of the River Darent. The defences in the area consist of predominantly walls and high ground on either side of the channel. The defences are privately owned, but the Environment Agency and private owners maintain different sections of the defences. Responsibilities for maintaining particular lengths of the defences should be confirmed with the Environment Agency.

It should be noted that several man-made flood defences in the area have been categorised as 'high ground' defences and as such, further investigation may be required to accurately establish the type of defence in these locations.

The condition grade of walls and high ground assets typically varies between 'Good' and 'Fair'. This suggests that there are defects present and although some may only be minor, larger defects could reduce the overall performance of the defences protecting the village.

Defences lining the River Darent provide a typical standard of protection of 20% AEP (1 in 5-year flood event). However, the Brasted Alleviation Scheme was conducted and completed between 2007 and 2009 to improve the standard of protection to 43 properties within Brasted[70]. The scheme primarily involved the construction of a 600m flood wall/embankment along the River Darent, the installation of seven manually-operated flood gates and localised ground level raising along Rectory Lane to provide a standard of protection of 1% AEP (1 in 100-year flood event)[71],[72]. This is significantly higher than standard of protection provided by the other defences lining the banks of the watercourse.

It should be noted that the minimum standard of protection of 50% AEP (1 in 2-year flood event) is provided by a section of 'high ground' along the northern bank of the River Darent adjacent to the track leading north. Further investigation may be required to establish the type of defence in this location.

Leigh

The formal flood defences located to the south-east of Leigh form part of the Leigh Flood Storage Area (FSA), which is discussed further in Section 9.3.2**Error! Reference source not found.**. The embankments and sections of high ground located adjacent to Leigh serve two purposes: they protect the railway line and town from flooding, while impounding the large area of agricultural land that forms the FSA to reduce the risk of flooding in Tonbridge in the neighbouring borough.

Embankments predominantly line southern edge of the railway, Leigh station and sewage works, while sections of high ground line the branching channels of the River Medway. The embankments have a condition grade of 'Good', meaning that minor defects may be present but they should not reduce the overall performance of the defence. The sections of high ground, however, have a condition grade of 'Fair', meaning that defects may be present that could reduce the overall performance of these defences.

The standard of protection provided by these defences significantly differs. Given that the embankments protect important amenities in the south-east of Leigh, the defences provide a standard of protection of 1% AEP (1 in 100-year flood event), whereas the sections of high ground, only provide standard of protection of 20% AEP (1 in 5-year flood event). This is likely due to the fact that area of land these defences serve to protect form part of the Leigh FSA and attenuate floods from the Upper Medway catchment during times of increased flows.

It should be noted that further investigation may be required to accurately establish the type of defence categorised as 'high ground' along the River Medway.

70 Brasted Flood Alleviation Scheme Cost £1 Million Pounds (accessed October, 2016).

71 Halcrow, (April, 2008), Sevenoaks District Council Strategic Flood Risk Assessment for Local Development Framework (A.19 Flood Management Systems)

72 Hunton, Flood Gates: Manually operated flood gates (accessed (October, 2016)

9.3.2 Leigh Flood Storage Area

The Leigh Flood Storage Area (FSA) is the only FSA present within the district. The Leigh FSA is an online storage reservoir which was constructed in 1982 on the River Medway to reduce the risk of flooding in Tonbridge in the neighbouring borough. Under normal flow conditions, the FSA is kept empty. However, during times of increased flows, the FSA attenuates floods from the Upper Medway catchment (River Medway and River Eden) and aims to reduce the flow passing downstream through Tonbridge and beyond. The FSA consists of an impounding embankment with an outflow through three radial gates. It is operated to limit forward flows but has a maximum impounding level of 28.05m AOD. If that level is likely to be exceeded, then alternative operation of the FSA is considered by the Environment Agency. The majority of the area impounded by the embankment falls within Sevenoaks District and primarily consists of the agricultural land located south-east of Leigh. When the FSA is impounding to 28.05m AOD, the extent of the FSA extends slightly upstream beyond the confluence of the River Medway and River Eden.

Assigning a single standard of protection for the FSA is not possible as the inflows to the FSA, volume of water stored and reduced outflows (leading to reductions in flooding) vary on an event-by-event basis. The FSA has been regulated under the Reservoirs Act 1975 (now under the Flood and Water Management Act 2010) and has a condition grade of 1 (Very Good). A

The **Kent County Council Flood Risk to Communities – Tonbridge and Malling** (March 2016) report has stated that prior to the floods that occurred over the winter of 2013/2014, the Leigh FSA was planned to have work carried out by the Environment Agency to extend the life to 2035[73]. Since the event, a partnership has formed between the EA, KCC, Sevenoaks and Tonbridge and Malling Borough Council to bring forward plans to increase the capacity of the Leigh FSA. The proposals are being progressed in two linked phases, the first phase involving the volume capacity enhancement of the Leigh storage facility has been approved and the second phase involving the construction of an embankment and other works at Hildenborough is being progressed.

Proposed plans involve raising the maximum water level that can be accommodated within the Leigh Flood Storage Area by increasing the impounding level from 28.05m AOD up to 28.60m AOD, to increase the storage provided by the FSA by 24%This will potentially be a direct benefit to the district's neighbouring authority and reduce the risk of flooding in Tonbridge, Hildenborough, and East Peckham. However, in order to ensure that there are no adverse impacts to Leigh village, proposed plans also involve upgrading the pumping station, de-silting the river around the pumping station and the structures, and raising the embankment that currently protects the railway line between Leigh and Tonbridge[74]. Until the works and scheme are fully implemented and operational the potential effect on flood risk will not be included in the Strategic Flood Risk Assessment.

9.4 Other defence works

The Environment Agency's Flood and Coastal Erosion Management (FCERM) capital investment programme outlines how government investment will be managed to reduce risk and coastal erosion in England . The full programme lists all FCERM projects that are planned to take place over the next six years since April 2015 across the UK.

In order to reflect the increasing certainty of development, all projects are categorised into one of three stages of FCERM programme:

- Construction programme – includes projects that are already in construction, fully funded projects that are due to start construction in the coming financial year, or

73 Kent County Council Flood Risk to Communities – Tonbridge and Malling (2016)

74 Leigh Parish Council, (September, 2014), Minutes of Leigh Parish Council Meeting held in the Small hall, High Street, Leigh on Monday 1st September 2014 at 8.00pm

projects scheduled to start construction in the coming financial year subject to securing other funding contributions;

- Development programme – includes projects in development with full funding packages agreed and expected to start construction in future year subject to approval of a full business case, or projects in development that are expected to start construction in future years subject to approval of a full business case and securing other funding contributions;
- Pipeline programme – includes projects proposals that are likely to qualify for some government funding before 2021 and have been given an indicative allocation. However, they have not yet identified sufficient contributions and/or do not have a sufficiently well-Developed case to enter the development programme at this stage.

Based on the information published by the EA, there are three FCERM projects within the development programme that potentially have effects for Sevenoaks District, further details of which are included below.

9.4.1 Edenbridge Flood Alleviation Scheme

In order to reduce the risk of fluvial flooding from the River Eden and surface water flooding, a number of options are currently being considered by the Environment Agency:

- Replace the existing bridge over the River Eden at the southern end of the High Street with a bridge that would not block flow of the river during the 1 in 100-year (1% AEP) flood event[75];
- De-culvert a section of the River Eden to facilitate surface water runoff, or investigate the connection of the existing surface drainage network into the culverted section of the river and improve where possible[76];
- Construct a pumping station to discharge excess runoff to the watercourse downstream of Four Elms Road[77].

The overall scheme is expected to provide a better level of protection from flooding to 220 properties within Edenbridge, and the earliest date for construction to commence is between 2016 and 2018 subject to approval of a full business base and the securement of other funding contributions[78].

9.4.2 Upper Westerham Flood Alleviation Scheme

The Upper Westerham Flood Alleviation Scheme proposes to reduce the risk of fluvial flooding to properties and the section of the A25 highway between Squerryes Court and Long Pond. The scheme involves increasing conveyance in the main channel of the river and the provision of property level protection measures to the surrounding dwellings. In order to maintain the structural integrity of the A25 highway, essential works will also be required to the left bank of the River Darent[79].

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75 Sevenoaks District Council, (July, 2013), Draft Community Infrastructure Levy: Infrastructure Plan

76 Kent County Council, (January 2015), Environment & Transport Cabinet Committee Meeting: Costal and river flood defence investment (Appendix 1 – Full list of Kent flood defence schemes not yet started)

77 Kent County Council, (January 2015), Environment & Transport Cabinet Committee Meeting: Costal and river flood defence investment (Appendix 1 – Full list of Kent flood defence schemes not yet started)

78 Environment Agency, (July, 2016), Programme of flood and coastal erosion risk management schemes

79 Kent County Council, (January 2015), Environment & Transport Cabinet Committee Meeting: Costal and river flood defence investment (Appendix 1 – Full list of Kent flood defence schemes not yet started)

The scheme also proposes to provide limited upstream storage to attenuate floodwaters during times of high flows. The relevant risk management authorities will work with the North West Kent Countryside Partnership and landowners to provide increased floodplain storage and the creation of channel/floodplain habitats[80].

The scheme has now been constructed which is considered to better protect a total of five properties..

9.4.3 Shoreham Structures Scheme

In order to reduce the risk of fluvial flooding from the River Darent, the Shoreham Structures Scheme has been proposed, whereby a hydraulic modelling study and possible removal of the structures (weirs) along the River Darent in Shoreham will be undertaken[81].

The hydraulic modelling study primarily aims to identify flows, flood water levels and possible flood management options for Shoreham. Once the model has been produced, further testing into flood improvements and prevention can be carried out for local properties and the surrounding area. Given that it is unclear if the weirs along the river currently serve a purpose, the study will also be able to determine if there is any benefit from removing them in this area[82].

80 Kent County Council, (January 2015), Environment & Transport Cabinet Committee Meeting: Costal and river flood defence investment (Appendix 1 – Full list of Kent flood defence schemes not yet started)

81 Southern Regional Flood and Coastal Committee, (April 2016), Main Committee Meeting (Appendix 1 – Refreshed 6 year programme)

82 Shoreham Parish Council, (April 2016), Shoreham Parish Council Minutes for 6 April 2016 (pages 1 to 4).

10 FRA requirements and guidance for developers

10.1 Over-arching principles

This SFRA focuses on delivering a strategic assessment of flood risk within Sevenoaks District. To support planning applications and prior to any construction or development, site-specific assessments will need to be undertaken so all forms of flood risk at a site are fully addressed. In addition, at some sites the FRA must include evidence that demonstrates the proposals satisfy the Sequential and Exception Tests in accordance with the NPPF requirements (the Sequential Test must be performed for sites not already allocated in the plan). In these circumstances, further assessment should be performed and described in a detailed Flood Risk Assessment (FRA). Any site that does not pass the Exception Test should not be allocated for development.

It is the responsibility of the developer to provide an FRA to support a planning application, where this is required. It should be acknowledged that a detailed FRA may show that a site is not appropriate for development of a particular vulnerability or even at all. Where the FRA shows that a site is not appropriate for a particular usage, a lower vulnerability classification may be appropriate.

10.2 Requirements for flood risk assessments

10.2.1 What are site specific FRAs?

Site specific FRAs are carried out by (or on behalf of) developers to assess flood risk to and from a site. They are submitted with planning applications and should demonstrate how flood risk will be managed over the development's lifetime, taking into account climate change and vulnerability of users.

Paragraph 068[83] of the NPPF Flood Risk and Coastal Change Planning Practice Guidance sets out a checklist for developers to assist with site specific flood risk assessments.

10.2.2 When are site specific FRAs required?

Site specific FRAs are 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 due to their surface water impact which will be dealt with through a surface water drainage strategy.
- Where proposed development or a change of use to a more vulnerable class may be subject to other sources of flooding
- Proposals of less than one hectare in Flood Zone 1 where they could be affected by sources of flooding other than rivers and the sea (e.g. surface water)

An FRA may also be required for some specific situations:

- If the site may be at risk from the breach of a local defence (even if the site is actually in Flood Zone 1)
- Where the site is intended to discharge to the catchment or assets of a water management authority which requires a site-specific FRA

83 Site specific flood risk assessment: checklist. Ministry of Housing, Communities & Local Government. (2014) https://www.gov.uk/guidance/flood-risk-and-coastal-change#Site-Specific-Flood-Risk-Assessment-checklist-section

- Where evidence of historical or recent flood events have been passed to the LPA
- On land in the vicinity of small watercourses or drainage features that might not have been demarcated as being in a flood zone on the national mapping
- At locations where proposals could affect or be affected by overland surface water flow routes

A Surface Water Drainage Strategy is also required when submitting any planning application for 'major development', as defined under the **Town and Country Planning Act (1990)**[84] .

10.2.3 Site layout and design

Flood risk from all sources 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.

The NPPF states that a sequential, risk-based approach should be applied to try to locate more vulnerable land use away from flood zones, to higher ground, while more flood-compatible development (e.g. vehicular parking, recreational space) can possibly be located in higher risk areas. However, vehicular parking in floodplains should be based on the nature of parking, flood depths and hazard including evacuation procedures and flood warning and should not compromise floodplain storage or obstruct floodplain flows.

Waterside areas, or areas along known flow routes, can act as Green Infrastructure, being used for recreation, amenity and environmental purposes, allowing the preservation of flow routes and flood storage, and at the same time providing valuable social and environmental benefits contributing to other sustainability objectives. Landscaping should ensure safe access to higher ground from these areas, and avoid the creation of isolated islands as flood water levels rise.

10.2.4 Raised floor levels

When designing the layout for a development, consideration should be given to the potential effects of flood risk and great care should be taken so that development is safe and there are no adverse effects on existing land, property or people. In areas potentially at risk from surface water flooding particular attention should be given to proposed ground levels, drainage design and provisions for exceedance flows. Where there is a residual risk of flooding (from any source) to properties within a development the measures to address the effects would normally include raising internal floor levels above the minimum level specified by the building regulations so that potential risks are addressed. The raising of internal floor levels and threshold levels within a development reduces the risk of damage occurring to the interior, furnishings and electrics in times of flood.

It is understood from advice given by the Environment Agency that normally ground floor sleeping accommodation is not considered to be appropriate in areas where there is a known risk of flooding. In addition, it is advised that threshold and ground floor levels should normally be set to whichever is higher of the following:

- a minimum of 300mm above the design flood level for the 1% AEP fluvial event including an allowance for climate change
- a minimum of 300mm above the design flood level for the 0.5% AEP tidal event including an allowance for climate change
- 300mm above the general ground level of the site.

Where possible, sleeping accommodation should be on the first flood or above. Where this is not possible, finished floor levels for sleeping accommodation should normally be set to whichever is higher of the following:

84 Town and Country Planning Act (1990): https://www.legislation.gov.uk/ukpga/1990/8/contents

- a minimum of 600mm above the design flood level for the 1% AEP fluvial event including an allowance for climate change and an appropriate allowance for freeboard
- a minimum of 600mm above the design flood level for the 0.5% AEP tidal event including an allowance for climate change and an appropriate allowance for freeboard
- 300mm above the general ground level of the site.

The design flood level should be the level taking account of residual risks (i.e. the risk that remains should flood defences be breached or fail as well as any undefended risk).

If it is not practical to raise floor levels to those specified above, consultation with the Environment Agency will be required to determine alternative approaches.

The additional height that the floor level is raised above the maximum water level is referred to as the "freeboard". Additional freeboard may be required because of risks relating to blockages to the channel, culverts or bridges. These should be considered as part of a site-specific Flood Risk Assessment.

Allocating the ground floor of a building for less vulnerable, non-residential, use is an effective way of raising living space above flood levels.

Single storey buildings such as ground floor flats or bungalows are especially vulnerable to rapid rise of water (such as that experienced during a breach). This risk can be reduced by use of multiple storey construction and raised areas that provide an escape route. However, access and egress can still be an issue, particularly when flood duration covers many days.

Similarly, the use of basements should be avoided. Habitable uses of basements within Flood Zone 3 should not be permitted, whilst basement dwellings in Flood Zone 2 will be required to pass the Exception Test. Access should be situated 300mm above the design flood level and waterproof construction techniques used.

10.2.5 Development and raised defences

Construction of localised raised floodwalls or embankments to protect new development is not a preferred option, as a residual risk of flooding will remain if they are overtopped or breached. Compensatory storage must be provided where raised defences remove storage from the floodplain. It would be preferable for schemes to involve an integrated flood risk management solution.

Temporary or demountable defences are not acceptable forms of flood protection for a new development but might be appropriate to address circumstances where the consequences of residual risk are severe. In addition to the technical measures the proposals must include details of how the temporary measures will be erected and decommissioned, responsibility for maintenance and the cost of replacement when they deteriorate.

10.2.6 Resistance and resilience measures

There may be instances where flood risk to a development remains despite implementation of such planning measures as those outlined above. For example, where the use is water compatible, where an existing building is being changed, where residual risk remains behind defences, or where floor levels have been raised but there is still a risk at the 0.1% AEP scenario. In these cases, (and for existing development in the floodplain), additional measures can be put in place to reduce damage in a flood and increase the speed of recovery. These measures should not normally be relied on for new development as an appropriate mitigation method.

Resistance and Resilience measures will be specific to the nature of flood risk, and as such will be informed and determined by the FRA. Further guidance relating to appropriate resistance and resilience measures can be found at:

- Environment Agency's **Flood risk assessment in flood zones 2 and 3**[85] webpage.
- Kent Resilience Forum provides information and advice for individuals on **preparing for flooding**[86].

Resistance measures are suitable for existing development in the floodplain. Most of these measures should be regarded as reducing the rate at which flood water can enter a property during an event and considered an improvement on what could be achieved with sandbags. They are often deployed with small scale pumping equipment to control the flood water that does seep through these systems. The effectiveness of these forms of measures is often dependant on the availability of a reliable forecasting and warning system, so the measures are deployed in advance of an event. The following resistance measures are often deployed:

- **Permanent barriers**: Permanent barriers can include built up doorsteps, rendered brick walls and toughened glass barriers.
- **Temporary barriers**: Temporary barriers consist of moveable flood defences which can be fitted into doorways and/or windows. The permanent fixings required to install these temporary defences should be discrete and keep architectural impact to a minimum. On a smaller scale temporary snap on covers for airbricks and air vents can also be fitted to prevent the entrance of flood water.

Resilience measures are suitable for new developments where there is a residual flood risk. These measures should be regarded as reducing the impact the flood water has once it has entered a property. These typically include:

- **Water resistant materials**: Floors, walls and fixtures can be finished with water resistant materials to help reduce the damage and greatly shorten the recovery time after a flood. Materials can include waterproof plaster, solid concrete floors and tiled floor coverings.
- **Electrical installation**: Electrical circuitry can be installed at a higher level with power cables being carried down from the ceiling rather than up from the floor level to reduce the likelihood of the circuitry being affected by flood water.

10.2.7 Developer contributions

In some cases, and following the application of the Sequential Test, it may be appropriate for the developer to contribute to the improvement of flood defence provision that would benefit both proposed new development and the existing local community. Developer contributions can also be made to maintenance and provision of flood risk management assets, flood warning and the reduction of surface water flooding (i.e. SuDS).

For strategic flood defence schemes, contributions towards them could be raised through the Community Infrastructure Levy (CIL). CIL allows the local authority to raise funds from developers undertaking new building projects. The money raised is used to fund a wide range of infrastructure projects needed to support development in the locality.

In some cases, and following the application of the sequential test, it may be necessary for the developer to make a contribution to the improvement of flood defence provision that would benefit both proposed new development and the existing local community.

85 Flood risk assessment in flood zones 2 and 3. Environment Agency. (2012, updated 2017) https://www.gov.uk/guidance/flood-risk-assessment-in-flood-zones-2-and-3#extra-flood-resistance-and-resilience-measures

86 Prepare for flooding: https://www.kentprepared.org.uk/flooding

Developer contributions can also be made to maintenance and provision of flood risk management assets, flood warning and the reduction of surface water flooding (i.e. SuDS).

Operating authorities can make requests for contributions to activities including flood risk management schemes through DEFRA's Flood and Coastal Risk Management Grant in Aid (FCERM GiA)[87]. However, the availability of such funding is limited by the priorities for public spending and thus linked to the anticipated requirements set out in the Local Flood Risk Management Strategy (LFRMS). The available funding is based on the projected benefits and it is often the case that the cost of providing flood risk management measures is greater than the benefits that can be obtained by reducing the flood frequency. Often schemes are only partly funded by FCERM GiA and the shortfall in funds has to be found from elsewhere. For example, local levy funding, local businesses or other parties benefitting from the scheme or contributions from developers or other parties that benefit from the provisions.

For new development in locations without existing defences, or where the development is the only beneficiary, the full costs of appropriate risk management measures for the life of the assets proposed must be funded by the developer and should include the cost of maintenance.

10.3 Buffer strips

The provision of a buffer strip to 'make space for water', allows additional capacity to accommodate climate change and ensure access to the watercourse, structures and defences is maintained for future maintenance purposes. It also enables the avoidance of disturbing riverbanks, adversely impacting ecology and having to construct engineered riverbank protection. Building adjacent to riverbanks can also cause problems to the structural integrity of the riverbanks and the building itself, making future maintenance of the river much more difficult.

Various buffer strip Byelaws are in place within Sevenoaks District. Under the **Environmental Permitting (England and Wales) Regulations 2016**[88], the Environment Agency specifies that no development is permitted within 8m either side of a Main River or within 15m of the foot of the landward side of any sea defences or between the low water mark of medium tides and the seaward side of any sea defence. No byelaws are in in place for ordinary watercourses outside of IDB areas, however the provision for a buffer zone is expected by the LLFA, it is recommended that this is the same as those of Main Rivers.

87 Principles for implementing flood and coastal resilience funding partnerships (Environment Agency, 2012)

The Environmental Permitting (England and Wales) Regulations 2016. UK Government. (2016) https://www.legislation.gov.uk/uksi/2016/1154/contents/made

10.4 Reducing flood risk from other sources

10.4.1 Groundwater

Groundwater flooding has a very different flood mechanism to any other and for this reason many conventional flood defence and mitigation methods are not suitable. The only way to fully reduce flood risk would be through building design (development form), ensuring floor levels are raised above the water levels caused by a 1% AEP plus climate change event. Site design would also need to preserve any flow routes followed by the groundwater overland to ensure flood risk is not increased downstream.

Infiltration SuDS can cause increased groundwater levels and subsequently may increase flood risk on or off the site. Developers should provide evidence and ensure that this will not be a significant risk.

When redeveloping existing buildings, it may be acceptable to install pumps in basements as a resilience measure. However, for new development this is not considered an appropriate solution

10.4.2 Surface water and sewer flooding

Developers should discuss public sewerage capacity with the water utility company (Thames Water or Southern Water) at the earliest possible stage. The development must improve the drainage infrastructure to reduce flood risk on site and the wider area. It is important that a drainage impact assessment shows that this will not increase flood risk elsewhere, and that the drainage requirements regarding runoff rates and SuDS for new development are met.

If residual surface water flood risk remains, the likely flow routes and depths across the site should be modelled. The site should be designed so that these flow routes are preserved and building design should provide resilience against this residual risk.

When redeveloping existing buildings, the installation of some permanent or temporary flood-proofing and resilience measures could protect against both surface water and sewer flooding. Non-return valves prevent water entering the property from drains and sewers. These can be installed within gravity sewers or drains in a property's private sewer upstream of the public sewerage system. They need to be carefully installed and must be regularly maintained. Consideration must also be given to attenuation and flow ensuring that flows during the 1% AEP plus climate change storm event are retained within the site if any flap valves shut. This must be demonstrated with suitable modelling techniques.

10.4.3 Cumulative impacts of development

At some locations it will be necessary to include consideration in an FRA of not only the flood risk at a particular site, but also the cumulative effects of all proposed plan allocations within a defined catchment. Reference should be made to Appendix B with respect to the consideration that should be given in these circumstances.

11 Surface water management

11.1 What is meant by Surface Water Flooding?

For the purposes of this SFRA, the definition of surface water flooding is that set out in the Defra SWMP guidance[89]. Surface water flooding describes flooding from sewers, drains, and ditches that occurs during heavy rainfall in urban areas.

Surface water flooding includes:

pluvial flooding: flooding as a result of high intensity rainfall when water is ponding or flowing over the ground surface (overland surface runoff) before it either enters the underground drainage network or watercourse or cannot enter it because the network is full to capacity;

sewer flooding: flooding that occurs when the capacity of underground water conveyance systems is exceeded, resulting in flooding inside and outside of buildings. Normal discharge of sewers and drains through outfalls may be impeded by high water levels in receiving waters which may cause water to back up and flood on the urban surface. Sewer flooding can also arise from operational issues such as blockages or collapses of parts of the sewer network; and

overland flows entering the built-up area from the rural/urban fringe: includes overland flows originating from groundwater springs.

11.2 Role of the LLFA and LPA in surface water management

From April 2015, changes to the planning system require that major development should make provision for sustainable drainage systems to manage surface water run-off, where major developments are defined as:

- residential development: 10 dwellings or more, or residential development with a site area of 0.5 hectares or more where the number of dwellings is not yet known;
- non-residential development: provision of a building or buildings where the total floor space to be created is 1,000 square metres or more or, where the floor area is not yet known, a site area of one hectare or more;
- Development carried out on a site having an area of 1 hectare or more; and
- Waste and minerals development.

The Local Planning Authority must satisfy themselves that clear arrangements are in place for future management of the maintenance arrangements and the LLFA (Kent County Council), as statutory consultee is required to review the drainage and Sustainable Urban Drainage (SuDS) proposals to confirm they are appropriate.

When considering planning applications, Local Planning Authorities should seek advice from the relevant flood risk management bodies, principally the LLFA on the management of surface water (including what sort of SuDS they would consider to be reasonably practicable), satisfy themselves that the proposed minimum standards of operation are appropriate and ensure, through the use of planning conditions or planning obligations, that there are clear arrangements for on-going maintenance over the development's lifetime. Judgement on what SuDS system would be reasonably practicable should be through reference to Defra's **Non-statutory technical standards for SuDS**[90] document.

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89 Defra, Surface Water Management Plan Technical Guidance (March 2010). https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69342/pb13546-swmp-guidance-100319.pdf

90 Non-statutory technical standards for sustainable drainage systems. Defra. (2015) https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/415773/sustainable-drainage-technical-standards.pdf

In its role as LLFA Kent County Council:

- promotes the use of SuDS for the management of run-off;
- ensures their policies and decisions on applications support and compliment the building regulations on sustainable rainwater drainage, giving priority to infiltration over watercourses and then sewer conveyance;
- incorporates favourable policies within development plans;
- adopts policies for incorporating SuDS requirements into Local Plans; and
- encourages developers to utilise SuDS whenever practical, if necessary, through the use of appropriate planning conditions.

11.3 Sustainable Drainage Systems (SuDS)

It is essential that developers consider sustainable drainage at an early stage of the development process – ideally at the design brief or master-planning stage. This will assist with the delivery of well designed, appropriate and effective SuDS. Proposals should also comply with the key SuDS principles (the four pillars of SuDS design - Figure 11-1 enabling solutions that deliver multiple long-term benefits. These principles are:

- **Quantity**: should be able to cope with the quantity of water generated by the development at the agreed greenfield rate and volume with due consideration for climate change via a micro-catchment based approach. Where frequency of flood risk, steepness of topography or permeability of geology has a significant impact on the volume or rate of surface water being discharged from a site, the LLFA should be contacted, as a review of the greenfield runoff rate to be achieved may be needed.
- **Quality**: should utilise SuDS features in a "treatment train" that will have the effect of treating the water before infiltration or passing it on to a subsequent water body
- **Amenity**: should integrate greenery or water features to improve the visual characteristics of the area. These can be incorporated within "open space" or "green corridors" within the site and designed with a view to performing a multifunctional purpose.
- **Biodiversity**: should include a range of natural features such as plants, trees and other vegetation which will provide additional filtration of surface water runoff. These can be designed to complement and improve the ecology of the area.

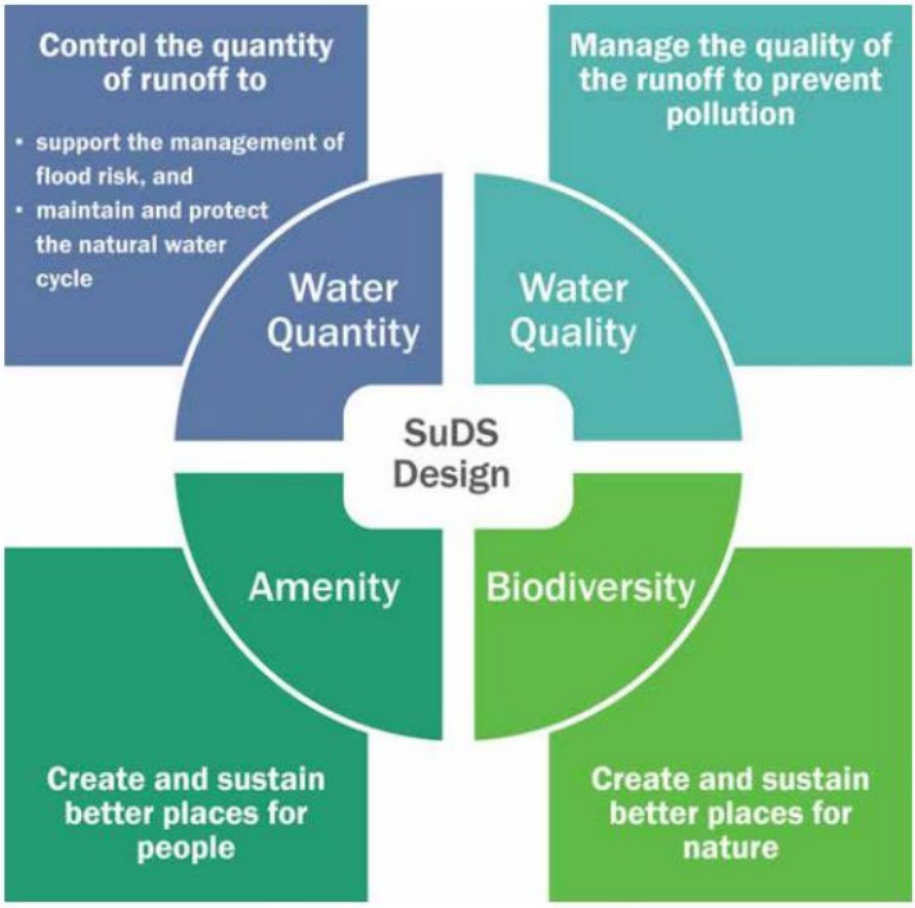
There are a number of ways in which SuDS can be designed to meet surface water quantity, climate change resilience, water quality, biodiversity and amenity goals. Given this flexibility, SuDS are generally capable of overcoming or working alongside various constraints affecting a site, such as restrictions on infiltration, without detriment to achieving these goals.

SuDS must be considered at the outset and during preparation of the initial conceptual site layout to ensure that enough land is given to design spaces that will be an asset to the development as opposed to an ineffective afterthought. For SuDS to work effectively appropriate techniques should be selected based on the objectives for drainage and the site-specific constraints. I t is recommended, that on all developments, source control is implemented as the first stage of a management train allowing for improvements in water quality and reducing or eliminating runoff from smaller, more frequent, rainfall events.

All new major development proposals should ensure that sustainable drainage systems for management of run-off are put in place. The developer is responsible for ensuring the design, construction and future/ongoing maintenance of such a scheme are carefully and

clearly defined, and a clear and comprehensive understanding of the existing catchment hydrological processes and existing drainage arrangements is essential.

Figure 11-1: The four pillars of SuDS design from the CIRIA SuDS Manual C753 (2015)



11.4 Types of SuDS Systems

There are many different SuDS techniques that can be implemented in attempts to mimic pre-development drainage (**Error! Reference source not found.**). Techniques can include soakaways, infiltration trenches, permeable pavements, grassed swales, green roofs, ponds and wetlands and these do not necessarily need to take up a lot of space. The suitability of the techniques will be dictated in part by the development proposal and site conditions. Advice on best practice is available from the Environment Agency and the Construction Industry Research and Information Association (CIRIA) e.g. **the CIRIA SuDS Manual C753 (2015)**[91].

91 CIRIA SuDS Manual C753. The Construction Industry Research and Information Association. (2015) https://www.ciria.org//Memberships/The_SuDs_Manual_C753_Chapters.aspx

Table 11-1: Examples of SuDS techniques and potential benefits

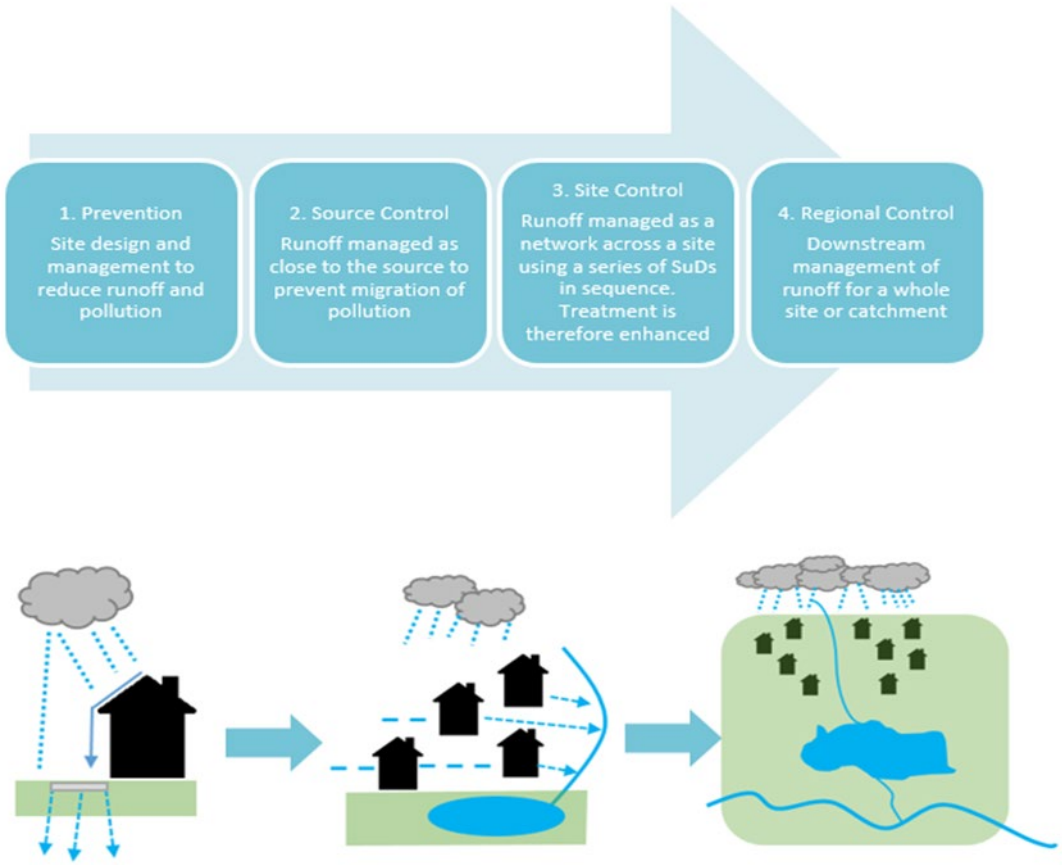
SuDS Technique	Flood Reduction	Water Quality Treatment & Enhancement	Landscape and Wildlife Benefit
Living roofs	✓	✓	✓
Basins and ponds	✓	✓	✓
Constructed wetlands	✓	✓	✓
Balancing ponds	✓	✓	✓
Detention basins	✓	✓	✓
Retention ponds	✓	✓	✓
Filter strips and swales	✓	✓	✓
Infiltration devices	✓	✓	✓
Soakaways	✓	✓	✓
Infiltration trenches and basins	✓	✓	✓
Permeable surfaces and filter drains	✓	✓	
Gravelled areas	✓	✓	
Solid paving blocks	✓	✓	
Porous pavements	✓	✓	
Tanked systems	✓		
Over-sized pipes/tanks	✓		
Storm cells	✓		

11.4.1 SuDS management train

SuDS should not be used individually but as a series of features in an interconnected system designed to capture water at the source and convey it to a discharge location. Collectively this concept is described as a SuDS Management Train (see Figure 10 2). The number of treatment stages required within the Management Train depends primarily on the source of the runoff and the sensitivity of the groundwater or receiving waterbody. A drainage strategy will need to demonstrate that an appropriate number of treatment stages are delivered.

SuDS components should be selected based on design criteria and how surface water management is to be integrated within the development and landscaping setting. By using a number of SuDS features in series it is possible to reduce the flow and volume of runoff as it passes through the system as well as minimising pollutants which may be generated by a development.

Figure 11-2: SuDS Management Train



11.4.2 Treatment of runoff

A key part of the four pillars of SuDS is to provide the maximum improvement to water quality through the use of the "SuDS Management Train". To maximise the treatment within SuDS, CIRIA recommends the following good practice is implemented in the treatment process:

1. **Manage surface water runoff close to source:** This makes treatment easier due to the slower velocities and also helps isolate incidents rather than transport pollutants over a large area.
2. **Treat surface water runoff on the surface:** This allows treatment performance to be more easily inspected and managed. Sources of pollution and potential flood risk is also more easily identified. It also helps with future maintenance work and identifying damaged or failed components.
3. **Treat a range of contaminants:** SuDS should be chosen and designed to deal with the likely contaminants from a development and be able to reduce them to acceptably low levels.
4. **Minimise the risk of sediment remobilisation:** SuDS should be designed to prevent sediments being washed into receiving water bodies or systems during events greater than what the component may have been designed.

5. **Minimise the impact of spill:** Designing SuDS to be able to trap spills close to the source or provide robust treatment along several components in series.

The number of treatment stages required depends primarily on the source of the runoff. A drainage strategy will need to demonstrate that an appropriate number of treatment stages are delivered. This involves determining a pollutant hazard score for each pollutant type. An index is then used to determine the treatment potential of different SuDS features for different pollutant types. This is known as the mitigation index. The Total SuDS mitigation index should be equal or greater than the pollution hazard score to deliver adequate treatment.

11.4.3 Overcoming SuDS constraints

The design of a SuDS system will be influenced by a number of physical and policy constraints. These should be taken into account and reflected upon during the conceptual, outline and detailed stages of SuDS design. **Error! Reference source not found.** details some possible constraints and how they may be overcome.

Table 11-2: Example SuDS design constraints and possible solutions

Considerations	Solution
Land availability	SuDS can be designed to fit into small areas by utilising different systems. For example, features such as permeable paving and green roofs can be used in urban areas where space may be limited.
Contaminated soil or groundwater below site	SuDS can be placed and designed to overcome issues with contaminated groundwater or soil. Shallow surface SuDS can be used to minimise disturbance to the underlying soil. The use of infiltration should also be investigated as it may be possible in some locations within the site. If infiltration is not possible linings can be used with features to prevent infiltration.
High groundwater levels	Non-infiltrating features can be used. Features can be lined with an impermeable liner or clay to prevent the egress of water into the feature. Additional, shallow features can be utilised which are above the groundwater table.
Steep slopes	Check dams can be used to slow flows. Additionally, features can form a terraced system with additional SuDS components such as ponds used to slow flows.
Shallow slopes	Use of shallow surface features to allow a sufficient gradient. If the gradient is still too shallow pumped systems can be considered as a last resort.
Ground instability	Geotechnical site investigation should be done to determine the extent of unstable soil and dictate whether infiltration would be suitable or not.
Sites with deep backfill	Infiltration should be avoided unless the soil can be demonstrated to be sufficiently compacted. Some features such as swales are more adaptable to potential surface settlement.
Open space in floodplain zones	Design decisions should be done to take into consideration the likely high groundwater table and possible high flows and water levels. Features should also seek to not reduce the capacity of the floodplain and take into consideration the influence that a watercourse may have on a system. Facts such as siltation after a flood event should also be taken into account during the design phase.
Future adoption and maintenance	Local Planning Authority should ensure development proposals, through the use of planning conditions or planning obligations, have clear arrangements for on-going maintenance over the development's lifetime.

11.5 Local policy and guidance on surface water management

11.5.1 Water. People. Places

The South East Seven is a collaboration of upper tier authorities that has produced a regional guide (**Water, People, Places**) for master planning sustainable drainage in developments. The Southern Lead Local Flood Authorities (including KCC) expect this guide to be used during initial planning and design process for all types of development in accordance with the National Planning Policy Framework (NPPF) and the Flood and Water Management Act (2010).

The guidance identifies specific site characteristics and constraints that can limit the effectiveness of SuDS including (but not limited to) existing flood conditions, runoff characteristics, high groundwater levels and Groundwater Source Protection Zones (GSPZ), topography, soil type, geology, contaminated land, existing infrastructure, land ownership, ecology and space constraints.

11.5.2 C753 CIRIA SuDS Manual (2015)

The C753 CIRIA SuDS Manual (2015) provides the latest guidance and best practice on planning, design, construction and maintenance of SuDS. The document is designed to help the implementation of SuDS features into new and existing developments, whilst maximising the key benefits regarding flood risk and water quality. It is recommended that developers and the LPA utilise the information within the manual to help design SuDS which are appropriate for development.

11.5.3 Defra Non-Statutory Technical Guidance (2015)

The guidance was developed to sit alongside PPG and provide non-statutory standards as to the expected design and performance for SuDS. The LPA will make reference to these standards when determining whether proposed SuDS are considered reasonably practicable and appropriate.

11.5.4 Kent County Council's Drainage and Planning Policy (adopted December 2019)

KCC's **Drainage and Planning Policy** sets out the requirements for sustainable drainage and how drainage strategies and surface water management provisions will be reviewed for SuDS schemes specific to Kent.

The policy provides the following requirements for developments on greenfield and previously developed sites:

- For developments on greenfield sites peak runoff rates from the 1 in 1-year (100% AEP) to the 1 in 100-year (1% AEP) rainfall events should be limited to the peak greenfield runoff rates for the same events.
- For developments on brownfield sites, the peak runoff rate must be as close as reasonably practicable to the greenfield runoff rate but should never exceed the existing rate of discharge prior to redevelopment. Unless it can be demonstrated to be reasonably impracticable, a 50% reduction in the peak runoff rate is expected.
- The drainage system must be designed to operate without flooding on any part of the site during any rainfall event up to (and including) a 1 in 30-year (3.3% AEP) rainfall event.
- The drainage system must also be designed to operate without flooding in any building up to (and including) a 1 in 100-year (1% AEP) plus climate change rainfall event, without exacerbating off-site flood risk.

- Exceedance flows that cannot be managed within the drainage system must be managed via exceedance flow routes that minimise the risks to people and property.
- Attenuation storage volumes provided by drainage areas must half empty within 24 hours to enable runoff from subsequent storms to be received. If the time taken to drain from full to empty exceeds 24 hours long duration events should be assessed to ensure drainage is not negatively impacted by inundation.

11.5.5 Kent County Council: Sustainable drainage – making it happen guidance

A **guidance document** supports the both the KCC Drainage and Planning Policy statement and the Non-Statutory Technical Standards for Sustainable Drainage. The guidance consists of technical appendices advising on the construction and design of SuDS features. This should be used to assist in the preparation of drainage design for any new development in Kent. It sets out the procedures relating to the design and subsequent adoption of surface water drainage systems and sets out requirements that KCC may have both as a Highway Authority and LLFA.

11.6 Groundwater Vulnerability Zones

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

Two maps are available:

- Basic groundwater vulnerability map: this shows the likelihood of a pollutant discharged at ground level (above the soil zone) reaching groundwater for superficial and bedrock aquifers and is expressed as high, medium and low vulnerability
- Combined groundwater vulnerability map: this map displays both the vulnerability and aquifer designation status (principal or secondary). The aquifer designation status is an indication of the importance of the aquifer for drinking water supply.

The groundwater vulnerability maps should be considered when designing SuDS.

11.7 Groundwater Source Protection Zones

The Environment Agency also defines Groundwater Source Protection Zones in the vicinity of groundwater abstraction points. These areas are defined to protect areas of groundwater that are used for potable supply, including public / private potable supply, (including mineral and bottled water) or for use in the production of commercial food and drinks. **The Environment Agency's approach to groundwater protection**[92] document defines what restrictions are placed on infiltration in these zones.

The definition of each zone is shown below:

- **Zone 1 (Inner Protection Zone)** – Most sensitive zone: defined as the 50-day travel time from any point below the water table to the source. This zone has a minimum radius of 50 metres.

92 Environment Agency (2017) The Environment Agency's approach to groundwater protection, available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/692989/Envirnment-Agency-approach-to-groundwater-protection.pdf [Accessed 10/06/2020]

- **Zone 2 (Outer Protection Zone)** – Also sensitive to contamination: defined by a 400-day travel time from a point below the water table. This zone has a minimum radius around the source, depending on the size of the abstraction.
- **Zone 3 (Total Catchment)** - Defined as the area around a source within which all groundwater recharge is presumed to be discharged at the source. In confined aquifers, the source catchment may be displaced some distance from the source. For heavily exploited aquifers, the final Source Catchment Protection Zone can be defined as the whole aquifer recharge area where the ratio of groundwater abstraction to aquifer recharge (average recharge multiplied by outcrop area) is >0.75. Individual source protection areas will still be assigned to assist operators in catchment management.
- **Zone 4 (Zone of special interest**) – A fourth zone SPZ4 or 'Zone of Special Interest' usually represents a surface water catchment which drains into the aquifer feeding the groundwater supply (i.e. catchment draining to a disappearing stream). In the future this zone will be incorporated into one of the other zones, SPZ 1, 2 or 3, whichever is appropriate in the particular case, or become a safeguard zone.

GSPZs in the Local Plan Review area

Several GSPZs of varying size have been identified within the northern half of Sevenoaks District. As shown in **Error! Reference source not found.**, the majority of these GSPZs are situated north of Sevenoaks Weald.

11.8 Nitrate Vulnerable Zones

Nitrate Vulnerable Zones (NVZs) are areas designated as being at risk from agricultural nitrate pollution. Nitrate levels in waterbodies are affected by surface water runoff from surrounding agricultural land entering receiving waterbodies.

The level of nitrate contamination will potentially influence the choice of SuDS and should be assessed as part of the design process. The definition of each NVZ is as follows:

- **Groundwater NVZ** – an area of land where groundwater supplies are at risk from containing nitrate concentrations exceeding the 50mg/l level dictated by the EU's Surface Water Abstraction Directive (1975) and Nitrates Directive (1991).
- **Surface Water NVZ** – an area of land where surface waters (in particular those used or intended for the abstraction of drinking water) are at risk from containing nitrate concentrations exceeding the 50 mg/l dictated by the EU's Surface Water Abstraction Directive (1975) and Nitrate Directive (1991).
- **Eutrophic NVZ** – an area of land where nitrate concentrations are such that they could / will trigger the eutrophication of freshwater bodies, estuaries, coastal waters and marine waters.

The locations of the Nitrate Vulnerable Zones in the Local Plan Review area are shown in Figure 11-4.

Figure 11-3: Groundwater Source Protection Zones in the Local Plan area

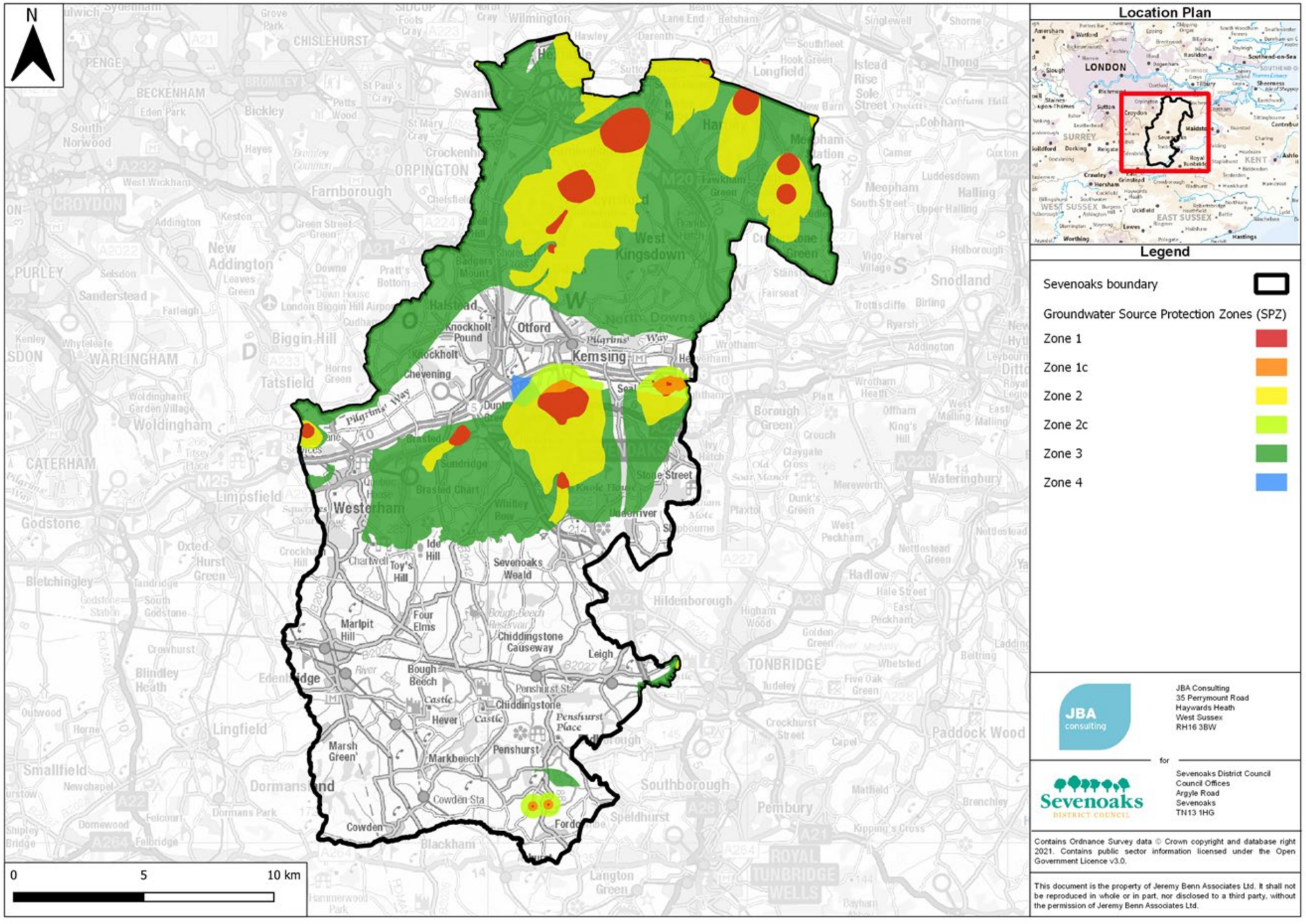
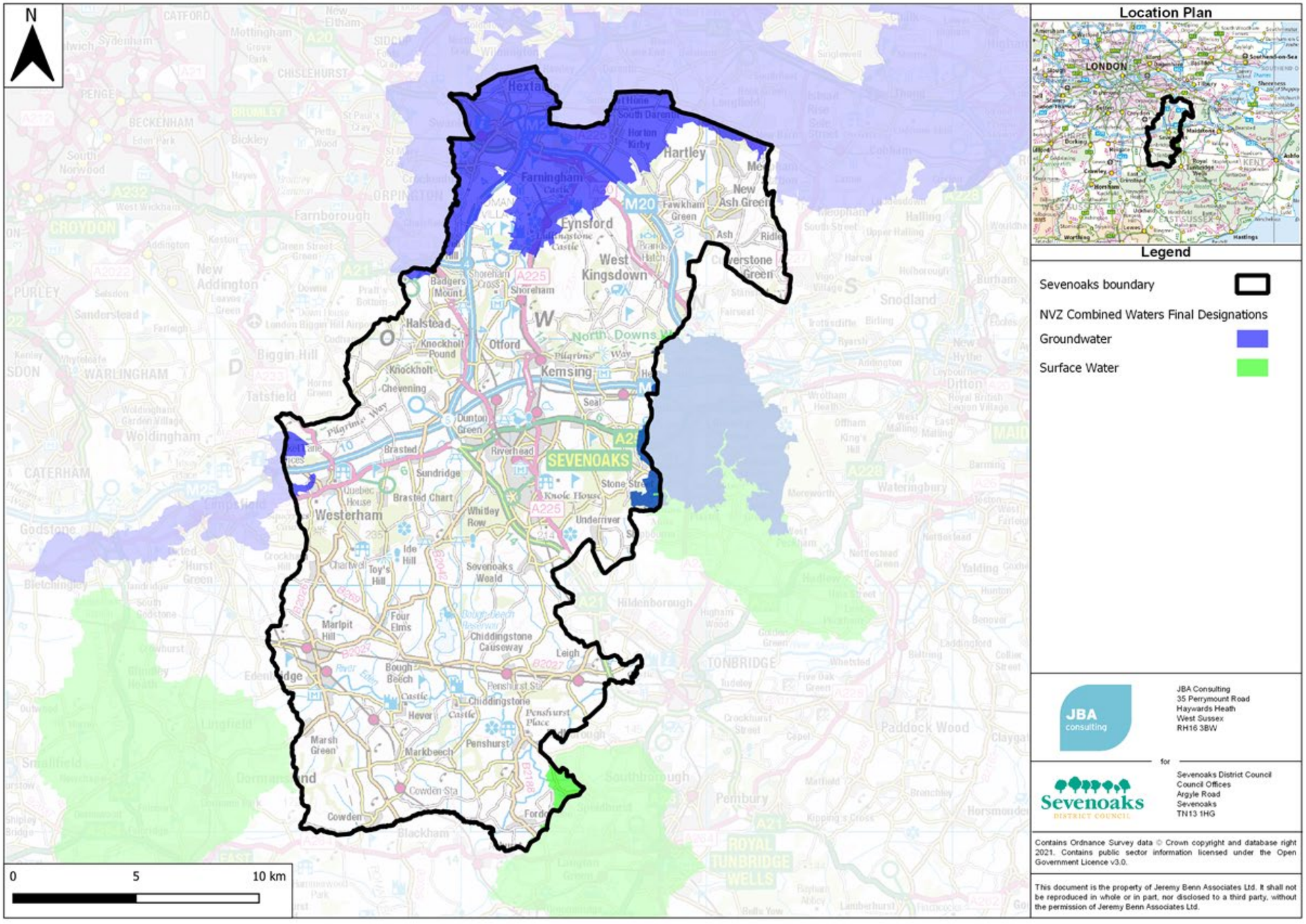


Figure 11-4: Nitrate Vulnerable Zones in the Local Plan area



12 Flood warning and emergency planning

12.1 Flood emergencies

Emergency planning is one option to help manage flood related incidents. From a flood risk perspective, emergency planning can be broadly split into three phases: before, during and after a flood. The measures involve developing and maintaining arrangements to reduce, control or mitigate the impact and consequences of flooding and to improve the ability of people and property to absorb, respond to and recover from flooding.

In development planning, a number of emergency planning activities are already integrated in national building control and planning policies e.g. the NPPF Flood Risk Vulnerability and Flood Zone 'Compatibility' table seeks to avoid inappropriate development in areas at risk from all sources of flooding. Flood warning and emergency planning is a last resort after using this SFRA to undertake the Sequential Test appropriately first.

However, safety is a key consideration for any new development and includes residual risk of flooding, the availability of adequate flood warning systems for the development, safe access and egress routes and evacuation procedures.

The Association of Directors of Environment, Economy, Planning and Transport (ADEPT) and the Environment Agency have published a **Flood Risk Emergency Plans for New Development**[93] document which provides guidance for Local Planning Authorities regarding their decisions over planning applications.

The **NPPF Planning Practice Guidance** outlines how developers can ensure safe access and egress to and from development in order to demonstrate that development satisfies the second part of the Exception Test. As part of an FRA, the developer should review the acceptability of the proposed access in consultation with the LPA and the Environment Agency.

There are circumstances where a flood warning and evacuation plan is required and / or advised:

- It is a **requirement under the 2019 NPPF** that safe access and escape routes are included in an FRA where appropriate, as part of an agreed emergency plan.
- The **Environment Agency and Defra's standing advice**[94] for undertaking flood risk assessments for planning applications states that details of emergency escape plans will be required for any parts of the building that are below the estimated flood level.

It is recommended that Emergency Planners at Sevenoaks District Council are consulted prior to the production of any emergency flood plan.

In addition to the **flood warning and evacuation plan considerations listed in the NPPF / NPPG**, it is advisable that developers also acknowledge the following:

- How to manage the consequences of events that are un-foreseen or for which no warnings can be provided e.g. managing the residual risk of a breach
- Proposed new development that places additional burden on the existing response capacity of the Councils will not normally be considered to be appropriate

93 Flood Risk Emergency Plans for New Development. ADEPT, Environment Agency. (2019). https://www.adeptnet.org.uk/system/files/documents/ADEPT%20%26%20EA%20Flood%20risk%20emergency%20plans%20for%20new%20development%20September%202019....pdf

94Flood Risk Assessment Standing Advice. Environment Agency. (2021) https://www.gov.uk/guidance/flood-risk-assessment-standing-advice

- Developers should encourage those owning or occupying developments, where flood warnings can be provided, to sign up to receive these warnings. This applies even if the development is defended to a high standard
- The vulnerability of site occupants
- Situations may arise where occupants cannot be evacuated (e.g. prisons) or where it is safer to remain "in-situ" and / or move to a higher floor or safe refuge area (e.g. at risk of a breach). These allocations should be assessed against the outputs of the SFRA and where applicable, a site-specific Flood Risk Assessment to help develop emergency plans.

Further emergency planning information links:

- **2004 Civil Contingencies Act**[95]
- **DEFRA (2014) National Flood Emergency Framework for England**[96]
- **Sign up for Flood Warnings with the Environment Agency**[97]
- **National Flood Forum**[98]
- **GOV.UK Make a Flood Plan guidance and templates**[99]
- **FloodRe**[100]

12.2 Flood Warning Systems

Flood warnings can be derived and, along with evacuation plans, can inform emergency flood plans or flood response plans. The Environment Agency is the lead organisation for providing warnings of fluvial flooding (for watercourses classed as Main Rivers) and coastal flooding in England. Flood Warnings are supplied via the Flood Warning Service (FWS), to homes and business within Flood Zones 2 and 3. The different levels of warnings are shown in **Error! Reference source not found.**.

95Civil Contingencies Act. UK Government. (2004). https://www.legislation.gov.uk/ukpga/2004/36/contents

96 National Flood Emergency framework for England. Defra, Environment Agency, Public Health England. (2014). https://www.gov.uk/government/publications/the-national-flood-emergency-framework-for-england

97Sign up for Flood Warnings. Environment Agency. https://www.gov.uk/sign-up-for-flood-warnings

98National Flood Forum website. https://nationalfloodforum.org.uk/

99 Prepare for flooding. UK Government. https://www.gov.uk/prepare-for-flooding/future-flooding

100 FloodRe website. https://www.floodre.co.uk/

Table 12-1: Environment Agency Flood Warnings

Flood Warning Symbol	What it means	What to do
	Flood Alerts are used to warn people of the possibility of flooding and encourage them to be alert, stay vigilant and make early preparations. It is issued earlier than a flood warning, to give customers advance notice of the possibility of flooding, but before there is full confidence that flooding in Flood Warning Areas is expected.	• Be prepared to act on your flood plan • Prepare a flood kit of essential items • Monitor local water levels and the flood forecast on the Environment Agency website • Stay tuned to local radio or TV • Alert your neighbours • Check pets and livestock • Reconsider travel plans
	Flood Warnings warn people of expected flooding and encourage them to take action to protect themselves and their property.	• Move family, pets and valuables to a safe place • Turn off gas, electricity and water supplies if safe to do so • Seal up ventilation system if safe to do so • Put flood protection equipment in place • Be ready should you need to evacuate from your home • 'Go In, Stay In, Tune In'
	Severe Flood Warnings warn people of expected severe flooding where there is a significant threat to life.	• Stay in a safe place with a means of escape • Co-operate with the emergency services and local authorities • Call 999 if you are in immediate danger
Warning no longer in force	Informs people that river or sea conditions begin to return to normal and no further flooding is expected in the area. People should remain careful as flood water may still be around for several days.	• Be careful. Flood water may still be around for several days • If you've been flooded, ring your insurance company as soon as possible

12.2.1 Flood Alert and Warning Areas in Sevenoaks District

There are currently three Flood Alert Areas and six Flood Warning Areas covering Sevenoaks District. The coverage of the Flood Alerts and Flood Warning Areas can generally be spilt into two areas: those covering the fluvial corridors of the River Eden and River Medway in the southern section of the district, and those covering fluvial corridor of the River Darent in the central and north-western section of the district. Approximately 15% of the district is located within a Flood Alert and Warning Area.

Appendix A shows the FWA coverage for Sevenoaks District. If your home or business falls within the FWA coverage, this means that the Environment Agency can provide you with flood warnings.

12.2.2 Groundwater alerts

In selected areas, the Environment Agency can provide a groundwater alert / warning. These tend to be for communities located on chalk bedrock or known have a history of groundwater flooding. If a groundwater alert is issued, this does not necessarily mean that properties within its coverage are definitely at risk. The Environment Agency note that the alerts cover large areas that could be affected if groundwater levels are high and that groundwater is difficult to predict as the location of the flooding is normally related to the local geology. The Environment Agency only provide a limited groundwater alert service and this does not currently cover the Sevenoaks area.

12.2.3 Lead times and onset of flooding

Flood alerts and warnings provide advanced notification that flooding is possible or expected. The time from when the alert or warning is issued to the onset of property flooding (termed the lead time) can provide time for people to prepare for flooding. The Environment Agency endeavour to give a two-hour lead time for issuing Flood Warnings; however, for fast responding catchments and areas at risk of flash flooding, this may not be possible.

A failure or breach of flood defences can cause immediate and rapid inundation to areas located near the vicinity of the breach or failure. Such incidents can pose a significant risk to life given the near lack of warning and lead time to prepare or respond.

For developers, it is therefore important to consider how to manage the consequences of events that are un-foreseen or for which no warnings can be provided. A typical example would be managing the residual risk of a flood defence breach or failure.

12.3 Managing flood emergencies

Kent County Council's **Kent Resilience Forum** (KRF) is one of a number of Local Resilience Forums (LRFs) that have bene set up across England. The overall aim of an LRF is to ensure that the various agencies and organisations plan and subsequently work together so that responses to emergencies are coordinated appropriately[101]. The KRF is made up of a number of different agencies and organisations that work together across a range of areas including planning for emergencies.

12.3.1 Kent County Council Flood Response Plan

The **Kent County Council Flood Response Plan** (Dec 2019)[102] sets out the principles that govern the Kent County Council's response to a significant flooding event within their local authority administrative area. The Plan was produced to meet the requirements of the Civil Contingencies Act 2004, and is built upon the existence and maintenance by Category 1 and 2 Responders of their own plans for response to flooding.

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101 Kent County Council: Flood Risk to Communities Tonbridge and Malling (March 2016)

102 Kent County Council Flood Response Plan (Dec 2019): https://www.kent.gov.uk/__data/assets/pdf_file/0019/12097/Flood-response-plan.pdf

Category 1 Responders for Sevenoaks are:

- Kent County Council
- Sevenoaks District Council
- Kent Police
- Kent Fire and Rescue Service
- South East Coast Ambulance Service
- Environment Agency

The Category 2 Responders for Sevenoaks are utility and transport providers, such as Southern Water, Thames Water, Network Rail etc.

The response plan provided information on Kent County Council's actions, roles and responsibility in response to a flood emergency in their administrative area.

12.4 Emergency planning and development

12.4.1 NPPF

The NPPF Flood Risk Vulnerability and Flood Zone 'Compatibility' table seeks to avoid inappropriate development in areas at risk from all sources of flooding. It is essential that any development which will be required to remain operational during a flood event is located in the lowest flood risk zones to ensure that, in an emergency, operations are not impacted on by flood water or that such infrastructure is resistant to the effects of flooding such that it remains serviceable/operational during 'upper end' events, as defined in the Environment Agency's Climate Change allowances (Updated in March 2020). For example, the NPPF classifies police, ambulance and fire stations and command centres that are required to be operational during flooding as Highly Vulnerable development, which is not permitted in Flood Zones 3a and 3b and only permitted in Flood Zone 2 providing the Exception Test is passed. Essential infrastructure located in Flood Zone 3a or 3b must be operational during a flood event to assist in the emergency evacuation process. All flood sources such as fluvial, surface, groundwater, sewers and artificial sources (such as canals and reservoirs) should be considered. In particular sites should be considered in relation to the areas of drainage critical problems highlighted in the relevant SWMPs.

The outputs of this SFRA should be compared and reviewed against any emergency plans and continuity arrangements. This includes the nominated rest and reception centres (and perspective ones), so that evacuees are outside of the high-risk Flood Zones and will be safe during a flood event.

12.4.2 Safe access and egress

The NPPF Planning Practice Guidance outlines how developers can secure safe access and egress to and from development in order to demonstrate that development satisfies the second part of the Exception Test. Access considerations should include the voluntary and free movement of people during a 'design flood' as well as for the potential of evacuation before a more extreme flood. The access and egress must be functional for changing circumstances over the lifetime of the development. The NPPF Planning Practice Guidance sets out that:

- Access routes should allow occupants to safely access and exit their dwellings in design flood conditions. Vehicular access to allow the emergency services to safely reach the development during design flood conditions will also normally be required.
- Where possible, safe access routes should be located above design flood levels and avoid flow paths including those caused by exceedance and blockage. Where this is unavoidable, limited depths of flooding may be acceptable providing the proposed access is designed with appropriate

signage etc. to make it safe. The acceptable flood depth for safe access will vary as this will be dependent on flood velocities and risk of debris in the flood water. Even low levels of flooding can pose a risk to people in situ (because of, for example, the presence of unseen hazards and contaminants in floodwater, or the risk that people remaining may require medical attention).

The depth, velocity and hazard mapping from hydraulic modelling should help inform the provision of safe access and egress routes.

As part of an FRA, the developer should review the acceptability of the proposed access in consultation with Sevenoaks District Council and the Environment Agency. Site and plot specific velocity and depth of flows should be assessed against standard hazard criteria to ensure safe access and egress can be achieved.

12.4.3 Potential evacuations

During flood incidents, evacuation may be considered necessary. The NPPF Planning Guidance states practicality of safe evacuation from an area will depend on:

1. the type of flood risk present, and the extent to which advance warning can be given in a flood event;
2. the number of people that would require evacuation from the area potentially at risk;
3. the adequacy of both evacuation routes and identified places that people could be evacuated to (and taking into account the length of time that the evacuation may need to last); and
4. sufficiently detailed and up to date evacuation plans being in place for the locality that address these and related issues.

The vulnerability of the occupants is also a key consideration. The NPPF and application of the Sequential Test aims to avoid inappropriate development in flood risk areas. However, developments may contain proposals for mixed use on the same site. In this instance, the NPPF Planning Practice Guidance states that layouts should be designed so that the most vulnerable uses are restricted to higher ground at lower risk of flooding, with development which has a lower vulnerability (parking, open space etc.) in the highest risk areas, unless there are overriding reasons to prefer a different location. Where the overriding reasons cannot be avoided, safe and practical evacuation routes must be identified.

The Environment Agency and Defra provide standing advice for undertaking flood risk assessments for planning applications. Please refer to **the government website**[103] for the criteria on when to follow the standing advice. Under these criteria, you will need to provide details of emergency escape plans for any parts of the building that are below the estimated flood level. The plans should show:

- single storey buildings or ground floors that do not have access to higher floors can access a space above the estimated flood level, e.g. higher ground nearby;
- basement rooms have clear internal access to an upper level, e.g. a staircase; and

103 Environment Agency and DEFRA (2012) Flood risk assessments if you're applying for planning permission, available at: https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications [Accessed 11/06/2020]

- occupants can leave the building if there is a flood and there is enough time for them to leave after flood warnings[104].

Situations may arise where occupants cannot be evacuated (e.g. prisons) or where it is safer to remain "in-situ" and / or move to a higher floor or safe refuge area (e.g. developments located immediately behind a defence and at risk of a breach). These allocations should be assessed against the outputs of the SFRA and where applicable, a site-specific Flood Risk Assessment to help develop appropriate emergency plans.

12.4.4 Flood warning and evacuation plans

Flood warning and evacuation plans are potential mitigation measures to manage the residual risk, as stated in the NPPF Planning Practice Guidance. It is a requirement under the NPPF that a flood warning and evacuation plan is prepared for sites at risk of flooding used for holiday or short-let caravans and camping and are important at any site that has transient occupants (e.g. hostels and hotels).

A flood warning and evacuation plan should detail arrangements for site occupants on what to do before, during and after a flood as this will help to lessen its impact, improve flood response and speed up the recovery process. The Environment Agency provides practical advice and templates on how to prepare flood plans for individuals, communities and businesses (see text box for useful links).

It is recommended that emergency planners at Kent County Council are consulted prior to the production of any emergency flood plan. The council will provide guidance to help local communities to protect their home and valuables and understand what to do before, during and after a flood.

Once the emergency flood plan is prepared, it is recommended that it is distributed to emergency planners at Kent County Council and the emergency services. When developing a flood warning and evacuation plan, it is recommended that it links in with the **Kent County Council Flood Response Plan[105]** and any existing parish / community level plans.

Guidance documents for preparation of flood response plans

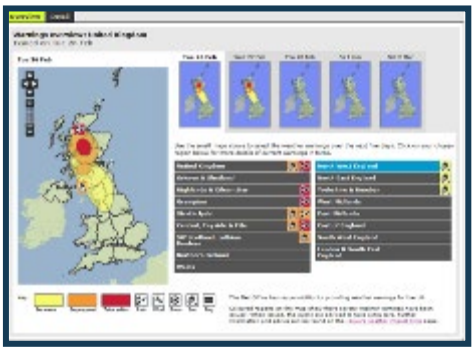
- **Environment Agency (2012) Flooding – minimising the risk, flood plan guidance for communities and groups**
- **Environment Agency (2014) Community Flood Plan template**
- **Environment Agency Personal flood plans**
- **Flood Plan UK 'Dry Run' - A Community Flood Planning Guide**
- **ADEPT and the Environment Agency (2019) - Flood Risk Emergency Plans for New Development**

104 Environment Agency and DEFRA (2012) Flood Risk Assessment: Standing Advice: https://www.gov.uk/flood-risk-assessment-standing-advice

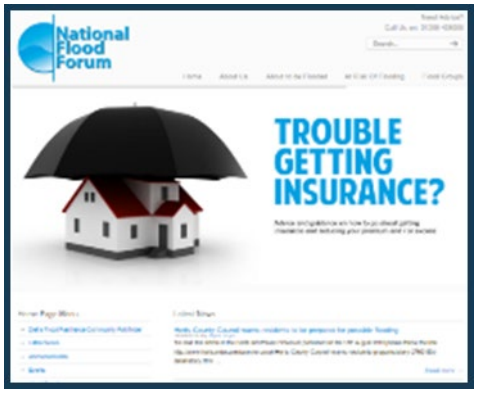
105 Kent County Council Flood Response Plan (December 2019): https://www.kent.gov.uk/__data/assets/pdf_file/0019/12097/Flood-response-plan.pdf

12.4.5 Other sources of information

As well as being a statutory consultee for new development at risk of flooding, the Environment Agency can offer independent technical advice. The Environment Agency website contains a breadth of information on flood risk and there are numerous publications and guidance available. For example, the **flooding from groundwater**[106] guide has been produced by the Environment Agency and Local Government Association to offer practice advice to reduce the impact of flooding from groundwater.



The Met Office provides a National Severe Weather Warning Service about rain, snow, wind, fog and ice. The severity of warning is dependent upon the combination of the likelihood of the event happening and the impact the conditions may have. In simplistic terms, the warnings mean: Yellow: Be Aware, Amber: Be Prepared, Red: Take Action. This service does not provide flood warnings. The Met Office provide many other services and products. For further information, please visit their **website**[107].



The **National Flood Forum**[108] (NFF) is a national charity, set up in 2002 to support those at risk and affected by flooding. The NFF helps people to prepare and recover from flooding as well as campaigning on behalf of flood risk communities, including providing advice on matters such as insurance.

106 Local Government Association and Environment Agency (2011) Flooding from groundwater, available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/297421/flho0911bugi-e-e.pdf [Accessed 11/06/2020]

107 Met office, Find a forecast, available at: https://www.metoffice.gov.uk/ [Accessed 11/06/2020]

108 National Flood Forum, available at https://nationalfloodforum.org.uk/ [Accessed 11/06/2020]

The Individual property flood resilience protection (PFR) measures are design to help protect homes and businesses from flooding. These include a combination of flood resistance measures - trying to prevent water ingress – and flood resilience measures - trying to limit the damage and reduce the impact of flooding, should water enter the building. It is important that any measures have the BSI Kitemark. This shows that the measure has been tested and ensures that it meets industry standards. Please visit the Government website: **Prepare for flooding**[109] for more information.

109 GOV.UK, Prepare for flooding, available at https://nationalfloodforum.org.uk/ [Accessed 11/06/2020]

13 Strategic flood risk solutions

13.1 Introduction

Strategic flood risk solutions may offer a potential opportunity to reduce flood risk in Sevenoaks District. The following sections outline different options which could be considered for strategic flood risk solutions. Any strategic solutions should ensure they are consistent with wider catchment policy and the local policies. It is important that the ability to deliver strategic solutions in the future is not compromised by the location of proposed development. When assessing the extent and location of proposed development consideration should be given to the requirement to secure land for flood risk management measures that provide wider benefits.

Not all measures will be appropriate for all development sites, however this is intended as a guide to identify some of the more common solutions. Discussions should be held with Kent County Council as the LLFA and the Environment Agency where strategic solutions are being considered to confirm their appropriateness. Design guides for many of these solutions are published by **CIRIA**[110].

13.1.1 Middle Medway Strategy

The **Middle Medway Strategy (MMS)**[111] was completed in August 2005 and investigated flood risk management options for the Middle Medway catchment through modelling, economic and strategic environment assessment. The strategy was intended to guide those involved in flood defence and planning to present a business case to justify future works and investment in flood risk management. The MMS was revised in 2010 to set out updated strategic options to manage flood risk from the River Medway, the River Beult and the River Teise. The options outlined included enlarging the capacity of the Leigh FSA from 5.5 million cubic metres to 8.8 million cubic metres to improve the standard of protection for properties along the fluvial River Medway and within Tonbridge in the neighbouring authority.

Along with increasing the FSA in the Medway Catchment, the River Medway CFMP noted that other outcomes of the MMS should be implemented, such as producing feasibility studies for further storage options at upstream locations to benefit locations on or around the confluence of the Medway and its tributaries. This includes the potential construction of a 5.6 million cubic meter flood storage scheme on the River Eden above Edenbridge. The River Thames Flood Risk Management Plan (2016) also recommended implementing the schemes within the MMS to reduce the risk of flooding to communities were possible.

13.2 Flood storage schemes

Flood storage schemes aim to reduce the flows passed downriver to mitigate downstream flooding. Development increases the impermeable area within a catchment, creating additional and faster runoff into watercourses. Flood storage schemes aim to detain this additional runoff, releasing it downstream at a slower rate, to avoid any increase in flood depths and/or frequency downstream. According to the **Environment Agency's Fluvial Design Guide**[112], methods to provide these schemes include:

- enlarging the river channel;
- raising the riverbanks; and/or
- constructing flood banks set back from the river.

110 CIRIA website. https://www.ciria.org/

111 Middle Medway Strategy (2005): https://gat04-live-1517c8a4486c41609369c68f30c8-aa81074.divio-media.org/filer_public/c4/88/c48851e0-228f-412e-8737-4263aa777ad3/appendix_8_-_middle_medway_strategy_par_v_1_2.pdf

112 Environment Agency: Fluvial Design Guide – Chapter 10. (2010). https://assets.publishing.service.gov.uk/media/60549b7a8fa8f545cf209a29/FDG_chapter_10_-_Flood_storage_works.pdf

Flood storage schemes have the advantage that they generally benefit areas downstream, not just the local area.

The Leigh Flood Storage Area is partially located within Sevenoaks to the south east of the district and across the boundaries of Tunbridge Wells Borough Council and Tonbridge and Malling Borough Council. The Leigh Flood Storage Area and the benefits offered by the scheme are outlined in Section 9.3.2.

13.3 Natural Flood Management

floodplains, rivers and the coast to reduce flood and erosion risk, benefit the natural environment and reduce costs of schemes. Natural flood management requires integrated catchment management and involves those who use and shape the land. It also requires partnership working with neighbouring authorities, organisations and water management bodies. The Environment Agency has developed **Natural Flood Management (NFM) mapping**[113] which displays opportunities for NFM.

Conventional flood prevention schemes may be preferred, but consideration of 're-wilding' rivers upstream could provide cost efficiencies as well as considering multiple sources of flood risk; for example, reducing peak flows upstream such as through felling trees into streams or building earth banks to capture runoff, could be cheaper and smaller-scale measures than implementing flood walls for example. With flood prevention schemes, consideration needs to be given to the impact that flood prevention has on the WFD status of watercourses. It is important that any potential schemes do not have a negative impact on the ecological and chemical status of waterbodies.

A number of the different NFM approaches and techniques are summarised in the following sections.

13.3.1 Catchment and floodplain restoration

Compared to flood defences and flood storage, floodplain restoration represents the most sustainable form of strategic flood risk solution, by allowing watercourses to return to a more naturalised state, and by creating space for naturally functioning floodplains working with natural processes.

Although the restoration of floodplain is difficult in previously developed areas where development cannot be rolled back, the following measures should be adopted:

- Promoting existing and future brownfield sites that are adjacent to watercourses to naturalise banks as much as possible. Buffer areas around watercourses provide an opportunity to restore parts of the floodplain (see Section 10.3)
- Removal of redundant structures to reconnect the river and the floodplain
- Apply the Sequential Approach to avoid new development within the floodplain.

For those sites considered within the Local Plan Review and/or put forward by developers, that also have watercourses flowing through or past them, the sequential approach should be used to locate development away from these watercourses. This will ensure the watercourses retain their connectivity to the floodplain. Loss of floodplain connectivity could potentially increase flooding.

13.3.2 Re-naturalisation

There is potential to re-naturalise a watercourse by re-profiling the channel, removing hard defences, re-connecting the channel with its floodplain and introducing a more natural morphology (particularly in instances where a watercourse has historically been modified

113 Working with Natural Processes. JBA Consulting, Defra, Environment Agency. (2021) wwnp.jbahosting.com

through hard bed modification). Detailed assessments and planning would need to be undertaken to gain a greater understanding of the response to any proposed channel modification.

13.3.3 Structure removal and/ or modification

Structures, both within watercourses and adjacent to them can have significant impacts upon rivers including alterations to the geomorphology and hydraulics of the channel through water impoundment and altering sediment transfer regime, which over time can significantly impact the channel profile including bed and bank levels, alterations to flow regime and interruption of biological connectivity, including the passage of fish and invertebrates.

Many artificial in-channel structures (examples include weirs and culverts) are often redundant and/or serve little purpose and opportunities exist to remove them where feasible. The need to do this is heightened by climate change, for which restoring natural river processes, habitats and connectivity are vital adaptation measures. However, it also must be recognised that some artificial structures may have important functions or historical/cultural associations, which need to be considered carefully when planning and designing restoration work.

In the case of weirs, whilst removal should be investigated in the first instance, in some cases it may be necessary to modify a weir rather than remove it. For example, by lowering the weir crest level or adding a fish pass. This will allow more natural water level variations upstream of the weir and remove a barrier to fish migration.

13.3.4 Bank stabilisation

Bank erosion should be avoided, and landowners encouraged to avoid using machinery and vehicles close to or within the watercourse except where required for maintenance.

There are several techniques that can be employed to restrict the erosion of the banks of a watercourse. In an area where bankside erosion is particularly bad and/or vegetation is unable to properly establish, ecologically sensitive bank stabilisation techniques, such as willow spiling, can be particularly effective. Live willow stakes thrive in the moist environment and protect the soils from further erosion allowing other vegetation to establish and protect the soils.

13.4 Green Infrastructure

Green infrastructure (GI) is a planned and managed network of natural environmental components and green spaces that intersperse and connect the urban centres, suburbs and rural fringe and consist of:

- Open spaces – parks, woodland, nature reserves, lakes
- Linkages – River corridors and canals, and pathways, cycle routes and greenways
- Networks of "urban green" – private gardens, street trees, verges and green roofs.

The identification and planning of Green Infrastructure is critical to sustainable growth. It merits forward planning and investment as much as other socio-economic priorities such as health, transport, education and economic development. GI is also central to climate change action and is a recurring theme in planning policy. With regards to flood risk, green spaces can be used to manage storm flows and free up water storage capacity in existing infrastructure to reduce risk of damage to urban property, particularly in city centres and vulnerable urban regeneration areas. Green infrastructure can also improve accessibility to waterways and improve water quality, supporting regeneration and improving opportunity for leisure, economic activity and biodiversity.

13.5 Engaging with key stakeholders

Flood risk to an area or development can often be attributed to a number of sources such as fluvial, surface water and/or groundwater. In rural areas the definition between each type of flood risk is more distinguished. However, within urban areas flooding from multiple sources can become intertwined. Where complex flood risk issues are highlighted it is important that all stakeholders are actively encouraged to work together to identify issues and provide suitable solutions.

Engagement with riparian owners is also important to ensure they understand their rights and responsibilities including:

- maintaining river bed and banks;
- allowing the flow of water to pass without obstruction; and
- controlling invasive alien species e.g. Japanese knotweed.

More information about riparian owner responsibilities can be found in the Environment Agency's guidance on **Owning a Watercourse**[114] (2018).

114 Guidance: Owning a watercourse. Environment Agency. (2018). https://www.gov.uk/guidance/owning-a-watercourse

14 Level 1 summary assessment of potential development locations

14.1 Introduction

A total of 371 sites were provided by Sevenoaks District Council as shown in

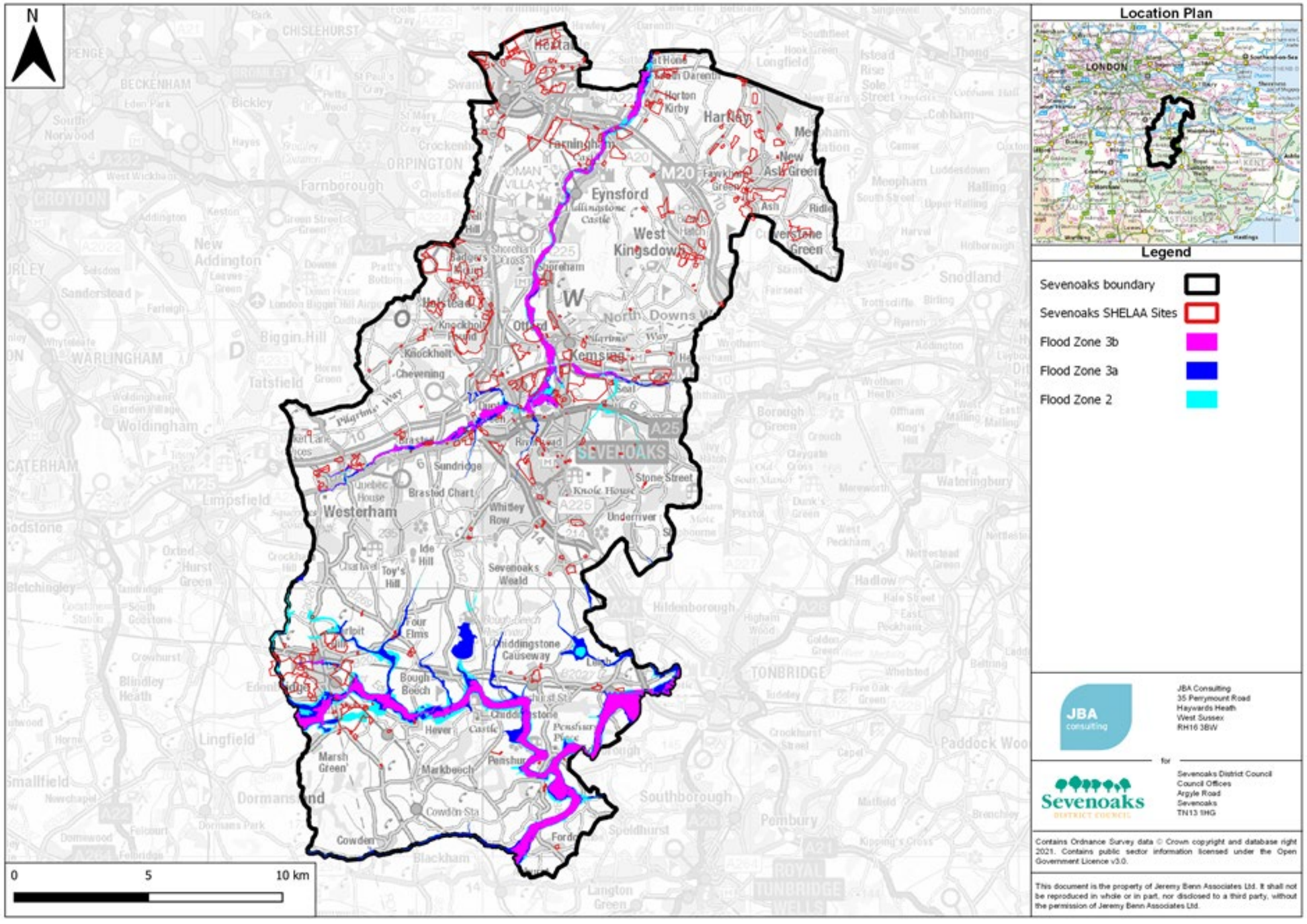
These sites were identified through Sevenoaks District Council's 2021 SHELAA and were screened against a suite of available flood risk information and spatial data to provide a summary of risk to each site (see Appendix C).

The information considered includes the flood risk datasets listed below:

- SFRA Flood Zones 2, 3a and 3b
- Fluvial climate change allowances (including the updated Darent and Cray model outputs)
- Environment Agency Risk of Flooding from Surface Water
- Environment Agency Risk of Flooding from Surface Water with allowances for climate change
- Environment Agency Historic Flood Map
- Kent County Council recorded flood incidents
- JBA Groundwater Flood Map

A site screening spreadsheet has been prepared which identifies the proportion of each site that is affected by the different sources of flooding. The information provided is intended to enable a more informed consideration of the sites when applying the sequential approach. The site screening spreadsheet has been used to determine whether more detailed assessment of sites is needed to further identify those that should be taken forward as potential development allocations for a Level 2 assessment.

Figure 14-1: Sevenoaks SHELAA sites and SFRA flood zones



14.2 Overview of flood risk at identified sites

A summary of flood risk at each of the sites in light of the screening is provided below:

- The majority of the sites have Flood Zone 1 comprising the largest proportion of their area, with 273 sites completely located within Flood Zone 1.
- 51 sites are partially located in Flood Zone 2
- 38 sites are partially located in Flood Zone 3a
- 22 sites are partially located in Flood Zone 3b
- 200 sites are predicted to be at risk during a current day 1% AEP surface water flood event
- 236 sites are predicted to be a risk during a future 1% AEP surface water flood event with a 40% increase in rainfall.
- 51 sites intersect the Environment Agency's historic flood outlines

14.3 Sequential Testing

The SFRA does not include the Sequential Test of the development sites that were screened. However, Appendix C summarises the flood risk to the potential and confirmed development sites and provides evidence for use in the completion of the Sequential Test.

The assessments undertaken for this SFRA will assist Sevenoaks District Council in the preparation of the Sequential Test.

14.4 Cumulative impacts of development on flood risk

Cumulative impacts are defined as the effects of past, current and future activities on the environment. Under the 2021 NPPF, strategic policies and their supporting Strategic Flood Risk Assessments, are required to 'consider cumulative impacts in, or affecting, local areas susceptible to flooding' (para 160).

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

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

The cumulative impacts will be considered in more detail on an individual site basis within the Level 2 SFRA, if this is required. In addition, site-specific FRAs must consider the cumulative impact of the proposed development on flood risk within the wider catchment area if there are potentially material effects.

As part of the Level 1 SFRA, an assessment of the cumulative effects within catchments in Sevenoaks has been undertaken. The cumulative impacts assessment was also carried out in partnership with Tonbridge and Malling Borough Council. This can be found in Appendix B.

14.4.1 Approach and methodology

The approach is based on providing an assessment of catchments where the allocation of more than one site could result in effects that increase the flood risk to third parties. At a strategic level this involves comparison of catchments, to assess the quantum of proposed development and the sensitivity of the catchment to changes in flood risk. Historic flooding incidents are also included in the assessment, as these are an indicator of the actual sensitivity of locations within a catchment to flood events.

The methodology deploys a range of metrics to assess the potential cumulative impacts, which provide a balance between predicted and observed flooding data recorded by Sevenoaks District Council and the Environment Agency. In addition, it was considered important to identify those catchments where an increase in flows (as a result of development) would potentially have the greatest impact upon downstream flood risk.

14.4.2 Datasets

Catchments

The WFD river catchments defined in the River Basin Management Plans and LIDAR data were used to divide Sevenoaks and surrounding local authorities into manageable areas on which to base a cumulative impact assessment. The surrounding local authorities included in the CIA are:

- Bexley London Borough
- Bromley London Borough
- Tandridge District
- Wealden District
- Tunbridge Wells District
- Tonbridge and Malling
- Gravesham District
- Dartford District

Current developed area

OS Open Zoomstack data buildings layer was used to assess the current developed area in each catchment.

Proposed level of growth

To understand areas of Sevenoaks that are likely to experience the greatest pressure for future growth, all potential future development sites received for consideration though the Call for Sites have been analysed. The sites allocated through the Local Plans of neighbouring authorities have also been taken into account within the proposed level of growth for each catchment.

This allowed the calculation of the overall increase in development from the existing scenario to identify catchments likely to be under the greatest pressure for development. The context for this being that in circumstances where the proportion of proposed new development is greater, then it is more likely to give rise to cumulative effects.

It should be noted that it was assumed that all sites will be developed, and that the entire site footprint would be developed.

Historic Flood Risk

A historic flood risk score was derived for each catchment within the study area using the total current number of National Receptor Database (NRD) properties within the Environment Agency's historic flood map extent in each catchment.

Properties sensitive to increased flood risk

It is important to understand which catchments are most sensitive to increases in flood flows which may theoretically be caused by new development. Predicted flood risk was assessed using the following datasets:

- Total number properties within the merged 1% AEP surface water flooding extent and Flood Zone 3a for each catchment
- Total number properties within the merged 0.1% AEP surface water flooding extent and Flood Zone 2

The difference in the number properties at risk in these two datasets has then been used as an indicator to identify which catchments are more sensitive to increases in flood flows.

14.4.3 Ranking of catchments

To identify which catchments are more sensitive to cumulative impacts, each catchment was given a ranking for each of the three metrics (proposed level of growth, historic flood risk and properties sensitive to growth). These rankings were then combined to give an overall ranking which was divided into three categories - high, medium, and low according to how sensitive each catchment is to cumulative impacts relative to one another.

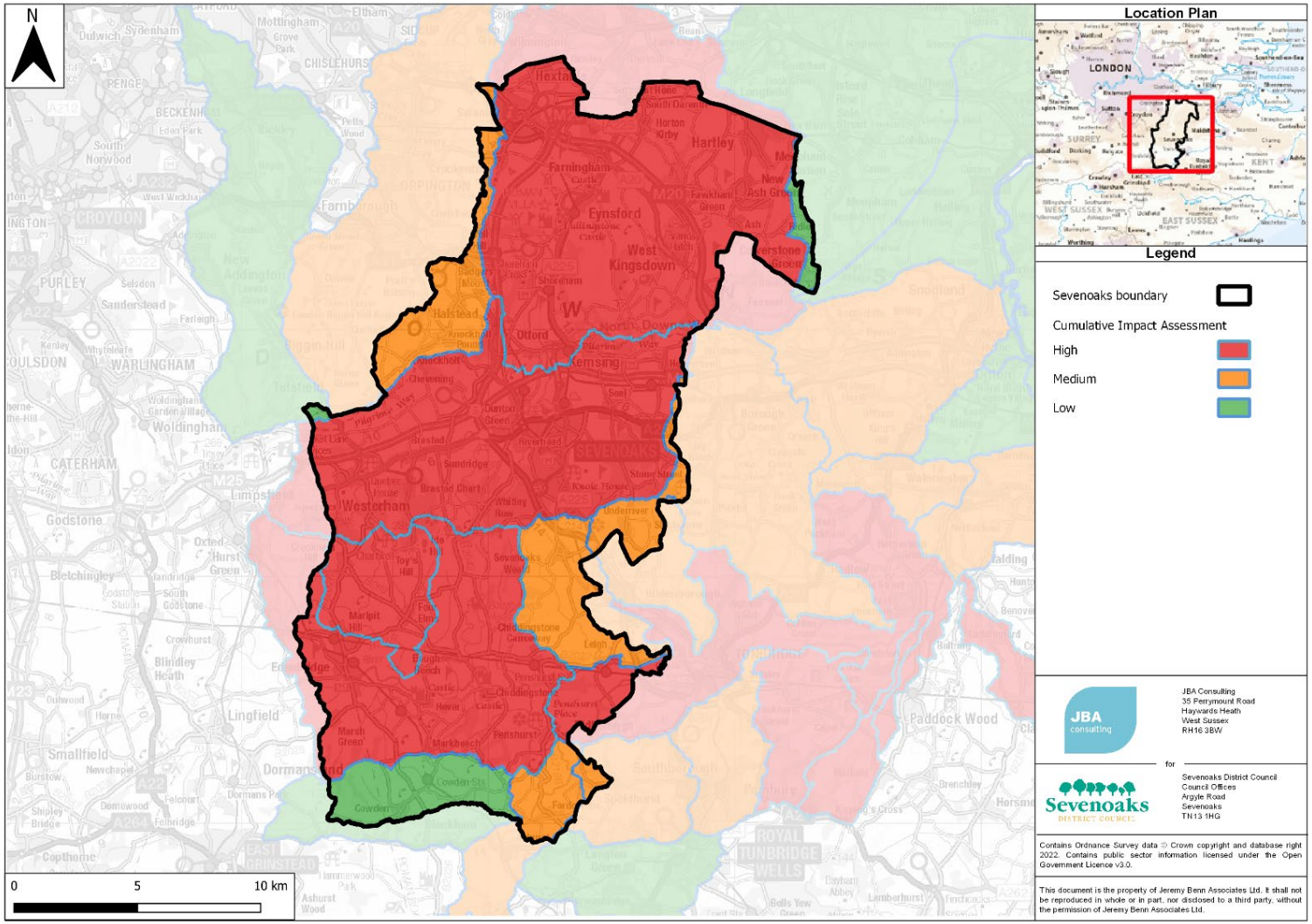
14.4.4 Conclusions of the Cumulative Impact Assessment

A summary of the Cumulative Impacts Assessment results is shown in Figure 14-2. The Cumulative Impact Assessment highlights areas where there is a high chance of encountering cumulative effects from planned development. In these catchments this should be considered by developers and specifically addressed within FRAs for proposed development.

Including consideration of cumulative effects requires that FRAs should assess:

- The location and sensitivity of receptors to cumulative effects and the mechanisms that potentially result in flooding (e.g. locations that are reliant on the performance of pumped drainage systems to manage flood risk, locations where existing flooding is experienced and can be exacerbated by relatively small changes in flood flow magnitude, volume or flood duration, etc).
- The potential quantum of proposed cumulative development within a River Basin and assessment of the effect on sensitive receptors of the cumulative benefit afforded by piecemeal mitigation at the respective allocation sites.
- The requirement for measures to address potential cumulative effects (these can be both 'on-site' measures and contributions to strategic 'off-site' measures).
- The opportunity to integrate site mitigation measures with strategic flood risk management measures planned in the River Basin.
- The long-term commitments to management and maintenance.

Figure 14-2: Cumulative Impact Assessment of WFD Catchments Within Sevenoaks District



15 Summary and Recommendations

15.1 Summary

This Level 1 SFRA delivers a strategic assessment of all sources of flooding in the Local Plan area. It also provides an overview of policy and provides guidance for planners and developers.

The study area comprises the administration area of Sevenoaks District.

15.1.1 Historic flooding

Sevenoaks has experienced a number of recorded flood incidents across the River Darent, Eden and Medway. Data from the EA and local authority indicate flooding was often due to channel capacities being exceeded during intense storms, with no raised defences preventing floodwater overspills. In other cases, flooding was a result of the local drainage network and surface water sources more generally. Data for this spans from 1958 to 2013.

When looking at the River Darent in specific, areas commonly affected by flooding include Eysnford, Shoreham, Chipstead, Farningham, Otford, Sundridge, Brasted and Westerham. While work performed in 1968 aimed to improve channel and floodplain conveyance, problems still remain and the Darent has continued to flood, most notably in 1969, 1971, 1972, 1976, 2003 and 2013 49.

The River Eden and Medway also have a history of flooding. Most notably, Edenbridge, Penshurst and Hilden Brook have all suffered from historic flooding. While intervention has been implemented to reduce risk at Edenbridge in particular, it has still experienced frequent episodes of flooding.

15.1.2 Fluvial flood risk

The River Darent, Eden and Medway are the main watercourses within the Local Plan area identified to be contributing to fluvial flood risk.

Flood Zone mapping of the fluvial flood risk in the Local Plan area has been prepared as part of the Level 1 SFRA and can be found in Appendix A. The key settlements identified to be at risk from fluvial flooding include Dunton Green, which is located close to the Darent as to be expected. Further south, Flood Zone Mapping indicates a high level of fluvial flood risk is situated around the River Eden, most notably around Edenbridge, Hever and Penshurst. This therefore reflects where the majority of Sevenoaks' historic flooding has occurred.

15.1.3 Surface water flood risk

Flooding from surface water runoff (or 'pluvial' flooding) is caused by intense short periods of rainfall and usually affects lower lying areas, often where the natural (or artificial) drainage system is unable to cope with the volume of water. Surface water flooding problems are inextricably linked to issues of poor drainage or drainage blockage by debris, and sewer flooding.

The Risk of Flooding from Surface Water dataset shows that surface water predominantly follows topological flow paths of existing watercourses, dry valleys or roads, with some areas of ponding upslope of topographic features including railway lines and roads. To support this, Sevenoaks has experienced a number of events that have historically been attributed to surface water. The mapped areas of greatest risk also seem to agree with the above as the high risk areas also closely mirror the locations at greatest risk to fluvial flooding. The most notable locations include Edenbridge, Hever and Penshurst, as well as Chipstead.

15.1.4 Groundwater flood risk

The JBA Groundwater Flood Map identifies the majority of Sevenoaks is considered to be at 'no risk' or have a 'low likelihood'. Localised areas of higher risk primarily follow the River Darent in the north of Sevenoaks, and along the River Eden to the south. With that being said, this higher risk area very closely follows the river and are effectively on the river floodplain where development and housing is limited. It should be noted that as this information is based on a national dataset there may be localised differences in groundwater flood risk. Planners and developers should consult the LLFA to find out if they hold any local information.

15.1.5 Reservoir flood risk

Outlines from the Risk of Flooding from Reservoirs dataset (informed from the National Reservoir Inundation Mapping) shows worst case inundation extents of eleven reservoirs impacting the Local Plan area. Areas at risk of flooding from reservoirs include Farningham, Eynsford, Shoreham, Otford, Dunton Green, Chipstead, Edenbridge, Hever and Penshurst.

15.1.6 Sewer flood risk

Sevenoaks falls within both Southern Water and Thames Water's administrative area. Sewer flooding (SIRF) data was requested as part of this study, although this data was only provided by Southern Water. This indicates that there have been at least 49 sewer flooding incidents since 2011 in the district, although the spatial distribution and further details are unknown.

15.1.7 Flood defences

A high-level review of flood defences was carried out for this SFRA, involving an interrogation of existing information on asset condition and standard of protection. There are a number of flood defences is the district, predominantly along the River Medway and River Darent.

The Leigh Flood Storage Area (FSA) plays an important role in managing flood risk in the district. The Leigh FSA is an online storage reservoir which was constructed in 1982 on the River Medway to reduce the risk of flooding in Tonbridge in the neighbouring borough. The FSA consists of an impounding embankment with an outflow through three radial gates. Proposed plans involve raising the maximum water level that can be accommodated within the Leigh Flood Storage Area from a retained level of 26.05m AOD up to 26.00m AOD, to increase the storage provided by the FSA by 24%. This preparation of this scheme is ongoing and until it is fully implemented and operational the potential benefits it affords will not be included in the SFRA.

15.2 Recommendations

A review of national and local policies has been conducted against the information collected on flood risk in this SFRA. Following this, several recommendations have been made for Sevenoaks Council to consider as part of Flood Risk Management in the study area.

15.3 Local Plan recommendations

15.3.1 Local Plan policies

15.3.2 Level 2 Strategic Flood Risk Assessment

This report fulfils Level 1 SFRA requirements. Following the application of the Sequential Test, where sites cannot be appropriately accommodated in Flood Zone 1, Sevenoaks District Council may need to apply the NPPF's Exception Test. In these circumstances, a Level 2 SFRA may be required, to consider the detailed nature of the flood characteristics within a Flood Zone and assessment of other sources of flooding.

If a Level 2 Assessment is required, any updates to the Environment Agency's climate change allowances will be considered when preparing more detailed assessments of hazards and actual risks.

15.3.3 Buffer strips

The provision of buffer strips is important in preserving watercourse corridors, flood flow conveyance and future watercourse maintenance and improvement. It also enables the avoidance of disturbing ecology and the structural integrity of riverbanks.

Developers should:

- Not build within 8m from the edge of bank of any Ordinary Watercourse within the District
- Not build within 8m from the edge of bank of any Main River within the District in accordance with the Environment Permitting Regulations (2016) .
- Seek opportunities on a site-by-site basis to increase these buffer distances to 'make space for water', allowing additional capacity to accommodate climate change.

15.3.4 Reduction of flood risk through site allocations and appropriate site design

- Locate new development in areas of lowest risk, in line with the Sequential Test, by steering sites to Flood Zone 1. If a Sequential Test is undertaken and a site at risk of flooding is identified as the only appropriate site for the development, the Exception Test shall be undertaken.
- After application of Exception Test, a sequential approach to site design must be used to reduce risk. Any re-development within areas of flood risk which provide other wider sustainability benefits should provide flood risk betterment and be made resilient to flooding.
- Identify long-term opportunities to remove development from the floodplain and to make space for water.
- Ordinary watercourses not currently afforded flood maps should be modelled to an appropriate level of detail to enable a sequential approach to the layout of the development.
- Differences in flood extents from climate change should be considered by the Council when allocating sites, to understand how much additional risk there could be, where this risk is in the site, whether the increase is marginal or activates new flow paths, whether it affects access/ egress and how much land could still be developable overall
- Ensure development is 'safe', dry pedestrian egress from the floodplain and emergency vehicular access should be possible for all residential development. If at risk, then an assessment should be made to detail the flood duration, depth, velocity and flood hazard rating in the 1% AEP plus climate change fluvial flood event and the 0.5% AEP plus climate change tidal event, in line with FD2320.
- Where there is a residual risk of flooding (from any source) to properties within a development, residential and commercial finished floor levels should be raised above whichever is higher of either 300mm above the 1% AEP plus climate change fluvial flood level, 300mm above the 0.5% AEP plus climate change coastal flood level or 300mm above the general ground level of the site. Finished floor levels for sleeping accommodation should be raised above whichever is higher of either 600mm above the 1% AEP plus climate change fluvial flood level, 600m above the 0.5% AEP plus climate change coastal flood level or 300mm above the general ground level of the site.
- Protect and Promote Areas for Future Flood Alleviation Schemes.

- Safeguard functional floodplain (Flood Zone 3b in Appendix A) from future development.
- Identify opportunities for brownfield sites at risk of flooding to reduce risk and provide flood risk betterment elsewhere, for example, by incorporating flood storage into sites.
- Identify opportunities to help fund future flood risk management through developer contributions (S106 and Community Infrastructure Levy) to reduce risk for surrounding areas.
- Seek opportunities to make space for water to accommodate climate change.

15.3.5 Promote SuDS to mimic natural drainage routes to improve water quality

- SuDS design should demonstrate how constraints have been considered and how the design provides multiple benefits e.g. landscape enhancement, biodiversity, recreation, amenity, leisure and the enhancement of historical features.
- Planning applications for phased developments should be accompanied by a Drainage Strategy, which takes a strategic approach to drainage provision across the entire site and incorporates adequate provision for SuDS within each phase.
- Use of the SuDS management train to prevent and control pollutants to prevent the 'first flush' polluting the receiving waterbody.
- SuDS are to be designed so that they are easy to maintain, and it should be set out who will maintain the system, how the maintenance will be funded and should be supported by an appropriately detailed maintenance and operation manual.

15.3.6 Reduce surface water runoff from new developments and agricultural land

- SuDS should be considered and implemented as part of all new development, in line with Kent County Council's polices on SuDS and surface water drainage.
- sites and outline proposals.
- Promote biodiversity, habitat improvements and Countryside Stewardship schemes98 to help prevent soil loss and to reduce runoff from agricultural land.

15.3.7 Enhance and restore river corridors and habitat

- Liaise with other asset owners to assess condition of existing assets and upgrade, if required, to ensure that the infrastructure can accommodate pressures / flows for the lifetime of the development.
- Natural drainage features should be maintained and enhanced.
- Identify opportunities for river restoration / enhancement to make space for water.
- A presumption against culverting of open watercourses except where essential to allow highways and / or other infrastructure to cross, in line with CIRIA's Culvert screen and outfall manual, (C786 PR) and to restrict development over culverts.
- There should be no built development within 8m from the top of a Main River or ordinary watercourses within the Local Plan area.
- There should be no built development within 15m of the foot of the landward side of any sea defences or between the low water mark of medium tides and the seaward side of any sea defence.

15.3.8 Mitigate against risk, improved emergency planning and flood awareness

- Work with emergency planning colleagues and stakeholders to identify areas at highest risk and locate most vulnerable receptors away from these areas.

- Exceedance flows, both within and outside of the site, should be appropriately designed to minimise risks to both people and property.
- For a partial or completely pumped drainage system, an assessment should be undertaken to assess the risk of flooding due to any failure of the pumps. The design flood level should be determined if the pumps were to fail; if the attenuation storage was full, and if a design storm occurred.
- An emergency overflow should be provided for piped and storage features above the predicted water level arising from a 100-year rainfall event, inclusive of climate change and urban creep.
- Consideration and incorporation of flood resilience measures up to the 1 in 1,000-year event.
- Ensure robust emergency (evacuation) plans are produced and implemented for major developments.
- Increase awareness and promote sign-up to the Environment Agency Flood Warnings Direct (FWD) within Sevenoaks.

15.4 Technical recommendations

The Environment Agency regularly reviews its flood risk mapping, and it is important that they are approached to determine whether updated (more accurate) information is available prior to commencing a site-specific FRA.

15.4.1 Climate change modelling

This SFRA is based on the best available data at the time of publication and no climate change modelling has been undertaken for this study. New allowances for peak river flows and peak rainfall intensity are expected to be published by the Environment Agency later in 2022.

15.4.2 Updates to SFRA

SFRAs are high level strategic documents and, as such, do not go into detail on an individual site-specific basis. This SFRA has been developed using the best available information, supplied at the time of preparation. This relates both to the current risk of flooding from a range of sources, and the potential impacts of future climate change. Other datasets used to inform this SFRA may also be periodically updated and following the publication of this SFRA, new information on flood risk may be available from Risk Management Authorities. It is recommended that the SFRA is reviewed internally, in line with the Environment Agency's Flood Zone map updates to ensure latest data is still represented in the SFRA, allowing a cycle of review and a review of any updated data by checking for any new information available from RMAs including the Environment Agency and Sevenoaks District Council.

Appendices

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