Sevenoaks District Council Level 1 Strategic Flood Risk Assessment

Final Report

July 2024

Prepared for:
Sevenoaks District Council

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Contract

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This report describes work commissioned by Sevenoaks District Council, by an instruction dated 17 August 2023. The Client's representative for the contract was Carlyn Kan of Sevenoaks District Council. Lucy Briscoe, Elise Coughlin and Harriet Freestone of JBA Consulting carried out this work.

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The conclusions and recommendations contained in this Report are based upon information provided by others and upon the assumption that all relevant information has been provided by those parties from whom it has been requested and that such information is accurate. Information obtained by JBA has not been independently verified by JBA, unless otherwise stated in the Report.

The methodology adopted and the sources of information used by JBA in providing its services are outlined in this Report. The work described in this Report was undertaken between August 2023 and March 2024 and is based on the conditions encountered and the information available during the said period. The scope of this Report and the services are accordingly factually limited by these circumstances.

Acknowledgements

We would like to acknowledge the assistance of

- Sevenoaks District Council;
- Environment Agency;
- Kent County Council;
- Neighbouring Authorities;
- Thames Water; and
- Southern Water

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Abbreviations

AEP	Annual Exceedance Probability
BGS	British Geological Survey
BSI	British Standards Institution
CFMP	Catchment Flood Management Plan
CIA	Cumulative Impact Assessment
CIL	Community Infrastructure Levy
CIRIA	Construction Industry Research and Information Association
Defra	Department for Environment, Food and Rural Affairs
DPD	Development Plan Documents
DTM	Digital Terrain Model
DWMP	Drainage and Wastewater Management Plan
EA	Environment Agency
EU	European Union
FCERM	Flood and Coastal Erosion Risk Management
FCERM GiA	Flood and Coastal Erosion Risk Management grant-in-aid
FRA	Flood Risk Assessment
FRM	Flood Risk Management
FRMP	Flood Risk Management Plan
FSA	Flood Storage Area
FWMA	Flood and Water Management Act
FWS	Flood Warning Service
GI	Green Infrastructure
GSPZ	Groundwater Source Protection Zone
HELAA	Housing and Economic Land Availability Assessment
IDB	Internal Drainage Board
JBA	Jeremy Benn Associates
KCC	Kent County Council
KRF	Kent Resilience Forum
LFRMS	Local Flood Risk Management Strategy
LIDAR	Light Detection and Ranging
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
LRF	Local Resilience Forum

mAOD	metres Above Ordnance Datum
MHCLG	Ministry of Housing Communities & Local Government
MMS	Middle Medway Strategy
NFM	Natural Flood Management
NPPF	National Planning Policy Framework
NVZ	Nitrate Vulnerable Zones
OS	Ordnance Survey
PFR	Property Flood Resilience
PFRA	Preliminary Flood Risk Assessment
PPG	Planning Practice Guidance
RBMP	River Basin Management Plans
RMA	Risk Management Authority
RoFSW	Risk of Flooding from Surface Water
SAB	Safety Advisory Board
SFRA	Strategic Flood Risk Assessment
SHLAA	Strategic Housing Land Availability Assessment
SPZ	Source Protection Zone
SoP	Standard of Protection
SuDS	Sustainable Drainage Systems
SWMP	Surface Water Management Plan
UKCP09	UK Climate Projections 2009
UKCP18	UK Climate Projections 2018
WFD	Water Frame Directive

Definitions

Annual Exceedance Probability: The probability that a flood of a given magnitude will occur within a period of one year.

Brownfield: Previously developed parcel of land.

Climate Change: Long term variations in global temperature and weather patterns caused by natural and human actions.

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.

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.

Flood Defence: Systems put in place to reduce, or ideally prevent, damage by flood water.

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. These were revoked in December 2023.

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 or watercourse.

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.

Green Infrastructure: a network of natural environmental components and green spaces that intersperse and connect the urban centres, suburbs and urban fringe.

Greenfield: Undeveloped parcel of land

Housing and Economic Land Availability Assessment: An appraisal of the amount of land available for housing and economic use and is required in order to assess the capacity of suitable land.

Indicative Flood Risk Area: Nationally identified flood risk areas, based on the definition of ‘significant’ flood risk described by Defra.

Lead Local Flood Authority: Local Authority responsible for taking the lead on local flood risk management.

Main River: A watercourse shown as such on the Main River Map, and for which the Environment Agency has responsibilities and powers.

Ordinary Watercourse: All watercourses that are not designated Main River. Local Authorities or, where they exist, Internal Drainage Boards (IDBs) have similar permissive powers as the Environment Agency in relation to flood defence work. However, the riparian owner has the responsibility of maintenance.

Pluvial Flooding: Flooding as a result of high intensity rainfall when water is ponding or flowing over the ground surface (surface runoff) before it enters the underground drainage network or watercourse or cannot enter it because the network is full to capacity (see also Surface Water Flooding).

Resilience Measures: Measures aimed at adapting an internal property, limiting the damage caused if water enters the building; this could include increasing the height of electric sockets.

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.

Sewer Flooding: Flooding caused by a blockage or overflowing in a sewer or urban drainage system.

Strategic Housing Land Availability Assessment: The Strategic Housing Land Availability Assessment (SHLAA) is a technical piece of evidence to 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.

Standard of Protection (SoP): 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.

Sustainable Drainage Systems (SuDS): Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques.

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.

Surface Water Management Plan (SWMP): A SWMP should outline the preferred surface water management strategy and identify actions, timescales and responsibilities of each partner.

Executive Summary

The study area for this Strategic Flood Risk Assessment (SFRA) is the Sevenoaks District Council area. This 2024 document supersedes the previous 2022 Sevenoaks District Council Level 1 SFRA.

The report has been prepared to provide comprehensive and supporting evidence to inform future updates to the Sevenoaks District Local Plan. The Core Strategy, adopted 22 February 2011, along with the Allocations and Development Management Plan, adopted 17 February 2015, forms part of the current Local Plan for the Sevenoaks District. The new Local Plan will be submitted for public examination, by a government-appointed Planning Inspector, in early 2025.

The SFRA update was required to be compliant with the latest guidance described in the updated 2022 Planning Policy Guidance (PPG). The 2024 SFRA provides flood risk evidence and a long term strategy to support the management and planning of development to protect the environment and deliver infrastructure. It also supports the selection of site allocations in the Local Plan and provides information and guidance to be used in the preparation of Flood Risk Assessments in support of site specific planning applications.

SFRA Objectives

The key objectives of the 2024 SFRA update are:

- To provide up to date information and guidance on flood risk in Sevenoaks District, taking into account the latest flood risk information (including the probable impacts of climate change), the current state of national planning policy and legislation and relevant studies.
- To provide the basis for applying the flood risk Sequential Test, and if necessary the Exception Test.
- To provide a comprehensive set of maps presenting flood risk from all sources that can be used as part of the evidence base for the Local Plan and to support the preparation of Neighbourhood Plans.
- To inform decisions on the location of future development and the preparation of sustainable policies for the long-term management of flood risk.
- To identify and provide recommendations on opportunities to reduce the causes and impacts of flooding to existing communities and developments.

SFRA Outputs

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

- Assessment of all potential sources of flooding
- Assessment of the potential impact of climate change on flood risk
- An assessment of surface water management issues and the application of Sustainable Drainage Systems (SuDS)

- A review and update of any new and amended data sources (e.g. Catchment Flood Management Plans, Preliminary Flood Risk Assessment, Updated Flood Maps and modelling, etc)
- 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
- Guidance for developers including requirements for site-specific flood risk assessments
- Mapping of location and extent of functional floodplain
- Mapping areas at risk from other sources including surface water, sewer, ground water and reservoirs
- Mapping areas covered by an existing flood alert / warning
- Identification of opportunities to reduce flood risk
- High-level screening of proposed development sites against flood risk information
- Identification of flood defence infrastructure.

Summary of Assessment

Flood Risk

Historic flooding

The Sevenoaks District has a notable history of flooding, primarily resulting from 'fluvial' sources, or river and ordinary watercourse overflows. Significant flood events occurred in the years 1958, 1960, 1968, 2000, and 2002/2003 and winter of 2013/14.

- Fluvial flood risk: Within Sevenoaks District, the main fluvial flooding sources are from the River Darent, River Eden and River Medway.
- Surface water flood risk: The mapping identifies some constrained surface water flow paths within the District's urban areas, including Sevenoaks, Swanley, Edenbridge and Kemsing
- Groundwater flood risk: JBA's Groundwater Flood Risk map shows that the areas with the shallowest groundwater levels generally follow the flow paths of the major watercourses in the Sevenoaks District.
- Flooding from reservoirs: There is a potential risk of flooding from reservoirs both within the district and those outside. The level and standard of inspection and maintenance required under the Reservoirs Act means that the risk of flooding from reservoirs is relatively low. However, there is a residual risk of a reservoir breach and this risk should be considered in any site-specific Flood Risk Assessments (where relevant).
- Sewer flood risk: A significant number of locations within the Sevenoaks District area are at risk of flooding in a 1 in 50 year storm and at risk of flooding due to hydraulic overload including Edenbridge, Swanley and Sevenoaks.

Flood defences

Raised defences are present in Edenbridge, Brasted, and Leigh, offering protection from river flooding. Leigh's defences are part of the Leigh Flood Storage Area (FSA), aimed at reducing flood risks in Tonbridge by attenuating flows from the Upper Medway catchment.

Development and flood risk

The Sequential and Exception Test procedures for both Local Plans and Flood Risk Assessments have been documented, along with guidance for planners and developers. Links have been provided for various guidance documents and policies published by other Risk Management Authorities, such as the LLFA and the Environment Agency.

Use of SFRA data

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 rivers, the sea and surface water and where available the potential effects of future climate change.

It should be noted that the Environment Agency's Flood Map for Planning is correct as of the date of this report, therefore online datasets should be checked and where different the online datasets should be used as the latest available data. When using the SFRA to prepare FRAs it is important to check that the most up to date information is used, as is described in amendments to the flood mapping prepared and issued by the Environment Agency at regular intervals.

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 provided by Risk Management Authorities.

How to use this report

Planners

The report has updated the content that was included in the previous SFRA to provide appropriate supporting evidence for the submission of the Local Plan.

This includes how the cumulative impact of development should be considered.

It provides the latest flood risk data and guidance to inform the Sequential Test and provides guidance on how to apply the Exception Test. The Council can use this information to apply the Sequential Test to strategic allocations and identify where the Exception Test will also be needed.

The SFRA provides guidance for developers, which can be used by development management staff to assess whether site-specific Flood Risk Assessments meet the required quality standard.

Developers

For sites that are not strategic allocations, developers will need to use this SFRA to help apply the Sequential Test. For sites which fall into the following categories, whether strategic allocations or windfall sites, developers will need to apply the Exception Test and use information in a site-specific Flood Risk Assessment to inform this test at planning application stage.

- Highly vulnerable and in Flood Zone 2
- Essential infrastructure in Flood Zone 3a or 3b
- More vulnerable in Flood Zone 3a

This is a strategic assessment and does not replace the need for site-specific Flood Risk Assessments. A Flood Risk Assessment is needed for developments:

- in Flood Zones 2 or 3
- more than 1 hectare in Flood Zone 1
- less than 1 hectare in Flood Zone 1, including a change of use in development type to a more vulnerable class, where they could be affected by sources of flooding other than rivers and sea (for example surface water or reservoir flooding)
- in an area within Flood Zone 1 which has critical drainage problems as notified by the Environment Agency
- land identified in an SFRA as being at increased risk in the future

In addition, a surface water drainage strategy will be needed for all major developments in any Flood Zone to satisfy Kent County Council, the Lead Local Flood Authority (LLFA).

Developers can use the information in this SFRA, alongside site-specific research to help scope out what additional work will be needed in a detailed Flood Risk Assessment. At the planning application stage, developers may need to undertake more detailed hydrological and hydraulic assessments of the watercourses to verify flood extent (including latest climate change allowances), inform master planning and demonstrate, if required, that the Exception Test is satisfied. As part of the Environment Agency's updated guidance on climate change, which must be considered for all new developments and planning applications, developers will need to undertake a detailed assessment of climate change as part of the planning application process when preparing FRAs.

Developers need to ensure that new development does not increase surface water runoff from a site or contribute to cumulative effects at sensitive locations.

Site-specific Flood Risk Assessments will need to identify how flood risk will be mitigated to ensure the development is safe from flooding. In high-risk areas, the site-specific Flood Risk Assessment will also need to consider emergency arrangements, including how there will be safe access and egress from the site.

Residual risk is the risk that remains after mitigation measures are considered. The residual risk includes the consideration of flood events that exceed the design thresholds of the flood defences or circumstances where there is a failure of the defences, e.g. flood banks

collapse. Residual risks should be considered as part of site-specific Flood Risk Assessments.

Any developments located within an area protected by flood defences and where the standard of protection is not of the required standard (either now or in the future) should be identified and the use of developer contributions considered to fund improvements.

Neighbourhood plans

Neighbourhood planning groups can use this information to assess the risk of flooding to sites within their community. The SFRA will also be helpful for developing community level flood risk policies in high flood risk areas.

Cumulative Impact Assessment

A cumulative impact assessment has been carried out and has identified which catchments in the Sevenoaks District are more sensitive to the cumulative impact of development and where more stringent policy regarding flood risk is recommended. Any development in these areas should seek to contribute to work that reduces wider flood risk in those catchments.

1 Introduction

This section outlines the purpose of a Strategic Flood Risk Assessment and the outputs. It introduces the study area and explains key flood risk management concepts.

1.1 Purpose of the Strategic Flood Risk Assessment

"Strategic policies should be informed by a strategic flood risk assessment, and should manage flood risk from all sources. They should consider cumulative impacts in, or affecting, local areas susceptible to flooding, and take account of advice from the Environment Agency and other relevant flood risk management authorities, such as lead local flood authorities and internal drainage boards" (National Planning Policy Framework, paragraph 166).

Sevenoaks District Council commissioned JBA Consulting to update the Level 1 Strategic Flood Risk Assessment (SFRA) for Sevenoaks District in August 2023. The SFRA study area covers the whole of Sevenoaks District.

The main purpose of the SFRA update is to prepare a document providing a comprehensive and robust evidence base to support the production of Sevenoaks District Council's emerging Local Plan 2040. This can be used to support decision making and 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.

This Level 1 SFRA (2024) document supersedes the previous Level 1 SFRA (2022). The report has updated the content that was included in the previous SFRA and to provide a comprehensive and robust evidence base to support the production of the Sevenoaks District Council's emerging Local Plan 2040.

The SFRA update is also required to be compliant with the latest guidance described in the 2023 revision to the National Planning Policy Framework (NPPF) and subsequent minor amendments, the implications of the August 2022 changes to the Planning Practice Guidance (PPG) and subsequent minor amendments and support the selection of site allocations in the Local Plan and to provide information and guidance to be used in the preparation of Flood Risk Assessments (FRAs) in support of site specific planning applications. The evidence in this SFRA shall also be used to support the formulation of Neighbourhood Plans.

The key objectives of the 2024 SFRA are:

- To provide up to date information and guidance on flood risk in Sevenoaks District, taking into account the latest flood risk information (including the probable impacts of climate change), the current state of national planning policy and legislation and relevant studies
- To provide the basis for applying the flood risk Sequential Test, and if necessary the Exception Test

- To provide a comprehensive set of maps presenting flood risk from all sources that can be used as part of the evidence base for the Local Plan and to support the preparation of Neighbourhood Plans.
- To identify the requirements for site-specific flood risk assessments and the application of Sustainable Drainage Systems (SuDS).

1.2 Levels of SFRA

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

- Level One: 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 Two: where land outside Flood Zones 2 and 3 cannot appropriately accommodate all the necessary development creating the need to apply the NPPF's Exception Test. In these circumstances the assessment should consider the detailed nature of the flood characteristics within a Flood Zone and assessment of other sources of flooding.

This report fulfils the Level 1 SFRA requirements.

1.3 SFRA outputs

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

- Assessment of all potential sources of flooding.
- Assessment of the potential impact of climate change on flood risk.
- An assessment of surface water management issues and the application of Sustainable Drainage Systems (SuDS).
- A review and update of new and amended data sources (e.g., updated Flood Maps and modelling).
- 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.
- Guidance for developers including requirements for site-specific flood risk assessments.
- Mapping of location and extent of functional floodplain.
- Mapping areas at risk from other sources including surface water, sewer, ground water and reservoirs.
- Mapping areas covered by an existing flood alert / warning.
- Identification of opportunities to reduce flood risk.
- High-level screening of proposed development sites against flood risk information
- Identification of flood defence infrastructure.

1.4 SFRA Study area

Sevenoaks District Council covers an area of approximately 370km², with a population of approximately 120,000 according to the 2021 Census. The area is located in West Kent, covering the towns of Sevenoaks and Swanley alongside other smaller towns and villages including Edenbridge, Kemsing, Otford and Westerham. The main rivers which flow through Sevenoaks District include the River Darent, River Eden and River Medway.

Sevenoaks District Council is located within the Kent County Council's administrative area and is bounded by eight other local authorities:

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

An overview of the study area and the neighbouring authorities is displayed in Figure 1-1.

The sewerage companies for the area are Southern Water and Thames Water. South East water provide the potable water. Kent County Council is the Lead Local Flood Authority (LLFA). The Upper Medway Internal Drainage Board (IDB) operates to the south of the District surrounding the Rivers Eden and Medway.

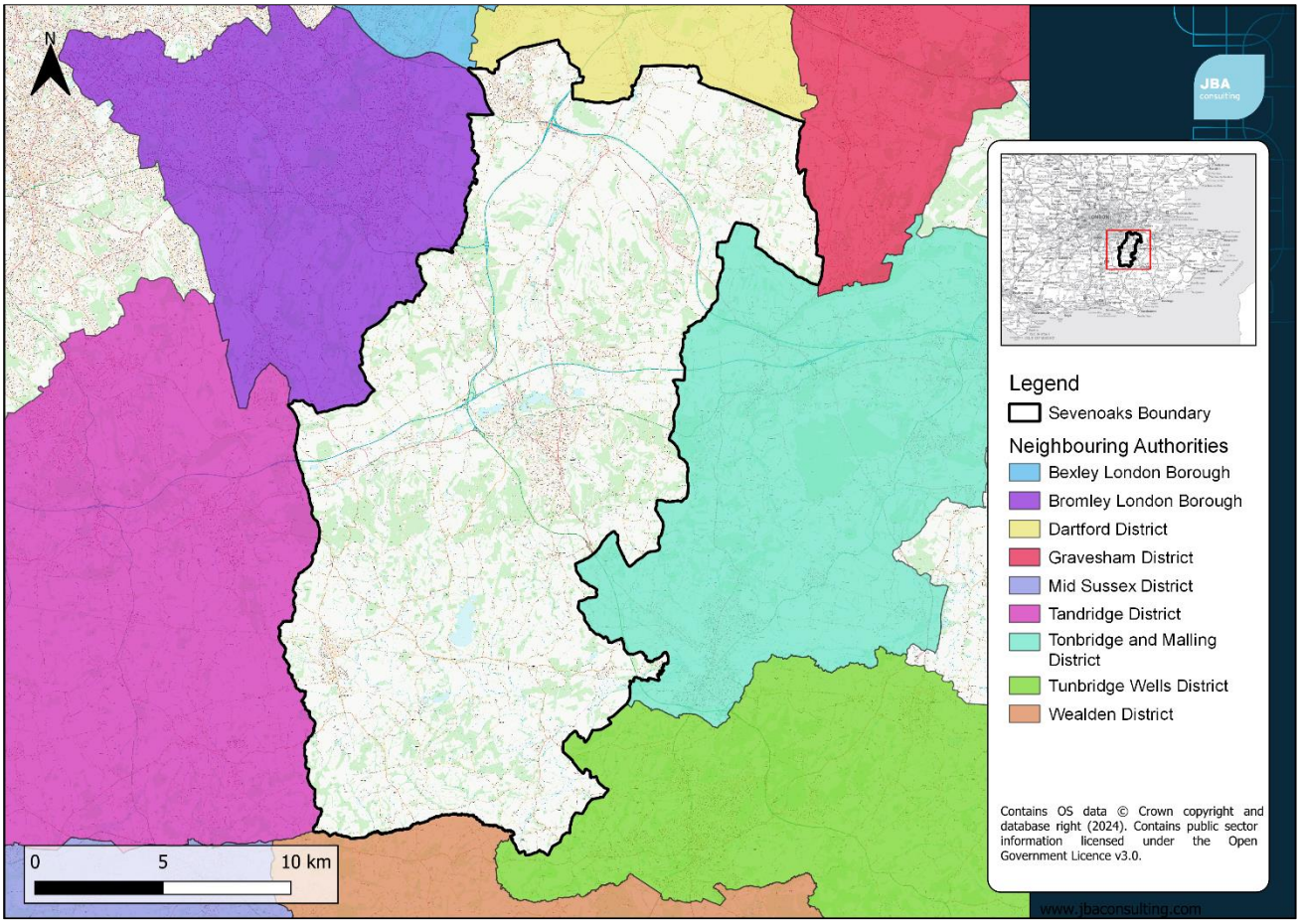


Figure 1-1: Sevenoaks District alongside its neighbouring authorities.

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
- Neighbouring Authorities to Sevenoaks District:
    i. Dartford Borough Council
    ii. Gravesham Borough Council
    iii. London Borough of Bexley Council
    iv. London Borough of Bromley Council
    v. Tandridge District Council
    vi. Tonbridge and Malling Borough Council
    vii. Wealden District Council

1.6 Use of SFRA data

It is important to recognise that Level 1 SFRAs are high level strategic documents and, as such, do not go into detail on an individual site-specific basis. The SFRA has been developed using the best available information at the time of preparation. This relates both to the current risk of flooding from all sources, and the potential impacts of future climate change.

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

SFRAs should be a 'living document', and as a result should be updated when new information on flood risk, new planning guidance, or legislation becomes available. New information on flood risk may be provided by Sevenoaks District Council, Kent County Council, the Environment Agency, Thames Water and Southern Water. Such information may be in the form of:

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

The Environment Agency regularly reviews their flood risk mapping, and it is important that they are approached to determine whether updated information is available prior to commencing a detailed Flood Risk Assessment. 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 with the above bodies for any new information.

1.7 Understanding flood risk

This section provides useful background information on how flooding arises and how flood risk is determined.

1.7.1 Sources of flooding

Flooding can occur from many different and combined sources and in many different ways, as illustrated in Table 1-1. Major sources of flooding include:

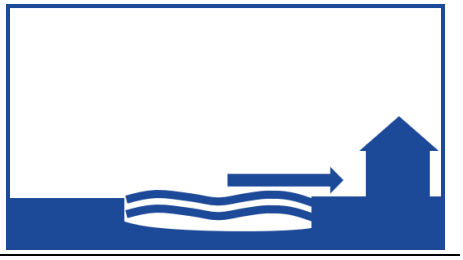
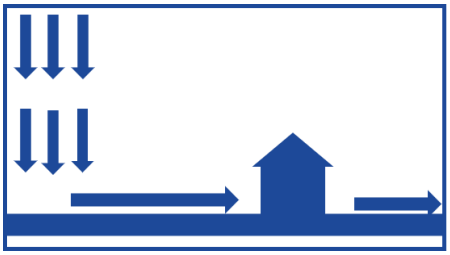
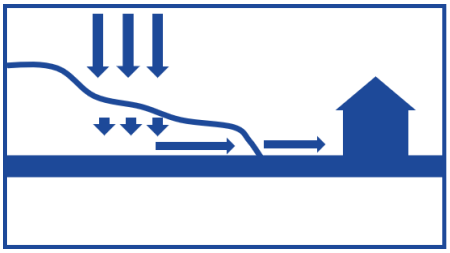
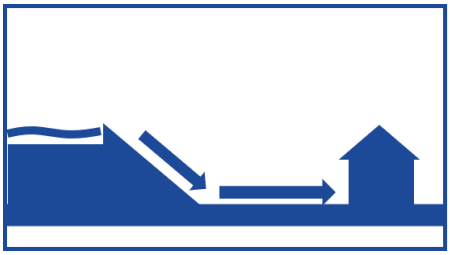
- **Fluvial (rivers)** - inundation of floodplains from rivers and smaller watercourses; inundation of areas outside the floodplain due to influence of bridges, embankments and other features that artificially raise water levels; overtopping or breaching of defences; blockages of culverts; blockages of flood channels/corridors. Please see sections 6.2, 6.3.3 and 6.4 for more on fluvial flooding as the main cause of surface water flooding in Sevenoaks.
- **Surface water** - direct run-off from land due to exceeding the infiltration rate of the soil or the capacity of the drainage network. It is generally 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 blocked by debris and sewer flooding.

- **Groundwater** – rising water table; most likely to occur in low-lying areas underlain by permeable rock (aquifers) or groundwater recovery after pumping for mining or industry has ceased.
- **Sewer** – exceeding of sewer capacity, misconnections of surface water to foul networks, infiltration, connection/occupation of new development ahead of completion of any necessary network upgrades
- **Infrastructure failure** - reservoirs; canals; industrial processes; burst water mains; blocked sewers or failed pumping stations.

Flood hazards vary greatly between different sources of flooding due to variations in the speed of onset or inundation, flood water depths and duration. Interactions can also occur between different types of flooding, for example groundwater entering sewer systems. With climate change, the frequency, pattern and severity of flooding are expected to change and become more damaging.

Table 1-1: Description and illustration of each different type of flooding.

Flooding type	Description	Illustration
Fluvial (River)	River flows exceed the capacity of the river channel, with water spilling out on to the floodplain. Can include breach or overtopping of flood defences.	
Surface water	Water falls onto the ground and is unable to soak into the ground due to impermeable surfaces or rainfall intensities exceeding the infiltration rate into the soil or the capacity of the drainage network.	
Groundwater	Water is stored in rock layers underground. The water table rises as infiltration exceeds the drainage from the aquifer or permeable layer, leading to the water table rising to the surface through springs or wetted areas.	
Residual risk	Breach or overtopping of a raised structure storing water, such as a reservoir.	

1.8 The source-pathway-receptor model

Flood risk is a combination of the likelihood of flooding and the potential consequences arising. It is assessed using the source – pathway – receptor model as displayed in Figure 1-2. This is a standard environmental risk model common to many hazards and should be the starting point of any assessment of flood risk. It should be remembered that flooding could occur from many different sources and pathways, and not simply those shown in the illustration below.

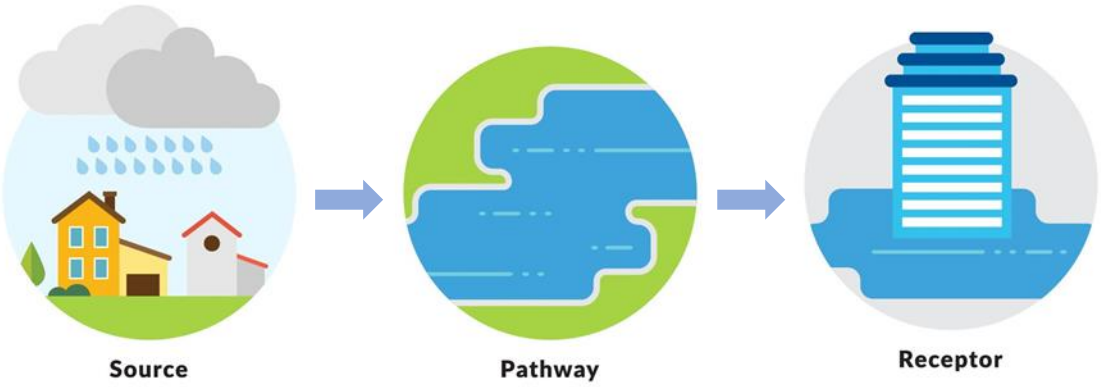


Figure 1-2: Diagram summarising the source – pathway – receptor model.

The Sevenoaks study area is susceptible to flooding from all source areas identified in Table 1-1. Pathways include the rivers themselves, drains, sewers, overland flows, floodplains and defence assets (for example through overtopping or breach). Receptors can include people, properties and the environment. All these elements must be present for flood risk to arise. Mitigation measures have little or no effect on the magnitude of the sources that cause flooding, but they can block or impede pathways, remove receptors or increase the resilience of receptors.

The planning process is primarily concerned with the appropriate location of receptors, taking appropriate account of potential sources and pathways that might put those receptors at risk. It is therefore important to define the components of flood risk to apply this guidance in a logical and consistent manner.

1.9 Likelihood

The likelihood of flooding is often measured by a percentage probability or by stating how regularly it may occur on average. Many everyday practitioners refer to a 1% Annual Exceedance Probability (AEP) flood as a 1 in 100-year flood. However this does not mean that the flood will only happen once every 100 years. Instead, the chance of a flood of this magnitude occurring in any given year is 1% and it is therefore possible that two 100-year floods could happen within a single year. Higher probability flood events may occur between the larger events.

Drainage systems and flood defences are designed to provide Standards of Protection (SoP) from events with specific magnitudes. Some examples of SoP are as follows:

- Surface water drains and sewers are designed to have a surcharged capacity (the water in the sewer system is at or below ground level) for a 3.3% AEP event.
- Fluvial defences are often built to protect against a 1% AEP event.
- Drainage for new highways is designed to a 3.3% AEP event. However, the majority of the existing highway network is not built to modern standards. The AEP of a flooding event which exceeds the highway drainage network in some areas could be 10% or higher.

It should be noted that not all flood defences are bult to provide this SoP. It is recommended to contact the Environment Agency to get more information about specific flood defences' SoP.

1.10 Consequence

The consequences of flooding include fatalities, property damage and disruption to lives and businesses, with severe social and economic implications for people. Consequences of flooding depend on the hazards caused by flooding such as the depth of water, speed of flow, rate of onset and duration, and the vulnerability of receptors such as the type of development and population demographics.

1.11 Risk

Risk varies depending on the severity of the event, the source of the water, the pathways of flooding (such as the condition of flood defences) and the vulnerability of receptors as mentioned above. Flood risk as an equation is then expressed in terms of the following relationship, as displayed in Figure 1-3.

Figure 1-3: Conceptual model depicting how risk can be defined.

1.12 Resilience

Resilience to flood risk describes the capacity of people and places to plan for, better protect, respond to, and recover from flooding and coastal change[1]. It includes making the best land use and development choices, protecting people and places, responding to, and recovering from flooding and coastal change whilst also adapting to and planning for climate changes we are likely to see over the next 100 years.

[1]https://assets.publishing.service.gov.uk/media/5f5f96db8fa8f5106777106e/15482_Environment_agency_digital_Glossary_PDFA.pdf

Flood risk is constantly changing, and in the context of climate change we are likely to see flooding in areas which have not flooded historically. Approaches to managing flood risk must therefore be able to adapt to changes in our understanding, for example the introduction of non-stationarity fluvial flood frequency estimation into guidance for funding future flood risk reduction projects.

2 Flood risk policy and strategy

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 and flood risk policy. In preparing the subsequent sections of this SFRA, appropriate planning and policy amendments have been acknowledged and taken into account.

2.1 Roles and responsibilities

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. There are wide ranging responsibilities across multiple organisations and private owners for both flood and land drainage.

2.1.1 Sevenoaks District Council

As a Local Planning Authority (LPA), Sevenoaks District Council assesses, consults on and determines whether development proposals are acceptable, ensuring that flooding and other risks are effectively managed in line with planning policy. The LPA can carry out flood risk management works on minor watercourses.

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 and Thames Water, that have an interest in the planning application.

2.1.2 Kent County Council

Kent County Council is the Lead Local Flood Authority (LLFA) for Sevenoaks District. As 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).
- Maintain a 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.
- 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[2].
- Enforcement: The LLFA has enforcement powers under the Land Drainage Act 1991 and Flood and Water Management Act (FWMA) 2010.

Kent County Council is also the Local Highway Authority and manages highway drainage, carrying out maintenance and improvement works on an on-going basis, as necessary, to maintain existing standards of flood protection for highways, making appropriate allowances for climate change. It also has the responsibility to ensure road projects cause no increase flood risk. Kent County Council are consultees with respect to drainage and SuDS for proposed new developments.

2.1.3 Highways England

Highways England is responsible for managing highway drainage and drainage ditches on major trunk roads in the Sevenoaks District area. These include the M25, M26, M20, A20 and A21.

2.1.4 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. The Environment Agency has powers to work on Main Rivers to manage flood risk. These powers are permissive, which means they are not a duty, and they allow the Environment Agency to carry out flood and coastal risk management work.

The Environment Agency also has powers to regulate, and consent works to Main Rivers. Prior written consent is required from the Environment Agency for any work in, under, over or within eight metres of a Main River or between the high-water line and the secondary line of defence e.g. earth embankment. The Environment Agency also has a strategic overview role across all types of flooding as well as other types of water management matters.

In England, the Environment Agency has duty to deliver the River Basin Management Plans. Within these plans are statements of reasons waterbodies are not achieving good ecological or ecological potential status and the actions and measures required to rectify and restore this. All development opportunities and phases must ensure compliance

The Environment Agency can support in the instigation of local flood partnerships and flood response community groups.

2.1.5 Upper Medway Internal Drainage Board (IDB)

The Upper Medway IDB operates to the south of Sevenoaks District surrounding the Rivers Eden, River Medway and associated watercourses.

[2] https://www.kent.gov.uk/environment-waste-and-planning/flooding-and-drainage/sustainable-drainage-systems/owning-and-maintaining-a-watercourse

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 Internal Drainage District (IDD). 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 within their IDD.

2.1.6 Water and Wastewater providers

Southern Water and Thames Water are the sewerage undertakers for the Local Plan area. Figure 2-1 displays the approximate boundaries of these providers. They have the responsibility to maintain public foul and combined sewers and some surface water sewers (where adopted by the utility). When flows (foul or surface water) are proposed to enter public sewers, Southern Water and Thames 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 in collaboration with the developer and the LPA. Requests for connection of surface water to water utility companies' networks should only occur once the LLFA have confirmed that is no other option for disposal. 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.
South East Water provides potable water to the Local Plan area. Consent, prior to commencing work, is required from the relevant provider if installing water systems, or altering existing systems, is intended.

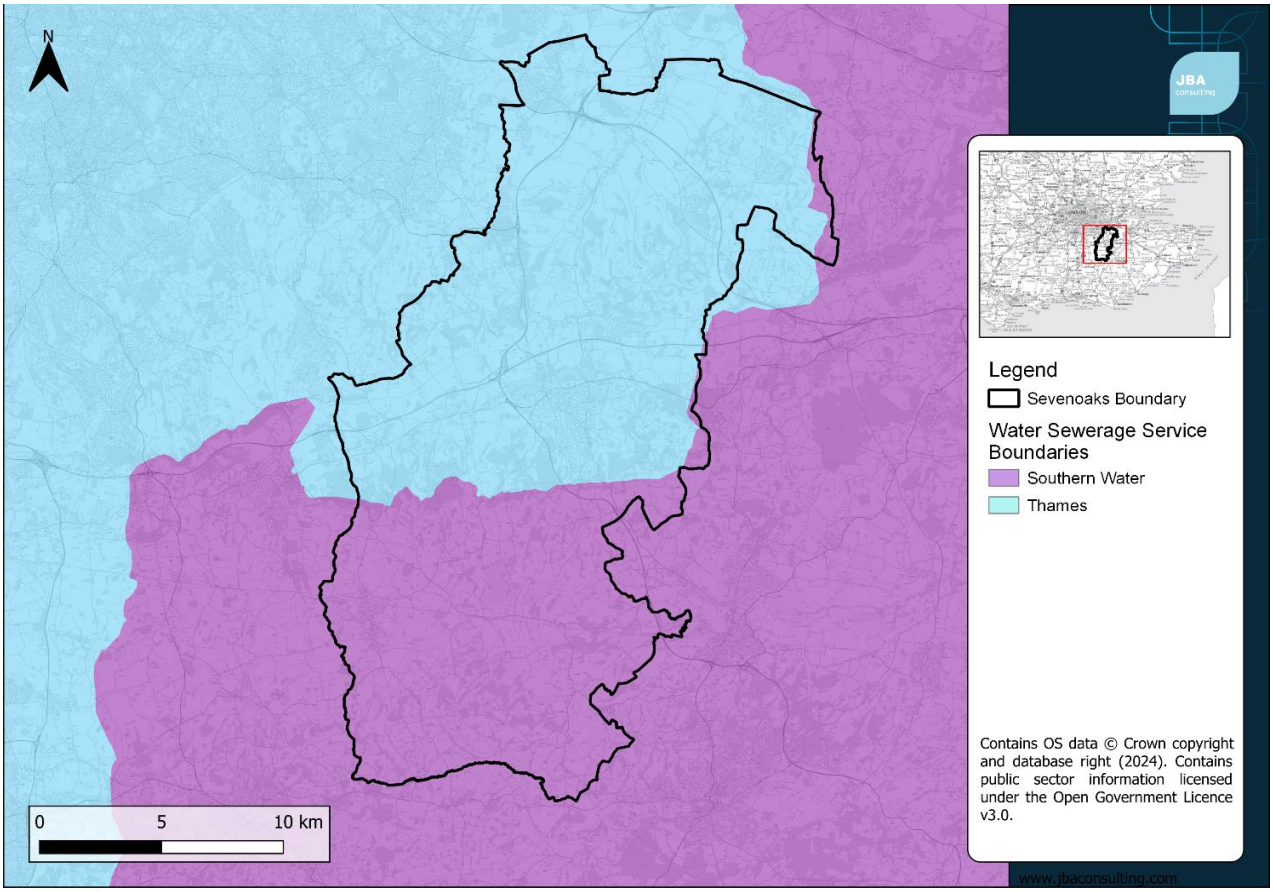


Figure 2-1: Approximate sewerage undertaker boundaries for Sevenoaks District.

2.1.7 Riparian owners

Riparian owners responsibilities include maintaining the bed and bank of a the watercourse, keeping structures within the watercourse free from blockages and accepting the flow of water through the land.

2.2 Key legislation for flood and water management in the study area

This section summarises the key legislation for flood and water management within Sevenoaks District. Please note that, since the last Sevenoaks District Level 1 SFRA (2022) was published, the Flood Risk Regulations (2009) have been revoked by the UK Government. This occurred on the 01 January 2024 after a review into retained European Union (EU) legislation concluded that these largely duplicate existing domestic legislation, namely the Flood and Water Management Act (2010).

2.2.1 Flood and Water Management Act (2010)

The Flood and Water Management Act (2010) aims to create a simpler and more effective means of managing both flood risk and coastal erosion and implements some of Sir Michael Pitt's recommendations following his review of the 2007 floods.

The FWMA established Lead Local Flood Authorities (LLFAs). Kent County Council is the LLFA for the study area. Further information on the LLFA role and responsibilities are provided in Section 2.1.2.

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

The purpose of the Water Framework Directive (WFD), which was transposed into English Law by the Water Environment Regulations (first published in 2003 and updated in 2017), is to deliver improvements across Europe in the management of water quality and water resources.

2.2.3 Environmental permitting

The Environmental Permitting Regulations (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. Developers are required to contact the Environment Agency for permits regarding main river defences and any flood risk activities which will take place in, over or under a main river. This includes flood risk activities, for example:

- on or within 8 metres of a main river;
- on or within 8 metres of a flood defence structure or culvert;
- involving quarrying or excavation within 16 metres of any main river, flood defence (including a remote defence) or culvert; and
- in a floodplain more than 8 metres from the riverbank, culvert or flood defence structure 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.

2.2.4 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. The Upper Medway IDB operates in the south of Sevenoaks District surrounding the River Eden, River Medway and associated watercourses. Mapping displaying the IDD and wider watershed catchment of the Upper Medway IDB is available online.

Under the Land Drainage Act (1991), Internal Drainage Boards were also given the power to implement their own Byelaws. 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 IDB's drainage district and watershed (or catchment) within the Local Plan area. The Upper Medway IDB's Planning and Byelaw Strategy was published in November 2023 and is due to for update in November 2024. The Upper Medway IDB's Byelaws which are most relevant to flood risk management include:

- Byelaw 3 (surface water)- Consent is required where a discharge of surface water is proposed to a watercourse within the IDD and within the wider watershed catchment. Any consent granted will likely be conditional, pending the payment of a Surface Water Development Contribution fee, calculated in line with the Board's charging policy (https://medwayidb.co.uk/development/).
- Byelaw 3 (foul water) - Consent is required where a discharge of treated foul water is proposed to a watercourse within the IDD.
- Byelaw 4 (and Section 23 of the Land Drainage Act 1991) - Consent is required where works are proposed to alter the flow of a Board Maintained or a riparian watercourse within the IDD. This includes culverting, realignment, erection of dams, sluices etc.Outside of the IDD the LLFA is the consenting authority.
- Byelaws 10 and 17 - Consent is required for all works within 8 metres of the edge of Board Maintained drainage and flood risk management infrastructure.

2.2.5 Additional legislation

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

- The Town and Country Planning Act (1990, updated as of 2023) and the Water Industry Act (1991, updated as of 2023). These set out the roles and responsibilities for organisations that have a role in Flood Risk Management (FRM).
- The Localism Act (2011) outlines plans to shift and re-distribute the balance of decision making from central government back to councils, communities and individuals. The Localism Act was given Royal Assent on 15 November 2011.
- Other environmental legislation such as the Habitats Directive (1992), Environmental Impact Assessment Directive (2014) and Strategic Environmental Assessment Directive (2001) also apply as appropriate to strategic and site-specific developments to guard against environmental damage.
- The Environment Act (2021) consolidates the UK's plans for maintaining and improving the natural environment, following Britain's exit from the EU. Part 5 of the Act relates to Water, and supports previous regulation of water companies, in addition to land drainage, set out by the Land Drainage Act 1991, with the addition of valuation calculations of the land.

Key national, regional and local policy documents and strategies. Table 2-1 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 Sevenoaks District.
- provide guidance and/or standards that informs how a developer should assess flood risk and/or design flood mitigation and SuDS.

Table 2-1: National, regional and local key flood risk policy and strategy documents

Scale	Document, Lead Author & Date	Purpose of document	Next Update Due
National	National Flood and Coastal Erosion Management Strategy (Environment Agency, 2020)	Policy and measures.	2026
National	National Planning Policy Framework (Ministry of Housing, Communities and Local Government (MHCLG, 2023)	Policy. Development design requirements.	-
National	Planning Practice Guidance (MHCLG, 2023)	Policy and measures. Development design requirements.	-
National	The Climate Crisis: a guide for Local Authorities on Planning for Climate Change (TCPA) 2023	Information	-
Regional	Thames River Basin Management Plan (Environment Agency, 2022)	Information Policy and measures.	2027
Regional	River Medway Catchment Flood Management Plan (Environment Agency, 2012) and North Kent Rivers Catchment Flood Management Plan (Environment Agency, 2009)	Information. Policy and measures.	-
Regional	Climate change guidance for development and flood risk (Environment Agency, 2020)	Development design requirements.	-
Local	Kent Local Flood Risk Management Strategy 2017-2023 (Kent County Council, 2017)	Information. Development design requirements.	-
Local	Sevenoaks Stage 1 Surface Water Management Plan (Kent County Council, 2014)	Information. Policy and measures.	

Scale	Document, Lead Author & Date	Purpose of document	Next Update Due
		Development design requirements.	
Local	Water. People. Places. A guide for master planning sustainable drainage into development (2013)	Information Policy and measures Development design requirements	-
Local	Making it happen – Kent Design Guide (Chapter 2 - drainage systems)	Information Policy and measures Development design requirements	-
Local	Southern Water Drainage and Wastewater Management Plan (DWMP) (Southern Water, 2023) Thames Water Drainage and Wastewater Management Plan (DWMP) (Thames Water, 2023)	Information. Policy and measures. Development design requirements.	

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

The National Flood and Coastal Erosion Risk Management Strategy (FCERM) for England provides the overarching framework for future action by all risk management authorities to tackle flooding and coastal erosion in England. The 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. A progress update to the Strategy was published in 2022 outlining what had been achieved by 2022 and the roadmap to achieving the goals set out in the Strategy until the year 2026.

The Strategy has been split into three 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. 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.

The Flood and Coastal Erosion Risk Management Strategy Roadmap to 2026 describes how the National Flood and Coastal Erosion Risk Management Strategy for England will be translated into practical actions until the year 2026, and what aspirations it hopes to achieve. By defining actions, the Strategy Roadmap supports the government's £5.2 billion Flood and Coastal Erosion Risk Management Investment Programme in decision making for allocating funds.

The Strategy Roadmap also incorporates innovating programmes to improve evidence on the costs and benefits of new resilience actions. Improving the knowledge base will help inform future approaches and investments in flood and coastal risk management. The three programmes which address this are:

- The Flood and Coastal Resilience Innovation Programme which enables local authorities, businesses and communities to test and demonstrate innovative actions.
- The Adaptive Pathways Programme which develops long term investment plans for managing flood and coastal change to 2100 and beyond.
- The Coastal Transition Accelerators Programme which supports communities in areas at significant risk of coastal erosion to transition and adapt to changing climate.

The Strategy Roadmap describes a cross-disciplinary, multi-organisational approach to assessing and addressing flood and coastal erosion risk in England, including the funding structures, and with sensitivity to sustainability and the environment.

2.2.7 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.

The Thames RBMP was updated in 2022 and describes the challenges that threaten the water environment and how these challenges can be managed. 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

2.2.8 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.

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 District falls across both the North Kent Rivers CFMP (2009) and the Medway CFMP (2012).

2.3 Kent County Council Local Flood Risk Management Strategy

Local Flood Risk Management Strategies (LFRMS) set out how Lead Local Flood Authorities such as Kent County Council will manage local flood risk i.e. from surface water runoff, 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 current Kent County Council LFRMS 2017-2023 (2017) sets out Kent County Council's priorities for managing local flood risk. The Medway Catchment, which includes the southernmost areas in Sevenoaks District surrounding the River Eden and River Medway, was identified within the plan as a 'focus area' for local flood risk management.

Kent County Council is undergoing the process of updating its LFRMS ,Kent Local Flood Risk Management Strategy 2024-2034. At the time of writing this SFRA, the finalised LFRMS was not yet published.

2.3.1 LLFAs, surface water and SuDS

The 2023 NPPF states that: 'Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate' (Para 175). When considering planning applications, local planning authorities should consult the relevant LLFA on the management of surface water in order to satisfy that:

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

Kent County Council's requirements for new developers on SuDS are set out on their website, alongside supporting documents. Kent County Council's surface water management plans should also be referred to.

The 2023 NPPF states that flood risk should be managed "using opportunities provided by new development and improvements in green and other infrastructure to reduce the causes and impacts of flooding." As such, although incorporating SuDS is only a requirement for major development, it is best practice for all development.

2.4 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.

Kent County Council published the Sevenoaks Stage 1 SWMP in 2014.

2.5 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. 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.

2.6 Drainage and Wastewater Management Plans

Required as per the 2021 Environment Act, Drainage and Wastewater Management Plans (DWMPs) are strategic documents produced by sewerage undertakers. They consider current and future sewerage capacity, sewerage pressures and future risks to sewerage networks such as climate change.

Southern Water and Thames Water published their DWMPs in May 2023. A review of these DWMPs has been competed as part of this SFRA and is available as Appendix A (Southern Water) and Appendix B (Thames Water).

2.7 Natural Flood Management (NFM) Plans

The Environment Agency has developed Working with natural processes to reduce flood risk mapping which displays opportunities for NFM. These maps are to be used as a guide and supplemented with local knowledge to provide a starting point for discussions about NFM. NFM aims to protect, restore and emulate the natural functions of catchments, floodplains, rivers and the coast. NFM should be used on a catchment wide scale and is the linking of blue and green infrastructure.

The maps identify NFM opportunities on different catchment scales:

- National River Basin Districts
- River Basin Districts showing Management Catchments
- Management Catchments showing Water Body Catchments
- Water Body Catchments

Discussions about NFM should be had with catchment stakeholders in combination with local knowledge.

3 Planning policy for flood risk management

This section summarises national planning policy for development and flood risk.

3.1 National Planning Policy Framework and Guidance

The revised National Planning Policy Framework (NPPF) was published in February 2019 and last amended in December 2023. The NPPF details the UK Government's planning policies for England. The NPPF 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 (paragraph 166) 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."

The Planning Practice Guidance (PPG) for Flood Risk and Coastal Change was first published in March 2014 and last updated in August 2022 and sets out how the NPPF should be implemented. Diagram 1 of the PPG sets out how flood risk should be considered in the preparation of Local Plans.

3.2 The risk-based approach

The NPPF takes a risk-based approach to development in flood risk areas. Since July 2021 the approach has adjusted the requirement for the Sequential Test (as defined in Para 168 of the NPPF) so that all sources of flood risk are included in the consideration. At the time of preparation of the 2023 SFRA no updated guidance (PPG) has been published to describe how the approach to the Sequential Test should be modified. The requirement has been addressed by adopting the approach set out in the sections below. Further information can be found in Appendix L.

3.2.1 Flood Zones

The definition of the Flood Zones is provided below. 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.

The Flood Zones do not take into account surface water, sewer or groundwater flooding or the impacts of canal or reservoir failure, they do not cover watercourse catchments with areas of less than 3km^2 and they do not consider climate change. Hence there could still be a risk of flooding from other sources and that the level of flood risk will change over time during the lifetime of a development.

The Flood Zones are:

- **Flood Zone 1 (low probability):** Land having a less than 0.1% annual probability of river or sea flooding. All land uses are appropriate in this zone. For development proposals on sites comprising one hectare or above, the vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off, should be incorporated in a flood risk assessment.
- **Flood Zone 2 (medium probability):** Land having between a 1% and 0.1% annual probability of river flooding; or having land between a 0.5% and 0.1% annual probability of sea flooding. Essential infrastructure, water compatible infrastructure, less vulnerable and more vulnerable land uses (as set out by NPPF) are appropriate in this zone. Highly vulnerable land uses are permitted provided they pass the Exception Test. All developments in this zone require an FRA.
- **Flood Zone 3a (high probability):** Land having a 1% or greater annual probability of river flooding; or land having a 0.5% or greater annual probability of sea flooding. Developers and the local authorities should seek to reduce the overall level of flood risk, relocating development sequentially to areas of lower flood risk and attempting to restore the floodplain and make open space available for flood storage. Water compatible and less vulnerable land uses are permitted in this zone. Highly vulnerable land uses are not permitted. More vulnerable land uses and essential infrastructure are only permitted if they pass the Exception Test. All developments in this zone require an FRA.
- **Flood Zone 3b (functional floodplain):** this zone comprises land where water from rivers or the sea has to flow or be stored in times of flood. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. 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. They must also be safe for users and not increase flood risk elsewhere. Essential Infrastructure will only be permitted if it passes the Exception Test. Where development is appropriate in this flood zone all applications require an FRA. Functional floodplain will normally comprise:
    - land having a 3.3% or greater annual probability of flooding, with any existing flood risk management infrastructure operating effectively; or
    - land that is designed to flood (such as a flood attenuation scheme), even if it would only flood in more extreme events (such as 0.1% annual probability of flooding).
    - Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency.

Flood Zone 3b, unlike other Zones, shows flood risk that accounts for 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.

3.3 The Sequential Test

Firstly, land at the lowest risk of flooding and from all sources should be considered for development. A test is applied called the 'Sequential Test' to do this. Figure 3-1 summarises the Sequential Test. The LPA will apply the Sequential Test to strategic allocations. For all other developments in Flood Zones 2 and 3 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. 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 a 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 PPG shows whether, having applied the Sequential Test first, the vulnerability of development is not compatible with a particular Flood Zone and where the exception test is required to determine the suitability of that vulnerability of development to the flood zone.

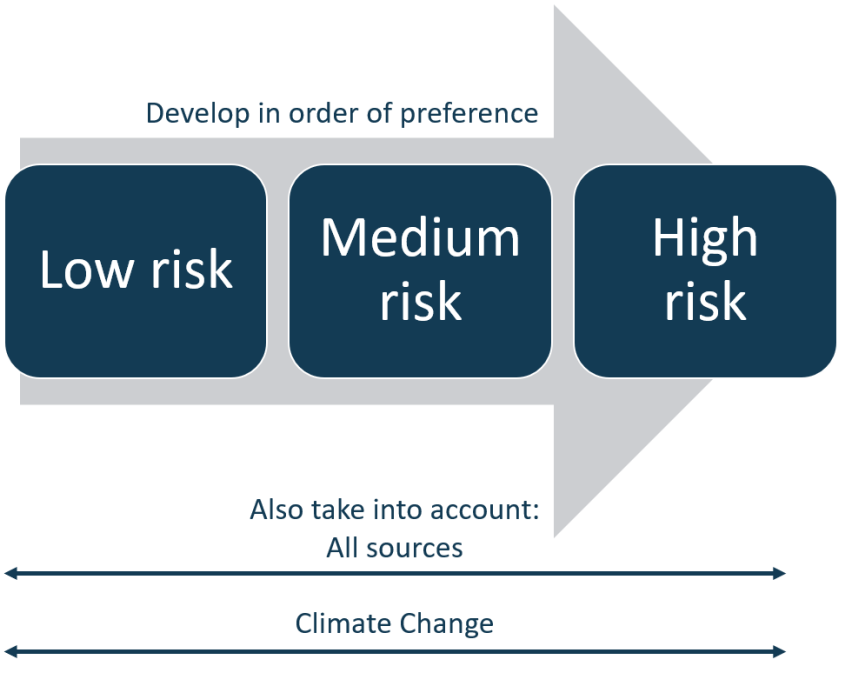


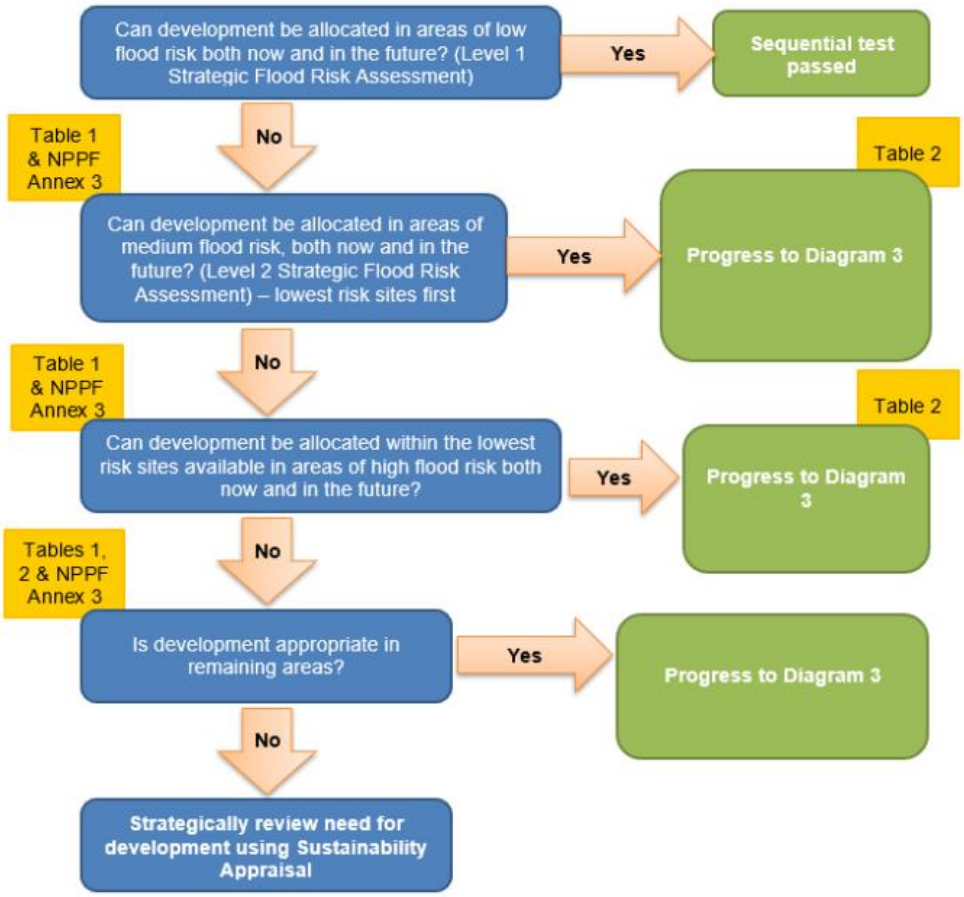
Figure 3-1 Diagram summarising the concept of the Sequential Test.

Figure 3-2 illustrates the Sequential Test as a process flow diagram using the information contained in this SFRA to assess potential development sites against areas of flood risk

and development vulnerability compatibilities. Further details on the sequential test methodology can be found in Appendix L.

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.



† Diagram 2 of NPPG: Flood Risk and Coastal Change (paragraph 026, Reference ID 7-026-20220825) Revised August 2022.

Figure 3-2: Application of the Sequential Test for plan preparation.

3.4 The Exception Test

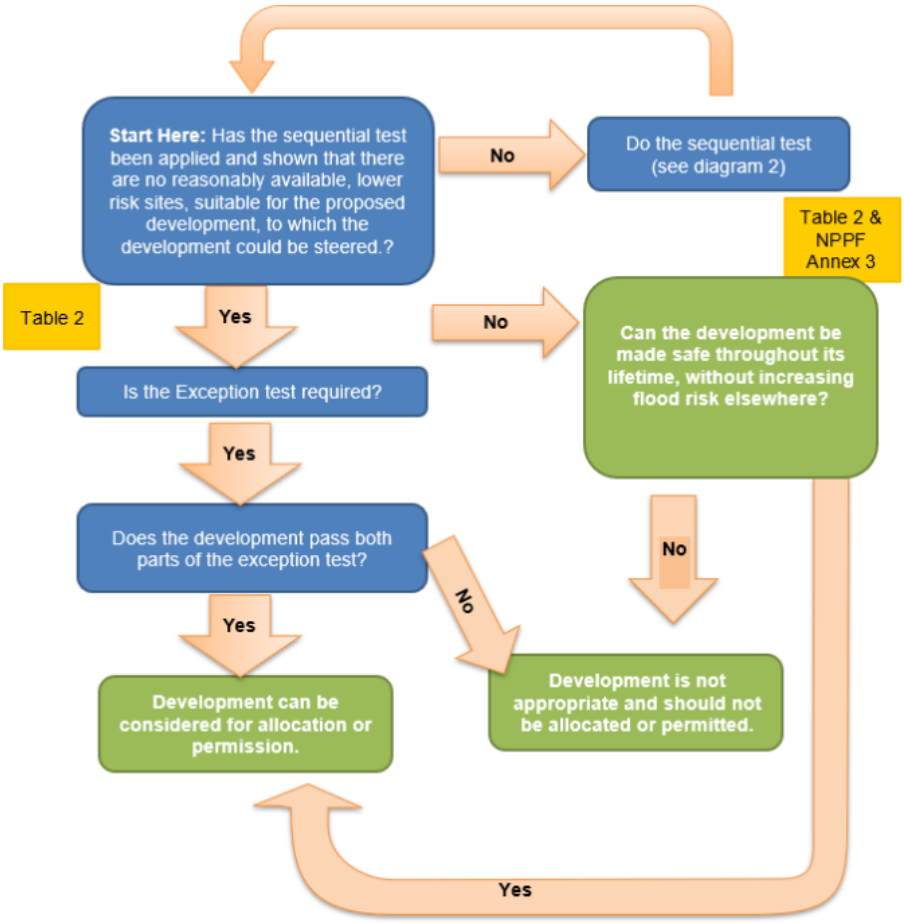
It will not always be possible for all new development to be allocated on land that is not at risk from flooding. To further inform whether land should be allocated, or Planning Permission granted, a greater understanding of the scale and nature of the flood risks is required. In these instances, the Exception Test will be required. Diagram 3 of the PPG (Figure 3-3) summarises the Exception Test.

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

- Essential infrastructure in Flood Zone 3a or 3b

- More vulnerable in Flood Zone 3a (this is NOT permitted in Flood Zone 3b)
- Highly vulnerable in Flood Zone 2 (this is NOT permitted in Flood Zone 3a or 3b)
- Any development in a high risk Surface Water Zone.

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.



† Diagram 3 of NPPG: Flood Risk and Coastal Change (paragraph 033, Reference ID 7-033-20220825) Revised August 2022.

Figure 3-3: Application of the Exception Test to plan preparation.

3.4.1 Making a development safe from flood risk over its lifetime

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

- The actual risk is the risk to the site considering existing flood mitigation measures. The PPG defines the design standard for new development ('the design flood event') to consider the suitability of development and any mitigation measures.
- Safe access and egress should be available during the design flood event. Firstly, this should seek to avoid areas of a site at flood risk. If that is not possible then access

routes should be located above the design flood event levels. Where that is not possible, access through shallow and slow flowing water that poses a low flood hazard may be acceptable.

- Residual risk is the risk that remains after the effects of flood defences have been taken into account and / or from a more severe flood event than the design event. The residual risk can be:
    - The effects of an extreme 0.1% chance flood in any year event. Where there are defences this could cause them to overtop, which may lead to failure if this causes them to erode; and/or
    - Structural failure of any flood defences, such as breaches in embankments or walls.
    - Blockage or failure of normal operation of assets (such as culverts and pumping stations)

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

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

3.5 Applying the Sequential Test and Exception Test to individual planning applications

3.5.1 The Sequential Test

Sevenoaks District Council, taking account of views from other relevant parties, is responsible for considering whether the Sequential Test has been satisfied.

When appropriate Developers are required to apply the Sequential Test to development sites, unless the site is either:

- a strategic allocation and the test has already been carried out by the LPA
- a change of use (except to a caravan, camping or chalet site, or to a mobile home or park home site)
- a minor development (householder development, small non-residential extensions with a footprint of less than 250m^2); or
- a development in Flood Zone 1 unless there are other flooding issues in the area of the development (e.g., surface water, groundwater, 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 is preparing the Sequential Test, including the consideration of reasonably available sites at lower flood risk now and in the future, but more detailed site specific information should also be prepared where appropriate.

Sevenoaks District Council as the LPA must use local knowledge 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
- Sites with Planning Permission but not yet built out
- Housing and Economic Land Availability Assessments (HELAAs)/ 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 alternative sites.

3.5.2 The Exception Test

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

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

- Demonstrating that the development would provide wider sustainability benefits to the community that outweigh the flood risk using a method agreed with Sevenoaks District Council.
- Demonstrating that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

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

- the design, operation and maintenance of any flood defence infrastructure;
- access and egress;
- design of the development to manage and reduce flood risk wherever possible;
- resident awareness;

- flood warning and evacuation procedures, including whether the developer would increase the pressure on emergency services to rescue people during a flood event; and
- any funding arrangements required for implementing measures.

3.6 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 LLFA.

4 Climate Change

4.1 Climate change and the NPPF

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

The NPPF also states that the *'sequential approach should be used in areas known to be at risk now or in the future from any form of flooding'* (para 168).

4.2 Climate change guidance and allowances

The **Climate Change Act 2008** creates a legal requirement for the UK to put in place measures to adapt to climate change and to reduce carbon emissions by at least 80% below 1990 levels by 2050. Planning policy and decisions on planning applications have roles in mitigating climate change and adapting to its impacts.

In 2018, the Met Office published new **UK Climate Projections** (UKCP18). The Environment Agency has since updated their **guidance on climate change allowances** for tidal (in 2019), river flow (in 2021) and rainfall intensity (in 2022) for new developments. This includes information on how these allowances should be included in both SFRAs and FRAs. The guidance adopts a risk-based approach considering the vulnerability of the development and (in the case of fluvial and rainfall intensity) considers risk allowances on a management catchment level.

Developers should check on the government website for the most recent guidance before undertaking a detailed FRA. To further support this, the Environment Agency can provide a preliminary opinion to applicants on their proposals at pre-application stage. There may be a charge associated with this.

4.3 Peak river flows

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

The peak river flow allowances provided in the guidance show the anticipated changes to peak flow for the management catchment (sub-catchment of river basin districts) within which the subject watercourse is located. Once the management catchment has been identified, guidance on uplift in peak flows are provided for three 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.

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

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

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 but a period of at least 75 years is likely to form a starting point for assessment. Further information on what is considered to be the lifetime of development is provided in the PPG.

Sevenoaks District is located across the 'Darent and Cray' and 'Medway' management catchments. A small area of the Sevenoaks District is located with the London River Basin Management Catchment. Maps showing the extent of the management catchments are published by the Environment Agency.

4.3.1 Peak river flow allowances for Sevenoaks District Council

Table 4-1 and Table 4-2 display the peak river flow allowances that apply to the Darent and Cray Management Catchment and Medway Management Catchment respectively for fluvial flood risk. Climate change scenarios have been run for relevant fluvial models for the 3.3%, 1% and 0.1% AEP events in line with the PPG requirements to assess high, medium and low risk both now and in the future.

Table 4-1 Peak river flow allowances for the Darent and Cray Management Catchment

Allowance Category	Total potential change anticipated for the 2020s (2015 to 2039)	Total potential change anticipated for the 2050s (2040 to 2069)	Total potential change anticipated for the 2080s (2070 to 2115)
Upper End	21%	23%	41%
Higher Central	11%	8%	18%
Central	6%	3%	10%

Table 4-2 Peak river flow allowances for the Medway Management Catchment

Allowance Category	Total potential change anticipated for the 2020s (2015 to 2039)	Total potential change anticipated for the 2050s (2040 to 2069)	Total potential change anticipated for the 2080s (2070 to 2115)
Upper End	29%	37%	62%
Higher Central	19%	21%	37%

Allowance Category	Total potential change anticipated for the 2020s (2015 to 2039)	Total potential change anticipated for the 2050s (2040 to 2069)	Total potential change anticipated for the 2080s (2070 to 2115)
Central	14%	15%	27%

4.3.2 Which peak river flow allowance to use?

The Flood Zone and flood risk vulnerability classification should be considered when deciding which allowances apply to the development or the plan. Vulnerability classifications are found in the PPG. The Environment Agency guidance states that both the central and higher central allowances should be assessed in strategic flood risk assessments. Specific guidance for which climate change allowance estimates should be applied can be found in the Environment Agency guidance on climate change allowances. For site specific Flood Risk Assessments, the central allowances should be used in most instances with the exception of 'essential infrastructure' where the guidance is to use the 'higher central' allowance.

Currently there in no guidance on considering the impact of climate change on flood risk to development located within Flood Zone 1.

4.4 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. The Environment Agency have developed a peak rainfall allowances map which shows anticipated changes in peak rainfall intensity which can be used for site-scale applications (like drainage design), surface water flood mapping in small catchments (less than 5km^2) and urbanised drainage catchments.

The guidance suggests that direct rainfall modelling may not be suited to larger (>5km^2) catchment with rural land use. In these instances, the guidance states that the fluvial flood risk affected by climate change should be assessed using uplifts from peak river flow allowances (Section 4.3.1).

4.4.1 Peak rainfall intensity allowances for Sevenoaks District Council

Sevenoaks District Council is located within the Darent and Cray Management Catchment and the Medway Management Catchment for peak rainfall intensity. The Environment Agency's peak rainfall climate change allowances by management catchment mapping provides the allowances that should be used (Table 4-3 and Table 4-4).

Table 4-3 Peak rainfall intensity allowances for the Darent and Cray Management Catchment

% Annual Exceedance Probability event	Epoch	Central allowance	Upper end allowance
3.3%	2050s	20%	35%
3.3%	2070s	20%	35%
1%	2050s	20%	45%
1%	2070s	25%	40%

Table 4-4 Peak rainfall intensity allowances for the Medway Management Catchment

% Annual Exceedance Probability event	Epoch	Central allowance	Upper end allowance
3.3%	2050s	20%	35%
3.3%	2070s	20%	35%
1%	2050s	20%	45%
1%	2070s	20%	40%

For this SFRA, the following climate change uplifts have been applied to the Environment Agency Risk of Flooding from Surface Water dataset:

- 3.3% AEP 2070s upper end climate change allowance – 35% uplift
- 1% AEP 2050s upper end climate change allowance – 45% uplift

4.4.2 Which peak rainfall intensity allowance to use?

All rainfall intensity climate change uplifts should be applied to both the 3.3% and 1% AEP events. The recommended epoch and use of either the central or upper end allowances should be based on the design lifetime of the proposed development. Further details are provided within the Environment Agency guidance on climate change allowances.

For development with a lifetime beyond 2100 the Upper end allowance should be used. For development with a shorter lifetime the Central allowance can be used. In some locations (including the Darent and Cray Management Catchment and Medway Management Catchment) the allowance for the 2050s epoch is higher than that for the 2070s epoch. If so, and development has a lifetime beyond 2061, the Environment Agency guidance outlines that the higher of the two allowances should be used.

4.5 Groundwater

The effect of climate change on groundwater flooding problems, and those watercourses where groundwater has large influence of winter flood flows, is 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.

4.6 The impact of climate change in the Local Plan

4.6.1 Previous national studies

The UKCP18 provides a number of future projections for different variables across the UK.

South East England

- Increased mean summer temperatures of over 8ºC by 2099.
- Increased mean winter temperatures of up to 7ºC 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 60% 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.

4.6.2 Adapting to climate change

The PPG contains information and guidance 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.

4.6.3 Local strategy

Sevenoaks District Council have committed to tackling the challenge of climate change, as detailed in Sevenoaks District's 'Climate Change Strategy'. As part of this, Sevenoaks District have pledged to do all we can with our available resources to tackle this important issue. It provides a framework for our actions aimed at reducing carbon emissions (mitigation) and adapting to the effects of climate change that are already happening (adaptation), to provide a better environment for future generations. Our Strategy places

community leadership and engagement at the forefront and recognises that through working with our residents, businesses, partners, visitors and community groups to raise climate awareness and unlock potential, we can make more of a difference.

Additionally, at a county level, Kent County Council declared a UK climate emergency in May 2019. They have set out a Kent and Medway Energy and Low Emissions Strategy (2020) which covers how all the district and borough councils will work in partnership to respond to the UK climate emergency, reduce fuel poverty and eliminate poor air quality. Kent County Council have also published an action plan pledging to reach net zero carbon emissions by 2030, for their estate and operations.

5 Sources of information used in preparing the SFRA

This chapter describes the key sources of flood risk information used within and for the preparation of this SFRA.

5.1 Topography, geology, soils and watercourses

Topography, geology, soils and watercourses data was obtained from the following sources:

- Topography data was obtained from the Environment Agency's **1m LiDAR Composite Digital Terrain Model (DTM) 2022.**
- Bedrock Geology and Superficial Deposits data was procured from the **British Geological Society's (BGS) 50K mapping** dataset.
- Soils data was sourced from **Cranfield University Soilscapes mapping.**
- Watercourses data – main rivers were mapped using the Environment Agency's **Statutory Main River Map** dataset, and ordinary watercourses from the Environment Agency's (Partner Only) Detailed River Network dataset.

5.2 Historic flood risk

The historic flood risk within Sevenoaks District Council's administrative area has been assessed using point information of recorded flooding incidents provided by Kent County Council (flood incidents database and Section 19 investigations) and the Environment Agency's Recorded Flood Outlines dataset.

Please note that the Environment Agency's Recorded Flood Outlines dataset is not exhaustive. Just because there are no historic flood outlines within an area it does not necessarily mean there are no records of flooding to these areas.

5.3 Flood Zones

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 described in this SFRA should be used as the basis for informing updates to the Sevenoaks District Local Plan.

The details of the categories used to define each Flood Zone can be found in section 3.2.1.

5.3.1 Functional floodplain (Flood Zone 3b) definition

The mapping in the SFRA identifies Flood Zone 3b as land which would flood with a 3.3% chance (Annual Exceedance Probability) in each and every year (a 1 in 30-year return period event), where detailed modelling exists. Where the 3.3% 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.

Flood Zone mapping for the Local Plan area can be found in Appendix C.

Care should be taken when interpreting how Flood Zone 3b is predicted to change as a consequence of climate change effects. It is possible that the assessment performed to estimate the frequency of inundation (3.33% AEP for Flood Zone 3b) will not include an allowance for the potential increase in standard of protection provided by flood risk management features. In these circumstances more detailed assessments should be performed when considering whether development is appropriate to understand the commitment required to improve the standard of protection and how this affects the extent of Flood Zone 3b.

Table 5-1 displays the names and relevant details regarding the fluvial models which were used to inform the SFRA.

Table 5-1 Flood risk hydraulic models used in the Level 1 SFRA

Model Name	Year	Software (type)
Medway Model 1	2015	ISIS-TUFLOW
Darent and Cray Model	2018	Flood Modeller-TUFLOW

5.4 Climate change modelling for fluvial flood risk

The Sevenoaks District area falls within two management catchments. The Medway management catchment and the Darent and Cray management catchment.

The Environment Agency climate change guidance shows that for watercourses in the Medway management that the 27% and 37% allowances should be considered. For the Darent and Cray Management Catchment, 10% and 18% should be considered. As part of this SFRA, the models were run with these uplifts.

Where there is no fluvial model available, Flood Zone 2 has been used to provide indicative information on the potential effects of climate change. This level of assessment is suitable for a Level 1 SFRA. However, detailed hydraulic modelling using topographic survey would be required at a site-specific level to confirm the flood risk to these sites.

Table 5-2 summarises which datasets have been used to determine future flood risk within the Sevenoaks District.

Table 5-2: Summary of modelling datasets used to inform climate change

Climate change datasets	
Medway Model 1	Fluvial 3.3%, 1% and 0.1% AEP + Central and Higher Central CC
Darent and Cray model	Fluvial 3.3%, 1% and 0.1% AEP + Central and Higher Central CC

5.5 Surface Water

Mapping of surface water flood risk in the Local Plan areas has been taken from the Risk of Flooding from Surface Water (RoFSW) dataset, published online by the Environment Agency. These maps are intended to provide a consistent standard of assessment for surface water flood risk across England 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 Table 5-3.

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.

Table 5-3: 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 an 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 the Local Plan areas can be found in Appendix E.

5.5.1 Surface water flood risk with climate change uplifts

JBA has carried out additional modelling to account for the impact of climate change on surface water flood risk in the SFRA study area.

Based on the updated 2022 climate change allowances for peak rainfall intensity, for development with a lifetime beyond 2100 the Upper End allowance should be used. For development with a shorter lifetime the Central allowance can be used.

For both the Darent and Cray Management Catchment and Medway Management Catchment, the allowance for the 2050s epoch is higher than that for the 2070s epoch. In these cases, and where development has a lifetime beyond 2061, the Environment Agency guidance outlines that the higher of the two allowances should be used.

As a result, a +45% uplift allowance has been applied to the RoFSW, corresponding with the 2050s upper end allowance for both the Darent and Cray Management Catchment and Medway Management Catchment.

Mapping showing the extents of the 1% AEP plus the climate change scenarios can be found in Appendix F.

5.6 Groundwater

JBA has developed a range of Groundwater Emergence Map products at the national scale. The 5m resolution JBA Groundwater Emergence 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 Emergence Map categorises the head difference (m) into five feature classes based on the 100-year model outputs which are outlined in Table 5-4.

Table 5-4: JBA Groundwater Emergence 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. The map also shows where groundwater is predicted to emerge, but it does not show where the flooding is likely to occur, or to what depths, velocity or hazard.

It should be noted that as the JBA Groundwater Emergence 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 G.

5.6.1 Impact of climate change on groundwater flooding

The groundwater mapping completed does not provide the confidence or certainty required to undertake the Sequential Test.

The risk of emergence mapping has been combined with supplementary GIS analysis to understand where the groundwater is likely to flow once it has emerged and support a ‘screening exercise’. This supplementary assessment has been performed using the 1 in 1000-year Risk of Flooding from Surface Water mapping to provide an indication of the likely flow paths as the generalised modelling is based on the topography of the area (Figure 5-1). Where a surface water flow path insects and is downstream of, a groundwater emergence zone this has been highlighted as an area potentially at-risk from groundwater flooding. If the flow path is also associated with a watercourse, this has not been identified as an at-risk area as this would already be considered in the base flow of the watercourse and therefore fluvial flooding.

As previously highlighted groundwater analysis does not provide the confidence or certainty to identify substantive areas at risk therefore this analysis can be used to ‘screen out’ locations where there is unlikely to be groundwater flooding.

If a site is identified as being potentially at risk from groundwater flooding a more detailed assessment should be undertaken within the Level 2 SFRA which should consider local conditions on a site-by-site basis using available historic, borehole, geological and LIDAR data.

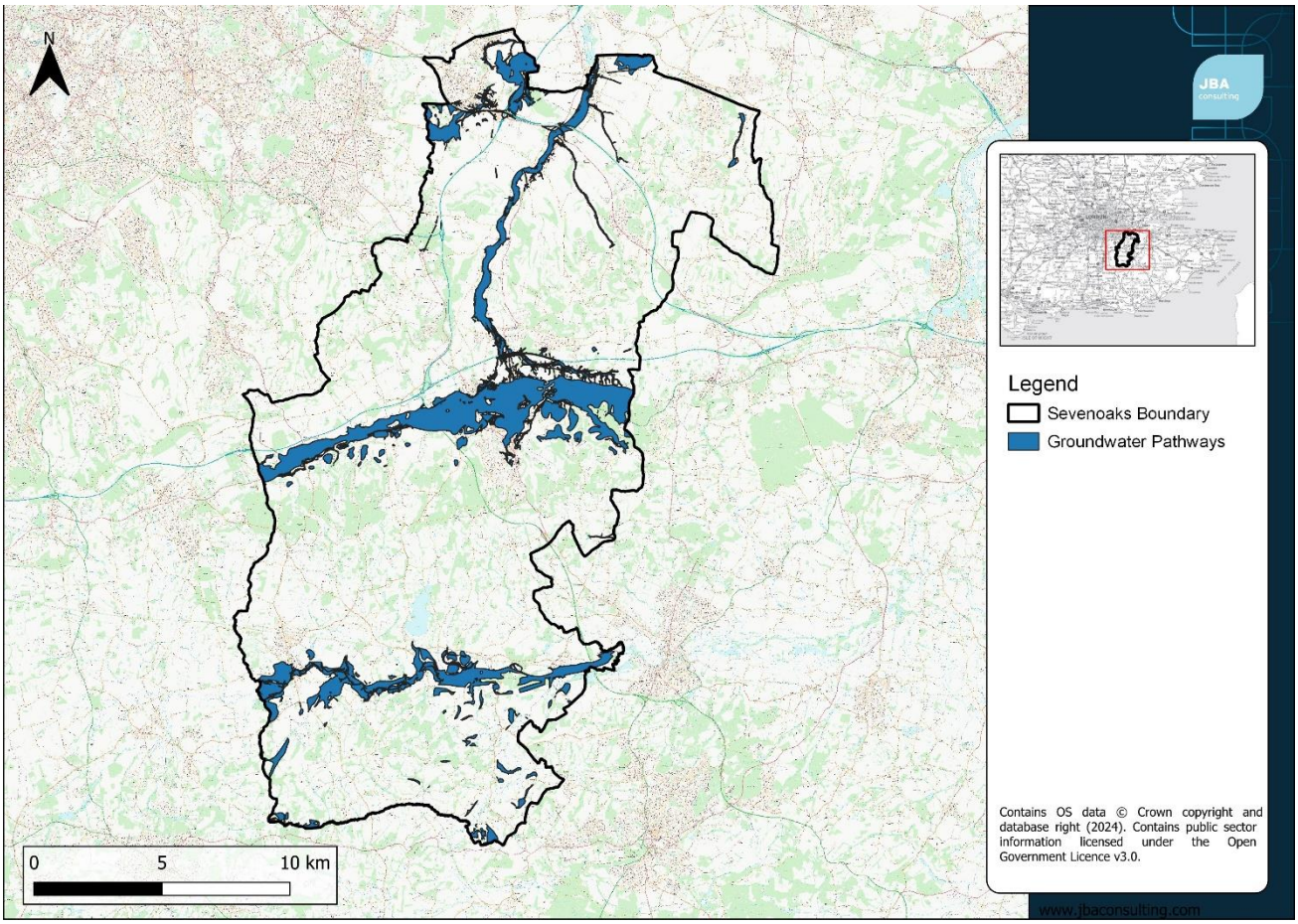


Figure 5-1. Groundwater emergence map with risk of surface water mapping to indicate groundwater flow paths.

5.7 Sewers

In May 2023, Southern Water and Thames Water published their DWMPs for the Sevenoaks area. A DWMP describes the basis for long term investment proposals by water and sewerage companies that span the next 25 years and set out the commitment needed to ensure they are robust and resilient to future pressures. A significant number of locations within the Sevenoaks area are at risk of flooding in a 1 in 50 year storm and at risk of flooding due to hydraulic overload including Swanley and Sevenoaks.

5.8 Reservoirs

The risk of inundation due to reservoir breach or failure of reservoirs within the area has been assessed using the Environment Agency's Risk of Flooding from Reservoirs dataset.

This dataset displays a prediction of the credible worst-case scenario. The dataset gives no indication of the likelihood or probability of reservoir flooding. The Reservoir Flood Maps do not describe the risk of flooding (simply a credible worst case) and data includes layers for:

- 'Dry days' – Individual flood extents for all large, raised reservoirs in the event that they were to fail and release the water held on a "dry day" when local rivers are at normal levels.
- 'Wet days' – Individual flood extents for all large, raised reservoirs in the event that they were to fail and release the water held on a "wet day". A wet day is assumed to be a failure at the same time is experiencing a river flood with a 1 in 1000 chance of occurring.
- 'Fluvial contribution' – The extent of river flooding added to the reservoir model to determine the impacts of failure on a wet-day.

The flood extents for reservoir flooding for the Local Plan area are located in Appendix H.

5.9 Suite of maps

All the mapping can be found in the appendices to this SFRA. These are presented in the following structure:

- Appendix A: Southern Water DWMP
- Appendix B: Thames Water DWMP
- Appendix C: Flood Zone Mapping
- Appendix D: Fluvial risk plus climate change
- Appendix E: Risk of Flooding from Surface Water
- Appendix F: Surface Water and Climate Change.
- Appendix G: JBA Groundwater Mapping
- Appendix H: Reservoir Mapping
- Appendix I: Flood Defences
- Appendix J: Flood Warning Areas
- Appendix K: Site Screening
- Appendix L: Sequential Test Methodology

6 Understanding Flood Risk in Sevenoaks District

This section is a strategic summary of the flood risk within Sevenoaks District Council's administrative area. This section explores the factors affecting flooding within Sevenoaks District Council's administrative area – including topography, soils and geology – as well as the key sources of flooding.

Developers should use this chapter to scope out the flood risk issues they need to consider in greater detail in a site-specific Flood Risk Assessment to support a Planning Application.

6.1 Topography, geology, soils and watercourses

6.1.1 Topography

Figure 6-1 displays the topography (elevation) of Sevenoaks District. 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. 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.

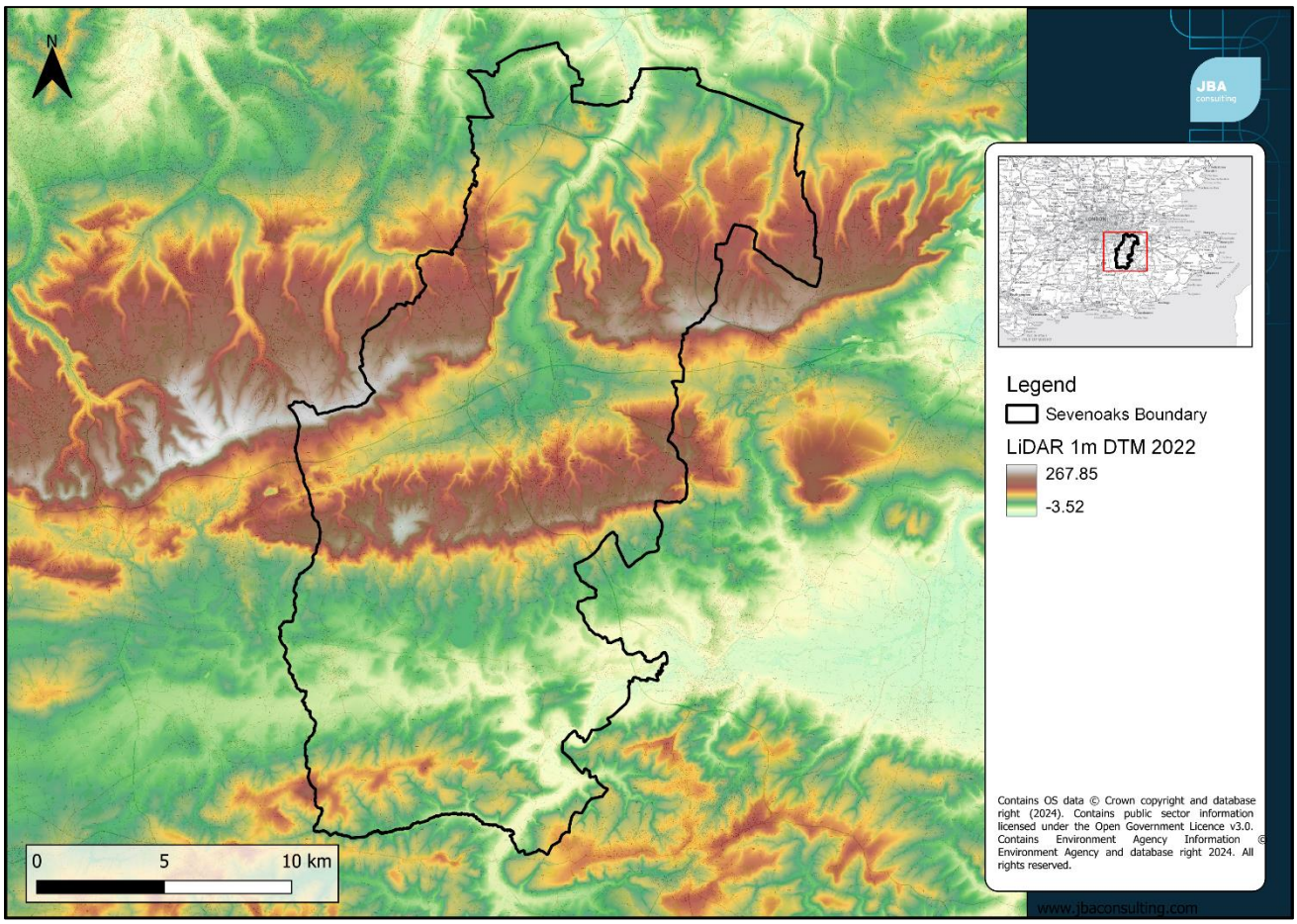


Figure 6-1: Topography of Sevenoaks District Council, displaying elevations in metres above Ordnance Datum (mAOD).

6.1.2 Geology

Sevenoaks District primarily consists of three main bedrock geologies (Figure 6-2); the Wealden Group, the Lower Greensand Group and the White Chalk Sub-group.

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.

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. 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 (Figure 6-3). Clay-with-Flints Formation (diamicton) characterise the North Downs, whereas Alluvium (clay, silt and sand) and River Terrace Deposits (undifferentiated – sand and gravel) characterise the floodplains and areas surrounding the three main rivers in the district.

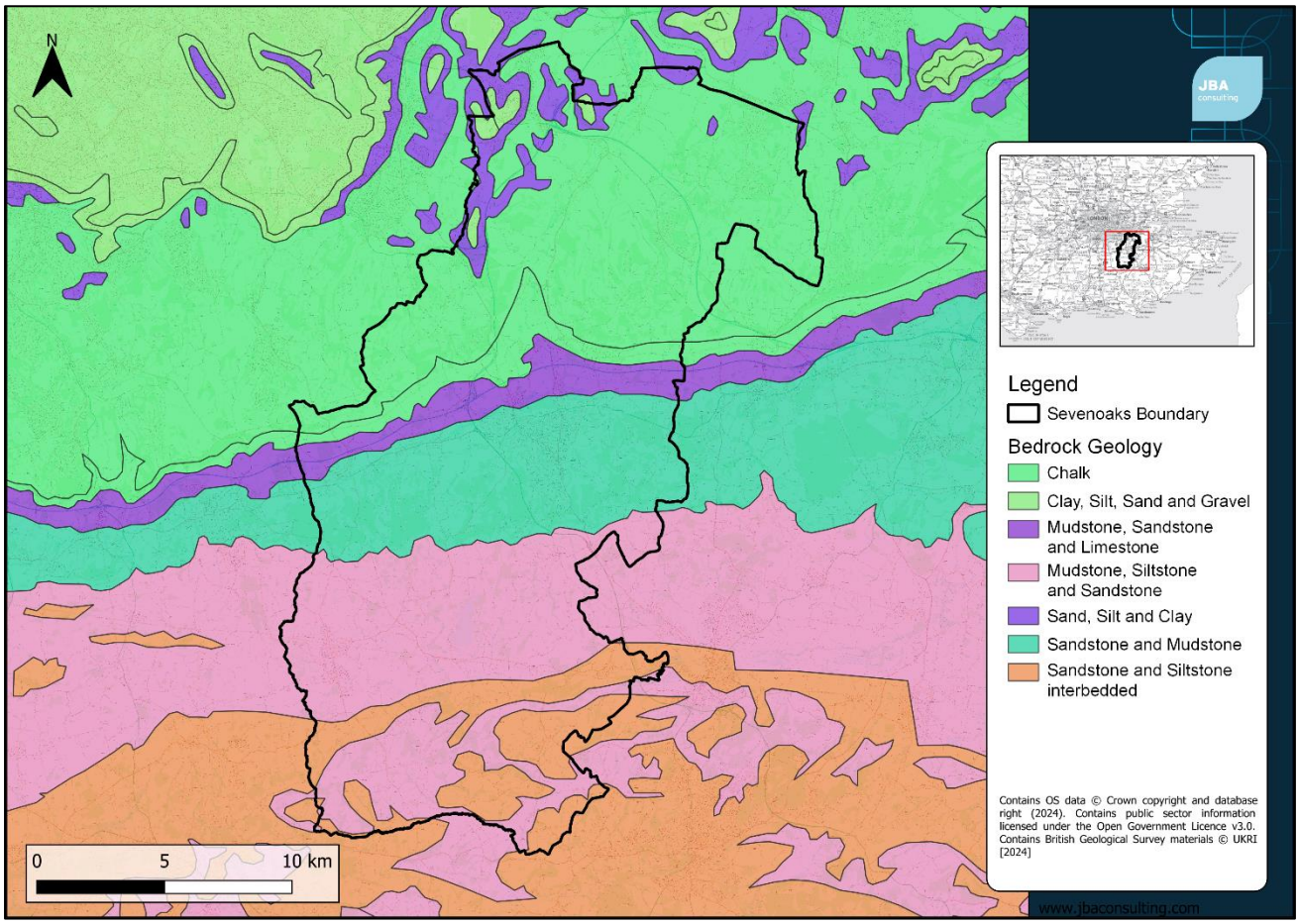


Figure 6-2: the underlying bedrock geology of Sevenoaks District.

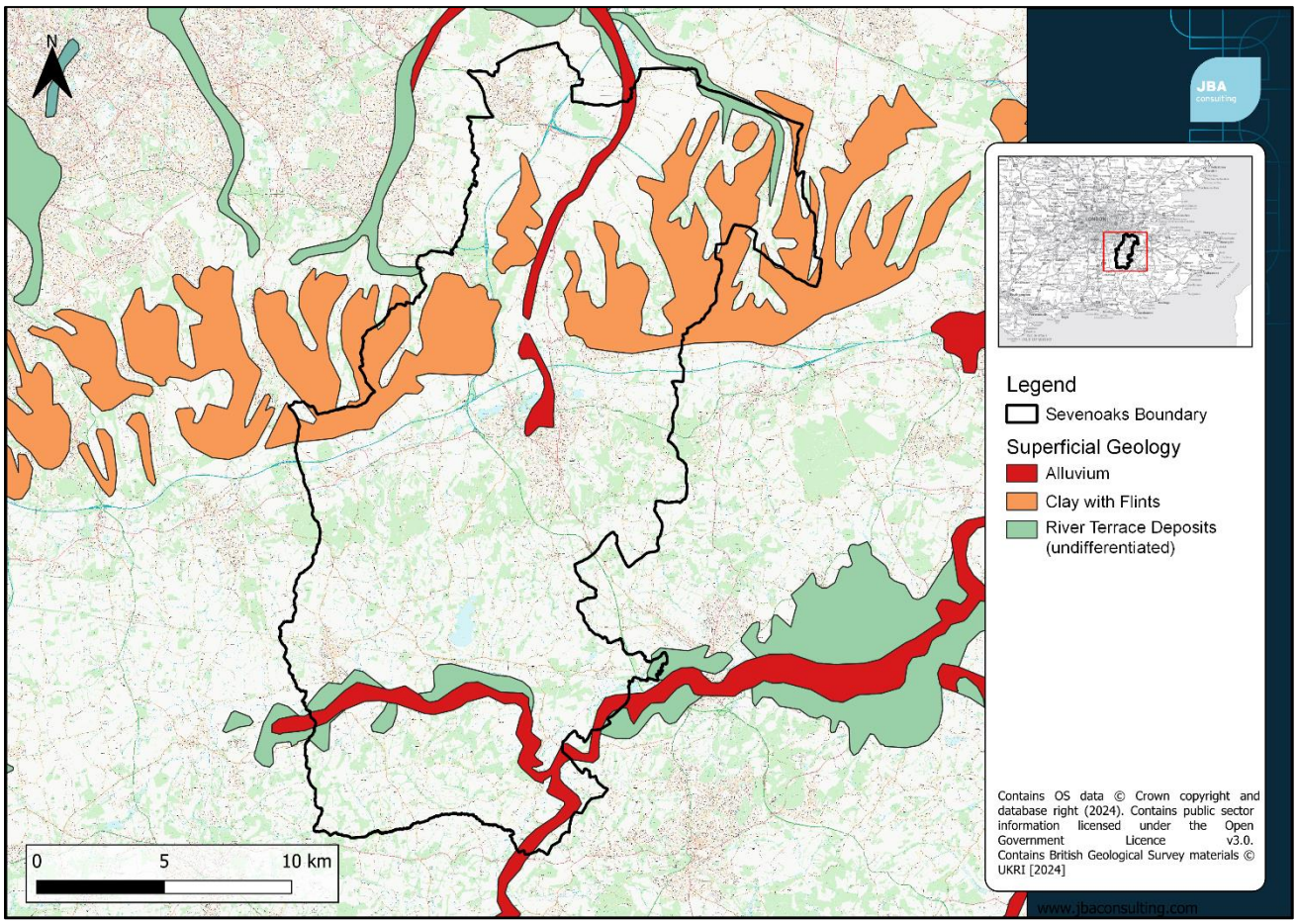


Figure 6-3: the superficial geology overlaying the bedrock within Sevenoaks District.

6.1.3 Soils

There are a variety of different soil types within Sevenoaks District, but they are generally classified as loamy and clayey soils. Specific soil types within Sevenoaks District include (**Land Information System, soilscape**):

- **Slowly permeable, seasonally wet, slightly acid but base-rich loamy and clayey soils** – surrounding the River Darent, River Eden and River Medway.
- **Slightly acid loamy and clayey soils with impeded drainage and slightly acid loamy and clayey soils with impeded drainage –** surrounding the North Downs.
- **Loamy and clayey soils of coastal flats with naturally high groundwater** – generally located in the centre of the district surrounding Sevenoaks and Swanley.
- **Slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils –** located in the rural central parts of the District, such as Chiddingstone Causeway and Sevenoaks Weald.
- **Freely draining slightly acid loamy soils** – isolated patches to the east of the District near Plaxtol.

- **Loamy soils with naturally high groundwater** – to the south of the District surrounding Edenbridge.

6.1.4 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. Mapping of the watercourses within the Sevenoaks area are included in Figure 6-4.

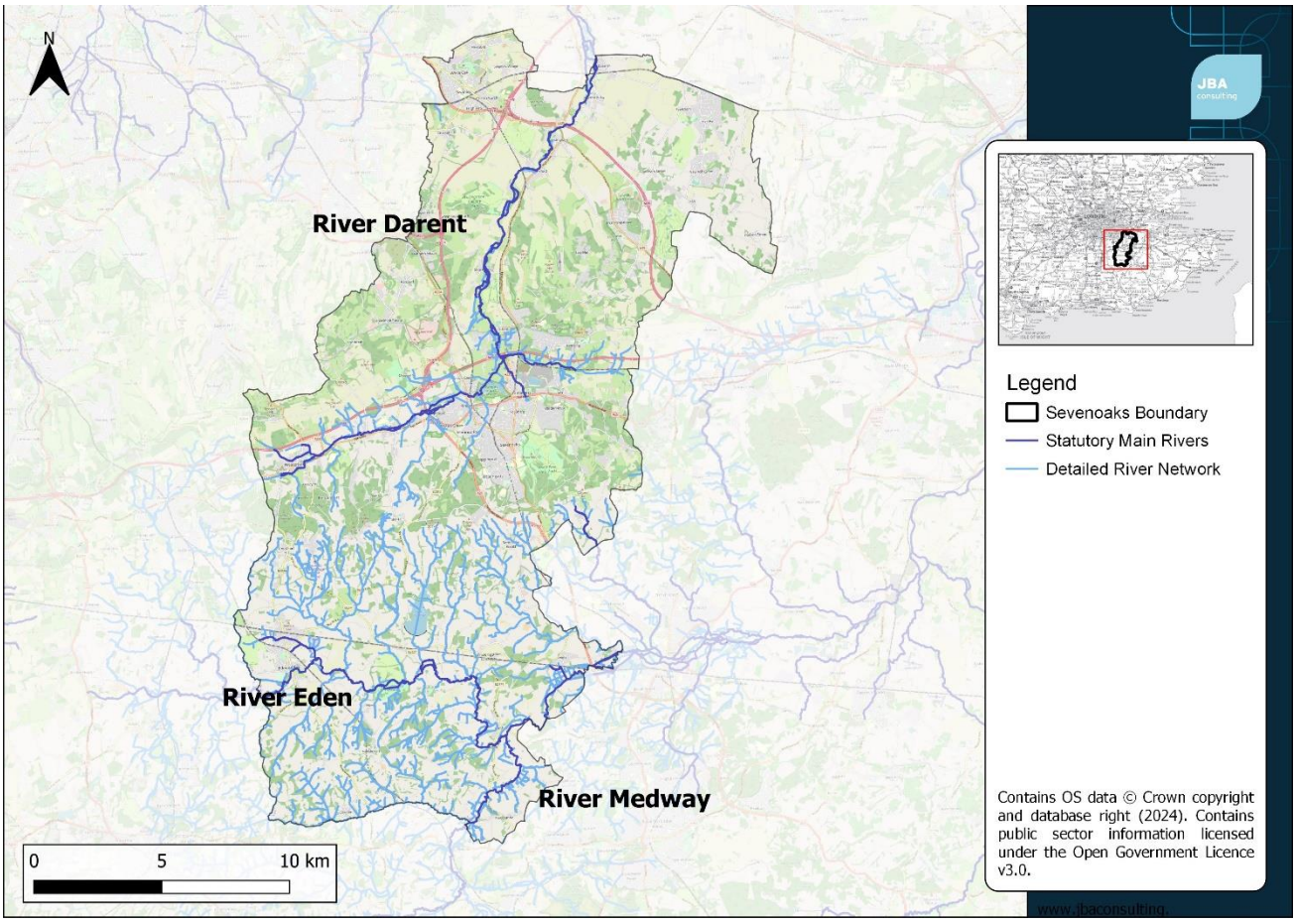


Figure 6-4: Watercourses in the Sevenoaks District

6.2 Historic flooding

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

The events of 1958, 1960, 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 (Figure 6-5)

The following historic flooding incidents are notable in Sevenoaks;

- Flooding during the winter of 2013/14;
- Ightham flooding – June 2016;
- Swanley flooding – June 2019.
- West Kingsdown – June 2019
- Swanley flooding – July and October 2021

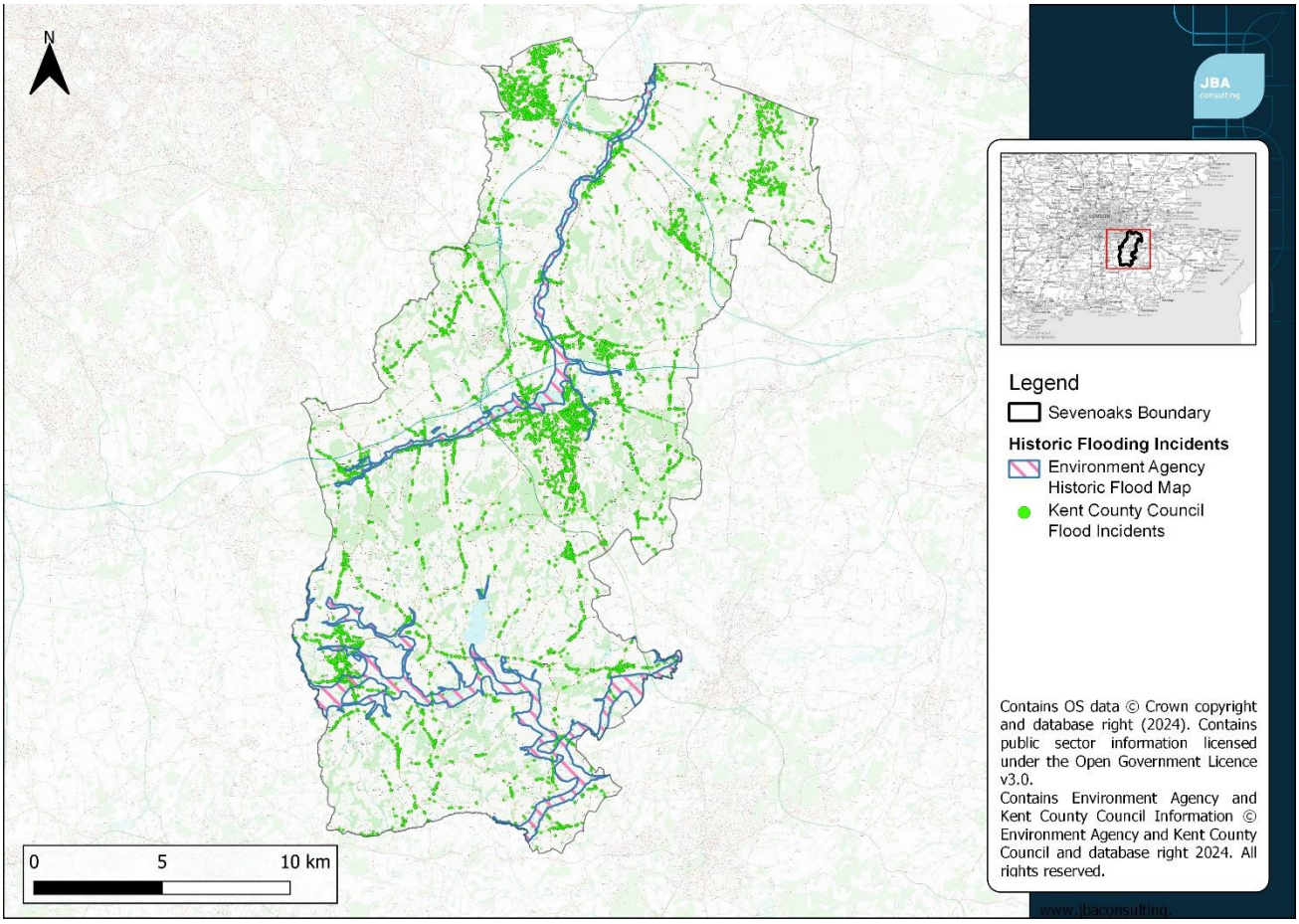


Figure 6-5: Historical flooding in the Sevenoaks District

6.3 Fluvial flood risk

Within Sevenoaks District, the main fluvial flooding sources are from the River Darent, River Eden and River Medway. SFRA present day Flood Zone mapping is located in Appendix C.

6.3.1 Present day fluvial flood risk

There is widespread flooding recorded historically within the district (particularly along the floodplains of the River Darent, Eden and Medway, particular areas (e.g. roads) of the district susceptible to fluvial flooding have not been identified specifically as they are so numerous. A general overview of fluvial flooding in the district is outlined below.

The River Darent (Environment Agency main river) flows northwards from Westerham, through Sevenoaks, and eventually into the River Thames approximately 6km north of Sevenoaks District. According to SFRA flood zones mapping, the urban areas at risk of fluvial flooding from the River Darent (and tributaries including the River Guzzlebrook) include:

- Westerham
- Northern Sevenoaks (including Dunton Green and Bat and Ball)
- Otford
- Eynsford
- Farningham
- Horton Kirby.

The River Eden flows from west to east in the southern half of Sevenoaks District, reaching its confluence with the River Medway at Penshurst (both are Environment Agency main rivers). According to SFRA Flood Zones mapping, the urban areas at risk of fluvial flooding from the Rivers Eden and Medway include Edenbridge, Penshurst and Leigh.

Other, smaller (‘Ordinary’) watercourses may also pose localised fluvial flood risks but are more difficult to predict.

For examples, the Sevenoaks SWMP states that 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. Issues include blocked trash screens and culverts, and high water levels are known to have had a knock-on effect on highway drainage.

6.3.2 Fluvial flood risk with climate change

Appendix D includes mapping displaying the fluvial climate change hydraulic model extents (with Environment Agency river flow climate change allowances applied) within Sevenoaks District. There are only minimal differences in the in the fluvial flood extents between these

climate change scenarios and the present day scenarios. Nevertheless, there are some minor increases in fluvial flooding extents, such as surrounding Hever and Edenbridge on the River Eden.

6.3.3 Ordinary Watercourses

The Sevenoaks SWMP states that ordinary watercourses have also repeatedly flooded in the district. For example, a tributary of the River Eden northeast of Marlpit Hill and southwest 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. 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 catchments greater than 3km^2. Therefore, whilst these smaller watercourses may not be shown as having flood risk in the Flood Map for Planning dataset (fluvial flood zones), 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.

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 7.

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

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 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. The Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset can be used to identify areas of residual risk.

6.4 Surface water flooding

Flooding from surface water runoff (or ‘pluvial’ flooding) is usually caused by intense rainfall that may only last a few hours. Flooding usually occurs when rainfall fails to infiltrate to the ground or enter the drainage system. Ponding generally occurs at low points in the topography. The likelihood of flooding is dependent not only on the rate of runoff but also

saturation of the receiving soils, the groundwater levels, and the condition of the surface water drainage system (i.e., surface water sewers, highway authority drains and gullies, open channels, Ordinary Watercourses and SuDS). Surface water flooding problems are inextricably linked to issues of poor drainage, or drainage blockage by debris, and sewer flooding.

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.

Information provided by members of the public indicate areas around Westerham have flooded as a result of surface water flooding following heavy rainfall in winters 2019, 2020 and 2023.

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.

The Environment Agency's RoFSW mapping for the 3.3% AEP, 1% AEP and 0.1% AEP return periods within Sevenoaks District predominantly follow the routes of watercourses or dry valleys with some isolated areas of ponding located in low lying areas. The mapping also identifies some constrained surface water flow paths within the District's urban areas, including Sevenoaks, Swanley, Edenbridge and Kemsing. Mapping of the RoFSW throughout the borough is provided in Appendix E.

It is accepted that climate change will increase the intensity and frequency of rainfall across the Southeast of England. Winter storms are also expected to become increasingly frequent and hence all types of flooding, including surface water, will increase. Mapping of the climate-change uplifted RoFSW is also provided in Appendix F.

6.5 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 (2013)** 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.

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

6.6 Reservoir flood risk

Reservoirs with an impounded volume greater than 25,000 cubic metres are governed by the Reservoir Act 1975 and are on a register held by the Environment Agency. The register includes all water storage structures with an impounded volume over 25,000 cubic metres, even though they may not necessarily be used as reservoirs for drinking water. The level and standard of inspection and maintenance required by a Supervising Panel of Engineers under the Act means that the risk of flooding from reservoirs is very low.

Flooding from reservoirs occurs following partial or complete failure of the control structure designed to retain water in the artificial storage area. Reservoir flooding is very different from other forms of flooding; it may happen with little, or no, warning and evacuation will need to happen immediately. The likelihood of such flooding cannot be estimated but is normally extremely low compared to flooding from other sources. It may not be possible to seek refuge upstairs from floodwater as buildings could be unsafe or unstable due to the force of water from the reservoir breach or failure.

The Environment Agency hold mapping showing what might happen if reservoirs fail. Developers and planners should check the Long-Term Risk of Flooding website before using the reservoir data shown in this SFRA to make sure they are using the most up to date mapping. Although the risk of reservoir flooding is extremely low, there remains a residual risk to development from reservoirs which developers should consider during the planning stage:

- Developers should contact the reservoir owner for information on:
- the Reservoir Risk Designation
- reservoir characteristics: type, dam height at outlet, area/volume, overflow location
- operation: discharge rates / maximum discharge
- discharge during emergency drawdown; and
- inspection / maintenance regime.
- The EA online Reservoir Flood Maps contain information on the extents following a reservoir breach (note: only for those reservoirs with an impounded volume greater than 25,000 cubic metres which are governed by the Reservoir Act 1975). Consideration should be given to the extent shown in these online maps.
- The GOV.UK website on Reservoirs: owner and operator requirements provides information on how to register reservoirs, appoint a panel engineer, produce a flood plan and report an incident.
- In addition, developers should consult the Kent Resilience Forum about emergency plans.

Developers should use the above information to:

- Apply the sequential approach to locating development within the site.
- Consider the impact of a breach and overtopping, particularly for sites proposed to be located immediately downstream of a reservoir. This should consider whether there is sufficient time to respond, and whether in fact it is

appropriate to place development immediately on the downstream side of a reservoir.

- Assess the potential hydraulic forces imposed by sudden reservoir failure event and check that that the proposed infrastructure fabric could withstand the structural loads.
- Develop site-specific Emergency Plans and/ or Off-site Plans if necessary and ensure the future users of the development are aware of these plans. This may need to consider emergency drawdown and the movement of people beforehand.

The current mapping indicates that there are ten reservoirs which could impact Sevenoaks District during a "wet day" scenario if there were to fail (Table 6-1). The reservoir flood mapping for both the "dry day" and "wet day" scenarios in Sevenoaks District has been provided in Appendix H.

During a "wet day" breach scenario, the areas of Sevenoaks District fringing the tributaries of the River Darent, River Eden and River Medway would be flooded.

The Environment Agency maps represent a credible worst-case scenario. In these circumstances it is the time to inundation, the depth of inundation, the duration of flooding and the velocity of flood flows that will be most influential.

Table 6-1: Reservoirs with the potential to flood Sevenoaks District during a "wet day" breach scenario.

Reservoir	Grid Reference	Reservoir Undertaker	Local Authority	Within Sevenoaks District?
Bay Pond	TQ 35315 51564	Surrey Wildlife Trust	Surrey County Council	No
Bough Beech	TQ 49300 47800	Sutton and East Surrey Water PLC	Kent County Council	Yes
Coombe Bank Lake	TQ 47800 55800	Lynxtrade UK Limited	Kent County Council	Yes
Hedgecourt Lake	TQ 35500 40300	Crawley Mariners Yacht Club Ltd	Surrey County Council	No
Hever Castle Lake	TQ 48400 45400	Hever Castle Ltd	Kent County Council	Yes
Leigh Barrier (Medway) Flood Storage Area	TQ 5562 945755	Environment Agency	Kent County Council	Yes

Reservoir	Grid Reference	Reservoir Undertaker	Local Authority	Within Sevenoaks District?
Leigh Place Pond	TQ 36000 50900	Mr and Mrs M McGhee	Surrey County Council	No
Main Lake, Eridge Park	TQ 56500 35000	Broadoak Fishing Club	East Sussex County Council	No
Weirwood	TQ 40600 35300	Southern Water Services Ltd	East Sussex County Council	No
Wiremill Lake	TQ 36800 41700	Wiremill Waterski Club	Surrey County Council	No

6.7 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. In addition to the combined effects of urban creep and climate change, sewer flooding can also be exacerbated by poor de-watering practice in construction, misconnections (surface water must not be connected to the foul sewer network) and blockage caused by items it was not designed to carry. 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. Developers must undertake due diligence when designing the site drainage, including to determine the elevation of the development, and implement any measures required to ensure that flood risk does not increase are installed. Surface and foul water should be drained separately, with only foul flows communicating with the public foul system.

SIRF data was provided by Southern Water. This database records incidents of flooding relating to public foul, combined or surface water sewers and displays properties that both

internal and external flooding. The database covers reported incidents of sewer flooding up to 2021 (Table 6-2).

Table 6-2: 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**

7 Flood Defences

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

Defences are categorised as either raised flood defences (e.g. walls/embankments) or Flood Storage Areas (FSAs). The assessment of the Environment Agency Spatial Flood Defence dataset has considered defences which potentially provide a standard of protection from a 5% AEP event or more. The dataset includes man-made defences and the presence of naturally high ground.

7.1 Defence standard of protection and residual risk

Flood defences are designed to give a specific Standard of Protection (SoP), reducing the risk of flooding to people and property in flood prone areas. For example, a flood defence with a 100-year SoP means that the flood risk in the defended area is reduced to a 1% chance of flooding in any given year.

Over time the actual SoP provided by the defence may decrease, for example due to deterioration in condition or increases in flood risk due to climate change. The understanding of SoP may also change over time as RMAs undertake more detailed surveys and flood modelling studies.

It should be noted that the Environment Agency's on-going hydraulic modelling programme may revise flood risk datasets and, as a consequence, the standard of protection offered by flood defences in the area may differ from those discussed in this report.

Developers should consider the SoP provided by defences and residual risk as part of a detailed FRA.

7.2 Defence condition

Formal structural defences are given a rating by the Environment Agency based on a grading system for their condition[3]. A summary of the grading system used by the Environment Agency for condition is provided in Table 7-1.

[3] Condition Assessment Manual, Environment Agency (2012)

Table 7-1: 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.

7.3 Defences in Sevenoaks District

Mapping showing the existing flood defences in Sevenoaks District can be found in Appendix I, this information is taken from the Environment Agency's Spatial Flood Defences dataset.

7.3.1 Raised defences

7.3.1.1 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'.

7.3.1.2 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'.

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.

7.3.2 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 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). The Environment Agency Released a policy paper on the Leigh Flood Storage Area in December 2022.

- 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. Since the event, a partnership has formed between the EA, KCC, ~~Sevenoaks~~ South East Local Enterprise Partnership

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. 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.

7.3.3 Upper Westerham Flood Alleviation Scheme

The Upper Westerham Flood Alleviation Scheme reduced the risk of fluvial flooding to properties and the section of the A25 highway between Squerryes Court and Long Pond. The scheme increased conveyance in the main channel of the river, pavement/kerbs were lowered to road level to enable overflow from blocked gullies to drain into watercourses and re-align the culvert beneath Squerryes Drive reducing the flood risk to the surrounding dwellings. In order to maintain the structural integrity of the A25 highway , essential works took place on the left bank of the **River Darent**.

7.4 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 between April 2021 and March 2027 across the UK.

There are currently no Environment Agency capital programmes planned for the Sevenoaks area.

7.5 Residual flood risk

Residual risks are those remaining after applying the sequential approach and taking mitigating actions. 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 inability of pumping systems to cope with the incoming discharges; and/or

- 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, or failure of pumping stations.

The Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset can be used to identify areas of residual risk.

In circumstances where measures are put in place to manage the flood risk there remains a possibility of flooding being experienced, either as a consequence of the event exceeding the design capacity or the failure of the asset providing the appropriate standard of protection. It is the responsibility of the developer to fully assess flood risk, propose measures to mitigate it and demonstrate that any residual risks can be safely managed.

This SFRA does not assess the probability of failure other than noting that such events are very rare. However, in accordance with NPPF, all sources of flooding need to be considered. If a breach or overtopping event were to occur, then the consequences to people and property could be high. Developers should be aware that any site that is at or below defence level may be subject to flooding if an event occurs that exceeds the design capacity of the defences, or the defences fail, and this should be considered when building resilience into low level properties.

7.5.1 Overtopping

The risk from overtopping of defences is based on the relative heights of property or defence, the distance from the defence level and the height of water above the crest level of the defence. The Defra and Environment Agency Flood Risks to People guidance document provides standard flood hazard ratings based on the distance from the defence and the level of overtopping.

Any sites located next to defences or perched ponds/ reservoirs, may need overtopping modelling or assessments at the site-specific FRA stage, and climate change needs to be taken in to account.

7.5.2 Defence breach

A breach of a defence occurs when there is a failure in the structure and a subsequent ingress of flood water occurs.

Where defences are present, risk of breach events should be considered as part of the site-specific flood risk assessment. Flood flows from breach events can be associated with significant depths and flow velocities in the immediate vicinity of the breach location and so FRAs must include assessment of the hazards that might be present so that the safety of people and structural stability of properties and infrastructure can be appropriately taken into account. Whilst the area in the immediate vicinity of a breach can be subject to high flows, the whole flood risk area associated with a breach must also be considered as there may be areas remote from the breach that might, due to topography, involve increased depth hazards.

Considerations include the location of a breach, when it would occur and for how long, the depth of the breach (toe level), the loadings on the defence and the potential for multiple breaches. There are currently no national standards for breach assessments and there are various ways of assessing breaches using hydraulic modelling. Work is currently being undertaken by the Environment Agency to collate and standardise these methodologies. It is recommended that the Environment Agency are consulted if a development site is located near to a flood defence, to understand the level of assessment required and to agree the approach for the breach assessment.

8 FRA requirements and flood risk management guidance

8.1 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, 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.

8.2 Requirements for flood risk assessments

8.2.1 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 080 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.

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
- 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 (such as an IDB) which requires a site-specific FRA
- 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 substantial overland surface water flow routes

8.2.2 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. Flood mitigation options should be considered, including the use of soft engineering techniques where appropriate.

8.2.3 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 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:

- 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
- 600mm 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.

8.2.4 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.

8.2.5 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** webpage.
- Kent Resilience Forum provides information and advice for individuals on **preparing for flooding**.

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.

8.3 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.

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)[4]. 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 must 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.

8.4 Mitigation Measures

Mitigation measures should be regarded as a last resort to address flood risk issues where the site has passed the Exception Test and therefore has strong planning/sustainability reasons for development. Consideration should first be given to minimising risk by planning sequentially across a site. Once risk has been minimised as far as possible, only then should mitigation measures be considered.

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

Often the determining factors in deciding whether a particular development is appropriate are the practical feasibility, financially viability and long-term maintenance implications of flood risk mitigation rather than technical limitations. Detailed technical assessments are required in the FRA to assess the practical feasibility, together with a commercial review by the developer of the cost of the mitigation works and how contributions will be made for their long-term maintenance. At the SFRA stage, broad assumptions must be made regarding the feasibility of flood risk mitigation to highlight sites with greater development potential. The formulation of measures that not only provides an appropriate standard of protection to new development, but also reduces the risk to existing communities will be an important consideration.

Attention must also be paid to the provision of safe access and egress during flood events (see section 10.4.2), including climate change, and how this is linked to flood warning and emergency evacuation where necessary. The Emergency Services and local authority should be consulted on the evacuation and rescue capabilities and any advice or requirements included. Consideration should also be given to residual risk to understand the safety implications during events where the design capacity is exceeded or there is a failure.

There should normally be no interruption to flood flows or loss of flood storage as a result of any proposed development. Flood storage compensation may be appropriate for sites on the edge of the existing floodplain or within a flood cell. However there should be no loss of storage volume and any compensation should be provided level for level. Where some development is considered appropriate such as some forms of less vulnerable development then resilience rather than resistance measures should be used if flood plain compensation is not being provided. However, more vulnerable forms of development should not be permitted where there is any risk of internal flooding.

Whilst it might be possible to identify appropriate flood mitigation measures for some sites, it is worth noting that in some instances the findings of individual FRAs may determine that the risk of flooding to a proposed development is too great and mitigation measures are not feasible or appropriate.

8.5 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**, the Environment

Agency specifies that no development is permitted within 8m either side of a Main River. It is understood from the Environment Agency that this is to:

- Allow for natural river function (such as erosion and meandering)
- Allow for river maintenance
- Allow space for future flood alleviation schemes to be constructed
- Ensure the natural river corridor is maintained for biodiversity reasons.

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.

8.6 Making space for water

The PPG sets out a clear aim to make use of natural and sustainable flood risk management methods wherever they may be effective when opportunities are presented by new developments. The documentation encourages consideration of net gains and multiple benefits of applying such measures. Strategic Flood Risk Assessments are to identify opportunities for nature-based solutions. Developments subject to the Exception Test must reduce overall flood risk where possible.

All new development should consider the opportunity presented to improve and enhance the river environment, seeking opportunities for river restoration and enhancement as part of the development. A sustainable drainage approach can alleviate flood risk as well as increase surface water infiltration, increasing vegetation (and improving biodiversity), providing additional flood storage, and reducing the surface water load of the existing sewerage network.
Natural flood Management (NFM) techniques work with natural processes to protect, restore, and emulate natural functions of catchment, floodplains, rivers, and coasts. Examples include land management to improve soil health and infiltration rates and soil moisture storage, river restoration, restoring or creating wetland areas, and woodland creation. When designed properly, such measures can have benefits such as reducing the costs of maintaining hard engineering structures, reducing flood risk, improving water quality and increasing biodiversity. Social benefits are also gained by increasing green space and access to the river.

8.7 Reducing flood risk from other sources

8.7.1 Groundwater

Groundwater flooding has a very different flood mechanism to any other source of flooding, and for this reason many conventional flood defences 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.

8.7.2 Surface water and sewer flooding

LLFA's are responsible for surface water management. The surface water hierarchy should be followed for new developments, with close consultation with the LLFA. The Developer should approach the LPA with a new development and design work may need to be considered to identify the best solution. Planning permission may be made conditional upon evidence that steps are taken to ensure the public sewer will be able to cope with the increased load, through the use of planning conditions. The LPA can then determine any details submitted in accordance with any views expressed by the water utility company.

Developers should discuss public sewerage capacity with the water utility company (Thames Water or Southern Water) at the earliest possible stage. Requests for connection of surface water to water utility companies' networks should only occur once the LLFA have confirmed that is no other option for disposal. 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.

9 Surface water management and SuDS

9.1 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**. Surface water flooding describes flooding from sewers, drains, and ditches that occurs during heavy rainfall.

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.

9.2 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.

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 document**.

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.

9.2.1 Implementation of Schedule 3 of the Flood and Water Management Act (2010)

In January 2023, DEFRA released 'The review for implementation of Schedule 3 to The Flood and Water Management Act 2010'. In England, Schedule 3 was not commenced as part of the Act's ratification in 2010. The implementation of Schedule 3 in England will follow that of Wales where the schedule was commenced into law in January 2019.

The Jenkins review of the arrangements for determining responsibility for surface water and drainage assets (2020), a precursor to the review for implementation of Schedule 3, suggested the existing planning-led approach alone in England is not effective, and recommended that non-statutory technical standards for sustainable drainage systems be made statutory. The review indicated that in general there are no specific checking systems in place to ensure that SuDS are constructed as agreed, leading to concerns surrounding unsatisfactory standards of design and construction, and of difficulties associated with ensuring proper maintenance once construction is complete.

Schedule 3 provides a framework for the approval and adoption of drainage systems by a SuDS Approving Body (SAB), and national standards on the design, construction, operation, and maintenance of SuDS.

Government will now consider how Schedule 3 will be implemented, with the schedule expected to be implemented in 2024.

9.3 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. At this stage it is also helpful to consult with the respective water and wastewater service providers. 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 9-1) 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. It 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.

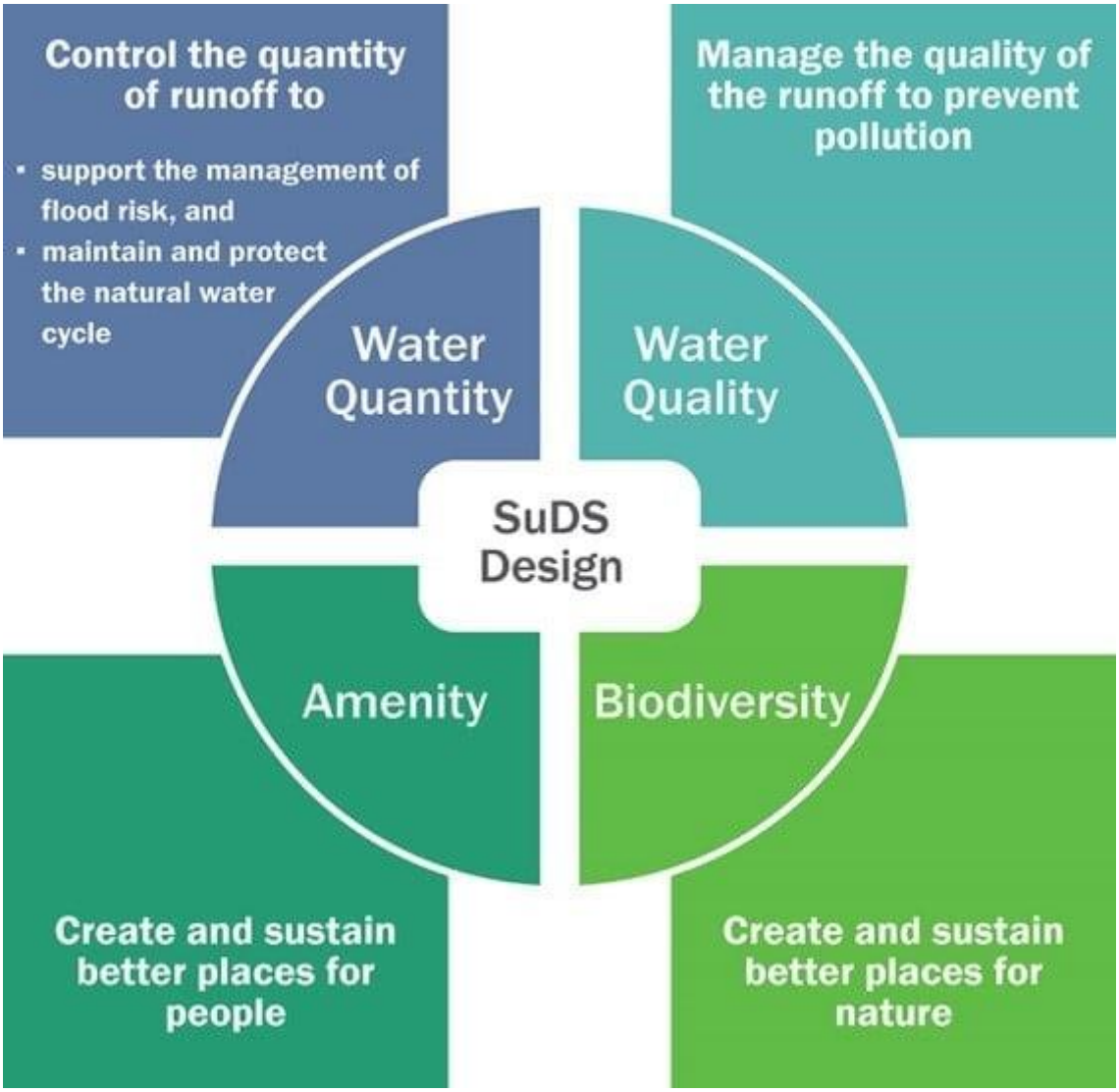


Figure 9-1 Four pillars of SuDS design (The SuDS Manual C753, 2015)

9.4 Types of SuDS Systems

There are many different SuDS techniques that can be implemented in attempts to mimic pre-development drainage (Table 9-1), many of which do not necessarily need to take up a lot of space. Techniques can include soakaways, infiltration trenches, permeable pavements, grassed swales, green roofs, ponds, and wetlands. 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).**

Table 9-1 Examples of SuDS techniques and their 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	✓		

9.4.1 SuDS management

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 (Figure 9-2). 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.

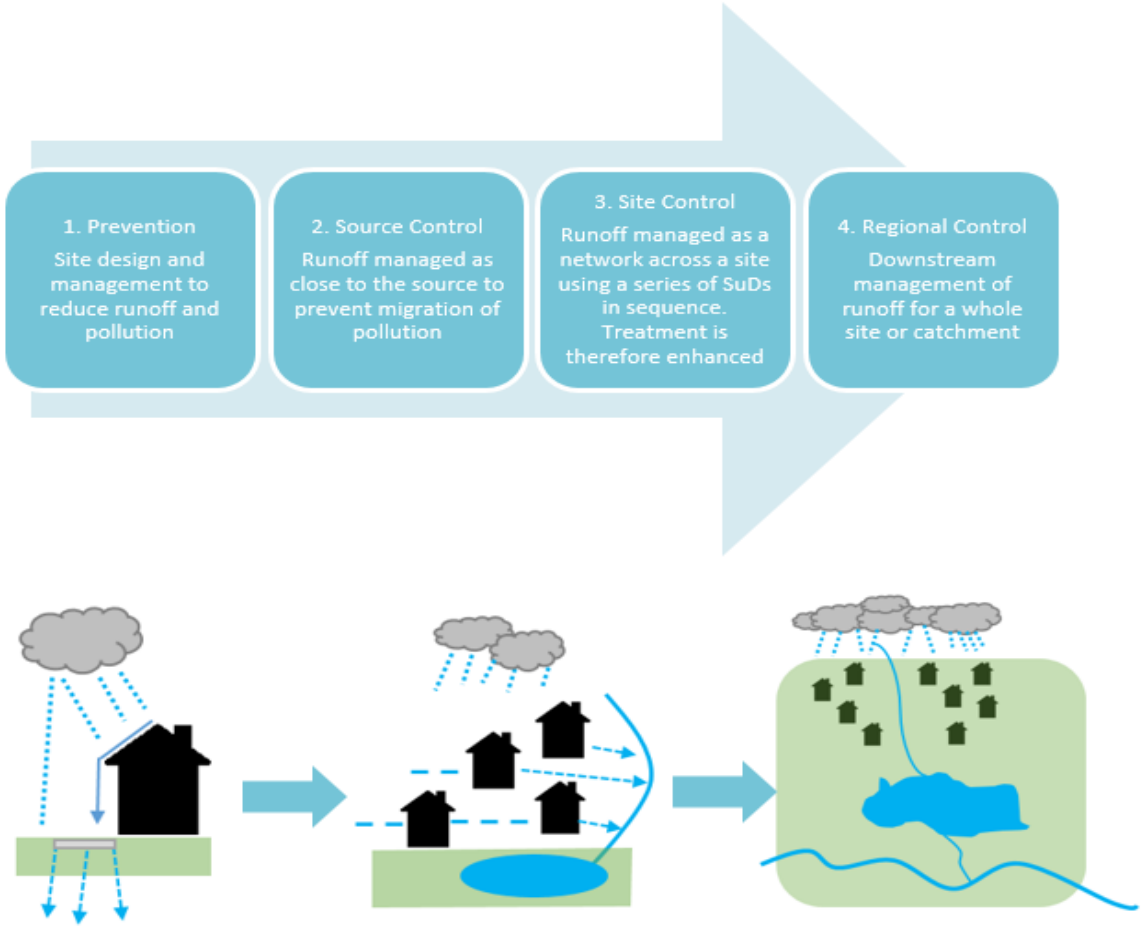


Figure 9-2: Diagram outlining the SuDS management sequence

9.4.2 Treatment

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:

- Manage surface water runoff close to source: This makes treatment easier due to the slower velocities and helps isolate incidents rather than transport pollutants over a large area.
- 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.
- 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.

- 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.
- 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.

9.4.3 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. Table 9-2 details some possible constraints and how they may be overcome.

Table 9-2: Example of 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 within 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.

Considerations	Solution
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 flood risk 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. Any sewer adoption by a wastewater service provider would be under the requirements set out in Sewerage Sector Guidance

9.5 Policy and guidance on surface water management

9.5.1 C753 CIRIA SuDS Manual (2015)

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

9.5.2 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.

9.5.3 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.

9.5.4 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.

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

A guidance document which 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.

9.5.6 Southern Water: Outline Guidance SuDS and Source Protection Zones

Southern Water have produced guidance which includes a hierarchy for water being considered for discharge into the companies network. It also includes recommendations for the implementation of SuDS.

Guidance is also provided for sustainable drainage in source protection zones. Southern Water will review each proposed SuDS design on a case-by-case basis and the outcome of their review will be based on the hydrogeological sensitivity of the area and the treatment proposed prior to discharge. Southern Water recommend that a full hydrogeological risk assessment inform the design of all SuDS proposed in an SPZ1 and SPZ2.

9.6 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. Please also see the additional guidance developed by Southern Water for designing SuDS within SPZ.

9.7 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** 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.

- 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.

Several GSPZs of varying size have been identified within the northern half of Sevenoaks District. As shown in Figure 9-3, the majority of these GSPZs are situated north of Sevenoaks Weald.

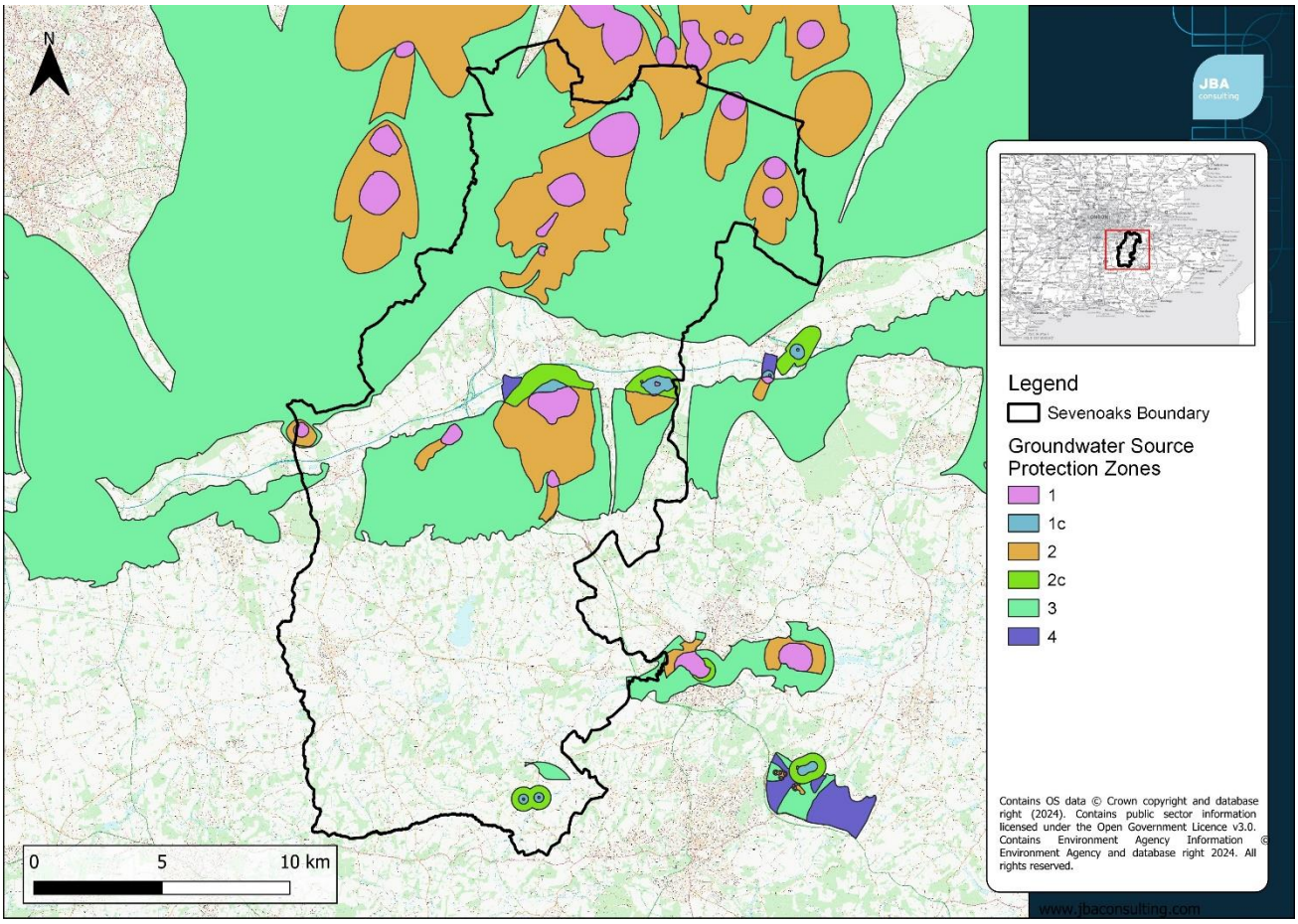


Figure 9-3 Groundwater Source Protection Zones in the Local Plan area

9.8 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 9-4.

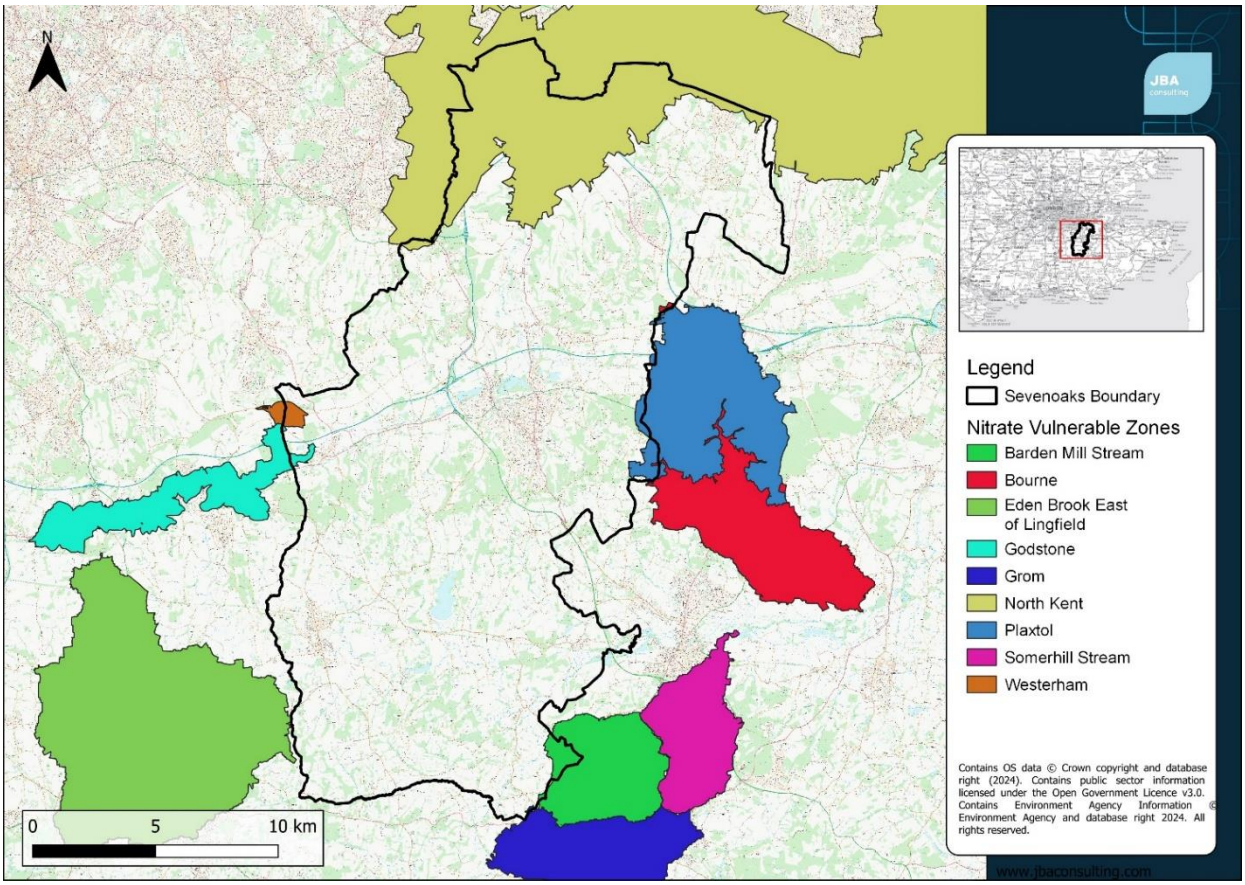


Figure 9-4 Nitrate Vulnerability Zones in the Local Plan area

10 Flood warning and emergency planning

10.1 Emergency planning

The Civil Contingencies Act 2004 lists Local Authorities, the Environment Agency and emergency services as Category 1 responders. Category 1 responders are responsible for reducing, controlling and mitigating the effects of emergencies in both response and recovery phases.

The National Planning Policy takes this into account by seeking to avoid inappropriate development in areas of flood risk and considering the vulnerability of new developments to flooding.

For Flood Emergency Planning, the 2023 NPPF (para. 173) requires site level FRAs to demonstrate that

"any residual risk can be safely managed; and

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

In accordance with the NPPF; SFRAs, PFRAs and SWMPs can be used in the preparation and execution of a flood emergency plan as they can indicate areas that may be at risk of flooding. These can be provided as part as an FRA or as a separate document. Decisions regarding whether an Emergency Plan is required sits with the Local Planning Authority, with advice from their Emergency Planning Teams, the Environment Agency and LLFA.

According to the PPG, an emergency plan is needed wherever emergency flood response is an important component of making a development safe, this includes the free movement of people during a 'design flood' and potential evacuation during an extreme flood.

Emergency plans are essential for any site with transient occupancy in areas at risk of flooding, such as holiday accommodation, hotels, caravan and camping sites (PPG para. 043).

Emergency Plans should consider:

- The type of flood risk present, and the extent to which advance warning can be given in a flood event
- The number of people that would require evacuation from the area potentially at risk
- The vulnerability of site occupants.
- The impact of the flooding on essential services e.g., electricity, gas, telecommunications, water supply and sewerage
- Safe access and egress for users and emergency services

Further information is available from the following documents / websites with hyperlinks provided:

- **The National Planning Policy Guidance**
- **2004 Civil Contingencies Act**
- **Defra (2014) National Flood Emergency Framework for England**
- **FloodRe**
- The EA and Defra's **Standing Advice for FRAs**
- EA's **'How to plan ahead for flooding'**
- **Sign up for Flood Warnings with the EA**
- **The National Flood Forum**
- **GOV.UK 'Prepare for flooding' page**
- **ADEPT Flood Risk Plans for new development**

10.2 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 Table 10-1.

Table 10-1: The Environment Agency's flood warning symbols and a short explanation of each of them describe

Flood Warning Symbol	What it means	What to do
 **Flood Alert**	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 Warning Symbol	What it means	What to do
 **Flood Warning**	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 Warning**	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.

It is the responsibility of individuals to sign-up to this service in order to receive the flood warnings. Registration and the service is free and publicly available through **https://www.gov.uk/sign-up-for-flood-warnings** or by calling 0345 988 1188.

It is recommended that any household considered at risk of flooding signs-up. Developers should also encourage those owning or occupying developments, where flood warnings can be provided, to sign up to receive them. This applies even if the development is defended to a high standard.

10.2.1 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 J shows the FWA coverage for Sevenoaks District.

10.2.2 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.

10.2.3 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.

10.3 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. 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.

10.3.1 Kent County Council Flood Response Plan

The **Kent County Council Flood Response Plan** (October 2023) 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 (updated 2023), and is built upon the existence and maintenance by Category 1 and 2 Responders of their own plans for response to flooding.

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

10.4 Emergency planning and development

10.4.1 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 (see Section 4). 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. 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.

10.4.2 Safe access and egress

The NPPF Planning Practice Guidance outlines how developers can secure safe access and egress to and from development 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.

10.4.3 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** 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
- occupants can leave the building if there is a flood and there is enough time for them to leave after **flood warnings**.

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.

10.4.4 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.

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** and any existing parish / community level plans.

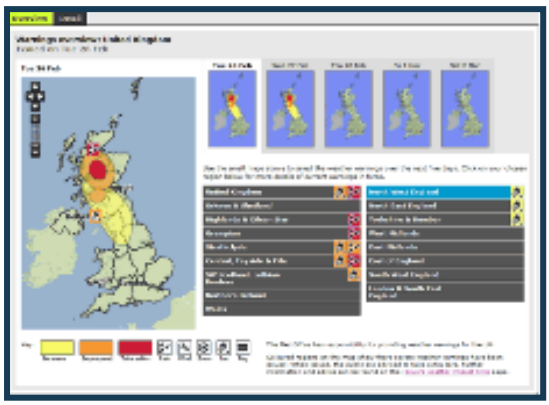
Guidance documents for preparation of flood response plans:

- **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**
- **ADEPT and the Environment Agency (2019) – Flood Risk Emergency Plans for New Development**

10.4.5 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 guide** has been produced by the Environment Agency and Local Government Association to offer practicle 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**.



The **National Flood Forum** (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.

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** for more information.

10.5 Possible responses to flooding

10.5.1 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.

10.5.2 Avoid

The sequential approach means 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 so 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.

10.5.3 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.

11 Strategic flood risk solutions

11.1 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**.

11.1.1 Middle Medway Strategy

The **Middle Medway Strategy (MMS)** 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. A number of options have been considered to reduce flood risk to Edenbridge, none have been proved to be technically feasible. Therefore the main option is to continue with maintenance of existing assets.

11.2 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**, methods to provide these schemes include:

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

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 southeast 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 7.3.2.

11.3 Natural Flood Management

Natural Flood Management is a method of flood risk management that uses a more nature based approach, such as planting native trees where appropriate, and utilising or restoring natural features in floodplains, rivers and the coast to reduce flood and erosion risk. In doing this there is a great benefit to the natural environment and reduces the overall 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** which displays opportunities for NFM.

The maps identify NFM opportunities on different catchment scales:

- National River Basin Districts
- River Basin Districts showing Management Catchments
- Management Catchments showing Water Body Catchments
- Water Body Catchments

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.

Discussions about NFM should be had with catchment stakeholders in combination with local knowledge. Kent County Council as the LLFA has an NFM lead officer and it is recommended that they are contacted to promote collaborative working. A number of the different NFM approaches and techniques are summarised in the following sections.

11.3.1 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 8.4)
- 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.

11.3.2 Re-naturalisation

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

11.3.3 Biodiversity Net Gain

Biodiversity net gain (BNG) was mandatory from February 2024. Developers must deliver a BNG of 10%. This means a development will result in more or better quality natural habitat than there was before development.

11.3.4 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.

11.3.5 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 can be effective.

11.4 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.

11.5 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 riverbed and banks;
- allowing the flow of water to pass without obstruction; and
- controlling invasive alien species e.g. Japanese knotweed and floating pennywort.

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

12 Level 1 Summary assessment of potential development locations

This section details the site screening of potential development sites that was carried out as part of the Level 1 SFRA. Please refer to Appendix K which displays the site screening for Sevenoaks District Council.

12.1 Introduction

At total of 55 sites were provided by Sevenoaks District Council as displayed in Figure 12-1. They have been screened against a suite of available flood risk information and spatial data to provide a summary of flood risk to each site.

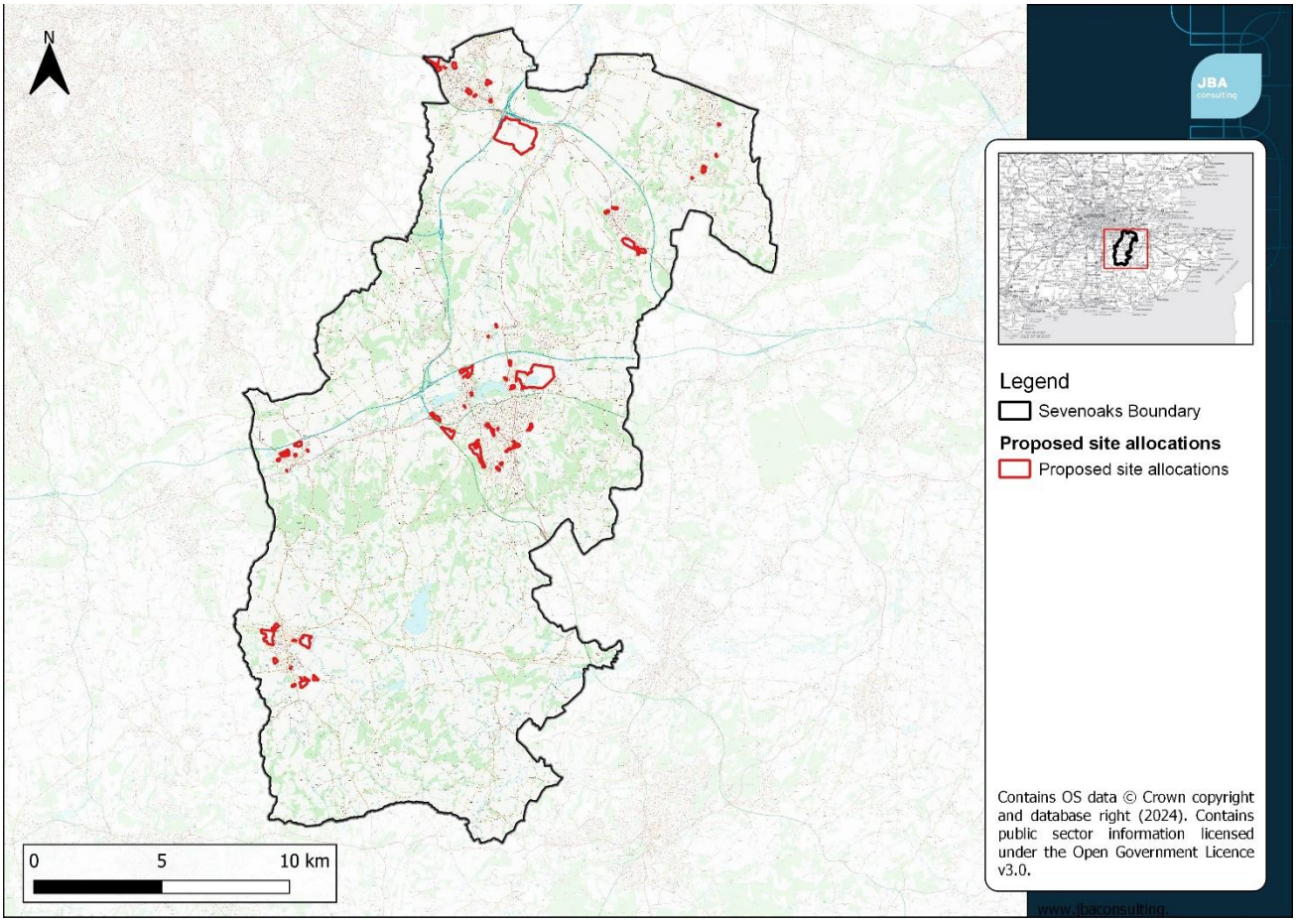


Figure 12-1 The sites screened as part of this Level 1 SFRA

The information considered includes the flood risk datasets listed in Table 12-1 below.

Table 12-1: Datasets screened as part of this Level 1 SFRA.

Flood Risk	Dataset	Layers Screened
Fluvial and tidal	Flood Map for Planning	Flood Zones 1, 2 and 3
	Present Day SFRA Flood Zones	Flood Zones 1, 2, 3a and 3b
	Fluvial and Tidal Flood Risk plus Climate Change	3.3% AEP defended plus Central climate change allowance 3.3% AEP and 0.5% defended plus Higher Central climate change allowance 3.3% AEP and 0.5% defended plus Upper End climate change allowance 1% AEP undefended plus Central climate change allowance 1% AEP undefended plus Higher Central climate change allowance 1% AEP undefended plus Upper End climate change allowance 0.1% AEP undefended plus Central climate change allowance 0.1% AEP undefended plus Higher Central climate change allowance 0.1% AEP undefended plus Upper End climate change allowance Flood Zone 2 as proxy where no detailed model available
Surface Water	Environment Agency Risk of Flooding from Surface Water	3.3% AEP 1% AEP 0.1% AEP
	Climate change uplifted Environment Agency Risk of Flooding from Surface Water	3.3% AEP plus 35% climate change (2070s upper end allowance) 1% AEP plus 45% climate change (2050s upper end allowance)

Flood Risk	Dataset	Layers Screened
Reservoir	Environment Agency's Risk of Flooding from Reservoirs	Dry day Wet Day
Groundwater	JBA Groundwater Emergence Flood Risk	High Risk (within 0- 0.025m of ground surface, grid code 4) Moderate risk (within 0.025- 0.05m of ground surface, grid code 3)
Historic Flooding	Environment Agency's Historic Flood Map	
	Kent County Council's Flood Incident Database (pre-2020)	

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.

12.2 Overview of identified sites

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

- The majority of all screened sites have SFRA Flood Zone 1 comprising the largest proportion of their area, with 44 sites completely located within SFRA Flood Zone 1.
- 10 sites are wholly or partially located in SFRA Flood Zone 2.
- Seven sites are wholly or partially located in SFRA Flood Zone 3a.
- Four sites are partially located in SFRA Flood Zone 3b.
- 45 sites are predicted to be at risk during a present day 0.1% AEP surface water flood event.
- 37 sites are predicted to be at risk during a present day 1% AEP surface water flood event.
- 29 sites are predicted to be at risk during a current day 3.3% AEP surface water flood event.
- Four sites are at risk of reservoir flooding following a breach in a wet day scenario
- 10 sites intersect with the Environment Agency's Historic Flood Map outlines.
- 11 sites are classed as being partially located within a 'high risk' groundwater emergence flood risk zone (groundwater within 0-0.025m of the ground surface).

12.3 Sequential Testing

This SFRA does not include the Sequential Test of the development sites that were screened, as this is described under separate cover. However, Appendix L summarises the flood risk to the potential and confirmed development sites and provides evidence for use in the completion of the Sequential Test.

Inclusion of the potential development sites in the SFRA does not imply that development can be permitted without further consideration of the Sequential Test. The required evidence should be prepared as part of a Local Plan Review Sustainability Appraisal or 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 Review. The assessments undertaken for this SFRA will assist Sevenoaks District Council in the preparation of the Sequential Test.

12.4 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 NPPF, strategic policies and their supporting SFRAs, are required to 'consider cumulative impacts in, or affecting, local areas susceptible to flooding' (para 166).

When allocating land for development, consideration should be given to the potential cumulative impact on flood risk within a catchment. Development and urban creep 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. Changes in land use, such as loss of vegetation can also increase sediment input into watercourses. 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 sensitive 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.

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 District boundary has been undertaken.

12.4.1 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 Kent County 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.

12.4.2 Datasets

Catchments

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

- London Borough of Bexley
- London Borough of Bromley
- Dartford
- Gravesham
- Mid Sussex
- Tandridge
- Tonbridge and Malling
- Tunbridge Wells
- Wealden

The catchments used in this CIA are displayed in Figure 12-2.

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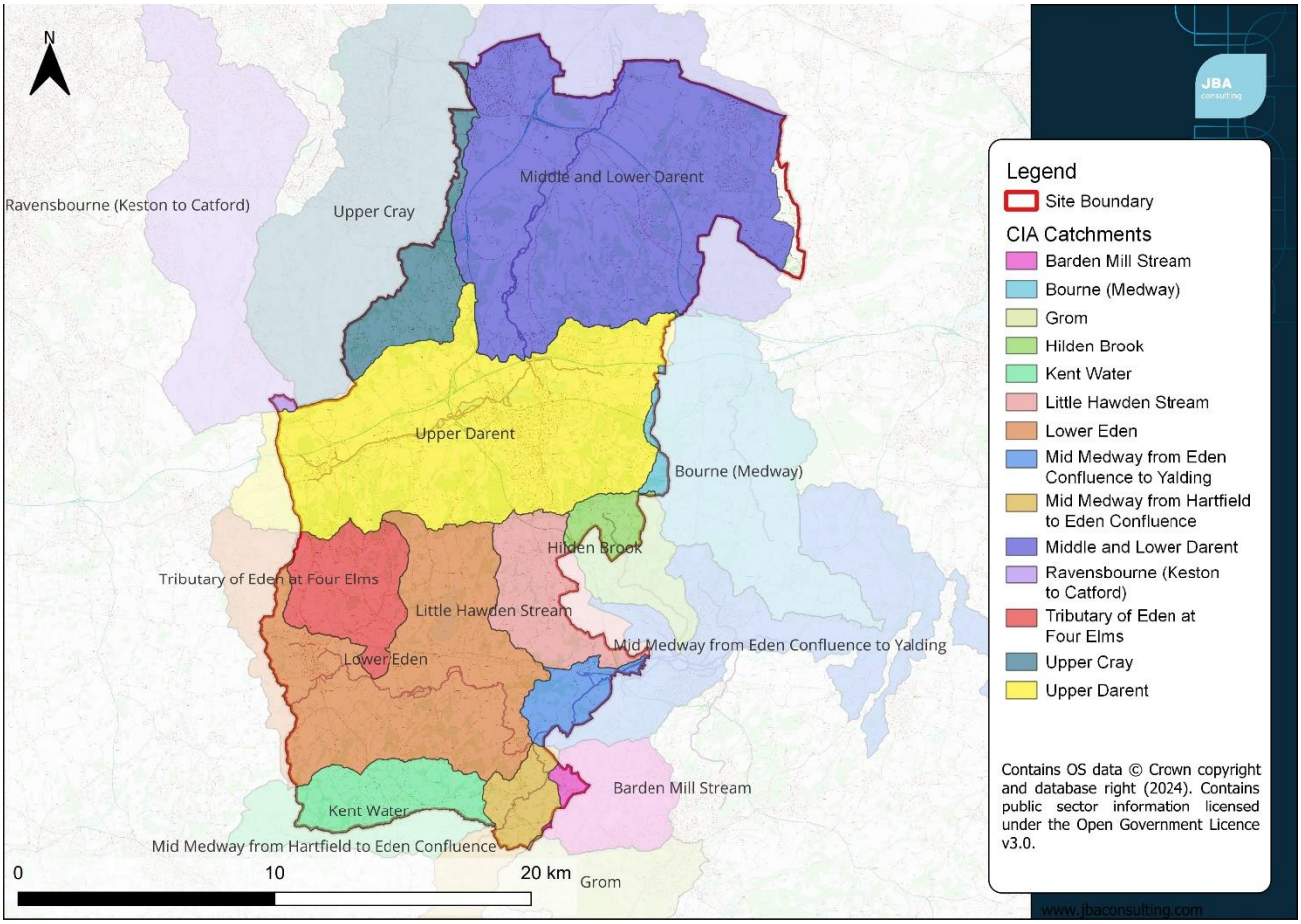


Figure 12-2: Catchments within the Cumulative Impact Assessment for this Level 1 SFRA.

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 District boundary that are likely to experience the greatest pressure for future growth, all potential future development sites received for consideration 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 from 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 area of 'buildings' from the OS Open Zoomstack data within the Environment Agency's historic flood map extent for 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 for each catchment.

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.

12.4.3 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.

12.4.4 Conclusions from the Cumulative Impact Assessment

A summary of the Cumulative Impacts Assessment results is shown in Figure 12-3. The Cumulative Impact Assessment highlights areas where there is a high chance of encountering cumulative effects from planned development. Catchments identified include the Upper, Middle and Lower Darent, the Lower Eden and the Middle Medway for Eden Confluence to Yalding. 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.

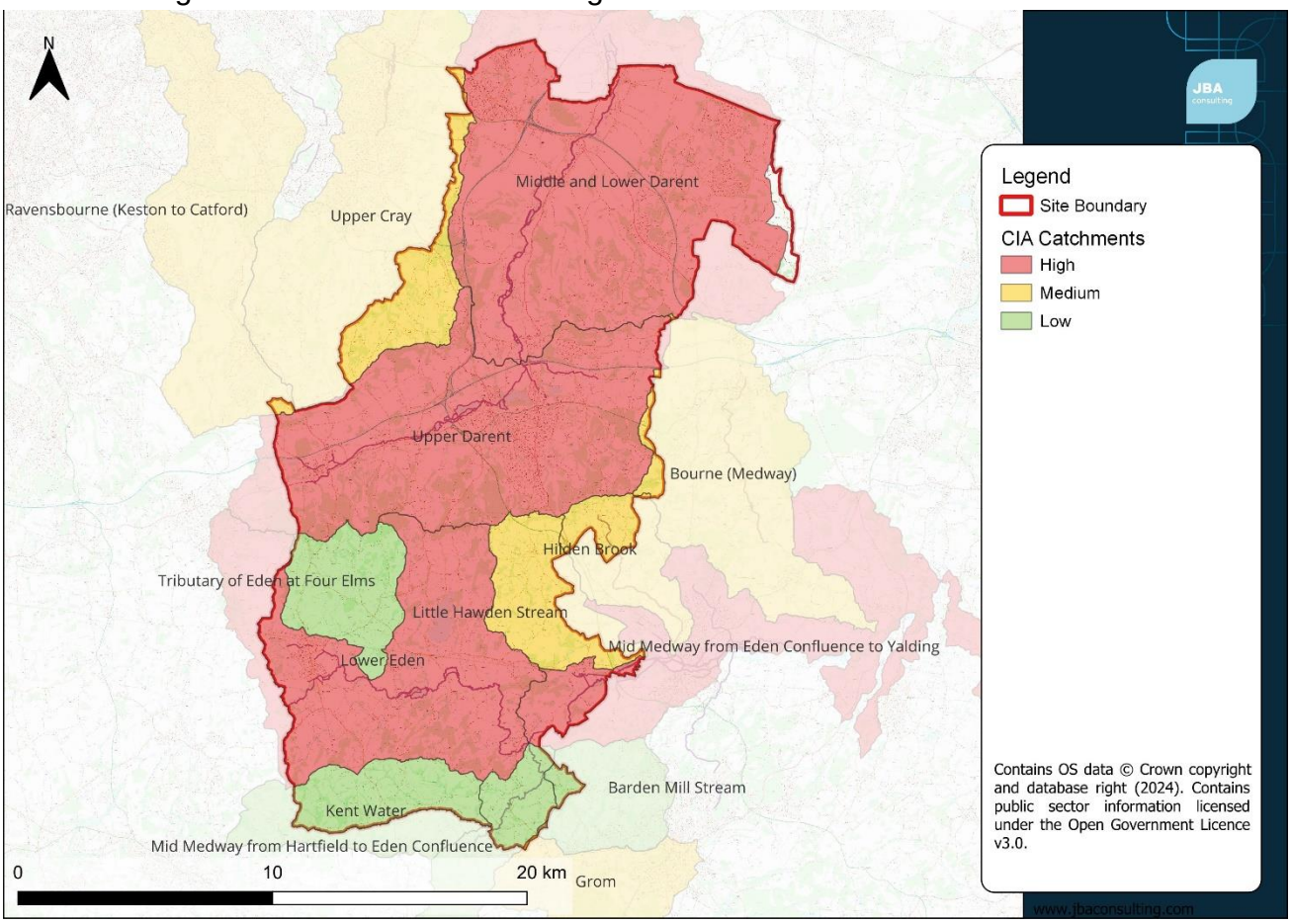


Figure 12-3 Result of cumulative impact assessment

12.4.5 Next steps

- The assessment highlights the catchments in Sevenoaks District Council's boundary where the cumulative impacts of development on flood risk could potentially be greatest. Developers and Sevenoaks District Council should take the assessment into consideration when identifying appropriate sites for development.
- For sites in catchments identified as being at high or medium risk of cumulative impacts FRAs should contain an assessment of the potential cumulative impacts of development further.

13 Summary

13.1 Overview

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 administrative area of Sevenoaks District Council.

13.2 Sources of flood risk

13.2.1 Historic flooding

The Sevenoaks District has a notable history of flooding, primarily resulting from 'fluvial' sources, or river and ordinary watercourse overflows. Significant flood events occurred in the years 1958, 1960, 1968, 2000, and 2002/2003, which led to widespread flooding across the district due to heavy and prolonged rainfall. More recent flooding incidents were recorded during the winter of 2013/14, with significant flooding from the River Medway.

13.2.2 Fluvial flood risk

One of the main sources of flooding in the Local Plan area is fluvial flooding. Fluvial flooding often occurs concurrently with surface water and sewer flooding as a response to extreme rainfall events and constrictions within the drainage systems.

Within Sevenoaks District, the main fluvial flooding sources are from the River Darent, River Eden and River Medway.

Flood Zone mapping and climate change mapping of the fluvial flood risk in the Local Plan area has been prepared as part of the Level 1 SFRA. The key areas identified to be at risk from fluvial flooding include Westerham, Northern Sevenoaks (including Dunton Green and Bat and Ball), Otford, Eynsford, Farningham, Horton Kirby, Edenbridge, Penshurst and Leigh.

13.2.3 Surface water flood risk

The Environment Agency's RoFSW mapping for Sevenoaks District predominantly follow the routes of watercourses or dry valleys with some isolated areas of ponding located in low lying areas. The mapping also identifies some constrained surface water flow paths within the District's urban areas, including Sevenoaks, Swanley, Edenbridge and Kemsing.

13.2.4 Groundwater flood risk

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.

13.2.5 Flooding from reservoirs

Reservoirs with a capacity over 25,000 cubic meters are regulated under the Reservoir Act 1975 and listed by the Environment Agency. There are ten reservoirs that could affect the Sevenoaks District in a "wet day" scenario, with areas near the tributaries of the River Darent, River Eden, and River Medway at risk.

13.2.6 Sewer flood risk

Southern Water and Thames Water's DWMPs describe the basis for long term investment proposals by water and sewerage companies that span the next 25 years and set out the commitment needed to ensure they're robust and resilient to future pressures. A significant number of locations within the Sevenoaks area are at risk of flooding in a 1 in 50 year storm and at risk of flooding due to hydraulic overload including Swanley and Sevenoaks. Reviews of Southern Water's DWMP and Thames Water's DWMP can be found in Appendix A and Appendix B respectively.

13.3 Flood defences

A high-level review of formal flood defences was carried out using existing information to provide an indication of their condition and standard of protection. Details of the flood defence locations and condition were provided by the Environment Agency for the purpose of preparing this assessment.

Raised defences are present in Edenbridge, Brasted, and Leigh, offering protection from river flooding with conditions ranging from 'Good' to 'Fair'. In Edenbridge and Brasted, defences consist of embankments, walls, and areas categorized as 'high ground'. Leigh's defences are part of the Leigh Flood Storage Area (FSA), aimed at reducing flood risks in Tonbridge by attenuating flows from the Upper Medway catchment.

13.4 Key policies

There are many relevant regional and local key policies which have been considered within the SFRA, such as Thames River Basin Management, Kent County Council LFRMS and Sevenoaks SWMP. Other policy considerations have also been incorporated, such as sustainable development principles, climate change and flood risk management.

13.5 Development and flood risk

The Sequential and Exception Test procedures for both Local Plans and Flood Risk Assessments have been documented, along with guidance for planners and developers. Links have been provided for various guidance documents and policies published by other Risk Management Authorities, such as the LLFA and the Environment Agency.

14 Recommendations for planners

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 District Council to consider as part of Flood Risk Management in the study area.

14.1 Development management

14.1.1 Sequential approach to development

The NPPF supports a risk-based and sequential approach to development and flood risk in England, so that development is located in the lowest flood risk areas where possible; it is recommended that this approach is adopted for all future developments within the district.

New development and re-development of land should wherever possible seek opportunities to reduce overall level of flood risk at the site, for example by:

- 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.
- Reducing volume and rate of runoff through the use of SuDS, as informed by the Water, People, Places: A guide for master planning sustainable drainage into developments, national and local guidance. The NPPF states that: ‘Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate’ (Para 175).
- Creating space for flooding – include consideration of Green Infrastructure to provide mitigation and risk reduction for surface water flooding.
- Consideration must be given to the potential cumulative impact of development on flood risk.

14.1.2 Site-specific flood risk assessments

Site specific FRAs are required by developers to provide a greater level of detail on flood risk and any protection provided by defences and, where necessary, demonstrate the development passes part b of the Exception Test.

Developers should, where required, undertake more detailed hydrological and hydraulic assessments of the watercourses to verify flood extents (including latest climate change allowances), inform development zoning within the site and prove, if required, whether the Exception Test can be passed. The assessment should also identify the risk of existing flooding to adjacent land and properties to establish whether there is a requirement to secure land to implement strategic flood risk management measures to alleviate existing and future flood risk. Any flood risk management measures should be consistent with the wider catchment policies set out in the CFMP, FRMPs and LFRMS.

Where a site-specific FRA has produced modelling outlines which differ from the Flood Map for Planning then a full evidence-based review would be required. Where the watercourses are embanked, the effect of overtopping and breach must be considered and appropriately assessed.

All new development within the 1% AEP (Annual Exceedance Probability) fluvial flood extent including an allowance for climate change (for the lifetime of the development) must not normally result in a net loss of flood storage capacity. Where possible, opportunities should be sought to achieve an increase in the provision of floodplain storage. Where proposed development results in a change in building footprint, the developer should ensure that it does not impact upon the ability of the floodplain to store or convey water and seek opportunities to provide floodplain betterment. Similarly, where there are no other alternatives and ground levels are elevated to raise the development out of the floodplain, compensatory floodplain storage within areas that currently lie outside the floodplain should normally be provided so the total volume of the floodplain storage is not reduced. Any flood risk management measures should be consistent with the wider catchment policies set out in the Catchment Flood Management Plan, Flood Risk Management Plan and Local Flood Risk Management Strategy.

An updated NPPF was published in 2023 setting out the Government's planning policies for England and how these are expected to be applied. This revised framework replaces the previous NPPF published in July 2018.

There are also several guidance documents which provide information on the requirements for site-specific Flood Risk Assessments:

Standing Advice on Flood Risk (Environment Agency)

Flood Risk Assessment for Planning Applications (Environment Agency)

Site-specific Flood Risk Assessment: CHECKLIST (NPPG, Defra)

Developers should consult with Kent County Council, Sevenoaks District Council, the Environment Agency and the relevant sewerage company at an early stage to discuss flood

risk including requirements for site-specific FRAs, detailed hydraulic modelling, and drainage assessment and design.

14.1.3 Sequential and Exception tests

The SFRA has identified that areas of Sevenoaks are at high risk from surface water, groundwater and fluvial sources. Developers should consult with Sevenoaks District Council, the Environment Agency, Southern Water and Thames Water at an early stage to discuss flood risk including requirements for site-specific FRAs, detailed overland flow modelling, consideration of climate change and drainage assessment and design.

It is expected that several proposed development sites will be required to pass the Sequential and, where necessary, Exception Tests in accordance with the NPPF. Sevenoaks District Council should use the information in this SFRA when deciding which development sites to take forward in the emerging Local Plan. It is the responsibility of Sevenoaks District Council to be satisfied that the Sequential Test has been passed.

14.1.4 Council review of planning applications

The Council should consult the Environment Agency's 'Flood Risk Assessment: Local Planning Authorities' when reviewing planning applications for proposed developments at risk of flooding.

When considering planning permission for developments, planners may wish to consider the following:

- Will the natural watercourse system which provides drainage of land be adversely affected?
- Will a minimum 8m width access strip be provided adjacent to the top of both banks, of Main Rivers, respectively, for maintenance purposes and is appropriately landscaped for open space and biodiversity benefits?
- Will the development ensure no loss of open water features through draining, culverting or enclosure by other means and will any culverts be opened up?
- Have SuDS been given priority as a technique to manage surface water flood risk?
- Will there be a betterment in the surface water runoff regime; with any residual risk of flooding, from drainage features either on or off site not placing people and property at unacceptable risk?
- Is the application compliant with the policy set out by the LLFA?
- Have the relevant water and wastewater service providers been consulted?

The Council will consult the relevant statutory consultees as part of the planning application assessment and they may, in some cases, also contact non-statutory consultees (e.g. Water Companies) that have an interest in the planning application.

14.1.5 Drainage strategies and SuDS

Planners should be aware of the conditions set by the LLFA for surface water management and ensure development proposals and applications are compliant with the Council's policy. These policies should also be incorporated into the Local Plan. Wherever possible, SuDS should be promoted:

- It should be demonstrated through a Surface Water Drainage Strategy, that the proposed drainage scheme, and site layout and design, will prevent properties from flooding from surface water. A detailed site-specific assessment of SuDS would be needed to incorporate SuDS successfully into the development proposals. All development should adopt source control SuDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff.
- For proposed developments, it is imperative that a site-specific infiltration test is conducted early on as part of the design of the development, to confirm whether the water table is low enough to allow for SuDS techniques that are designed to encourage infiltration.
- Where sites lie within or close to Groundwater SPZs or aquifers, there may be a requirement for a form of pre-treatment prior to infiltration. Further guidance can be found in the CIRIA SuDS manual and the LLFA's SuDS guidance and requirements on the level of water quality treatment required for drainage via infiltration.
- Consideration must also be given to residual risk and maintenance of sustainable drainage and surface water systems.
- SuDS proposals should contain an adequate number of treatments stages to ensure any pollutants are dealt with on site and do not have a detrimental impact on receiving waterbodies.
- The promotion and adoption of water efficient practices in new development will help to manage water resources and work towards sustainable development and will help to reduce any increase in pressure on existing water and wastewater infrastructure.

14.1.6 Cumulative impact of development and cross boundary issues

The cumulative impact of development should be considered at the planning application and development design stages 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 to the surrounding area.

14.1.6.1 Broadscale recommendations

The broadscale cumulative impact assessment for Sevenoaks has highlighted the potential for development to have a cumulative impact on flood risk. Catchments have been identified as high, medium or low risk.

New development can potentially increase flood risk and thus the need for incremental action and betterment in flood risk terms across all of Sevenoaks is appropriate.

The following policy recommendations therefore apply to all catchments within the study area:

- SDC should work closely with neighbouring local authorities to develop complementary Local Planning Policies for catchments that drain into and out of the District to other local authorities in order to minimise cross boundary issues of cumulative impacts from development.
- Developers should incorporate SuDS and provide details of adoption, ongoing maintenance and management on all development sites.
- Where appropriate, the opportunity for Natural Flood Management in rural areas, SuDS retrofit in urban areas and river restoration should be maximised. Culverting should be opposed, and day-lighting existing culverts promoted through new developments.
- Where applicable, development proposals should undertake a site-specific Flood Risk Assessment. Site-specific FRAs should explore opportunities to provide wider community flood risk benefit through new developments. Measures that can be put in place to contribute to a reduction in flood risk downstream should be considered. This may be either by provision of additional storage on site e.g. through oversized SuDS, natural flood management techniques, green infrastructure and green-blue corridors, and/ or by providing a Partnership Funding contribution towards any flood alleviation schemes.
- LPAs should work closely with the EA and the LLFA to identify any areas of land that should be safeguarded for any future flood alleviation schemes and natural flood management features.

14.1.6.2 Recommendations for developments in high-risk catchments

- LLFAs and LPAs should work closely with the EA and the LLFA to identify any areas of land that should be safeguarded for any future flood alleviation schemes and natural flood management features. The Working with Natural Processes mapping shows there are opportunities for floodplain reconnection, riparian woodland and additional floodplain woodland in high risk catchments. The mapping also indicates locations where there are potential for runoff attenuation features to reduce flows. These areas should all be safeguarded.
- The LPA should explore the potential for development in High-Risk catchments to contribute towards works to reduce flood risk and enable

regeneration as well as contributing to the wider provision of green infrastructure.

- Within any FRAs consideration should be given to the potential cumulative effects of all proposed development and how this affects sensitive receptors.
- The LLFA and LPA should consult with Local Non-For-Profit organisations such as wildlife trusts, rivers trusts and catchment partnerships to understand ongoing and upcoming projects where NFM, flood storage and attenuation, and environmental betterment may be possible alongside developments and aid in reducing flood risk.

14.1.7 Residual risk

Residual risk is the risk that remains after mitigation measures are considered. The residual risk includes the consideration of flood events that exceed the design thresholds of the flood defences or circumstances where there is a failure of the defences, e.g. flood banks collapse. Residual risks should be considered as part of site-specific Flood Risk Assessments.

Further, any developments located within an area protected by flood risk management measures, where the condition of those defences is 'fair' or 'poor', where the standard of protection is not of the required standard or where the failure of the intended level of service gives rise to unsafe conditions should be identified.

14.1.8 Safe access and egress

Safe access and egress will normally need to be demonstrated at all development sites and emergency vehicular access should be possible during times of flood. Where development is located behind flood defences, consideration should be given to the potential safety of the development, finished floor levels and for safe access and egress in the event of rapid inundation of water due to a defence breach with little warning.

Where there is a residual risk of flooding (from any source) to properties within a development, residential and commercial minimum finished floor levels should be set at least 300mm above the 100-year plus climate change peak flood level. An additional allowance may be required because of risks relating to blockages to the channel, culvert or bridge and should be considered as part of an FRA

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.

Resilience measures will be required if buildings are situated in the flood risk area, and opportunities to enhance green infrastructure and reduce flood risk by making space for water should be sought.

14.1.9 Future flood management

Developments should demonstrate opportunities to create, enhance and link green assets. This can provide multiple benefits across several disciplines including flood risk and

biodiversity/ ecology and may provide opportunities to use the land for an amenity and recreational purposes. Development that may adversely affect green infrastructure assets should not be permitted.

The information provided in the SFRA should be used as a basis for investigating potential strategic flood risk solutions within the study area. Opportunities could consist of the following:

- Catchment and floodplain restoration – Floodplain restoration represents a sustainable form of strategic flood risk solution, by allowing watercourses to return to a more naturalised state.
- Flood storage areas – Upstream storage schemes are often considered as one potential solution to flooding. However, this is not a solution for everywhere. Upstream storage should be investigated fully before being adopted as a solution.
- Sequential approach to site layout
- Opening up culverts, weir removal, and river restoration;
- The Regional Habitat Creation Programme; and
- Green infrastructure.

For successful future flood risk management, it is recommended that local planning authorities adopt a catchment partnership working approach in tackling flood risk and environmental management.

14.2 Technical recommendations

14.2.1 Potential modelling improvements

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. The Environment Agency is currently working on the second iteration of the National Flood Risk Assessment (NAFRA2) platform which is expected in late 2024.

A Southern Water DWMP review

B Thames Water DWMP review

C Flood Zone Mapping

D Fluvial plus Climate Change

E Risk of Flooding from Surface Water

F Surface Water and Climate Change

G JBA Groundwater Mapping

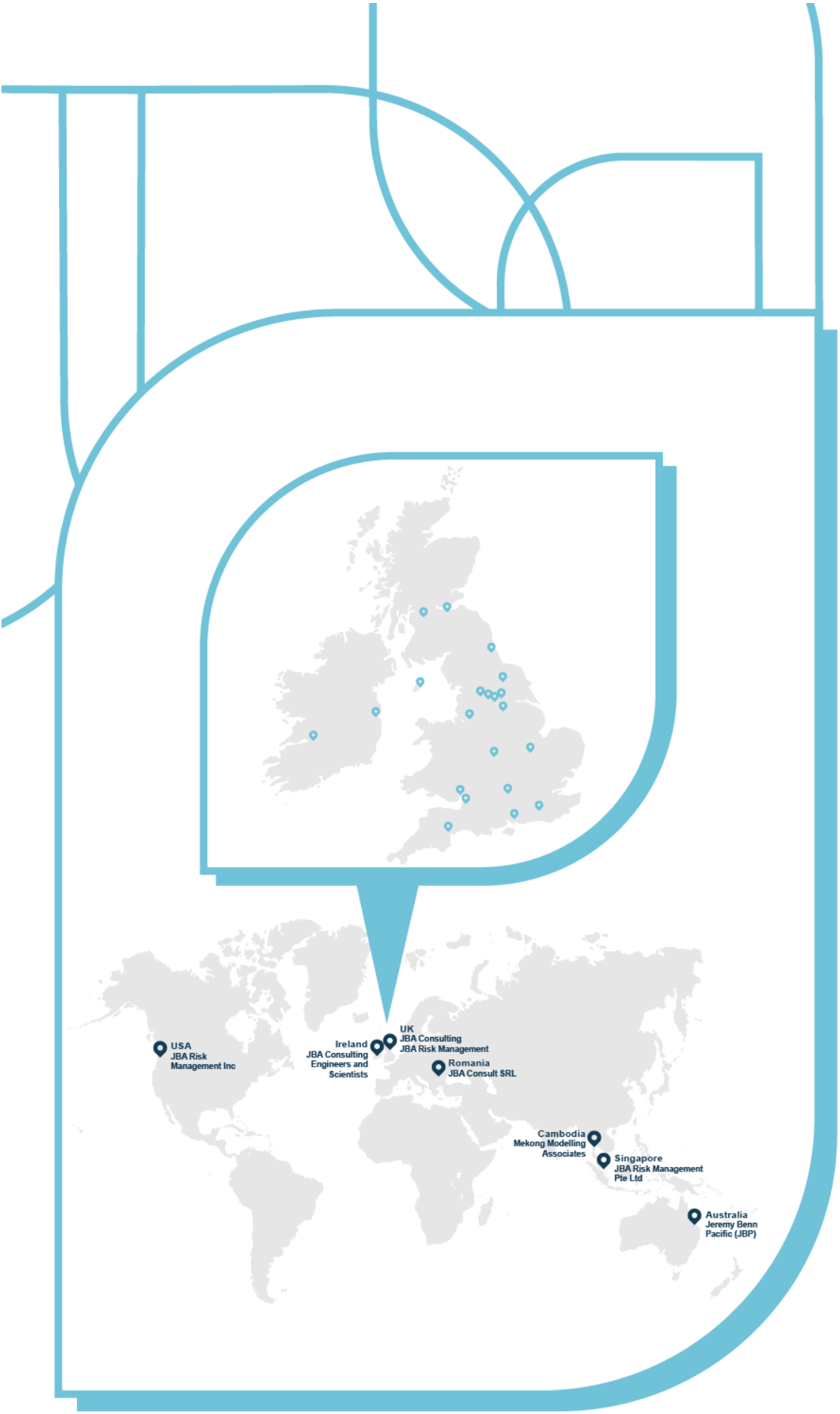
H Reservoir Flooding

I Flood defences

J Flood Warning Areas

K Site Screening

L Sequential Test Methodology



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