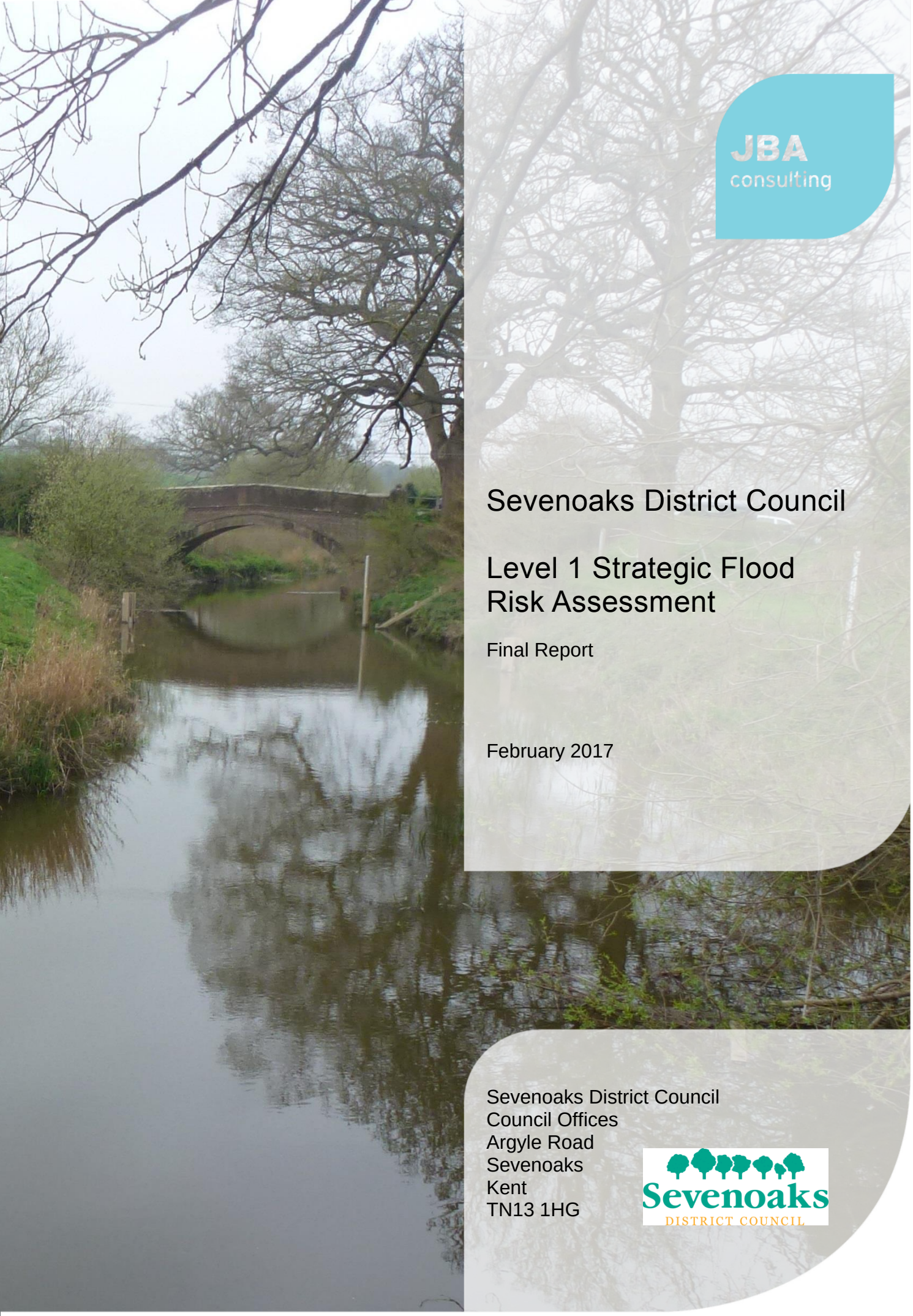

Sevenoaks District Council

Level 1 Strategic Flood Risk Assessment

Final Report

February 2017

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Revision History

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Draft v1 (December 2016)	Draft report sections 1-12	Claire Pamberi and Helen French (Sevenoaks District Council)
Draft v2 (January 2017)	Draft report sections 1-12 following comments received from Sevenoaks District Council on 16 December 2016 and 5 January 2017	Claire Pamberi and Helen French (Sevenoaks District Council)
Final v3 (February 2017)	Updated Sevenoaks District Council logo throughout the report to the latest version	Claire Pamberi and Helen French (Sevenoaks District Council)

Contract

This report describes work commissioned by Sevenoaks District Council. The Council's representatives for the contract are Claire Pamberi and Helen French. Georgina Latus, Kristie Darling and Ben Gibson of JBA Consulting carried out this work.

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Purpose

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Executive Summary

Introduction

This Strategic Flood Risk Assessment (SFRA) 2017 document replaces the Level 1 SFRA originally published by Sevenoaks District Council in August 2008 and provides supporting evidence for the emerging Local Plan.

This updated SFRA will be used in decision-making regarding the location of future development and the preparation of sustainable policies for the long-term management of flood risk.

SFRA objectives

The Planning Practice Guidance that supports the National Planning Policy framework (NPPF) advocates a tiered approach to risk assessment and identifies the flowing two levels of SFRA:

- Level 1: where flooding is not a major issue and where development pressures are low the assessment should be sufficiently detailed to allow application of the Sequential Test.
- Level 2: where land outside Flood Zones 2 and 3 cannot appropriately accommodate all the necessary development, creating the need to apply the National Planning Policy Framework's (NPPF) Exception Test, the assessment should consider the detailed nature of the flood characteristics within a Flood Zone and assessment of other sources of flooding.

This document is an updated Level 1 SFRA document. The key objectives of the 2017 SFRA are:

- To take into account the latest flood risk policy following key changes to policy and guidance that have occurred since the previous SFRA was published.
- Take into account the latest flood risk information and available data since the previous SFRA.
- To provide initial flood risk analysis information to support understanding of risk in the district and at sites identified by the Council as part of their Local Plan preparation.
- 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.

SFRA outputs

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

- Appraisal of all potential sources of flooding, including Main Rivers and surface water, groundwater.
- An updated review of historical flooding incidents.
- Mapping of the location and extent of the functional floodplain.
- Reporting on the standard of protection provided by existing flood risk management infrastructure.
- Consideration of the potential increase in flood risk due to climate change.
- Areas at risk from other sources of flooding, for example surface water or reservoirs.
- An assessment of existing flood warning and emergency planning procedures, including an assessment of safe access and egress during an extreme event.
- Recommendations of the criteria that should be used to assess future development proposals and the development of a Sequential Test and sequential approach to flood risk.

Summary of Level 1 Assessment

The SFRA has considered all sources of flooding within the district. Fluvial flood risk has been analysed using the results from the computer models supplied by the Environment Agency, as well as existing Environment Agency Flood Zone mapping. Surface water flood risk has been assessed using the updated Flood Map for Surface Water published online by the Environment Agency and recorded flood incidents supplied by various sources. A number of other data sources have been drawn upon as an evidence base, including data from Southern Water, Environment Agency Risk

of Flooding from Reservoirs and various geology / groundwater products and datasets from the Environment Agency.

The Level 1 SFRA assessment concluded the following:

- Sevenoaks District has a history of documented flood events and flood records indicate that the main source of risk is from fluvial sources.
- The primary sources of fluvial flood risk to the district are the River Darent and the River Eden. Other sources of fluvial flood risk include but are not limited to the Honeypot Stream, Watercress Stream, Hilden Brook and the River Medway, all of which are designated Main Rivers.
- The most significant flood events reported to have affected the District occurred in 1968, 2000, 2002 and 2013/14, each of which included notable flooding from the rivers Eden, Darent and Medway.
- The district has also experienced a number of historic surface water / drainage related flood events, which have been attributed to a range of sources. The primary source of surface water flooding was attributed to heavy rainfall overloading carriageways and drains/gullies, but other sources of flooding have been caused by blockages or high levels within receiving watercourses impeding free discharge from surface water drains and gullies.
- Data from the Sewer Incident Report Form data supplied by Southern Water indicates a total of 32 recorded flood incidents in the district. The more frequently flooded postcodes are TN8 5, TN8 6 and TN11 8. However, it is important to recognise that the information does not identify whether flooding incidences were caused by general exceedance of the design sewer system, or by operational issues such as blockages.
- Multiple groundwater flood events have been recorded across the district, the causes of which are thought to be related to high water tables in several locations. The Areas Susceptible to Groundwater Flooding (AStGWF) mapping suggests that the susceptibility to groundwater flooding is greatest in the areas surrounding Otford, Edenbridge and Penshurst. The groundwater flood potential is consistent with the location of more permeable deposits that characterise these areas.
- Risk of Flooding from Reservoirs mapping indicates that there are 12 reservoirs that could affect the district in the event of a breach. Due to the location of these reservoirs, a breach would primarily affect the southern section of the district and have implications for the settlements located along the fluvial floodplains of the River Eden and River Medway. Other areas at risk of flooding from a breach include those located in the north-west and northern extents of the district.

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 conditions were obtained from the Environment Agency for the purpose of preparing this assessment, in addition to some explanation of such defences.

This SFRA provides details of the Flood Risk Assessment (FRA) requirements and guidance for developers. These recommendations include those of the NPPF, the Environment Agency standing advice, as well as reference to regional and local policy. Where appropriate, site-specific FRAs should include the assessment of mitigation measures required to safely manage flood risk along with the promotion of Sustainable Drainage Systems (SuDS) to create a conceptual drainage strategy and safe access/egress at the development in the event of a flood.

Surface water flooding and the role of the Lead Local Flood Authority (LLFA) and the Local Planning Authority (LPA) in surface water management has been defined with guidance for the design and implementation of SuDS as part of the initial planning stage of all types of residential, commercial and industrial developments. The SFRA provides details of the types of SuDS available and when they should be used, and outlines the recommendations included in the relevant national, regional and local guidance documents.

Strategic flood risk solutions should be considered and understood when considering development within the district. Developers should work with stakeholders to identify issues and provide suitable solutions.

Emergency planning considerations have been included and flood warning coverage assessed; currently there are three Flood Alert Areas and six Flood Warning Areas covering Sevenoaks District. Requirements outlined by the NPPF for safe access and egress have also been set out.

Recommendations

Assessing Flood Risk and Developments

- 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.
- A site-specific FRA is required for all developments which are located in the Environment Agency's Flood Zones 2 and 3, or developments greater than 1 ha in size in Flood Zone 1. They are also required for developments less than 1 ha in Flood Zone 1 where there is a change in use to a more vulnerable development where they could be affected by sources of flooding other than rivers and the sea (e.g. surface water drains, reservoirs). All developments located in areas of Flood Zone 1 highlighted as having critical drainage problems must also be accompanied by an FRA. The FRA should be proportionate to the degree of flood risk, as well as the scale, nature and location of the development.
- The impact of climate change to a proposed site should be considered in FRAs and the percentage increases which relate to the proposed lifetime of the development and the vulnerability classification of the development should be identified and taken into account. The Environment Agency and LLFA should be consulted to confirm a suitable approach to assessing climate change in light of the latest guidance.
- Opportunities to reduce flood risk to wider communities could be sought through the regeneration of brownfield sites, through reductions in the amount of surface water runoff generated on a site.
- The LPA, Environment Agency and LLFA should be consulted to confirm the level of assessment required and to provide any information on any known local issues at sites.
- When assessing sites not identified in the Local Plan (windfall sites), developers should use evidence provided in this SFRA to apply the Sequential Test as well as provide evidence to show that they have adequately considered other reasonably available sites.

Future Developments

Development must seek opportunities to reduce overall levels of flood risk at the site, for example by:

- Reducing volume and rate of surface water runoff based on Local Plan policy and LLFA Guidance
- Locating development to areas with lower flood risk
- Creating space for flooding
- Integrating green infrastructure into mitigation measures for surface water runoff from potential development and consider using Flood Zones 2 and 3 as public open space.

The LPA should consult the NPPF and Environment Agency's 'Flood Risk Standing Advice (FRSA) for Local Planning Authorities', published in March 2014, when reviewing planning applications for proposed developments at risk of flooding.

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 development zoning within the site and prove, if required, whether the Exception Test can be passed.

Promotion of 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.

- A detailed site-specific assessment of SuDS would be needed to incorporate SuDS successfully into the development proposals. New or re-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 Source Protection Zones 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 on the level of water quality treatment required for drainage via infiltration. Further restrictions may still be applicable and guidance should be sought from the LLFA.
- Developers need to ensure that new development does not increase the surface water runoff rate from the site and should therefore contact the LLFA and other key stakeholders at an early stage to ensure surface water management is undertaken and that SuDS are promoted and implemented, designed to overcome site-specific constraints.
- The LPA will need to consider drainage schemes for major applications, but it is advised developers utilise the LLFA's Polices and Guidance to develop their drainage scheme for minor applications.

Infrastructure and Access

Safe access and egress will need to be demonstrated at development sites. Consideration of alternative access and egress routes should be made in the event that primary routes are inundated with flood water. 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.

Green Infrastructure and WFD

Opportunities to enhance green infrastructure and reduce flood risk by making space for water should be sought. In addition, opportunities where it may be possible to improve the WFD status of watercourses, for example by opening up culverts, weir removal, and river restoration, should be considered. Green infrastructure should be considered within the mitigation measures for surface water runoff from development.

Use of SFRA data and future updates

It is important to recognise that the SFRA has been developed using the best available information at the time of preparation.

The SFRA should be periodically updated when new information on flood risk, flood warning or new planning guidance or legislation becomes available. New information on flood risk may be provided by authorities including Sevenoaks District Council, Kent County Council (in its role as LLFA), the Highways Authority, Southern Water and the Environment Agency. It is recommended that the SFRA is reviewed internally on an annual basis, allowing a cycle of review, followed by checking with the above bodies for any new information to allow updated information to be prepared.

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Using this document

Hyperlinks

Hyperlinks have been provided where there are useful reference points. These are shown as **green bold text.**

Contents, list of figures, list of tables and references to other sections, figures and tables have also been hyperlinked to enable easy navigation around the report.

Abbreviations and Glossary of Terms

Term	Definition
AEP	Annual Exceedance Probability
AStGWF	Areas Susceptible to Groundwater Flooding
Brownfield	Previously developed parcel of land
CC	Climate change - Long term variations in global temperature and weather patterns caused by natural and human actions.
CFMP	Catchment Flood Management Plan- A high-level planning strategy through which the Environment Agency works with their key decision makers within a river catchment to identify and agree policies to secure the long-term sustainable management of flood risk.
CIRIA	Construction Industry Research and Information Association
Defra	Department for Environment, Food and Rural Affairs
Designated Feature	A form of legal protection or status reserved for certain key structures or features that are privately owned and maintained, but which make a contribution to the flood or coastal erosion risk management of people and property at a particular location.
DG5 Register	A water-company held register of properties which have experienced sewer flooding due to hydraulic overload, or properties which are 'at risk' of sewer flooding more frequently than once in 20 years.
EA	Environment Agency
EU	European Union
FEH	Flood Estimation Handbook
Flood defence	Infrastructure used to protect an area against floods as floodwalls and embankments; they are designed to a specific standard of protection (design standard).
Flood Risk Area	An area determined as having a significant risk of flooding in accordance with guidance published by Defra and WAG (Welsh Assembly Government).
Flood Risk Regulations	Transposition of the EU Floods Directive into UK law. The EU Floods Directive is a piece of European Community (EC) legislation to specifically address flood risk by prescribing a common framework for its measurement and management.
Floods and Water Management Act	Part of the UK Government's response to Sir Michael Pitt's Report on the Summer 2007 floods, the aim of which is to clarify the legislative framework for managing surface water flood risk in England.
Fluvial Flooding	Flooding resulting from water levels exceeding the bank level of a main river
FRA	Flood Risk Assessment - A site-specific assessment of all forms of flood risk to the site and the impact of development of the site to flood risk in the area.
FRMP	Flood Risk Management Plan
FWMA	Flood and Water Management Act
FZ	Flood Zones
GI	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
Ha	Hectare
Indicative Flood Risk Area	Nationally identified flood risk areas, based on the definition of ‘significant’ flood risk described by Defra and WAG.
JBA	Jeremy Benn Associates
LFRMS	Local Food Risk Management Strategy
LLFA	Lead Local Flood Authority - Local Authority responsible for taking the lead on local flood risk management
LPA	Local Planning Authority
mAOD	metres Above Ordnance Datum
Main River	A watercourse shown as such on the Main River Map, and for which the

Term	Definition
	Environment Agency has responsibilities and powers
NPPF	National Planning Policy Framework
Ordinary Watercourse	All watercourses that are not designated Main River. Local Authorities or, where they exist, IDBs have similar permissive powers as the Environment Agency in relation to flood defence work. However, the riparian owner has the responsibility of maintenance.
OS NGR	Ordnance Survey National Grid Reference
PFRA	Preliminary Flood Risk Assessment
Pluvial flooding	Flooding as a result of high intensity rainfall when water is ponding or flowing over the ground surface (surface runoff) before it enters the underground drainage network or watercourse, or cannot enter it because the network is full to capacity.
PPG	National Planning Policy Guidance
PPS25	Planning and Policy Statement 25: Development and Flood Risk – superseded by the NPPF and PPG
Resilience Measures	Measures designed to reduce the impact of water that enters property and businesses; could include measures such as raising electrical appliances.
Resistance Measures	Measures designed to keep flood water out of properties and businesses; could include flood guards for example.
Risk	In flood risk management, risk is defined as a product of the probability or likelihood of a flood occurring, and the consequence of the flood.
Return Period	Is an estimate of the interval of time between events of a certain intensity or size, in this instance it refers to flood events. It is a statistical measurement denoting the average recurrence interval over an extended period of time.
SDC	Sevenoaks District Council
Sewer flooding	Flooding caused by a blockage or overflowing in a sewer or urban drainage system.
SHLAA	Strategic Housing Land Availability Assessment - The Strategic Housing Land Availability Assessment (SHLAA) is a technical piece of evidence to support local plans and Sites & Policies Development Plan Documents (DPDs). Its purpose is to demonstrate that there is a supply of housing land in the district which is suitable and deliverable.
SFRA	Strategic Flood Risk Assessment
SoP	Standard of Protection - Defences are provided to reduce the risk of flooding from a river and within the flood and defence field standards are usually described in terms of a flood event return period. For example, a flood embankment could be described as providing a 1 in 100-year standard of protection.
Stakeholder	A person or organisation affected by the problem or solution, or interested in the problem or solution. They can be individuals or organisations, includes the public and communities.
SuDS	Sustainable Drainage Systems - Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques
Surface water flooding	Flooding as a result of surface water runoff because of high intensity rainfall when water is ponding or flowing over the ground surface before it enters the underground drainage network or watercourse, or cannot enter it because the network is full to capacity, thus causing what is known as pluvial flooding.
SWMP	Surface Water Management Plan - The SWMP plan should outline the preferred surface water management strategy and identify the actions, timescales and responsibilities of each partner. It is the principal output from the SWMP study.
uFMfSW	Updated Flood Map for Surface Water
WFD	Water Framework Directive

1 Introduction

1.1 Purpose of the Strategic Flood Risk Assessment

This Strategic Flood Risk Assessment (SFRA) 2017 document replaces the Level 1 SFRA originally published by Sevenoaks District Council in August 2008. The report has been prepared to replace the content that was included in the previous SFRA and to provide appropriate supporting evidence for the emerging Local Plan.

The 2017 SFRA update will be used in decision making, to inform the process for location of land for future development and the preparation of sustainable policies for the long-term management of flood risk.

The key objectives of the review performed during the preparation of the 2017 SFRA are:

1. To take into account the latest flood risk policy

So the SFRA assessment is up to date with key changes to policy and guidance that have occurred since the existing SFRA was published in 2008, which include:

- Changes to legislation and guidance, both relating to flood risk and planning policy, including the Flood Risk Regulations (2009), Flood and Water Management Act (2010), the National Planning Policy Framework (NPPF) (2012), the Localism Act (2011) and the Climate Change Act (2008); and new powers and responsibilities bestowed on Kent County Council as the Lead Local Flood Authority (LLFA) under the Flood and Water Management Act (2010) and the resulting dependencies with the Council's local development and forward planning roles.
- Recent guidance published in April 2015 regarding the role of LLFAs, Local Planning Authorities and the Environment Agency with regards to SuDS approval.
- Changes to technical guidance, for example the Consultation on SuDS Regulations and Standards (2011), Defra's Non-statutory technical standards for sustainable drainage systems (March 2015), and NPPF Planning Practice Guidance replacing PPS25 and PPG25, CIRIA SuDS Manual C753 (2015)
- Latest guidance on climate change allowances for flood risk assessments released by the Environment Agency in February 2016.

2. Take into account the latest flood risk information and available data

We have identified a number of changes to available data that have occurred since the 2008 SFRA was published, including:

- Environment Agency flood risk modelling of the River Darent (2009)
- Environment Agency flood risk modelling of the fluvial River Medway (2015), including climate change information following the Environment Agency's latest guidance (2016)
- Kent County Council Local Flood Risk Management Strategy (2013)
- Sevenoaks Stage 1 Surface Water Management Plan (2013)
- Availability of the updated Flood Map for Surface Water (uFMfSW)

3. To provide specific flood risk analyses for sites identified by the Council as part of their Local Plan preparation.

The new Local Plan will set out the Council's spatial strategy to help guide and manage future development in the most sustainable way up to 2035. The potential sites will require more detailed assessment if the SFRA is taken forward to a Level 2 SFRA.

4. To provide a comprehensive set of maps including, but not limited to

- fluvial flood risk, including functional floodplain and climate change;
- surface water risk;
- groundwater risk; and
- flood warning coverage.

1.2 SFRA objectives

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

- Level 1: where flooding is not a major issue and where development pressures are low. The assessment should be sufficiently detailed to allow application of the Sequential Test.
- Level 2: where land outside Flood Zones 2 and 3 cannot appropriately accommodate all the necessary development (see outputs from the Level 1 SFRA) creating the need to apply the NPPF's Exception Test. In these circumstances the assessment should consider the detailed nature of the flood characteristics within a Flood Zone and assessment of other sources of flooding.

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

1.3 SFRA outputs

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

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

1.4 Approach

1.4.1 General assessment of flood risk

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

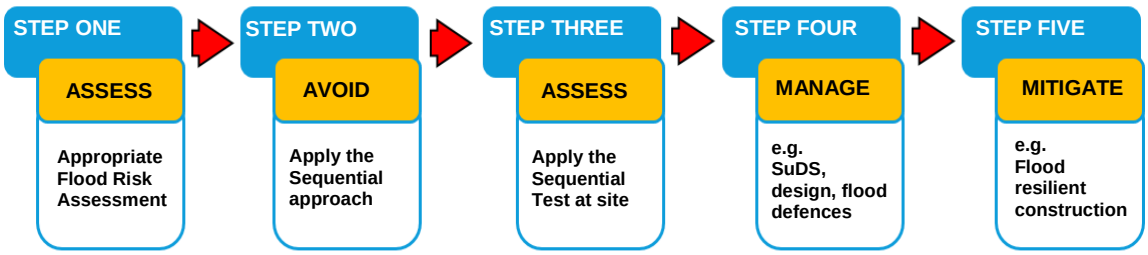
- the nature of the flood risk (the source of the flooding);
- the spatial distribution of the flood risk (the pathways and areas affected by flooding);
- climate change impacts; and
- the degree of vulnerability of different types of development (the receptors).

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

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

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

Figure 1-1: Flood Risk Management Hierarchy



1.4.2 Technical assessment of flood hazards

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

- Environment Agency fluvial (river) models
  - River Darent (2009)
  - River Medway (2015), including latest climate change modelling (2016)
  - National Flood Zone modelling
- Environment Agency surface water (rainfall) models
  - Updated Flood Map for Surface Water (2013)

1.5 Consultation

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

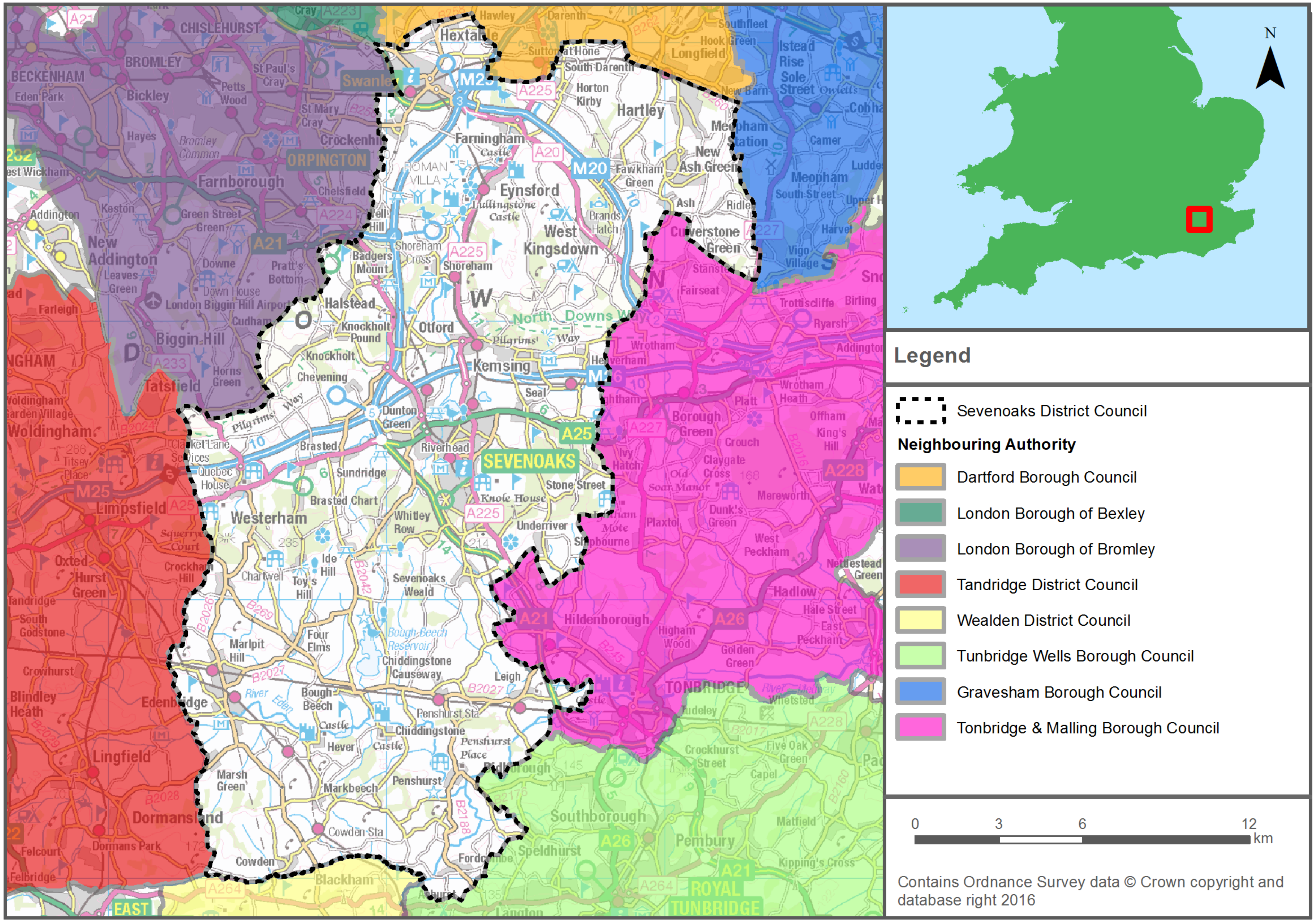
- Environment Agency
- Kent County Council (as Lead Local Flood Authority)
- Southern Water

1.6 SFRA user guide

Table 1-1: SFRA report contents

Section	Contents
1. Introduction	Provides a background to the study, defines objectives, outlines the approach adopted and the consultation performed.
2. The Planning Framework and Flood Risk Policy	Includes information on the implications of recent changes to planning and flood risk policies and legislation, as well as documents relevant to the study.
Level 1 Strategic Flood Risk Assessment	
3. How flood risk is assessed	Provides an overview of flooding and risk, Flood Zones, and what they mean.
4. The Sequential, risk based approach	Describes the Sequential approach and application of Sequential and Exception Tests. Describes the modelling and data used for the assessment. Outlines mapping that should be used for the Sequential and Exception Tests
5. Understanding flood risk in Sevenoaks District	Gives an introduction to the assessment of flood risk and provides an overview of the characteristics of flooding affecting the district. Provides a summary of responses that can be made to flood risk, together with policy and institutional issues that should be considered.
6. Flood defences	Assessment of residual risk from flood defences, including future protection from climate change.
7. FRA requirements and guidance for developers	Identifies the scope of the assessments that must be submitted in FRAs supporting applications for new development. Provides guidance for developers and outlines conditions set by the LLFA that should be followed.
8. Surface water management and SuDS	Advice on managing surface water run-off and flooding
9. Flood warning and emergency planning	Outlines the flood warning service in the Sevenoaks District and provides advice for emergency planning, evacuation plans and safe access and egress.
10. Strategic flood risk solutions	Summary of strategic flood risk solutions.
11. Development control recommendations	Sets out recommendations for considering and assessing flood risk in Sevenoaks District.
Summary and recommendations	
12. Summary	Reviews Level 1 SFRA and provides recommendations

Figure 1-2: Sevenoaks District and neighbouring authorities



2 The Planning Framework and Flood Risk Policy

2.1 Introduction

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

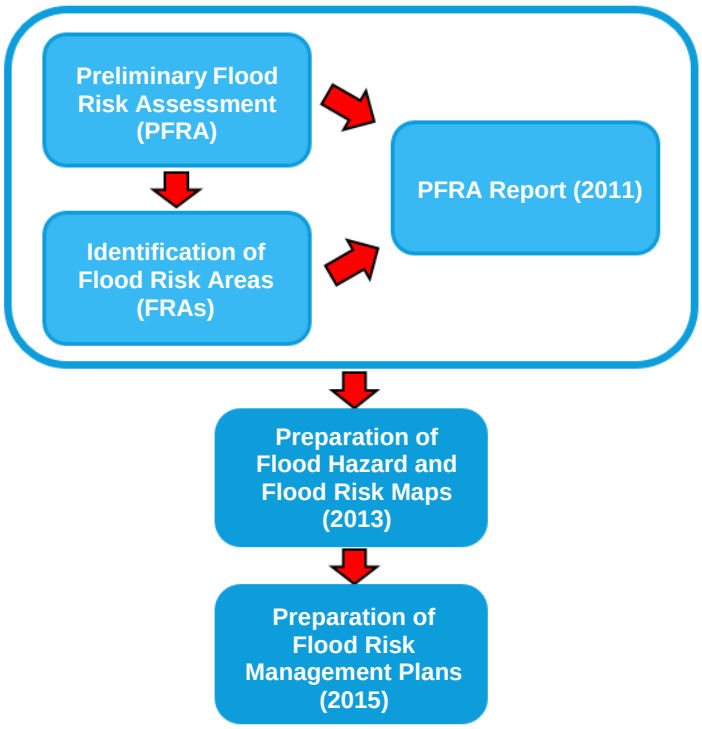
2.2 Flood Risk Regulations (2009) and Flood and Water Management Act (2010)

2.2.1 Flood Risk Regulations, 2009

The Flood Risk Regulations (2009) are intended to translate the current EU Floods Directive into UK law and place responsibility upon all Lead Local Flood Authorities (LLFAs) to manage local flood risk. Under the Regulations, the responsibility for flooding from rivers, the sea and reservoirs lies with the Environment Agency. However, responsibility for local and all other sources of flooding rests with LLFAs. Kent County Council is the LLFA for the area covered by this SFRA.

Figure 2-1 illustrates the steps that have / are being taken by LLFAs to implement the requirements of the EU Directive in the UK via the Flood Risk Regulations.

Figure 2-1: Flood Risk Regulation Requirements



Under this action plan and in accordance with the Regulations, LLFAs had the task of preparing a Preliminary Flood Risk Assessment (PFRA) report. The PFRA document that covers the district was published by Kent County Council in 2011[1]. There are no areas of significant local flood risk as defined by the regulations in the area covered by the SFRA.

Under the Regulations the Environment Agency exercised an 'Exemption' and did not prepare a PFRA for risk from rivers, reservoirs and the sea. This then made it a requirement for the Environment Agency to prepare and publish a Flood Risk Management Plan (FRMP) together with

[1] Kent County Council PFRA (2011): http://www.kent.gov.uk/about-the-council/strategies-and-policies/environment-waste-and-planning-policies/flooding-and-drainage-policies/preliminary-flood-risk-assesment

risk and hazard maps. The FRMP process adopts the same catchments as used in the preparation of River Basin Management Plans, in accordance with the Water Framework Directive. Accordingly, more detailed strategic information on proposed strategic measures and approaches can be found in the Thames River Basin District Flood Risk Management Plan - Parts A, B, C and D[2]. The FRMP draws on previous policies and actions identified in Catchment Flood Management Plans and also incorporates information from Local Flood Risk Management Strategies. All of the London Boroughs and 17 contributing catchments are covered by the Thames River Basin. Sevenoaks District lies within the Darent and Cray catchment area in the north as well as the Medway catchment area south of Sevenoaks and Westerham. The FRMP summarises the flooding affecting the area and describes the measures to be taken to address the risk in accordance with the Flood Risk Regulations.

2.2.2 Flood and Water Management Act, 2010

The Flood and Water Management Act (2010)[3] aims to create a simpler and more effective means of managing both flood risk and coastal erosion and implements Sir Michael Pitt's recommendations following his review of the 2007 floods. The FWMA received Royal Assent in April 2010.

Kent County Council as LLFA has developed a Local Flood Risk Management Strategy under the Act, in consultation with local partners. This is discussed further in Section 2.2.5. This Strategy acts as the basis and discharge of duty for Flood Risk Management co-ordinated by Kent County Council. The final version of the strategy was published for June 2013.

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

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

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

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

2.2.3 Lead Local Flood Authorities

The FWMA established Lead Local Flood Authorities (LLFAs). Kent County Council is the LLFA for the Sevenoaks District Council administrative area. Duties for LLFAs include:

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

[2] Environment Agency, Thames River Basin District Flood Risk Management Plan 2015-2021 Part C (March 2016). Available: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/507148/LIT_10231_THAMES_FRMP_PART_C.pdf
[3] Flood and Water Management Act (2010): http://www.legislation.gov.uk/ukpga/2010/29/pdfs/ukpga_20100029_en.pdf

On 18 December 2014 a Written Ministerial Statement laid by the Secretary of State for Communities and Local Government set out changes to the planning process that would apply for major development from 6 April 2015. In considering planning applications, local planning authorities should consult the LLFA on the management of surface water, satisfy themselves that the proposed minimum standards of operation are appropriate and ensure, and through use of planning conditions or obligations, that there are clear arrangements in place for ongoing maintenance over the lifetime of the development.

In March 2015 the LLFA was made a statutory consultee which came into effect on 15 April 2015. As a result, Kent County Council, will be required to provide technical advice on surface water drainage strategies and designs put forward for new major developments.

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; and
- 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 1 hectare or more.

2.2.4 Kent Preliminary Flood Risk Assessment (2011)

The Flood Risk Regulations required Kent County Council (as the LLFA) to prepare and publish a Preliminary Flood Risk Assessment (PFRA) on past and future flood risk from sources of flooding. The **PFRA** reports on significant past and future flooding from all sources except from Main Rivers and Reservoirs, which are covered by the Environment Agency, and sub-standard performance of the adopted sewer network (covered under the remit of Southern Water).

The PFRA is a high-level screening exercise and considers floods which have significant harmful consequences for human health, economic activity, the environment and cultural heritage. The Regulations require the LLFA to identify significant Flood Risk Areas. The threshold for designating significant flood Risk Areas is defined by Defra and the PFRA is the process by which these locations can be identified. Of the ten national indicative Flood Risk Areas that were identified by the Defra/Environment Agency, none encroach on the administrative area of Sevenoaks District Council and the indicative designations have been accepted.

No Flood Risk Areas have been identified based on critical infrastructure/access routes, sewer/surface water problems and areas prone to significant ponding.

2.2.5 Kent Local Flood Risk Management Strategy (2013)[4]

Kent County Council is responsible for developing, maintaining, applying and monitoring a **LFRMS** for Kent, which covers the Sevenoaks District. The Strategy is used as a means by which the LLFA (Kent County Council) co-ordinates Flood Risk Management on a day to day basis. The Strategy also sets measures to manage local flood risk i.e. flood risk from surface water, groundwater and Ordinary Watercourses. The Environment Agency is responsible for managing flooding from main rivers and reservoirs, with the LLFA responsible for managing Ordinary Watercourses. The high-level objectives proposed in the Strategy for managing flood risk are:

1. Understanding flood risk in Kent
2. Managing the likelihood of flooding
3. Helping Kent's citizens to manage their own risk
4. Ensuring appropriate development in Kent
5. Improving flood prediction, warning and post flood recovery

[4] http://www.kent.gov.uk/about-the-council/strategies-and-policies/environment-waste-and-planning-policies/flooding-and-drainage-policies/kent-flood-risk-management-plan

The LFRMS also sets out an action plan of how the LLFA intends to achieve these objectives. The action plan contains the following information:

- A description of the action.
- The objective the action relates to.
- The driver behind the action.
- The organisation with key accountability.
- Supporting organisations.
- The funding source.
- When the action was added.
- Timescale for completion or current status.

The Strategy should be updated regularly or when key triggers are activated. An example of a key trigger would be issues such as amendments to partner responsibilities, updates to legislation, alterations in the nature or understanding of flood risk or a significant flood event, may also require the update of the Strategy and action plan.

2.3 National Planning Policy Framework

The **National Planning Policy Framework** (NPPF)[5] was issued on 27 March 2012 to replace the previous documentation as part of reforms to, firstly, make the planning system less complex and more accessible, and, secondly, to protect the environment and promote sustainable growth. It replaces most of the Planning Policy Guidance Notes (PPGs) and Planning Policy Statements (PPSs) that were referred to in the previous version of the SFRA. The NPPF is a source of guidance for local planning authorities to help them prepare Local Plans and for applicants preparing planning submissions.

Paragraph 100 of the NPPF:

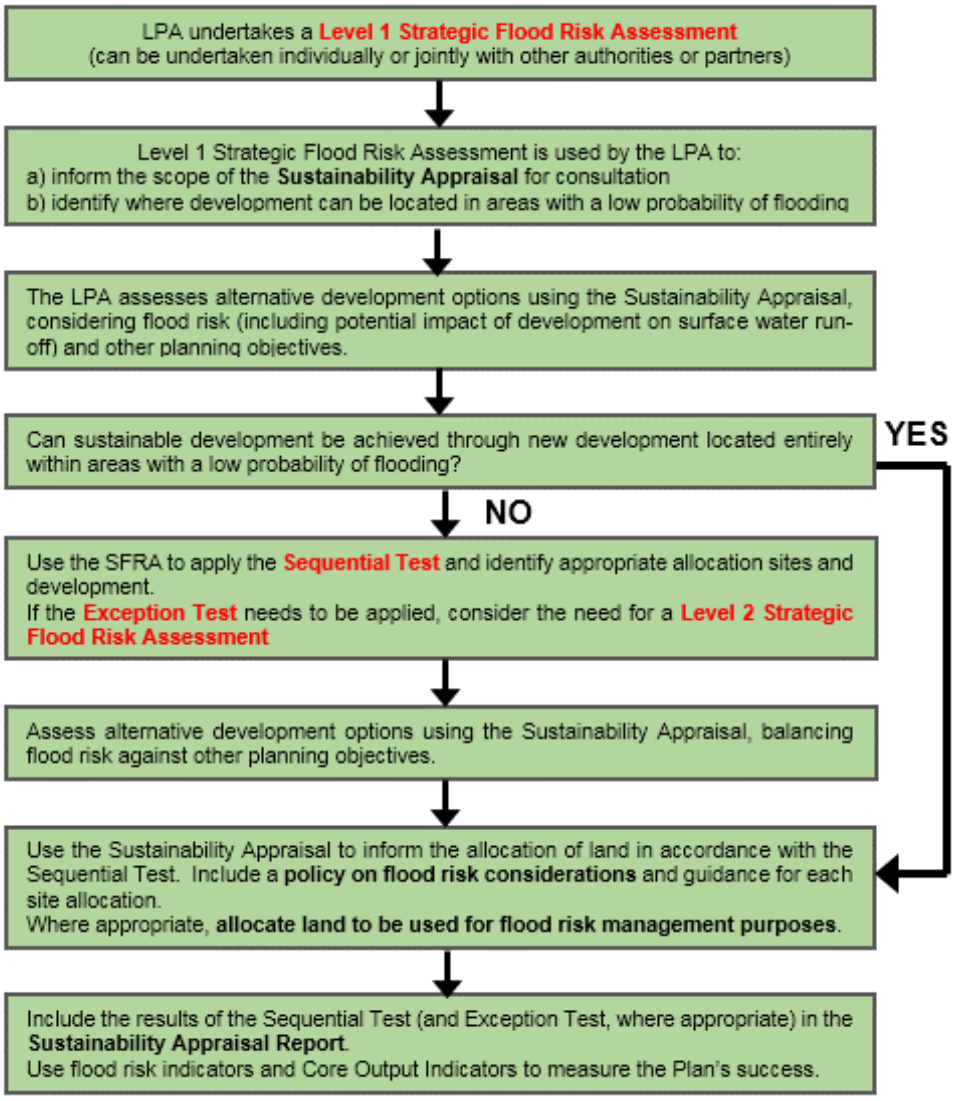
> ***"Local Plans should be supported by a strategic flood risk assessment and develop policies to manage flood risk from all sources, taking account of advice from the Environment Agency and other relevant flood risk management bodies, such as Lead Local Flood Authorities and Internal Drainage Boards. Local Plans should apply a sequential, risk-based approach to the location of development to avoid, where possible, flood risk to people and property and manage any residual risk, taking account of the impacts of climate change".***

Planning Practice Guidance on flood risk was published in March 2014 and sets out how the policy should be implemented. NPPF sets out Flood Zones, the appropriate land uses for each zone, flood risk assessment requirements and the policy aims for developers and authorities regarding each Flood Zone. Further details on Flood Zones and associated policy is provided in Table 3-1 and throughout this report.

A description of how flood risk should be taken into account in the preparation of Local Plans is outlined in Diagram 1 contained within the Planning Practice Guidance (Figure 2-2).

[5] National Planning Policy Framework (Department for Communities and Local Government, March 2012)

Figure 2-2: Flood risk and the preparation of Local Plans†



† Based on Diagram 1 of NPPF Planning Practice Guidance: Flood Risk and Coastal Change (paragraph 004, Reference ID: 7-005-20140306) March 2014

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. The action plan from SWMPs should be reviewed and updated as a minimum every six years.

The Surface Water Management Plan applicable to the Sevenoaks District area is listed below, with a link provided to this document.

- **Sevenoaks Stage 1 SWMP (2013)[6]**

Seven drainage areas are considered within the SWMP covering the area. General actions, as well as specific actions for each drainage area (where applicable), are recorded in the SWMP. The outcomes and actions from the SWMP should be considered in the context of proposed developments within the area of Sevenoaks District.

2.5 Catchment Flood Management Plans

Catchment Flood Management Plans (CFMPs) are a high-level strategic plan 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:

1. No active intervention (including flood warning and maintenance). Continue to monitor and advise.
2. Reducing existing flood risk management actions (accepting that flood risk will increase over time).
3. 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).
4. 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).
5. Take action to reduce flood risk (now and/or in the future)
6. 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.

The CFMP provides a starting point for measures being considered strategically to manage flood risk within its area. To that end, an important consideration of the NPPF for Sevenoaks District relates to safeguarding land from development that is required for current and future flood management (paragraph 100).

Two CFMPs cover the Sevenoaks District, the North Kent Rivers CFMP (2009) and River Medway CFMP (2009), which are discussed below.

2.5.1 North Kent Rivers CFMP (2009)

The northern section of district is covered by the **North Kent Rivers CFMP[7].** The primary policy units for Sevenoaks are:

- Sub Area 1: Shuttle and Upper Cray – Policy Option 5
- Sub Area 2: Upper Darent and tributaries – Policy Option 6
- Sub Area 5: North Kent Downs – Policy Option 6

Policy Option 5 is for areas of moderate to high flood risk where the Environment Agency can generally take further action to reduce flood risk.

Policy Option 6 is for areas of low to moderate flood risk where the Environment Agency will take actions with others to store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits.

[6] http://www.kent.gov.uk/about-the-council/strategies-and-policies/environment-waste-and-planning-policies/flooding-and-drainage-policies/surface-water-management-plans/sevenoaks-surface-water-management-plan

[7] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/293893/North_Kent_rivers_Catchment_Flood_Management_Plan.pdf

2.5.2 River Medway CFMP (2009)

The southern section district is covered by the **River Medway CFMP[8].** The primary policy units for Sevenoaks are:

- Sub Area 1: Upper catchment – Policy Option 3
- Sub Area 2: Edenbridge – Policy Option 5
- Sub Area 3: Upstream of Tonbridge – Policy Option 6

Policy Option 3 is for areas of low to moderate flood risk where the Environment Agency are generally managing existing flood risk effectively.

2.6 River Basin Management Plans

River Basin Management Plans (RBMPs) are prepared under the Water Framework Directive (WFD) and assesses the pressure facing the water environment in River Basin Districts. The WFD aims to achieve at least 'good' status for all water bodies by 2015. The Sevenoaks District Council area falls within the Thames River Basin District.

2.6.1 Thames River Basin Management Plan (2015)

The second cycle of **The Thames RBMP[9]** was published in February 2016, replacing the previous version published in 2009. The document provides information on the following:

- Current state of the water environment
- Pressures affecting the water environment
- Environmental objectives for protecting and improving waters
- Programme of measures. And actions needed to achieve the objectives
- Progress since the 2009 plan

The Thames RBMP identified a number of significant water management issues, including:

- Physical modifications
- Pollution from waste water
- Pollution from towns, cities and transport
- Changes to the natural flow and level of water
- Negative effects of invasive non-native species
- Pollution from rural areas

The RBMP describes how development planning needs to consider a number of issues relevant to the RBMP including housing locations, sewage treatment options, initiatives to reduce flow to sewage works, water efficiency measures and the reduction of nutrients from diffuse pollution.

The RBMP notes that 11% of water bodies in the Thames River Basin District currently have a 'good or better' overall status, which is expected to increase to 13% by 2021. However, this 'good or better' overall status is forecast to increase notably for the extended deadline of 2027 reported in the RBMP.

2.7 Association of British Insurers Guidance on Insurance and Planning in Flood 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[10]. 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:

[8] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/293890/Medway_Catchment_Flood_Management_Plan.pdf

[9]https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/500548/Thames_RBD_Part_1_river_basin_management_plan.pdf

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

- 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.

2.8 Implications for Sevenoaks

The new and emerging responsibilities under the Flood and Water Management Act 2010 and the Flood Risk Regulations 2009 are summarised in Table 2-1.

Table 2-1: Roles and responsibilities in Sevenoaks District

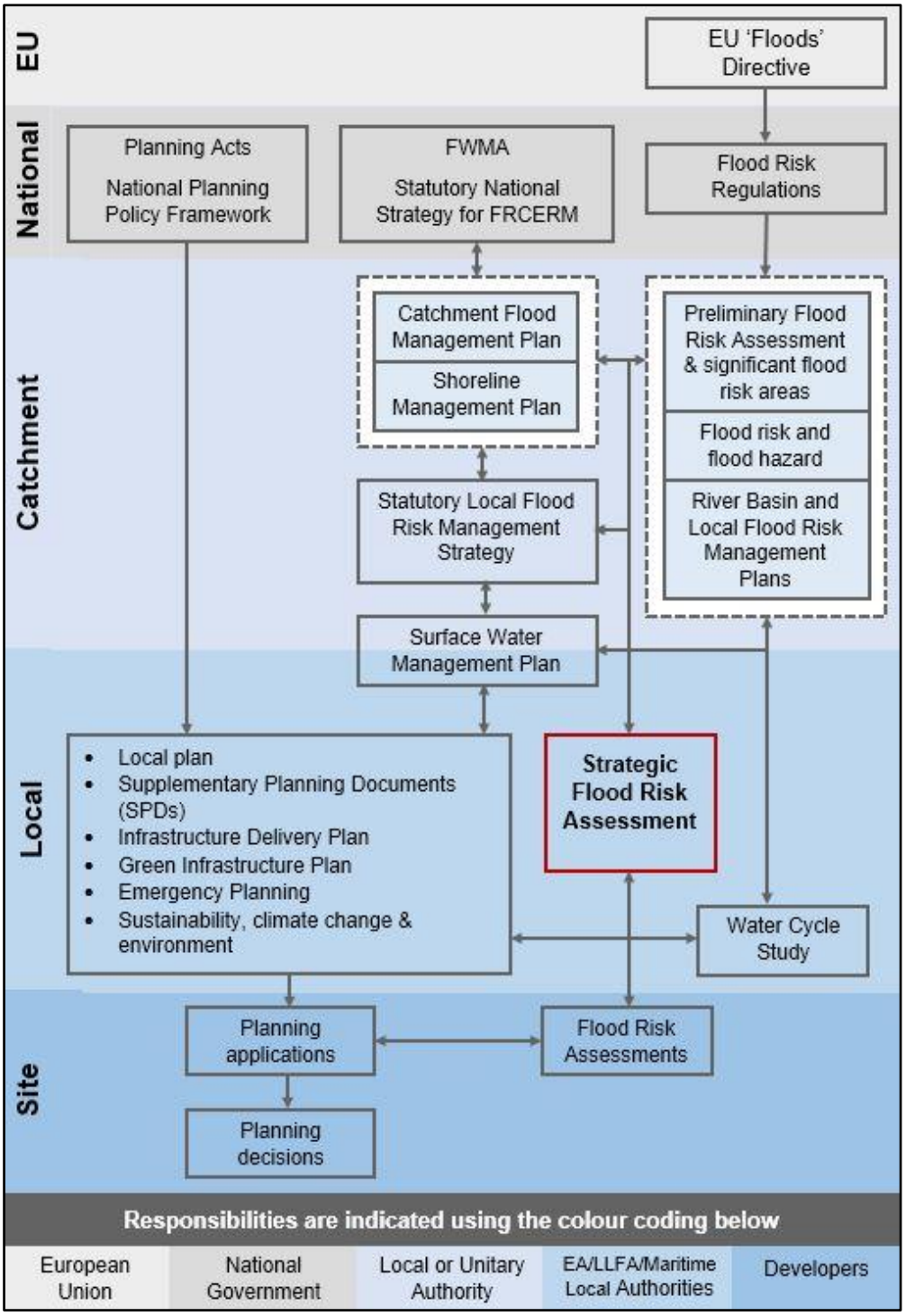
Risk Management Authority (RMA)	Strategic Level	Operational Level
Environment Agency	National Statutory Strategy Reporting and supervision (overview role)	• Preliminary Flood Risk Assessment (per River Basin District)* • Managing flooding from main rivers and reservoirs and communication flood risk warnings to the public, media and partner organisations. • Identifying Significant Flood Risk Area* • Preparation of Flood Risk and Hazard Maps • Preparation of Flood Risk Management Plan • Enforcement authority for Reservoirs Act 1975 • Managing RFCCs and supporting funding decisions, working with LLFAs and communities. • Emergency planning and multi-agency flood plans, developed by local resilience forums
Lead Local Flood Authority (Kent County Council)	Input to National Strategy. Formulate and implement Local Flood Risk Management Strategy.	• Responsible for enforcing and consenting works for Ordinary Watercourses, risk assessing Ordinary Watercourses. • Managing local sources of flooding from surface water runoff and groundwater and carrying out practical works to manage flood risk from these sources where necessary. • Preparing and publishing a PFRA • Identifying Flood Risk Areas • Preparing Flood Hazard and Flood Risk Maps • Preparing Flood Risk Management Plans (where local flood risk is significant) • Investigating certain incidents of flooding in Section 19 Flood Investigations • Statutory roles in planning for surface water drainage. • Keeping asset registers of structures and features which have a significant effect on local flood risk. • Acting consistently with LFRMS in realising FRM activity and have due regard in the discharge of other functions of the strategy
Local Planning Authority (Sevenoaks District Council)	Input to National and Local Authority Plans and Strategy (e.g. Sevenoaks Local Plan – to develop a spatial strategy for growth within the area which accounts for flood risk)	• Preparation of a Local Plan to guide development. • The competent determining authority for planning applications and have the ultimate decision on the suitability of a site in relation to flood risk and management of surface water run-off. • Responsibilities for emergency planning as a responder to a flood event. • Own and manage public spaces which can potentially be used for flood risk management.

* Environment Agency did not prepare a PFRA; instead they exercised an exception permitted under the Regulations

Figure 2-3 outlines the key strategic planning links for flood risk management and associated documents. It shows how the Flood Risk Regulations and Flood and Water Management Act, in conjunction with the Localism Act's "duty to cooperate", introduce a wider requirement for the mutual exchange of information and the preparation of strategies and management plans.

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

Figure 2-3: Strategic planning links and key documents for flood risk



† See Table 2-1 for roles and responsibilities for preparation of information

3 How flood risk is assessed

3.1 Definitions

3.1.1 Flood

Section 1 (subsection 1) of the Flood and Water Management Act (FWMA) (2010)[11] defines a flood as:

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

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

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

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

3.1.2 Flood Risk

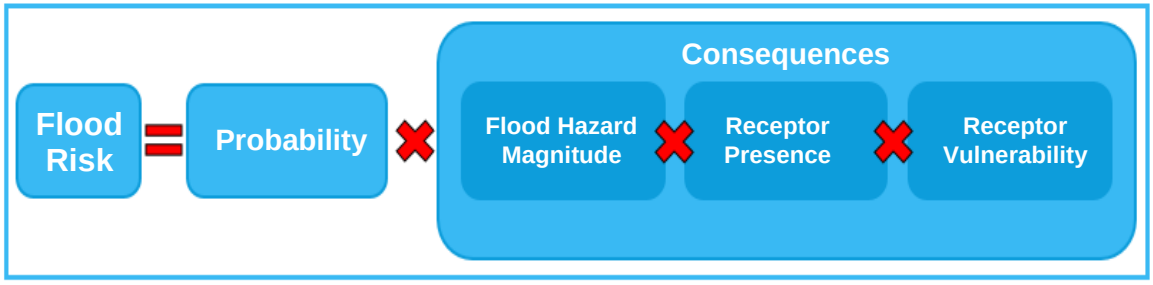
Section 3 (subsection 1) of the FWMA defines the risk of a potentially harmful event (such as flooding) as:

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

Thus, it is possible to summarise flood risk as:

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

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



Using this definition it can be seen that:

Increasing the probability or chance of a flood being experienced increases the flood risk: In situations where the probability of a flood being experienced increases gradually over time, for example due to the effects of climate change, then the severity of the flood risk will increase (flooding becomes more frequent or has increased effect).

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

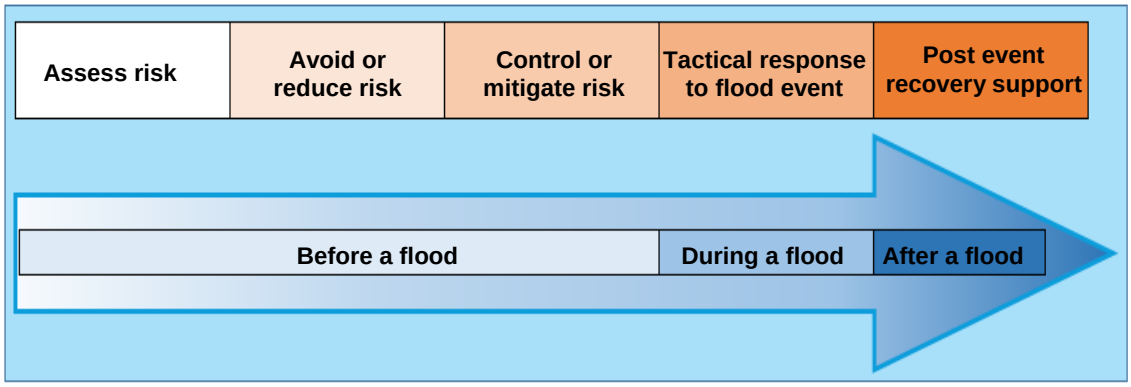
The potential scale of the consequences in a given location can increase the flood risk:

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

3.2 Using SFRA risk information

This SFRA contains information that can be used at strategic, operational and tactical levels as shown by Figure 3-1.

Figure 3-1: Use of SFRA information



The SFRA will complement the Kent Local Flood Risk Management Strategy (2013)[12] and will assist the LLFA with the stated objectives.

The assessment of flood risk in the SFRA is primarily based on the following three types of information:

1. Flood zones
2. Actual flood risk
3. Residual risk

3.2.1 Flood Zones

The SFRA includes maps that show the Flood Zones. These zones describe the land that would flood if there were no defences present. A concept diagram showing the classification of Flood Zones graphically is included in Figure 3-2. The Government's Planning Practice Guidance identifies the following Flood Zones (see Table 3-1). These apply to both Main River and Ordinary Watercourses.

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

[12] http://www.kent.gov.uk/about-the-council/strategies-and-policies/environment-waste-and-planning-policies/flooding-and-drainage-policies/kent-flood-risk-management-plan

Figure 3-2: Concept of Flood Zones

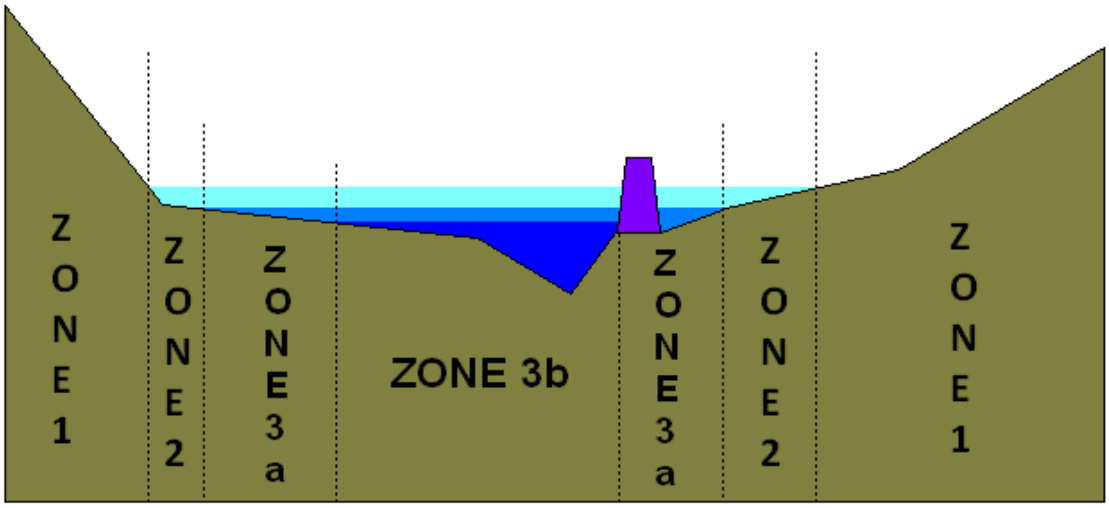


Table 3-1: Flood Zone descriptions

Zone	Probability	Description
Zone 1	Low	This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).
		All land uses are appropriate in this zone.
		For development proposals on sites comprising one hectare or above the vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off, should be incorporated in a flood risk assessment.
		Developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage systems.
Zone 2	Medium	This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (0.1% – 1%) or between 1 in 200 and 1 in 1000 annual probability of sea flooding (0.1% – 0.5%) in any year.
		Essential infrastructure, water compatible infrastructure, less vulnerable and more vulnerable land uses (as set out by NPPF) as appropriate in this zone. Highly vulnerable land uses are allowed as long as they pass the Exception Test.
		All developments in this zone require an FRA.
		Developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage systems.
Zone 3a	High	This zone comprises land assessed as having a greater than 1 in 100 annual probability of river flooding (>1.0%) or a greater than 1 in 200 annual probability of flooding from the sea (>0.5%) in any year Developers and the local authorities should seek to reduce the overall level flood risk, relocating development sequentially to areas of lower flood risk and attempting to restore the floodplain and make open space available for flood storage.
		Water compatible and less vulnerable land uses are permitted in this zone. Highly vulnerable land uses are not permitted. More vulnerable and essential infrastructure are only permitted if they pass the Exception Test.
		All developments in this zone require an FRA.

Zone	Probability	Description
		Developers and local authorities should seek opportunities to: - reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage systems. - relocate existing development to land in lower risk zones - create space for flooding by restoring functional floodplain and flood flow pathways and by identifying, allocating and safeguarding open spaces for flood storage.
Zone 3b	Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. SFRAs should identify this Flood Zone in discussion with the LPA and the Environment Agency. The identification of functional floodplain should take account of local circumstances.
		Only water compatible and essential infrastructure are permitted in this zone and should be designed to remain operational in times of flood, resulting in no loss of floodplain or blocking of water flow routes. Infrastructure must also not increase flood risk elsewhere.
		All developments in this zone require an FRA.
		Developers and local authorities should seek opportunities to: - reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage systems. - relocate existing development to land in lower risk zones

3.2.2 Actual Flood Risk

- If it has not been possible for all future development to be situated in Zone 1 then a more detailed assessment is needed to understand the implications of locating proposed development in Zones 2 or 3. This is accomplished by considering information on the "actual risk" of flooding. The assessment of actual risk takes account of the presence of flood defences and provides a picture of the safety of existing and proposed development. It should be understood that the standard of protection afforded by flood defences is not constant and it is presumed that the required minimum standards for new development are:
  - residential development should be protected against flooding with an annual probability of river flooding of 1% (1 in 100-year chance of flooding) in any year; and
  - residential development should be protected against flooding with an annual probability of tidal (sea) flooding of 0.5% (1 in 200-year chance of flooding) in any year.

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

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

rate of rise of floodwater it is possible to assess the level of hazard posed by flood events from the respective sources. This assessment will be needed in circumstances where consideration is given to the mitigation of the consequences of flooding or where it is proposed to place lower vulnerability development in areas that are at risk from inundation.

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

3.2.3 Residual Risk

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

- The effects of a flood with a magnitude greater than that for which the defences or management measures have been designed to alleviate (the 'design flood'). This can result in overtopping of flood banks, failure of flood gates to cope with the level of flow or failure of pumping systems to cope with the incoming discharges.
- 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 assessment of residual risk demands that attention be given to the vulnerability of the receptors and the response to managing the resultant flood emergency. In this instance, attention should be paid to the characteristics of flood emergencies and the roles and responsibilities during such events. Additionally, in the cases of breach or overtopping events, consideration should be given to the structural safety of the dwellings or structures that could be adversely affected by significant high flows or flood depths.

3.3 Possible responses to flooding

3.3.1 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.

3.3.2 Avoid

The sequential approach requires that the first requirement is to avoid the hazard. If it is possible to place all new growth in areas at a low probability of flooding, then the flood risk management considerations will include provisions sot that proposed development does not increase the probability of flooding to others. This can be achieved by implementing Sustainable Drainage Systems (SuDS) and other measures to control and manage run-off. In some circumstances it might be possible to include measures within proposed growth areas that reduce the probability of flooding to others and assist existing communities to adapt to the effects of climate change. In such circumstances the growth proposals should include features that can deliver the necessary levels of mitigation so that the standards of protection and probability of flooding are not reduced by the effects of climate change. In Sevenoaks District, consideration should be given not only to the peak flows generated by new development but also to the volumes generated during longer duration storm events.

3.3.3 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.

It should be noted that the Flood and Coastal Risk Management Grant in Aid (FCRMGiA) funding arrangements (introduced in 2011) do not make government funds available for any new development implemented after 2012. Accordingly, it is essential that appropriate funding arrangements are established for new development proposed in locations where a long-term investment commitment is required to sustain Flood Risk Management (FRM) measures. The strategic investment commitment is required so that in future the FRM measures can be maintained and afforded for the lifetime of the development, since the available funds from FCRMGiA will potentially not reflect the scale of development that is benefitting. The policy statement Flood and Coastal Resilience Partnership Funding (2013) sets out the arrangements that will apply for the allocation of capital Flood Defence Grant-in-Aid (FDGiA) to flood and coastal erosion risk management projects. Flood and Coastal Resilience Partnership Funding will form part of the Environment Agency's overall capital allocation projects until the end of the 2014/2015 financial year. Under this system, central government contributions will cover the full cost of a scheme if it has high benefits – such as if a high number of houses are protected. However, where the benefits are not high enough for central government contributions to cover the costs, local contributions may be available to top up the funding.

The National Flood and Coastal Erosion Management Strategy[13] summarises the new system:

> *"In essence, instead of meeting the full cost of a limited number of schemes, a new partnership approach to funding could make government money available to pay a share of any worthwhile scheme. The amount in each case will depend on the level of benefits the scheme provides. For example, the number of households protected, or the amount of damage that can be prevented. The level of government funding potentially available towards each scheme can be easily calculated. Local authorities and communities can then decide on priorities and what to do if full funding isn't available. Projects can still go ahead if costs can be reduced or other funding can be found locally."*

There are a number of potential impacts of this change in funding. The Government stated that its proposals will help to:

- Encourage total investment in Flood and Coastal Erosion Risk Management by operating authorities to increase beyond what is affordable to national budgets alone;
- Enable more local choice within the system and encourage innovative, cost-effective options to come forward in which civil society may play a greater role.
- Maintain widespread uptake of flood insurance.

[13] Defra (2011) - The national flood and coastal erosion risk management strategy for England - https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/228898/9780108510366.pdf

4 The Sequential, risk based approach

4.1 The Sequential, risk-based approach

This approach is established so areas with little or no risk of flooding (from any source) are developed in preference to areas at higher risk, with the aim of keeping development outside of medium and high flood risk areas (Flood Zones 2 and 3) and other sources of flooding, where possible.

It is often the case that it is not possible for all new development to be allocated on land that is not at risk from flooding. In these circumstances the Flood Zone maps (that show the extent of inundation assuming that there are no defences) are too simplistic. A greater understanding of the scale and nature of the flood risks is required.

When deciding on the ability to manage flood risk for new development located in Zones 2 and 3, consideration must be given to a wide range of issues. The issues to be addressed include how any evacuation of the occupants would be handled, how the new development fits in with the existing flood management provision and, in circumstances where flooding is experienced, how quickly the wider area would recover and return to normal. At some locations it could be found that Flood Risk Management (FRM) measures are more easily integrated alongside proposed new development to address the flood risk issues, usually as a consequence of the prevailing natural or artificial topography. In these circumstances the FRM proposals could be deployed without causing a significant alteration to the design and its place setting. However, even in these circumstances it should be recognised that FRM measures at one location can have the potential to cause an alteration to the flood risk to adjacent property or in flood cells on the opposite bank.

4.2 Applying the Sequential Test and Exception Test in the preparation of a Local Plan

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

The Sequential Test should be applied to the whole Local Planning Authority area to increase the likelihood of allocating development in areas not at risk of flooding. The Sequential Test can be undertaken as part of a Local Plan Sustainability Appraisal. Alternatively, it can be demonstrated through a free-standing document, or as part of strategic housing land or employment land availability assessments. NPPF Planning Practice Guidance for Flood Risk and Coastal Change describes how the Sequential Test should be applied in the preparation of a Local Plan (Figure 4-1).

The Exception Test should only be applied following the application of the Sequential Test and as set out in Table 3 of the NPPF Planning Practice Guidance: Flood Risk and Coastal Change. NPPF Planning Practice Guidance: Flood Risk and Coastal Change describes how the Exception Test should be applied in the preparation of a Local Plan (Figure 4-2).

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

The NPPF Planning Practice Guidance[14] sets out how developers and planners need to consider flood risk to, and from, the development site, following the broad approach of assessing, avoiding, managing and mitigating flood risk. A checklist for site-specific Flood Risk Assessments is provided in Paragraph 68 of the Guidance.

A site-specific Flood Risk Assessment should be carried out to assess flood risk to, and from, a development. The assessment should demonstrate how flood risk will be managed over a development's lifetime, taking climate change and the user vulnerability into account.

[14] NPPF Planning Practice Guidance: Flood Risk and Coastal Change (paragraph 033, Reference ID: 7-056-20140306) March 2014

Figure 4-1: Applying the Sequential Test in the preparation of a Local Plan

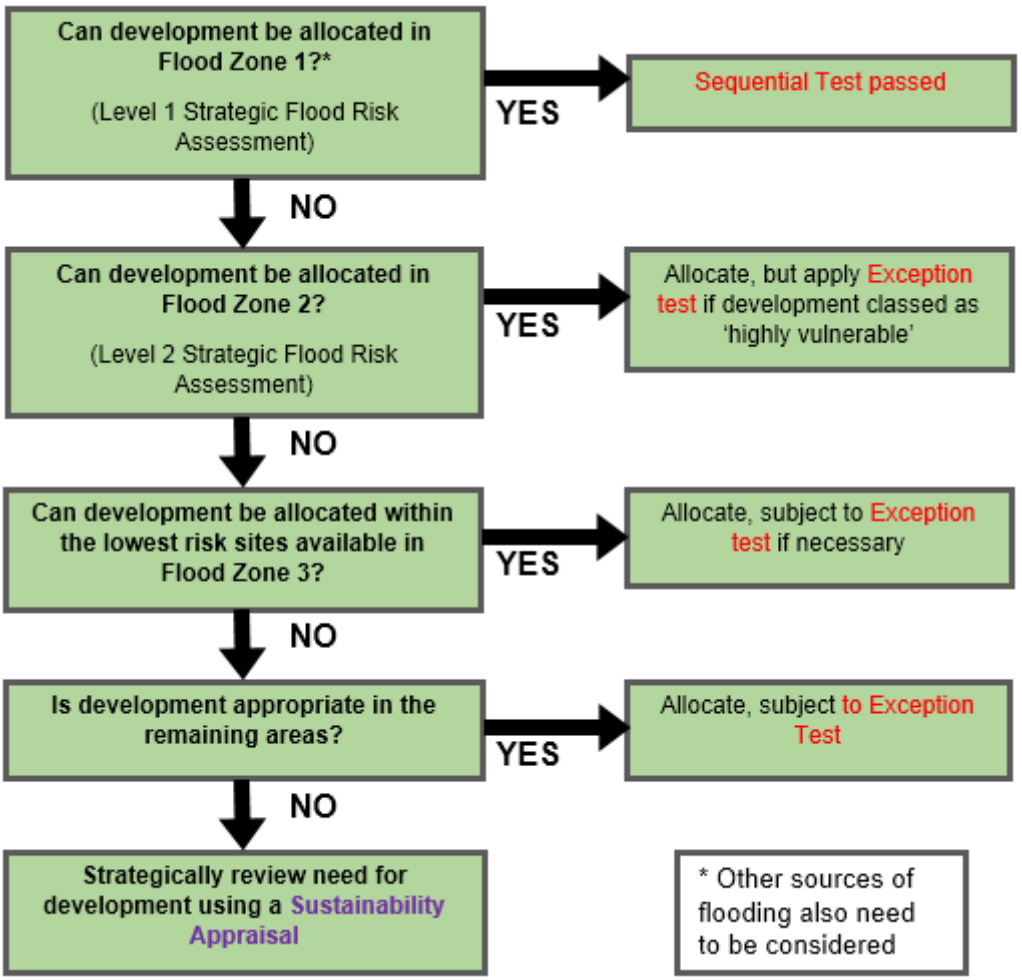
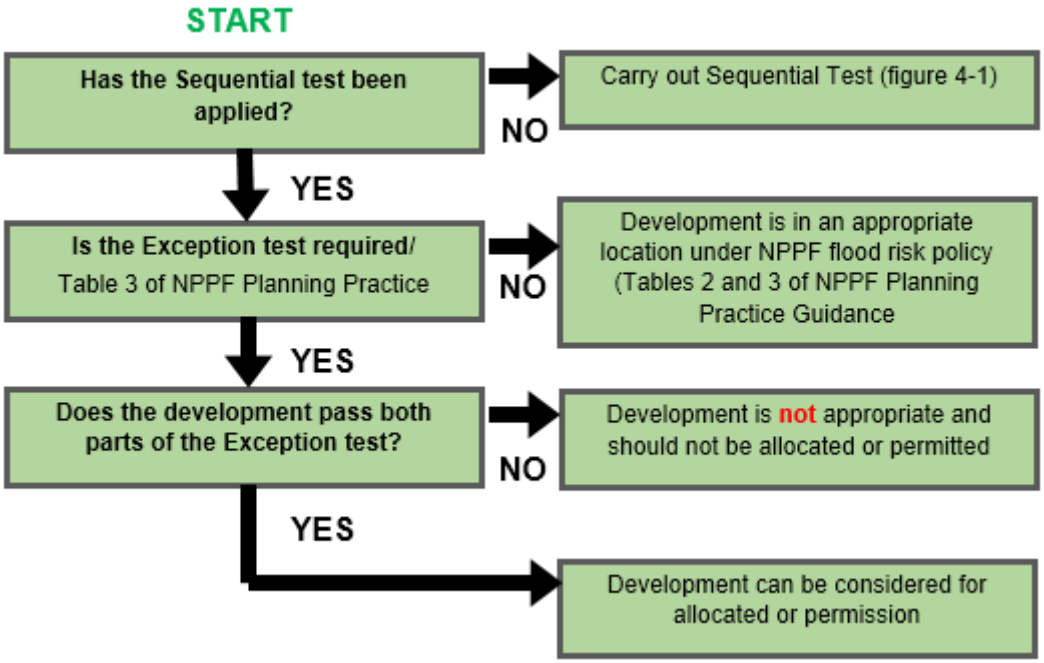


Figure 4-2: Applying the Exception Test in the preparation of a Local Plan



The NPPF Planning Practice Guidance sets out the following objectives for a site-specific Flood Risk Assessment (FRA) and states it should establish

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

4.3.1 Sequential Test

The Sequential Test must be performed when considering the placement of future development and for planning application proposals. The sequential approach to locating development should be followed for all sources of flooding. The Flooding and Coastal Change Planning Practice Guidance to the NPPF gives detailed instructions on how to perform the test.

The Sequential Test does not need to be applied for individual developments under the following circumstances:

- The site has been identified in development plans through the Sequential Test.
- Applications for minor development or change of use (except for a change of use to a caravan, camping or chalet site, or to a mobile home or park home site).

It is normally reasonable to presume and state that individual sites that lie in Zone 1 satisfy the requirements of the Sequential Test; however, consideration should be given to risks from all sources, areas with critical drainage problems and critical drainage areas (as defined in SWMPs).

For developments that do not fall under the above categories, local circumstances must be used to define the area of application of the Sequential Test (within which it is appropriate to identify reasonably available alternatives). The criteria used to determine the appropriate search area relate to the catchment area for the type of development being proposed. For some sites this may be clear, in other cases it may be identified by other Local Plan policies[15]. A pragmatic approach should be taken when applying the Sequential Test.

Sevenoaks District Council, with advice from the Environment Agency, are responsible for considering the extent to which Sequential Test considerations have been satisfied, and will need to be satisfied that the proposed development would be safe and not lead to increased flood risk elsewhere.

The information provided in this SFRA can be used to:

- Identify the area to be assessed (including alternatives) on the Flood Zone maps that are provided with this assessment.
- Establish the risk of flooding from other sources.
- Follow the instructions given in the Planning Practice Guidance.

4.3.2 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 deemed appropriate. The aim of the Exception Test is to ensure that more vulnerable property types, such as residential development can be implemented safely and are not located in areas where the hazards and consequences of flooding are inappropriate. For the Test to be satisfied, both of the following elements have to be accepted for development to be allocated or permitted:

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

   Local Planning Authorities will need to consider what criteria they will use to assess whether this part of the Exception Test has been satisfied, and give advice to enable

[15] NPPF Planning Practice Guidance: Flood Risk and Coastal Change (paragraph 033, Reference ID: 7-056-20140306) March 2014

applicants to provide evidence to demonstrate that it has been passed. If the application fails to prove this, the Local Planning Authority should consider whether the use of planning conditions and / or planning obligations could allow it to pass. If this is not possible, this part of the Exception Test has not been passed and planning permission should be refused[16] .

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

   The site-specific Flood Risk Assessment should demonstrate that the site will be safe and the people will not be exposed to hazardous flooding from any source. The following should be considered[17]:

   - The design of any flood defence infrastructure.
   - Access and egress.
   - Operation and maintenance.
   - Design of the development to manage and reduce flood risk wherever possible
   - Resident awareness.
   - Flood warning and evacuation procedures.
   - Any funding arrangements required for implementing measures.

The NPPF and Planning Practice Guidance provide detailed information on how the Test can be applied.

4.4 Summary of SFRA mapping for all sources of flood risk

4.4.1 Fluvial

The data used to prepare the fluvial mapping for this study is based on the results from hydraulic models provided by the Environment Agency. The outputs from these models is presented within the Flood Zone mapping which is presented within the fluvial flood risk mapping. A summary of the technical assessments into flood hazards which provide this data are summarised in section 1.4.2.

4.4.2 Surface Water

Mapping of surface water flood risk in Sevenoaks District Council has been taken from the updated Flood Map for Surface Water (uFMfSW) published by the Environment Agency. This information is based on a national scale map identifying those areas where surface water flooding poses a risk. Surface water flood risk is subdivided into the following four categories:

- High: An area has a chance of flooding greater than 1 in 30 (3.3%) each year.
- Medium: An area has a chance of flooding between 1 in 100 (0.1%) and 1in 30 (3.3%) each year.
- Low: An area has a chance of flooding between 1 in 1000 (0.1%) and 1in 100 (1%) each year.
- Very Low: An area has a chance of flooding of less than 1 in 1000 (0.1%) each year.

4.4.3 Hazard Maps

Hazard mapping has also been produced for Sevenoaks District Council using data, (where available) derived from the results of Environment Agency hydraulic modelling (see section 1.4.2). The hazard rating is calculated using data generated by the models and utilises the classifications of hazard presented in DEFRA's R&D Technical Note FD2320: Flood Risk Assessment.

4.4.4 Suite of Maps

All of the mapping can be found in the appendices to this SFRA and is presented in the following structure:

[16] NPPF Planning Practice Guidance: Flood Risk and Coastal Change (paragraph 037, Reference ID: 7-056-20140306) March 2014
[17] NPPF Planning Practice Guidance: Flood Risk and Coastal Change (paragraph 038, Reference ID: 7-056-20140306) March 2014

- Appendix A: Index grids for Appendix Mapping
- Appendix B: Watercourses in Sevenoaks
- Appendix C: Environment Agency Flood Zone Mapping
- Appendix D: Climate Change Mapping
- Appendix E: Surface Water Mapping
- Appendix F: Groundwater Mapping
- Appendix G: Flood Warning Coverage

4.5 Other relevant flood risk information

Users of this SFRA should also refer to other relevant information on flood risk where available and appropriate. This information includes:

- **The North Kent Rivers Catchment Flood Management Plan** (2009)
- **River Medway Catchment Flood Management Plan** (2009)
- **Kent County Council Preliminary Flood Risk Assessment** (2011)
- **Kent Local Flood Risk Management Strategy** (2013)
- **Sevenoaks Stage 1 Surface Water Management Plan** (2013)
- Flood Risk Management Plan in accordance with the Flood Risk Regulations (available in 2015) – Environment Agency and Lead Local Flood Authority.
- Environment Agency's Asset Information Management System (AIMS) – users should note that recently completed schemes may not yet be included in this dataset.

5 Understanding flood risk in Sevenoaks District

5.1 Topography, geology, soils and hydrology

Sevenoaks District covers an area of approximately 370km^2 and has a population of approximately 118,409[18]. There are 26 wards in the district, the largest of which is Sevenoaks Town and St John's with a population of approximately 6575[19]. Other sizeable wards include Swanley White Oak, Ash and New Ash Green, Brasted, Chevening and Sundridge, and Fawkham and West Kingsdown.

Please note that all referenced figures are provided at the end of the Section 5.

5.1.1 Topography

The topography that characterises the district is displayed in Figure 5-1. The topography primarily comprises higher elevations and steeper slopes which form the North Downs in the north section of the district and the High Weald in the south section of the district. The highest elevations reach approximately 247 metres Above Ordnance Datum (m AOD) at The Chart near Weardale. Elevations decrease in a north and south-east direction due to the presence of several river valleys in the district. For example, elevations reach approximately 20m AOD near South Darenth and Leigh, both of which are located in separate river valleys. There are three main watercourses within the district boundary; the River Darent which originates from higher elevations in the north, and the Rivers Eden and Medway which occupy the lower elevations in the south.

5.1.2 Geology and soils

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

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

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

Superficial (at the surface) deposits in Sevenoaks District are located on the North Downs as well as the floodplains of the Rivers Eden, Medway and Darent. Clay-with-Flints Formation (diamicton) characterise the North Downs, whereas Alluvium (clay, silt and sand) and River Terrace Deposits (undifferentiated – sand and gravel) characterise the floodplains and areas surrounding the three main rivers in the district.

Figure 5-2 shows the arrangement of the various bedrock formations throughout the district, while Figure 5-3 shows the arrangement of the various superficial deposit formations throughout the district.

[18] Office for National Statistics, (June 2013), Population Estimates for the UK, England and Wales, Scotland and Northern Ireland – mid-2015 (MYE3: components of population change for local authorities in the UK, mid-2015).
[19] Kent County Council Business Intelligence Statistical Bulletin (Page 16: 2001 to 2011 Census ward level population change for Tonbridge and Malling Borough Council) November 2012.

5.2 Historical flooding

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

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

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

- Saints Hill
- Penshurst
- Leigh
- Bough Beech
- Edenbridge
- Four Elms
- Cowden
- Westerham
- Sundridge
- Sevenoaks
- Shoreham
- Eynsford
- Farningham
- Horton Kirby

The maximum extent of flooding indicated by the historical flood records (all extents from these events combined) are shown in Figure 5-4. The location and source (where known) of each flood event are also shown in Figure 5-4. This information is also presented in larger scale mapping in Appendix H.

Details of the significant flood events noted to affect Sevenoaks District are summarised as follows:

- September 1968: prolonged heavy rainfall associated with a slow-moving depression and thunderstorms caused severe flooding across the south east of England. Between the 14th and 15th of September, 150mm-200mm of rainfall was recorded across Kent[20]. It is suspected that the ground was dry and hard following the summer and that this exacerbated the runoff in the district. As a result, the River Eden, River Darent and River Medway exceeded their channel capacities, which caused extensive flooding of agricultural land, damage to properties in Edenbridge[21], Westerham, Shoreham, Brasted, Sundridge and Sevenoaks, as well as the destruction of the bridge in Otford[22].
- October 2000: the autumn of 2000 was the wettest on record and many river catchments were subjected to multiple flood events. Large areas of Kent and Sussex were left under water as several rivers burst their banks[23]. Flooding of properties and roads occurred from both the River Eden and River Darent around Edenbridge, Penshurst and Eynsford.
- December 2002 – January 2003: between the 24th December and the 3rd January, three weather fronts moved in from the west and each bought 20mm-25mm of rain across the district. The most severe weather occurred over the North Downs (>100mm of total rainfall) and the River Darent catchment was the worst affected; approximately 50 properties were flooded in Westerham, Brasted, Sundridge, Chipstead, Farningham and South Darenth. It is noted that flooding in most of these locations was caused by a combination of high river flows, surface runoff and blocked culverts.
- December 2013: During the winter of 2013-14 a series of Atlantic depressions brought heavy rainfall and stormy conditions to much of England and Wales. Edenbridge located within the district was reported to be notably affected by flood water from the River Eden. Elsewhere Maidstone, Tonbridge and Yalding (outside of the district) were also noted to be flooded by the River Medway[24]Outside of the River Medway catchment, properties in Brasted, Sundridge and Westerham were flooded when water levels in the River Darent exceeded bank level on the 17 January 2014[25].

[20] Tonbridge Weather Notes Post 1929 (1968: 14 & 15th September)
[21] Edenbridge Town, Edenbridge Floods 15/16 September 1968 (2001)
[22] Kent Live, Flooding anniversary approaches for area (August, 2008).
[23] The Met Office: The Wet Autumn of 2000 (November 2012)
[24] BBC News, Kent County Council report says new flood warning system needed, (22nd January 2014).
[25] BBC News, South East flooding: How has the region coped? (17th February 2014).

Historic flood records provided by the Environment Agency, Sevenoaks District Council and Kent County Council also show a number of surface water flood incidents to have occurred across the district. A large number of surface water flood incidents are noted to have occurred in and around Sevenoaks, Edenbridge, Westerham and Eynsford and there are records of external and internal property flooding.

Other historical flood records provided by Kent County Council are summarised as follows:

- Brasted, Eynsford, Bradbourne Lakes, Sevenoaks, Kemsing and Brittains Lane are recorded to have experienced groundwater flooding between 2000 and 2003. Both Brasted and the area surrounding the Bradbourne Lakes are noted to be particularly vulnerable to groundwater flooding.
- Areas of Sevenoaks, Eynsford, West Kingsdown, Crockenhill, Knole Park, Dunton Green, and Otford are recorded to have experienced sewer flooding events since between 2000 and 2012. Issues with foul sewer capacities and flooding are noted in Crockenhill and Bat and Ball Station north of Sevenoaks.

5.2.1 Winter 2013-2014 flooding

The most recent significant flood events to affect Sevenoaks occurred in the winter of 2013-2014. The Kent Severe Weather Impacts Monitoring System (SWIMS) recorded five successive weather events across Kent and Medway:

- The St Jude's storm (28 October 2013)
- Fluvial event (1 November 2013)
- East coast tidal surge (5-6 December 2013)
- Fluvial and surface water floods (20 December 2013 – 28 March 2014)
- Groundwater floods (25 January 2014).

The SWIMS Event Summary Report for Kent & Medway states that Kent received 242% of the long-term average rainfall during the 2013-2014 winter. As part of the National Severe Weather Warning Service, 43 Yellow and 7 Amber weather warnings as well as 63 flood alerts were issued.

Of particular note is the storm of the 23-24 December 2013, which bought heavy rain (50-70mm) to southern England and caused significant widespread flooding[26]. Heavy rainfall on already saturated catchments caused river, surface water and sewage flooding across Kent and affected hundreds of homes and businesses[27].

The impacts from wider reports are summarised as follows:

- During the winter of 2013-2014, 929 residential and commercial properties in Kent were flooded, 36 of which were located in the Sevenoaks District Council area. The Christmas and New Year 2013-2014 Storms and Floods Report[28] states that these figures are likely to be an underestimate as they are based on the number of properties known to have flooded by rivers, groundwater or groundwater-fed rivers. Information of the number of properties flooded by surface water and sewage is less certain.
- Edenbridge and South Darenth, amongst other locations in Kent, were noted to be the worst affected communities following the storms in December 2013[29].
- Train services were suspended in Sevenoaks and Tonbridge following a landslide at Wadhurst[30] and several main roads (A25 and A224) became impassable[31]
- Low-lying properties in Brasted, Sundridge High Street and Westerham were flooded as the River Darent burst its banks in mid-January[32].

[26] The Met Office: Winter Storms, December 2013 to January 2014 (July, 2014)
[27] Thanet District Council: Christmas & New Year 2013-2014 Storms & Floods Final Report (Appendix 1)
[28] Thanet District Council: Christmas & New Year 2013-2014 Storms & Floods Final Report (Appendix 1)
[29] Thanet District Council: Christmas & New Year 2013-2014 Storms & Floods Final Report (Appendix 1)
[30] SWIMS Event Summary Report for Kent & Medway Winter 2013-2014 Full Report
[31] Sevenoaks Chronical, BREAKING: Extreme flooding closes A25, (17th January 2014)
[32] BBC News, South East flooding: How has the region coped? (17th February 2014).

- The Sevenoaks Adult Education Centre, as well as highways in Edenbridge and Penshurst were identified as hotspots of vulnerability as they were repeatedly flooded throughout the winter[33].
- In order to deal with emergencies, Sevenoaks street cleansing personnel were redeployed to prepare and deliver sandbags to assist flooding prevention in the District, the cost of which totalled £10,300[34]

5.3 Fluvial flood risk

5.3.1 Watercourses

Watercourses flowing through Sevenoaks District include the:

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

The two principle watercourses within the district are the River Darent, tributaries of which include the Honeypot Stream and the Watercress Stream, and the River Eden which is a major tributary of the River Medway. Tributaries to these watercourses include primarily smaller Ordinary Watercourses and unnamed drains. A description of these watercourses is provided in Table 5-1.

The River Darent catchment (at Hawkey NGR 55200 72000) receives approximately 729mm of rain on average per year[35]. The adjoining catchments of the Honeypot Stream (downstream extent: NGR 55660 158250) and the Watercress Stream (downstream extent: NGR 552700 158100) receive similar levels of average rainfall per year.

The River Eden catchment (downstream extent: NGR 552750 143400) receives approximately 742mm of rain on average per year[36], which is similar to the levels received by the River Medway Catchment at Allington Lock: NGR 574850 158150.

5.3.2 Flood risk

The primary fluvial flood risk to Sevenoaks District is associated with the River Darent and the River Eden. The main rivers in Sevenoaks District are detailed in Table 5-1 and a figure of their location is provided in Appendix B.

Records of fluvial flood events known to have affected the district are shown in Figure 5-5.

5.3.2.1 River Darent

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

There is a long history of flooding from the River Darent and areas commonly affected by flooding from the river include Eysnford, Shoreham, Chipstead, Farningham, Otford, Sundridge, Brasted and Westerham[37]. Historical records show that flooding along the River Darent is primarily caused by intense storms and high rainfall in conjunction with an impervious catchment (e.g. already saturated by rain)[38]. For example, the storms and prolonged rainfall in September 1968 was considered to cause a flood event with a return period greater than 1 in 100 years[39]. As a result,

[33] SWIMS Event Summary Report for Kent & Medway Winter 2013-2014 Full Report
[34] SWIMS Event Summary Report for Kent & Medway Winter 2013-2014 Full Report
[35] SAAR value extracted from the FEH CD-ROM v3.0 © NERC (CEH). © Crown copyright. © AA. (2009)
[36] SAAR value extracted from the FEH CD-ROM v3.0 © NERC (CEH). © Crown copyright. © AA. (2009)
[37] Kent County Council: Sevenoaks Stage 1 Surface Water Management Plan (2013)
[38] Environment Agency: North Kent Rivers Catchment Flood Management Plan (December, 2009)
[39] Sevenoaks District Council, Strategic Flood Risk Assessment for Local Development Framework, (April, 2008)

agricultural land, roads, bridges and properties between Westerham and Farningham were extensively flooded and damaged[40].

The event triggered subsequent work on the River Darent to improve channel and floodplain conveyance, and reduce the risk of flooding. For example, the Darent channel was realigned and enhanced at Westerham and flood relief channels were constructed to divert floodwaters to a storage lake at Chipstead. However, some problems still remain at Brasted and Shoreham, and the River Darent has flooded multiple times post-1968. Recorded events include 1969, 1971, 1972, 1976, and 2003[41]. The most recent event to affect the district occurred in the winter of 2013/2014 when extreme winter weather and exceptionally heavy rainfall caused the River Darent to continually rise, exceed its channel capacity and inundate properties at Brasted, Sundridge, Westerham, Swanley and Sevenoaks[42,43].

Fluvial flood risk within Sevenoaks District also arises from the Upper Darent and its tributaries. Areas surrounding the River Darent from its source, as well as the Honeypot and Watercress Streams are susceptible to flooding from a combination of high river flows, insufficient watercourse capacities, unmaintained watercourses, blocked culverts, trash screens and bridges, and problems with the operation of sluices[44].

5.3.2.2 Rivers Eden and Medway

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

The most severe flood event from the River Eden occurred in 1958 before any flood defences were built to protect Edenbridge and the surrounding communities[45]. Following a series of severe storms and heavy rainfall, the River Eden exceeded its channel capacity and caused widespread flooding damage to Edenbridge High Street. Despite the river being dredged in the 1960's and the subsequent construction of flood walls, earth embankments and channel improvements to offer further flood protection, Edenbridge has regularly been affected by a number of flood events[46]. This includes the widespread flooding following the winter storms of 2013/2014 when the River Eden burst its banks and caused structural damage to properties[47] and regular inundation of the highways in Edenbridge and Penshurst[48]. It is noted that the regular flooding in and around Edenbridge may be due to the fact that the headwaters of the river come together upstream of the town before being constricted by bridge crossings and the inability of the local infrastructure and to convey flows in extreme events through the urban area[4950].

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

5.3.2.3 Ordinary Watercourses

The Sevenoaks SWMP states that ordinary watercourses have also repeatedly flooded in the district. For example, an ordinary watercourse north of Marlpit and south of Four Elms reportedly flooded in 1958 and 1960, and properties have been recorded to be affected in the past along Coppings Road and Hartfield Road, within Kippington and throughout Sevenoaks.

[40] National Rivers Authority, River Darent Catchment Management Plan Consultation Report, (July, 1994)
[41] Kent County Council: Sevenoaks Stage 1 Surface Water Management Plan (2013)
[42] BBC News: Floodwater pumped from homes in west Kent (January 2014)
[43] KentOnline: Met Office flood warnings will remain in Kent as overnight rain sparks levels to rise, with people in Dartford, Otford and Darenth on alert (January 2014)
[44] Environment Agency: North Kent Rivers Catchment Flood Management Plan (December, 2009)
[45] http://www.edenbridgetown.com/stories_events/2009/flood_history.php
[46] Environment Agency: River Medway Catchment Flood Management Plan (December, 2009)
[47] Kent and Sussex Courier: Edenbridge community pulls together in face of floods (December, 2013)
[48] SWIMS Event Summary Report for Kent & Medway Winter 2013-2014 Full Report
[49] Environment Agency: River Medway Catchment Flood Management Plan (December, 2009)
[50] Kent County Council: Sevenoaks Stage 1 Surface Water Management Plan (2013)

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[51]. Issues include blocked trash screens and culverts, and high water levels are known to have had a knock-on effect on highway drainage.

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

Given the widespread flooding recorded historically within the district (particularly along the floodplains of the River Darent, Eden and Medway as evidenced in Figure 5-4) particular areas (e.g. roads, settlements) of the district susceptible to fluvial flooding have not been identified specifically as they are so numerous. It should be noted that defences are present within the district which act to reduce flooding. This may be particularly important when considering the functional floodplain (Flood Zone 3b) for development proposals. Further details on defences in Sevenoaks District are presented in section 6.

The delineation of the fluvial Flood Zones and the areas of Sevenoaks District which are within fluvial Zones are shown in Map 1 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.

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

Table 5-1: Watercourses in the district

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

5.4 Tidal flood risk

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

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

5.5 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 on not only 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 updated Flood Map for Surface Water (uFMfSW) predominantly follows topographical flow paths of existing watercourses or dry valleys with some isolated ponding located in low lying areas. Mapping of the uFMfSW throughout the district is provided in Appendix E.

Surface water flood records provided by a variety of data sources are shown in Figure 5-6. It should be noted that information provided by KCC highways covers a period from 2008 to 2013. There are limited records of older events from other key partners but the majority of records were provided by KCC. Therefore, based on the data provided, there are at least 192 records of surface water flooding in total and 117 records of surface water flooding across the district since 2008.

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

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

5.6 Groundwater flooding

Compared with other sources of flooding, current understanding of the risks posed by groundwater flooding is limited and mapping of flood risk from groundwater sources is in its infancy. Under the Flood and Water Management Act (2010), LLFAs have powers to undertake risk management functions in relation to groundwater flood risk. Groundwater level monitoring records are available for areas on Major Aquifers. However, for low lying valley areas, which can be susceptible to groundwater flooding caused by a high water table in mudstones, clays and superficial alluvial deposits, very few records are available. Additionally, there is increased of groundwater flooding where long reaches of watercourses are culverted as a result of elevated groundwater levels not being able to naturally pass into watercourses and be conveyed to less susceptible areas.

As part of the SFRA deliverables, mapping of the whole district has been provided showing the Areas Susceptible to Groundwater Flooding (AStGWF). This information is provided in Appendix F. The AStGWF is a strategic-scale map showing groundwater flood areas on a 1km square grid. The data was produced to annotate indicative Flood Risk Areas for PFRA studies and allow the LLFAs to determine whether they may be at risk of flooding from groundwater. This data shows the proportion of each 1km grid square, where geological and hydrogeological conditions indicate that groundwater might emerge. It does not show the likelihood of groundwater flooding occurring, nor does it take account of the chance of flooding from groundwater rebound. This dataset covers a large area of land and only isolated locations within the overall susceptible area are actually

likely to suffer the consequences of groundwater flooding. The information indicates that susceptibility to groundwater flooding is greatest in the areas surrounding Otford, Edenbridge and Penshurst, where >50% of the area within the 1km grid squares are considered to be susceptible to groundwater flooding. This strongly links to the geology in these areas, with the alluvial deposits (clay, silt, sand and gravel) being a contributing factor. Furthermore, the susceptibility to groundwater flooding is typically <25% across the southern and central areas of the district, and no information is presented in the more northern areas either side of the River Darent.

The AStGWF data should be used only in combination with other information, for example local or historical data. It should not be used as sole evidence for any specific flood risk management, land use planning or other decisions at any scale. However, the data can help to identify areas for assessment at a local scale where finer resolution datasets exist. It should be noted that although an area may be designated as susceptible to groundwater flooding, this does not mean that groundwater flooding will definitely be a problem within these areas, rather it provides an indication of the risk.

The Sevenoaks SWMP and historical flood records provided by Kent County Council indicate that Brasted, Eynsford, Bradbourne Lakes, Sevenoaks, Kemsing and Brittains Lane are vulnerable to or have experienced groundwater flooding in the past. Specifically, it has been observed that the Bradbourne Lakes are spring-fed, meaning that groundwater is typically high and the area is at risk of groundwater flooding[52]. Furthermore, there are several locations in Sevenoaks where the aquifer cap is missing, which results in groundwater infiltration when full[53]. Waterlogged gardens have been recorded in these areas but there are no records of any serious property flooding.

The Sevenoaks SWMP also notes that it is difficult to ascertain if the source of flood event in other areas of the district is from groundwater. This is because it may be a result of a combination of sources, or a culverted watercourse being mistaken for a spring or underground stream[54].

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

5.7 Flooding from artificial sources

5.7.1 Flooding from sewers

Sewer flooding occurs when intense rainfall overloads the sewer system capacity (surface water, foul or combined), and/or when sewers cannot discharge freely into watercourses due to high water levels. Sewer flooding can also be caused when problems such as blockages, collapses or equipment failure occur in the sewerage system. Infiltration, entry of soil or groundwater into sewer systems via faults within the fabric of the sewerage system is another cause of sewer flooding. Infiltration is often related to shallow groundwater, and may cause high flows for prolonged periods of time. Based on the information provided by Southern Water and Thames Water, the Sevenoaks SWMP identified sewer flooding events to be predominantly caused by hydraulic overloading and/or blockages of surface water, foul and/or combined sewer systems[55]. Specifically, it is highlighted that there may be an issue of foul sewer flooding in Crockenhill, and numerous incidents of sewer flooding have been reported within Sevenoaks Town due to repeated blockages caused by the disposal of Fats Oils and Grease (FOGs) and hydraulic overloading within sewers[56].

Since 1980, the Sewers for Adoption[57] guidelines 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, although until recently this did not apply to smaller private systems. This means that even where sewers are built to current specification, they are likely to 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). Existing sewers can also become overloaded as new development adds to their catchment, or due to incremental increases in roofed and paved

[52] Sevenoaks District Council, (April, 2008), Strategic Flood Risk Assessment for Local Development Framework (Table 2: Sources of Flooding)
[53] Sevenoaks District Council, (April, 2008), Strategic Flood Risk Assessment for Local Development Framework (Table 2: Sources of Flooding)
[54] Kent County Council, (October, 2013), Sevenoaks Stage 1 Surface Water Management Plan
[55] Kent County Council, (October, 2013), Sevenoaks Stage 1 Surface Water Management Plan (Appendix C: Flood History Table)
[56] Kent County Council, (October, 2013), Sevenoaks Stage 1 Surface Water Management Plan
[57] Sewers for Adoption 7th Edition - A Design & Construction Guide for Developer. WRc plc. September 2012.

surfaces at the individual property scale (urban creep). Sewer flooding is therefore a problem that could occur in many locations across the district.

Historical incidents of flooding are detailed by Southern Water and Thames Water in their DG5 register. The databases record incidents of flooding relating to public foul, combined or surface water sewers and displays which properties suffered flooding. For confidentiality reasons, this data has been supplied on a postcode basis from the Sewer Incident Report Form (SIRF) hydraulic overload database. Data covers all reported incidents or the most recent incident as of its export on 30th September 2016. The information from the SIRF database is shown in Table 5-2.

The SIRF hydraulic overload information indicates a total of 32 recorded flood incidents in the Sevenoaks District. The more frequently flooded postcodes are TN8 6 (21), TN8 5 (3) and TN11 8 (3). It is important to recognise that the information does not present whether flooding incidences were caused by general exceedance of the design sewer system, or by operational issues such as blockages. The information also represents a snap shot in time and may become outdated following future rainfall events. Also, risk in some areas may reduce in some locations by capital investment to increase of the capacity of the network. As such, the sewer flooding flood risk is not a comprehensive 'at risk register' and updated information should be sought to enhance understanding of flood risk from sewers at a given location.

Table 5-2: SIRF database for Sevenoaks District

Southern Water		Thames Water	
Post Code	**Recorded Flood Incidents**	**Post Code**	**Recorded Flood Incidents**
TN3 0	1	DA3 7	1
TN8 5	3	TN13 2	1
TN8 6	21	TN14 6	1
TN11 8	3	TN16 3	1
Total: 32			
Note: Based on information exported on 30th September 2016 provided from Southern Water and Thames Water			

5.7.2 Flooding from reservoirs

Reservoirs are artificial bodies of water, where water is collected and stored behind a man-made structure and released under control either to reduce the flow magnitudes in downstream channels or to meet a requirement when needed for purposes such as irrigation, municipal needs or hydroelectric power[58].

Flooding from reservoirs may occur following partial or complete failure of the control structure designed to retain water in the artificial storage area. It is estimated that the risk of such failure is low and the occurrence of complete reservoir failure is exceptionally rare since the introduction of safety legislation in 1930. However, 1.1 million properties in England are in areas to be considered at risk of flooding from reservoir failure[59].

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 is very difficult to estimate, but it is much less likely than flooding from rivers or surface water. It may not be possible to seek refuge from floodwaters upstairs as buildings could be unsafe or unstable due to the force of water from the reservoir breach or failure. The Environment Agency maps (available online at the Environment Agency **'What's in Your Backyard'** website[60] represent a credible worst case scenario. In these circumstances, it is the time to inundation, the depth of inundation and the velocity of flood flows that will be most influential.

There are 5 reservoirs located within Sevenoaks District, the details of which are provided in Table 5-3. There are also 7 reservoirs located outside of the district boundary that could inundate parts of the district following a breach or failure. The details of these reservoirs are also provided in Table 5-3.

[58] Defra – national flood and coastal erosion risk management strategy for England (2011): https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/228898/9780108510366.pdf
[59] DEFRA and the Environment Agency: The national flood and coastal erosion risk management strategy for England (September, 2011).
[60] http://apps.environment-agency.gov.uk/wiyby/default.aspx

Outlines from the Risk of Flooding from Reservoirs dataset (informed from the National Inundation Reservoir Mapping (NIRIM) study) show the worst-case inundation extents across Sevenoaks District if the reservoirs within and surrounding the district boundary were to breach and fail. As shown in Figure 5-7, reservoir breaches would primarily affect the southern section of the district, including the areas surrounding Forest Row, Edenbridge, Chiddingstone, Penshurst and Leigh. This is due to the fact that 9 of the 12 reservoirs are located along the River Eden and the River Medway. Therefore, a breach of these reservoirs could have serious implications for the settlements located along fluvial floodplains in the southern section of the district.

Other areas at risk of flooding from reservoirs within the district include Brasted and Sundridge (Coombe Bank Lake), Chipstead and Knockholt (Knockholt No. 2), Farningham, Horton Kirby and South Darenth (Farningham Hill No.2). However, the risk of flooding from reservoirs in these areas is less extensive compared to the risk of flooding in the southern section of Sevenoaks District.

Therefore, a breach of these reservoirs would have serious implications for areas located along the floodplains of the River Eden and the River Medway.

Table 5-3: Reservoirs that may potentially affect Sevenoaks District in the event of a breach or failure

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

The risk to development for reservoirs is residual but developers should consider reservoir flooding during the planning stage.

- Developers should seek to contact the reservoir owner to obtain information which may include:
    - Reservoir characteristics: type, dam height at outlet, area / volume, outflow location
    - Operation: discharge rates / maximum discharge
    - Discharge during emergency drawdown
    - Inspection / maintenance regime

- Developers should apply the sequential approach to locating development within the site. The following questions should be considered:
    - Can risk be avoided through substituting less vulnerable uses or by amending the site layout?
    - Can it be demonstrated that less vulnerable uses for the site have been considered and reasonably discounted?
    - Can layout be varied to reduce the number of people or flood risk vulnerability or building units located in higher risk parts of the site?
- Developers should consult with relevant authorities regarding emergency plans in case of reservoir breach.

5.8 The impact of climate change

Flood Risk Assessments (FRAs) are required to demonstrate future implications of climate change have been considered, and risks managed where possible, for the lifetime of the proposed development. This may include for instance:

- Consideration of the vulnerability of the proposed development types or land use allocations to flooding and directing the more vulnerable away from areas at higher risk due to climate change.
- Use of 'built in' resilience measures. For example, raised floor levels.
- Capacity or space in the development to include additional resilience measures in the future, using a 'managed adaptive' approach.

The last consideration acknowledges that there may be instances where some flood risk management measures are not necessarily needed now but may be in the future. This 'managed adaptive' approach may include for example setting a development away from a river so it is easier to improve flood defences in the future.

The latest guidance on climate change allowances for flood risk assessment released by the Environment Agency[61]provide predictions of anticipated change for

- peak river flow;
- peak rainfall intensity;
- sea level rise; and
- offshore wind speed and extreme wave height.

5.8.1 Fluvial flooding

Climate change mapping for Sevenoaks District has been provided in Appendix D. This presents Flood Zone 3a climate change mapping for +35% and +70% scenarios following the latest guidance and was made available by the Environment Agency to inform the SFRA. This information has not yet been prepared for other watercourses in the district, but should be prepared to support site-specific assessments of flood risk. For non-Medway watercourses, the mapping presented displays the Flood Zone 2 information, which it is expected provides a conservative (larger) estimate of climate change flood risk and so can be used to assess potential sensitivity of areas of the district to climate change.

It is important to note that climate change does not just affect the extent of flooding. Even where flood extents do not significantly change; flooding is likely to become more frequent under a climate change scenario. The impact of an event with a given probability is also likely to become more severe. For example, as water depths, velocities and flood hazard increase, so will the risk to people and property. Although qualitative statements can be made as to whether extreme events are likely to increase or decrease over the UK in the future, there is still considerable uncertainty regarding the magnitude of localised impact of these changes. Further details regarding the uncertainties in predicting the impacts of climate change can be found in:

[61] https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

- **Environment Agency (2016) Flood Risk Assessments: Climate Change Allowances**
- **UK Climate Projections (UKCP09)**

5.8.2 Tidal flooding

Climate change is predicted to influence the rate of sea level rise, in addition to offshore wind speed and extreme wave height. For Sevenoaks District, rivers within the district are of fluvial influence only and predicted to remain so under predicted changes in the climate. Therefore, climate change implications of tidal flood risk to the district has not been considered further as part of this SFRA.

5.8.3 Surface Water flooding

Climate change is predicted to increase rainfall intensity in the future by up to 40%[62] (for the Upper End estimate to the 2080s epoch (2070 to 2115) under the new range of allowances published by the Environment Agency. This will increase the likelihood and frequency of surface water flooding, particularly in impermeable urban areas, and areas that are already susceptible. Changes to predicted rainfall should be incorporated into flood risk assessments and drainage and surface water attenuation schemes associated with developments.

5.8.4 Groundwater flooding

The effect of climate change on groundwater flooding problems, and those watercourses where groundwater has a large influence on winter flood flows, is more uncertain. The updated climate change guidance released in February 2016 does not provide information on expected changes to groundwater flooding under future climate change. However, milder wetter winters may increase the frequency of groundwater flooding incidents in areas that are already susceptible, but warmer drier summers could counteract this effect by drawing down groundwater levels to a greater extent during the summer months. Where groundwater flooding is expected to influence a development site, it will be expected that consideration of groundwater flooding under a changing climate is assessed and measures taken to mitigate any change in risk.

5.8.5 Climate change assessment of flood risk at sites

To inform the SFRA, outputs made use of the hydraulic modelling and mapping of fluvial flood risk from the River Medway as is expected under climate change. This information was prepared by the Environment Agency and permitted for use in the SFRA. The modelling and mapping completed focused on predicted flood risk at the 2080s epoch (2070-2115) under increased flow rates of +35% and +70% for the undefended case 1% AEP event (Flood Zone 3a). The fluvial flow allowances represent the High Central and Upper End allowances under the latest guidance.

Flood Zone mapping following the latest climate change guidance is not available for non-Medway watercourses. Consideration of development outside the Medway floodplain should seek to confirm whether the site(s) would be influenced by flood risk from other watercourses both in the present day and with anticipated changes in flows brought about by climate change. Within the mapping presented within Appendix D, where climate change flooding predictions are not available following the latest guidance, the mapping presented displays the Flood Zone 2 information. This is expected to provide a conservative (larger) estimate of flood risk predicted as a consequence of climate change effects.

With respect to the vulnerability classification of development and its intended lifetime, the Environment Agency consider that within Flood Zone 3a More Vulnerable development types should consider the Higher Central (+35% flows) estimate as the design flood, whilst Essential Infrastructure should consider the Upper End (+70% flows) estimate. Less Vulnerable and Water Compatible development should consider the Central (+25% flows) estimate as the design flood, which is not available from the current flood risk information.

[62] https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

Figure 5-1: Sevenoaks District Topography

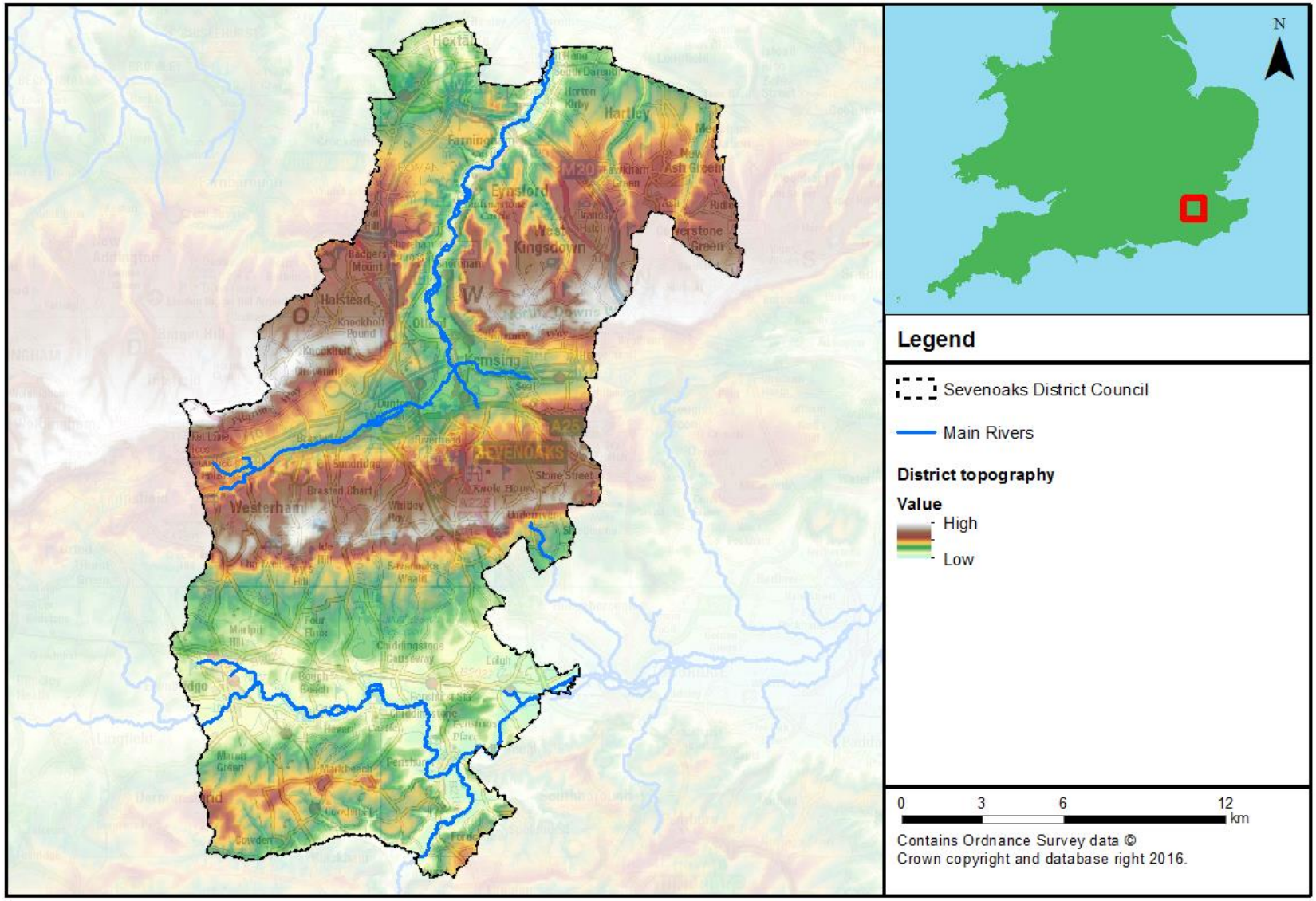


Figure 5-2: Bedrock deposits in Sevenoaks District

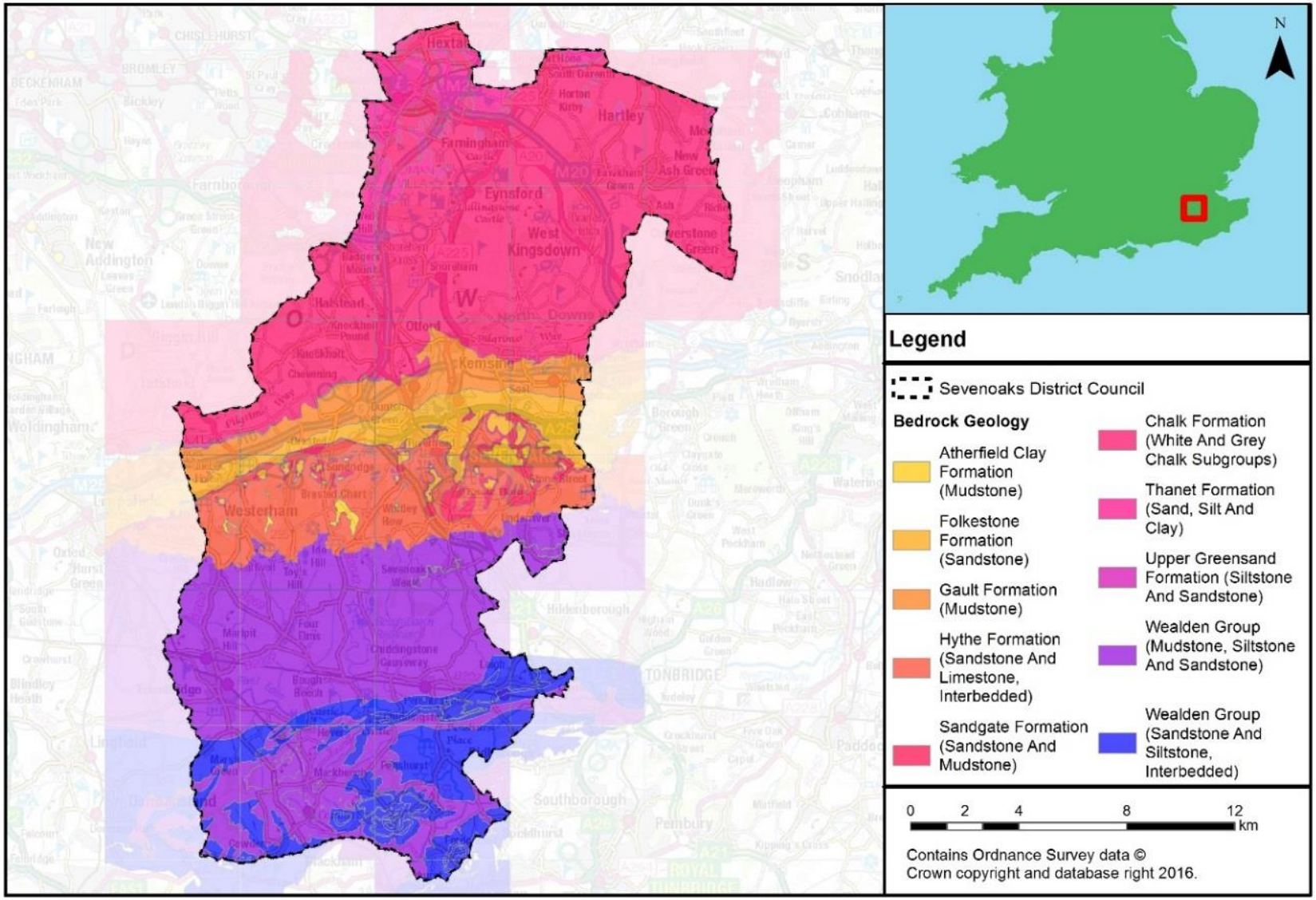


Figure 5-3: Superficial deposits in Sevenoaks District

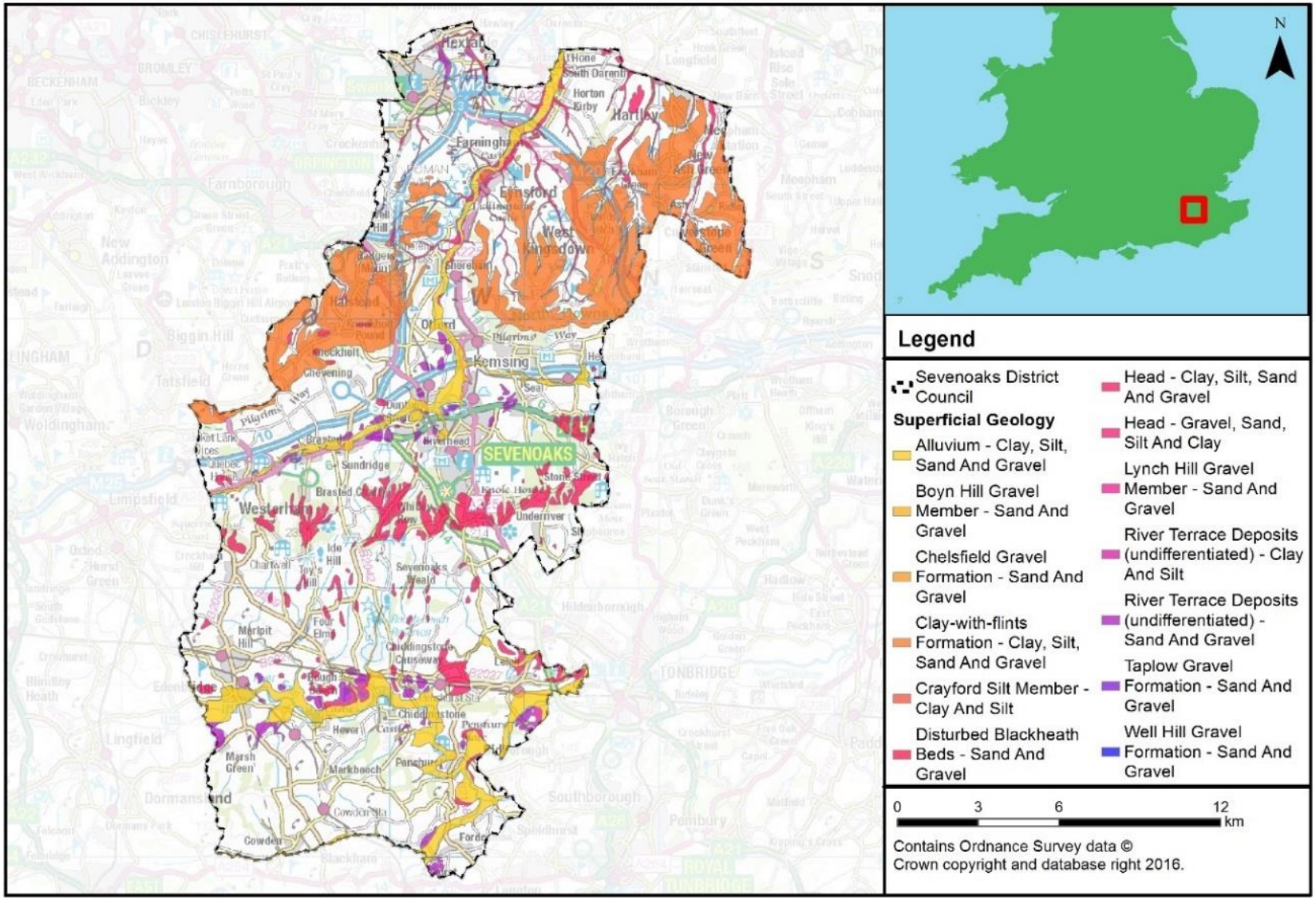


Figure 5-4: Historical flood records across Sevenoaks District

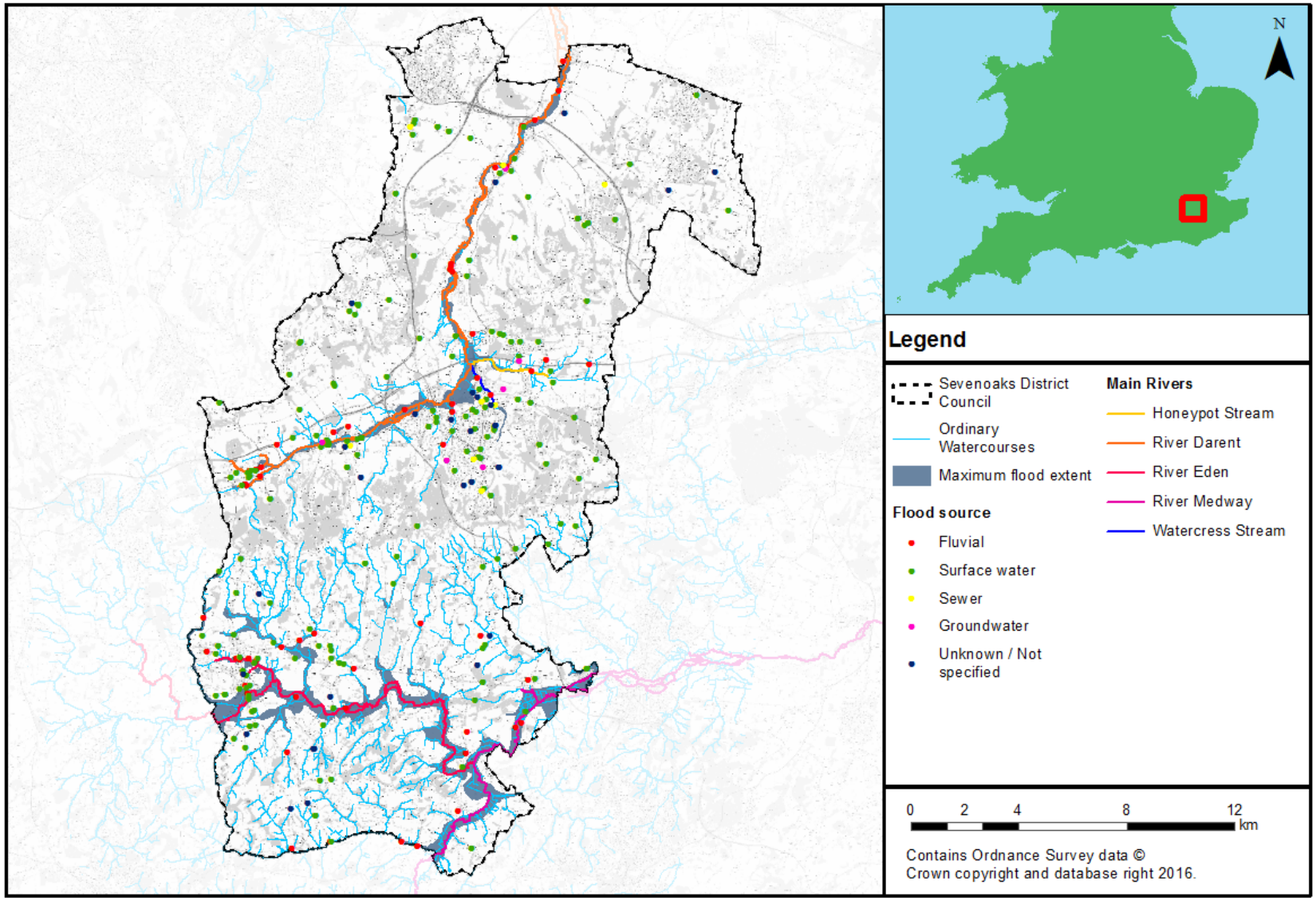


Figure 5-5: Fluvial flood records

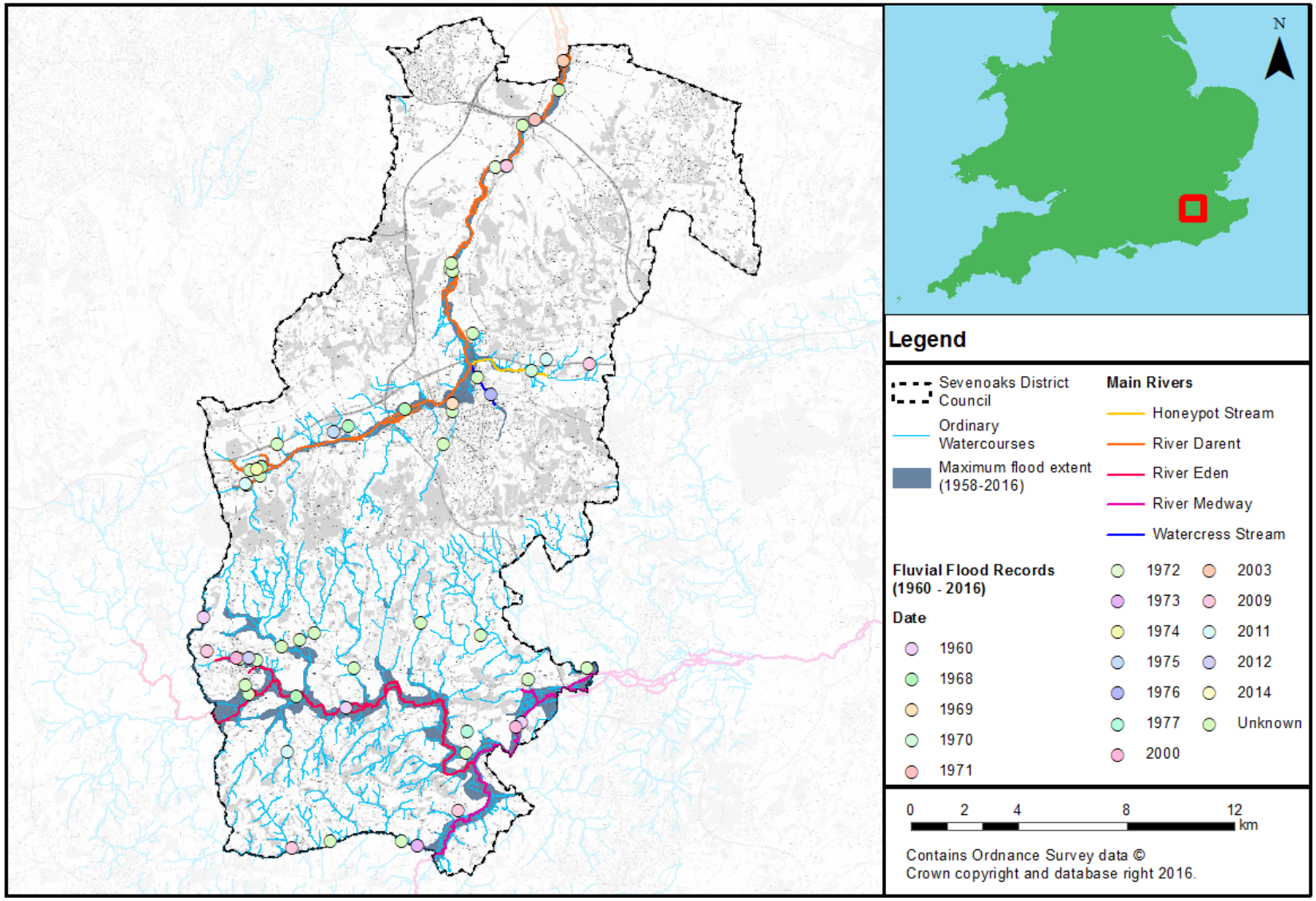


Figure 5-6: Surface water flooding records

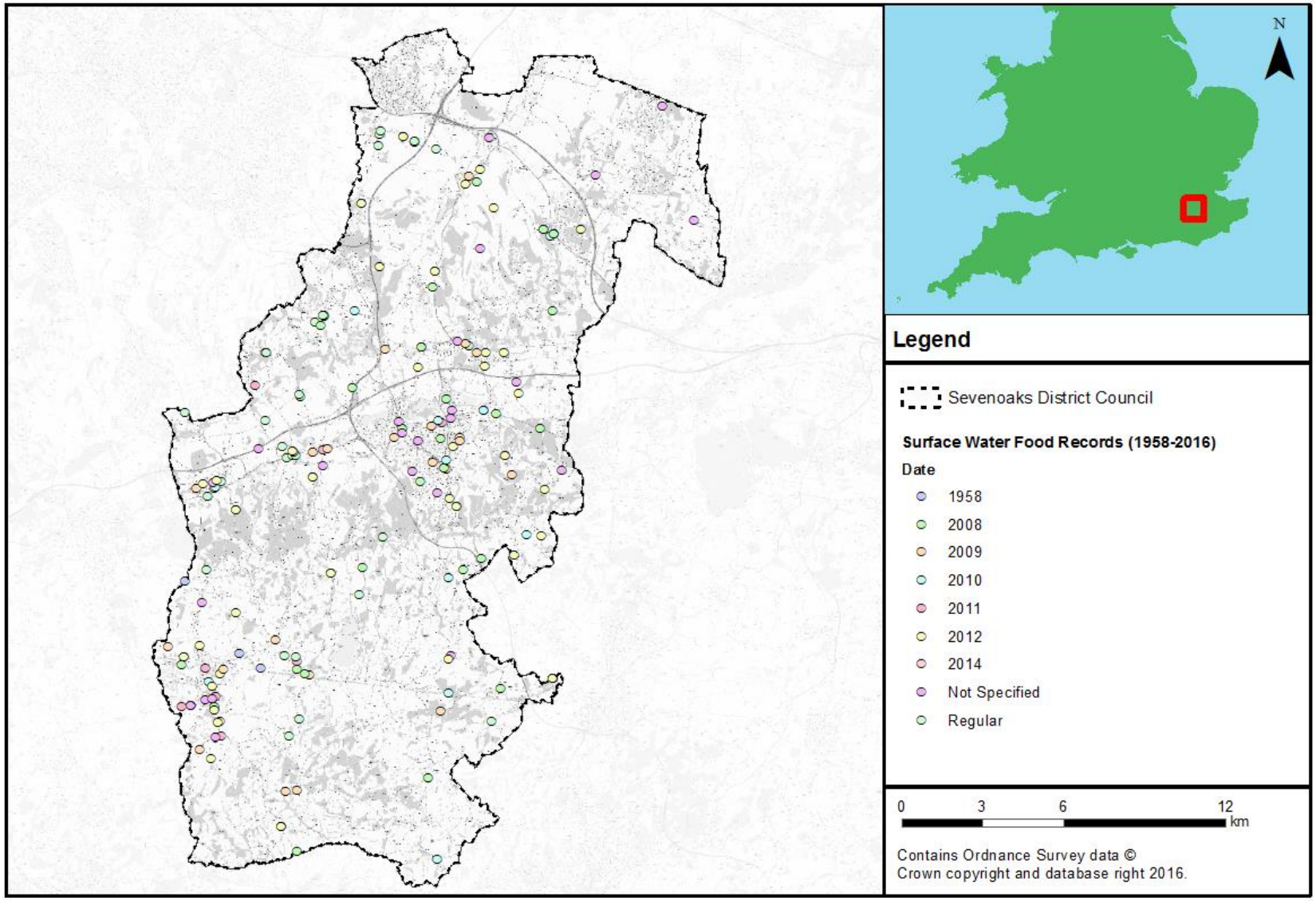
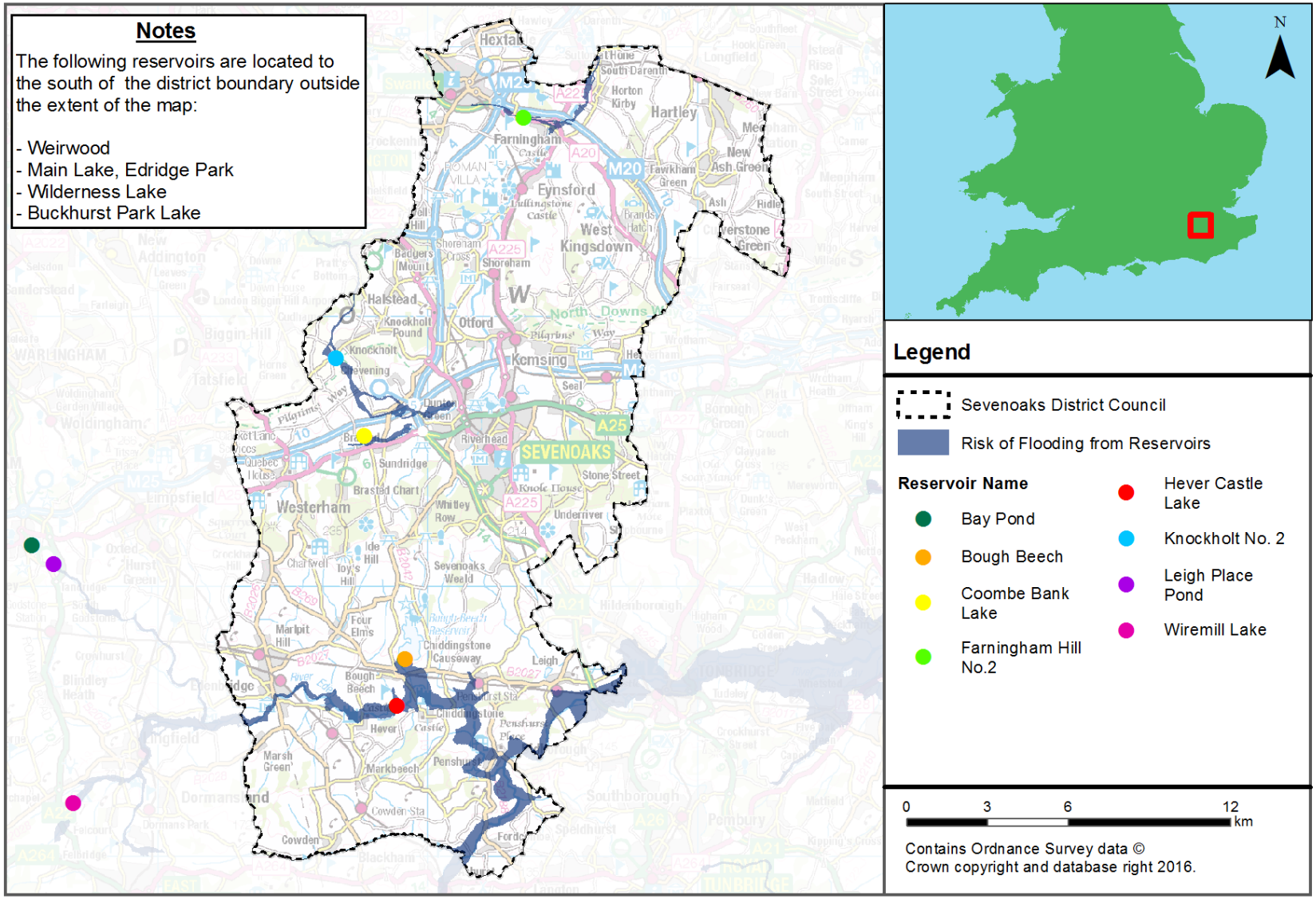


Figure 5-7: Areas of risk of reservoir flooding following a breach or failure



6 Flood defences

A high-level review of formal flood defences was carried out for this SFRA interrogating existing information that gives 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, in addition to some further explanation of the details of some of these defences. Defences considered are categorised as either raised flood defences (e.g. walls/embankments) or flood storage areas (FSAs). The assessment has considered man-made defences and not natural defences which may arise for instance due to the presence of naturally high ground adjacent to a settlement.

These types of defences and their location is summarised in the sections below.

6.1 Defence standard of protection and residual risk

One of the principal aims of the SFRA is to outline the present risk of flooding across Sevenoaks District including consideration of the effect of flood risk management measures (including flood banks and defences). The modelling that informs understanding of flood risk within the district is typically of a catchment-wide nature, suitable for preparing evidence on possible site options for development. In cases where a specific site risk assessment is required, more detailed studies should be performed to seek to refine the current understanding of flood risk from all sources.

Consideration of the residual risk behind flood defences has been undertaken as part of this study. The residual risk of flooding in a flood event or from failure of defences should also be carefully considered. Developers should also consider the standard of protection provided by defences and residual risk as part of a detailed Flood Risk Assessment (FRA).

6.2 Defence condition

Formal structural defences are given a rating based on a grading system for their condition[63]. A summary of the grading system used by the Environment Agency for condition is provided in Table 6-1. This detail, in addition to descriptions and standard of protection for each, were provided by the Environment Agency for the purpose of preparing this SFRA which reports on the standard of protection using this information.

Table 6-1: 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.

Source: Condition Assessment Manual – Environment Agency 2006

The condition of existing flood defences and whether they will continue to be maintained and/or improved in the future requires consideration as part of the risk based sequential approach and, in light of this, whether possible site options for development are appropriate and sustainable. In addition, detailed FRAs 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.

A review of key defences across Sevenoaks District, their condition and standard of protection is included in the following sections.

[63] Condition Assessment Manual, Environment Agency (2006)

6.3 Defences in Sevenoaks District

6.3.1 Raised defences

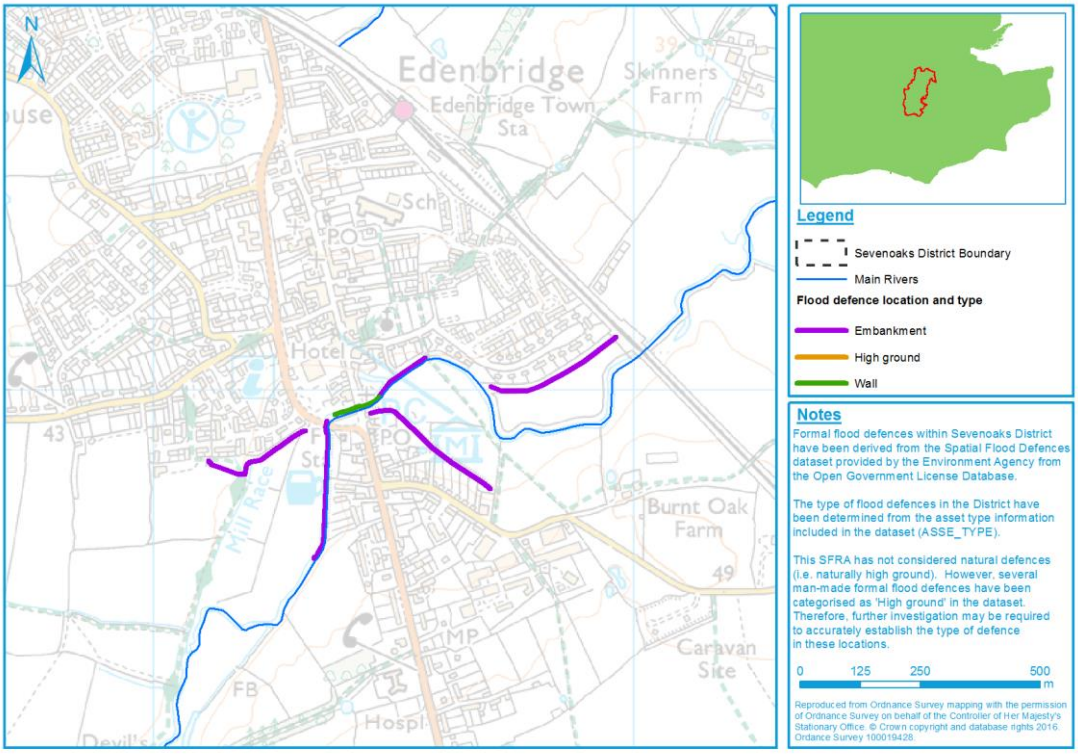
Edenbridge

Within Edenbridge, raised flood defences are set back from the channel of the River Eden to protect certain areas from river flooding. The location of these defences is displayed in Figure 6-1. 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' (Figure 6-2). Therefore, defects may be present on the embankments that could reduce the performance of these flood defences

Local sources state that the raised embankment adjacent to Cobbetts Way was damaged during December 2013 when efforts to raise barrier and protect the surrounding properties from the rising water levels in the channel undermined the defence[64]. During the winter, sandbags were provided by the EA to temporarily line, protect and strengthen the defence and works to repair the defence were scheduled at the beginning of May 2014. The embankment required approximately £45,000 of repair work from the EA's recovery budget[65].

The standard of protection afforded by the defences within Edenbridge 3.33% AEP (1 in 30-year flood event). However, the raised embankment along Mont St Aignan Way only provides a standard of protection of 20% AEP (1 in 5-year flood event) (Figure 6-3).

Figure 6-1: Location of defences within Edenbridge



[64] Kent Live, (April 2014), Edenbridge flood defence barrier to be repaired
[65] Kent Live, (February, 2015), Is flooding solution a bridge too far for Edenbridge?

Figure 6-2: Condition grade of defences within Edenbridge

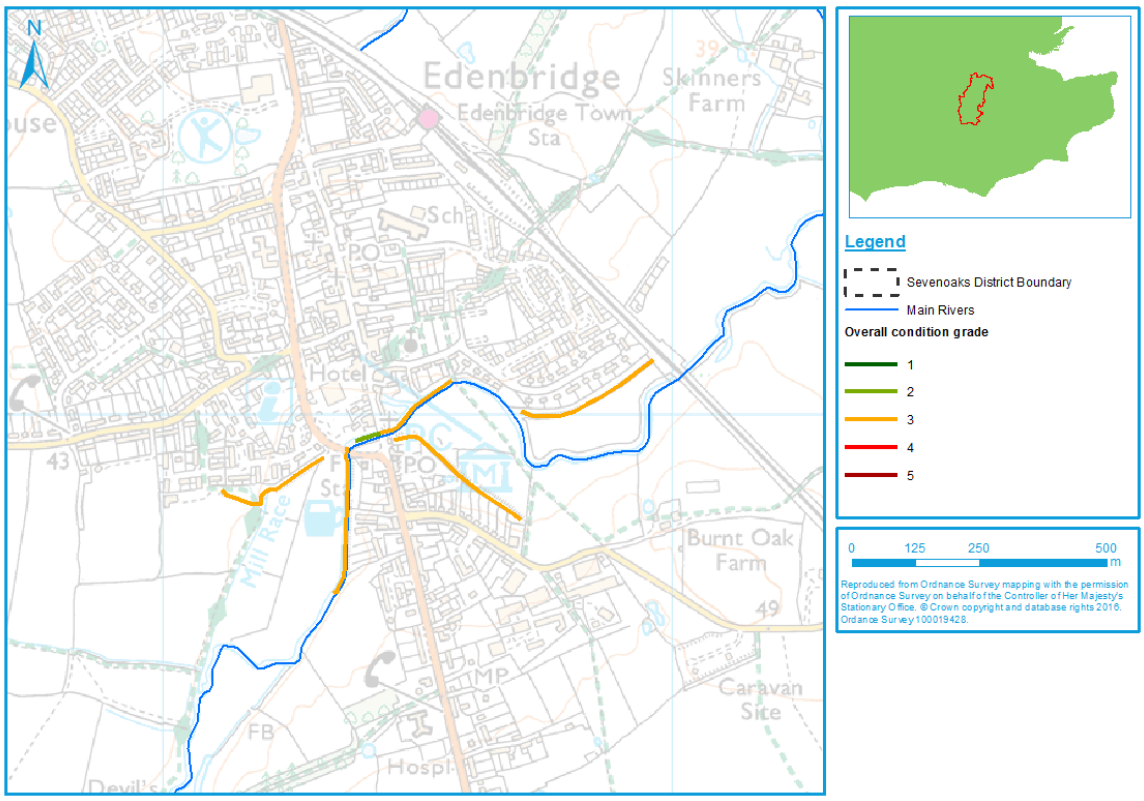
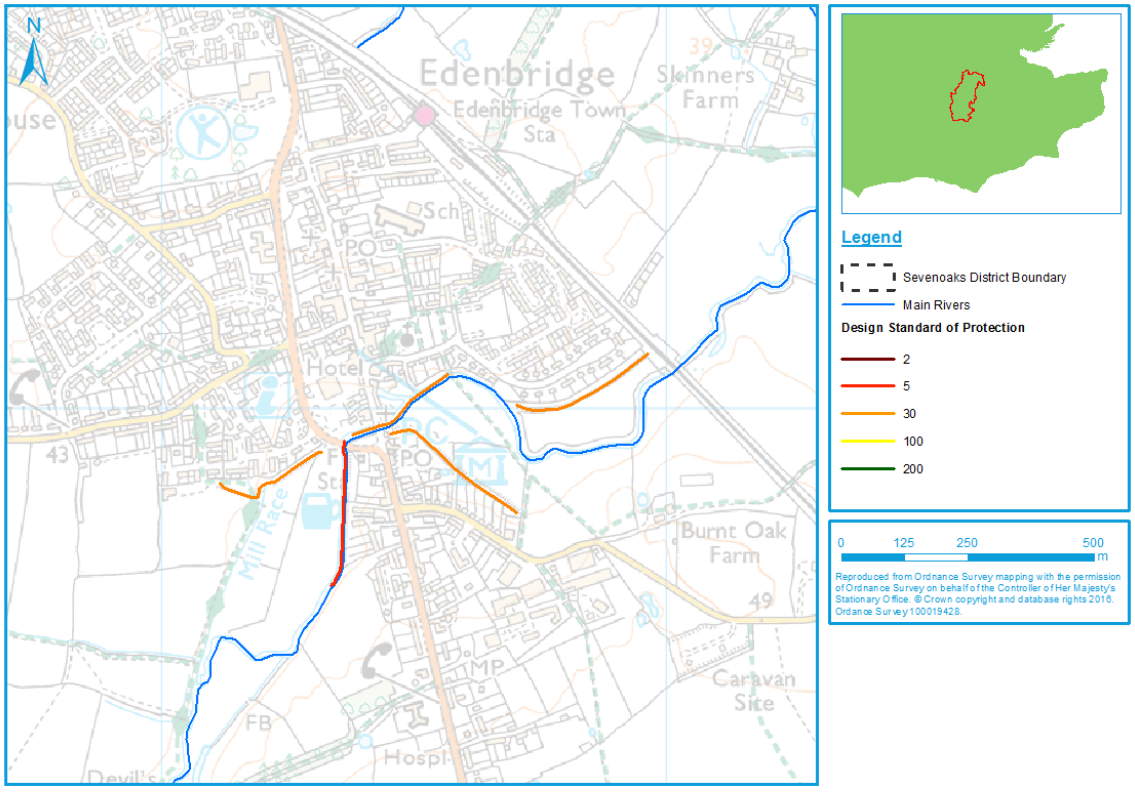


Figure 6-3: Design Standard of Protection for defences within Edenbridge



Brasted

There are a number of raised flood defences within Brasted located along the banks of the River Darent (Figure 6-4). The defences in the area consist of predominantly walls and high ground on either side of the channel. The defences are privately owned, but the Environment Agency and private owners maintain different sections of the defences. Responsibilities for maintaining particular lengths of the defences should be confirmed with the Environment Agency.

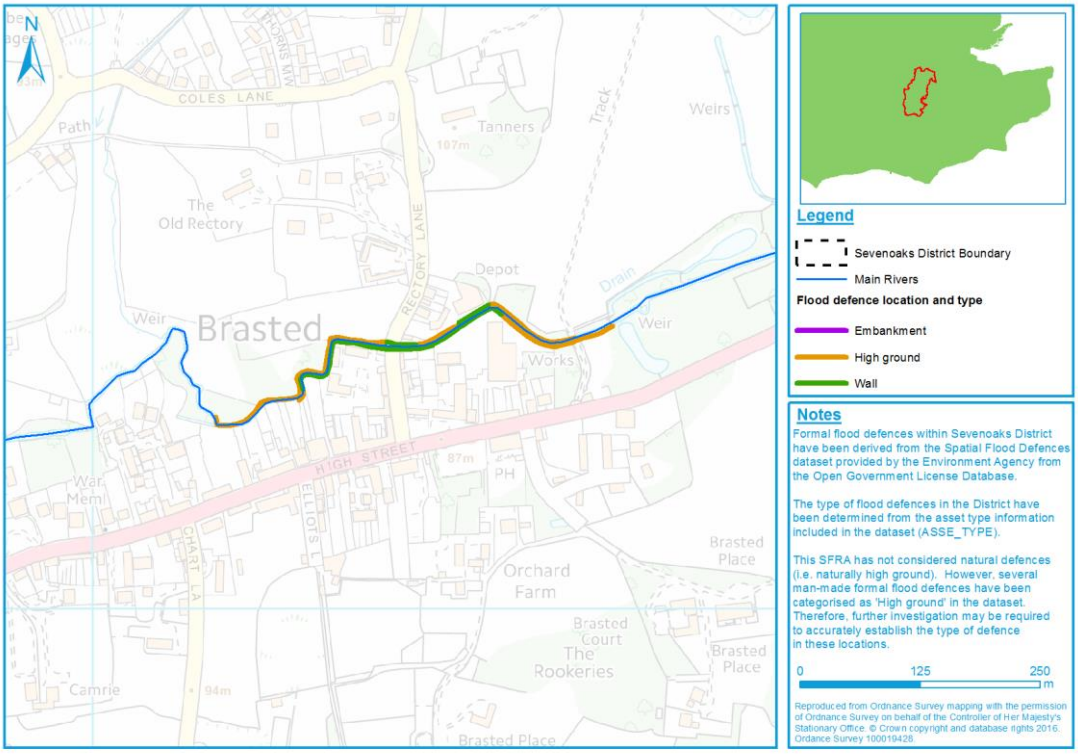
It should be noted that several man-made flood defences in the area have been categorised as 'high ground' defences and as such, further investigation may be required to accurately establish the type of defence in these locations.

The condition grade of walls and high ground assets typically varies between 'Good' and 'Fair'. This suggests that there are defects present and although some may only be minor, larger defects could reduce the overall performance of the defences protecting the village (Figure 6-5).

Defences lining the River Darent provide a typical standard of protection of 20% AEP (1 in 5-year flood event). However, the Brasted Alleviation Scheme was conducted and completed between 2007 and 2009 to improve the standard of protection to 43 properties within Brasted[66]. The scheme primarily involved the construction of a 600m flood wall/embankment along the River Darent, the installation of seven manually-operated flood gates and localised ground level raising along Rectory Lane to provide a standard of protection of 1% AEP (1 in 100-year flood event)[67],[68]. This is significantly higher than standard of protection provided by the other defences lining the banks of the watercourse.

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

Figure 6-4: Location of defences within Brasted



[66] Brasted Flood Alleviation Scheme Cost £1 Million Pounds (accessed October, 2016).
[67] Halcrow, (April, 2008), Sevenoaks District Council Strategic Flood Risk Assessment for Local Development Framework (A.19 Flood Management Systems)
[68] Hunton, Flood Gates: Manually operated flood gates (accessed (October, 2016)

Figure 6-5: Condition grade of defences within Brasted

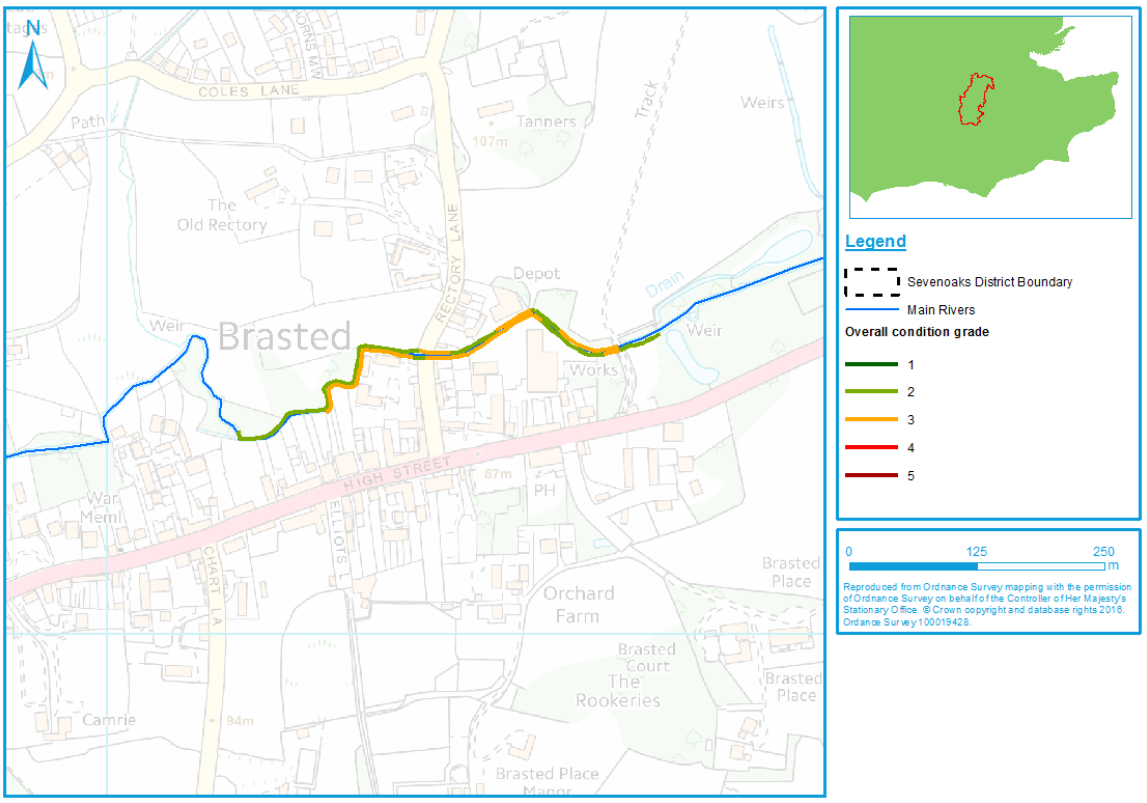
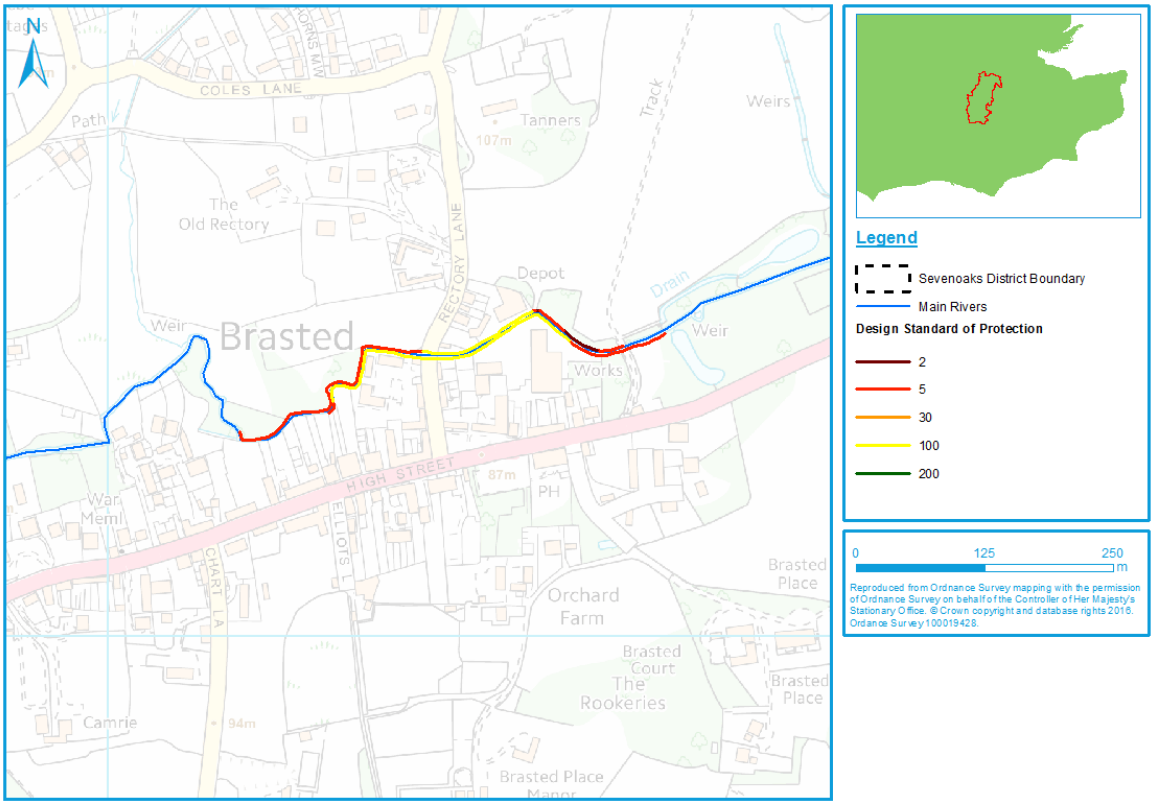


Figure 6-6: Design Standard of Protection for defences within Brasted



Leigh

The formal flood defences located to the south-east of Leigh form part of the Leigh Flood Storage Area (FSA), which is discussed further in Section 6.3.2. The embankments and sections of high ground located adjacent to Leigh serve two purposes: they protect the railway line and town from flooding, while impounding the large area of agricultural land that forms the FSA to reduce the risk of flooding in Tonbridge in the neighbouring borough.

As shown in Figure 6-7, embankments predominantly line southern edge of the railway, Leigh station and sewage works, while sections of high ground line the branching channels of the River Medway. The embankments have a condition grade of 'Good', meaning that minor defects may be present but they should not reduce the overall performance of the defence (Figure 6-8). The sections of high ground, however, have a condition grade of 'Fair', meaning that defects may be present that could reduce the overall performance of these defences (Figure 6-8).

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

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

Figure 6-7: Location of defences within Leigh

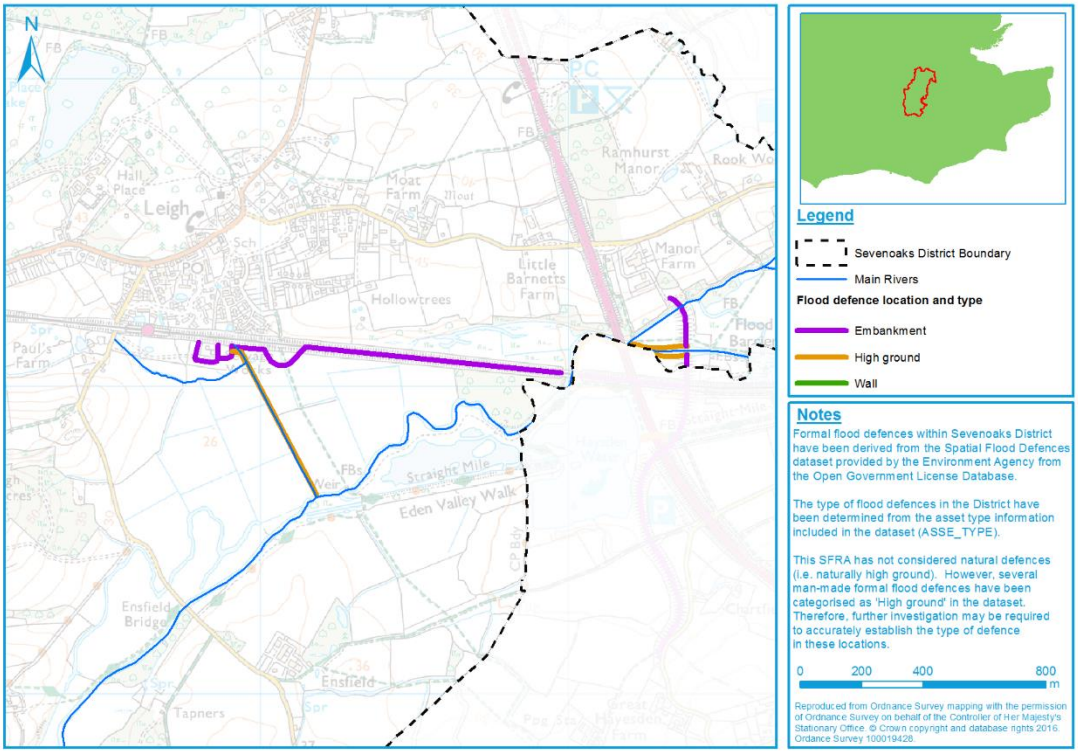


Figure 6-8: Condition grade of defences within Leigh

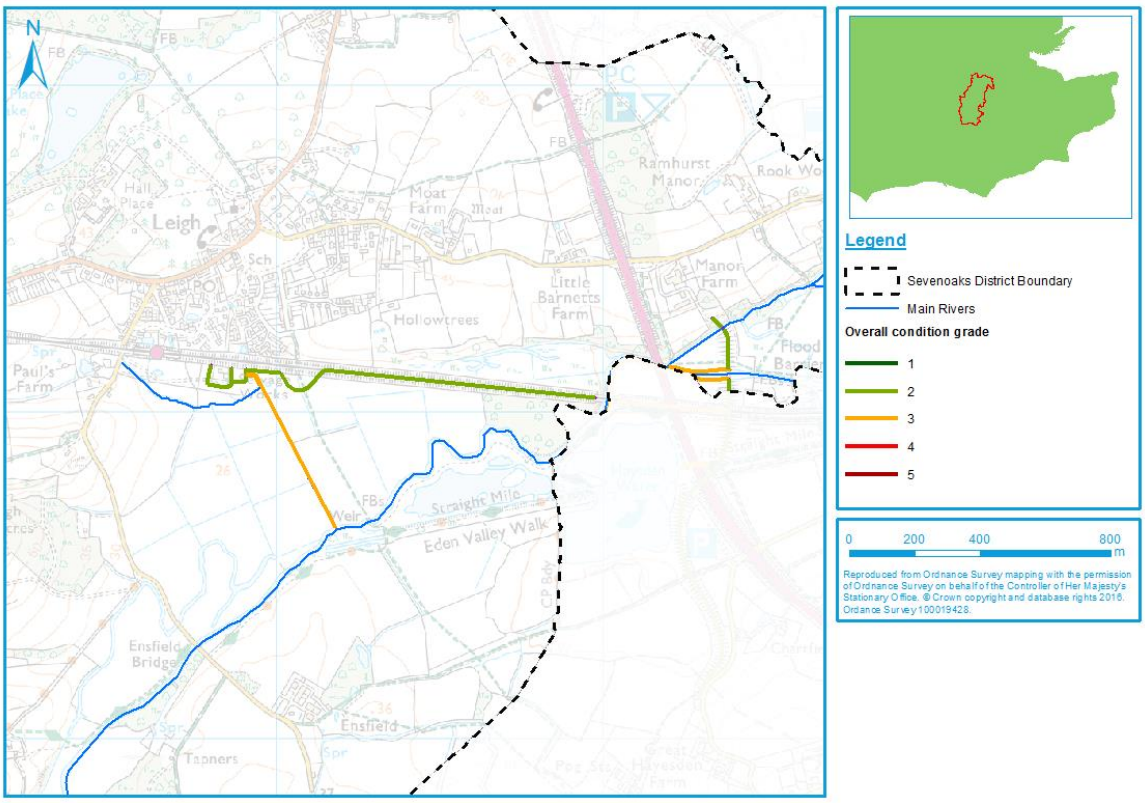
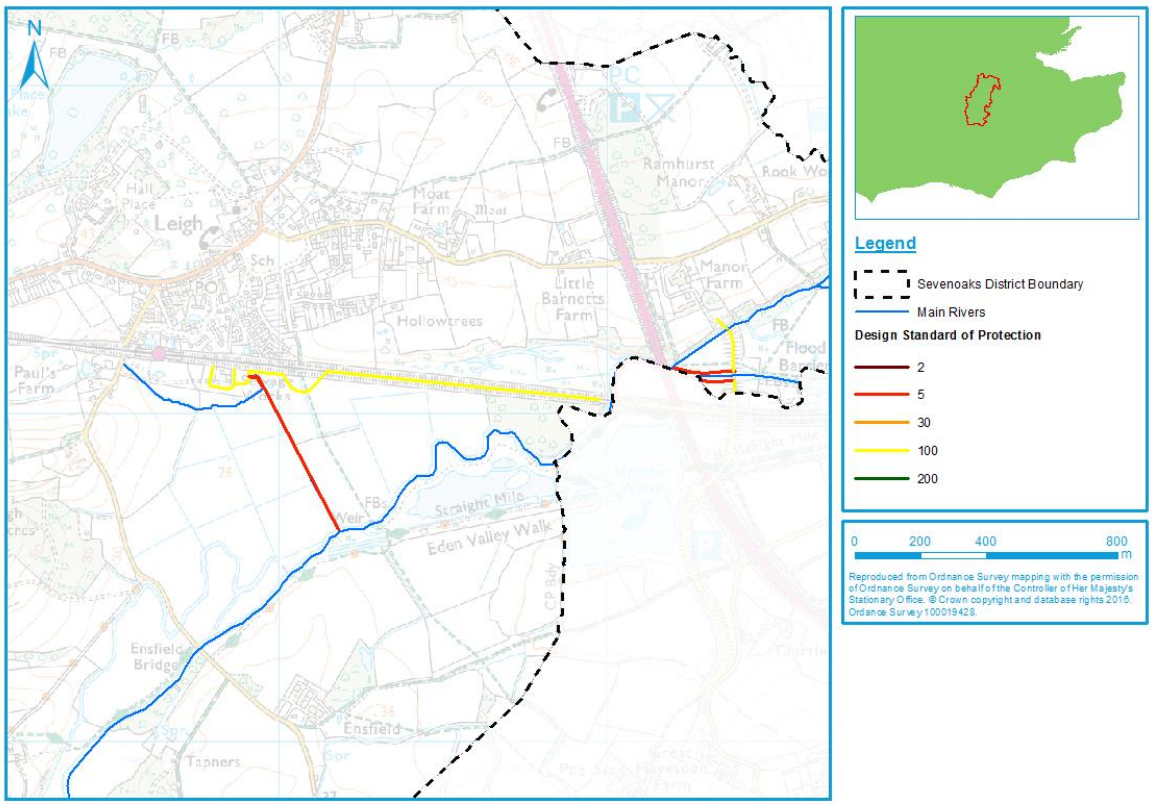


Figure 6-9: Design Standard of Protection for defences within Leigh



6.3.2 Leigh Flood Storage Area

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

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

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[69]. Since the event, a partnership has formed between the EA, KCC, Sevenoaks and Tonbridge and Malling Borough Council to bring forward plans to increase the capacity of the Leigh FSA.

Proposed plans involve raising the crest height of the Leigh Flood Storage Area by 1m to increase the storage provided by the FSA by as much as 30%[7071]. This will 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[72]. It is anticipated that preliminary works will commence in 2018 with the aim to complete the main construction by 2022[73].

6.4 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[74]. The full programme lists all FCERM projects that are planned to take place over the next six years since April 2015 across the UK.

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

- Construction programme – includes projects that are already in construction, fully funded projects that are due to start construction in the coming financial year, or projects scheduled to start construction in the coming financial year subject to securing other funding contributions;
- Development programme – includes projects in development with full funding packages agreed and expected to start construction in future year subject to approval of a full business case, or projects in development that are expected to start construction in future years subject to approval of a full business case and securing other funding contributions;
- Pipeline programme – includes projects proposals that are likely to qualify for some government funding before 2021 and have been given an indicative allocation. However,

[69] Kent County Council Flood Risk to Communities – Tonbridge and Malling (2016)

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

[71] Environment Agency, (May, 2012), Policy paper: Leigh flood storage area

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

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

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

they have not yet identified sufficient contributions and/or do not have a sufficiently well-Developed case to enter the development programme at this stage.

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

6.4.1 Edenbridge Flood Alleviation Scheme

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

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

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

6.4.2 Upper Westerham Flood Alleviation Scheme

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

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

The scheme is expected to provide a better level of protection from flooding to a total of 40 properties in Upper Westerham, and the earliest date for construction to commence is between 2016 and 2018 subject to the approval of a full business case[81].

6.4.3 Shoreham Structures Scheme

In order to reduce the risk of fluvial flooding from the River Darent, the Shoreham Structures Scheme has been proposed, whereby a hydraulic modelling study and possible removal of the structures (weirs) along the River Darent in Shoreham will be undertaken[82].

The hydraulic modelling study primarily aims to identify flows, flood water levels and possible flood management options for Shoreham. Once the model has been produced, further testing into flood improvements and prevention can be carried out for local properties and the surrounding area. Given that it is unclear if the weirs along the river currently serve a purpose, the study will also be able to determine if there is any benefit from removing them in this area[83].

[75] Sevenoaks District Council, (July, 2013), Draft Community Infrastructure Levy: Infrastructure Plan
[76] Kent County Council, (January 2015), Environment & Transport Cabinet Committee Meeting: Costal and river flood defence investment (Appendix 1 – Full list of Kent flood defence schemes not yet started)
[77] Kent County Council, (January 2015), Environment & Transport Cabinet Committee Meeting: Costal and river flood defence investment (Appendix 1 – Full list of Kent flood defence schemes not yet started)
[78] Environment Agency, (July, 2016), Programme of flood and coastal erosion risk management schemes
[79] Kent County Council, (January 2015), Environment & Transport Cabinet Committee Meeting: Costal and river flood defence investment (Appendix 1 – Full list of Kent flood defence schemes not yet started)
[80] Kent County Council, (January 2015), Environment & Transport Cabinet Committee Meeting: Costal and river flood defence investment (Appendix 1 – Full list of Kent flood defence schemes not yet started)
[81] Environment Agency, (July, 2016), Programme of flood and coastal erosion risk management schemes
[82] Southern Regional Flood and Coastal Committee, (April 2016), Main Committee Meeting (Appendix 1 – Refreshed 6 year programme)
[83] Shoreham Parish Council, (April 2016), Shoreham Parish Council Minutes for 6 April 2016 (pages 1 to 4).

Although funding is in place to prepare the hydraulic model, it is unclear when the hydraulic modelling study will begin and how many properties will be provided with a better level of protection from flooding.

6.5 Potential flood management schemes

Section 6.3 reports on current flood risk management infrastructure within the district which contributes to reduce flood risk. In addition to these, the Environment Agency are considering additional flood risk management measures. However, it is uncertain whether and these will proceed. When considering proposed development, the most recent developments in such schemes should be determined to understand whether a proposed development may benefit from, hinder, adjust or facilitate the development of such schemes.

7 FRA requirements and guidance for developers

7.1 Over-arching principles

This SFRA focuses on delivering a strategic assessment of flood risk within Sevenoaks District. To support planning applications and prior to any construction or development, site-specific assessments will need to be undertaken so all forms of flood risk at a site are fully addressed. In addition, at some sites the FRA must include evidence that demonstrates the proposals satisfy the Sequential and Exception Tests in accordance with the NPPF requirements (the Sequential Test must be performed for sites not 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 with an application.

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.

7.2 Requirements for flood risk assessments

Principal aims of an FRA are to demonstrate that the development is protected to the 1 in 100-year fluvial flood scenario and is safe during the design flood event, including an allowance for climate change. This includes assessment of mitigation measures required to safely manage flood risk. Development proposals requiring FRAs should:

- be performed in accordance with the requirements of the Sequential and, when necessary, Exception Tests;
- not increase flood risk, either upstream or downstream, of the site, taking into account the impacts of **climate change**;
- seek to not increase surface water volumes or peak flow rates to those above the level permitted by Kent County Council, Southern Water and Thames Water, which would result in increased flood risk to the receiving catchments (the permissible rates should be agreed with the relevant authorities);
- use opportunities provided by new development to, where practicable, reduce flood risk within the site and elsewhere;
- ensure that where development is necessary in areas of flood risk (after application of Sequential and Exception Tests), provisions are made so it is safe from flooding for the lifetime of the development, taking into account the impact of climate change; and
- consider all sources of flood risk.

FRAs for sites located in the Sevenoaks area should follow the approach recommended by the NPPF (and associated guidance) and guidance provided by the Environment Agency and Kent County Council. In circumstances where FRA's are prepared for windfall sites then they should include evidence that demonstrates the proposals are in accordance with the policies described in the Local Plan and satisfy the Sequential Test.

There may be instances where flood risk management measures are not necessary now but may be in the future. If it is not appropriate to include full provision for climate change effects within the proposals at the time of implementation of new development consideration can be given to a 'managed adaptive approach', e.g. setting the development away from a river so it is easier to improve flood defences in the future. If a managed adaptive approach is proposed the evidence submitted must describe how the necessary future commitment is secured for the investment required. The Environment Agency will consider whether an FRA has incorporated a management adaptive approach for planning applications[84] .

[84] https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

7.3 Mitigation measures

Mitigation measures should be seen as a last resort to address flood risk issues. Consideration should first be given avoiding and reducing risk by planning sequentially across a site. Once risk has been minimised as far as possible, only then should mitigation measures be considered.

Often the determining factor in deciding whether a particular development is appropriate is 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. When deciding on land allocation in the Local Plan the evidence in the SFRA should enable broad assumptions to be made regarding the feasibility of flood risk mitigation to highlight sites with greater development potential. The identification of measures that not only provide an appropriate standard of protection to new development, but also reduce the risk to existing communities will be an important consideration. Reference should be made to Section 6 of the SFRA so that proposals complement the strategic arrangements for managing flood risk and that proposed development does not compromise the feasibility of practical implementation of modifications to flood risk management measures, as might be necessary to address climate change effects to existing communities.

Attention must also be paid to the provision of safe access and egress during flood events, 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 (refer to section 9).

There should not normally be any obstruction of flood flows or loss of flood storage as a result of proposed development. Flood storage compensation may be appropriate for sites on the edge of the existing floodplain or within a flood cell. If proposed development does present an obstruction, then the effects on adjacent land should be evaluated and if necessary appropriate mitigation measures included.

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. In these instances, the development is likely to be subject to an objection by the Environment Agency, the Local Authority or the Lead Local Flood Authority.

The minimum acceptable standard of protection against flooding for new residential property within flood risk areas is the 1 in 100 annual probability event for fluvial flooding and 1 in 100 annual probability event for surface water flooding. Developments susceptible to flood risk resulting from blockage or exceedance of structures should be protected beyond the 1 in 100 annual probability event plus an allowance for climate change. An allowance for climate change over the lifetime of the development must be made when assessing each of these scenarios. The **latest guidance for climate change** requires allowance to be made for peak flow for different river basin districts (in the case of watercourses within Sevenoaks District, the Thames River Basin District). Developers should refer to the latest climate change guidance when designing a site. The measures chosen will depend on the nature of the flood risk and the vulnerability of the development.

7.4 Reducing flood risk

7.4.1 Site layout and design

Flood risk should be considered at an early stage in deciding the layout and design of a site to provide an opportunity to reduce flood risk within the development.

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.

7.4.2 Raised floor levels

The raising of floor levels within a development avoids damage occurring to the interior, furnishings and electrics in times of flood. If it has been agreed with the Environment Agency that, in a particular instance, the raising of floor levels is acceptable, the development should be raised to a minimum of 600mm above the maximum water level caused by a 1 in 100 annual probability fluvial flood event including an appropriate allowance for climate change plus an appropriate allowance for climate change[85]. However, if raised floor levels are proposed these should be agreed with Sevenoaks District Council. The minimum Finished Floor Level (FFL) may change depended on the vulnerability and flood risk of the development. Reference to the **latest climate change guidance** will be made when considering the FFL.

The additional height that the floor level is raised above the predicted flood water level is referred to as the "freeboard". Additional freeboard may be required to account for risks such as blockages to the channel, culvert or bridge, uncertainty in the predictions and should be considered as part of an FRA.

Many areas currently situated within Flood Zone 2 may become part of Flood Zone 3a in the future due to the effects of climate change. Therefore, it is essential that the potential risk of flooding in the future is considered when planning development.

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

- shops;
- restaurants, cafes and hot food takeaways;
- parking associated with the proposed development

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 would still be an issue, particularly when flood duration covers many days. All sleeping accommodation in Flood Zone 2 and 3a should be located above the recommended flood level. No sleeping accommodation should be located in Flood Zone 3b.

Similarly, the use of basements should be avoided in Zone 2 and Zone 3 or in areas where flood risk from other sources could result in rapid inundation. Under the NPPF, habitable uses of basements within Flood Zone 3 should not normally be permitted, whilst basement dwellings in Flood Zone 2 will be required to pass the Exception Test.

7.4.3 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. 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. Consideration should also be given to the residual risk if the defences fail or are overtopped during an event that exceeds the design capacity. Breach and overtopping assessments should not only consider the residual risks to the occupants of new development but should also address the ability of proposed structures to withstand the dynamic and hydrostatic loadings associated with a breach event.

Temporary or demountable defences are not normally 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.

[85] Environment Agency (2012): Flood risk assessment: standing advice. Available: https://www.gov.uk/guidance/flood-risk-assessment-standing-advice

7.4.4 Modification of ground levels

Modifying ground levels to raise the land above the required flood level is an effective way of reducing flood risk to a particular site in circumstances where the land does not act as conveyance for flood waters. However, care must be taken at locations where the effect on flood flows and volumes as a consequence of raising ground levels could adversely affect existing communities and property.

In most areas of fluvial flood risk, raising land above the floodplain would reduce conveyance or flood storage and could worsen flood risk downstream or on neighbouring land. Compensatory flood storage should be provided, and would normally be on a level for level, volume for volume basis on land that does not currently flood but is adjacent to the floodplain (in order for it to fill and drain). It should normally be in the vicinity of the site and within the red line of the planning application boundary (unless the site is strategically allocated).

Raising ground levels can also deflect flood flows, so analyses should be performed to demonstrate that there are no adverse effects on third party land or property. Raising levels can also create areas where surface water might pond during significant rainfall events. Any proposals to raise ground levels should be tested to ensure it would not cause increased ponding or build-up of surface runoff on third party land.

Any proposal for modification of ground levels will need to be assessed as part of a detailed FRA.

7.4.5 Developer contributions

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

Operating authorities can make requests for contributions to activities including flood risk management schemes through DEFRA's Flood and Coastal Risk Management Grant in Aid (FCRMGiA)[86]. 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 FCRMGiA and the shortfall in funds has to be found from elsewhere. For example, local levy funding, local businesses or other parties benefitting from the scheme or contributions from developers or other parties that benefit from the provisions.

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

However, the provision of funding by a developer for the cost of the necessary standard of protection from flooding or coastal erosion does not mean the development is appropriate as other policy aims must also be met. Funding from developers should be explored prior to the granting of planning permission and in partnership with the local planning authority and the Environment Agency.

The Environment Agency is committed to working in partnership with developers to reduce flood risk. Where assets are in need of improvement or a scheme can be implemented to reduce flood risk, the Environment Agency request that developers contact them to discuss potential solutions.

7.4.6 Resilience measures

There may be instances where flood risk to a development remains despite implementation of such planning measures as those outlined in this chapter. 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 from larger flood events. 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. Most of the

[86] Principles for implementing flood and coastal resilience funding partnerships (Environment Agency, 2012)

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 sand bags. They are often deployed with small scale pumping equipment to control the flood water that does seep through these systems. The following 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.

Wet-proofing

Interior design measures to reduce damage caused by flooding. For example:

- Electrical circuitry installed at a higher level with power cables being carried down from the ceiling rather than up from the floor level
- Water-resistant materials for floors, walls and fixtures
- Non-return valves to prevent waste water from being forced up bathrooms, kitchens or lavatories
- If redeveloping existing basements for non-residential purposes, new electrical circuitry installed at a higher level with power cables being carried down from the ceiling rather than up from the floor level to minimise damage if the development floods

Resilience measures will be specific to the nature of flood risk, and as such will be informed and determined by the FRA.

Community resilience measures

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

Emergency planning

Safe access and egress from the site should be provided to reduce the residual risks to a development. The developer should seek to incorporate an emergency plan and a safe refuge point if the development site has been identified to be at risk of flooding. The local authority and Emergency Services should be consulted when designing an emergency plan. For further details on emergency planning, see section 9.

7.5 Making Space for water

The NPPF sets out a clear policy aim in Flood Zone 3 to create space for flooding by restoring functional floodplain.

All new development close to rivers should consider the opportunity presented to improve and enhance the river environment. Developments should, where possible, encompass opportunities for river restoration and enhancement as part of the development. Options include backwater creation, de-silting, in-channel habitat enhancement and removal of structures. 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.

Consideration for making space for water should also be applied to surface water generated by impermeable surfaces. All new developments should aim to incorporate SuDS to minimise the amount of surface water that is generated. Through a sequential design, known areas of flood risk from surface water can be set aside as open space to ensure flow routes are not blocked,

preventing water from building up to potentially dangerous depths. The provision of SuDS also allows water related features to become part of the landscape, offering improved aesthetics to a development and removing the need for underground storage or culverting.

7.6 Reducing flood risk from other sources

7.6.1 Groundwater

Groundwater flooding has a very different flood mechanism to flooding from other sources and for this reason many conventional flood defence and mitigation methods are not suitable. The only way practicable to fully reduce flood risk is through building design (development form), so that floor levels are raised above flood water levels e.g. the water levels caused by a 1 in 100 annual probability plus climate change event. Site design would also need to preserve any flow routes followed by the groundwater overland so flood risk is not increased downstream or on adjacent land.

Infiltration SuDS can cause increased groundwater levels and subsequently may increase flood risk on or off of 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.

7.6.2 Surface water and sewer flooding

Developers should discuss public sewerage capacity with the water utility company at the earliest possible stage, and determine whether there is a requirement to improve the drainage infrastructure to reduce flood risk on site and regionally. 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. Since most drainage collection and conveyance systems are designed to meet specified thresholds it is important to evaluate how systems will perform when these criteria are exceeded and confirm that new development is safe and flood risk is not exacerbated downstream or on adjacent land. Wherever appropriate the site should be designed so that these exceedance 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. Non-return valves can be installed within gravity sewers or drains within a property's private sewer upstream of the public sewerage system. These need to be carefully installed and must be regularly maintained. Consideration must also be given to attenuation and flow ensuring that flows during the 100 annual probability plus climate change storm event are retained within the site if any flap valves shut. This must be demonstrated with suitable modelling techniques.

7.6.3 Sustainable Drainage Systems

Sustainable Drainage Systems (SuDS) aim to mimic the natural processes of greenfield surface water drainage by encouraging water to flow along natural flow routes and thereby reduce runoff rates and volumes during storm events while providing some water treatment benefits. SuDS also have the advantage of providing effective blue and green infrastructure and ecological and public amenity benefits when designed and maintained properly.

The inclusion of SuDS within developments should be seen as an opportunity to enhance ecological and amenity value, and promote Green Infrastructure, incorporating above ground facilities into the development landscape strategy. SuDS must be considered at the outset, during preparation of the initial site conceptual layout to ensure that enough land is given to design spaces that will be an asset to the development rather than an after-thought. Advice on best practice is available from the Environment Agency and the Construction Industry Research and Information Association (CIRIA). More detailed guidance on the use of SuDS is providing in Section **8.4**.

8 Surface water management and SuDS

8.1 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[87]. Surface water flooding describes flooding from sewers, drains, and ditches that occurs during heavy rainfall in urban areas.

Surface water flooding includes

- **pluvial flooding:** flooding as a result of high intensity rainfall when water is ponding or flowing over the ground surface (overland surface runoff) before it either enters the underground drainage network or watercourse or cannot enter it because the network is full to capacity;
- **sewer flooding:** flooding that occurs when the capacity of underground water conveyance systems is exceeded, resulting in flooding inside and outside of buildings. Normal discharge of sewers and drains through outfalls may be impeded by high water levels in receiving waters which may cause water to back up and flood on the urban surface. Sewer flooding can also arise from operational issues such as blockages or collapses of parts of the sewer network; and
- **overland flows entering the built-up area from the rural/urban fringe:** includes overland flows originating from groundwater springs.

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

From April 2015 local planning policies and decisions on planning applications relating to major development or major commercial development should make provision for sustainable drainage systems to manage run-off, where major development is 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; and
- 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 LLFA will also provide advice on minor development on a non-statutory basis).

The Local Planning Authority must satisfy themselves that clear arrangements are in place for future maintenance of the management 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 technical standards and should take into account design and construction costs.

It is essential that the consideration of sustainable drainage takes place at an early stage of the development process – ideally at the master-planning stage. This will assist with the delivery of well designed, appropriate and effective SuDS. Proposals should also comply with the key SuDS principles regarding 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 rate with due consideration for climate change via a micro-catchment based approach
- **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

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

- **Amenity/Biodiversity:** should be incorporated within “open space” or “green corridors” within the site and designed with a view to performing a multifunctional purpose

Kent County Council and Sevenoaks District Council will:

- promote the use of SuDS for the management of run off;
- ensure their policies and decisions on applications support and complement the Building Regulations on sustainable rainwater drainage, giving priority to infiltration over watercourses and then sewer conveyance;
- incorporate locally distinctive favourable policies within development plans, where appropriate;
- adopt locally distinctive policies for incorporating SuDS requirements into Local Plans, where appropriate;
- encourage developers to utilise SuDS whenever practical, if necessary, through the use of appropriate planning conditions; and
- develop joint strategies with sewerage undertakers to further encourage the use of SuDS.

8.3 Level 1 and 2 Assessment of Surface Water Flood Risk

In assessing the surface water flood risk across Sevenoaks District, the Environment Agency’s updated Flood Map for Surface Water (uFMfSW) has been used (Appendix E). These maps are intended to provide a consistent standard of assessment for surface water flood risk across England and Wales in order to help LLFAs, the Environment Agency and any potential developers to focus their management of surface water flood risk.

The uFMfSW 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 8-1).

Table 8-1: uFMfSW risk categories

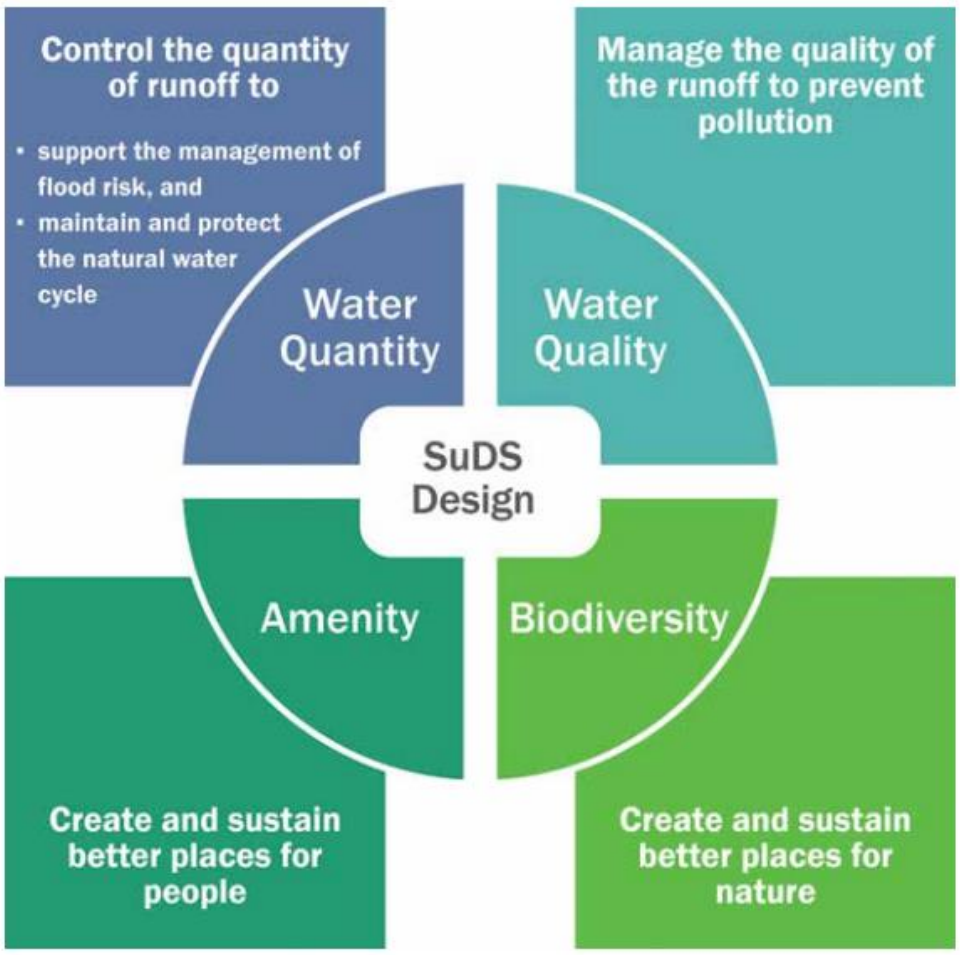
Category	Definition
High	Flooding occurring as a result of rainfall with a greater than 1 in 30 chance in any given year (annual probability of flooding 3.3%)
Medium	Flooding occurring as a result of rainfall of between 1 in 100 (1%) and 1 in 30 (3.3%) chance in any given year.
Low	Flooding occurring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

Although the uFMfSW offers improvement on previously available datasets, the results should not be used to understand flood risk for individual properties. The results should be used for high level assessments such as SFRAs for local authorities. If a particular site is indicated in the Environment Agency mapping to be at risk from surface water flooding, a more detailed assessment should be considered to more accurately illustrate the flood risk at a site-specific scale. Such an assessment will use the uFMfSW in partnership with other sources of local flooding information to confirm the presence of a surface water risk at that particular location. This may include information within other strategy documents, such as the Kent Local Flood Risk Management Strategy (see section 2.2.5) and the Sevenoaks Stage 1 SWMP (see section 2.4). It will be important for this to consider the potential impacts of climate change. Guidance relating to climate change allowances is made in section 5.8.

8.4 Sustainable Drainage Systems (SuDS)

Sustainable Drainage Systems (SuDS) are water management practices which aim to enable surface water to be drained in a way that mimics (as closely as possible) the run-off and drainage prior to site development. The primary benefits of SuDS can be categorised under four distinct themes. These are highlighted in Figure 8-1 and are referred to as the four pillars of SuDS design.

Figure 8-1: Four pillars of SuDS design



Source: The SuDS Manual C753 (2015)

There are a number of ways in which SuDS can be designed to meet surface water quantity, 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.

The inclusion of SuDS within developments should also be seen as an opportunity to enhance ecological and amenity value as well as promote Green Infrastructure by incorporating above ground facilities into the landscape development strategy. 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 trains to work effectively the 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.

Where practicable, 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 is carefully and clearly

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

8.5 Types of SuDS Systems

There are many different SuDS techniques that can be implemented in attempts to mimic pre-development drainage (Table 8-2). 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).

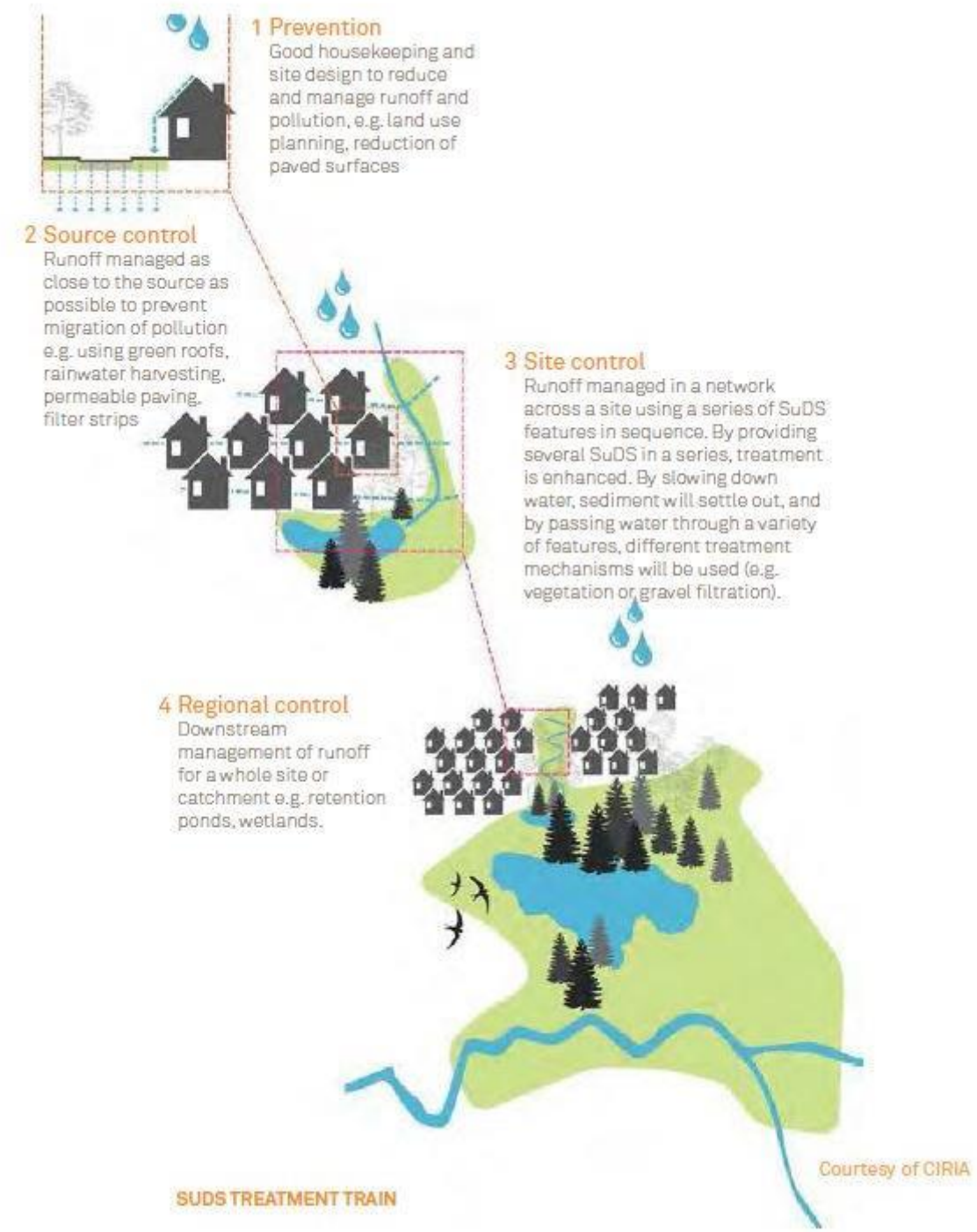
Table 8-2: Examples of SuDS techniques and potential benefits

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

8.5.1 SuDS Treatment Train

SuDS should not be used individually but as an interconnected system, designed to capture water at the source and convey it to a discharge location. This system is described as a SuDS Treatment Train (Figure 8-2). 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, minimise the pollutants which may be generated by a development, and tailor surface water management to the local context.

Figure 8-2: SuDS Management Train



Source: Water. People. Places: A guide for master planning sustainable drainage into developments (2013)

8.5.2 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 Treatment Train. To maximise the treatment within SuDS, CIRIA recommends the following good practice guide is implemented in the treatment process:

1. **Manage surface water runoff close to source**: This makes treatment easier due to the slower velocities and also helps isolate incidents rather than transport pollutants over a large area.
2. **Treat surface water runoff on the surface**: This allows treatment to be delivered by vegetation and the sources of pollution to be more easily identified. It also helps with future maintenance work and identifying damaged or failed components of the treatment train.
3. **Treat a range of contaminants**: SuDS should be chosen and designed to deal with the likely contaminants that may pose a risk to the receiving environment and be able to reduce them to acceptably low levels.
4. **Minimise the risk of sediment remobilisation**: SuDS should be designed to prevent sediments being washed into receiving water bodies or systems during events greater than those for which the component may have been specifically designed.
5. **Minimise the impact of a spill**: Designing SuDS to be able to trap spills close to the course, facilitate contamination management and removal. The selected SuDS should also provide robust treatment along several components in series.

The number of treatment stages required depends primarily on the source of the runoff. The C753 SuDS Manual advises a simple index approach to determining the number of treatment stages. 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.

8.6 Kent SuDS Guidance

Information and guidance regarding SuDS design and implementation is available from a number of sources published by Kent County Council.

8.6.1 Water. People. Places: A guide for master planning sustainable drainage into developments[88]

The guide for master planning sustainable drainage into developments was published in 2013 by the LLFAs of the South East of England, of which Kent County Council is a part of, to outline the process for integrating SuDS into the master planning of large and small developments. The South East LLFAs expect this guidance to be used as part of the initial planning and design plans for all types of residential, commercial and industrial development. The guidance complements existing guidance on SuDS design, maintenance and operation which should also be used to inform detailed design and delivery of SuDS.

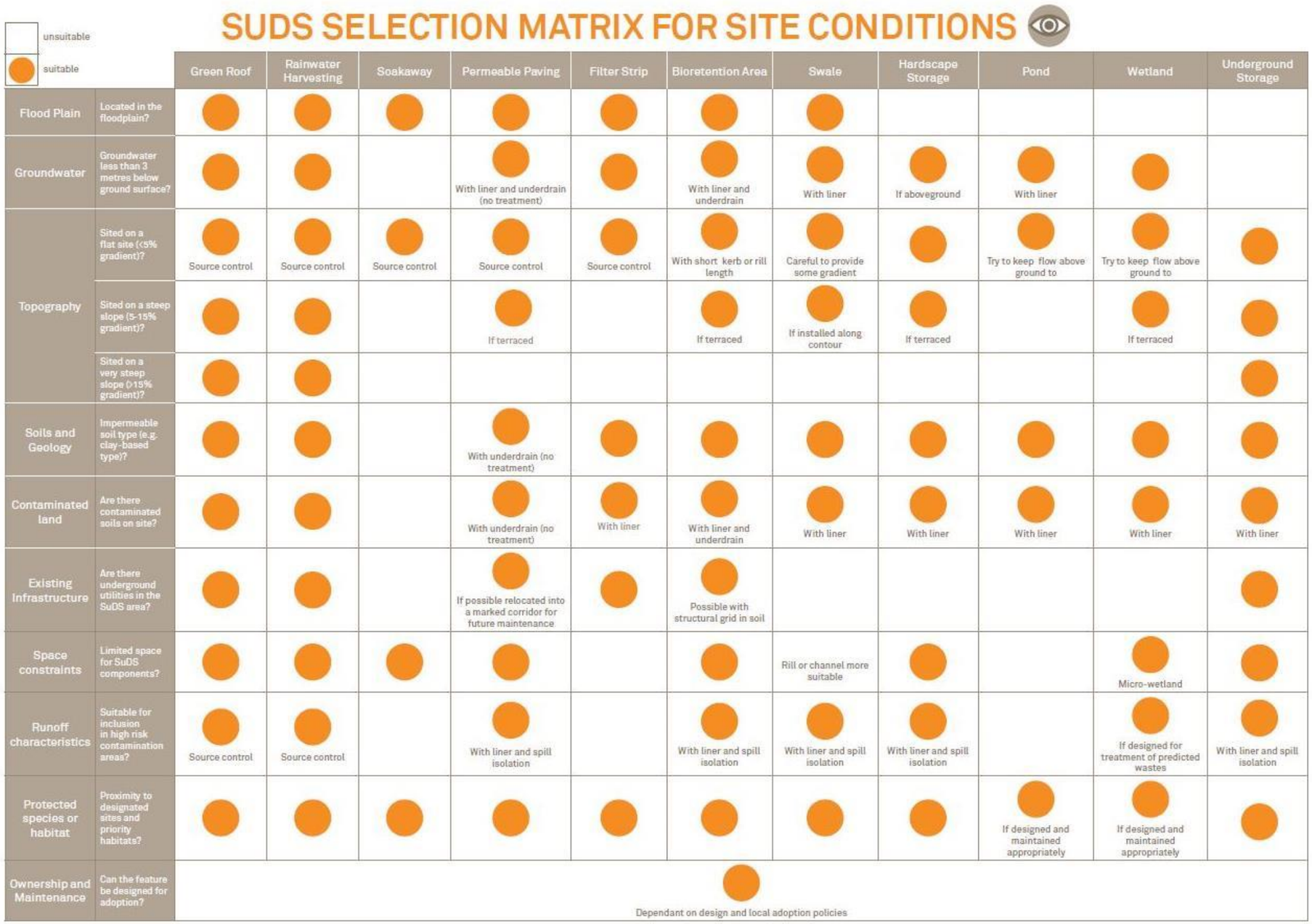
Although SuDS can be applied to any site, there are a variety of conditions and constraints that could restrict the suitability of different types of SuDS or trigger the need for bespoke design. Therefore, consideration of the movement of water and its interaction with site-specific conditions (e.g. soil types) at the earliest stage of design is crucial to the success of a SuDS scheme.

Section 4 of the 'Water. People. Places' document provides detailed SuDS design guidance for a range of commonly encountered site conditions. A summary of this guidance is provided in the SuDS Selection Matrix (Figure 8-3), whereby the suitability of each type of SuDS is presented for each common site condition.

It is noted in the guidance document that SuDS design should be fully integrated into a master plan as an essential part of land use and development planning, and considered in conjunction with other aspects of the design. Although there is no formal process for master planning, a typical design process for SuDS is outlined in Sections 5 and 6 of the guidance document. The process is designed to allow planners and designers to scope and embed opportunities for SuDS as land use and design ideas evolve.

[88] Water. People. Places: A guide for master planning sustainable drainage into developments. Prepared by the Lead Local Flood Authorities of the South East of England (AECOM, 2013)

Figure 8-3: SuDS selection matrix for site conditions



Extract from the SuDS guidance document prepared by the Lead Local Flood Authorities of the South East of England: Water. People. Places: A guide for master planning sustainable drainage into developments.

8.6.2 Sevenoaks Stage 1 SWMP

Kent County Council state that the relevant SWMPs should also be referred to during the formulation of a SuDS scheme for a site. In this case SuDS developers should refer to the guidance provided in the Sevenoaks Stage 1 SWMP. The document provides advice regarding the feasibility of SuDS across Sevenoaks District.

Again, it is noted that the choice of SuDS is site-specific, depending on the nature of the proposed development and local conditions. Sevenoaks District is underlain by several different geologies, meaning that areas which are underlain by low permeability deposits may not be suitable for infiltration drainage. When considering infiltration options, Groundwater Source Protection Zones must also be considered. If discharge is proposed within a source protection zone, then additional information may be required to demonstrate that there is not an unacceptable risk to groundwater and the surrounding environment. Additional information and advice can be found on the **Environment Agency's Website** and within the 'Groundwater protection: Principles and practice (GP3)[89]' document.

The SWMP also states that new development should seek to incorporate SuDS to reduce surface water runoff where feasible and appropriate to the size and scale of development. The hierarchy of surface water disposal is as follows:

- The use of SuDS techniques, appropriate to the location, size and type of the development.
- Discharge to the watercourse.
- Discharge to a surface sewer.
- Discharge to a combined sewer.

8.6.3 Further information and guidance

Developers should also have regard for the documents developed to provide further information and guidance about SuDS and their implementation in new developments across the district. Such documents include:

- The Allocations and Development Management Plan (February, 2015)[90] – forms part of the Local Plan and includes policies to integrate Green Infrastructure and Sustainable Drainage System features into all new developments (see policies EN1, GI1 and GI2).
- The Kent Design Guide[91] - updates the Kent Design – A Guide to Sustainable Development' originally published in 2000 and assists designers to achieve high standards of design and construction by promoting a common approach to the main principles that underlie the criteria for assessing planning applications. The guide is also accompanied by a set of technical appendices that replace previous advice about the design of housing and industrial estates.
- The 'Making it Happen – Sustainability (Drainage Systems)'[92] document includes advice, guidance and information about the design and implementation of drainage systems, including SuDS for both residential and industrial developments.

Along with the guidance provided by the South East LLFAs and the Stage 1 SWMPs, development applications should have regard for and consider the above documents during the design and delivery of SuDS for all types of development.

8.7 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

[89] Groundwater protection: principles and practice (GP3), (Environment Agency, 2013).
[90] Allocations and Development Management Plan (Sevenoaks District Council, 2015).
[91] The Kent Design Guide (Kent County Council, 2005) Available: http://www.kent.gov.uk/about-the-council/strategies-and-policies/regeneration-policies/kent-design-guide#
[92] Making It Happen – Sustainability (Drainage Systems) (Kent County Council, 2007)

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.

8.8 Groundwater Source Protection Zones (GSPZ)

In addition to the Areas Susceptible to Ground Water Flooding (AStGWF) data, 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 GSPZ requires attenuated storage of runoff to prevent infiltration and contamination. The definition of each zone is noted 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.

8.8.1 GSPZs in Sevenoaks District

Unlike the southern half of the district, several GSPZs of varying size have been identified within the northern half of Sevenoaks District. As shown in Figure 8-4, the majority of these GSPZs are situated north of Sevenoaks Weald in the following areas:

- Walters Green Road
- Spring Hill Road
- Recreation Ground, Sevenoaks
- St John's and Greatness, Sevenoaks
- Honey Pot Lane and Watery Lane, Noah's Ark
- Cerne Easter, Westerham
- Pumping Station, Castle Farm Road, Eynsford
- Lullingstone Park, Eynsford
- Eynsford Station, Eynsford
- Sundridge (including the main A25 Road)
- Farningham (including the M20)
- Red Hill Wood, New Ash Green

- Hartley Hill, Hartley
- Fawkham Road, Longfield

Furthermore, the area surrounding Longford including a small section of M26 is characterised as a zone of special interest (Zone 4). This is the only zone of special interest located within Sevenoaks District.

8.9 Nitrate Vulnerable Zones

Nitrate Vulnerable Zones (NVZs) are areas designated are 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 50 mg/l level dictated by the EU Council's Surface Water Abstraction Directive (1975)[93] and Nitrates Directive (1991)[94].
- 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 level dictated by the EU Council's Surface Water Abstraction Directive (1975) and Nitrates 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.

There are two very small areas along the eastern boundary of the district near Fordcombe and Stone Street that are classed as surface water NVZs, one of which is also classed as a groundwater NVZ. A more extensive groundwater NVZ area is also located in the north-western section of the district, which covers Well Hill, Crockenhill, Swanley, Eynsford, South Darenth and the northern edge of Hartley. The locations of these NVZs are shown in Figure 8-5. No eutrophic NVZs areas have been identified within Sevenoaks District.

[93] The EU Council's Surface Water Abstraction Directive (Annex II, parameter 7*), June 1975
[94] The EU Council's Nitrates Directive (Annex I), December 1991

Figure 8-4: Groundwater Source Protection Zones

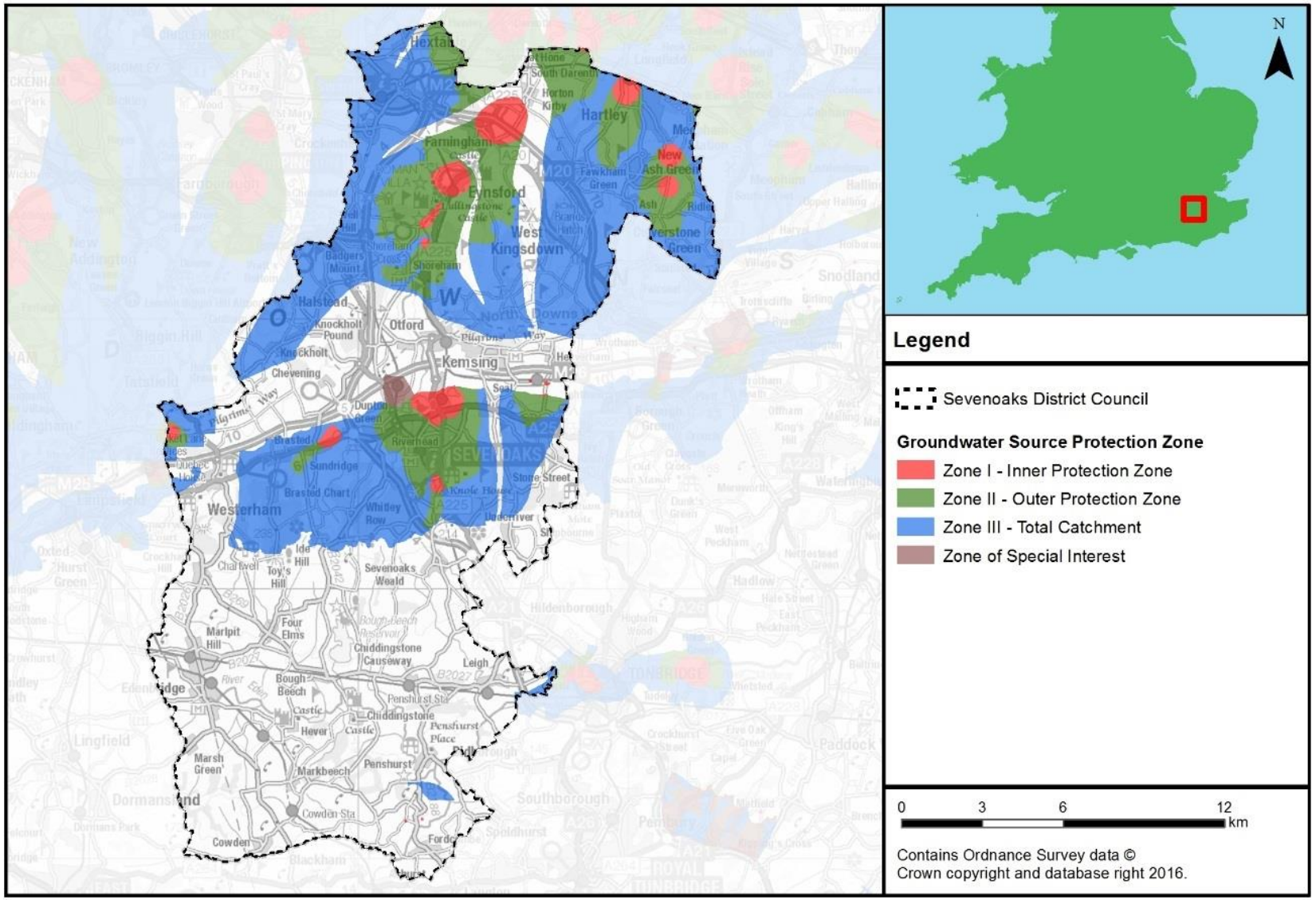
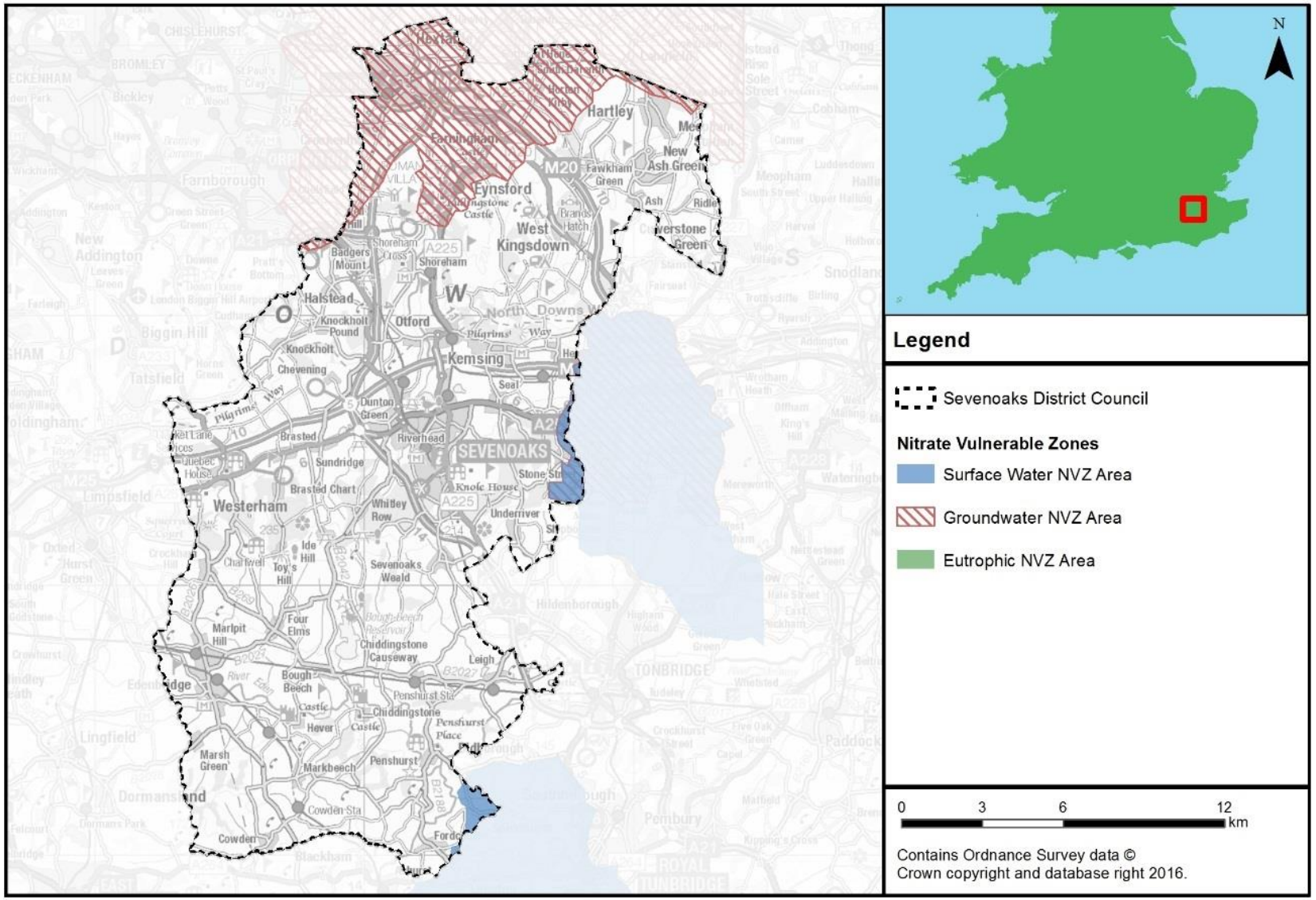


Figure 8-5: Nitrate Vulnerable Zones



9 Flood warning and emergency planning

9.1 Flood emergencies

The evidence used to prepare this SFRA report demonstrates that Sevenoaks District is affected by flood risk hazards and that particular communities are potentially vulnerable to flooding during events that exceed the design capacity of the defences, or from failure of those defences (residual risk)

Emergency planning is an option to help manage flood related incidents and is relevant in circumstances where there is a residual risk of flooding. Emergency planning is a core component of civil protection and public safety practices and seeks primarily to prevent, or secondly mitigate the risk to life, property, businesses, infrastructure and the environment. In the UK, emergency planning is performed under the direction of the 2004 Civil Contingencies Act (CCA).

From a flood risk perspective, emergency planning can be broadly split into three phases: before, during and after a flood. The measures involve developing and maintaining arrangements to reduce, control or mitigate the impact and consequences of flooding and to improve the ability of people and property to absorb, respond to and recover from flooding. In development planning, a number of these activities are already **integrated** in national building control and planning policies e.g. the NPPF.

Emergency planning and flood risk management links

- 2004 Civil Contingencies Act: **http://www.legislation.gov.uk/ukpga/2004/36/contents**
- DEFRA (2014) National Flood Emergency Framework for England: **https://www.gov.uk/government/publications/the-national-flood-emergency-framework-for-england**
- Government guidance for public safety and emergencies is available at: **https://www.gov.uk/topic/public-safety-emergencies/emergencies-**

Safety is a key consideration for any new development and includes the likely impacts of climate change and, where there is a residual risk of flooding, the availability of adequate flood warning systems for the development, safe access and egress routes and evacuation procedures. 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)[95] and for essential ancillary sleeping or residential accommodation for staff required by uses in this category [water-compatible development]. Flood warning and evacuation plans may also be referred to as an emergency flood plan or flood response plan.

9.2 Existing Flood Warning Systems

The Environment Agency is the lead organisation for providing warnings of fluvial flooding (for watercourses classed as Main Rivers) and coastal flooding in England. The Environment Agency supplies Flood Warnings via the Floodline Warnings Direct (FWD) service, to homes and business within Flood Zones 2 and 3, and this covers, fluvial, tidal and coastal flooding. Using the latest available technology, Environment Agency staff monitor rainfall, river levels and sea conditions 24 hours a day and use this information to forecast the possibility of flooding. If flooding is forecast, warnings are issued using a set of four easily recognisable codes, shown below in Table 9-1. Generic advice and examples on actions to be taken on receipt of the warning are shown in the column called “What to do”.

Flood warnings are disseminated to people registered to receive flood warnings via the FWD service using the following communication methods; phone, text and / or e-mail. Warnings may also be reported in news and weather bulletins. The Environment Agency have a Floodline number (0345 988 1188) and a quick-dial number specific to the Flood Warning Area, which the public can call to receive more detailed information regarding the flood warning.

It is the responsibility of individuals to sign-up this service, in order to receive the flood warnings via FWD. Registration and the service are free and publicly available. It is recommended that any

[95] NPPF Planning Practice Guidance: Flood Risk and Coastal Change (paragraph 056, Reference ID: 7-056-20140306) March 2014

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.

Sevenoaks District falls within the Kent and South London Environment Agency Areas.

Table 9-1: Environment Agency Flood Warnings Explained

Flood Warning Symbol	What it means	What to do
	**Flood Alerts** are used to warn people of the possibility of flooding and encourage them to be alert, stay vigilant and make early preparations. It is issued earlier than a flood warning, to give customers advice notice of the possibility of flooding, but before we are fully confident that flooding in Flood Warning Areas is expected.	✓ Be prepared to act on your flood plan ✓ Prepare a flood kit of essential items ✓ Monitor local water levels and the flood forecast on the Environment Agency website ✓ Stay tuned to local radio or TV ✓ Alert your neighbours ✓ Check pets and livestock ✓ Reconsider travel plans
	**Flood Warnings** warn people of expected flooding and encourage them to take action to protect themselves and their property.	✓ Move family, pets and valuables to a safe place ✓ Turn off gas, electricity and water supplies if safe to do so ✓ Seal up ventilation system if safe to do so ✓ Put flood protection equipment in place ✓ Be ready should you need to evacuate from your home ✓ 'Go In, Stay In, Tune In'
	**Severe Flood Warnings** warn people of expected severe flooding where there is a significant threat to life.	✓ Stay in a safe place with a means of escape ✓ Co-operate with the emergency services and local authorities ✓ Call 999 if you are in immediate danger
Warnings 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

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

9.2.2 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[96]. 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.

There are currently no national systems offering flood warnings for flooding from Ordinary Watercourses, surface water, sewer, road and drainage sources or reservoir / flood management infrastructure failure.

9.3 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 (see the "What to do" column in Table 9-1). 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 (see section 3.2.3 for further information on residual risk).

9.4 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[97]. 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.

9.4.1 Kent County Council Flood Response Plan

The **Kent County Council Flood Response Plan** (July 2015) sets out the principles that govern the Kent County Council's response to a significant flooding event within their local authority administrative area. The Plan was produced to meet the requirements of the Civil Contingencies Act 2004, and is built upon the existence and maintenance by Category 1 and 2 Responders of their own plans for response to flooding.

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

[96] Environment Agency (2014) Flood Warning Data Integrity Guide

[97] Kent County Council: Flood Risk to Communities Tonbridge and Malling (March 2016)

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

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

9.4.2 Sevenoaks District Council's Emergency Plan

Sevenoaks District Council have a modular Major Emergency Plan that is flexible to deal with any major emergency and has been developed in conjunction with the emergency services, the Kent Resilience Forum, the Environment Agency and town and parish councils[98].

Part 8.3 of the Major Emergency Plan comprises the Local Multi Agency Flood Plan[99]. This document sets out the principles that govern a multi-agency response to a significant flood in the Sevenoaks District Council administrative area. The main objective of the plan is to ensure a coordinated response to a flood that will protect life and well-being.

In a flooding emergency, Sevenoaks District Council have the following responsibilities:

- Work with Kent County Council, the police, fire and rescue services and the Environment Agency to co-ordinate a response during severe flooding;
- Set up welfare centres for people who are evacuated and unable to stay with family or friends, and to also arrange temporary housing.
- Support other Category 1 and 2 responders and provide resources (where required and in the remit of the local authority).
- Try and mount a reasonable flood defence response by making sandbags available at the locations of high risk.

Sandbags have been traditionally used to block doorways, drains and other openings to properties. Sandbags are not waterproof and will be unable to permanently prevent the ingress of water to an area protected by them. However, they are useful in diverting shallow flowing water that has somewhere else to go, or deflecting waves caused in shallow water by passing vehicles.

Although the provision of sandbags is not a statutory function of Sevenoaks District Council, the Council aims to support its residents during times of imminent flooding. Therefore, the Council have a specific approach to the provision of sandbags, how and where they will be delivered and the means of their disposal. This approach will help preserve sandbag stocks for emergency responses and aim to prevent people being flooded out of their properties.

It should be noted that in the heat of a flood emergency, the Council cannot guarantee that sandbags will be delivered in sufficient time or quantities to prevent/reduce damage to a property due to the limited stocks available[100].

The Environment Agency has produced a guidance document on how to use sandbags properly for flood protection, downloadable from their **website**.

Evacuation

If a decision is made to evacuate then the responsibility to lead the evacuation rests with the Police, with assistance from other agencies by door knocking at each property. Decisions to evacuate are not taken lightly and are based on information relating to public safety and expected ground conditions. The preference will always be to evacuate when it is deemed safest to do so, i.e. before water has reached or entered a property but is expected to do so.

Flood Wardens

Flood Wardens have been allocated to areas where flooding can be managed effectively. The Flood Wardens are local volunteers and are trained by the Kent Resilience Team. The role of a Flood Warden involves:

- Keeping an eye on the local watercourses.
- Use their own local knowledge to recognise and report flood risks.

[98] Sevenoaks District Council: Planning for emergencies – The Sevenoaks District Emergency Plan v11
[99] Sevenoaks District Council: Planning for emergencies – The Sevenoaks District Emergency Plan v11 – Part 8.3 Chapter 1 – local Multi Agency Flood Plan v11
[100] Sevenoaks District Council, (September, 2016), Sandbags

- Relay messages about potential flooding to others in the area they cover.
- Provide emergency services with important information in the event of a flood.

The role of a flood warden is primarily to observe and report, they should not place themselves in any danger, take responsibility for moving or protecting anyone's property, or clear ditches or culverts. To find out who your local Flood Warden is, or if you would like to volunteer to become a Flood Warden, then you should contact Sevenoaks District Council.

9.4.3 Parish Council Emergency Plans

Part 6.4 of the Major Emergency Plan for Sevenoaks District Council outlines the various town or parish council's resilience plans that may be deployed to assist in a broader emergency response. These plans are owned and administered by each town or parish council and may cover general arrangements to support the local community during a severe weather event, through to specific arrangements such as localised warning and informing. There are several 'Area Specific Flood Plans' in place across the district. The plans are currently in place for:

- Edenbridge
- Westerham
- Sevenoaks, Chipstead, Riverhead and Dunton Green
- South Darenth and Horton Kirby.

Each plan provides information on the available flood warning service within the area, what actions should be taken at different stages of a flood warning (area-specific thresholds and triggers), and evacuation and shelter information, such as specific rest centres[101].

9.4.4 Community Flood Plans

Edenbridge is also served by the Edenbridge Town Council Community Response Team which is managed by the Edenbridge Town Council Emergency Planning Committee. The team is available to provide support for welfare, resources and communications in an emergency such as a flood event[102].

In the event of an emergency, the Committee is authorised to act without waiting from any form of Council approval, in co-operation with, and under the broad guidance of Sevenoaks District Council and other emergency services. They have a Community Emergency Plan in place to help support such activities, as well as a small budget for a Private Business Radio network and packet radio capability, which is capable of reliable communities to Sevenoaks District Council at Argyll Road.

Following the flooding during Winter 2013/2014, the Environment Agency worked with authorities across Kent to train a new team of flood wardens to co-ordinate the responses to the risk of flooding across Kent[103].

Within Sevenoaks District, flood wardens and Community Flood Plans were specifically established for:

- Westerham
- Sundridge
- Chipstead
- Otford
- Shoreham
- Horton Kirby

[101] Sevenoaks District Council: Planning for emergencies – The Sevenoaks District Emergency Plan v11 – Part 6.4 – Community Plans
[102] Sevenoaks District Council: Planning for emergencies – The Sevenoaks District Emergency Plan v11 – Part 8.3 Section 2 Area Specific Flood Plans
[103] Kent Online, (August, 2014), Environment Agency trained new flood wardens for Sevenoaks, Tonbridge, Malling and Maidstone

- South Darenth

Sevenoaks District Council funded the equipment required by the flood wardens to establish and implement their Community Flood Plan. It is noted that the plans are regularly tested and practical exercises are carried out so that these remain safe and viable in the event of a flood.

9.5 Emergency planning and development

9.5.1 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 normally 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 guidance. For example, the NPPF classifies police, ambulance and fire stations and command centres that *are required* to be operational during flooding as Highly Vulnerable development, which is not permitted in Flood Zones 3a and 3b and only permitted in Flood Zone 2 providing the Exception Test is passed. Essential infrastructure located in Flood Zone 3a or 3b must be operational during a flood event to assist in the emergency evacuation process. All flood sources such as fluvial, surface, groundwater, sewers and artificial sources (such as canals and reservoirs) should be considered. In particular, sites for proposed development should be considered in relation to the areas of drainage critical problems highlighted in the Sevenoaks SWMP.

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

9.5.2 Safe access and egress

The NPPF Planning Practice Guidance outlines how developers can secure safe access and egress to and from development in order to demonstrate that development satisfies the second part of the Exception Test[104]. 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. In addition, vehicular access for emergency services to safely reach development in design flood conditions is normally required; and
- 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.

[104] NPPF Planning Practice Guidance: Flood Risk and Coastal Change (paragraph 039, Reference ID: 7-056-20140306) March 2014

9.5.3 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[105]

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 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[106]. 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 FRAs 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[107].

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 FRA to help develop appropriate emergency plans.

[105] NPPF Planning Practice Guidance: Flood Risk and Coastal Change (paragraph 057, Reference ID: 7-057-20140306) March 2014
[106] NPPF Planning Practice Guidance, Reducing the causes and impacts of flooding. Paragraph: 053 Reference ID: 7-053-20140306
[107] Environment Agency and DEFRA (2012) Flood Risk Assessment: Standing Advice: https://www.gov.uk/flood-risk-assessment-standing-advice

9.5.4 Flood warning and evacuation plans

Flood warning and evacuation plans are potential mitigation measure 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); and

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 a flood plan for individuals, communities and businesses (see text box for useful links).

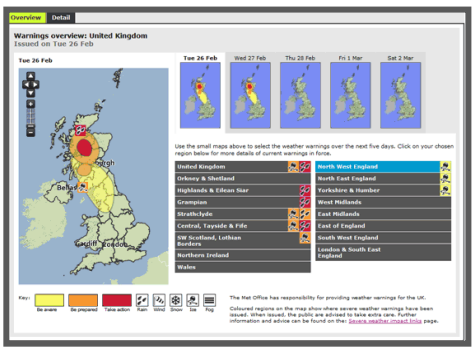
Guidance documents for preparation of flood response plans

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

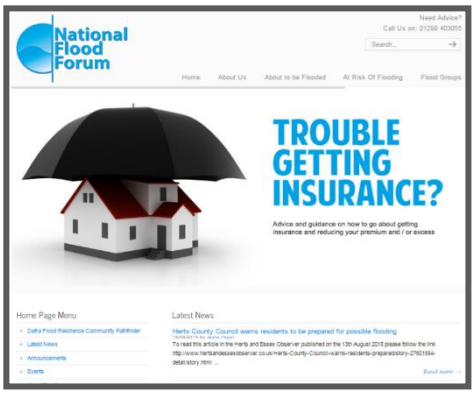
It is recommended that emergency planners at Sevenoaks District Council are consulted prior to the production of any emergency flood plan. The Council will provide guidance to help local communities to protect their home and valuables and understand what to do before, during and after a flood, as shown under Objective 5 of the Kent LFRMS. Once the emergency flood plan is prepared, it is recommended that it is distributed to emergency planners at Sevenoaks District Council and the emergency services. When developing a flood warning and evacuation plan, it is recommended that it links in with any existing parish / community level plan.

9.5.5 Other sources of information

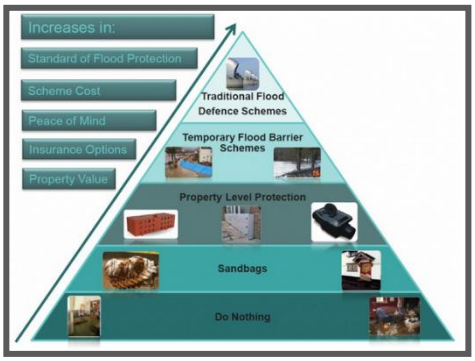
As well as being a **statutory consultee** for new development at risk of flooding, the Environment Agency can offer independent technical advice. The Environment Agency website contains a breadth of information on flood risk and there are numerous publications and guidance available. For example, the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



The Met Office provides a **National Severe Weather Warning Service** about rain, snow, wind, fog and ice. The severity of warning is dependent upon the combination of the **likelihood** of the event happening and the **impact** the conditions may have. In simplistic terms, the warnings mean: Yellow: Be Aware, Amber: Be Prepared, Red: Take Action. This service does not provide flood warnings. The Met Office provides 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.



Individual property-level protection (PLP) 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: "improve your property's flood protection"** for more information.

10 Strategic flood risk solutions

10.1 Introduction

Strategic flood risk solutions may offer potential opportunity to reduce flood risk in Sevenoaks District Council. As described in Section 2.5, the upper catchment of the River Medway where the Medway and Eden rise have been assigned policy option 3 under the River Medway CFMP, which means flood risk is being managed effectively. The implementation of strategic flood risk management schemes would potentially reduce the actual risk of flooding, but the flood zones would not be affected as these describe a scenario where no account is taken of the effect of the measures implemented (such as defences or flood storage areas).

However, several other areas of the district have been assigned policy options 5 and 6 under the River Medway CFMP and North Kent Rivers CFMP, meaning that further action can be taken to further reduce flood risk overall and/or provide environmental benefits. Of the preferred actions identified in the CFMPs, the following common actions are applicable to the preparation of strategic flood risk solutions in the district:

- Implement the outcomes of the Middle Medway Strategy to reduce the flood risk across the District (Further details of the Middle Medway Strategy are provided in section 10.1.1).
- Develop System Asset Management Plans (SAMPs) to review maintenance and operation regimes of current flood risk measures, maintain the current level of investment and assess potential future investment needs, and reduce the current level of flood risk across the district.
- Influence and further develop local emergency response plans.
- Work with LPAs to provide development control advice and influence spatial planning so that new developments are sited away from flood risk areas with no increase in run-off to the surrounding areas
- Ensure that flood resilience measures are taken up by those living on fluvial floodplains within the district.

More detailed strategic information on proposed strategic measures and approaches can be found in the Thames River Basin District Flood Risk Management Plan - Parts A, B, C and D[108].

10.1.1 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[109]. 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[110]. 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[111]. 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[112]. This includes the potential construction of a 5.6 million cubic meter flood storage scheme on the River Eden above Edenbridge[113]. The River Thames Flood

[108] Environment Agency, Thames River Basin District Flood Risk Management Plan 2015-2021 Part C (March 2016). Available: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/507148/LIT_10231_THAMES_FRMP_PART_C.pdf
[109] Environment Agency: Middle Medway Strategy Study for Flood Risk Management – Project Appraisal Report (2005)
[110] Environment Agency: Middle Medway Strategy Study for Flood Risk Management – Project Appraisal Report (2005)
[111] Environment Agency, River Medway Flood Storage Areas (FSAs) Project (2015). Available: https://www.gov.uk/government/publications/river-medway-flood-storage-areas-fsas-project/river-medway-flood-storage-areas-fsas-project
[112] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/293890/Medway_Catchment_Flood_Management_Plan.pdf
[113] Environment Agency: Middle Medway Strategy Study for Flood Risk Management – Project Appraisal Report (2005)

Risk Management Plan (2016)[114] also recommended implementing the schemes within the MMS to reduce the risk of flooding to communities were possible.

10.2 Flood defences

Formal flood defences are located in Edenbridge, Brasted and Leigh (see section 6.3 for details). A number of potential sites identified within the district could be influenced by the presence of these defences. At these locations it will be important to understand the benefit that defences can have on reducing flooding, and consequences if their design standard is exceeded or they fail.

Flood mitigation measures should only be considered if, after application of the Sequential Approach, development sites cannot be located away from higher risk areas. If defences are constructed to protect a development site, it will need to be demonstrated that the defences will not have a resulting negative impact on flood risk elsewhere, and that there is no net loss in floodplain storage.

10.3 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. Some flood storage schemes aim to detain this additional runoff brought about by development, releasing it downstream at a slower rate, to avoid any increase in flood depths and/or frequency downstream. Methods to provide these schemes include[115]:

- Enlarging the river channel
- Raising the riverbanks
- Constructing flood banks set back from the river
- Implementation of SuDS storage schemes

Flood storage schemes have the advantage that they generally benefit areas downstream, not just the local area. Benefits of a flood storage area may therefore cross local authority borders to those for instance further downstream along the River Medway.

The construction of new upstream storage schemes as part of upstream catchment-based approaches on watercourses in Sevenoaks District Council could provide one potential strategic solution to flood risk. Watercourses which are rural in their upper reaches but have high levels of flood risk to urban areas in the downstream reaches are potential candidates, as the open land in the upper reaches can potentially provide the space for an attenuation area, providing benefit to the urban area downstream.

Opportunities to work with natural processes to reduce flood and erosion risk, benefit the natural environment, and reduce cost of schemes should be sought. This requires integrated catchment management and involving those who use and shape the land. It also requires partnership working with neighbouring authorities, organisations and water management bodies.

Conventional flood prevention schemes listed above will likely still be preferred, but consideration of ‘re-wilding’ rivers upstream could provide cost efficiencies as well as considering multiple sources of flood risk; for example, through wider land management practices (e.g. woodland management, creation of upland wetlands and managed farming practices) or building earth banks to capture runoff, could be cheaper and smaller-scale measures than implementing flood walls for example. Again, this may require partnership working with neighbouring authorities and landowners. 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.

[114] Environment Agency, Thames River Basin District Flood Risk Management Plan 2015-2021 Part C (March 2016). Available: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/507148/LIT_10231_THAMES_FRMP_PART_C.pdf

[115] Environment Agency: Fluvial Design Guide – Chapter 10 (2010)

Possible locations for potential flood storage schemes have been identified by the MMS and the River Medway CFMP[116]. The report recommends that a feasibility study of storage options upstream of Edenbridge is undertaken in order to benefit both Edenbridge and Penshurst[117], but also elsewhere along the River Eden and River Medway.

Expansion of existing Leigh FSA could also decrease the flood risk in the district. The Environment Agency is currently planning to expand Leigh FSA, with work commencing in 2018[118]. Refer to section 6.5 for further information on other potential flood risk management schemes in the district.

10.3.1 Promotion of SuDS

Surface water flood risk is present across parts of the district. By considering SuDS at an early stage in the development of a site, the risk from surface water can be mitigated to a certain extent within the site as well as reduce the risk that the site poses to third party land. Regionally, SuDS should be promoted on all new developments to ensure the quantity and quality of surface water is dealt with sustainably to reduce flood risk. Given the detailed policies and guidance produced by the LLFA (summarised in section 8) Sevenoaks District Council should actively promote developers to use this information to produce technically proficient and sustainable drainage solutions.

10.4 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 could be considered:

- 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
- Removal of redundant structures to reconnect the river and the floodplain. There are a number of culverted sections of watercourse located throughout the district which if returned to a more natural state would potentially reduce flood risk to the local area
- Apply the Sequential Approach to avoid new development within currently undefended floodplain.

10.5 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 easier to distinguish. 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 appropriate solutions.

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

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

More information about riparian owner responsibilities can be found in the Environment Agency's publication **'Living on the Edge'** (2012).

[116] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/293890/Medway_Catchment_Flood_Management_Plan.pdf
[117] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/293890/Medway_Catchment_Flood_Management_Plan.pdf
[118] Kent County Council: Flood Risk to Communities Tonbridge and Malling (March 2016)

11 Development control recommendations

11.1 Overview

There are a number of policy considerations relating to flood risk management in Sevenoaks District Council, which are described in sections 2 and 8. This chapter sets out recommendations for considering and assessing flood risk in Sevenoaks District Council.

11.2 Development control policy

The following recommendations have been identified for flood risk policy for new development. The first recommendations are relevant to all development regardless of the Flood Zone they are in. The remaining recommendations are relevant to specific Flood Zones (note some policies are relevant to more than one flood zone and hence will have been repeated).

Recommendations relevant for development in all Flood Zones (1, 2, 3a, 3b)

- Where Flood Zones do not currently exist for smaller watercourses and drains (those with a catchment area less than 3km^2), the uFMfSW can give a broad indication of the potential flow path and flood extent from these watercourses. At the planning application stage, developers would be expected to undertake more detailed hydrological and hydraulic assessments of the watercourses to verify flood extents, inform development zoning within the site and prove, if required, whether the Sequential and Exception Tests can be satisfied. 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
- A FRA is required for all developments over 1ha and should be proportionate to the degree of flood risk, as well as the scale, nature and location of the development. The LPA and Environment Agency should be consulted to confirm the level of assessment required and to provide any information on any known local issues.
- The LPA should consult the Environment Agency's 'Flood Risk Standing Advice (FRSA) for Local Planning Authorities', when reviewing planning applications for proposed developments at risk of flooding
- 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, allowing for climate change effects. They should also show that flood risk elsewhere will not be exacerbated by increased levels of surface runoff. Consideration must also be given to residual risk and maintenance of sustainable drainage and surface water systems
- Surface water runoff management should be undertaken, through the utilisation of appropriate SuDS techniques, prioritising the use of surface SuDS features which provide additional benefits (e.g. biodiversity, amenity space)
- Normally no buildings should be constructed within eight metres of the banks of watercourses. This is to allow access for maintenance, as well as providing an ecological corridor

Recommendations for Flood Zone 1

Fluvial flood risk is not a significant constraint to development within Flood Zone 1. However, there are a number of locations in Zone 1 where flooding from Ordinary Watercourses or drains are not shown on Environment Agency flood maps and this should be reviewed and assessed as appropriate. There is also residual risk, in some locations, from reservoirs within the council area.

- FRA is required for all developments over 1ha.
- Reference should be made to the Local Flood Risk Management Strategy and consideration given to requirements for the management of local flood risk.

Recommendations for Flood Zone 2

Most development is permitted in Flood Zone 2 with the exception of Highly Vulnerable development. Highly Vulnerable development is only permitted if it has passed the Exception Test.

- An FRA is required for all developments within this zone.
- Development design should incorporate mitigation measures to manage any flood risk to the development, including residual risk. Finished Floor Levels should be above the 1 in 100-year (1% AEP) flood level, plus an allowance for climate change (agreed with the Environment Agency and Sevenoaks District Council).
- The layout of buildings and access routes should adopt a sequential approach, steering buildings towards areas of lowest risk within the site.

Recommendations for Flood Zone 3a

Development in Flood Zone 3a is significantly constrained by flood risk. Highly Vulnerable development is not permitted within this zone and More Vulnerable development and Essential Infrastructure are only permitted if the Exception Test can be passed.

- An FRA is required for all developments within this zone.
    - It should be demonstrated that flood defences provide an acceptable standard of protection, including an allowance for climate change for the lifetime of the development.
    - Residual risks should be assessed, and the Environment Agency consulted regarding whether there is a need for a breach analysis to map a rapid inundation zone.
- The layout of buildings and access routes should adopt a sequential approach, steering buildings towards areas of lowest risk within the site. Where rapid inundation zones have been identified, development should be avoided in these areas.
- Development should not impede flow routes, reduce floodplain storage or consume flood storage in a 'flood cell' within a defended area. If the development does result in a loss of storage, compensatory floodplain storage should be provided on a 'level for level' and 'volume for volume' basis.
- If existing defences are to be upgraded as part of the development, an assessment should be undertaken to ensure it does not result in an increase in flood risk elsewhere.
- Development design should incorporate mitigation measures, to manage any flood risk to the development, including residual risk for the lifetime of the development. FFLs should be above the 1 in 100-year (1% AEP) flood level, plus an allowance for climate change.
- It is recommended that all types of new development behind flood defences is avoided, where possible, due to the residual risks of breach and overtopping
- Consideration should be given to the type of building that will be permitted, for example single-storey buildings and basements should be avoided.

Recommendations for Flood Zone 3b (Function Floodplain)

Development is highly constrained within Flood Zone 3b. Only Essential Infrastructure and Water Compatible uses are permitted in this zone, and only if the Exception Test has been passed.

Functional floodplain is vital for the conveyance and storage of floodwater. Development within this zone will potentially impede the flow of floodwater as well as result in a loss of flood storage, increasing flood risk both within the area and further downstream. Consideration should be given to 'rolling back' development in this zone, withdrawing development from the floodplain and allowing it to return back to a natural floodplain. This has an additional benefit of reducing flood risk to communities further downstream.

For the purpose of the SFRA, the defended case 20-year return period (5% Annual Exceedance Probability) event informs the Functional Floodplain within Sevenoaks District council. However,

where flood outlines of Flood Zone 3b are not available, Flood Zone 3a should be considered as Flood Zone 3b unless, following further work as part of a site-specific FRA, and in consultation with the Environment Agency, it can be proven as Flood Zone 3a.

- Essential infrastructure should only be allocated in this zone if no reasonable alternative sites are available in areas of lower flood risk.
- An FRA is required for Essential Infrastructure within this zone and should include evidence to demonstrate the Exception Test has been passed. Should the site pass the Exception Test, it should be designed and constructed to:
    - remain operational and safe for users in times of flood
    - result in no net loss of floodplain storage
    - not impede water flows and not increase flood risk elsewhere
- Development should not impede flow routes or reduce floodplain storage. If the development does result in a loss of storage, compensatory floodplain storage should be provided on a 'level for level' and 'volume for volume' basis.
- Development design should incorporate mitigation measures, to manage any flood risk to the development, including residual risk. Floor levels should be above the 1 in 100-year (1% AEP) flood level, plus an allowance for climate change.

12 Summary

12.1 Level 1 SFRA Assessment

The Level 1 assessment can be summarised as follows:

12.1.1 Sources of flood risk

- Sevenoaks District has a history of documented flood events from several sources of flood risk. Flood records indicate that the main source of risk if from fluvial sources.
- The two principle watercourses flowing through Sevenoaks District are the River Darent, the tributaries of which include the Honeypot Stream and the Watercress Stream, and the River Eden, which is a major tributary of the River Medway. The main sources of fluvial flood risk are associated with the River Darent and the River Eden.
- The most significant flood events reported to have affected the district occurred in 1968, 2000, 2002 and 2013.2014, all of which included notable flooding from the rivers Eden, Darent and Medway.
- Historic records also indicate that Sevenoaks District has experienced several surface water / drainage related flood events, which have been attributed to a range of sources. Although the historical records of surface water flooding are relatively dispersed throughout the district, Edenbridge and Sevenoaks are noted to have experienced a relatively large number of these flood events. The primary source of surface water flooding is attributed to heavy rainfall overloading carriageways and drains/gullies, but other sources of flooding have been caused by blockages or high levels within receiving watercourses impeding free discharge from surface water drains and gullies. The updated Flood Map for Surface Water (uFMfSW) shows a number of surface water flow paths which predominantly follow topographical flow paths along existing watercourses or dry valleys with some isolated ponding located in low lying areas.
- Multiple groundwater flood events have been recorded in Sevenoaks District, the causes of which are thought to be related to high water tables during these periods. The Areas Susceptible to Groundwater Flooding (AStGWF) mapping suggests that the susceptibility to groundwater flooding is greatest in the areas surrounding Otford, Edenbridge and Penshurst. The groundwater flood potential is consistent with the location of more permeable deposits that characterise these areas.
- The Sewer Incident Report Form data supplied by Southern Water indicates a total of 32 recorded flood incidents in the district. The more frequently flooded postcodes are TN8 5, TN8 6 and TN11 8. However, it is important to recognise that the information does not present whether flooding incidences were caused by general exceedance of the design sewer system, or by operational issues such as blockages.
- In relation to artificial sources of flooding, there are no records of flooding from reservoirs impacting properties within Sevenoaks District. However, the Environment Agency's mapping of the Risk of Flooding from Reservoirs indicates that reservoirs located within or outside the district boundary could affect properties in the event of a breach. A breach of these reservoirs would primarily affect the southern section the district and could have notable implications for the settlements located along the fluvial floodplain of the Rivers Eden and Medway.

12.1.2 Key Policies

There are a number of regional and local key policies which have been considered in the SFRA. The regional policies include the North Kent Rivers and the River Medway CFMPs (December, 2009), the River Thames Basin Management Plan (December, 2015), and the Thames Basin District Flood Risk Management Plan - Parts A, B, C and D (March, 2016).

Key policies include the following:

- Thames River Basin District Flood Risk Management Plan (FRMP): Part C of the Plan identified the priority to implement the outcomes of the Middle Medway Strategy and reducing the risk of flooding to communities where possible.
- Kent County Council Preliminary Flood Risk Assessment (PFRA): the PFRA reports significant past and future flooding from all sources except Main Rivers, the Sea and

Reservoirs, which are covered by the Environment Agency, and sub-standard performance of the adopted sewer network (covered under the remit of Southern Water). The Flood Risk Regulations (2009) require the Lead Local Flood Authority (LLFA) to identify significant Flood Risk Areas. No Flood Risk Areas have been identified in Sevenoaks District based on critical infrastructure/access routes, sewer/surface water problems and areas prone to significant ponding.

- Kent Local Flood Risk Management Strategy (2013): The Strategy is used as a means by which the LLFA co-ordinates Flood Risk Management on a day to day basis and sets out measures to manage local flood risk (i.e. flood risk from surface water, groundwater and Ordinary Watercourses). The Strategy also sets out an action plan of how the LLFA intends to achieve the high-level objectives proposed for managing flood risk.
- Surface Water Management Plans (SWMPs): SWMPs 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. Options to alleviate the risks are identified and presented as a long-term action plan to manage local flooding in a particular area. The Sevenoaks Stage 1 SWMP (2013) has been considered in this SFRA.

12.1.3 Development and flood risk

This SFRA provides details of the Flood Risk Assessment (FRA) requirements and guidance for developers. These recommendations include those of the NPPF, Environment Agency standing advice, as well as reference to regional and local policy. Site-specific FRAs should include assessment of mitigation measures required to safely manage flood risk along with the promotion of Sustainable Drainage Systems (SuDS) to create a conceptual drainage strategy and safe access/egress at the development in the event of a flood.

Surface water flooding and the role of the LLFA and the Local Planning Authority (LPA) in surface water management has also been defined with guidance provided for the design and implementation of SuDS as part of the initial planning stage of all types of residential, commercial and industrial developments. The SFRA provides details of the types of SuDS available and when they should be used, and outlines the recommendations included in the relevant national, regional and local guidance documents.

The merits of strategic flood risk solutions should be identified and understood when considering development within the district as these can involve measures that deliver wider strategic benefits and can be more easily and efficiently maintained than a myriad of individual smaller scale measures. Developers should work with stakeholders to identify issues and provide appropriate solutions.

12.1.4 Defences and residual risk

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 their condition were obtained from the Environment Agency for the purpose of preparing this assessment, in addition to explanations of some of such defences.

Alongside the current flood risk management infrastructure within the district, the Environment Agency are considering additional flood risk management measures. However, it is uncertain at this time whether and in what form these will proceed. When considering proposed development, consideration must be given to the status and timing of flood risk management measures and schemes to provide evidence on whether a proposed development may benefit from, hinder, adjust or facilitate delivery and implementation.

12.1.5 Flood warning and emergency planning

Emergency planning considerations have been included and the flood warning service coverage assessed; currently there are there are three Flood Alert Areas and six Flood Warning Areas covering Sevenoaks District. Requirements outlined by the NPPF for safe access and egress have also been set out.

12.2 Recommendations

12.2.1 Assessing Flood Risk and Developments

- 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.
- A site-specific FRA is required for all developments which are located in the Environment Agency's Flood Zones 2 and 3, or developments greater than 1ha in size in Flood Zone 1. They are also required for developments less than 1 ha in Flood Zone 1 where there is a change in use to a more vulnerable development where they could be affected by sources of flooding other than rivers and the sea (e.g. surface water drains, reservoirs). All developments located in areas of Flood Zone 1 highlighted as having critical drainage problems must also be accompanied by an FRA. The FRA should be proportionate to the degree of flood risk, as well as the scale, nature and location of the development.
- It is recommended that the impact of climate change to a proposed site is considered in FRAs and that the percentage increases which relate to the proposed lifetime of the development and the vulnerability classification of the development is identified and taken into account. The Environment Agency and LLFA should be consulted to confirm a suitable approach to climate change in accordance with latest guidance.
- Opportunities to reduce flood risk to wider communities could be sought through the regeneration of brownfield sites, through reductions in the amount of surface water runoff generated on a site.
- The LPA, Environment Agency and LLFA should be consulted to confirm the level of assessment required and to provide any information on any known local issues.
- When assessing sites not identified in the Local Plan (windfall sites), developers should use evidence provided in this SFRA to apply the Sequential Test as well as provide evidence to show that they have adequately considered other reasonably available sites.

12.2.2 Future Developments

Development must seek opportunities to reduce overall levels of flood risk at the site, for example by:

- Reducing volume and rate of surface water runoff based on Local Plan policy and LLFA Guidance
- Locating development to areas with lower flood risk
- Creating space for flooding.
- Integrating green infrastructure into mitigation measures for surface water runoff from potential development and consider using Flood Zones 2 and 3 as public open space.

The LPA should consult the NPPF and Environment Agency's 'Flood Risk Standing Advice (FRSA) for Local Planning Authorities', published in March 2014, when reviewing planning applications for proposed developments at risk of flooding.

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 development zoning within the site and prove, if required, whether the Exception Test can be passed.

12.2.3 Promotion of 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.

- A detailed site-specific assessment of SuDS would be needed to incorporate SuDS successfully into the development proposals. New or re-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 Source Protection Zones 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 on the level of water quality treatment required for drainage via infiltration. Further restrictions may still be applicable and guidance should be sought from the LLFA.
- Developers need to ensure that new development does not increase the surface water runoff rate from the site and should therefore contact the LLFA and other key stakeholders at an early stage to ensure surface water management is undertaken and that SuDS are promoted and implemented, designed to overcome site-specific constraints.
- The LPA will need to consider drainage schemes for major applications, but it is advised developers utilise the LLFA's Polices and Guidance to develop their drainage scheme for minor applications.

12.2.4 Infrastructure and Access

Safe access and egress will need to be demonstrated at development sites. Consideration of alternative access and egress routes should be made in the event that primary routes are inundated with flood water. 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.

12.2.5 Green Infrastructure and WFD

Opportunities to enhance green infrastructure and reduce flood risk by making space for water should be sought. In addition, opportunities where it may be possible to improve the WFD status of watercourses, for example by opening up culverts, weir removal, and river restoration, should be considered. Green infrastructure should be considered within the mitigation measures for surface water runoff from development.

12.3 Use of SFRA data and future updates

It is important to recognise that the SFRA has been developed using the best available information at the time of preparation.

The SFRA should be periodically updated when new information on flood risk, flood warning or new planning guidance or legislation becomes available. New information on flood risk may be provided by authorities including Sevenoaks District Council, Kent County Council (in its role as LLFA), the Highways Authority, Southern Water and the Environment Agency. It is recommended that the SFRA is reviewed internally on an annual basis, allowing a cycle of review, followed by checking with the above bodies for any new information to allow a periodic update.

Appendices

A Index grid squares for Appendix mapping

B Watercourses in Sevenoaks District

C Flood Zone mapping

D Climate change mapping

E Surface water mapping

F Groundwater mapping

G Flood warning coverage

H Historic flood records

I Sevenoaks District overview map

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