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Strategic Flood Risk Assessment

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Strategic Flood Risk Assessment
Canterbury City Council

Contents Amendment Record

This report has been issued and amended as follows:

Issue	Revision	Description	Date	Written by	Checked by
1	0	Draft report.	11 Feb 2011	SPH/TE	RB
2	1	Revised draft.	22 Feb 2011	SPH/TE	RB
3	2	Final draft for consultation.	25 Feb 2011	SPH/TE	RB
4	3	Final Report.	25 Aug 2011	TE/SPH	PB
5	4	Report updated in line with changes to policy and historic information. Draft report submitted to CCC for review.	17 May 2016	KT/AC	DM/SMB
6	5	Update to climate change section.	25 May 2016	KT	SMB
7	5	Report issued for comment.	18 Aug 2017	KT	-
8	6	Final report.	23 May 2018	KT	SMB
9	7	Update to NPPF. Final report re-issued.	26 Oct 2018	AW	KT
10	8	Update to NPPF and title of Drainage Impact Assessment Guidance Note. Final report re-issued.	08 Aug 2019	KT	SMB
11	9	Report updated in line with changes to policy and NPPF.	17 June 2022	AW	SMB
12	10	Report updated in line with changes to NPPG.	07 October 2022	AW, AB	SMB
13	11	Report updated in line with changes to NPPF and model results.	08 January 2024	AW	NW
14	12	Minor update to text.	13 February 2024	AW	-

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Executive Summary

The National Planning Policy Framework (NPPF) published by the Department for Communities and Local Government in 2012, and last updated in 2023, requires Local Planning Authorities (LPA) to apply a risk-based approach to the preparation of their development plans in respect of potential flooding. In simple terms, the NPPF requires LPAs to review flood risk across their District, and to steer development towards areas of lowest risk. Where development is to be permitted in areas that may be subject to some degree of flood risk, the NPPF requires the Council to demonstrate that there are sustainable mitigation solutions available that will ensure that the risk to property and life is minimised (throughout the lifetime of the development), should flooding occur.

Herrington Consulting Ltd. has been commissioned by Canterbury City Council (CCC) to update the existing Strategic Flood Risk Assessment (SFRA), which was previously prepared in 2011 and updated in 2019. Additional numerical modelling has also been undertaken for key locations to inform the strategic purpose of this document. This study has identified that the District is at risk of flooding from a number of sources and therefore, it is essential that future development is planned carefully, where possible away from areas that are most at risk from flooding. It is also necessary to ensure that any future development does not exacerbate flooding elsewhere.

Many of the coastal settlements, including Whitstable and Herne Bay, are situated within Flood Zone 3 and benefit from the protection provided by high quality flood defence infrastructure. Graveney, Seasalter, Reculver and the Lower Stour area comprise the majority of the low-lying areas of the District, which are primarily devoted to agricultural use, with a large percentage of these areas protected for nature conservation purposes. However, many of the urban areas within the district are also susceptible to flooding from other sources, which have to be taken into consideration as part of new legislation. In addition, there are a number of established towns and villages that are located within the floodplain and the future sustainability of these communities relies heavily upon their ability to grow, prosper and, where necessary, redevelop.

Therefore, the focus of this SFRA update is to address any changes in policy and in legislation since both the original SFRA (2011) and the previous update (2019) were published. The SFRA 2022 update aims to bring the planning context and flood risk information up-to-date, to assist the Council in the preparation of their emerging Local Plan.

It should be recognised that at the time of publication, CCC is continuing to develop the emerging Local Plan and as such, the information contained within this report will help to support this process. This report is supplemented by a series of maps, which provide the key information required to appraise the risk of flooding.

The SFRA is a living document, which should be periodically updated to ensure that the most contemporary information in relation to flood risk is considered. It should be recognised that the National Planning Policy Guidance (NPPG) was updated at the end of August 2022, shortly before the SFRA was planned to be published. As such, some of the content presented within this report may be subject to change.

For sites that are proposed for allocation in the Local Plan, which cannot be located within the lowest flood risk area, a Level 2 Assessment has been prepared alongside this SFRA and the results are presented as a separate document.

Contents Page

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1. Introduction

1.1. Overview

Herrington Consulting has been commissioned by CCC to update the existing Strategic Flood Risk Assessment (SFRA) for the District, which was originally prepared in 2011 and updated in 2019.

The National Planning Policy Framework (NPPF) published by the Department for Communities and Local Government (DCLG) in March 2012 (last updated in December 2023) requires Local Planning Authorities (LPA) to apply a risk-based approach to the preparation of their development plans in the respect of potential flooding. This district-wide appraisal of flood risk is to be delivered through the SFRA, the key requirements of which are described in paragraphs 9 to 19 of the Planning Practice Guidance: Flood Risk and Coastal Change (2022).

In addition, the latest updates to the National Planning Policy Guidance (NPPG), published at the end of August 2022, set a greater emphasis on the SFRA to identify sites which are shown to be at risk of flooding, whilst taking the impacts of climate change into account. This is to aid in the application of the Sequential Test, steering development to areas at lowest risk, including a consideration for climate change.

1.2. Key SFRA Objectives

The overarching aspiration for the SFRA is to provide the end user with as much qualitative risk-based information as possible. This approach assists the Council in preparing its development plans and undertaking the Sequential Test, but also allows other users to gain an understanding of the complex and wide-ranging flooding issues that exist within the District. Improvements and changes in the data available to achieve this objective have prompted the revision of the 2011 report and the subsequent update in 2019, which was prepared in accordance with national and local planning policy.

The key objectives of the SFRA are to:

- provide sufficient data and information to enable the Council to apply the Sequential Test to land use allocations and to identify whether the application of the Exception Test is likely to be necessary;
- provide a basis on which the Council can support the appropriate policies for the management of flood risk within the adopted and emerging Local Development Documents and to assist in the testing of site proposals;
- give guidance on the level of detail required for site-specific Flood Risk Assessments (FRAs) in particular locations;
- enable the Council to determine the acceptability of flood risk in relation to its emergency planning capability.

1.3. SFRA Format

Under the NPPF there is a requirement that, where the Local Plan has been unable to allocate all proposed development in low flood risk areas, the scope of the SFRA shall be increased in order to provide fuller information in the application of the Sequential and Exception Tests. This Level 2 SFRA is a more detailed study of the individual major flood risk areas where development may be proposed under the Local Plan. To achieve the Council's housing targets in accordance with central government requirements and the target that all development is constructed on previously developed land, it is confirmed that development is required in areas of medium to high flood risk.

Since the previous SFRA was prepared and in turn updated, there have been a number of detailed modelling studies carried out which inform the Level 2 SFRA, which are discussed further in Section 5.2 of this report. The information and outputs from these various models and studies have been used to inform this revised SFRA, to provide the quantitative data in relation to flood risk. This data is required to enable the Council to apply a risk-based approach to the preparation of its development plans.

Nevertheless, whilst the previous SFRA was a combined report comprising both the Level 1 and Level 2 requirements within a single document, due to the detailed information available to undertake the Level 2 analysis, the reports have now been published as two separate documents. Consequently, this Level 1 document focusses on the overall risk of flooding within the district, whereas the Level 2 report issued alongside provides a more detailed risk analysis of the potential sites identified for allocation within the emerging Local Plan.

It is important to recognise that the SFRA is a 'living' document. Consequently, as new information becomes available, updates will need to be made to the SFRA and its associated flood maps. This is especially important at a time where the Environment Agency (EA) flood and coastal erosion risk management strategy is recommending significant expenditure on flood defence infrastructure in the District over the next 20 years.

It should be recognised that additional detailed numerical flood modelling has been undertaken as part of this SFRA to inform the maps included within the Appendices. The results are yet due to be approved by the Environment Agency. Whilst it is recognised that the SFRA is a live document, users of this document should therefore be aware that some of the content of this SFRA may be subject to change in the near future.

2. SFRA Approach and Methodology

2.1. Overall Approach

The SFRA is at the core of the NPPF and supporting Planning Practice Guidance. It provides the essential information on flood risk, taking climate change into account, thereby allowing the LPA to understand risk across its District so that the Sequential Test can be applied appropriately. The need for LPAs to consider flood risk when preparing Local Development Documents (LDD) and to produce SFRAs is highlighted in paragraphs 09 and 10 of the *Planning Practice Guidance: Flood Risk and Coastal Change*. In addition, the EA has released separate guidance on how to prepare a SFRA and what should be included.

Both the NPPG and EA's guidance promote a two stage approach to undertaking a SFRA. The first stage (Level 1) involves discussing the scope of the SFRA with key stakeholders, in particular the EA, Internal Drainage Boards (IDBs) and sewerage undertakers. This scoping stage is recommended so that an understanding of the strategic flood risk issues that need to be assessed can be gained.

Where the Level 1 SFRA demonstrates that land in Flood Zone 1 (taking climate change into account) cannot accommodate the necessary development, then the Exception Test needs to be applied. This will involve a more detailed Level 2 SFRA that includes further data collection and analysis.

The town centres of the three main urban areas of the District, namely Canterbury, Whitstable and Herne Bay, where the majority of the District's population live and work, lie either fully, or partially within Flood Zone 3. The Council had considered these issues in detail before commencing the update to the SFRA, and in anticipation commissioned a Level 2 assessment. The purpose was to gain a better understanding of flood risk and its consequences for the strategic sites which are proposed to be allocated as part of the emerging Local Plan.

Consequently, whilst the original SFRA combined both the Level 1 and the Level 2 SFRA, the report has subsequently been split to provide a more user-friendly SFRA, which can also be used by external users. In addition, the purpose of this document is to provide further evidence on flood risk based on updated legislation, to inform the application of the Sequential Test for smaller sites, aimed at achieving the housing target for the District.

2.2. SFRA Outputs

The focus of the SFRA is to provide sufficient data and information to enable the LPA to apply the Sequential Test to land use allocations and, where necessary, to apply the Exception Test. The NPPF also indicates that Sustainability Appraisals (SA) should be informed by the SFRA for their area. Under the Town and Country Planning (Local Development - England) Regulations 2004, a SA is required for all Local Plans. The purpose is to promote sustainable development through better integration of sustainability considerations in the preparation and adoption of plans. The

Regulations stipulate that SAs for Local Plans should meet the requirements of the Strategic Environmental Assessment (SEA) Directive.

A SFRA is used as a tool by a LPA for the production of development briefs, setting constraints, identifying locations of emergency planning measures and requirements for site-specific FRAs. It is important to reiterate that the NPPF and supporting Planning Practice Guidance are not applied in isolation as part of the planning process. The formulation of Council policy and the allocation of land for future development must also meet the requirements of other planning policy.

Clearly a careful balance must be sought in these instances, and the SFRA aims to assist in this process through the provision of a clear and robust evidence base, upon which informed decisions can be made.

2.3. The Sequential Test

LPAs are encouraged to take a risk-based approach to proposals for development in or affecting flood risk areas through the application of the Sequential Test. The objectives of this test are to steer new development away from high risk areas towards those at lower risk of flooding. However, in some areas where developable land is in short supply there can be an overriding need to build in areas that are at risk of flooding. In such circumstances, the application of the Sequential Test is used to ensure that the lower risk sites are developed before the higher risk ones.

Paragraph 167 of the NPPF (2023) states to

*'…apply a sequential, risk-based approach to the location of development **- taking into account all sources of flood risk and the current and future impacts of climate change** – so to avoid, where possible, flood risk to people and property. They should do this, and manage any residual risk, by:*

a) *Applying the sequential test and then, if necessary, the exception test as set out below;*

b) *Safeguarding land from development that is required, or likely to be required, for current or future flood management;*

c) *using opportunities provided by new development and **improvements in green and other infrastructure** to reduce the causes and impacts of flooding, (making as much use as possible of natural flood management techniques **as part of an integrated approach to flood risk management)**; and*

d) *where climate change is expected to increase flood risk so that some existing development may not be sustainable in the long-term, seeking opportunities to relocate development, including housing, to more sustainable locations.'*

Paragraph 168 goes on further to state that;

'The aim of the sequential test is to steer new development to areas with the lowest risk of flooding from any source. Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower risk of flooding. The strategic flood risk assessment will provide the basis for applying this test. The sequential approach should be used in areas known to be at risk now or in the future from any form of flooding.'

The NPPG was also revised in August 2022, providing further guidance on how the Sequential Test should be applied. In accordance with the updates to the NPPF and NPPG, it is evident that a greater emphasis is given to including an allowance for climate change when assessing the suitability of sites in terms of flood risk.

Where it is not possible to locate development in areas identified to be at 'low' risk of flooding including an allowance for climate change, a comparison of reasonably available sites at 'medium' risk should be carried out. Only if it is demonstrated that there are no reasonably available sites situated within low or medium risk areas, should sites be compared which are shown to be at 'high' risk of flooding.

Existing flood risk management infrastructure should not initially be taken into consideration, due to the uncertainty in long-term funding, maintenance and the potential impacts of climate change. When appraising the suitability of reasonably alternative sites, an approach considering spatial variation of risk within first the medium, and then the high risk areas should be applied. This aids to identify the areas at lowest risk. The influence of flood risk management infrastructure on the variation of risk can then be considered, taking an exceedance event or failure of the infrastructure into consideration.

In consideration of the above, the EA's Flood Zones have been referenced in conjunction with the information extracted from the EA's 'Flood Risk from Surface Water' maps to produce combined 'Potential Risk of Flooding' maps for both current day and future, to account for climate change. These maps are provided in Appendix A.4 and A.5.

The 'Potential Risk of Flooding' map does not indicate areas which are at risk of flooding from other sources, such as sewers, groundwater or ordinary watercourses. Instead, the Local Flood Risk Management Strategy provides some indicative groundwater flood risk mapping, and Surface Water Management Plans appraise the risk of surface water flooding, including detailed surface water sewer flooding.

Whilst numerical flood modelling has been undertaken by Herrington Consulting (HC) for key locations to inform the SFRA, it should be recognised that the vast majority of models presented within the 'Potential Risk of Flooding – Climate Change' map is based on modelling which does *not* include the latest allowance for climate change. As such, these maps have been produced for strategic purposes and it is recommended that a detailed review of the flood risk is undertaken as part of any site-specific Flood Risk Assessment.

In addition, no detailed national modelling is available to appraise the impacts of climate change on surface water. Nevertheless, the EA's maps do include an exceedance event which has been referenced to provide an indication of the likely impact of climate change.

The 'Potential Risk of Flooding' map can be used in the first instance to identify sites which are potentially at risk of flooding from *all* sources and therefore, identify those areas which require the Sequential Test to be applied.

Discussions are still being held with the Environment Agency to agree an acceptable approach on defining low, medium and high risk areas. However, at this stage, the following is proposed;

Low risk areas	Medium risk areas	High risk areas
Flood Zone 1 Areas **outside** the blue extent on the ***'Potential Risk of Flooding – Current Day'*** map Areas **outside** the blue extent on the ***'Potential Risk of Flooding –Climate Change'*** map Areas **outside any other risk areas** as identified by other supporting documents	**Flood Zone 2…OR** Areas **outside** the flood extent on the ***'Potential Risk of Flooding – Current Day'*** map…**BUT** Areas **inside** the flood extent on the ***'Potential Risk of Flooding –Climate Change'*** map and areas **inside other risk areas as** identified by other supporting documents	**Flood Zone 3…OR** Areas **inside** the blue extent on the ***'Potential Risk of Flooding – Current Day'*** map

Table 2.1 - Classification of low, medium and high risk areas

Based on the above criteria, development sites which are determined to be subject to the Sequential Test will be required to submit supporting information to the LPA to accompany the planning application. Further details on applying the Sequential Test on a site-scale basis is provided in Section 8.

2.4. The Exception Test

If following the application of the Sequential Test it is not possible, consistent with wider sustainability objectives, for the development to be located in an area at lower risk of flooding, the Exception Test can be applied.

As part of this process it is necessary to consider the type and nature of the development. Table 2 of the *Planning Practice Guidance: Flood Risk and Coastal Change* (Paragraph 66) defines the type and nature of different development classifications in the context of their flood risk vulnerability.

This has been summarised in *Table 3 of the NPPF: Flood risk vulnerability classification*, which highlights the combinations of vulnerability and flood zone incompatibility that require the Exception Test to be applied.

Flood Risk Vulnerability Classification	Zone 1	Zone 2	Zone 3a	Zone 3b
Essential infrastructure – Essential transport infrastructure, strategic utility infrastructure, including electricity generating power stations	✓	✓	e	e
High vulnerability – Emergency services, basement dwellings, caravans and mobile homes intended for permanent residential use	✓	e	✗	✗
More vulnerable – Hospitals, residential care homes, buildings used for dwelling houses, halls of residence, pubs, hotels, non-residential uses for health services, nurseries and education	✓	✓	e	✗
Less vulnerable – Shops, offices, restaurants, general industry, agriculture, sewerage treatment plants	✓	✓	✓	✗
Water compatible development – Flood control infrastructure, sewerage infrastructure, docks, marinas, ship building, water-based recreation etc.	✓	✓	✓	✓

Key:
✓ Development is appropriate
✗ Development should not be permitted
e Exception Test required

Table 2.2 - Flood risk vulnerability and flood zone incompatibility

It should be acknowledged that Paragraph 79 of the *NPPG: Flood Risk and Coastal Change* states the following about Table 3:

> *"This table does not show the application of the Sequential Test which should be applied first to guide development to the lowest flood risk areas; nor does it reflect the need to avoid flood risk from sources other than rivers and the sea";*

Therefore, it is necessary to consider the risk of flooding to development sites from all sources to determine whether the development would require, and indeed pass the Exception Test.

The EA's 'Flood Map for Planning' shows the associated flood zone for sites. These maps and the associated information are intended for guidance, and do not provide details for individual properties. They do not take into account other considerations such as existing flood defences, alternative flooding mechanisms and detailed site based surveys. They do, however, provide high level information on the type and likelihood of flood risk in any particular area of the country. The flood zones are classified as follows:

Zone 1 – Low probability of flooding – This zone is assessed as having less than a 1 in 1000 (0.1%) annual probability of river or sea flooding in any one year.

Zone 2 – Medium probability of flooding – This zone comprises land assessed as having between a 1 in 100 (1%) and 1 in 1000 (0.1%) annual probability of river flooding or between 1 in 200 and 1 in 1000 annual probability of sea flooding in any one year.

Zone 3a – High probability of flooding - This zone comprises land assessed as having a 1 in 100 (1%) or greater annual probability of river flooding or 1 in 200 (0.5%) or greater annual probability of sea flooding in any one year.

Zone 3b – The Functional Floodplain – This zone comprises land where water has to flow or be stored in times of flood and can be defined as land which would flood during an event having an annual probability of 1 in 30 (3.3%) or greater. This zone can also represent areas that are designed to flood in an extreme event as part of a flood alleviation or flood storage scheme.

The EA's 'Flood Map for Planning' only identifies areas to be situated within Flood Zone 3 without further subdividing it into Zone 3a and 3b (referred to as the *functional floodplain*). Clarification between Flood Zone 3a and 3b is an important distinction that needs to be made when determining when the Exception Test is applicable. Table 3 identifies that no development, other than essential transport and utilities infrastructure, will be permitted within the functional floodplain.

To determine whether a development is located within the functional floodplain, the following test should be applied;

- *Do predicted flood levels show that the site will be affected by an event with a return period of 1 in 30 years or less?*
- *Is the site defended by flood defence infrastructure that prevents flooding under events with a return period of 1 in 30 years or greater?*
- *Does the site provide a flood storage or floodwater conveyance function?*
- *Does the site contain areas that are 'intended' to provide transmission and storage of water from other sources?*

The NPPG states that the Strategic Flood Risk Assessment should identify areas located within the functional floodplain and its boundaries, in agreement with the EA. A map showing the functional floodplain for the district is presented in Appendix A.3. It should be recognised that the model data provided by the EA as part of this assessment has been prepared prior to the latest update to the NPPG. As such, modelled flood outputs for the functional floodplain as defined by the NPPG 2022 are only available for the following watercourses and coastline;

- Coastline covered by the East Kent Coast Modelling Study (2018)
- The Gorrell Stream (main river)
- The Nailbourne (main river)

For all other watercourses and areas shown to be at risk of flooding from tidal or fluvial sources, a strategic approach has been adopted and the **1 in 50 year flood event has been referenced to show the likely extent of the functional floodplain (i.e. 1:30 year return period)**. Where this is the case, the indicative functional floodplain has been differentiated on the map shown in Appendix A.3. Nevertheless, the reader should be mindful that this scenario is likely to *overestimate* the extent of the functional floodplain in many cases and therefore, further investigation is recommended to be undertaken as part of a site-specific Flood Risk Assessment, where applicable.

In addition, the extent of the functional floodplain within Canterbury City Centre has been refined following sensitivity testing by Herrington Consulting of the EA's Great Stour 2 Model. A more detailed overview of the work undertaken is provided in Section 4.3 of this report. The subsequent results have been included in Appendix A.3 as separate outputs. It should be noted that review of the results for defining the functional floodplain is still ongoing with the EA.

Sites which are identified as requiring the Exception Test to be applied, cannot be permitted or allocated until the Exception Test is passed. There are two criteria which make up the Exception Test, both of which must be satisfied;

A. *the development would provide wider sustainability benefits to the community that outweigh the flood risk; and*

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

Development sites which have been allocated will still be required to meet the objectives of the Exception Test before permission can be granted.

2.5. Special Cases and Exceptions

To date the Sequential Test has presented the Council with a significant challenge because, as discussed above, there are sustainability reasons to develop/redevelop parts of the three town centres - all located within Flood Zone 3a.

As such, it can be seen there are overriding sustainability reasons for development to be carried out in the town centres within Flood Zones 2 and 3. The Sequential Test has therefore been applied to the town centre areas and considered to be satisfied in accordance with the requirements of the NPPF and its Planning Practice Guidance. Development in these town centres should still be considered against the Exception Test to determine whether development can proceed safely with the flood risk managed. Some areas within the town centres are located within Flood Zone 3b (i.e. the functional floodplain). In these areas, development is highly restricted to certain vulnerability classifications as outlined in Table 2.2. As such, consideration should be given to the appropriateness of development in Flood Zone 3b, even if the Sequential Test is initially considered to be passed.

The EA has a statutory responsibility and must be consulted on all development applications located within Zones 2 and 3, including areas with critical drainage problems. For all of these cases the EA will require the Council to demonstrate that there are no reasonable alternatives in lower flood risk categories available for development.

In order to address this issue, an agreement was previously made between CCC and the EA as part of the original SFRA with regard to the development of brownfield sites in Whitstable and Herne Bay. This outlines a number of requirements for planning application within areas at risk of flooding from tidal sources, which have been summarised in the local Memorandum of Understanding (MoU). As the tidal modelling for Whitstable and Herne Bay is currently reviewed by the EA, the MoU has not yet been updated to include the latest model outputs. An updated version is proposed to be provided once the updated tidal modelling has been agreed.

Prior to the NPPG update in 2022, Flood Zone 3b was classified by the extent of flooding under an extreme fluvial event with a 1 in 20 year return period (now updated to 1:30 year return period). The previous SFRA aimed to better represent the true extent of the functional floodplain at that time, after it was discovered that the published results of the EA's Great Stour Flood Mapping Study in 2013 appeared to show (unrealistically) that a large proportion of Canterbury city centre was located within the *functional floodplain* (Flood Zone 3b). A more detailed review of the study, undertaken by Herrington Consulting on behalf of CCC, identified that the flood extents predicted by the EA model for an event with a 1 in 20 year return period were not wholly congruent with historic evidence recorded by Canterbury Council Engineers. The report concluded that the strategic nature of the EA model resulted in a significant overestimation of the extent of flooding under lower return period events, including the 1 in 20 year flood event. As a consequence, the alternatives for determining and mapping the true extent of the functional floodplain were discussed with the EA.

The Planning Practice Guidance that accompanies the NPPF states that "…*The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters*".

With reference to the guidance above, it was agreed between CCC and the EA that the results of the original River Great Stour fluvial model (used in the 2011 SFRA), provided a more realistic representation of the functional floodplain within the city centre and as such, should be used to better define the extent of the functional floodplain within Canterbury city centre.

It is recognised that the definition of the functional floodplain has since been updated and the NPPG (2022) now refers to the functional floodplain as an event with a 1 in 30 year return period. However, the 2011 fluvial model does not include modelled flood data for this scenario. In addition, there have been numerous updates to flood model guidance since and as such, simply updating the historic model to produce outputs for the 1 in 30 year return period was not considered appropriate. Consequently, the EA's more contemporary Great Stour 2 model has been sensitivity tested to obtain results which are commensurate with historic flood evidence as recorded by Canterbury Council Engineers and to obtain similar results. A more detailed overview of the work undertaken is provided in Section 4.3 of this SFRA. As the results are based on the outputs from the EA's Great Stour 2 model, no results are available for the 1 in 30 year return period and instead, the 1 in 50 year return period has been included in Appendix A.3. It should be noted that the sensitivity testing undertaken by Herrington Consulting to define the functional floodplain for the SFRA is currently being reviewed by the EA and confirmation from the EA for its proposed use is yet outstanding.

To determine the impact of fluvial flood events with a return period which is greater than the 1 in 50 year event, it was previously agreed with the EA that the modelled flood extents from the EA's Great Stour Flood Mapping Study (2013) should be referenced. This remains unchanged in this version of the SFRA.

For sites considered to be at risk of flooding from the River Great Stour which are located outside of the extents of the modelling undertaken by Herrington Consulting in 2011, the EA should be contacted to request modelled flood level data from the Great Stour Flood Mapping Study (2013, updated in 2016 to include climate change allowances). The definition of the functional floodplain within this data should be interpreted with caution and a detailed Flood Risk Assessment appraising the site specific risk of flooding under the 1 in 30 year event should accompany any planning application.

In addition to the above, the NPPF and NPPG states that the following developments are exempt from the Sequential Test;

- Development classified as 'minor development' in relation to flood risk.
- A change of use application whereby the lawful planning use is changed. For example, Part 3, Class M: changing a Class A1 (shops) to Class C3 (dwelling houses). The exception is for applications for a change of use to a caravan, camping or chalet site, or to a mobile home or park site.

Where sites have been allocated as part of the Local Plan process, the Sequential Test does not need to be applied again. Nevertheless, it may be necessary to re-apply the Exception Test '*if relevant aspects of the proposal had not been considered when the test was applied at the plan-*

making stage, or if more recent information about existing or potential flood risk should be taken into account.' (Paragraph 166 of the NPPF).

3. The Study Area

3.1. Overview of the District

Canterbury is a historic city with a national and global reputation that outweighs its size both in geography and population. The wider Canterbury District also boasts assets of great potential, including the coastal towns of Whitstable and Herne Bay, numerous villages that are often of outstanding historic quality, and a varied and beautiful countryside.

The District is located in the East Kent sub-region, sharing boundaries with five other local authorities: Ashford, Swale, Folkestone and Hythe (formerly Shepway), Dover, and Thanet. The Canterbury District sits at the centre of this sub-region and covers an area of 31,000 hectares (310 square kilometres) with a population of over 44,000. About 15% of the District is low-lying with approximately 46 square kilometres lying within the EA's Zone 3a flood risk area.

The District has a coastal frontage that extends for 21 kilometres between its western boundary at Graveney Marshes through to the Northern Seawall east of Reculver. The land at both the western and eastern boundaries of the District is low lying, but between these the coastline is undulating with clay or sandstone cliffs between the valleys at Whitstable, Swalecliffe, Hampton and Herne Bay. A total of 10.1 km of the District's coast is low lying – all of which is defended by a seawall with a shingle beach in front. The River Stour virtually bisects the District and runs through the centre of the city of Canterbury. Other important watercourses are the coastal brooks – Sarre Penn, North Stream, River Wantsum, Gorrell Stream, Swalecliffe Brook, West Brook and Plenty Brook – and the Nailbourne/Little Stour chalk stream.

The City of Canterbury has a significant retail focus and an existing role as a population and service centre, as well as a focal point for higher and further education facilities. Herne Bay is a traditional Victorian seaside resort that has suffered some economic decline of its town centre and is currently the subject of significant regeneration efforts. Whitstable is an attractive coastal town with a lively independent retail sector and strong arts culture. The desirability of the town has led to significant numbers of second home owners. The rural area of the District contains a great diversity of settlements in terms of character, size and facilities. Figure 3.1 shows the geographical extents of the District along with the main towns and villages.

The high quality landscape in the District is a distinctive and variable feature of the area. This diverse landscape gives rise to a wide range of wildlife habitats and there are four internationally designated nature conservation sites as well as fifteen national sites and numerous local nature reserves. Much of the area of flood risk in the District, from both river and coastal flooding, coincides with the location of designated wildlife habitats where no development is proposed. These designated habitats include 'The Swale' (a complex of brackish and freshwater, with floodplain grazing marsh, saltmarshes and mud-flats), 'Thanet Coast and Sandwich Bay' (including tidal river, estuaries and mud flats) and 'Stodmarsh' (including inland water bodies, marshes and fens). These are all areas where inundation or saturation by surface or ground water (be that at different frequencies and duration) is essential to their quality and survival and must be protected at appropriate levels. However, the area of flood risk also affects large parts of the villages and urban areas due to the historical attraction of population to rivers and coastal areas. There was significant widespread inland flooding in 2000/2001. As a result of climate change, rising sea levels and increasing frequency of extreme weather patterns, flood risk will become an increasingly important issue for the District.

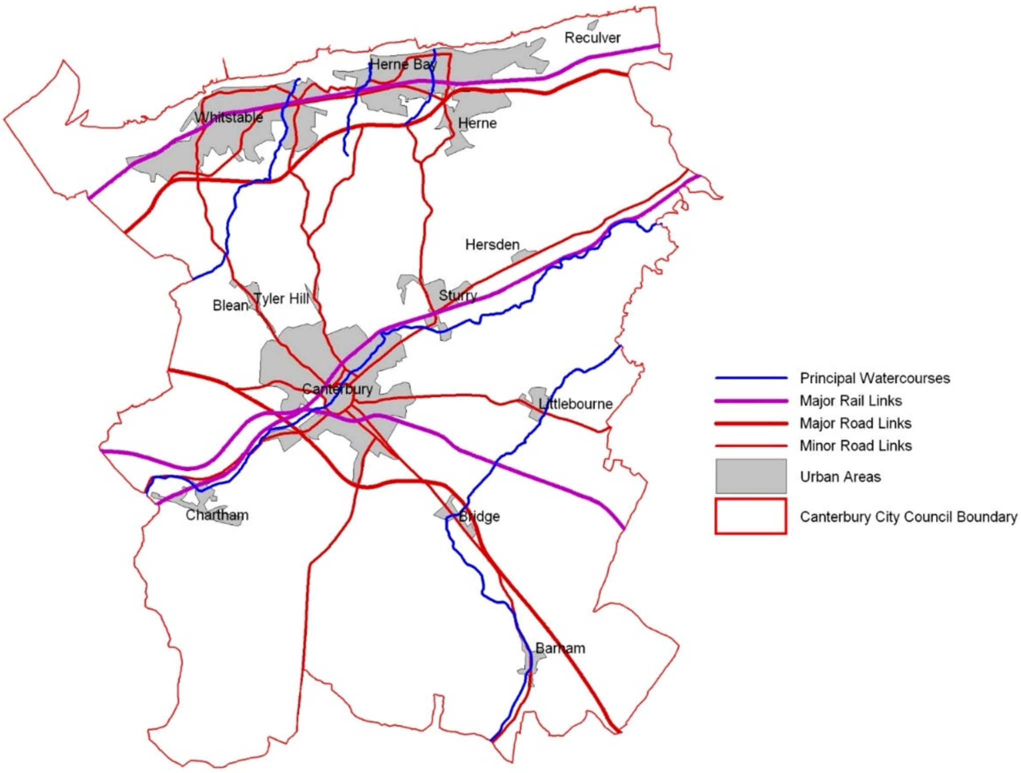

Figure 3.1 - Location plan showing the Canterbury District Boundary and the SFRA study area.

3.2. Geology and Hydrogeology

In terms of the strategic appraisal of flood risk, it is important to understand the geology and hydrogeology of the District. This provides a background both for an evaluation of the potential for groundwater flooding and for an understanding of the role of infiltration drainage, either as part of a sustainable drainage system, or within the overall natural water cycle.

The bedrock across the District is broadly split into three elements. To the south of Canterbury the geology is dominated by chalk which forms the high ground of the North Downs.

The central and eastern part of the District is formed by the Thanet Sand Formation characterised by pale yellow-brown, fine-grained sand that can be clayey and glauconitic and consisting of the Oldhaven, Blackheath, Woolwich and Reading and Thanet Beds. The Thanet Sand Formation lies unconformably on the Chalk.

To the north and west between Canterbury and Whitstable and Herne Bay the bedrock geology is London Clay, part of the Thames Group. The London Clay lies unconformably on the Woolwich and Reading Beds.

The majority of the District has no recorded drift deposits. This includes large areas to the south of the District over the higher chalk bedrock and large areas to the north over the London Clay. Where there are drift deposits, these are concentrated in the valleys and lower lying areas of the District.

Within the chalk valleys superficial geology consists of clay with flints. This is a residual deposit formed by the reworking of the chalk and is typically orange brown sandy clay with nodules and pebbles of flint. Along the Stour and lower Nailbourne valleys, plus to the north east and north west of the District are superficial deposits of alluvium, characterised by soft to firm consolidated, compressible silty clay, that can contain layers of silt, sand, peat and basal gravel.

To the centre and in areas of the northern part of the District are deposits of Brickearth, which varies from silt to clay and is usually yellow-brown and massive.

To the east of Canterbury are river terrace deposits of sand and gravel. Further sand and gravel deposits are found in isolated areas east of Herne. Finally, along the northern coastline between Herne Bay and Reculver is an area of landslip deposits.

Figures 3.2 and 3.3 below show a simplification of the solid and drift geology of the Canterbury District.

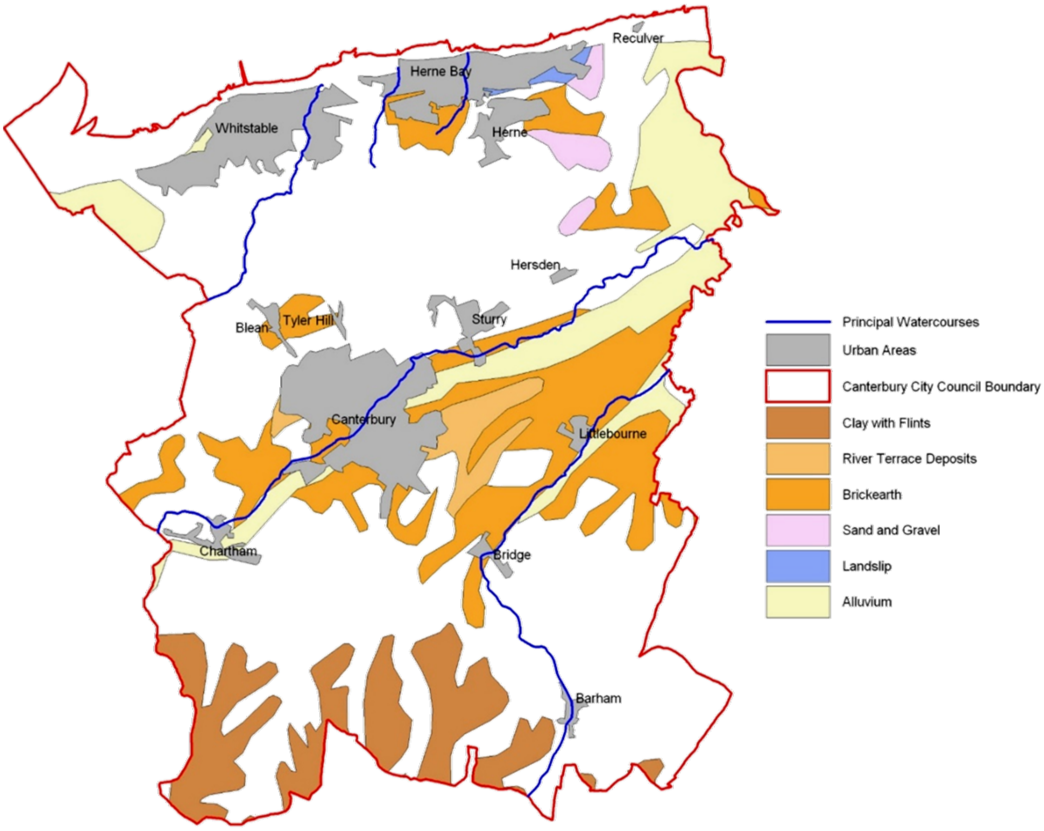

Figure 3.2 - Drift geology of the Canterbury District.

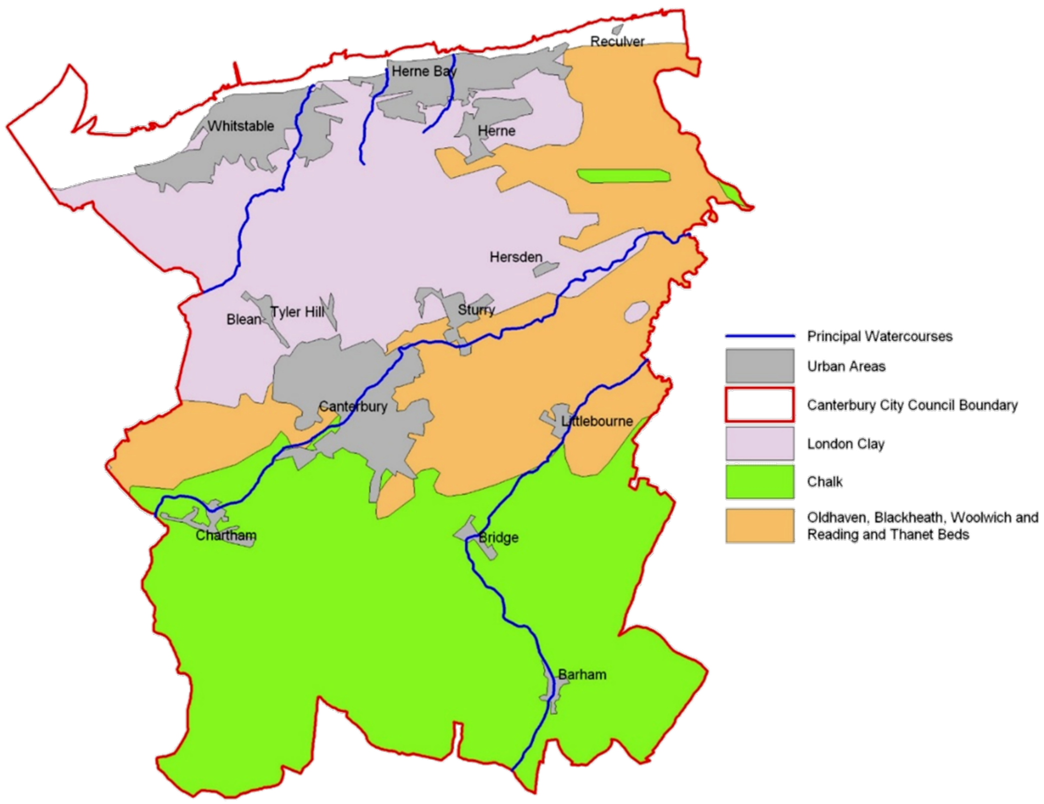

Figure 3.3 - Solid geology of the Canterbury District.

The River Stour is the main hydrological feature running west to east through the District. There are no significant tributaries joining the Stour within the District, although the Nailbourne does flow into the Stour, via the Little Stour, to the east of the District boundary. Flow into the Stour from north and south is via smaller streams and via groundwater base flow. To the east the Stour valley widens to form the low-lying marshy land of the Westbere, Chislet and Stodmarsh Marshes.

The chalk south of Canterbury forms a principle bedrock aquifer. Streams run northwards from this area towards the River Stour. Many of the valleys in the chalk are dry valleys whilst some have ephemeral streams that flow intermittently. There are several water extraction points along the Stour and within the chalk aquifer. A secondary aquifer is formed by the Thanet Sand Formation to the east and north east of Canterbury.

To the north of Canterbury, London Clay dominates. This stiff clay leads to low permeability with run-off flowing across the land surface through a network of ditches and streams, to several more major watercourses running south to north and discharging to the North Sea.

3.3. Soils

Soil type provides a generic description of the drainage characteristics of soils. This will dictate, for example, the susceptibility of soils to water logging or the capacity of a soil to freely drain to allow infiltration to groundwater. Generally, soil types can only be fully determined after suitable ground investigations, however, it is possible to use the mapped soil types (Soil Association) within the study area as an indicator of permeability and infiltration potential. The soil characteristic map in Figure 3.4 has been based on the soil types within the Canterbury District as mapped by the National Soil Resources Institute.

The soil types within the Canterbury District closely follow the bedrock and superficial geology. To the south of the District there are shallow lime-rich soils over the higher chalk areas. In the dry valleys where superficial deposits have been deposited the soils are clayey with impeded drainage. The soils across the central section are generally freely draining whilst to the north, overlying the London Clay, the soils are seasonally wet or have naturally high groundwater levels.

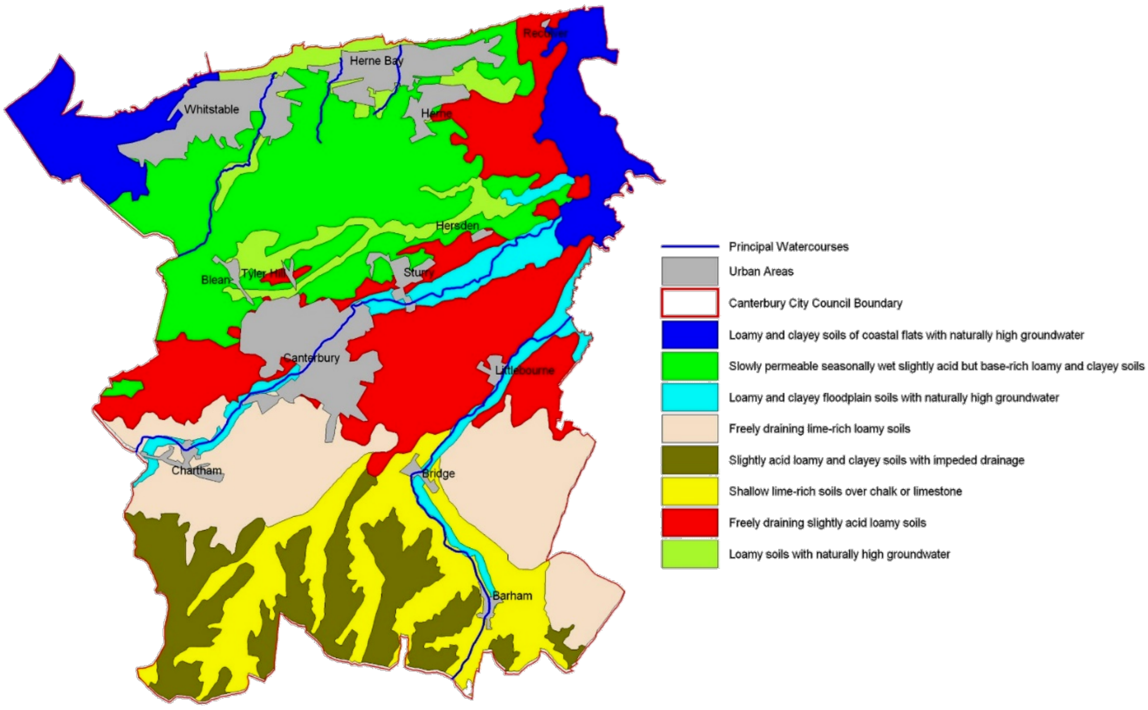

Figure 3.4 - Map showing the range of soil characteristics across the Canterbury District.

3.4. Topography

The topography varies significantly across the District; areas along the north Kent coast are located below the mean high water level, whilst the North Downs located to the south of the District are elevated, approximately 155m Above Ordnance Datum (AODN). The topography south of Canterbury is characterised by chalk downland falling fairly steeply from 155m AODN in the south to between 30-40m AODN around Canterbury, Littlebourne and Chartham. This area is bisected by several dry valleys or in the case of the Nailbourne valley an ephemeral stream that runs intermittently. Groundwater flow through the chalk is the predominant mechanism by which water flows in this area and it is characterised by springs and intermittently running streams. 1m aerial height data from Defra Survey Data has been used to illustrate the topographic variation across the study area and is included within Appendix A.1.

A further area of high ground lies to the north of the Stour Valley with levels reaching 75-85m AODN around Blean and Tyler Hill. This ridge of high ground forms a watershed with several streams running north towards Whitstable and Herne Bay. To the south, flow is directed towards the River Stour via small streams and groundwater flow.

The northwest and north east of the District is characterised by very low lying marshland at Seasalter and Chislet Marshes respectively. Land here is lower than 5m AODN and defended from inundation by sea defences along the coast. Between these two low lying areas the topography along the coastline varies with sand cliffs to the east and clay slopes interspersed with low lying areas in Herne Bay, Swalecliffe and Whitstable. The low lying areas are below 5m AODN whilst the slopes and cliffs rise to 20-35m AODN.

As well as the importance of the elevation of the land above sea level, topography is also important in assessing the risk of flooding from other sources such as overland flow and groundwater flooding. This data, in combination with the geology and soils maps can be used to gain an understanding of the potential for these mechanisms of flooding and is also useful in the determination of the appropriateness of Sustainable Drainage Systems (SuDS).

4. Data Sources

4.1. Consultation and Data Collection

The following organisations have been consulted either during the development of the original SFRA or for comment on the updated version.

- Canterbury City Council
- EA
- River Stour (Kent) Internal Drainage Board
- Kent County Council - Highways
- Southern Water

The data supplied for use within the SFRA has been summarised in the following Table.

Organisation	Data Supplied	Use within SFRA
Canterbury City Council	OS 10k National Grid mapping	Flood risk mapping
	Historic flood database and mapping	Historic Flooding
	Isle of Grain to South Foreland SMP Review 2010 (Halcrow)	Information on shoreline management policy
	Coastal defence asset database	Information on existing defences and their standard of service
	Coastal defence strategy plans (Whitstable, Tankerton, Swalecliffe, Herne Bay, Reculver)	Information on coastal processes and proposed defence improvements
	Flood Scrutiny Review Report and Appendices, various site specific flood reports and analyses	Information on flooding history, flood policy and post-flood improvements
	Wave Overtopping Rates	Tidal modelling of Whitstable and Herne Bay
EA	Flood Zone 2 and 3 extents (GIS layer)	Mapping of flood zones
	Historic flooding extents (GIS layer)	Mapping of historic flooding
	AIMS Spatial Flood Defences (inc. standardised attributes)	Information on existing defences owned, managed and inspection by the EA
	Extreme sea levels – taken from the EA's Coastal flood boundary conditions for the UK: Update 2018 report	Section 7 of this report
	River Great Stour Modelling and Mapping Study Report (v2 2013) and subsequent 2016 Climate Change update	Flood risk analysis and mapping
	East Kent Coast Modelling Study (2018)	Flood risk analysis and mapping
	Isle of Sheppey & Oyster Coast Brooks Modelling Study (2014) including 2017 Climate Change update	Flood risk analysis and mapping
	Plenty Brook Modelling Study (2013)	Flood risk analysis and mapping
	Nailbourne Fluvial Mapping Study 2019	Flood risk analysis and mapping
	Little Stour and Nailbourne Flood Risk Mapping Study (2013)	Flood risk analysis and mapping
	Lower Stour Modelling Study (2010)	Flood risk analysis and mapping
Department for Environment, Food and Rural Affairs (Defra)	National LIDAR Programme DTM (2022) – 1m resolution provided	Topography and SFRA Level 2 studies

Organisation	Data Supplied	Use within SFRA
Southern Water	Information on historic flooding and improvements to the sewer network	Historic Flooding
KCC	Information on historic flooding	Historic Flooding

Table 4.1 - Summary of data supplied.

4.2. Existing Hydraulic Modelling

Since the publication of the original SFRA in 2011 there has been a number of hydraulic modelling studies undertaken for both the coast and watercourses within the Canterbury District, a list of which is provided in Table 4.1 above.

Various changes to the guidance on climate change allowances have been released since the previous SFRA update, including:

- December 2019: new sea level rise predictions,
- July 2021: new predictions for increases in peak river flow (refer to Peak River Flow below), and,
- May 2022: new climate change predictions for peak rainfall.

The majority of the previous studies do not take account of these new changes and therefore, it should be acknowledged that some caution should be applied when using these sources to appraise the risk of flooding. Whilst these sources may be the most contemporary data currently available, it will still be necessary to examine the results from these studies in more detail when preparing a site-specific Flood Risk Assessment.

Great Stour Flood Risk Mapping Study (2013) – including 2016 Climate Change

In 2013, a Flood Risk Mapping study of the Great Stour between Wye and Fordwich was commissioned by the EA. A strategic flood model was produced for the Great Stour with the aim of updating the Flood Zone Maps and to test different options to reduce flood risk within the catchment. This study extends from Wye to Fordwich and comprises 1D-2D models constructed in ISIS-TUFLOW. Due to the size of the model, this reach of watercourse has been split into two smaller models which are linked. The section of the River Stour from the M20 (Ashford) to upstream of Canterbury is referred to as ‘Model 1’. Upstream of Canterbury to Stodmarsh Valley is ‘Model 2’.

In 2017, the EA has updated the model to include different climate change scenarios which range from a 25% increase in peak river flow to a 105% increase.

Isle of Sheppey and Oyster Coast Brooks Flood Risk Mapping Study (2014) - including 2016 Climate Change

In 2014, a Flood Risk Mapping study of four watercourses in Kent was commissioned by the EA. Three of the watercourses are located within the Canterbury District; the Swalecliffe Brook, Kite

Farm Ditch and West Brook are all located on the Oyster Coast between Whitstable and Herne Bay. The fourth, the Scrapsgate Drain, is located on the Isle of Sheppey at Minster. Flood models were produced for each watercourse and the peak fluvial flow and the maximum water level during the tidal cycle were run coincidently, to provide a worst-case scenario. The results of this study were used to update the EA's Flood Zone Maps and to test different options to reduce flood risk within the catchment.

The EA has since updated the modelling for the Swalecliffe Brook, Kite Farm Ditch and West Brook to include the climate change allowances published in 2016. The risk of flooding from the Scrapsgate Drain has been modelled separately.

East Kent Coast Modelling Study (2018)

The East Kent Coast Model consists of two domains, with domain one covering the coastline within the district boundary and stretching from Seasalter to Kingsdown. The aim of the model was to assess the tidal risk of flooding for the study area and included the tidal reaches of the Lower Stour. The model includes wave overtopping which applies the climate change allowances outlined in Section 6.2.2 below. In addition, several breach locations have been modelled, 4 of which lie within the district;

- Failure of flood gate at Whitstable Harbour
- Breach at wall of Harbour Street behind Whitstable Harbour
- Breach of wall fronting the Tennis Courts at Whitstable
- Breach of the Northern Sea Wall at Groyne Bay 3, near Reculver

Further breach modelling has been undertaken of the Northern Sea Wall at Groyne Bay 9, near Reculver and whilst the breach is located outside of the district, the extents would still affect parts of the district.

Plenty Brook Modelling Study (2013)

In 2013, the EA commissioned the Flood Risk Mapping Study of the Plenty Brook, the results of which were subsequently used to update the 'Flood Map for Planning'. The aim of the study was to understand the mechanism of flooding within the catchment of the Plenty Brook and to provide flood extents which could be used in the National Flood Risk Assessment.

A review of the Plenty Brook model in 2018, undertaken by Herrington Consulting, found that the continuity of the network was compromised, which results in an overprediction of flooding in Herne Bay town centre. Consequently, the network continuity error had been corrected and the revised model has been sent to the EA for review. Discussions are currently (2022) being held with the EA regarding how the Plenty Brook model can be refined to better represent the risk of flooding at this location, but until these discussions are concluded, the results from this model should be used with caution.

Little Stour and Nailbourne Flood Risk Mapping Study (2013)

Modelling was undertaken in 2013 for the Little Stour and Nailbourne. The Nailbourne discharges into the Little Stour upstream of Littlebourne and is a groundwater fed watercourse, predominantly flowing when groundwater levels are elevated. The Little Stour is a river typically flowing all year around and has been modelled up to Seaton, before it joins the Lower Stour.

The modelling study tests scenarios for a range of different return period events and was updated in 2016 to include additional climate change allowances. However, since the model was originally released, a new modelling study solely focussed on the Nailbourne has been undertaken (see below).

Nailbourne Fluvial Mapping Study 2018

A detailed fluvial model of the Nailbourne has been constructed by others and released in December 2018. The model covers the reach of the Nailbourne from Lyminge to Bekesbourne and forms part of a wider scope of works, which seeks to investigate options testing to identify suitable flood risk management measures.

Lower Stour Modelling Study (2010)

Originally published in 2010, the model has been updated in 2012 to include further details regarding the tidal undefended scenarios. The study considers the river from Fordwich to Pegwell Bay, near Richborough and has been undertaken to assess both the impact of tidal and fluvial flooding of the river. Since the study was prepared, new modelling studies have become available for the area and the tidal extent of the Lower Stour has since been included in the East Kent Coast modelling study (see above). Nevertheless, there is no updated modelling as yet (2022) for the fluvial flood risk from the Lower Stour, although the EA has confirmed that the 2010 model of the Lower Stour is due to be updated by early 2023.

North Kent Coast Modelling Study (2013-2019)

The North Kent Coast modelling Study consists of three Domains;

- Domain 1: Erith to St Mary Hoo (2019)
- Domain 2: St Mary Hoo to Seasalter, including the tidal River Medway to Allington Lock (2018)
- Domain 3: Whitstable to Margate (2013)

Domain 3 of the North Kent Coast modelling study has since been superseded by the East Kent Coast modelling study. The East Kent Coast modelling study only includes an area up to the south of Whitstable, where Domain 2 of the North Kent Coast modelling study starts. Whilst no breach modelling has been undertaken in the area of Seasalter, the model results include the impact of wave overtopping.

Whilst detailed numerical flood modelling has been provided by the EA for the district, further updated numerical flood modelling may be required for key strategic areas within the District. As the SFRA is considered to be a live document, this section of the report will be updated once further updated model results become available.

4.3. Bespoke Flood Risk Modelling

One of the primary objectives of the SFRA is to refine the quality of flood risk information available to decision makers so that planning decisions can be better informed. Therefore, the four main EA flood models covering areas within the District have been updated to provide the latest possible data to the planners for key locations.

Whitstable and Herne Bay Tidal Flood Model 2023

Two separate tidal flood models simulate flooding from the sea at Herne Bay and at Whitstable. By agreement, detailed numerical flood modelling has been undertaken for these two coastal towns due to their strategic importance and the likely impacts of flooding at these locations on the existing population. Each model update includes the following;

- Redevelop the offshore boundaries using the latest available tidal water level data and Environment Agency Coastal Flood Boundary (CFB);
- Applied the latest Sea Level Rise (SLR) adjustments following the National Planning Policy Framework (NPPF) for climate change allowances;
- Applied the latest available Defra LiDAR data;
- Applied the latest available wave overtopping rates as supplied by the Southeast Regional Coastal Monitoring Programme (via Canterbury City Council and the Channel Coastal Observatory);
- Incorporated the surveyed defence heights and the future defence height increases proposed by Canterbury City Council to achieve their target wave overtopping rates; and
- Reconstruct the model in a GIS workspace (the previous version used MapInfo) and use the latest available version of the software.

The coastal defence levels representing present day conditions use Canterbury City Council survey data dating from 2016, which have been confirmed to be the latest available. Future proposed defence height raising has been applied to represent the 2100 and 2125 epochs following the guidance of Canterbury City Council and their advisors. The future defence height raising has been guided by the aim of achieving specific allowable overtopping rates (not published here) and generally lead to defence height increases in the order of 1.0 m to 1.1 m, with some variance for specific defence sections.

In addition to modelling the actual risk scenarios, residual risk scenarios (i.e. a breach of the defences) has been modelled for Whitstable to account for the latest climate change allowances. Due to its potential high severity, a breach in the defences at Whitstable Tennis Court has been simulated for strategic purposes and to inform the Memorandum of Understanding. Appendix A.6 includes the outputs of the modelling, alongside the EA's East Kent Coast 2018 model outputs for breach scenarios at Whitstable Quay and Whitstable Harbour Street.

The East Kent Coast model does not include residual risk scenarios for Herne Bay. Following the update to the NPPG in August 2022, meetings held with the EA have concluded that residual risk scenarios should be modelled for Herne Bay as part of the SFRA. Two possibilities have been considered:

- Failure to mount the demountable defences prior to a flood event; and
- Failure to close the Neptune's Arm car park flood gate as well as failure to mount the demountable flood defences prior to a flood event.

The results are shown in Appendix A.6.

<u>It should be noted that the tidal models are currently being reviewed by the EA for sign-off and therefore the results are subject to change.</u>

Plenty Brook Model Update January 2024

Herrington Consulting has completed an extensive, but partial update to the EA's Plenty Brook 2013 model so that the model results can be incorporated into the SFRA. Correspondence with the EA has confirmed that the Plenty Brook 2013 model is set to be fully updated in the future and therefore, the results presented within this SFRA are intended as interim results until such time that a fully updated model is available. Specifically, the area immediately upstream of Eddington requires a new topographic survey to represent recent extensive changes and therefore facilitate a complete model update. At the time of writing the updated Plenty Brook model is nearing the completion of the review process with the EA.

The interim updates to the model included;

- Corrections to culverts and the model domain
- Updates to the model boundaries to represent current climate change allowances;
- Updates to include the latest aerial height data
- Updates to the most recent model version
- Changing model to a "bare earth" approach, removing raised buildings

As the model is an interim update, some elements which could further have an impact on the flood extent of the Plenty Brook have been excluded, namely the following;

- Upstream flood storage area and new residential development at Thanet Way (A2990) has not been included within the model.
- Hydrology has not been reviewed and updated.

The outputs of the interim Plenty Brook model have been included within the maps appended to this document.

Great Stour 2 Model Sensitivity Testing 2023

The existing Great Stour 2 2013 model has previously been demonstrated to overestimate, particularly in respect to the functional floodplain. Therefore, a series of sensitivity tests have been agreed to establish the possible causes of the model's overestimation.

To facilitate the sensitivity testing process, the Great Stour 2 model has been re-worked extensively to establish model stability in the most recent version of the modelling software (including a conversion of the model from a Flood Modeller/TUFLOW combination to a pure TUFLOW model). Although outside of the agreed sensitivity testing process, improving the stability of the model alone demonstrated improvements in the model's ability to predict flooding. The existing model has already been stated to overpredict the calibration event by around 35% although no correction had followed. Consequently, historic records of flooding in Canterbury have been used to adjust the model to similar recorded extents for the 1 in 20 year flood event. To achieve this, the following sensitivity tests have been undertaken ;

- Scaling of the input hydrology;
- Impact of inclusion/exclusion of specific river walls (Sally's Orchard);
- In-channel Manning's n bed roughness; and
- DEM modernisation with 2022 LiDAR.

The scaling of the input hydrology to around 60% (reduction in peak flows of 40%) brings the flood extents of the 1 in 20 year return period significantly closer to the historic records of flooding. Such a reduction in the input flood hydrograph is consistent with recognised overprediction of the original model. The absence of various river walls throughout Canterbury has been shown to significantly impact the extents of flooding. Including these river walls brings the model's results much closer to observed flood extents. Increasing in-channel bed roughness in selected weedy reaches to more realistic values has shown to impact flood extents for the 1 in 20 year return period event at key locations in Canterbury. However, it is recognised that significant efforts would be required to adjust the roughness of the channel throughout Canterbury to correctly represent the whole of the modelled river network.

Updating the model grid DEM to use the latest 2022 LiDAR data yields no significant changes to the predicted flood extents in Canterbury.

The functional floodplain extent shown in Appendix A.3 for Canterbury city centre takes the changes listed above into consideration. It should be noted that the appropriateness of the model for defining the functional floodplain extent in the town centre is currently still being discussed with the EA and therefore, the results may be subject to change.

4.4. Historic and Localised Flooding

There is a detailed history of flooding within Canterbury District that has been well documented by the Council's Engineering Team and the EA. Information on actual and potential sea flood events since World War II and inland flooding over the past thirty years is held. There are particularly good records of the flooding that took place over the winters of 2000/2001 and 2013/2014. The relevant details have been reproduced in a Table format in Appendix A.2, which accompanies the Historic Flood Map.

In addition, both KCC and SW have been contacted to obtain historic flood incidents since 2016. These have been summarised and are also included within Appendix A.2.

The most significant flood events that have affected the District are discussed in more detail below.

1953 North Sea Surge – During the January 1953 storm, the sea defences along most of the North Kent coast were overtopped or breached and severely damaged. Both Whitstable and Herne Bay town centres were badly flooded and at Seasalter and Reculver the sea breached the railway line hundreds of metres inland of the primary sea defences. The storm is estimated to have a return period of about 1 in 150 years (Canterbury City Council – Coastal Management Study 1993) and a still water level of 4.7m AODN was recorded at Whitstable.

The worst flooding was at Whitstable where the sea defences failed mainly due to a breach in the golf course seawall at the western end of the floodplain. There was also significant overflow and overtopping at Whitstable Harbour, at the eastern end, which quickly filled the low lying land behind it. Failure of the golf course seawall resulted in floodwater also breaching the golf course bund (secondary defence) and flooding much of the town by the "back door". Water coming through the harbour flooded the eastern part of the town, which is particularly low lying in the Gorrell area. Flooding to a depth of nearly two metres was recorded at the lowest part of the town at Cromwell Road.

The floodwater extended to the railway and passed through the bridge at Canterbury Road to flood some of the land and properties south of the railway. Seafront properties all along the Whitstable frontage were badly flooded due to a combination of overtopping and isolated pockets of overflow. Over 2,000 people became temporarily homeless as a result of the flooding, but there were no fatalities or serious injuries.

At Herne Bay during the same 1953 storm event, there was no major failure of the main seawall. The flooding resulted from significant overtopping and even some overflow of the low seawall. Flooding to a depth of about 1.2 metres was recorded at the lowest part of the town at the Beach Street car park.

Figure 4.1 - Herne Bay Seafront during 1953 Storm.

Figure 4.2 - Flooding at Whitstable, January 1953.

1978 Storm – The coincidence of high tides and storm force north easterly gales in January 1978 resulted in considerable damage to property on the coast at Herne Bay, but flooding was mainly limited to property along the seafront and just inland. The storm is estimated to have been a 1 in 20/30 year return period event with a still water level of 4.1m AODN. Although the waves were bigger than in 1953, the sea level was lower. This accounted for the severity of the damage but the depth of flooding to property was only in the order of 250mm, except for basements. The number of properties flooded by this event was small.

The impact of this event was reduced because the sea defences had been raised following the 1953 floods. In addition, the seawall was not breached. Due to the orientation of its coastline in relation to the predominant direction of the 1978 storm there was little flooding at Whitstable as a result of this storm. However, significant flooding to houses along Faversham Road, Seasalter was reported and some of the properties on the beach were washed off their foundations.

Figure 4.3 - Damage at Herne Bay as a result of the 1978 Storm.

1987 Hurricane – Some flooding occurred to property abutting the Great Stour through Chartham, Canterbury and Fordwich as a result of the October 1987 hurricane. The river overtopped its banks at a number of locations, however, this mainly occurred just upstream of culverts that had been almost totally blocked by fallen trees and other debris.

1996 Storm – This storm is estimated to have had a return period of 1 in 10 years, yet despite the fact that the wind was from the north-east (the worst direction), no significant flooding occurred at Herne Bay. The Neptune car park was flooded to a depth of up to 300mm in places with some water flowing from there down Market Street. There are no records of internal flooding to property during this event, although the impacts of this storm may well have been mitigated through the early deployment of sandbags. This storm occurred after the major sea defence works of 1992 at Herne Bay, which proved to be very effective as lesser storms prior to 1992 had caused property flooding on the seafront and in Market Street.

During this event flooding also occurred at a number of houses along Faversham Road in Seasalter. The seawall east of Reculver Towers also failed and only the rapid installation of emergency works prevented a full breach and extensive inland flooding.

Figure 4.4 - Failed Seawall at Reculver caused by the 1996 Storm.

April 2000 Floods – On 4 April 2000, 50mm of rain fell steadily over a twelve hour period on ground that was already saturated. This resulted in widespread flooding across the District from rivers, minor watercourses, surcharged surface water sewers and from surface water run-off. Internal flooding to property was recorded at numerous locations within the District, with the worst affected area being Eddington near Herne Bay where flooding from the Plenty Brook resulted in flooding to 18 properties.

Winter 2000/2001 Floods – The winter 2000/2001 was the wettest since records began with over twice the average rainfall. There were also two days when about 50mm of rain fell over a twelve hour period (12 October 2000 and 8 February 2001) and in early November 2000 flood flows equating to a 1 in 50 year event were recorded in the Great Stour. Flooding occurred at locations throughout the District, although the sources varied considerably.

Given the extreme flood flows in the Great Stour, there were relatively few properties flooded. Those that were affected were generally as a result of overtopping of defences and not defence failure. The flooding from the Stour was partly due to the overtopping of the two storage reservoirs upstream of Ashford. These reservoirs were designed to accommodate a 1 in 100 year single storm event. However, a sequence of lesser storms occurred over a relatively short period. This did not allow the reservoirs to fully drain before the onset of the next storm, thus causing them to overflow.

Flooding directly resulting from other main rivers overtopping their banks, particularly the Little Stour, was quite high. Flooding from (at the time) non-main rivers, such as the Plenty Brook, was also a major cause of problems but the reasons for this are quite complex in a number of locations. Much flooding was as a result of surface water sewers and road drains not being able to cope with the volumes of water, particularly in rural areas where they became blocked with silt from fields.

Again, in more rural areas or on the outskirts of urban areas, unmaintained minor watercourses and significant run-off from open fields resulted in localised flooding. Springs appeared throughout the District that had not been known to flow in living memory, with some of these causing flooding to houses.

One of the most distressing aspects was flooding to properties from foul sewers either backing up or when pumping stations had failed. In what was estimated to be a 1 in 100 year event, a combination of flooding from rivers, groundwater emergence, overland flow and run-off from farmland as well as highways and sewer surcharging caused flooding to properties in all of the villages along the Nailbourne and Little Stour - at Barham, Kingston, Bishopsbourne, Bridge, Patrixbourne, Littlebourne, Ickham and Wickhambreux. Some houses at Bishopsbourne and Patrixbourne remained flooded for months. In total across the District, 290 houses were known to have been flooded internally, although there were probably more unreported cases. Many other properties were saved from internal flooding by the provision of sandbags. The Flooding Scrutiny Panel Report contained in Appendix A.7 details the event and also the various flood alleviation works carried out afterwards.

Figure 4.5 - Flooding from the Nailbourne at Barham.

August 2007 Whitstable Flood – On 12th August 2007, flash flooding occurred in the low lying part of the Whitstable town centre, as a result of 50mm of rain falling in two hours. This was estimated to be in the order of a 1 in 100 year rainfall event. At least 30 and probably nearer 50 houses were flooded internally due to surcharging of the old, often combined, sewers. There were also problems with overflowing of the Gorrell Tank (Southern Water) outfall system that is located adjacent to the harbour.

Winter 2013/2014 Floods – Following a stormy winter, where the district had experienced the biggest storm surge since 1953 in early December, England experienced the wettest January since records began in 1766. The south-east alone received 258% of its average rainfall for January. As a result, the ground became more saturated and the Nailbourne, a winterbourne that is usually dry downstream of Lyminge, began to flow.

By early February the Nailbourne was beginning to flow out of bank and flood roads and farmland. The flooding continued to intensify throughout the first part of February, exacerbated by rising groundwater levels and springs. Over-pumping of bridges occurred at Barham, Bridge, Patrixbourne and Ickham, and a pump was installed at Bishopsbourne to move water back into the river channel. In total 16 houses were flooded from the river, although most of these also had groundwater flooding and flooding from springs. A further 25 were flooded from groundwater, surface water and from foul sewers. There were also significant issues with surcharged sewers throughout the length of the Nailbourne.

Figure 4.6 - Photograph of flooding at Out Elmstead Lane, Barham January 2014.

Concurrently, the Petham Bourne began to flow, a very rare occurrence even in wet winters. This flooded roads and fields from Waltham through to its confluence with the Great Stour at Shalmsford Street. In addition, it flooded (and shut down) the Canterbury West – Ashford railway line at

Shalmsford Street. However, no houses were flooded by the Petham Bourne, or by groundwater in this area.

The Great Stour also caused problems with long term flooding of farmland particularly at Grove, where the road was closed for 3 weeks and one house was flooded. Only minor flooding to car parks occurred in the centre of Canterbury. There was significant flooding of gardens at Fordwich from December 2013 through to March 2014, but only minor internal flooding to one house. The very high sea storm surge of December 2013 did not cause any flooding to properties, but the houses along Faversham Road at Seasalter were evacuated on one night as a precaution.

Winter 2019/2020 Floods - After lying dormant for several years, the Nailbourne started to flow again in early 2020 following heavy rainfall in autumn 2019. Similar to the flooding witnessed in 2013/2014, several roads became flooded, preventing residents of Out Elmstead Lane to drive towards Valley Road and instead, forcing them to leave via a dangerous junction with the A2. South Barham Road became a waterway with flood barriers, pumps and sandbags having been installed to protect the properties along the road. There have been no records of internal flooding as a result of the flood event.

Since the various flood events catalogued above, significant improvements have been made to the sea defences and flood alleviation systems have been introduced across the District.

4.5. Sea Flood Defence Infrastructure

Over 10km of the District's 21km coastline is low-lying, which, without the protection of the existing sea defence infrastructure, would be inundated on a regular basis. With the exception of the agricultural land at the east and west, the land behind the defences is highly developed and includes the towns of Whitstable and Herne Bay.

In order to protect these developed areas, sea defences have been constructed along the entire length of the District's low-lying frontage.

Since 1953 all seawalls protecting low-lying land have been raised, and where necessary reconstructed, to a level of at least 5.8m AODN (1m above the 1 in 200 year extreme sea level). All seawalls are protected against failure by a large shingle beach, stabilised by a comprehensive system of timber groynes. The shingle beach plays a significant role in reducing wave overtopping, as well as reducing the risk of the seawalls being undermined. In more recent years, major sea defence improvement works have been carried out at Whitstable (1989 and 2006), Swalecliffe (1988), Hampton (1996, 2013 and 2015), Herne Bay (1992) and Reculver (1998).

Figure 4.7 - Reduction of Overtopping due to 1990 Breakwater at Herne Bay.

These are extensive formal defences - mainly comprising a concrete seawall, fronted by a large shingle beach, kept in place by timber groynes.

Figure 4.8 - Sea defences under construction at Herne Bay in 1990.

The beaches, as well as protecting the seawall against wave attack and undermining, also contribute to the overall level of protection by considerably reducing the amount of wave overtopping. The groynes are generally close spaced to ensure that a sufficient volume of beach is maintained within each groyne bay. At the majority of locations there is a relatively stable beach. The beaches are monitored at least three times every year as part of the Regional Strategic Coastal Monitoring Programme and the data analysed regularly to ensure the profile of the beach remains within the design limits.

The Council has an annual beach recycling contract to deal with any areas where the beach is eroding. It also has an adequate annual maintenance budget to repair groynes and the seawall and to make minor improvements. Over the last twenty years, major capital projects have been carried out to bring all defences protecting developed areas up to the 1 in 200 year design standard. There is also a long-term capital programme for further improvements to the defences, which mainly comprises of raising seawalls, to sustain this standard of protection in line with projected rising sea levels.

Sections 7.1 of this report describes the four Flood and Coastal Erosion Risk Management Strategies covering the short, medium and long term proposals to maintain and improve the sea defences over time, and also the Council's approved Policy Statement on Flood and Coastal Defence. These all reiterate the need for, and the Council's commitment to, continued maintenance of the defences and planned beach replenishments where necessary. The strategy reports also highlight the need for the raising of seawalls in some locations by up to 0.7m, probably in 20 to 30 years' time. That work is included in the overall costs for schemes that are in the EA's Medium

Term Plan. It should be noted that the costs for raising seawalls is relatively low and could be covered from the Council's maintenance budget if carried out in stages, should Central Government funding be limited in the future.

The coastal flood defence assets along the District's coastline are identified on the map in Appendix A.1. All relevant data, including type and construction, standard of protection, crest height, condition etc. is summarised in the accompanying Table A.1.1 also in Appendix A.1.

4.6. River Flood Defence Infrastructure

With the exception of the various floodwalls and sluice gates on the Great Stour through Canterbury's city centre, there are very few physical flood defence structures on the watercourses in the District. However, many of the watercourses within the District have benefited from flood alleviation schemes and various improvement works over the last twenty years, particularly after the 2000/2001 and 2014/2015 floods. Due to the nature of these schemes it is more appropriate to describe these within the main document rather than highlighting on a map. The key information is therefore summarised in Table 4.2 below.

Watercourse	Improvement Works Undertaken
Great Stour	Construction of major flood storage reservoirs upstream of Ashford at Hothfield and Aldington in 1990 which improved the standard of protection to 1 in 100 years (single event) through Canterbury (see also Section 5.5 of this report). Minor improvements to weed screens, sluices and weirs through the city centre, particularly at Barton Mill, since 2000. Programme of river training works including dredging and bank cutting back downstream of Fordwich to improve flow. Repairs to river walls are complete in Wickhambreaux and nearing completion in Stodmarsh and Grove.
Nailbourne	In response to the 2000/2001 flood events, a number of improvements were made to the Nailbourne through all of the villages. These works were mainly carried out to increase the capacity of the river channel and culverts. A new diversion channel was constructed at Littlebourne and improvements to highway drainage were carried out at a number of the villages. Recutting of banks and watercourse bed throughout the reach from Barham to Bishopsbourne to improve flow and remove obstructions. Flood walls and new weed screens at Barham. New, improved capacity, road culverts at Barham, Kingston and Bishopsbourne. Major capital project on river at Bridge in 1995. New diversion channel, deepening of ford and other works at Patrixbourne. New floodgate at Brewery Lane ford. Construction of a new drain from The Street at Bishopsbourne through to the Nailbourne. Demountable flood barriers to keep the Nailbourne in its course at Derringstone. Short length of earth bunding at The Street in Barham. Clearance of the Blackhole Dyke upstream of Wickhambreaux. Reinstatement of the damaged river bund on the Nailbourne at Bridge. An extension of the riverside bund at Bridge, to prevent a reoccurrence of the river coming out of the bank and flowing down Brewery Lane.
Little Stour	Flood relief diversion channel from Littlebourne to Wickhambreux. Removal of obstructions and improved maintenance to channel downstream of Littlebourne. Penstock to control flows between the Little Stour and Blackhole Dyke (Summer 2016). Repairs to the bund beside the Little Stour at Littlebourne. Work on a more easily cleared weed screen at the existing culvert at Wickham Lane.
Gorrell Stream	Improved regime and additional pump by Southern Water at the Gorrell Tank outfall. New weed screen at entry to piped section. Clearing out of channel and removal of obstructions plus improvement works by EA commenced in September 2010.

Watercourse	Improvement Works Undertaken
Kite Farm Ditch	Re-cutting of banks and watercourse bed through majority of open section plus weed screen improvements works by EA commenced in September 2010.
Swalelciffe Brook	A second outfall structure constructed alongside existing outfall to double discharge capacity to the sea (Refer to Figure 8.2 below).
Plenty Brook	New outfall structure as part of sea defence improvements in 1990. Clearance of obstructions and minor improvements to piped section by Southern Water. New weed screen and channel improvements at Eddington. Full clearance and extension to total 26,000m^3 capacity of Southern Water holding reservoir at Eddington. Improvements to capacity of Kent Highways A299 balancing lagoons. New 35,000m^3 online balancing lagoon at Bullockstone and 10,000m^3 offline holding lagoon below Herne.

Table 4.2 - Improvement Works to Rivers within the District.

Figure 4.9 - Improvement to the Swalecliffe Brook Outfall.

In addition to the above and following further flooding along the Nailbourne, Little Stour, Great Stour and Peltham Bourne, in 2014/15 CCC has been working with the EA, Kent County Council (KCC) and representatives from key parish councils to identify measures to try to reduce any future flooding.

Projects managed and funded by CCC include:

- New floodgate at Brewery Lane ford
- Construction of a new drain from The Street at Bishopsbourne through to the Nailbourne
- Demountable flood barriers to keep the Nailbourne in its course at Derringstone
- Short length of earth bunding at The Street in Barham
- Major clearance of ditches along the route of Petham Bourne from Waltham to Shalmsford Street
- Clearance of the Blackhole Dyke upstream of Wickhambreaux
- Discussions are being held about the possibility of improving the flow of the Nailbourne by increasing capacity at the listed footbridges at The Causeway in Barham and Keepers Hill in Patrixbourne
- Penstock to control flows between the Little Sour and Blackhole Dyke (Summer 2016)

The EA's Recovery Programme – measures funded by Central Government to repair existing flood defences that were damaged in the floods.

- Reinstatement of the damaged river bund on the Nailbourne at Bridge and repairs to the bund beside the Little Stour at Littlebourne are complete
- Repairs to river walls are complete in Wickhambreaux and nearing completion in Stodmarsh and Grove
- Work on a more easily cleared weed screen at the existing culvert at Wickham Lane
- An extension of the riverside bund at Bridge, to prevent a reoccurrence of the river coming out of the bank and flowing down Brewery Lane
- A major clearance of growth, desilting of the river and removal of gravel build up, along with a small realignment of the Nailbourne at Patrixbourne
- Major cut back of trees encroaching into the river and dredging between Fordwich and Grove

Southern Water has also carried out a number of upgrades to its pumping stations reducing the risk of flooding from sewers. In 2013, on a £1 million programme to tackle the problem of high levels of groundwater flooding, repairs to the sewer network in villages along the Nailbourne river began. Engineers used remote operated CCTV cameras to extensively survey over ten kilometers of sewers and 250 manholes. A total of 3.5km sewer repairs have been completed in the following locations;

- Bridge, near Brewery Lane and Mill Lane
- Bourne Park, at Bishopsbourne
- Charlton Park
- Barham

- Other locations along the Nailbourne

Notwithstanding this, Southern Water has stated that they will continue to monitor the situation across the catchment and undertake any work, where necessary, to mitigate the risk of future drainage issues.

5. Overview of Flood Risk

5.1. Sources of Flooding

The topography and geology of the land within the boundaries of the Canterbury District are diverse and complex, as is the range of flood sources. This section of the SFRA therefore examines each source of flood risk and discusses the mechanisms by which flooding can occur.

5.1.1. Flooding from the Sea

The part of Canterbury District's shoreline that is low lying is approximately 10km long and is defended throughout its length. At each end of the District, these defences protect lower-lying, fertile agricultural land and important infrastructure at Graveney/Seasalter to the west and Reculver/Northern Seawall to the east. The land levels in these areas are generally at or below the Mean High Water Springs (MHWS) level of 2.7m AODN and consequently, without the protection of the existing sea defences much of this land would be inundated on a regular basis. The defences also protect the low-lying urban areas of Whitstable, Swalecliffe, Hampton and Herne Bay. At Whitstable there are locations where the land and houses are at or slightly below the MHWS level of 2.7m AODN, whilst at Herne Bay the lowest land level is around 3.3m AODN. The defences are therefore essential to protect the coastal towns from regular flooding from the sea and in some cases permanent inundation.

There are two main ways that the sea can cause flooding; An extreme increase in the sea level, or through wave overtopping; These two mechanisms are discussed below.

- An extreme increase in water levels, known as a surge event, can occur when an already high tide coincides with a low-pressure weather event, resulting in the surface of the sea becoming elevated. Unlike the day-to-day tide, the height of a surge event is difficult to predict. Elevated sea levels due to a surge could result in flooding in coastal locations.

- A wave overtopping event usually occurs when large powerful waves collide with the shoreline, or sea defences, forcing seawater landwards. In this event the effects can be exacerbated by strong onshore winds, which contribute to increased runup and spray from the waves, allowing water to pass over the crest of the sea defences.

The whole of the District's shoreline faces north and has the potential to be affected by North Sea surges, which can raise the sea level by up to 2.5m. However, due to the relatively shallow foreshore, wave heights are generally depth limited and are therefore relatively small, even during storm surges.

Given the presence of the existing sea defences, flooding from the sea can only occur as a result of either the existing defences breaching or being overtopped by wave action. Depending upon the location of the particular site with respect to the breach or overtopping event, the consequences can vary significantly. Nevertheless, both town centres of Whitstable and Herne Bay are low-lying and therefore, if water was to reach the town centre through either flood mechanism, flooding would be extensive.

5.1.2. *Flooding from Rivers*

There are a number of watercourses within the District, which have been categorised as main rivers and, as can be seen in the section on historic flooding, these watercourses have caused flooding problems in the past. The locations of these watercourses are shown on the map in Appendix A.1 and are described as follows:

River Great Stour – The various tributaries of the Great Stour meet at Ashford, the river then flows unimpeded through rural chalk downs from south west to north east bisecting the District. It passes through the village of Chartham into Canterbury's city centre, where it is highly modified. The river splits into three channels and a complicated series of sluices, gates and mill races control river flows. Localised flood walls provide protection to some pockets of development. These structures have an important role to play in managing flood risk within the city.

Downstream of the city the river enters the tidally influenced Lower Stour at Fordwich and eventually flows into the sea near Sandwich. Upstream of Canterbury, two flood storage reservoirs, at Hothfield and Aldington, were constructed south of Ashford in the early 1990s. These, together with natural flood storage on the agricultural land between Ashford and Canterbury, provide protection against flooding to most parts of the city for events up to around 1 in 100 years. However, whilst these flood storage reservoirs provide a reasonably high standard of protection against a single larger return period event, the standard of protection against two consecutive lesser events is limited by the time taken to discharge the reservoirs. Flood modelling of the River Great Stour has been carried out by the EA as part of the Great Stour Flood Risk Mapping Study (2013 and 2016).

Petham Bourne – The Petham Bourne is not classified as a main river and is a tributary of the Great Stour joining it at Shalmsford Street. It is groundwater fed and flows very infrequently; 1930, 2000/2001 and 2013/2014 are the only recorded events. Its route is poorly defined in places but when it does flow there is a risk to property adjacent to it, particularly at Shalmsford Street.

Nailbourne/Little Stour – The Nailbourne is a chalk fed stream, which rises during prolonged periods of rainfall. Its source is at Lyminge and, within the District, it flows through the villages of Barham, Kingsdown, Bishopsbourne, Bridge, Patrixbourne and Bekesbourne. The Nailbourne eventually joins the Little Stour near Littlebourne, which then flows through the villages of Wickambreux and Seaton before its confluence with the Great Stour at Stourmouth.

Flow in the Nailbourne is intermittent, locally thought to flow on average once every seven years. However, in recent years it has flowed in 2000/2001, 2003, 2010, 2013/2014, 2014/2015, 2015/2016 and 2019/2020. The significant flooding in 2000/2001 was estimated to have a return period of between 50 and 100 years. Property close to the river in all the villages were affected to some extent. Similar impacts were seen during the winter of 2013/2014 and 2019/2020.

Considerable improvements to the river have been carried out since 2001, however, there are still a number of restrictions, such as road culverts, where localised flooding can occur upstream. It is considered that the risk of flooding to parts of the Nailbourne/Little Stour villages is in the order of 1% - 2% AEP (estimated return period between 50 and 100 years).

Sarre Penn – The Sarre Penn is sourced at Dunkirk and runs north of Canterbury at Harbledown through to Broad Oak and then parallel to the A28 to Sarre, eventually joining the River Wantsum. The Sarre Penn flows predominantly through agricultural land that is remote from developed areas, however, there are localised land drainage problems associated with this watercourse, particularly in north Canterbury and where road culverts restrict flow. Where property is located in close proximity to the Sarre Penn there may be a risk of flooding. Consequently, before further development adjacent to this watercourse the risk of flooding would need to be investigated in greater detail.

Oyster Coast Brooks – The EA, in the Stour CFPM, has grouped together the five short rivers known as Gorrell Stream, Kite Farm Ditch, Swaleciffe Brook, West Brook and Plenty Brook and refers to them as the Oyster Coast Brooks. They are all similar in that they are characterised by a clay catchment, are heavily modified, have a short and steep channel gradient and a tide-locked outfall controlled by a sluice gate. The rivers respond quickly to rainfall due to the urban area through which they mainly flow, the steepness of the catchment and the clay geology. The steep gradient means that the rivers drain into the sea very quickly so peak flows are of a short duration. However, the peak can be influenced by tide locking which makes the effects of flooding much worse. Various structures and culverts along their routes restrict flow, as does the typical narrow channel section. Significant recent development that has taken place beside these rivers has exacerbated flood risk to some degree.

In 2014, a Flood Risk Mapping study of the Oyster Coast Brooks was commissioned by the EA (refer to Section 4.2). Flood models were produced for three of the five watercourses with the peak fluvial flow and maximum of the tidal cycle modelled to coincide, to provide a worst-case scenario. The results of this study were used to update the EA's Flood Maps and to test difference options to reduce flood risk within the catchment.

*The **Gorrell Stream*** has its source at Duncan Downs above Whitstable and flows steeply downhill into the town at St Andrews Close. It is then in a defined channel with concrete sides, with short lengths culverted, through to Belmont Road. Thereafter through to its outfall, a length of 1.1km, the stream is fully piped (1400mm diameter) and is designated as a public surface water sewer maintained by Southern Water. The Gorrell Tank, at the stream's outfall, has a capacity of 18,000 cubic metres. There is a gravity outfall into Whitstable Harbour plus a pumping station to deal with high flows discharging to a sea outfall. Because of the complex system of interconnecting sewers, the potentially high flow rate and the reliance on a pumped outfall, the lower Gorrell catchment through the town of Whitstable is particularly at risk from flash flooding, as occurred in the winter of 2000/2001 and August 2007.

The ***Kite Farm Ditch*** has its source within the Chestfield Golf Course and is mostly natural open channel, although it is culverted where it passes under the Thanet Way, railway line and various other roads. It discharges to the sea at the Swaleciffe Sea View Caravan Park via a sluice gate (operated by CCC) which is normally left fully open, but is closed to prevent high tides causing levels in the watercourse to back-up.

The greatest risk of flooding is at the lowest section, along Colewood Road. After passing under the railway, the stream emerges briefly into an open ditch but very soon leads into a Southern Water surface water sewer. This picks up the flow from other surface water sewers and at the junction of Colewood Road and St John's Road the surface water sewer outfalls into the open channel that runs alongside the road leading to the caravan park and thence to the sea. This whole area between the railway line and the sea is virtually flat, meaning that flow rates in this part of the sewer/ditch system are always low. Consequently, high rainfall can rapidly lead to surface water sewers surcharging, which is exacerbated whenever the outfall is tide-locked. This was the cause of several houses in the area suffering internal flooding during the winter of 2000/2001.

The ***Swalecliffe Brook*** rises close to the A290 midway between Blean and the Thanet Way at Whitstable and then runs in a northerly direction for just over 8km until it reaches the sea at Long Rock, Swalecliffe. However a sequence of ditches can claim to extend the source of the Brook several kilometres further inland. Most of the Swalecliffe Brook's course is through fields and woodlands so any flooding has little impact on roads or houses. However, properties backing onto the watercourse at Chestfield and through the built-up area of Swalecliffe, north of the Herne Bay Road, are vulnerable to flooding.

The Brook is carried under the earth-bund coast protection at Long Rock in a culvert fitted with two sluice gates (both operated by CCC). The winter of 2000/2001 showed that even with both sluices fully open, the flow in the Brook was so great that the culvert formed a constriction which prolonged the upstream flooding across the playing fields. This problem was addressed in 2002 by installing three, 900mm diameter pipes through the earth bund near the culvert, each fitted with a flap-valve on its seaward side. After the bund, the Brook enters the Long Rock Site of Special Scientific Interest.

Over the last few decades the mouth of the Swalecliffe Brook has been gradually pushed to the west as a spit of beach shingle is slowly extended by the natural east-west littoral drift. Generally there is sufficient flow in the Brook to keep the mouth clear but low summer flows mean that from time to time it is completely blocked by shingle and has to be cleared by machine. These works are undertaken by the EA.

The ***West Brook*** rises in Thornden Wood and, after just over 5 kilometres, reaches the sea at Hampton Pier Avenue. Most of its course lies through fields and woodlands but when the West Brook emerges from under the A2990 (the old Thanet Way) and the railway line, it enters the urban area of Studd Hill – Hampton, where properties adjacent to the brook are at risk of flooding. At its mouth the West Brook is carried under the concrete seawall by a short culvert, which is controlled by a sluice gate operated by CCC. As well as some houses at Hampton, infrastructure is also vulnerable to flooding from the West Brook. A 500m section of Whitstable Road/Sea Street was inundated in April 2001 including the Sea Street / Hampton Pier Avenue junction, which caused considerable disruption to traffic. The bridge providing access into the Studd Hill Estate over the West Brook from Hampton Pier Avenue is also vulnerable.

*The **Plenty Brook*** rises on the northern edge of West Blean Woods and runs slightly east of north for some 11 kilometres until it discharges to the sea at Herne Bay, close to the Clock Tower. For the majority of its length it runs in a natural open channel but once entering a culvert to pass under the railway line it stays underground for 1.5km, all the way to its outfall.

The culvert follows the line of Cherry Gardens, Dering Road, Beach Street and finally the alleyway that runs diagonally from Mortimer Street to Central Parade. The outfall is controlled by a sluice gate operated at the Neptune car park. The culverted section is a designated Southern Water public surface water sewer and is a brick lined structure of between $2m^2$ and $3m^2$ cross sectional area.

There are a number of surface water inlets to the culvert draining parts of the built up area of Herne Bay. Consequently, when the culverted section is running at full capacity, road gullies and manhole covers can begin to surcharge causing localised flooding to roads.

Serious flooding from the Plenty Brook occurred in April 2000 and February 2001 as a result of storm events estimated to have a return period of between 10 and 20 years. These storms resulted in a large number of properties being flooded, both north and south of the railway culvert. This was mostly attributed to intense rainfall over a short time generating such a high run-off that the culvert mouth leading the Plenty Brook under the railway was unable to cope.

As a result of these events, numerous improvements have been made to the watercourse. The main ones were the construction of two new storage lagoons, one on line and one off line, at the Herne Bay Golf Club and increased capacity to existing storage reservoirs. These improvements are designed to reduce the flood risk from the river to Herne Bay and Eddington and now provide a standard of protection between 1 in 50 and 1 in 100 years.

5.1.3. Flooding from Surface Water Run-off and Overland Flow

Overland flooding typically occurs in natural valley bottoms as normally dry areas become covered in flowing water and in low spots where water may pond. This flooding mechanism can occur almost anywhere, but is likely to be of particular concern in any topographical low spot, or where the pathway for run-off is restricted by terrain or man-made obstructions. Parts of the District, especially at Whitstable, Herne Bay and north Canterbury are potentially vulnerable to this type of flooding. There are also a number of villages situated within valleys or at the base of hills that are also at risk and have been flooded by this mechanism in the past. In particular Littlebourne, Bridge and Bishopsbourne, although this problem can occur at many of the villages within the District, particularly affecting isolated rural communities.

Whitstable town centre lies within a valley formed by fairly steep slopes to the south, east and west. The sea borders it to the north. Although there are some individual low spots, the centre generally has a gentle incline towards the sea. Any significant overland flow would therefore disperse eventually to the sea through the town's drainage system. The slopes on the three sides are mainly developed with a surface water sewer network and hence the risk of major overland flow is reduced. There is no historical evidence of any serious flooding in the area as a direct result of overland flow. All the roads within the town centre are drained by a system of highway gullies, which drain to the public sewer network. It is accepted that parts of this system are old and in places localised ponding and blockages in gullies takes place during heavy rain. Kent Highways is aware of the problem areas and maintain the problematic parts of the system more frequently than elsewhere. Although no serious flooding has occurred in recent times as a direct result of overland flow, flood events in winter 2000/2001 and again in August 2007 did cause internal flooding. This resulted from a combination of river flooding and sewer surcharging. The topography of the town has exacerbated the problem and its effects. Those events are described elsewhere in this report.

The situation at Herne Bay is similar, with the town centre lying within a valley formed by fairly steep slopes to the east and west and gentle slopes to the south and the sea to the north. Consequently, during extreme and intense rainfall events there is potential for overland flow to be focussed on the lower-lying areas of this urban catchment. There is also a physical barrier to any overland flow draining naturally to the sea. This is the High Street, which would block the flow from the south and could potentially result in flooding to the lower land immediately to the south of it. As described elsewhere in this report, there has been surface water flooding in lower lying locations but this has been primarily as a result of the sewer network becoming surcharged.

In Canterbury the main potential problem area is the north of the city from Harbledown round to Broad Oak. The problem is exacerbated by non-functioning land drains, poorly maintained minor ditches and unchecked water flow across grassed hillsides. Particular areas where flooding as a result of overland flow has occurred are downhill from Dukes Meadow through to the cemetery, parts of St Stephens immediately below the university grounds and the northern part of Hales Place. As elsewhere, the flooding is often also due to a combination of surcharging and under-capacity surface water sewers, which themselves lead into the very old sewer system in the older parts of the city.

In rural areas, overland flooding has occurred at Littlebourne and Bridge and has the potential to occur at Barham, Bishopsbourne, Kingston, Sturry, Herne and Petham. All of these villages have suffered some degree of flooding in recent years, often resulting from a combination of road flooding, watercourses flowing out of bank, ground water and springs, as well as water coming off fields.

It is considered that changes to farming practices may well exacerbate the potential for overland flooding in rural areas and on the outskirts of urban areas. Two particular potential causes are the grubbing up of many of the orchards traditional to Kent over the last few decades and the removal of hedgerows and ditches. It is acknowledged that orchards significantly hold up surface water naturally and their removal increases the rate of run-off from fields. The reduction in hedgerows and ditches has meant that water is not so well channelled, flow downhill increases and often this can be very silt laden, thus quickly blocking gullies and drains.

A further perceived cause of increased risk of overland flow is the ploughing of land downhill rather than parallel to the contours of the slope. Very recently, a significant increase in risk may be due to the erection of massive expanses of polytunnels over fields, particularly used for growing strawberries in this District. Unless substantial and effective drainage measures are put in place in conjunction with these practices, then considerable increased surface water run-off from these areas will occur, exacerbating flood risk to downstream areas of the catchment. This needs to be taken into consideration when planning both the erection of polytunnels and any development in their vicinity.

The historic flooding map included within Appendix A.2 highlights the locations where surface water flooding has been recorded. However, it should be noted that there may well be other historic flooding locations where no records are held and so those locations are not shown on the map. Ensuring that surface water run-off from new development is controlled in a sustainable manner is an essential part of the flood risk management process and consequently, the NPPF sets out clear guidelines for developers. These have been amplified as part of this SFRA to make sure that surface water management issues specific to the District are taken into account in the planning process. This is discussed in more detail in Section 10 of this report.

It is also essential that the site-specific risks of flooding as a result of surface water or overland flow are considered as part of any site-specific FRA. Such appraisals should take into account the topography and nature of the surrounding land so that potential flow paths can be established. Scheme designs should also be checked to ensure that any potential flow paths through the site are not obstructed such that they could cause water to pond.

In the Flood and Water Management Act 2010 and the Flood Risk Regulations 2009, particular concern is raised with respect to surface water flooding, and measures to prevent / reduce such flooding will be implemented. These are discussed further in Section 10 of this report.

5.1.4. Flooding from Groundwater

Water levels below the ground rise during wet winter months, and fall again in the summer as water flows out into rivers. In very wet winters, rising water levels may lead to the flooding of normally dry land, as well as reactivating flow in ‘bournes’ (streams that only flow for part of the year). Where land that is prone to groundwater flooding has been built on, the effect of a flood can be very costly, and because groundwater responds slowly compared with rivers, floods can last for weeks or months. Groundwater flooding generally occurs in rural areas although it can also occur in more urbanised areas where the process known as groundwater rebound can cause localised flooding of basements. This increase in the water table level is occurring as a result of the decrease in groundwater extraction that has taken place since the decline in urban aquifer exploitation by heavy industry.

Data on groundwater flooding has been compiled by the British Geological Society (BGS) and is illustrated on mapping, which is the product of integrating several datasets: a digital model of the land surface, digital geological map data and a water level surface based on measurements of groundwater level made during a particularly wet winter. This dataset provides an indication of areas where groundwater flooding may occur, but is primarily focussed on the groundwater flooding potential of the chalk strata of southern England. Chalk shows some of the largest seasonal variations in groundwater level and so is particularly prone to groundwater flooding incidents.

Inspection of the BGS dataset shows that the Stour Valley is an area at high risk of groundwater flooding. The sandstone area to the south and east of the River Stour is classified as being at medium risk whilst the remainder of the District is located within a low risk area. The sands in the centre and north east of the District also have moderate to significant running sand potential, indicating that the lithology is suitable for fluidisation of the sand by the presence of groundwater and that groundwater can be conveyed through the sand. These characteristics mean that groundwater flooding can be of localised importance and consequently, site-specific FRAs will need to investigate any localised risks of groundwater flooding.

In the higher parts of the District the extensive fissures in the Chalk provide considerable storage for groundwater. Groundwater flooding from the chalk bournes (Petham Bourne and Nailbourne) was extensive in the winter of 2000/2001 and there have also been problems as a result of high groundwater levels along the Nailbourne in 2003, 2010, and the winters of 2013/2014 and 2014/15. This is described in more detail elsewhere in this report under historic flooding.

Specific areas of groundwater emergence are at Bishopsbourne, Patrixbourne, Duncan Downs at Whitstable and parts of the south east of the Whitstable town centre and Thurston Park area. It is possible that the problems in Whitstable are due to an underground watercourse as opposed to groundwater flows, although this has not been verified. There have also been reported groundwater problems in the developed parts of Seasalter, again it is understood that these are more likely due to minor watercourses and drainage ditches that have been in-filled, restricting flow paths.

Although not strictly a groundwater flooding problem, there is also a need to highlight flooding problems in the villages of Chestfield and Blean. At both these villages there has been localised flooding in the past due to a combination of causes. Particularly at Chestfield but also to a lesser extent at Blean, the upper soil geology is a thick layer of stiff London Clay with only a thin band of topsoil / soft clay overlying it. During periods of prolonged winter rainfall the soil becomes saturated resulting in water lying on the surface for long periods of time. There has been considerable development in the past at both these villages and many local ditches and field drains have been filled in or inadequately piped resulting in there being nowhere for the standing water to go.

5.1.5. Flooding from Sewerage Infrastructure

In urban areas, rainwater is frequently drained into surface water sewers or sewers containing both surface and wastewater known as “combined sewers”. Flooding can result when the sewer is overwhelmed by heavy rainfall, becomes blocked or is of inadequate capacity, and this will continue until the water drains away. When this happens to combined sewers, there is a high risk of land

and property flooding with water contaminated with raw sewage as well as pollution of rivers due to discharge from combined sewer overflows.

In the three main developed locations of Canterbury, Whitstable and Herne Bay most of the sewers in the more established areas are combined and, particularly in Canterbury city centre, very old. Flooding from sewers has occurred in all these locations. There has also been flooding from sewers (both foul and surface water) in recent years in the villages along the Nailbourne valley, at Blean, Fordwich, Chestfield, Lower Herne, Eddington, South Street (Whitstable), St Thomas Hill area (Canterbury), Seasalter Cross/Church Lane and Reculver Road in Beltinge. At Fordwich, Chestfield and Eddington extensive works by Southern Water appear to have resolved many of the surcharging problems.

Along the Nailbourne valley, the villages of Bridge, Patrixbourne and Bekesbourne have been worst affected by groundwater and infiltration into the foul sewer causing it to surcharge and the subsequent need to pump the flow from sewers into the Nailbourne. Properties immediately adjacent to the river have suffered flooding.

Southern Water undertook a detailed investigation into this problem in 2013, surveying over 10 kilometres of sewers. A total of 3.5 kilometres of sewer repairs have resulted from this investigation. Southern Water has stated that they will continue to monitor the situation and will undertake remedial work where necessary to mitigate the risk of future drainage issues.

In Whitstable, there have been three incidences of flooding from sewerage infrastructure since 2000. In each case, very heavy rainfall over a short period of time has overwhelmed the system with local drains being unable to cope and flooding to property resulting, some of which has been contaminated with effluent. On each of these occasions there have been problems with the sea outfall pumping station at the Gorrell Tank and also high flows in the Gorrell Stream. The worst affected locations have been in the area just south of the Gorrell Tank, which is very low lying, but other parts of the town at a higher level and also some distance from the outfall, have been affected. Generally the risk of flooding from sewers in Whitstable is moderate, however, the lower parts of the town close to the seafront are at an increased risk.

In the town of Herne Bay there had been occurrences of regular surcharging of the combined sewer system and localised flooding up to the early 1990s, when a new tank sewer and pumping station was constructed. Whilst this significantly reduced the problem, there have been localised flooding incidents from the sewer system on a number of occasions since that time with a more widespread event in September 2010. It is considered that these events were largely due to a combination of human error and mechanical failures of equipment and in theory the risk of flooding from sewers in Herne Bay is low.

Despite the age of much of Canterbury’s sewerage infrastructure, the instances of sewer flooding have been quite low in the city and usually combined with exceptionally high flows in the River Great Stour. Apart from some known trouble spots, which would require detailed investigation for any proposed development, the risk of flooding from sewers in the city is considered to be low.

In the village of Blean the public sewers have a limited capacity to manage heavy rainfall. For any future development, there is a need to carefully consider surface water disposal with attenuation probably required for even small sites and the possibility of the use of deep bore soakaways.

5.1.6. *Flooding from Reservoirs and Artificial Waterways*

Non-natural or artificial sources of flooding can include reservoirs, canals and lakes where water is retained above natural ground level. Operational and redundant industrial processes including mining, quarrying and sand and gravel extraction, are also important as they may increase floodwater depths and velocities in adjacent areas. The potential effects of flood risk management infrastructure and other structures also need to be considered. Reservoir or canal flooding may occur as a result of the facility being overwhelmed and/or as a result of dam or bank failure. Also, any man-made drainage system such as a drain, sewer or ditch could potentially cause flooding.

There are no potable water reservoirs within the District nor are there any artificial waterways such as canals. There are, however, a number of impounding or storage reservoirs or balancing lakes that have been constructed to reduce downstream flood risk on watercourses. When the A290 (new Thanet Way) was built in 1998/1999 balancing lagoons generally of size up to 5,000m^3 were constructed at Swalecliffe, Greenhill and Eddington to attenuate the surface water run-off from the road. At Eddington there are 26,000m^3 (Southern Water), 35,000m^3 (EA) and 10,000m^3 (privately owned) balancing lagoons to attenuate the flow of the Plenty Brook.

Following flood events in Ashford in 1985 and 1986, the Aldington and Hothfield reservoirs were constructed in 1989 and 1991 respectively. These are designed to protect approximately 300 properties downstream of Aldington and Hothfield to a 1 in 100 year design standard. Although these reservoirs do not have a direct impact on properties within the Canterbury District, they have a strong influence on the flow within the Great Stour as far downstream as Wye.

All of the above only begin to fill at times of heavy rainfall and have restricted outlet devices, but also have bypass mechanisms to prevent excessive overtopping of their banks. They are all of fairly recent construction and designed to minimise the risk of rapid flooding to property downstream from them.

Further to the above, there is a large balancing pond/lake on the Nailbourne with dam and controlled outlet at Bourne Park (near Bishopsbourne). Its structural condition is unknown but any failure would be likely only to result in flooding to farmland with no property immediately at risk.

There are also numerous artificial lakes throughout the District but the large ones are mainly just off the Stour between Chartham and Thannington and at Fordwich and Westbere. These are all old sand/gravel workings and, as such, are excavations below surrounding ground level with no embankments or control structures apart from some minor weirs. It is not considered likely that these lakes would themselves cause flooding and they can actually help to attenuate surface water and watercourse flow. However, during exceptionally wet weather these lakes can fill to overflowing and add to any risk of flooding from groundwater and overland flow.

6. Climate Change

The global climate is constantly changing, but it is widely recognised that we are now entering a period of accelerating change. Over the last few decades there have been numerous studies into the impact of potential changes in the future and there is now an increasing body of scientific evidence which supports the fact that the global climate is changing as a result of human activity. Past, present and future emissions of greenhouse gases are expected to cause significant global climate change during this century.

The nature of climate change at a regional level will vary: for the UK, projections of future climate change indicate that more frequent short-duration, high-intensity rainfall and more frequent periods of long-duration rainfall of the type responsible for the recent UK flooding could be expected.

These effects will tend to increase the size of flood zones associated with rivers, and the amount of flooding experienced from other inland sources. The rise in sea level will change the frequency of occurrence of high water levels relative to today's sea levels. It will also increase the extent of the area at risk should sea defences fail, although this increase will be comparatively small in the District due to the valley topography of the coastal floodplains. Changes in wave heights due to increased water depths, as well as possible changes in the frequency, duration and severity of storm events are also predicted.

To ensure that any recommended mitigation measures are sustainable and effective throughout the lifetime of the development, it is necessary to base the appraisal on the extreme flood level that is commensurate with the planning horizon for the proposed development. The NPPF and supporting Planning Practice Guidance Suite state that residential development should be considered for a minimum of 100 years, but that the lifetime of a non-residential development depends on the characteristics of the development. For non-residential development, a 75 year design life is typically assumed, although the LPA and EA should be consulted to determine the most appropriate design life for each development.

6.1. The 'Design Flood' Event

The magnitude of a flood events is expressed as its probability of occurrence. This can be defined as the average number of years expected before another event of the same magnitude will occur (termed the 'recurrence interval'). This is more commonly referred to as the return period and is expressed as the '1 in X year return period' event. It should be recognised that an event with a return period of 1 in 10 years, for example, does not imply that the event is expected to occur every 10 years. It is possible to experience such an event with a greater or lesser 10-year interval of occurrence (e.g. such an event could be experienced more than once a year).

Alternatively, events are defined as the probability that an event with a greater magnitude will occur in any one year, this is referred to as the annual exceedance probability (AEP) and is expressed as a percentage (i.e. X% AEP).

The NPPF requires that the risk of flooding is appraised for the 'design flood' event. For most sources of flooding this is defined as the 1 in 100 year return period or 1% AEP event. The exception is tidal flooding, where the design flood is based on the 1 in 200 year return period or 0.5% AEP event. In all circumstances, an allowance for climate change over the expected lifetime of the proposed development is also required to be considered.

The design event is used to appraise the suitability of a development and should inform the design of any mitigation measures.

6.2. Potential Changes in Climate

6.2.1. Extreme Sea Level

Global sea levels will continue to rise, depending on greenhouse gas emissions and the sensitivity of the climate system. The relative sea level rise in England also depends on the local vertical movement of the land, which is generally falling in the south-east and rising in the north and west.

Reference to guidance published by the EA specifies allowances for different epochs and regions across England. The predicted rates of relative sea level rise for the 'South East' region, relevant to the district, are shown in Table 6.1. These values which correspond with the Higher Central and Upper End percentiles (the 70th and 90th percentile respectively).

Administrative Region	Allowance Category	Net Sea Level Rise (mm/yr) (Relative to 2000)			
		2000 to 2035	2036 to 2065	2066 to 2095	2096 to 2125
South East	Higher Central	5.7	8.7	11.6	13.1
	Upper End	6.9	11.3	15.8	18.2

Table 6.1 – Recommended contingency allowances for net sea level rise.

From these values, the extreme sea level at the site can be seen to change with time and this change is not linear. The 1 in 200 year extreme sea level at the site has therefore been calculated for a number of steps between the current day and the year 2125 and these values are shown in Table 6.2 below.

Year	1 in 200 year extreme water level (m AODN)			
	Whitstable (3479)		Herne Bay (3483)	
	Higher Central	Upper End	Higher Central	Upper End
Current day (year 2017)	4.51	4.51	4.44	4.44
2035	4.61	4.63	4.54	4.56
2065	4.87	4.97	4.80	4.90
2080	5.05	5.21	4.98	5.14
2095	5.22	5.45	5.15	5.38
2115	5.48	5.81	5.41	5.74
2125	5.61	5.99	5.54	5.92

Table 6.2 - Climate change impacts on extreme flood levels.

6.2.2. *Offshore Wind Speed and Extreme Wave Height*

As a result of increased water depths resulting from changes in the climate, wave heights may change. The following allowances in Table 6.3 for offshore wind speed and wave height applicable around the entire English coast and are relative to a 1990 baseline. These figures include a sensitivity allowance which should be used to show that the range of impact of climate change is understood.

Parameter	1990 to 2055	2056 to 2115
Offshore wind speed allowance	+5%	+10%
Offshore wind speed sensitivity test	+10%	+10%
Extreme wave height allowance	+5%	+10%
Extreme wave height sensitive test	+10%	+10%

Table 6.3 - Recommended climate change allowance and sensitivity ranges for offshore wind speed and extreme wave height (relative to 1990).

6.2.3. *Peak River Flow*

Since the last update of the SFRA in 2019, the EA has published new guidance on the peak river flow allowances for climate change. The new figures show the anticipated changes to peak river flow by **Management Catchment,** as defined on the EA's 'Peak River Flow' map. Management catchments are sub-catchments of **River Basin Districts**, as defined by the EA 'River Basin District' maps.

For each Management Catchment, a range of climate change allowances are provided for three different time epochs. For each epoch there are three climate change allowances defined. These represent different levels of statistical confidence in the possible emissions scenarios on which they are calculated. The three levels of allowance are as follows:

- Central: based on the 50th percentile
- Higher Central: based on the 70th percentile
- Upper End: based on the 95th percentile

The EA has provided guidance regarding the application of the climate change allowances and how they should be applied in the planning process. The range of allowance for the Management Catchment in which the development site is located are shown in Table 6.5 below.

For each district a range of climate change allowances are provided for different time epochs over the next century, which correlate with the planning horizons for the varying classifications of development.

For each epoch there are three climate change allowances defined. These represent different levels of statistical confidence in the possible emissions scenarios on which they are calculated. The three levels of allowance are as follows:

- Central: based on the 50th percentile
- Higher Central: based on the 70th percentile
- Upper End: based on the 90th percentile

With reference to this methodology, it is recognised that although the higher percentile allowances are possible, these events are less likely to occur.

As well as encouraging sustainable development to meet the demands of a growing population, the NPPF also promotes a precautionary approach. For more vulnerable development in areas of higher risk of flooding, a higher percentile allowance is recommended in order to manage the risk of flooding over the lifetime of the proposed development. The EA has therefore provided guidance regarding the application of the climate change allowances and how they should be applied in the planning process, which can be seen in Table 6.4 below.

Flood Risk Vulnerability Classification	Flood Zone 2	Flood Zone 3a	Flood Zone 3b
Essential infrastructure	↗	↗	↗
Highly vulnerable	→	x	x
More vulnerable	→	→	x
Less vulnerable	→	→	x
Water compatible development	→	→	→

Key:

↑	Upper End	→	Central
↗	Higher Central	x	Development should not be permitted

Table 6.4 - Recommended Climate Change allowance percentile based on flood risk vulnerability and flood zone compatibility. Adapted from the EA guidance 'Flood risk assessments: climate change allowances'.

The allowances for the Canterbury District cover both the Thames and South East river basin districts. The allowances for these and the corresponding Management Catchment are shown in Table 6.5 below.

Management Catchment Name (River Basin District)	Allowance Category	2015 to 2039	2040 to 2069	2070 to 2115
Stour (South East)	Upper End	40%	55%	101%
	Higher Central	25%	30%	55%
	Central	18%	20%	38%
North Kent (Thames)	Upper End	28%	36%	67%
	Higher Central	15%	17%	34%
	Central	10%	9%	22%

Table 6.5 - Recommended peak river flow allowances for each epoch for the Stour Management Catchment (1981 to 2000 baseline). Adapted from the EA guidance 'Flood risk assessments: climate change allowances'.

The guidance further states that where the dominant source of flooding is from a neighbouring management catchment, the climate change allowances for this catchment should be used when appraising the risk of flooding.

6.2.4. *Peak Rainfall Intensity*

The recommended allowances for increase in peak rainfall intensity have recently been updated (May 2022). The allowances correspond to the Management Catchments as outlined in Section 7.2.3 above and provide a range of values for both central and upper end percentiles (the 50th and 90th percentile respectively) over two-time epochs. In addition, allowances have been provided for a 3.3% annual exceedance rainfall event and a 1% annual exceedance rainfall event. The recommended allowances are shown in Table 6.6 below.

Management Catchment Name (River Basin District)	Allowance Category	3.3% annual exceedance rainfall event		1% annual exceedance rainfall event	
		2050s	2070s	2050s	2070s
Stour (South East)	Upper End	40%	40%	45%	45%
	Central	20%	20%	20%	20%
North Kent (Thames)	Upper End	40%	40%	45%	40%
	Central	20%	20%	20%	20%

Table 6.6 - Recommended peak rainfall intensity allowance for small and urban catchments (1981 to 2000 baseline). Adapted from the EA guidance 'Flood risk assessments: climate change allowances'.

The allowances referenced above are applicable for site-scale applications (e.g drainage design), surface water flood mapping in small catchments (<5km2) and urbanised drainage catchments. For large (>5km^2) rural drainage catchments, the allowances for peak river flow (Table 6.5) should be used when assessing fluvial flood risk, as direct rainfall modelling is not considered appropriate for these catchments.

The guidance goes on further to state that allowances should be assessed for both the 3.3% annual exceedance rainfall event and a 1% annual exceedance rainfall event. There is a requirement for development to be designed for the 1% annual exceedance rainfall event to ensure that

- it will not result in an increase in flood risk elsewhere, and that
- it will be safe from surface water flooding.

Depending on the expected lifetime of the development, the EA requires different allowances to be considered, which are summarised in Table 6.7 below.

Development Lifetime – anticipated year		
Up to 2060	**2061 – 2100**	**Beyond 2100**
Use the central allowance for the 2050s	Use the central allowance for the 2070s	Use the Upper End allowance for the 2070s epoch

Table 6.7 - Recommended peak rainfall intensity allowance category based on development lifetime. Adapted from the EA guidance 'Flood risk assessments: climate change allowances'.

The EA recognised that there are some locations where the climate change allowance for the 2050s epoch is higher than for the 2070s epoch. If this is the case and the development lifetime exceeds the future year 2061, the higher of the two allowances should be used.

6.2.5. Credible Maximum Scenarios for Nationally Significant Infrastructure Projects, New Settlements or Urban Extensions

Whilst the allowances for climate change listed above are typically considered sufficient for appraising the risk of flooding as part of a Flood Risk Assessment, there are projects which require further consideration. For Nationally Significant Infrastructure Projects (NSIPs), the EA states further that the flood risk should be assessed from a 'credible maximum climate change scenario'. The relevant national policy statement should be checked for further details depending on the type of project.

For other projects which include new settlements or significant urban extensions amongst others, the following allowances should be used:

- Extreme Sea Level: 'H++' climate change scenario should be used, which is an increase of 1.9m for the total sea level rise to 2100.
- Peak River Flow: The 'Upper End' allowance should be assessed.
- Offshore Wind Speed and Extreme Wave Height: The sensitivity test allowances should be used and an additional 2mm for each year on top of sea level rise allowances from 2017 should be applied for storm surges.

The climate change allowances listed above have been prepared in accordance with the latest guidance published by the EA. However, it should be noted that the EA is constantly reviewing their recommendations on how climate change should be considered and as such, all of the above recommended allowances for climate change should be used as a guideline and can be superseded.

Additionally, in the instance where flood mitigation measures are not considered necessary at present but will be required in the future (as a result of changes in climate), a "managed adaptive approach" may be adopted where development is designed to allow the incorporation of appropriate mitigation measures in the future.

6.3. Actual Risk and Residual Risk

The NPPF requires the actual risk of flooding to a development to be appraised. The actual risk considers the likelihood of flooding under extreme conditions (e.g. the design flood event), whilst considering the influence of any defence infrastructure, or drainage systems, which may provide a level of protection to the site.

The presence of such defences, or drainage system, does not imply a low risk of flooding, as locations where the design standard is low can still result in flooding under the design flood event.

Examples of actual risk are as follows;

- A combination of a storm surge and extreme waves resulting in waves overtopping the sea wall;
- The in-channel river level exceeding the crest height of the flood embankment which has a low standard of protection (e.g. 1 in 20 years);
- Surface water ponding in a topographic depression following a heavy rainfall event;
- Flooding from the emergence of groundwater due to a rising water table following prolonged rainfall;
- The capacity of the public sewer being exceeded, due to its design standard (typically 1 in 30 years);
- Flooding within the highway due the highway gullies becoming overwhelmed, as these gullies are typically designed to manage the 1 in 2 year return period event.

The NPPF requires development to be appraised against the *actual* risk of flooding under design flood event conditions. However, from the above examples it is evident that many sites within the district are reliant on the protection of flood defences or are dependent on the influence of on-site drainage systems to ensure that the *actual* risk of flooding under the design event is reduced.

If the defences, or drainage system were to fail (i.e. due to a breach or a blockage), or if an event greater than the design flood event was to occur and overtop the defences (i.e. an exceedance event), properties would be inundated by floodwater. This is termed the *residual risk* of flooding.

Residual risk is a particular issue within the low-lying areas of Whitstable and Herne Bay, which are currently protected by the coastal and tidal defences.

When considering impacts of climate change into the future, the potential impact of residual risk is further exacerbated. Sea levels are predicted to increase, and much of the lower-lying areas of the coastal towns and surrounding the River Wantsum Channel will as a result be located below the anticipated extreme sea level in the future. Furthermore, as a result of the predicted increase in peak river flow, in-channel water levels are likely to rise. As a consequence, the district will be more reliant on the defences in the future and thus, it is inevitable that the defences will require upgrading, once their current defence standard is exceeded, to keep in line with increasing water levels and minimise the likelihood of the defences failing and the water level exceeding the crest height of the defences.

Given the rapid rate of inundation and extensive flooding which is likely to result from a residual risk flood event, the use of hydrodynamic numerical flood modelling is required to apprise the depth, extent and velocity of flooding under such scenarios. Such modelling has recently been undertaken by EA as part of the East Kent Coast Modelling Study. However, following the update to the NPPG in 2022, concerns have been raised by the EA that the residual risk scenario is not included within the East Kent Coast Modelling Study and therefore, this model may be inappropriate to use within the SFRA. Consequently, additional tidal modelling has been undertaken with a particular focus on Whitstable and Herne Bay, given that these two coastal towns are at the highest risk of such an event.

Similar modelling has been undertaken by the EA for reservoirs across the England to provide information on the expected depth and velocity of flooding in the event or a reservoir failure. The 'Flood Risk from Reservoirs' mapping show the impact of a failure of the balancing lagoons constructed to manage flows of the Plenty Brook. In addition, the mapping highlights the impact of reservoirs which are located outside the district but still have an impact on flows within the Great Stour. The results can be found at;

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

It is also necessary to consider the residual risk of flooding from a drainage system. An event which exceeds the design criteria, or a failure of the drainage system (i.e. due to a blockage) should both be considered when designing a drainage system. The potential overland flow routes and the area where floodwater is likely to pond following an exceedance event should also be appraised. This analysis will need to demonstrate that the proposed drainage system does not increase the risk of above ground flooding to the development, or to the surrounding area, and should be tested by applying the 1 in 100 year event, inducing an increase in peak rainfall intensity in accordance with the EA's guidance (Section 6.2.4).

6.4. Impacts of Climate Change on the SFRA Study Area

The EA Flood Zone maps are based on current day sea levels and climate conditions. For the coastal flood zones at Seasalter through to Reculver the impact of climate change will be comparatively small as the land slopes away quite steeply from the coastal floodplains; thus any rise in predicted flood levels results in a relatively small increase in the extents of the floodplain. East of Reculver, however, the impact will be more pronounced due to the relatively flat topography of the low-lying hinterland.

The reliance of the towns of Whitstable and Herne Bay on coastal flood defence infrastructure will increase over this next century and as sea levels increase, so will the consequences of the failure of these defences. It is therefore necessary to ensure that new development is designed so that these residual risks are mitigated.

The breach and wave overtopping modelling that has been undertaken by the EA as part of the East Kent Coast and North Kent Coast Modelling study (refer to Section 4.2 for more information) has been carried out using both the current day conditions and using increased wave and water level values commensurate with the predicted 2115 climate (prior to the publication of the revised extreme sea levels). These increases have a significant impact on the outcome of the modelling. Additional modelling has been undertaken as part of this SFRA for Whitstable and Herne Bay to account for the revised extreme sea levels and a future year of up to 2125.

When the dynamics of a breach are considered, the increase in sea level over the next 100 year period will result in a significantly increased volume of flow through the breach at the peak of the event. Higher water levels will also allow larger wave heights to be sustained closer inshore in combination with the predicted increase in offshore wind speeds, it is estimated that wave overtopping could increase by a factor of between 20 and 100, depending upon location, by 2125.

Modelling studies with different climate change allowances. varying between 10% to 105%, have been undertaken for other watercourses within the District. Whilst the model outputs do not include climate change allowances in accordance with the latest guidelines as outlined in Section 6.2, they provide an indication on the impacts of climate change on river levels and flows. An increase in peak river flow is shown to significantly increase the risk of flooding from rivers, predominantly in town centres where the river channel is restricted by the surrounding urbanised area.

Consequently, for the preparation of Flood Risk Assessments for Local Plans and planning applications, the EA's guidance on climate change allowance should be followed and a site-specific analysis of the impact of climate change should be made.

The District has many watercourses that are particularly flashy in their response to intense rainfall and historically this has caused many problems where they flow through urbanised areas, especially where they are culverted or form part of the surface water sewerage network and have tide locked outfalls. Consequently, increases in peak rainfall intensity and peak river flow are likely to significantly increase the risk of flooding from these watercourses.

In addition to the risk of fluvial flooding, consideration should also be paid to the impact of climate change with respect pluvial flooding. By managing surface water in a sustainable manner, through the use of SuDS for example, it is possible to ensure that new development does not exacerbate flood risk on site or elsewhere within the catchment. Taking climate change into account at the planning stage will ensure that its impacts are mitigated, thus the risk of flooding can be managed throughout the lifetime of the development.

Climate change will inevitably result in an increased risk of flooding from all sources. Consequently, the potential impacts of climatic change will require careful consideration before sites for development are allocated.

7. Policy Requirements

Positive planning has an important role in helping to deliver sustainable development and applying the Government's policy on flood risk management. It avoids, reduces and manages flood risk by taking full account in decisions on plans and applications of present and future flood risk, involving both the statistical probability of a flood occurring and the scale of its potential consequences, whether inland or on the coast. It also has a role in considering the wider implications for flood risk of development located outside flood risk areas.

7.1. Applicable Policies and Studies

Flood and Water Management Act (FWMA) (2010)

As a response to the Pitt Review of the summer 2007 floods and the requirements of the EU Flood Directive, the Flood and Water Management Act was implemented in England and Wales in April 2010. The act outlines the responsibilities for managing flood risk and drought, with an increased focus on the risk of flooding from local sources. An important outcome of the act is that County or Unitary Authorities are now classified as *'Lead Local Flood Authorities'* and have the responsibility for managing flood risk at a local scale. Additionally, it aims to encourage the use of SuDS, and promotes resolution of sewer misconnections.

National Planning Policy Framework (NPPF 2021)

The National Planning Policy Framework (NPPF) was published on the 27th March 2012, and most recently on the 19th December 2023. This Framework is a key part of the Government's reforms to make the planning system less complex and more accessible, to protect the environment and to promote sustainable growth. The NPPF sets out the Government's planning policies for England and is used in the preparation of local plans, as well as in decision making with respect to planning. The framework is executed by means of the accompanying Planning Policy Guidance Suite (March 2014, August 2021 and August 2022) which supersedes PPS25: Development and Flood Risk Practice Guide (2009).

Paragraphs 7 to 223 contain policy that represents the Government's view of sustainable development. In order to achieve sustainable development within different districts, local circumstances need to be taken into consideration. Each Local Planning Authority is required to complete a SFRA to assess the risk of flooding from all sources, following criteria set out in the NPPF. The overarching use of SFRAs is to implement the Sequential Test, and where necessary the Exception Test, when determining land use allocation.

Non-Statutory Technical Standards for Sustainable Drainage Systems (NTSS 2015)

As part of the Government's continuing commitment to protect people and property from flood risk, the Department for Environment, Food and Rural Affairs (Defra) consulted on a proposal to make better use of the planning system to secure sustainable drainage systems (2014).

National Standards for design, construction, maintenance and operation of SuDS came into effect from the 6th April 2015 and relate to Schedule 3, Paragraph 5 of the Flood and Water Management Act 2010.

These Non-Statutory Technical Standards for SuDS (NTSS) provide additional detail and requirements not initially covered by the NPPF, through specifying criteria to ensure sustainable drainage is included within applications classified as major development.

Kent County Council Local Flood Risk Management Strategy

Kent County Council (KCC) is the Lead Local Flood Authority (LLFA) and has the duty to manage local flooding. KCC has developed the Local Flood Risk Management Strategy to provide a countywide framework to manage risks of local flooding following the Flood and Water Management Act (2010). The strategy covers the risk of flooding from surface water, groundwater and ordinary watercourses and sets out how the risk from these sources can be reduced for people and businesses in Kent. In addition, it provides information and guidance on roles and responsibilities and how authorities will co-operate to manage flood risk. The 2017 to 2023 strategy builds upon knowledge and understanding resulting from delivering the previous strategy (2013-2016).

Kent County Council Flood Risk to Communities – Canterbury (2017)

Similar to the Local Flood Risk Management Strategy summarised above, The Kent County Council Flood Risk to Communities identifies the main risk of flooding across the district and outlines strategies and plans on how to manage the risk identified.

KCC Drainage and Planning Policy Statement (2019)

The Drainage and Planning Policy Statement outlines how KCC will review drainage submissions for all applications classified as major development in accordance with the objectives of the Local Flood Risk Management Strategy. The statement outlines the policy requirements for SuDS and other considerations which could impact the drainage design for a scheme.

Canterbury Surface Water Management Plan (SWMP 2012)

The SWMP for Canterbury was released in April 2012. The report provides an assessment of the risk of surface water flooding in Canterbury based on available data and also considers flooding from the Gorrell Stream, Swalecliffe Brook, Kite Farm Ditch, Westbrook and Plenty Brook, all of which are classified as main rivers. In addition, the study includes the watercourses Sarre Penn and Petham Bourne.

The results of the analysis have been used to recommend suitable surface water management strategies which could reduce the risk of flooding. This was primarily aimed at high risk areas within the urban confines of the towns situated on the Isle of Thanet, mainly Birchington and Margate.

Due to the high risk in Margate, a Surface Water Management Plan has been undertaken specifically for Margate as a ‘Stage 2’, with the aim of gaining a better understanding of the key flood risks and to provide more detailed solutions and actions to manage these risks. In the SWMP for Margate, the existing drainage systems in parts of Margate have been identified as ‘Tidally

Sensitive Areas'. This is on account of the impact of tidal water levels on the drainage at this location, which will require further consideration when designing new infrastructure. A map of these areas can be found in Appendix F.1 of the SWMP;

South East Inshore Marine Plan (2021)

The district coastline is located within the South East Inshore Marine Plan area and a marine plan for this area has been prepared in June 2021. The South East Marine Plan has been prepared following Section 51 of the Marine and Coastal Access Act 2009. The aim of the South East Marine Plan is to provide a framework to inform decision making on how the waters are enhanced whilst allowing sustainable economic growth over the next 20 years. A copy of the Marine Plan can be found at;

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1004493/FINAL_South_East_Marine_Plan__1_.pdf

Isle of Grain to South Foreland Shoreline Management Plan (SMP10)

The Shoreline Management Plan was adopted by the Council on 7 February 2008 and is a large-scale assessment of the risk associated with coastal erosion and flooding, which seeks to set out high-level management options over three time epochs; 0 to 20 years, 20 to 50 years, and 50 to 100 years. Whilst the SMP is not a statutory planning document, it is used to inform the coastal planning and each management policy was derived taking into account social, environmental, technical and economic drivers over the next 100 years.

A 'SMP Refresh' is currently ongoing (commenced in 2019) to review and revise the existing policy units. Whilst the 'refresh' has not yet been concluded, it should be recognised that the policy units may be subject to change in the future. At present, there are eight SMP policy units within the district and details of the relevant policies are listed in Table 7.1.

Location	Policy Unit Reference	SMP Policy		
		2008 to 2028	2028 to 2058	2058 to 2108
Faversham Creek to Seasalter (Blue Anchor) *Flood frontage*	4a07	Hold the line	Hold the line for Seasalter (Sportsman to Blue Anchor) Managed realignment for the rest of the policy unit	Managed realignment
Seasalter to Whitstable Town (Golf Course) *Erosion frontage*	4a08	Hold the line	Hold the line	Hold the line
Whitstable Town to Whitstable Harbour *Flood frontage*	4a09	Hold the line	Hold the line	Hold the line
Whitstable Harbour to Swalecliffe *Erosion frontage*	4a10	Hold the line	Hold the line	Hold the line
Swaleciffe to Herne Bay Breakwater *Flood & erosion frontage*	4a11	Hold the line	Hold the line	Hold the line
Herne Bay Breakwater to Reculver Country Park *Erosion frontage*	4a12	Hold the line	Hold the line	Hold the line
Reculver Country Park *Erosion frontage*	4a13	No Active Intervention	No Active Intervention	No Active Intervention
Reculver Towers to Minnis Bay *Flood & erosion frontage*	4a14	Hold the line	Hold the line for Reculver Towers Managed realignment for the majority of the rest of the policy unit	Hold the line for Reculver Towers Managed realignment for the majority of the rest of the policy unit

Table 7.1 - Summary of SMP policies for frontages within the Canterbury District

The importance of the current defences at both Whitstable and Herne Bay is highlighted in the SMP policy statements, which state the current policy is "to maintain the existing defences to protect the significant assets, which are important to the region's economy". In the second epoch the policy changes to "upgrade the defence structures, this will maintain the character of the frontage and protect the significant built assets from sea level rise".

The SMP also contains an Action Plan, which sets out the recommended works and improvements to the coastal defences in order to meet the policy objectives. This Action Plan is summarised below for those frontages containing a flooding element. The Plan is important in that it gives a clear indication as to future maintenance and improvement where necessary of sea defences that have an impact on the SFRA, and should be taken into consideration when defining future flood risk.

For all the policy units between and including Whitstable and Herne Bay, the Action Plan states to "*undertake engineering works and maintenance activities to hold the defence line, to maintain the seawall and to maintain beach and groynes".* For the two frontages at Seasalter and Reculver, where managed realignment is proposed commencing in the second epoch, the Action Plan states to "*engage with affected parties to enable adaptation to the change in coastline"* but to "*continue maintenance to hold the defence line and maintain the seawall"* prior to managed realignment.

Stour Catchment Flood Management Plan (CFMP)

A CFMP is a high-level strategic planning tool through which the EA seeks to work with other decision-makers within a river catchment to identify and agree policies for sustainable flood risk management. The primary objectives of the CFMP are to:

- Develop complementary policies for long-term (50 -100 years) management of flood risk within the catchment that take into account the likely impacts of changes in climate, land use and land management.
- To undertake a strategic assessment of current and future flood risk from all sources within the catchment and quantify the risk in economic, social and environmental terms.
- Identify opportunities and constraints within the catchment for reducing flood risk through strategic changes and identify how these benefits could be delivered.
- Identify opportunities to maintain, restore or enhance the total stock of natural and historic assets from flooding.
- Identify the relative priorities for the catchment and assign responsibility to the EA and other operating authorities, local authorities, water companies and other key stakeholders for further investigations or actions to be taken to manage and reduce flood risk within the catchment.

The Stour CFMP, relevant to the Canterbury District, was completed and published by the EA in March 2007. The CFMP has been examined as part of the SFRA process and the relevant policies and Action Plans are listed in Table 7.2.

Policy Unit	Preferred Policy	CFMP Outputs	
		Policy	Action Plan Summary
Middle Stour *Through to Shalmsford Street*	6	Take action to increase the frequency of flooding to bring benefits locally or elsewhere	High priority action to carry out Flood Risk Management (FRM) study to explore range of options and identify areas of floodplain for additional flood storage
Stour Canterbury *From Shalmsford Street through Canterbury and Fordwich*	5	Take further action to reduce flood risk (now and/or in the future)	High priority action to carry out FRM study to explore range of flood risk management options. High priority action to produce a System Asset Management Plan to determine how the assets can best be managed
Nailbourne & Little Stour *Nailbourne and Little Stour streams*	4	Take further action to sustain the current scale of flood risk into the future (responding to potential increases in flood risk)	Low priority action to carry out FRM study to explore range of flood risk management options including investigating sewer flooding and possible areas for additional flood storage
Lower Stour *From past Fordwich*	6	Take action to increase the frequency of flooding to bring benefits locally or elsewhere	Medium priority action to carry out FRM study to explore range of options and identify areas of floodplain for additional flood storage
Oyster Coast Brooks *Gorrell Stream, Swalecliffe Brook, Kite Farm Ditch, West Brook & Plenty Brook coastal streams*	5	Take further action to reduce flood risk (now and/or in the future)	Low priority action to carry out FRM study to explore range of flood risk management options. High priority action to produce a System Asset Management Plan to determine how the assets can best be managed

Table 7.2 - Summary of CFMP policies and Action Plans for Canterbury District

It should be noted that for those policy units where the preferred policy is Policy 6, this means that it is the intention to increase flood risk at specific locations only and not across the whole policy unit.

Regional Beach Management Plan 2015: Graveney to Northern Sea Wall

The Regional Beach Management Plan has been prepared by CCC on behalf of the Council and the EA. The plan sets out methodologies for intervention and monitoring to maintain the beach where it provides an integral part of the sea defences between Graveney and Northern Sea Wall. It is a framework to ensure continuous beach management, addressing coastal flooding and erosion.

Herne Bay Area Action Plan and Reculver Masterplan

The Canterbury District Local Development Framework to date includes the Herne Bay Area Action Plan, and numerous Supplementary Planning Documents including the Reculver Masterplan. The Herne Bay Area Action Plan, designed to focus the delivery of regeneration initiatives in the town, was adopted in April 2010. The plan recommends that developments within the town centre should be allowed to proceed, subject to individual site FRAs being produced at planning consent stage and should fully incorporate the conclusions and recommendations of the FRA.

The Reculver Masterplan has an overarching objective to develop Reculver as a high quality strategic regional hub for green tourism and education in East Kent.' This includes future aspirations for a large scale development of a saltwater marshland habitat, enabled by a strategic change in the location of sea defences.

Faversham Creek to Whitstable Harbour Coastal Defence Strategy

This Strategy Plan was completed and approved by Defra in 2004 and makes recommendations for implementing flood and coastal erosion risk management schemes along this length of coast. For the Whitstable flood frontage a number of phased capital construction schemes were proposed. The initial scheme, which comprised a major beach recharge and the construction of new groynes, was implemented in 2006 and raised the standard of protection along the full defended length to 1 in 200 years. Further beach recharges and groyne maintenance/reconstruction works are programmed for appropriate intervals throughout the century in order to continually maintain this standard.

In about 20 to 30 years' time, it is proposed to raise the rear seawall by 0.6m to allow for rising sea levels. For the whole 100 year capital and maintenance costs for the works proposed in the strategy there is a benefit cost ratio of 21:1 – clearly demonstrating the very high economic viability of the future sea defence improvement works.

Swalecliffe Coastal Defence Strategy Plan

The Strategy Plan includes the Swalecliffe and Hampton flood frontages. It was completed and submitted to the EA in March 2010 for approval. The strategy recommends continued maintenance and, where necessary, upgrading of the defences at both locations to maintain the 1 in 200 year defence standard over the next 100 years. Since 2010 the defences have been maintained and any damage rectified (e.g. groyne timber replacement). In 2015, localised improvements were undertaken at Hampton with the installation of additional floodgates along Hampton Pier Avenue.

The Hampton seawall and parts of the seawall at Swalecliffe, not already at an appropriate level, are proposed to be raised in 20 to 30 years' time to keep pace with the predicted rise in sea levels. The benefit cost ratio for the flood defence improvements recommended in the Strategy is 8:1 – indicating significant economic justification to continue maintaining and improving defences to a high standard.

Herne Bay Flood and Erosion Risk Management Strategy Plan

Preliminary work carried out for the study application and to inform the EA's Medium Term Plan indicates that some improvement works will be necessary in the short to medium term to maintain the 1 in 200 standard of the flood defences at Herne Bay over the next 100 years. An approval to carry out this strategy was received by the EA which was undertaken in 2013. The works included raising all of the Herne Bay central area defences to ensure a 1 in 200 year standard of protection is maintained. The strategy will also include raising the rear seawall by about 0.6m in about 20-30 years' time, depending upon sea level rise.

In 2015, the EA gave approval for a further more detailed study of this area, which included the towns from Hampton to Bishopstone. The aim of this study was to identify any need for improvements required to be carried out to the sea defences to the west of Herne Bay Pier and Kings Hall frontage. The works are due to be undertaken in 2016.

Reculver to Minnis Bay Coastal Defence Strategy Plan

The strategy was completed and approved by Defra in 1997. It demonstrated that it is economically beneficial for the entire defence length, including the Northern Seawall, to be maintained and improved where necessary to provide between a 1 in 50 and 1 in 100 year standard of protection over the next 100 years. As a result of these recommendations, capital works were carried out around the Reculver Towers area in 1998 to reconstruct various parts of the defences. The SMP currently recommends managed realignment in the medium term for the Northern Seawall.

Council Policy Statement on Flood and Coastal Defence

In March 2001 the Council formally adopted its policy with respect to flood and coastal defence. This states that the *"Council will provide an adequate, economically, technically and environmentally sound approach to providing the flood and coastal defence service and will ensure that appropriate maintenance regimes are in place for flood and coastal defence for which the Council takes responsibility*". This policy was reinforced by the Council's Flooding Scrutiny Panel report (adopted by Council in September 2001), which contained 50 actions to reduce flood risk in the District. This report concentrated on the reduction of inland flooding from whatever source, but under Action 3 specifically stated that "this Council should continue with its proactive approach to coastal defence, both maintenance and improvement works, to ensure that the risk of flooding and erosion is kept to the very minimum".

The Flooding Scrutiny Panel report has been regularly updated. The latest update, November 2007 (see Appendix A.7), was adopted by the Council in December 2007 and contains a summary of all improvements carried out to reduce flood risk in the District and further improvements to be made.

Council Policy on Drainage Impact Assessment Requirements for New Development

The Council require a Drainage Impact Assessment (DIA) and the surface water drainage pro-forma to be submitted and approved for all new development proposals. The drainage guidance for completing the surface water drainage pro-forma is located in Appendix A.8 and sets out all the necessary requirements to ensure that any proposed development increase the risk of flooding.

Depending upon the size of the development, developers may be required to carry out, or assist in funding works aimed at reducing the risk of flooding.

7.2. Definition of Development Types

There are a number of development classifications which are referenced throughout this SFRA. Applications submitted to CCC will be classified as either householder, minor, or major development, depending on the scale of development. However, such development may also fall under a second definition relevant to the management of flood risk and surface water. The definitions of these development types are provided below for reference;

7.2.1. Householder Development

Householder development is applicable for planning applications for internal changes and extensions to existing dwellings.

7.2.2. Minor Development

The NPPG outlines a definition of minor development in relation to flood risk. This definition is used by the EA to define development which is subject to different guidance on the management of flood risk (Refer to Flood Risk Standing Advice), and is used within the NPPF to identify developments which are not subject to the Sequential Test and Exception Test. The NPPG definition of minor development in relation to flood risk is not to be confused with the Council's definition of minor development (see above). Minor development in relation to **flood risk** is defined as;

- *minor non-residential extensions: industrial/commercial/leisure etc extensions with a footprint less than 250 square metres.*
- *alterations: development that does not increase the size of buildings e.g. alterations to external appearance.*
- *householder development: For example; sheds, garages, games rooms etc within the curtilage of the existing dwelling, in addition to physical extensions to the existing dwelling itself. This definition excludes any proposed development that would create a separate dwelling within the curtilage of the existing dwelling e.g. subdivision of houses into flats.*

7.2.3. Non-major Development b

Non-major development is applicable for planning applications which are not classified as householder development, but are not large enough to be considered as major development.

7.2.4. Major Development

Major development is defined within the Town and Country Planning (Development Management Procedure) (England) Order 2010 as development involving one or more of the following;

> a) *the winning and working of minerals or the use of land for mineral-working deposits;*
>
> b) *waste development;*
>
> c) *the provision of dwelling houses where:*
>
> (i) *the number of dwelling houses to be provided is 10 or more; or*
>
> (ii) *the development is to be carried out on a site having an area of 0.5 hectares or*
>
> (iii) *more and it is not known whether the development falls within sub-paragraph (c)(i);*
>
> d) *the provision of a building or buildings where the floor space to be created by the development is 1,000 square metres or more; or*
>
> e) *development carried out on a site having an area of 1 hectare or more.*

7.2.5. Permitted Development

The Town and Country Planning (General Permitted Development) Order 1995 was amended in May 2013 to allow householders to undertake a wide scope of enlargements, improvements, and other alterations to their properties. This allowed for greater flexibility under permitted development for the change of use of commercial premises, without the need for a full planning permission. In April 2016, the Order was revised to incorporate the change of use of other use classifications to residential use; including (but not limited to) laundrettes and light industrial use buildings. Further amendments to the categories of use change which are permitted have been made on an annual basis. An up-to-date summary of the class use changes which are allowed under *permitted development rights* can be found at:

https://www.planningportal.co.uk/info/200130/common_projects/9/change_of_use/2

7.2.6. 'Small-scale' Development

This SFRA outlines the requirements for managing surface water runoff from new development which applies to all development with the exception of 'small development'. This classification is not directly related to the type of planning application submitted, but instead determines whether the Surface Water Management Proforma is required to be submitted alongside the planning application. Small-scale development comprises the following:

- Minor non-residential extensions: industrial/commercial/leisure, extensions etc with a footprint less than 25m².
- Householder development: e.g. sheds, garages, games rooms etc. within the curtilage of the existing dwelling, in addition to physical extensions to the existing dwelling itself, that have a footprint less than 30m^2.
- Change of use/alterations to an existing development: development that does not increase the size of buildings e.g. alterations to external appearance. This includes any

development that would create a separate dwelling within the curtilage of the existing dwelling e.g. subdivision of houses into flats.

8. Flood Risk Management

8.1. When is a Site-specific FRA Required?

The role of the site specific FRA is to examine and quantify the risk of flooding to a particular site or development. However, the FRA also has to consider the impact that the proposed development may have on flood risk to areas outside of its own boundaries. Consequently, whilst the Flood Zone category is an important factor in triggering the requirement for a FRA, it is also necessary to consider areas of the District in which development could result in the exacerbation of flooding elsewhere.

A description of the flood zones and the specific circumstances that will require a planning application to be accompanied by a site-specific FRA are summarised below. However, for more general guidance on FRA requirements provided by EA can be accessed from the following link:

https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications

Flood Zone 1 – Low probability of flooding – This zone is assessed as having less than a 1 in 1000 probability of river or sea flooding in any one year.

> *If the site is less than 1 hectare then a site-specific FRA will only be required if it lies within:*
>
> *- an area defined by the Critical Drainage Area,*
>
> *- the Overtopping Hazard Zone; or*
>
> *- an area shown to be at risk of flooding from sources other than rivers and the sea.*
>
> *The exception is if the site is identified by the Council as being at risk from specific critical drainage problems, or is located within 20m of a main river.*

Flood Zone 2 – Medium probability of flooding – This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding or between 1 in 200 and 1 in 1000 probability of sea flooding in any one year.

> *A site-specific FRA will be required and this will need to be prepared in accordance with the requirements set out in paragraphs 20 - 22 and 54 of the Planning Practice Guidance: Flood Risk and Coastal Change.*

Flood Zone 3 – High probability of flooding - This zone comprises land assessed as having a 1 in 100 or greater probability of river flooding or 1 in 200 or greater annual probability of sea flooding in any one year.

A site-specific FRA will be required and this will need to be prepared in accordance with the requirements set out in paragraphs 20 - 22 and 54 of the Planning Practice Guidance: Flood Risk and Coastal Change. The requirement for compensatory flood storage needs to be taken into account for developments within the river flood zone.

Overtopping Zone – As a District that has approximately 21km of shoreline, much of it developed, there is a need to consider the way in which flood risk is managed in those areas that are affected by wave overtopping. The land along the seaward side of Faversham Road, Seasalter is specifically designated as being a Wave Overtopping Zone. This is because even for storms of relatively frequent return period (1 in 10 years and above) there is a risk of flooding due to wave overtopping. For development within this wave overtopping zone, there are hazards associated with localised flooding, structural integrity of buildings and safe access and egress to the buildings. When the impact of climate change is also taken into account, the impacts of wave overtopping on development within this zone will become more severe. Consequently, it is the view of both the Council and the EA that the SFRA should put in place measures to ensure that development in these locations is appropriate.

The effects of wave overtopping are illustrated by the photograph in Figure 10.1 below, which shows wave overtopping and the onset of localised flooding at an area that is classified as a Zone 1 flood risk area. Given that many areas that are subject to wave overtopping are located within Zones 2 or 3, it is quite possible that the initial or even the total flood extent would be due to wave overtopping and thus the overtopping issues should be dealt with as part of the site-specific FRA. However, for development sites located within 30m of the landward crest of the seawall, it will be necessary for a FRA to be prepared that addresses the hazards specifically associated with wave overtopping.

A site-specific FRA will be required, and this will need to be prepared in accordance with the requirements set out in paragraphs 20 - 22 and 54 of the Planning Practice Guidance: Flood Risk and Coastal Change. In particular this will need to examine the impacts of wave overtopping on the proposed development under current and future climatic conditions.

Figure 8.1 - Wave Overtopping eastern Herne Bay.

Definition of the Functional Floodplain in Locations Seaward of the Seawall

The NPPF splits Flood Zone 3 into two sub-divisions: Flood Zone 3a, defined as "*land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any one year*" and Flood Zone 3b, defined as The Functional Floodplain or "*land which would flood with an annual probability of 1 in 30 (3.3%) or greater in any year, or is designed to flood in an extreme (0.1%) flood, or at another probability to be agreed between the LPA and the EA, including water conveyance routes*".

There are many locations within the District where there are areas of Flood Zone 3 located seaward of the existing seawall. In some locations the level of the land/beach is above the predicted 1 in 30 year extreme level and could be misconstrued as being classified as Zone 3a rather than in Zone 3b. However, when the potential for beach drawdown and wave run-up is taken into consideration alongside the impacts of rising sea levels it is probable that areas of land/beach that are seaward of the seawall could be affected by wave run-up even if they were above the predicted 1 in 30 year still water level (SWL).

> *All undeveloped areas in front (seaward) of the seawall are therefore defined as being included in the Functional Floodplain (Zone 3b).*

For development that is permitted in the Functional Floodplain (Zone 3b), as set in Table 2 of the *Planning Practice Guidance: Flood Risk and Coastal Change,* the applicant will have to take the following requirements into account:

- The impacts of rising sea levels over the lifetime of the development including the increase in wave height and in other parameters consequent on the rising sea levels.
- The potential for beach drawdown.
- The degree of wave run-up that would occur for a range of wave height and water level combinations.

Development in the Functional Floodplain in Locations Seaward of the Seawall
A site-specific FRA will be required and this will need to be prepared in accordance with the requirements set out in paragraphs 20 – 22 and 54 of the Planning Practice Guidance: Flood Risk and Coastal Change. In particular this will need to examine the potential for beach drawdown under storm conditions and the potential for wave run-up under current and future climatic change scenarios. Flood extents and depths within the site shall be established by taking into account the dynamic nature of the land/beach in front of the seawall and the potential for wave run-up.

The only development which will be permitted in the Functional Floodplain seaward of the seawall is that listed in Table 2 of the *Planning Practice Guidance: Flood Risk and Coastal Change* under water-compatible development, together with essential infrastructure and works of, or associated with, coast protection and flood control.

Critical Drainage Area – There are no designated Critical Drainage Areas under the Town and Country Planning (General Permitted Development) (England) Order 2015, which introduced the concept of Critical Drainage Areas as "an area within Flood Zone 1 which has critical drainage problems and which has been notified to the LPA by the EA". However, there are two specific areas where drainage and localised surface water flooding have been a problem for many years. These are at Chestfield and Blean.

At these two locations particular care needs to be taken with regard to the disposal of surface water to ensure that any flooding in the villages is not exacerbated by new development. There are also some smaller individual locations where there have been recurrent surface water flooding problems that any development would need to take account of. All of the known "drainage/flooding hotspots" are shown on the mapping in Appendix A.2.

Particularly at Reculver behind the Northern Seawall, but also throughout much of the rural area close to the Stour, there is land that is drained by man-made watercourses that discharge to the main river or the sea. This drainage network is maintained and managed by the River Stour (Kent) Internal Drainage Board (IDB). At Graveney a similar situation applies with respect to man-made watercourses maintained by the Lower Medway IDB.

Any new development that increases the rate and volume of surface water run-off from a site will have the potential to increase the burden on this heavily managed network of watercourses. If surface water run-off in these areas is not managed appropriately, then there is a risk that the capacity of the pumps and tidal outlets that are used to drain the land will be exceeded. This will exacerbate the risk of flooding and therefore it is imperative that surface water drainage in these areas is managed responsibly.

In addition, many of the higher areas of the District fall within the upper catchment areas of the main rivers that flow through Canterbury, Whitstable and Herne Bay. These watercourses are already identified as posing a significant risk of flooding. Consequently, in order to ensure that this risk is not exacerbated by increased run-off from new development, specific policies have been developed.

> *All development applications should include drainage provision. For applications for non-major development, the Council's guidance on the management of surface water run-off from new development should be followed.*

Sites larger than 1 hectare – In accordance with the NPPF and its supporting Planning Practice Guidance, planning applications for development on sites greater than 1 hectare will need to be accompanied by a site-specific FRA even if it is located outside of Flood Zones 2 or 3. This is to ensure that development will not be affected by flooding from other sources such as overland flow or groundwater flooding.

The site-specific FRA will also need to demonstrate, through the development of a Surface Water Management Strategy, that the proposals will not have an adverse impact on flood risk to areas outside of the site boundaries. This SWMS will need be required to adhere to the National Standards for the design, construction, maintenance and operation of SuDS. These Technical Standards (S1 -14) provide additional detail and requirements not initially covered by the NPPF. However, it is recognised that SuDS should be designed to ensure that the maintenance and operation requirements are economically proportionate.

> *The application will need to be accompanied by a site-specific FRA. This will need to include a Surface Water Management Strategy, undertaken in accordance with the requirements of the Lead Local Flood Authority (KCC). The SWMS will also need to demonstrate that, where possible, a sustainable drainage (SuDS) approach has been adopted.*

Development within 20m of a Main River – Applications containing culverting or obstruction to the flow of a watercourse, or works within 20m of the top of the bank of a Main River require a site-specific FRA and consent from the EA.

> *The application will need to be accompanied by a site-specific FRA. This will need to include design details of the culvert and proposed flow control structure and will require Land Drainage consent from the EA*

Development within 15m of the landward toe of a tidal defence – Applications containing works within 15m of the landward toe of one of the EA's tidal defence structures or the Council's sea and coastal defence structures require the consent of the relevant authority and such mitigating works as considered necessary by the authority.

Such works will require Land Drainage Act consent from the EA or Coast Protection Act consent from Canterbury City Council.

Development within 8m, or connection to an IDB Watercourse – Applications containing culverting or obstruction to the flow of a watercourse, or works within 8m of the top of the bank of an IDB watercourse or including proposals to discharge surface water into any IDB watercourse require the consent of the relevant IDB.

In addition to any site-specific FRA that may be required, the applicant will need to consult with the IDB and gain consent for any works within this zone and/or connections to the IDB watercourse.

8.2. What should an FRA include?

The minimum requirements for an FRA are described in paragraphs 20-22 and 54 of the *Planning Practice Guidance: Flood Risk and Coastal Change*. In addition, the guidance provides a checklist for site-specific flood risk assessments.

https://www.gov.uk/guidance/flood-risk-and-coastal-change#Site-Specific-Flood-Risk-Assessment-checklist-section

The FRA must be appropriate to the scale, nature and location of the development, and consider all possible sources of flood risk, the effects of flood risk management infrastructure and the vulnerability of those that could occupy and use the proposed development.

The following sections of this report provide guidance on the various sections required within an FRA: application of the Sequential and Exception Test, designing to manage flood risk, and the management of surface water runoff from a development.

8.3. Sequential Test

The NPPF specifies that 'the Sequential approach should be used in areas know to be at risk now or in the future from any form of flooding'. The NPPG provides further guidance on how the Sequential Test should be applied, which has been discussed in Section 2.3. The 'Potential Risk of Flooding' maps included within the Appendix A.4 and Appendix A.5 of this report should be a starting point to determine whether a Sequential Test is required.

If the development site is subject to the Sequential Test, it will be necessary to search for reasonably available sites within low risk areas. The area to search for available sites depends on local circumstances which should be taken into consideration. This could mean limiting search areas to town centres where development is proposed in these areas. However, as the search area may depend on individual circumstances, it is recommended that the search area is agreed with CCC prior to undertaking the searches.

The updated NPPG 2022 includes further clarification in terms of defining reasonably available sites, which should be similar in size and scale to the development site. Reasonably available sites do not have to be within the ownership of the applicant and could include a series of smaller sites and/or parts of a larger development.

Whilst information on available sites may be provided by the local planning authority as part of their land availability assessments, it will still be necessary to also consider sites currently available on the open market as these may not be identified by the local planning authority.

If the searches for reasonably available sites concludes that no sites are available within the low risk areas, only then should the searches be carried out for sites located within the medium risk areas. Once the medium sites have been exhausted, the high risk areas can be considered. If reasonably available sites can be found in lower risk areas, the Sequential Test cannot be passed and development would subsequently be refused.

8.4. Exception Test

It is imperative to demonstrate that development has passed the Sequential Test before the Exception Test is considered.

As set out in Section 2.4, for the Exception Test to be passed there are two criteria that both must be satisfied. The first criteria (a) relates to the requirement to demonstrate that the development will provide wider sustainability benefits to the community that outweigh flood risk. Examples of benefits are included within the updated NPPG 2022 and include;

- re-use of brownfield sites as part of local regeneration
- Reduction in flood risk either by providing of financially contributing to appropriate flood risk management infrastructure
- Provision of multifunctional sustainable drainage systems

The second criterion (b) is the requirement that an FRA can demonstrate that the development will be safe and advice on this is given under the sub-headings following this one.

Development sites which have been allocated as part of the emerging Local Plan will still be required to meet the objectives of the Exception Test before permission can be granted.

8.5. Mitigation Measures

In accordance with the requirement of the NPPF outlined above, all development located in an area identified to be at risk of flooding is required to consider options for mitigating the risk of flooding. Mitigation measures should be designed up to and including the design flood event, and should remain effective even when an allowance for climate change is considered. This includes the impacts of residual risk scenarios. For development that is subject to the Exception Test, the use of appropriate mitigation measures will be necessary to ensure that the Part B can be met.

The NPPG outlines an updated hierarchy for flood risk management, which is shown in the flow chart below in order of preference.

Avoid	•Sequential Test •Sequential Approach on a site-basis •Raising Finished Floor Levels or Land
Control	•Flood and Coastal Erosion Management Schemes •Flood Defences •Impedance of Flood Flows
Mitigate	•Flood Resistance and Reslience •Compensatory Flood Storage
Manage	•Flood Warning and Evacuation

Table 8.1 - Flood Mitigation Hierarchy.

Following the hierarchy above, the following sections provide an overview of each mitigation measure and identifies any key points for consideration when designing a scheme.

8.5.1. Flood Risk Standing Advice

The EA's Flood Risk Standing Advice applies to the following development types;

- *a minor extension (household extensions or non-domestic extensions less than 250 square metres) located within flood zone 2 or 3.*
- *'more vulnerable' development located within flood zone 2 (except for landfill or waste facility sites, caravan or camping sites).*
- *'less vulnerable' development locate within flood zone 2 (except for agriculture and forestry, waste treatment, and water and sewage treatment).*
- *'water compatible' development located within flood zone 2.*

Details of the requirements outlined under the EA's Flood Risk Standing Advice can be found at; https://www.gov.uk/guidance/flood-risk-assessment-standing-advice

For all other types of development, the mitigation measures described in the following sections should be followed.

8.5.2. Sequential Approach

Following application of the Sequential Test, the ***sequential approach*** should be applied to locating and designing development on a site-based scale. For example, more vulnerable elements of the scheme should be located where the risk of flooding is lowest (e.g. on the higher parts of the site). The higher risk areas of the site (e.g. lower-lying parts of the site) should only be allocated for less vulnerable elements (e.g. parking, recreational land or even commercial buildings).

The Sequential Approach should also be applied within the design of the internal layout of the building. This would mean that more vulnerable elements such as sleeping accommodation should preferably be located above the less vulnerable elements (e.g. parking, offices, living accommodation on lower floors).

8.5.3. Flood Defences

Flood defences can be used to prevent floodwater from reaching a development site. Defences can be constructed on a strategic scale, as part of a flood defence scheme facilitated by the EA. Alternatively, defences can be used at a site-scale, such as the construction of an earth bund designed to manage overland flows through a development. Temporary defences may also be used to provide protection to a development in anticipation of an extreme flood event.

However, it should be recognised that flood defences will only provide protection up to the design standard of the protection, and as such, the development could still be subject to the *residual risk* of flooding (e.g. if the defences were to fail). The ongoing maintenance of any formal structures which are constructed will also need to be considered as part of the design of a flood defence, to ensure that the structure continues to function as designed.

Furthermore, the loss of flood storage from the area which is being protected may need to be offset to ensure that the risk is not increased elsewhere by directing floodwater into the surrounding flood compartment.

8.5.4. Land Raising and Raising Finished Floor Levels

If it is not possible to avoid floodwater reaching the development site, the finished floor levels should be raised to reduce the risk to the occupants/users of the site.

For sites at risk of tidal, pluvial or river flooding, the EA typically requires the finished floor levels for all new development to be raised 300mm above the design flood level for living accommodation and 600mm above the design flood level for sleeping accommodation. In order to achieve the required levels, it may be possible to use a combination of the following techniques;

- Raising the internal ground floor level to the required level. Where floor levels are raised substantially above the existing ground level, consideration should be made for access to/from the building, particularly where disabled access is required.

- The use of townhouse-style development, comprising parking or other non-habitable uses on the ground floor. When proposing a sacrificial ground floor, the requirements for access/egress to/from the development should be considered. Furthermore, the addition of a sacrificial floor can have an impact on other planning requirements (i.e. ridge height limitations).

- Raising land levels to create a development platform above the design flood level. When land raising, consideration needs to be given to the potential for the displacement of floodwater.

It is recognised that there may be circumstances where the requirements outlined above are not achievable within the constraints of the development. For example, where ridge height limitations, or the existing fabric of the building limit the height to which the internal floor level can be raised. In such circumstances, clarification with regard to the requirements for finished floor levels should be sought on a site-by-site basis. It is recommended that the EA/LLFA are consulted through their pre-application advice service at the earliest opportunity.

The Council's specific requirements for finished floor levels for new residential development on brownfield sites in Whitstable and Herne Bay is included within the Memorandum of Understanding. It should be recognised that discussions with the EA are ongoing in relation to the content of the Memorandum of Understanding and additional numerical flood modelling may be required to clarify the required finished floor levels for these areas.

8.5.5. *Resistance and Resilience*

For development located within a flood risk area, buildings should be designed appropriately to limit the potential impact of a flood event, and to minimise the cost and time of recovery following a flood event. The document '*Improving the Flood Performance of new buildings'* provides guidance on common building material and construction methods which could be considered to reduce the impact of flooding to a building. This document can be found at;

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/7730/flood_performance.pdf

For flood depths up to 0.3m, the preferred approach is to minimise floodwater ingress whilst maintaining structural integrity. This is achieved through the use of flood resistance measures. Typical examples include the use of low permeability building materials (e.g. engineering bricks, solid-concrete floors), or temporary measures such as covers for doors and airbricks. The use of permanent (termed *passive)* flood resistance measures is preferable over temporary (termed *active)* measures, as they do not require action by owners/users of the site during times of flooding.

Most flood resistance products are only effective to a flood depth up to 0.6m. Therefore, for flood depths equal to, or less than 0.6m, flood resistance measures should be used in an effort to limit the potential for the ingress of floodwater into the building. Notwithstanding this, in circumstances where the ingress of floodwater into a building is possible, the building should be designed to limit the impact that a flood event could have. This is focussed on the time and cost of recovering from such an event. Flood resilience measures can include, but are not limited to: raising appliances; boilers and other electrical fittings above the flood level; using materials such as tiles and waterproof plasterboard.

As flood depths exceed 0.6m, the design standard of most resistance measures is likely to be exceeded, resulting in internal flooding of the building. In such circumstance, flood resistance is still recommended in order to delay the ingress of water (i.e. as water levels rise outside the building). However, the emphasis is placed on using flood **resilient** design.

Typical applications that are recommended for residential development located within a flood risk area are as follows:

- Solid concrete floors should be used instead of suspended floor construction as they can provide an effective seal against water rising up through the floor, provided they are adequately designed. Solid concrete floors generally suffer less damage than suspended floors and are less expensive and faster to restore following exposure to floodwater.

- The use of stud walls and plasterboard on the ground floor of new buildings should be avoided wherever possible as these absorb water and generally have to be removed and replaced after a flood event.

- Electricity sockets should be located at least one metre above floor level (or well above likely flood level) with distribution cables dropping down from an upper level. Service meters should also be at least one metre above floor level (or well above likely flood level) and placed in plastic housings.

- Boilers, should be mounted on a wall above the level that floodwater is likely to reach.

- The use non-return valves or ‘anti-flooding devices’ at the inspection chamber may be considered beneficial. These should only be installed in the sewer of a property upstream of the public sewerage system.

- Demountable defences – There is now a range of products available that can be used to protect properties from flooding and these generally take the form of plastic covers that clip in place over doors, windows and air bricks. The use of such measures should, however, be seen as a method of managing residual flood risk rather than as a primary defence.

For minor development and change of use applications, it may not be possible to avoid internal flooding using the flood mitigation measures outlined above (e.g. the sequential approach, raising finished floor levels etc.). The EA's Flood Risk Standing Advice states where it is not possible to raise floor level at least 300mm above existing flood level, the LPA should be consulted if resistance and resilience measures are required.

Where internal changes to an existing building are proposed (i.e. change of use), it is unlikely that flood resistant and resilient construction techniques can be implemented successfully. However, there are an increasing number of products available which can be retrofitted into existing buildings. These are referred to as Property Level Protection (PLP) measures.

To install PLP measures requires a survey of the flood performance of the existing building to identify potential locations where floodwater could ingress. Information on PLP measures, and details of appropriately qualified PLP surveyors can be found at the Blue Pages, hosted on the National Flood Forum website:

http://bluepages.org.uk/

8.5.6. *Compensatory Flood Storage*

In circumstances where a building displaces floodwater, the volume of water displaced may need to be compensated for by providing a compensatory flood storage scheme. This is to ensure that the risk of flooding is not increased elsewhere.

Compensatory flood storage is typically *not* required for *tidal* flooding. When the extent of flooding from a tidal source is considered, it can be seen that the floodplain is not confined and does in fact extend for some considerable distance. It is therefore concluded that development proposed in the tidal floodplain is unlikely to have an adverse impact on maximum surrounding flood levels and therefore, compensatory flood storage is not required.

When considering the extent of flooding from a *fluvial* or *pluvial* source it is evident that the floodplain is more confined and consequently, the impact of displacing floodwater is likely to a greater impact on the flood levels in the surrounding floodplain. Therefore, under these circumstances it will be necessary to provide compensatory floodplain storage.

The EA requires the 'Upper End' allowance for peak river flow (refer to 'climate change') to be used to calculate compensatory flood storage in the following circumstances;

- When the catchment is particularly sensitive to small changes in volume, causing significant increases in flood depth or hazard.
- The affected area contains essential infrastructure or vulnerable uses such as primary schools, caravans, bungalows or basement dwellings.

The 'Central' allowance for peak river flow may be used to calculate compensatory flood storage if evidence is submitted to the EA to demonstrate that the affected area contains only low vulnerability uses such as water compatible development, taking into consideration future land uses based on allocated sites in the local plan and submitted planning applications.

The measures below have been listed in order of preference and should be followed when displacement from a fluvial source is evident:

- All the buildings should be located outside the predicted flood extent on site, in accordance with the Sequential Approach.

- If the buildings cannot be located outside the flood extent, compensatory floodplain storage should be provided onsite and on a level-for-level, volume-for-volume basis. An equal volume of water displaced by the development is to be provided and should be located outside of the flood extent. Floodplain storage can be provided as either a 'block' which matches the development, (i.e. covering a similar area), or alternatively floodplain storage may be distributed across the site at convenient locations (within the same flood compartment). However, an equal volume must apply at all levels between the lowest point on site and the design flood level to ensure that there is no adverse impact offsite.

It is recognised that there are circumstances where it may not be possible to provide compensatory flood storage. In these cases, it may be acceptable to provide flood storage offsite, provided the area proposed for flood storage is hydraulically and hydrologically linked to the wider flood compartment.

Whilst inappropriate development within flood risk areas is discouraged, sites which have demonstrated that there are no other reasonable locations for the development to be located (i.e. through the application of the Sequential Test), and it has been demonstrated that it is not possible to provide compensatory storage using the methods outlined above, then the EA/LLFA should be consulted to discuss the use of undercroft void space (otherwise referred to as 'stilts'). Through the use of undercroft voids, the ground floor level can be raised above the predicted flood level to allow the storage of floodwater beneath the building.

If voids are specified, they will typically be required to be 1m in width and there should be a minimum of one void for each 5m length of wall. The underside of the floor (top of the void) should be situated a minimum of 300mm above the design flood level. The voids should be designed to allow water to flow unimpeded beneath the building and the use of anti-vandalism, or anti-vermin mesh can be considered, providing there is a maintenance schedule in place to ensure that any mesh is cleared of obstructions on a regular basis.

It may be possible to incorporate a sacrificial ground floor within the scheme design (i.e. the use of undercroft parking) which is designed to enable floodwater to be stored beneath the building during an extreme flood event.

If it is not possible to mitigate the impacts of development in full through the provision of flood storage, it will be necessary to demonstrate the increase in risk of flooding to the site and surrounding area and assess its significance.

8.5.7. ***Impedance of Flood Flows***

All development should be designed to ensure any identified flow paths are not obstructed as part of the development proposals. The preferred mitigation would be to locate all development outside of the overland flow path. Green-blue infrastructure corridors should be incorporated into the scheme design to accommodate any overland flow routes through the development site and be incorporated into the open space provision where feasible. For large sites, it may be necessary to quantify the extent, depth and velocity of flood flows including an allowance for climate change into the future to enable suitable design of any green features (e.g. swales etc.). The CIRIA SuDS Manual provides advice on designing to accommodate overland flows.

If it is not possible to mitigate the impacts of development in full on flood flows, it will be necessary to demonstrate the increase in risk of flooding to the site and surrounding area and assess its significance.

8.5.8. ***Proximity to Watercourses***

There are several bodies responsible for rivers and ordinary watercourses according to the Water Resources Act 1991 and Land Drainage Act 1991.

- The LLFA are responsible for the regulation of ordinary watercourses.
- The Internal Drainage Board (IDB) is responsible for the regulation of watercourses located within defined 'internal drainage districts'. Within the District there is the Lower Stour IDB.
- The EA is responsible for watercourses which are designated as 'main rivers'. To determine whether the development site is in proximity to a main river, refer to the following website;

  https://environment.maps.arcgis.com/apps/webappviewer/index.html?id=17cd53dfc524433980cc333726a56386

8.5.9. ***Maintenance and Biodiversity Easements***

For main rivers, the EA require that an 8m buffer zone is retained between the river bank and any permanent construction such as buildings, or car parking etc. This buffer zone increases to 16m for tidal waterbodies and sea defence infrastructure. This buffer is required to allow access for maintenance and to promote biodiversity along the river corridor.

For development sites located in proximity to an ordinary or IDB maintained watercourse, it is recommended that the responsible body is contacted to confirm the access and maintenance requirements.

8.5.10. Permitting and Consent

In addition to the above, it may be necessary to obtain a Flood Risk Activity Permit from the EA for works undertaken;

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

Information on which activities are subject to a Flood Risk Activity Permit can be found at; https://www.gov.uk/guidance/flood-risk-activities-environmental-permits.

For works on ordinary, or IDB maintained watercourses, a Flood Risk Activity Permit is not required. However, the Land Drainage Act requires that formal written consent is sought from the relevant body for **any works adjacent to, or within a watercourse, that could affect in-channel flows** and is located within the buffer zone as defined by each responsible body. This includes any proposals for culverting a watercourse.

8.5.11. Safe Access Routes

The NPPG requires that new development is designed to ensure safe access/egress to/from the development is available under design event conditions. In addition, evacuation will need to be achievable for sites under the 1 in 1000 year flood event, including an appropriate allowance for climate change. This should include provision for the emergency services vehicles to safely reach the development.

To determine whether access/egress to/from a development is considered to be *safe*, the flood hazard should be quantified. The methodology for calculating flood hazard is outlined in the report 'Flood Risks to People' (R&D output FD2320/TR2) and is based on the expected depth and velocity of flooding along the anticipated access route. The flood hazard is classified into categories which show the degree of hazard;

Hazard Rating (HR)	Degree of flood hazard	Description
< 0.75	Low	Caution – shallow flowing water or deep standing water
0.75 to 1.25	Moderate	Dangerous for some, i.e. children – deep or fast flowing water
1.25 to 2.0	Significant	Dangerous for most people – deep fast flowing water
> 2.0	Extreme	Dangerous for all – extreme danger with deep and fast flowing water

Table 8.2 - Classification of Hazard Rating Thresholds.

For sites located within an area at risk of flooding, a Flood Warning and Evacuation Plan (FEP) may be requested by the EA. The NPPG also requires that a Flood Warning and Evacuation Plan (FEP) is prepared for *'sites used for holiday or short-let caravans and camping'*.

A FEP should provide information to owners/residents of a development on procedures to be followed on receipt of a flood alert, flood warning, or severe flood warning. This should include emergency contact numbers and a flood action plan explaining measures that residents/users of the development can take to lessen the impact of such an event (e.g. moving belongings upstairs, installing PLP measures). Other site-specific information, such as emergency access routes through the site to an area that is located above the predicted flood level (which can be used as a safe haven until floodwater recede), should be detailed within the FEP.

To inform early warning and evacuation, the EA operates a flood warning service in areas at risk of flooding from rivers or the sea. This service is based on different measurements of rainfall, river levels and tide levels and utilises in-house predictive models, rainfall radar data and information from the Met Office. This service operates 24 hours a day, 365 days a year.

Occupants/owners of developments which are located in an area identified to be at risk of flooding should sign up to the EA's Flood Warning Service;

https://www.gov.uk/sign-up-for-flood-warnings

More details of flood emergency practices are outlined in Section 9.

With the exception of development on the fringes of the coastal floodplains, it is not possible to provide safe and dry access from a new development located within a coastal floodplain to an area located outside the flood zone. This is of particular concern for potential development of brownfield sites in the larger floodplains within the towns of Whitstable and Herne Bay.

In order to allow development which would otherwise pass all the other requirements of the NPPF, it is necessary in exceptional circumstances to accept alternative arrangements, whereby occupants can seek refuge within the building itself. This will only be acceptable if internal access within the building is available, leading to a suitably sized area that is raised at least 600mm above the predicted 1 in 200 year sea level, including an appropriate allowance for climate change. In addition, the building shall have a means of escape by which residents can be rescued by the emergency services from a door, or freely opening window, of sufficient size.

9. Flood Risk Emergency Practices

9.1. Emergency Planning and Response

The Council has defined responsibilities under the Civil Contingencies Act 2004 to assess risk, and respond appropriately in case of an emergency, including a major flooding event. The Council's primary responsibilities are:

- to assess the risk of an emergency occurring;
- to assess the risk of an emergency making it necessary or expedient for the person or body to perform any of their or its functions;
- to maintain plans for the purpose of ensuring, so far as is reasonably practicable, that if an emergency occurs the person or body is able to continue to perform its functions;
- to maintain plans for the purpose of ensuring that if an emergency occurs or is likely to occur the person or body is able to perform its functions so far as necessary or desirable for the purpose of preventing the emergency, reducing, controlling or mitigating its effects, or taking other action in connection with it.

To meet the requirements of the Civil Contingencies Act the Council has produced a Local Multi-Agency Flood Plan. The purpose of the plan is to set out all the principles that will govern the multi-agency response to a significant flood event in the Canterbury District. The plan sits underneath the Pan Kent Multi Agency Flood Plan. The SFRA provides a summary of the sources and mechanisms of flooding within the District and may therefore be used to inform the assessment of flood risk in response to the requirements of the Act.

If flood warning systems are to have any value they must give people sufficient notice so that they can make appropriate and timely preparations and responses in order to reduce the resultant damage and distress. For Canterbury District this is achieved through District flood emergency plans. At the District level, the main emergency response is carried out by CCC with back-up from Kent County Council's emergency planning department and the emergency services. The essence of the plans, and in particular what will actually be done and the systems that are in place to do it, is given in the Kent County Council document "Co-ordination Plan for Major Emergencies" and the CCC documents "Major Emergency Plan" and "Flood Emergency Plan".

The Council has a duty engineer standby system set up to respond to flood warnings and flood emergencies. There are 12 engineers on the duty standby team and one of these, by rota, is always on duty such that there is cover 365 days a year and 24 hours a day. Because of the size of the team there will always be a number of engineers who are not on duty but who would also be available to respond to a call should the need arise. On top of this, there are other engineering staff, not on the duty rota, that are available to assist at relatively short notice. The majority of the duty standby team are experienced coastal engineers who have been on the team for a long time.

Considerable experience of actual emergency flood conditions and actions was gained as a result of the significant flooding and numerous Severe Flood Warnings during the fluvial flood events of winter 2000/2001 and winter 2013/2014. The duty engineers receive warning information from the Council's central control, which is permanently manned by at least two persons.

When a Flood Alert is issued, the duty engineer will ensure, by visual inspection, that all appropriate floodgates in the seawalls are properly closed and, if they are not, make arrangements to have them closed. The duty engineer can monitor actual sea conditions using data from a wave and tide recorder on Herne Bay Pier, which can be obtained online in real time, and take any further action deemed appropriate. This may include upgrading the local Flood Alert to a Flood Warning.

If conditions deteriorate, the Council's Major Emergency Plan is activated. This plan sets out all the necessary actions to be taken including action by the Council's emergency response contractor, evacuation procedures and the setting up of emergency rest centres. There is a specific Sea Flood Emergency Plan, which is updated annually, with particular reference to actions needed during sea flooding. A similar system is also in place for river flooding with procedures for opening river sluice gates and monitoring river levels. There are river level sensors on both arms of the Stour through the centre of Canterbury, which will automatically give a warning to the duty engineer if the level is above the set alarm value.

9.2. Flood Warning

The EA monitors rainfall, river levels and tides, as well as employing state of the art forecasting techniques. Based on the information received from these flood warning systems, Flood Warnings are issued using a set of three codes, each indicating the level of risk with respect to flooding. The warnings issued are as follows:

The EA changed the flood symbols in November 2010 and updated the warning messages so they are easier to understand, providing more local information and giving clearer guidance about what people need to do. The updated EA flood warning service now has three types of warnings that will help prepare for flooding and take action (Table 8.1). They are:

- Flood Alert
- Flood Warning
- Severe Flood Warning

Flood warning procedures are in place for the following locations within the District.

- Coast from Kemsley to Seasalter
- Coast from Whitstable to Herne Bay
- Swalecliffe Brook

- West Brook
- The Great Stour from Shalmsford Street to Thanington including Chartham
- The Great Stour at Canterbury
- The Great Stour at Fordwich and Sturry
- The Nailbourne
- Little Stour

	What it means	When it's used	What to do
 FLOOD ALERT	Flooding is possible. Be prepared.	Two hours to two days in advance of flooding.	Be prepared to act on your flood plan. Prepare a flood kit of essential items. Monitor local water levels and the flood forecast on our website.
 FLOOD WARNING	Flooding is expected. **Immediate** action required.	Half an hour to one day in advance of flooding.	Move family, pets and valuables to a safe place. Turn off gas, electricity and water supplies if safe to do so. Put flood protection equipment in place.
 SEVERE FLOOD WARNING	Severe flooding. **Danger to life.**	When flooding poses a significant threat to life or significant disruption to communities.	Stay in a safe place with a means of escape. Be ready should you need to evacuate from your home. Co-operate with the emergency services. Call 999 if you are in immediate danger.
Warnings no longer in force	No further flooding is currently expected in your area.	When river or sea conditions begin to return to normal.	Be careful. Flood water may still be around for several days. If you've been flooded, ring your insurance company as soon as possible.

Table 8.1 - EA Flood Symbol Guidance for Residents

Further information relating to the flood warning areas and procedures can be found on the EA's website.

10. Sustainable Drainage Systems (SuDS)

10.1. Overview

The NPPF requires that LPAs should promote Sustainable Drainage Systems (SuDS) and ensure that their policies encourage sustainable drainage practices in their Local Development Documents. SuDS is a term used to describe the various approaches that can be used to manage surface water drainage in a way that mimics the natural environment.

The management of surface water which is generated by rainfall falling onto a development site is considered essential in reducing future flood risk to both the site itself and to the surrounding area. Reducing the rate in which surface water runoff is discharged from urban sites is one of the most effective ways of reducing the risk of watercourses and sewers flooding.

In addition, appropriately designed SuDS can be utilised such that they not only attenuate flows but also provide a level of improvement to the quality of the water passed on, e.g. to a watercourses or into the groundwater table. This is known as Source Control and is a fundamental part of the SuDS philosophy. Furthermore, appropriately design SuDS can provide additional biodiversity benefits and can create areas for amenity which help to integrate water into the built environment.

10.2. SuDS at the Planning Stage

At the conceptual stage of the scheme design it is necessary to make an assessment of the way in which the surface water will be discharged from the site and how it will be managed, to ensure the risk of flooding will not be increased. The type of superficial and underlying geology is fundamental in the design process and the selection of the most appropriate SuDS system for a development. There are two variations in SuDS, these are:

- Infiltration SuDS; designed to discharge all, or part of the runoff directly to the ground. This type of system relies on a permeable geology.

- Attenuation SuDS; the drainage system is designed to store runoff onsite, before releasing water at a controlled rate to a watercourse or sewer. This type of system is typically used when infiltration is not a viable option.

It is recognised that large increases in impermeable surfacing can contribute to a significant increase in the volume of surface water that is discharged from a site. Similarly, the rate at which surface water is discharged from a site can also increase significantly if adequate SuDS are not incorporated into a development. One option to avoid the increase in the discharge rate is to attenuate the peak flow using a flow control device, in conjunction with onsite storage, which is designed to hold the water back until the storm event has passed. In some circumstances, where infiltration is available, it may also be possible to minimise the volume of runoff discharged from the development by discharging the runoff directly to the ground.

10.3. Application of SuDS

Part H of the Building Regulations recommends that wherever practicable, appropriate SuDS elements should be incorporated into the drainage system. It also sets out a hierarchy for surface water disposal and infiltration is the preferred method for achieving this. If this is not possible, the next favoured option is to discharge runoff to a watercourse. Only if neither of these options are achievable should the site discharge rainwater to a sewer.

A range of typical SuDS features that can be used to reduce the risk of flooding and improve the environmental impact of a development are listed in Table 10.1 below. The table also lists the other potential benefits of each feature and the appropriateness for different sites.

	Enhancements to Biodiversity	Improvement to Water quality	Suitability for low permeability soils (k<10-6)	Ground-water recharge	Suitable for small / confined sites?
Wetlands	✓	✓	✓	x	x
Retention ponds	✓	✓	✓	x	x
Detention basins	✓	✓	✓	x	x
Infiltration basins	✓	✓	x	✓	x
Swales	✓	✓	✓	✓	x
Filter strips	✓	✓	✓	✓	x
Rainwater harvesting	x	✓	✓	✓	✓
Permeable paving	x	✓	✓	✓	✓
Green roofs	✓	✓	✓	x	✓

Table 10.1 - Environmental improvements available through SuDS

In addition to the SuDS features listed above, other options are available to attenuate runoff from a development site, including the use of; underground storage tanks/crates, oversized pipes and flow control devices. These alternative SuDS options are particularly relevant to smaller, confined sites where space is a major limiting factor.

A description of the key benefits of the SuDS features listed in Table 10.1 is given below. For any retention or detention system it is important that the design allows for sufficient capacity to be available at the start of any storm allowing for the possibility that the system may already be partially full from a previous storm event

Wetlands – Provide a range of habitats for plants and wildlife, as well as provide biological treatment. Linear wetlands can also provide green corridors.

Retention Ponds – Open water bodies can significantly enhance the visual amenity of a development and provide opportunities for improvements to wildlife habitats.

Detention Basins – Provide treatment by detention and can be designed as an amenity or offer new habitat for wildlife.

Infiltration Basins – Treatment is provided through detention and filtration. Basins can be any shape, curving or irregular, with scope for improved visual amenity and can have a dual-purpose e.g. sports pitches, play areas, wildlife habitat.

Swales – Generally used to convey water to storage facilities and provide treatment by filtration. Swales are designed to remain dry between rainfall events and can be planted with trees and shrubs to provide green links/corridors. The preferred design will include as much infiltration as the surrounding ground can accommodate.

Rainwater Harvesting – Provides attenuation and allows rainwater to be reused within the development, reducing the pressure on potable water supplies.

Porous and Pervious Paving/Surfacing – Often provides large areas of permeable surfacing which can promote infiltration and can provide a pollution barrier. These types of systems can either infiltrate at source, or alternatively be tanked to provide storage for surface water runoff. On sites that are suitable for infiltration, unlined systems are favoured as these systems can infiltrate large amounts of water due to the large surface area that is in contact with the ground.

Green Roofs – As well as providing improved opportunities for biodiversity, vegetated roofs can help to reduce the volume and the rate of surface water runoff discharged from the development, as well as helping to remove pollution.

From the soil and geology information provided in Section 3.3, it can be seen that the ground conditions across the District vary greatly. Consequently, the applicability of different types of SuDS will be dependent on the location of each development site. Where ground conditions are suitable, infiltration should be the first choice for discharging surface water, as the benefits of using infiltration as part of a sustainable drainage system include the following:

- Infiltration of good quality surface water helps to recharge the aquifer and may benefit local groundwater use or groundwater dependent ecosystems.
- In naturally permeable soil locations, infiltration may mimic the natural water cycle, otherwise lost during the development process.
- Can significantly attenuate discharge rates.

A high percentage of new development in the District is likely to be concentrated in Canterbury and the coastal towns of Whitstable and Herne Bay. In these locations it is unlikely that infiltration will be an effective method of discharging surface water, however, it should be recognised that the level of detail contained within the geological and soils maps published as part of this SFRA is not always appropriate for site-specific decision making. Consequently, it may be necessary to undertake further site specific investigation to establish the ground conditions in greater detail, before ruling out infiltration as an option.

10.4. Constraints Regarding Discharge to Ground

There are some locations within the District that are shown by the EA's Groundwater Source Protection Zone map to be located within areas where infiltration is controlled. These are primarily located to the south of Canterbury, and in areas such as Chartham and Barham.

When considering which infiltration SuDS to use in these areas it is important to understand the nature of the aquifer body and the surrounding groundwater levels at the site. The main constraints associated with infiltration in these areas include the contamination from brownfield sites and contamination from road drainage.

It is possible to check whether a site is located within a groundwater source protection zone by referencing Defra's Magic Map website. Whilst development of a site which is shown to be located within a groundwater source protection zone does not preclude the use of infiltration, the following points must be considered:

- Soakaways must not be constructed greater than 3m below the existing ground level.
- In order for water to be discharged to the ground, it must be demonstrated that an unsaturated zone (typically 1m) will be available between the discharge point and the groundwater table at all times of the year. Advice on ground water levels may be available from the EA.
- Assuming that the above can be satisfied, run-off from roofs will need to be discharged to the soakaway via sealed downpipes. This arrangement must be capable of preventing both accidental and unauthorised contamination of the roof water.
- All discharge must be into a clean and uncontaminated area of natural ground.

11. Policy Recommendations

CCC's preferred option for reducing flood risk within its boundaries is to avoid inappropriate development in areas at highest risk within the broad character areas of the District. The planning process should be used to steer more vulnerable development to areas of lower risk and, where development is at higher risk, to ensure that new development is appropriately designed to manage residual risk throughout the lifetime of the development.

This approach fully supports the overarching objectives of the NPPF. The specific policy recommendations that are made by this SFRA to enable the Council to deliver these objectives are outlined and discussed below.

It should be recognised that the original draft set of policy recommendations was released to CCC prior to the NPPG update. As such, the policies below may differ from the policies released as part of the Draft Local Plan to inform Regulation 18.

Policy Recommendation 1

For new development on sites which have been identified to be at risk of flooding, the Sequential Test is typically required. Where required, the Exception Test should also be applied.

Whilst the Sequential Test is considered to be passed for sites in the town centres and commercial areas, as defined on the policies map, development in these areas should still be considered against the Exception Test to determine whether development can proceed safely with the flood risk managed.

In addition, the Sequential Test will not be required for the following development;

- Sites that have been allocated as part of the Local Plan
- Sites shown to be in a low risk area, taking all of flooding sources into consideration, including an allowance for climate change
- Householder development
- Minor development
- Change of Use
- Replacement dwellings

Where any of the types of development listed above fall within an area at risk of flooding, a site-specific Flood Risk Assessment will still be required to demonstrate that the risk of flooding is reduced to the occupants through appropriate design.

The Sequential Test should be undertaken for all other ‘Major’ and ‘Non-major’ development located in an area at risk of flooding. Where development is not covered by any of the types listed, the Council should be contacted to confirm whether the Sequential Test is required.

Policy Recommendation 2

Any new development will need to be designed such that the peak rate of surface water run-off from the site does not exceed the existing surface water run-off rate, to ensure that flood risk is not increased within the District. The proposals will also need to meet the requirements of the Council's Drainage Impact Assessment Guidance Note and the surface water management strategy recommendations of the NPPF. New development should incorporate sustainable drainage where practicable (following the principles outlined in the Non-Statutory Technical Standards for SuDS), to help reduce the rate and volume of surface water run-off from new development, and to improve the quality of the water passed on to watercourses. The emphasis should be put on SuDS which provide treatment on site and reduce the discharge of substances which could harm the environment. Where development is proposed within the Stodmarsh Catchment, as defined by Natural England, it will be necessary to demonstrate that any new proposals do not have an adverse effect on the dedicated Stodmarsh Special Area of Conservation (SAC) and RAMSAR site. Development should refer to the guidance published by Natural England.

It is recognised that the Council seeks to achieve 100% treatment of surface water runoff on large sites in accordance with the new guidance published by Natural England for the Stodmarsh area. Nevertheless, based on the current available SuDS features and the absence of studies which confirm the grade to which SuDS can remove harmful substances, it is considered unlikely to be achievable. As such, it is recommended that developers are referred to the guidance from Natural England for sites identified to be situated within the Stodmarsh catchment.

Policy Recommendation 3

Any development that is proposed to take place within 30m of the crest of the seawall will require a site-specific Flood Risk Assessment to be submitted. This should be compliant with the NPPF and should address the specific risk of wave overtopping.

Development in some of the District's seafront areas may be located very close to the shoreline and will therefore be subjected to an increased risk of flooding and damage from severe wave overtopping, even if shown to be located outside of Flood Zones 2 and 3.

Policy Recommendation 4

Any new development should not have an adverse impact on drinking water resources, by referencing the Groundwater Source Protection Zone maps published by the EA. The use of rainwater harvesting and grey water recycling systems are also encouraged to reduce the reliance on the District's potable water supply.

12. Conclusions

The Canterbury District is varied, from the historic city of Canterbury itself to the coastal towns of Whitstable and Herne Bay. Alongside these urban centres is the contrasting countryside and rural villages, all of which are exposed to a varying degree of flood risk. The risk of coastal flooding to the low-lying parts of the District does dominates much of this SFRA, however, it is recognised that there is also a history of fluvial and surface water flooding that should not be overlooked, particularly in view of the flood events witnessed in winter 2000/2001, 2014/2015 and 2019/2020.

It is possible to manage the risk of flooding from all sources in a sustainable manner and this can be achieved through the implementation of the NPPF, the CCC Local Plan and ensuring site specific assessments (FRAs and DIAs) are undertaken as part of the development process. Re-development of brownfield sites should provide opportunities to reduce overall flood risk, principally through the use of sustainable drainage systems. However, a planning solution to flood risk management should be sought wherever possible, steering vulnerable development away from areas affected by flooding in accordance with the Sequential Test.

The District benefits from a comprehensive and well maintained sea defence system, which has been comprehensively upgraded over the last 25 years. There is an adopted Shoreline Management Plan in place as well as Flood and Coastal Erosion Risk Management Strategies, all of which promote and support the long-term investment and, where necessary, improvements to the flood defence infrastructure in this area. These improvements are designed to keep pace with climate change and future sea level rise. Inland there is an adopted Catchment Flood Management Plan with recommendations to, at minimum, maintain the current standard of flood defence allowing for climate change. The risk of flooding to the coastal towns along the northern coastline of the District has been recognised by CCC for many years. In response to coastal flooding and erosion risk management strategies produced and adopted by the Council there is a long term commitment to sustaining the high standard of protection provided by the District’s coastal defences.

In the densely urbanised coastal towns of Herne Bay and Whitstable it is not always possible to locate new development away from the town centre for economic regeneration and other sustainability reasons and therefore, it is paramount to ensure that new development can be delivered safely without increasing the risk of flooding.

Additionally, since the original publication of the SFRA in 2011, a number of Flood Mapping and Modelling studies have been completed which enable the risks to be better understood and through the use of appropriate design, the potential impacts of flooding can be mitigated.

It should be acknowledged that whilst updated tidal modelling has been undertaken for key locations, the majority of the data referenced within this SFRA has been published *prior* to the latest changes to the NPPF (2023), NPPG (2022) and EA’s climate change guidance. Review of the additional numerical modelling undertaken as part of this document is still ongoing and as such, as the Local Plan is emerging, the maps produced to inform this SFRA are likely to change.

Notwithstanding this, the maps are based on the latest available data for the area and therefore, are still considered appropriate for use, providing both the Council and developers with a starting point to appraise whether development is acceptable in terms of flood risk.

For sites that are not identified through the Local Plan process and for windfall sites, the SFRA provides guidance for the completion of site-specific FRAs, as well as setting out policy recommendations to help manage the risk of flooding within the District.

Alongside the development control role of the SFRA, it should be recognised that emergency planning is imperative to minimise the risk to life posed by flooding within the District. The Council is fully cognisant of this and continues to review its civil contingency and emergency response plans, as well as drafting a new Local Multi Agency Flood Plan for the District and annually updating its in-house Flood Emergency Plan.

It is recommended that the Canterbury District SFRA is reviewed regularly and the review should address the following key questions:

- Has any major flooding been observed within the District since the previous review?
- Have any amendments to the NPPF and its accompanying Planning Practice Guidance been released since the previous review and will these impact upon the SFRA?
- Has the EA issued any amendments to their flood risk mapping and/or standing guidance since the previous policy review?
- Have any updates been made to the studies that underpin strategic flood risk management within the District, including the Catchment Flood Management Plan, the Shoreline Management Plan, and the Flood and Coastal Erosion Risk Management Strategies?
- Have there been any changes to Planning Policy that could affect the way in which flood risk is managed through the planning process?
- Has Government issued new guidance on climate change predictions?

In summary, the SFRA provides a clear picture of the potential risks associated with flooding within the Canterbury district based on the latest available data and outlines the requirements with regard to ensuring that these risks are managed in a sustainable manner into the future.

13. Appendices

Appendix A.1 - Existing Defence Infrastructure and Main Rivers

Appendix A.2 – Historic Flood Map

Appendix A.3 - Flood Zone 3b – Functional Floodplain

Appendix A.4 - Potential Risk of Flooding Map (2022)

Appendix A.5 - Potential Risk of Flooding Map (Climate Change)

Appendix A.6 –Whitstable and Herne Bay Model Outputs

Appendix A.7 - Council Flooding Scrutiny Panel Action Plan

Appendix A.8 - Canterbury City Council Drainage Impact Assessment Guidance and Pro-forma

Appendix A.9 – Memorandum of Understanding

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Appendix A.9 – Memorandum of Understanding

The content of the Memorandum of Understanding is currently being discussed with the Environment Agency. An updated version of the Memorandum of Understanding will therefore be available at a later stage.