Strategic Flood Risk Assessment
# Shepway District Council

July 2015 (Final Issue)

Shepway District Council
Civic Centre
Castle Hill Avenue
Folkestone
Kent
CT20 2QY

*This page is left intentionally blank*

Strategic Flood Risk Assessment
# Shepway District Council

## Contents Amendment Record

This report has been issued and amended as follows:

| Issue | Revision | Description | Date |
|---|---|---|---|
| 1 | 0 | Phase II Draft | 20 Feb 2015 |
| 2 | 1 | Phase II Second Issue | 02 June 2015 |
| 3 | 2 | Phase II Final | 10 July 2015 |

Herrington Consulting Limited
Unit 6 – Barham Business Park
Elham Valley Road
Barham
Canterbury
Kent, CT4 6DQ
Tel/Fax +44 (0)1227 833855

www.herringtonconsulting.co.uk

*This page is left intentionally blank*

# Contents

**Executive Summary** 1

**1 Introduction** 4

*1.1 Overview* 4

*1.2 Key SFRA Objectives* 4

*1.3 SFRA Format* 4

**2 The Study Area** 6

*2.1 Overview of the District* 6

*2.2 Hydrogeology* 7

*2.3 Geology and Hydrogeology* 8

*2.4 Soils* 9

*2.5 Topography* 10

**3 Policy Framework** 12

*3.1 National Policy* 12

*3.2 Local Planning Policy* 16

**4 SFRA Approach and Methodology** 19

*4.1 Overall Approach* 19

*4.2 SFRA Aims* 19

*4.3 SFRA Outputs* 20

**5 Data Sources** 21

*5.1 Consultation and Data Collection* 21

*5.2 Existing Hydraulic Modelling* 22

*5.3 Flood Zone Mapping* 22

*5.4 Historic and Localised Flooding* 23

**6 Overview of Flood Risk** 26

*6.1 Flooding from the Sea* 26

*6.2 Flooding from Rivers* 27

*6.3 Flooding from Surface Water Run-off and Overland Flow* 29

*6.4 Groundwater Flooding* 29

*6.5 Flooding from Sewerage Infrastructure* 30

*6.6 Flooding from Reservoirs and Artificial Waterways* 31

**7 Flood Risk and Climate Change** 33

*7.1 Potential Changes in Climate* 33

*7.2 Impacts of Climate Change on the SFRA Study Area 35*

**8 Flood Risk Management Practices 36**

*8.1 Existing Flood Defence Infrastructure 36*

*8.2 Emergency Planning 37*

*8.3 Flood Warning 38*

**9 Residual Risk 40**

*9.1 Breach Analysis 40*

*9.2 Wave Overtopping 40*

*9.3 Modelled Scenarios 41*

*9.4 2D Hydraulic Model Set-up 42*

*9.5 Modelling Outputs 43*

**10 Guidance for Site Specific FRAs 46**

*10.1 When is a Site-specific FRA Required? 46*

*10.2 FRA Requirements 49*

*10.3 Specific FRA Guidance 50*

*10.4 Surface Water Management Strategy Requirements 52*

**11 Policy Recommendations 53**

**12 Sustainable Drainage Systems (SuDS) 55**

*12.1 Overview 55*

*12.2 SuDS at the Planning Stage 55*

*12.3 Application of SuDS 56*

*12.4 Constraints on Discharges to Ground 58*

**13 Conclusions 59**

**14 Appendices 61**

# Executive Summary

Shepway is a District of unique contrasts, situated on the East Kent coast, 120 kilometres from London and covering an area of 363 square kilometres. Much of the District is low-lying with approximately 195km$^2$ (55%) lying within the Environment Agency's Zone 3a flood risk area.

Flooding can result not only in costly damage to property, but can also pose a risk to life and livelihood. It is essential therefore that future development is planned carefully, where possible steering it away from areas that are most at risk from flooding, and ensuring that it does not exacerbate flooding elsewhere.

Herrington Consulting has been commissioned by Shepway District Council to update the existing Strategic Flood Risk Assessment (SFRA) which was prepared for the District in 2009. This study provides an analysis of the main sources of flood risk to the District, together with a detailed means of appraising development allocations and existing planning policies against the risks posed by coastal flooding over this coming century.

The National Planning Policy Framework (NPPF) published by the Department for Communities and Local Government in March 2012, requires Local Planning Authorities to apply a risk-based approach to the preparation of their development plans in respect of potential flooding. In simple terms, the NPPF requires local planning authorities to review the variation in flood risk across their District, and to steer vulnerable development (e.g. housing) 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.

The Sequential Test provides clear guidance as to how this should be achieved. In simple terms, the Sequential Test requires that the District is delineated into areas of 'low', 'medium' and 'high' risk, i.e. Zones 1, 2 and 3. It then provides a list of suitable types of land use that should be permitted within each zone, depending upon the perceived vulnerability of the community that will be present day to day within that development.

The SFRA is the first step in this process and provides the building blocks upon which the Council's forward planning and development control decisions are made. One of the most pressing issues for Shepway District Council is the fact that such a large percentage of the District lies within Flood Zone 3.

However, the vast coastal floodplains within the District lie within Flood Zone 3 and benefit from the protection provided by a diverse range of flood defence infrastructure. Before the completion of the original SFRA in 2009, the degree of risk across these areas was generally un-quantified and therefore it was not possible for the Council to implement the primary objectives of the NPPF.

The completion of the original SFRA in 2009 provided quantifiable flood hazard information for the district. Nonetheless, developments since 2009 in Planning Policy, along with changes in climate change predictions, have meant that the report, and the associated mapping have now been revised.

The key objectives of the revised SFRA are therefore to meet the following key requirements:

- To collate all known sources of flooding, including river, surface water (local drainage), sewers and groundwater, overland flows and infrastructure failure, that may affect existing and/or future development within the District;
- To examine the impact of an extreme flooding event that exceeds the standard of protection provided by the existing coastal flood defences;
- To quantify the depth, velocity and other key parameters of flood events that result from the overtopping or failure of the existing defences;
- To map the outputs of this analysis in such a way so as to provide clear and precise information at a scale that is appropriate to inform the planning process at both a strategic and site-based level;

Whilst much of the low-lying area of the District is devoted to agricultural use, there are a number of established towns and villages. The future sustainability of these communities relies heavily upon their ability to grow and prosper and for this reason, the NPPF and supporting Planning Practice Guidance acknowledge that in some cases it is not possible to locate all new development outside of areas of flood risk.

In this situation, where the local planning authority has identified that there is a strong planning based argument for a development to proceed, it will be necessary for the Council to demonstrate that the Exception Test can be satisfied.

For the Exception Test to be passed there are two criteria that must be satisfied and these are listed below:

a) It must be demonstrated that the development provides wider sustainable benefits to the community that outweigh flood risk.

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

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

Effective development control policy is essential to assist the Council to manage flood risk, and to ensure a consistent approach at the planning application stage. This is essential to achieve future sustainability within the District with respect to flood risk management and to therefore to facilitate this, the SFRA provides detailed information on flood risk throughout the District.

In parallel with development control, emergency planning is imperative to minimise the risk to life posed by flooding within the District. It is therefore recommended that the Council review their adopted flood risk response plan in light of the findings and recommendations of the SFRA.

Furthermore, the SFRA has been developed building heavily upon existing knowledge with respect to flood risk within the District. The Environment Agency regularly review and update their flood maps and a rolling programme of detailed flood risk mapping within the South East region is currently underway. In addition some of the major flood defence infrastructure within the district is currently being improved, with plans for significant expenditure on further improvements in the near future.

These new defences and additional information will reduce risk and improve the current knowledge of flood risk within the District. Consequently this may influence future development control decisions and therefore the information within the SFRA will require updating.

In summary, it is imperative that the SFRA is adopted as a ‘living’ document and is reviewed regularly in light of emerging policy directives and an improving understanding of flood risk within the District.

# 1 Introduction

## 1.1 Overview

Herrington Consulting has been commissioned by Shepway District Council (SDC) to update the existing Strategic Flood Risk Assessment (SFRA) for the District, which was originally prepared in 2009.

The National Planning Policy Framework (NPPF) published by the Department for Communities and Local Government (DCLG) in March 2012 requires Local Planning Authorities (LPA) to apply a risk-based approach to the preparation of their development plans in 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 and 10 of the *Planning Practice Guidance: Flood Risk and Coastal Change* (DCLG, 2014).

## 1.2 Key SFRA Objectives

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 prepare appropriate policies for the management of flood risk within the Local Development Documents;

- inform the sustainability appraisal so that flood risk is taken account of when considering strategic land use policies;

- 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

At the inception stage of the SFRA (Phase II) it was established that a significant amount of detailed analysis would be required in order to provide the necessary quantitative flood risk data, which would enable the Council to apply a risk based approach to the preparation of its development plans. Therefore to provide best value, reduce the overall programme for delivery and to improve the structure of the SFRA, it was agreed that the original SFRA document would be updated based on the original hydrodynamic modelling, albeit with revised input data.

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's flood and coastal erosion risk strategy is recommending significant expenditure on flood defence infrastructure in the District over the next 10 years. The 2015 revision of this report takes into account changes since the original SFRA was produced in 2009.

This document has therefore been prepared in consideration that significant improvements works are currently being undertaken to major sea defences in the District. These unfinished defences have been recognised within this report, but are not considered to currently provide a benefit in terms of flood risk protection to the district and are therefore omitted from any quantitative analysis.

# 2 The Study Area

## 2.1 Overview of the District

Shepway is a district of unique contrasts, situated on the East Kent coast, 120 kilometres from London and covering an area of 363 square kilometres. Much of the District is low-lying with approximately 195km (55%) lying within the Environment Agency's Zone 3a flood risk area.

Shepway has a coastal frontage that extends for 41 kilometres between its eastern boundary at Folkestone's Gault Clay cliffs to the shingle barrier beach at Lydd. In addition, much of this land lies below the mean high water level and consequently the majority of Shepway's coastal frontage is protected by sea defences. These defences are either formal 'hard' structures or are formed by natural shingle barrier beaches that are actively managed to reduce the risk of breaching.

The main population is spilt across four major urban areas. Folkestone is the largest town in the District, Hythe the second largest followed by New Romney and Lydd. The remainder of the population is spread across of a number of rural settlements, villages and small towns. Figure 2.1 shows the geographical extents of the District along with the main towns and villages.

The rural landscape is diverse; with the District's hillier northern parishes falling predominantly within the Kent Downs Area of Outstanding Natural Beauty and the southern parishes being within the low-lying Romney, Walland and Denge Marsh areas.

There are also a number of key transport routes within the District. These include the M20 and the Channel Tunnel Rail Link, as well as the Eurotunnel terminal and the tunnel portal.

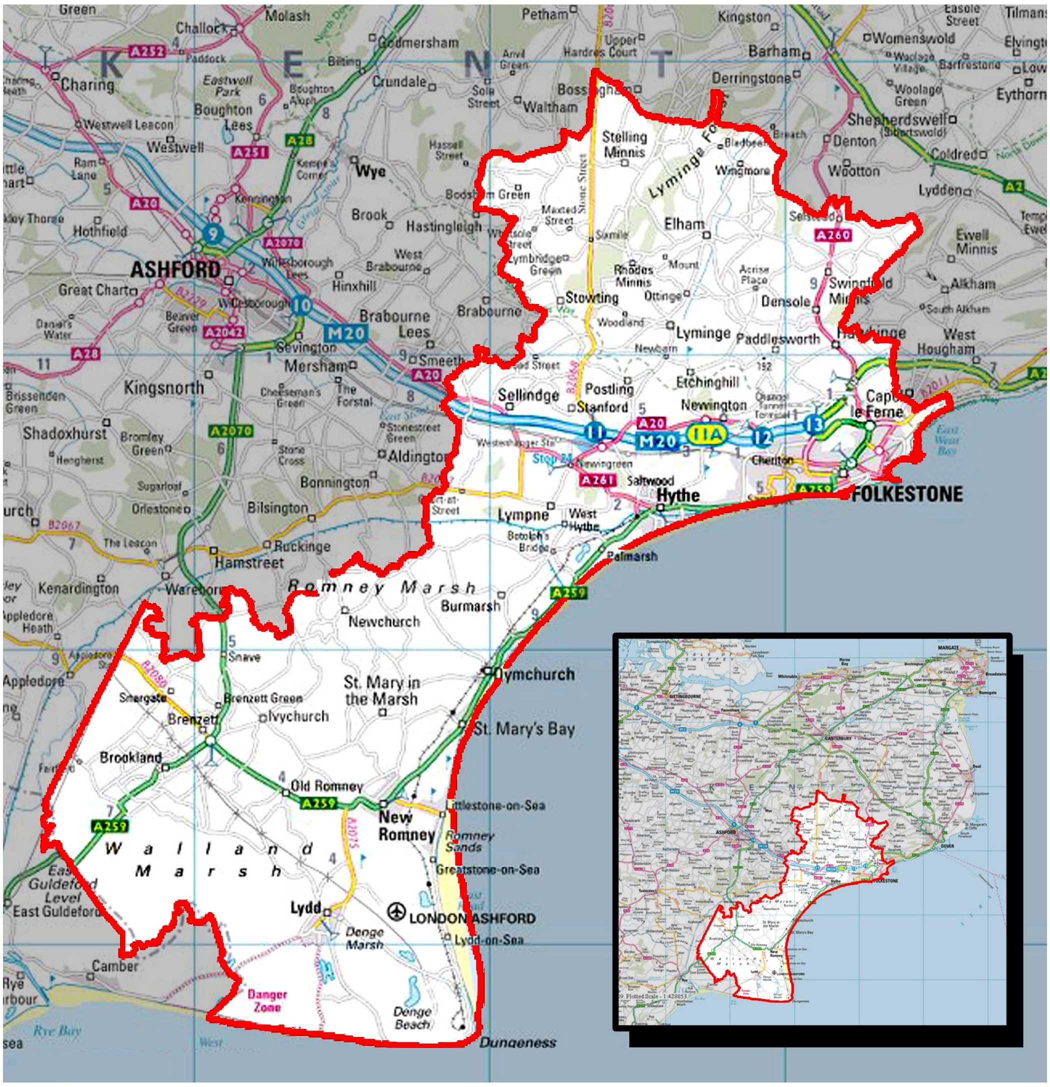


*Figure 2.1 – Location plan showing the Shepway District Boundary and the SFRA study area*

## 2.2 Hydrogeology

The upper catchments of the streams within the District are fed from aquifers from the chalk hills to the north of Folkestone. The lower chalk itself is relatively impermeable, nevertheless extensive fissures in the material provide considerable storage for groundwater, which is extracted by Folkestone and Dover Water Services to supply the towns of Folkestone and Hythe with public water.

To the south of the M20, the geology is predominantly Folkestone Beds/Sandgate Beds overlaid by Gault Clay. Groundwater is normally found at varying levels and in particular the interface between the Folkestone and Sandgate Beds. This has been a contributory cause of the landslips in this area in the past.

## 2.3 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 sustainable drainage system, or within the overall natural water cycle.

The recent drift deposits within the study area are typically marine alluvium and beach sands and gravels, located in the lower-lying areas of the District, and largely cohesive Head deposits in the higher, northern parts. The solid geology of the district is comprised of sedimentary deposits from the Cretaceous period, including the Hastings Beds subgroup (Tunbridge Wells sandstone, Wadhurst clay, Ashdown formation), Weald Clay, Lower Greensand group (Atherfield Clay, Hythe Beds, Sandgate Beds and Folkestone Beds), the Gault Clay and Chalk. Some of the steep slopes in the Lower Greensand, Gault Clay and Chalk have experienced instability and the extent of the known landslips is indicated on geological maps of the area. Figures 2.2 and 2.3 below show a simplification of the geological mapping of this area.

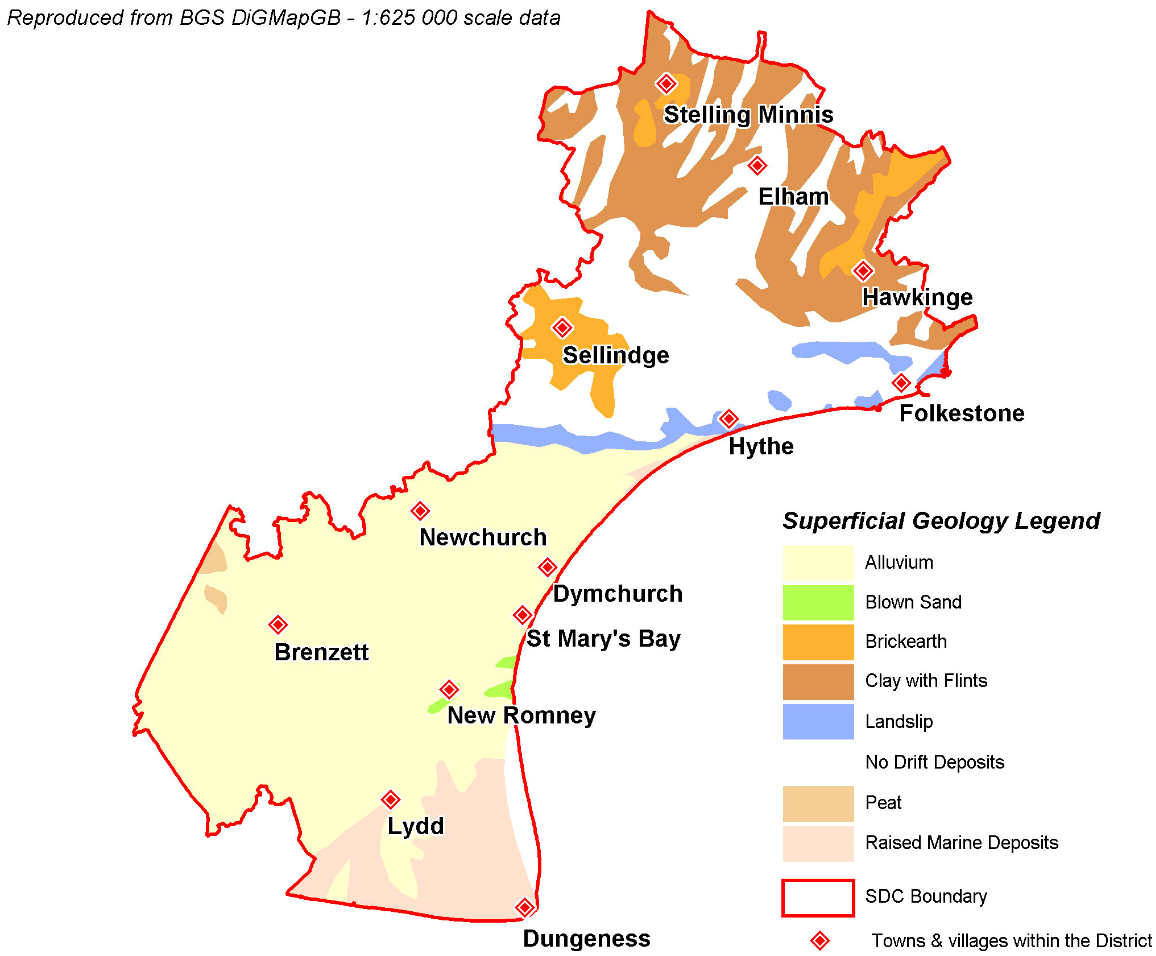


*Figure 2.2 – Drift geology of the Shepway District. Contains British Geological Survey materials © NERC 2015.*

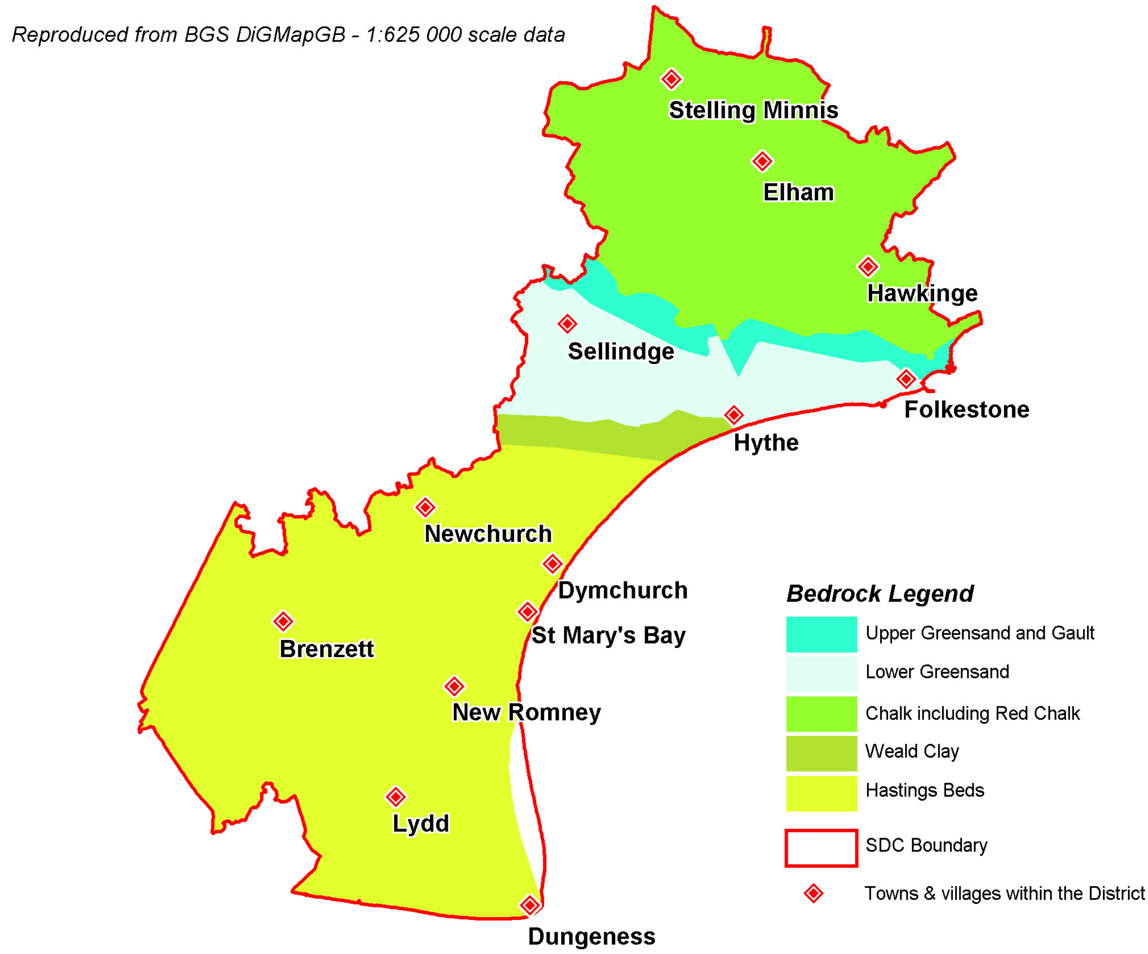


*Figure 2.3 – Solid geology of the Shepway District. Contains British Geological Survey materials © NERC 2015.*

## 2.4 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 2.4 has been based on the soil types within the Shepway District as mapped by the National Soil Resources Institute.

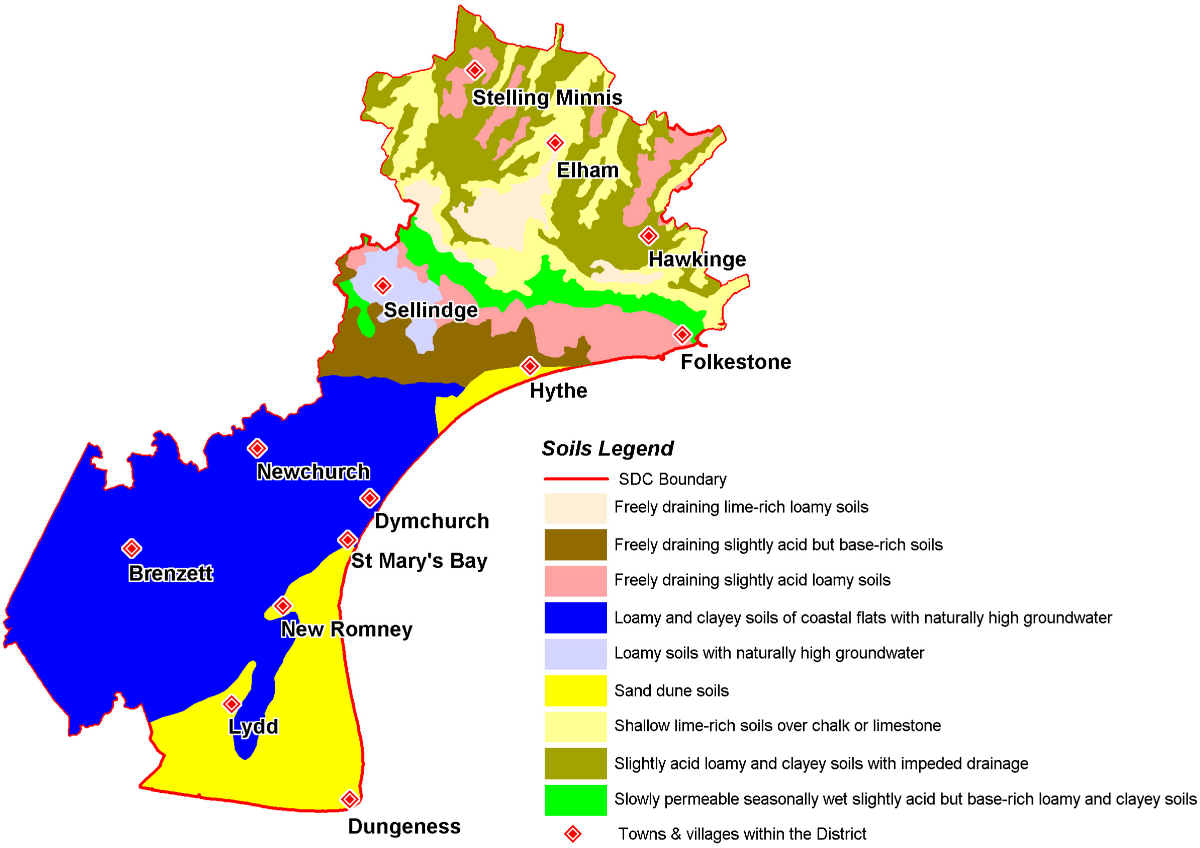


*Figure 2.4 – Map showing the range of soil characteristics across the Shepway District*

## 2.5 Topography

Shepway's topography varies significantly across the District, with the flat low-lying Romney Marsh being below mean high water level in many places. The majority of Folkestone is at around 40m Above Ordinance Datum Newlyn (AODN) and the northern areas being closer to 150m AODN.

As well as the importance of the elevation of the land relative to 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).

Height data from the Ordnance Survey Landform Panorama digital terrain model has been used to create Figure 2.5 below, which illustrates graphically the topographic variation across the study area. For the more detailed breach modelling and flood mapping work, which forms the basis of the flood risk and hazard analysis used in this SFRA, much higher resolution land level data derived by use of LiDAR (Light Detection And Ranging) has been used and is discussed further in Section 9 of this report.

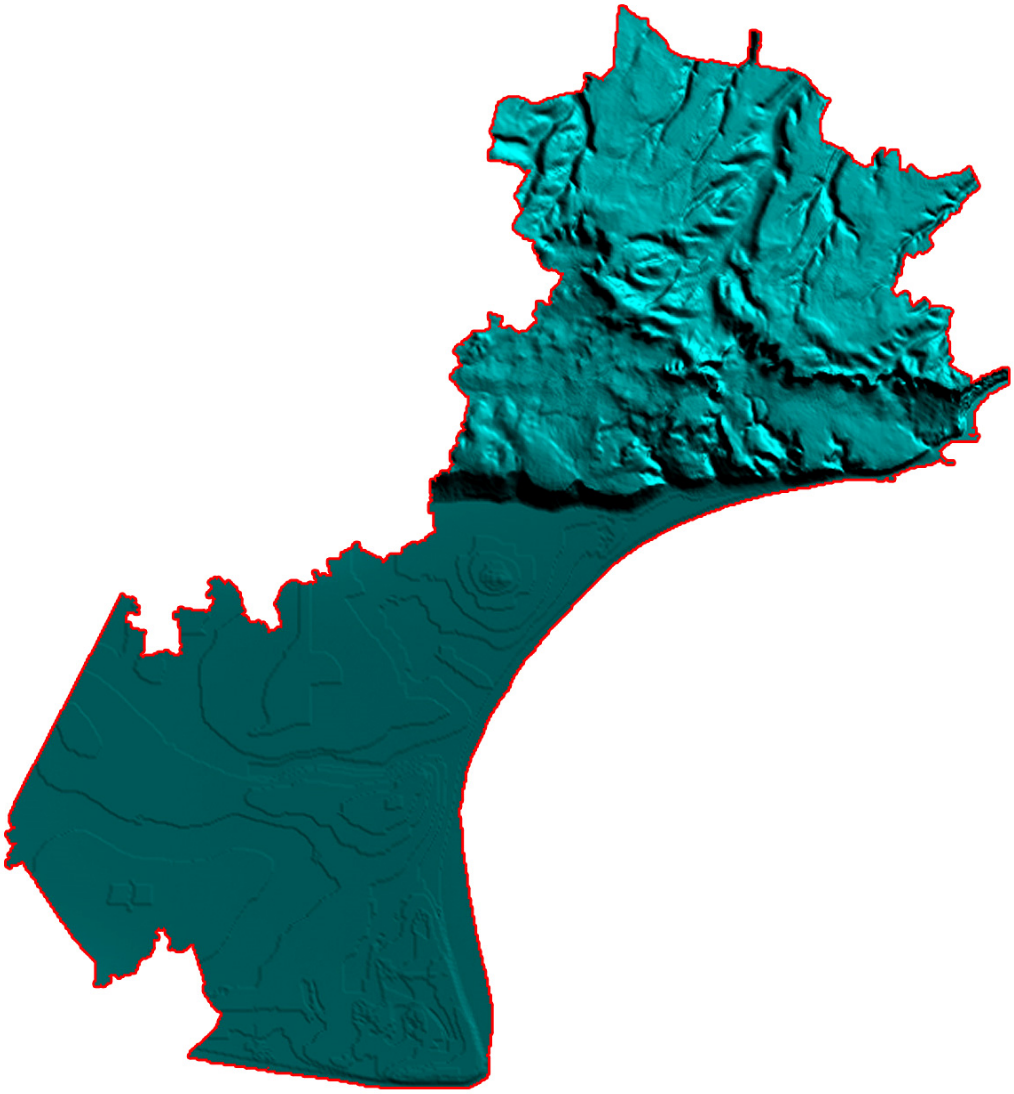

*Figure 2.5 - Topography of the Shepway District. Contains public sector information licensed under the Open Government Licence v3.0.*

# 3 Policy Framework

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.

## 3.1 National Policy

***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 Standards for design, construction, maintenance and operation of Sustainable Drainage Systems (SuDS)***

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 Floods and Water Management Act 2010.

These (non-statutory) Technical Standards for SuDS specify criteria to ensure sustainable drainage is included within developments of 10 dwellings or more; or equivalent non-residential, or mixed development (as set out in Article 2(1) of the Town and Country Planning (Development Management Procedure) (England) Order 2010).

These technical standards (S1 -14) provide additional detail and requirements not initially covered by the NPPF (see below). However, it is recognised that the sustainable drainage system should be designed to ensure that the maintenance and operation requirements are economically proportionate.

***National Planning Policy Framework (NPPF) (2012)***

The National Planning Policy Framework (NPPF) was published on the 27th March 2012. 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) which supersedes PPS25: Development and Flood Risk Practice Guide (2009).

Paragraphs 18 to 219 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 account. 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.

***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.

The NPPF states that the Sequential Test should be applied at all stages of the planning process and that generally the starting point is the Environment Agency's flood zone maps. 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 20 (5%) 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 NPPF states that only where there are no reasonably available sites in Flood Zones 1 or 2 should decision makers consider the suitability of Flood Zone 3, taking into account the flood risk vulnerability of land uses and applying the Exception Test if required.

To date the Sequential Test has presented the Council with a significant challenge because, as discussed above, over half of the entire District lies within Flood Zone 3a. It has therefore been one of the primary objectives of the SFRA to sub-divide the area within this flood zone so that the Sequential Test can be applied within Shepway's extensive Zone 3a area.

The Environment Agency 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 Environment Agency will require the Council to demonstrate that there are no reasonable alternatives in lower flood risk categories available for development.

***The Exception Test***

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

As part of this process it is, however, necessary to consider the type and nature of the development as not all situations require the test to be applied. 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 3.1 below, which highlights the combinations of vulnerability and flood zone compatibility 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 3.1 – Flood risk vulnerability and flood zone compatibility*

For the Exception Test to be passed there are two criteria that must be satisfied and these are listed below:

a) It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a Strategic Flood Risk Assessment where one has been prepared; and

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

The NPPF also promotes early consideration of flood risk in the formulation of Regional Spatial Strategies, Local Development Documents and proposals for development by Regional Planning Bodies, LPAs, the Environment Agency, other stakeholders and developers. This process should identify opportunities for development of infrastructure that offers wider sustainability benefits. These include dual use i.e. flood storage and recreation, and realising cost effective solutions for the reduction and management of flood risk.

## 3.2 Local Planning Policy

***Shepway Core Strategy***

Shepway District strategic local policy is set out within the Core Strategy, which was adopted in September 2013. The policy within the document is supported by extensive research, including a former iteration of the SFRA (2009). Policy and supporting text recognises the issue of flooding within the district and seeks to maximise opportunities for sustainable development throughout areas traditionally considered to be at risk.

Policy SS3 'Place-Shaping and Sustainable Settlements' Strategy specifically directs development to sustainable settlements with the objective of promoting sustainable, vibrant and distinct communities. Paragraph c. contains safeguards to ensure that there is a considered and appropriate approach to development proposals within areas of flood risk.

***South Foreland to Beachy Head Shoreline Management Plan (SMP)***

Whilst the SMP is not a statutory planning document, it does set policy for the management of the shoreline over the next 100 years. Consequently, the SMP is an important document when appraising the risk of coastal flooding on a regional and local scale.

The South Foreland to Beachy Head SMP, along with its recommended management policies, was adopted by Shepway in 2006. The SMP has been examined as part of the SFRA process and the relevant policies are listed below.

| Location | Policy Unit Reference | SMP Policy | | |
|---|---|---|---|---|
| | | 2006 to 2025 | 2025 to 2055 | 2055 to 2105 |
| Folkestone Warren | 4c06 | Hold the line | Hold the line | Hold the line |
| Copt Point | 4c07 | No active intervention | No active intervention | No active intervention |
| Folkestone and Sandgate | 4c08 | Hold the line | Hold the line | Hold the line |
| Sandgate to Hythe | 4c09 | Hold the line | Hold the line | Hold the line |
| Hythe Ranges | 4c10 | Hold the line | Hold the line | Managed realignment |
| Dymchurch Redoubt to Romney Sands | 4c11 | Hold the line | Hold the line | Hold the line |
| Romney Sands to Dungeness Power Station | 4c12 | Hold the line | Hold the line | Hold the line |
| Dungeness Power Station | 4c13 | Hold the line | Hold the line | Hold the line |
| Lydd Ranges | 4c14 | Managed Realignment | Managed Realignment | Managed Realignment |

*Table 3.2 – Summary of SMP policies for frontages with the Shepway District*

***Folkestone to Cliff End Flood and Erosion Management Strategy***

In May 2008 the Folkestone to Cliff End Strategy Plan was issued as a draft for consultation. This Plan sits beneath the SMP and makes recommendations for implementing flood and coastal erosion risk management schemes.

The Environment Agency carried out extensive consultation with partners and communities to ensure that the strategy was socially and environmentally acceptable, and technically and economically feasible.

The strategy identified the following schemes, some of which are located outside of the Shepway District, but still have an influence on the wider flood compartment:

- Pett Level coastal defence scheme. Completed in 2007 with annual shingle recycling for maintenance.
- Rother Tidal Walls West. Completed in 2006.
- Rother Tidal Walls East. Business case being developed.
- Broomhill Sands coastal defences. Currently under construction. Completion expected by winter 2015.
- Lydd Ranges. Business case being developed.
- Romney Sands (Greatstone). Business case being developed.
- Littlestone to St Mary's Bay. Rock groyne at Greatstone completed 2014, shingle recharge planned for 2015.
- Dymchurch. Completed 2011.
- Hythe Ranges. Business case being developed.

To ensure the entire marsh is protected from tidal flooding, four further schemes need to be constructed at a likely cost of around £100 million. The Environment Agency is now developing business cases to determine the most effective way to construct these new defences.

***Catchment Flood Management Plans (CFMP)***

A CFMP is a high-level strategic planning tool through which the Environment Agency 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 Environment Agency 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.

There are two CFMPs that are relevant to the Shepway District. The Stour CFMP, which includes the catchments of both the East Stour and the Pent Stream, and the Rother CFMP, which covers the Romney, Walland and Denge marsh areas, as well as the catchments of the watercourses in the Hythe and Seabrook areas. Both the Stour and Rother CFMPs are now finalised.

# 4 SFRA Approach and Methodology

## 4.1 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 properly applied. The need for LPAs to consider flood risk when preparing Local Development Documents (LDD) and to produce SFRAs is highlighted in paragraphs 10 and 11 of the *Planning Practice Guidance: Flood Risk and Coastal Change*. Paragraph 12 gives some preliminary guidance and this is developed below.

The *Planning Practice Guidance: Flood Risk and Coastal Change* promotes 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 Environment Agency, 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 appropriately accommodate all 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.

However, as discussed previously, approximately 55% of Shepway's total land area lies within Zone 3 and as a consequence the Council had considered these issues in detail before commissioning the SFRA. The Council has also engaged with the Environment Agency at the very early stages of the SFRA process to discuss the scope of the study and any detailed analysis requirements. As a consequence of these discussions, it was agreed that a Level 2 appraisal was undoubtedly required. Consequently this was commissioned from the outset.

During the SFRA inception meeting it was subsequently agreed by the Council and the Environment Agency that to reduce replication and to add clarity, the Level 1 and Level 2 documents should be combined into a single report. This report (originally prepared in 2009) has subsequently been updated to reflect current changes in Planning Policy.

## 4.2 SFRA Aims

As well as achieving the objectives set out in Section 1, at the project inception stage an overarching aspiration of the SFRA was identified. This was for the study to provide the end user of the SFRA with as much quantitative risk-based information as possible. This will not only assist the Council in preparing is development plans and undertaking the Sequential Test, but will also allow other users to gain an understanding of the complex and wide-ranging flooding issues that exist within the District.

## 4.3 SFRA Outputs

The aim 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, the Exception Test. The NPPF also indicates that Sustainability Appraisals should be informed by the SFRA for their area. Under the Town and Country Planning (Local Development - England) Regulations 2004, a Sustainability Appraisal (SA) is required for all Local Development Frameworks (LDF). 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 LDFs should meet the requirements of the 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 is 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.

# 5 Data Sources

## 5.1 Consultation and Data Collection

During the development of the SFRA the following organisations have been consulted;

- Shepway District Council
- Environment Agency
- Romney Marshes Area Internal Drainage Board
- River Stour Internal Drainage Board
- Kent County Council – Highways
- Kent County Council – Emergency Planning
- Southern Water

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

| Organisation | Data supplied | Use within SFRA |
|---|---|---|
| Shepway District Council | OS 10k National Grid mapping | Flood risk mapping |
| | Archive data on past flooding events | Historic flooding |
| | South Foreland to Beachy Head SMP, Halcrow (2006) | Information on shoreline management policy |
| | Hydraulic Analysis of the Royal Military Canal Hythe report, Scott Wilson (Jan 04) | Information on existing defences and flooding history |
| | Report on Folkestone and Hythe Flood Alleviation Scheme, Bullen (Oct 97) | Information on existing defences and flooding history |
| | Royal Military Canal Integrated Management Plan, Scott Wilson Kirkpatrick (Oct 96) | Information on existing defences and flooding history |
| Environment Agency | Flood Zone 2 & 3 extents (GIS layer) | Mapping of flood zones |
| | Historic flooding extents (GIS layer) | Mapping of historic flooding |
| | National Flood and Coastal Defence Database (NFCDD) | Information on existing defences |
| | LiDAR data – supplied at a resolution of 2m for the whole District. | Flood risk mapping |
| | Extreme sea levels – taken from EA/DEFRA SC060064/TR2 - Coastal flood boundary conditions for UK mainland and islands: Design sea levels (2011) | Flood risk mapping |
| | Folkestone to Cliff End Flood and Erosion Risk Management Strategy, Halcrow (2008) | Information on coastal processes and proposed improvement options |
| Romney Marshes Area IDB | Location of historic flooding areas and information on issues relating to critical drainage | Flood risk mapping and surface water management |
| Southeast Strategic Regional Coastal Monitoring Programme | Beach and structure profile data | Flood risk analysis and mapping |

*Table 5.1 – Summary of data supplied*

## 5.2 Existing Hydraulic Modelling

As can be seen from the above list of reports referenced as part of this study, there have been a number of hydraulic studies carried out for watercourses in this area. However, none of these include any flood mapping or accurately quantify the extent of flooding likely to occur as a result of an extreme flood event. The majority of these reports also pre-date current guidance on climate change and consequently their role as part of this SFRA in informing flood risk is limited. Notwithstanding this, where appropriate, data on the standard of protection provided and other technical detail has been used in the preparation of this SFRA.

## 5.3 Flood Zone Mapping

The Environment Agency Flood Zone maps show the areas at risk of flooding from rivers and the sea and are produced initially from a national generalised and large scale computer model (JFlow). The Environment Agency's Flood Zone mapping for the Shepway District has been reproduced and included in Appendix 1 of this report.

Whilst the Flood Zone maps divide up land areas into Zones 1, 2 or 3, this delineation is far too coarse for the application of the Sequential Test in the vast low-lying areas of Shepway's District. Although this mapping highlights areas that benefit from the defences constructed during the last 5 years, the process of creating the flood zone maps ignores the presence of existing defences. Furthermore, the maps are based on current climatic conditions and do not account for changes in climate in the future.

In order to meet the objectives of the SFRA in providing quantitative information on the risk of flooding across the district, more detailed modelling has been undertaken to classify the risk from coastal sources of flooding more accurately, taking into account both the existing (completed) flood defence infrastructure and changes in climate change over the next 100 years.

The lower lying marsh areas of the district are located below sea level in places and consequently this area is actively drained via a complex network of ditches. Irrigation of the fields also occurs in the summer months, meaning that the flow regime of this complex fluvial network is a product of intensive human intervention. Given the number of parameters that consequently affect fluvial flows in this region, it is not within the scope of this report to quantitatively represent the risk of flooding from rivers within this location. Nonetheless, the topography of the marshes means that the dominant source of potential flooding is coastal. Therefore the detailed modelling of coastal sources of flooding is considered to represent the primary risk to this area.

Consequently, as part of this SFRA, the flood zone mapping has been accompanied by the outputs of more detailed flood risk mapping. However, as described above, this analysis has only been undertaken for the *coastal* floodplains and therefore the flood risks associated with the many streams and man-made watercourses within the district are mapped solely with the existing Flood Zone mapping information.

## 5.4 Historic and Localised Flooding

There is a detailed history of flooding within Shepway's district that has been documented by the Council's Engineering Team and the Environment Agency. Information on around 101 flood events that have occurred during this last decade has been recorded and the relevant details have been reproduced in a table format in Appendix 2 along with the Historic Flood Map.

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

***Hythe Royal Military Canal (December 2002)*** – During the winter of 2002 heavy and prolonged rainfall resulted in high water levels in the canal. The ground within the catchment was also heavily saturated. On the 30th December 2002 an intense rainfall event coincided with high tide, which meant that the canal's outfall at Seabrook was tide-locked and therefore the canal could not discharge to the sea. This caused levels in the canal to exceed the crest of the canal's bank in areas where this was low. The flooding affected the low-lying areas south of the canal in the West Hythe areas of Pennypot and Burmarsh; in particular, The Haven, Shepherds Walk, and Romney Way. Whilst the flooding affected a significant number of properties, the relatively shallow depths meant that internal flooding only affected one or two buildings.

***Hythe (October 1999)*** - The coincidence of high tides and storm force southerly gales on the 24th October 1999 resulted in wave overtopping along the Hythe and Sandgate seafront. The most significant flooding occurred in Albert Road in Hythe as a result of wave overtopping. Other roads running perpendicular to West Parade were also affected. This same event also caused localised flooding to properties along the Sandgate Esplanade.

*Figure 5.1 – Flooding at Albert Road, 24th October 1999*

***Folkestone and Hythe (August 1996)*** – On the 12th August 1996 an intense rainstorm caused surcharging in the culverted sections and overtopping of banks in the open sections of the Seabrook, Enbrook, Brockhill, Mill Lease and Pent Streams. Almost 100mm of rain fell in less than two hours, which was estimated by the Meteorological Office as being an event that had a return period greater than 1 in 500 years.

As a result of this event, more than 400 properties were flooded, some to a depth of 1.7m. Of these, 44 were declared uninhabitable and more than 30 suffered structural damage. In response to this event a £2 million flood alleviation scheme was implemented by Shepway District Council in 1998/99.


*Figure 5.2 - Flooding in Folkestone (August 1996)*


*Figure 5.3 – Flooding in Folkestone (August 1996)*

***Newington and Frogholt (January 1995) –*** A rainstorm on the morning of the 26th January 1995 caused watercourses in the Folkestone and Hythe area to overflow their banks and flood houses and property. A number of roads were closed to traffic and there was widespread flooding in the villages of Newington and Frogholt.

In the build up to this event the chalk aquifers were steadily rising and reached their long term average level by late September 1994. Rainfall of 105mm in December 1994 brought groundwater levels up above the average level and with 67.3mm of rainfall between the 1st and 25th January, the ground was virtually saturated. Consequently during the intense rainfall event of the 25th January 1995 the effects were immediate and widespread.

The Mill Leese Stream flooded the A20 to a depth of 600mm and further downstream, the Mill House and pond above Mill Lane were flooded along with other properties and the main highway (A259) in Seabrook.

***Etchinghill (August 2007) –*** The area affected by this event was primarily St Mary's Drive, which is located on the southeast corner of the village. Numerous rainfall events have given rise to concerns related to incidents where surface water run-off from the rural land above this area of relatively recent development, flows towards the southern boundary of the development and ponds against the boundary wall. The August 2007 event caused the boundary wall to collapse under the pressure of the impounded water and this resulted in two properties being internally flooded and others affected externally.

Following this event, the landowner (Ministry of Defence) has installed soakaways and constructed a ditch and bund adjacent to the wall. The farmer has also adapted his ploughing regime and now ploughs the land across-slope in a north-south direction so that surface water is not encouraged to flow directly towards the low-lying areas affected in the past. The combined impact of this work has aided the drainage of the land and reduced the risk of a similar event reoccurring.

# 6 Overview of Flood Risk

The topography and geology of the land within the boundaries of Shepway's 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.

## 6.1 Flooding from the Sea

Shepway's shoreline is approximately 41km long and much of this is defended to protect the lower-lying, rich and fertile land that forms part of the Romney, Walland and Denge Marshes. The land levels in these marsh areas are generally below the mean high water springs (MHWS) level and consequently without the protection of the existing sea defences much of this land would be permanently inundated.

Due to the length of Shepway's shoreline and its juxtaposition with respect to the tidal flows in this part of the English Channel, the predicted extreme sea levels vary depending on location. The extreme sea levels that have been used by this appraisal are based on those published by the Environment Agency in the Coastal Flood Boundary Conditions for UK Mainland and Islands: Design Sea Levels (February, 2011). These are summarised in Table 6.1 below.

| Location | Extreme 1 in 200 year sea level (m AODN) |
|---|---|
| Dungeness | 4.85 |
| Dymchurch | 4.75 |
| Folkestone | 4.71 |

*Table 6.1 – Predicted Extreme Sea Levels*

Given the presence of the existing sea defences, flooding from the sea will generally result from either the existing defences breaching, or being overtopped by wave action. The latter being the mechanism that has caused localised flooding in Hythe and Sandgate in the past.

Depending upon the location of the particular site with respect to the breach or overtopping event, the consequences can vary significantly, as can be seen in Figure 6.1. It has therefore been necessary to analyse the risk of flooding from the sea in great detail so as to be able to define risk across Shepway's vast coastal floodplain. This work is described in further detail in Section 9 of this report.

*Figure 6.1 – Wave overtopping along Sandgate Esplanade, 24 October 1999*

## 6.2 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 have caused flooding problems in the past. The locations of these watercourses are shown on the map in Appendix 3 and are described as follows:

***Mill Leese Stream*** – The Mill Leese stream flows through Saltwood and eventually discharges into the Royal Military Canal. Just upstream of Saltwood the stream is culverted beneath a disused railway embankment and by restricting the flow at this location using a Hydrobrake, flows downstream are controlled to provide a 1 in 100 standard of protection. The excess flow is stored in the natural valley upstream and dammed by the railway embankment, an area which forms the Mill Leese Flood Storage Area (Section 6.6).

***Seabrook Stream*** – The source of the Seabrook Stream is located at the foot of the hills at Arpinge, east of Etchinghill. Groundwater from the disused railway cutting flows through a pipeline and overland to a pond south of Etchinghill where it joins the Seabrook Stream. The stream flows through Frogholt and via culverts under the M20 and the railway line and onto St Martin's Plain. The watercourse then flows to the Mill Pond, where it is culverted for a short length to Horn Street. From here it crosses under the Seabrook Road where it discharges into a silt trap before entering the Royal Military Canal.

***Pent Streams*** – There are four tributaries to the Pent Stream and these are referred to as Pent A, B, C and D. The source of these streams is located at the foot of the Downs, east of Peene and north of the Channel Tunnel Terminal.

The Pent Stream A catchment covers a large part of the Channel Tunnel Terminal site which was originally covered by a network of open ditches. Today these ditches have been infilled and replaced by french drains linking to a drainage system and the existing culvert in Pine Way, Cheriton. This section of the Pent can be seen at Ashley Avenue as an open ditch running along the rear of the properties of Postling Road before entering a culvert and re-emerging at the Cheriton Road Sports Ground.

Pent Stream B has a smaller catchment and has been largely infilled on the Channel Tunnel Terminal site. The stream emerges north of Caesar's Way where it passes through the site occupied by the Enterprise Centre before entering a culvert under Cherry Garden Lane and Morehall Recreation Ground. The stream then flows in an open channel at the rear of the properties in Fairway Avenue before passing through a culvert under the Municipal Sports Ground.

Pent Stream C is fed from an aquifer at the base of Castle Hill and an overflow from the reservoirs operated by Folkestone and Dover Water Services. The stream can be found north of Shearway Road where it enters a culvert before emerging in the rear gardens of Webb Close. The stream can also be seen on the Broadmead Estate before joining Pent Streams A and B at the Cheriton Road Sports Ground.

The Pent Streams A, B and C flow in an open channel through the Sports Centre Golf Course and Radnor Park to Park Farm Road and Blackbull Road. Here they join the Pent Stream D, which is culverted for its entire length and flows between the B&Q building alongside Park Farm Road to Radnor Park Road where it joins the main Pent Stream. From here the Pent Stream is culverted in sections along its route adjacent to Bradstone Avenue and beneath Tontine Street, until it discharges to the inner basin of the Folkestone Harbour.

***Enbrook Stream*** – The Enbrook Stream catchment is relatively small with a total area of just over 1.5km$^2$. The upper part of this steep sided catchment is now predominantly urban, with the all surface water from this developed area being directed into the open channel section of the stream at the junction between Chichester Road and Enbrook Road. The stream is also fed by a tributary that flows alongside Military Road.

The stream flows in a natural channel through the SAGA estate and into a culvert beneath Sandgate High Street. At this point the flow is split between two culverts, both of which discharge via a 600mm and 1200mm diameter outfall into the sea. The invert of these outfalls is set above mean high water and therefore under normal high tide conditions the stream will not be tide-locked. However, there is potential for these outfalls to become tide-locked under extreme sea level conditions, as well as becoming partially blocked by shingle from the beach.

***Brockhill Stream*** – The Brockhill Stream has a catchment of around 6km$^2$ and rises south of the M20 motorway. It flows through a relatively steep wooded valley and the Brockhill Country Park and is culverted in sections as it flows through Hythe and into the Royal Military Canal.

***East Stour River*** – The East Stour River rises in Postling on the northern boundary of Shepway's District and flows in a southerly direction through Stanford and then under the M20 motorway. From this point the river then flows in a westerly direction towards Sellindge and on towards Ashford where it joins the River Great Stour.

***The Nailbourne*** – The source of the Nailbourne is in Lyminge and from here the river flows intermittently in a north-easterly direction through Elham and out of the District. It is thought that this bourne is activated when groundwater levels are high, usually following prolonged period of rainfall. The Nailbourne eventually joins the Little Stour and the Great Stour, flowing out to sea at Sandwich on the east Kent coast.

## 6.3 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 in the Folkestone and Hythe areas, have very steep topography and are heavily urbanised. In addition, in many places surface water is discharged into the streams that flow through these towns. These streams flow predominantly in culverts through these densely populated urban areas and historically these have become surcharged during extreme rainfall events. This has resulted in surface water flows in streets, which has caused flooding to properties in the past.

There are also more rural areas within the district where surface water run-off from fields has caused flooding problems in the past. Reference to the Historic Flooding map in Appendix 2 highlights the locations where surface water flooding has been recorded.

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 further developed as part of this SFRA to make sure that surface water management issues that are specific to the District are taken into account as part of the planning process and are 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 the 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.

## 6.4 Groundwater Flooding

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 groundwater flooding potential over the Chalk of southern Britain as Chalk shows some of the largest seasonal variations in groundwater level, and is thus particularly prone to groundwater flooding incidents.

Inspection of the BGS dataset shows that the whole of the Shepway district is located within a low risk area. However, this high level mapping does not take into account the more localised causes of groundwater flooding that can be associated with low-lying land that is drained by man-made watercourses. The recent drift deposits within the lower-lying parts of the district area are typically marine alluviums and beach sands and gravels and as such have the potential to convey groundwater.

In the higher parts of the district the extensive fissures in the Chalk provide considerable storage for groundwater, which is abstracted by Folkestone and Dover Water Services to supply Folkestone and Dover with potable water. To the south of the M20 motorway the geology is predominantly formed from the Folkestone and Sandgate Beds, which are overlain by Gault Clay. Groundwater is normally found at varying levels and in particular at the interface between the Folkestone and Sandgate Beds, which is a contributory cause of the landslips that have occurred in this area in the past.

There are locations within the District where groundwater flooding has caused problems in the past and these are highlighted on the Historic Flood Map (Appendix 2). Consequently, site-specific FRAs will need to investigate any localised risks of groundwater flooding.

## 6.5 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 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.

Many parts of Shepway are served by combined sewers and consequently there is an inherent risk that these could become surcharged during an extreme rainfall event. Many of the surface water and highway sewers also discharge directly into the watercourses that flow through these urban areas, which further exacerbates the problem. Detailed information on flood risk from this source is not available on a district-wide scale and therefore this source of flooding will need to be investigated on a site-specific scale.

## 6.6 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.

Within the Shepway District there are two key features that have the potential to cause flooding;

***Royal Military Canal***

This was originally constructed in Napoleonic times as a military defence; however, the canal's most important use in contemporary times is as a drainage channel. The Canal is classified as a main river and drains a catchment of approximately 70km$^2$ to the sea at a number of tidal outlets, however, the flows within the canal are also affected by irrigation practices. The canal west of the West Hythe Dam is used to feed upland water into Romney Marsh in the summer months via a series of outfalls in order to maintain water levels for irrigation and livestock security (wet fencing).

The Hythe section of the Royal Military Canal is a Scheduled Ancient Monument and extends between the West Hythe Dam and its outfall to the sea at Seabrook, which is a fixed weir and via flap valve arrangement that becomes tide-locked over the high tide period.

The Hythe section of the canal is only 7km in length and passes through the developed low-lying areas of Burmarsh and Pennypot in West Hythe. Consequently there is a risk of flooding from the canal if a rainfall event, having a duration that coincides with the tidal peak occurs. During the period that the canal is tide-locked, all flows will need to be stored within the canal until the tide level falls sufficiently to allow the canal to discharge to sea. Whilst the canal banks are relatively high through the Hythe town area, there are low points along the southern bank of the canal where is passes through West Hythe.

Rainfall events as described above occurred during the winters of 2001 and 2002 and resulted in the flooding of properties in West Hythe. Following these flood events a hydraulic study of the Hythe Royal Military Canal was commissioned by Shepway District Council. This was undertaken by Scott Wilson Piesold and finalised in January 2004. This report was primarily a scoping study to investigate any potential improvements that could be made to reduce the risk of flooding from the canal, however, it did include predicted extreme water levels in the West Hythe reaches of the canal. These are summarised in Table 6.2 below.

| Return period (years) | Maximum water level in canal at West Hythe (m AODN) |
|---|---|
| 1:2 | 2.57 |
| 1:5 | 2.71 |
| 1:10 | 2.74 |

*Table 6.2 – Predicted flood levels in the Royal Military Canal, Hythe*

The minimum bank level recorded in 2002/03 was around 2.6m AODN in the vicinity of the 'The Haven' and 'Pennypot' areas; however, since this time works have been undertaken by Shepway to raise these localised low-spots.

***Mill Leese Flood Storage Area***

As well as the Royal Military Canal, there is also a flood storage area within the district that is formally classified as a reservoir (Appendix 3). This is the Mill Leese Flood Storage Area (FSA) that was constructed in 1998/99 following the significant flooding in Folkestone and Hythe during the summer of 1996.

The Mill Leese stream flows through Saltwood and eventually discharges into the Royal Military Canal. Just upstream of Saltwood the stream is culverted beneath a disused railway embankment and by restricting the flow at this location using a Hydrobrake, flows downstream are controlled to provide a 1 in 100 standard of protection. The excess flow is stored in the natural valley upstream and dammed by the railway embankment.

When the FSA is operating, a significant volume of water is impounded upstream of the disused railway embankment, which acts as a dam. Consequently as part of the original design, the risks associated with this were examined. This work included the testing of the Probable Maximum Flood (PMF) event, which is broadly defined as the largest flood that could physically occur at the location of interest. This work has shown that the embankment would be stable and that if water levels were to exceed the overflow or the embankment it would not result in catastrophic failure of the dam.

This assessment is, however, based on the assumption that the embankment remains structurally and geotechnical sound throughout its lifetime. Given that the embankment was not originally designed or constructed for the purposes of retaining water and has suffered from the effects of burrowing animals, the Environment Agency has undertaken some remedial works to seal the embankment using a bentonite slurry.

# 7 Flood Risk and Climate Change

When the impact of climate change is considered it is generally accepted that the standard of protection provided by current defences will reduce with time. 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 sources. The rise in sea level will change the frequency of occurrence of high water levels relative to today's sea levels. 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.

## 7.1 Potential Changes in Climate

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. The National Planning Practice Guidance Suite to the NPPF provides allowances for the regional rates of relative sea level rise and these are shown in Table 7.1.

| | Net Sea Level Rise (mm/yr) Relative to 1990 | | | |
|---|---|---|---|---|
| **Administrative Region** | **1990 to 2025** | **2025 to 2055** | **2055 to 2085** | **2085 to 2115** |
| East of England, East Midlands, London, SE England (south of Flamborough Head) | 4.0 | 8.5 | 12.0 | 15.0 |
| South West | 3.5 | 8.0 | 11.5 | 14.5 |
| NW England, NE England (north of Flamborough Head) | 2.5 | 7.0 | 10.0 | 13.0 |

*Table 7.1 - Recommended contingency allowances for net sea level rise*

When these values are applied to the current day predicted extreme sea levels it can be seen that the increase in sea level is significant and is not linear. The 1 in 200 year sea levels have therefore been calculated for four time steps between the current day and the year 2115 and are summarised in Table 7.2 below.

| Year | 1 in 200 year extreme water level (m AODN) | | |
|---|---|---|---|
| | **Dungeness** | **Dymchurch** | **Folkestone** |
| Current day | 4.85 | 4.75 | 4.71 |
| 2025 | 4.92 | 4.82 | 4.78 |
| 2055 | 5.17 | 5.07 | 5.03 |
| 2075 | 5.41 | 5.31 | 5.27 |
| 2085 | 5.53 | 5.43 | 5.39 |
| 2115 | 5.98 | 5.88 | 5.84 |

*Table 7.2 – Climate change impacts on extreme sea levels*

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 sea level that is commensurate with the planning horizon for the proposed development. For residential development this is taken as 100 years and for commercial development a 60 year design life is assumed.

The National Planning Practice Guidance Suite to the NPPF also provides guidance on sensitivity allowances for other climatic changes such as increased rainfall intensity and peak river flows. These are shown in Table 7.3 below.

| **Parameter** | **1990 to 2025** | **2025 to 2055** | **2055 to 2085** | **2085 to 2115** |
|---|---|---|---|---|
| Peak rainfall intensity | +5% | +10% | +20% | +30% |
| Peak river flow | +10% | | +20% | |
| Offshore wind speed | +5% | | +10% | |
| Extreme wave height | +5% | | +10% | |

*Table 7.3 - Recommended national precautionary sensitivity ranges*

## 7.2 Impacts of Climate Change on the SFRA Study Area

The breach and wave overtopping modelling that has been undertaken as part of this SFRA (Section 9) has been carried out for three individual time epochs representing a range of development horizons;

- Current day – 2015
- 60 years of climate change (2075) - Commercial development horizon
- 100 years of climate change (2115) - Residential development horizon

Each scenario tested uses the appropriate increase in wave height and water level values which are commensurate with the associated design horizons. These increases have a significant impact on the outcome of the modelling.

When the dynamics of a breach are considered, the increase in sea level over the next 60 and 100 years will result in almost twice volume of flow through the breach at the peak of the event. Over the duration of the modelled event, this has a significant impact on the extents and depths of predicted flooding. Higher water levels will also allow larger wave heights to be sustained closer inshore and in combination with the predicted increase in offshore wind speeds, it is calculated that wave overtopping could increase by an order of magnitude by 2115. The impact of these climatic changes is illustrated clearly by the two Hazard Maps included in Appendix 4.

The District also 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. Consequently, increases in peak rainfall intensity and peak river flow are likely to significantly increase the risk of flooding from these watercourses.

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

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.

# 8 Flood Risk Management Practices

## 8.1 Existing Flood Defence Infrastructure

Well over 50% of Shepway's District is low-lying marsh land, which without the protection of the existing sea defence infrastructure, would be inundated on a regular basis. Consequently the sea defences along the majority of the District's low-lying frontage are large formal defences. However, there are also significant lengths of shoreline that are protected by natural defences formed by either shingle beaches or sand dune systems.

At present the sand dunes at Greatstone provide a high standard of protection against flooding, however, the natural shingle beach that extends around Dungeness between Lydd-on-Sea and Denge Marsh provides a widely varying standard. These beaches are very dynamic and as a result of natural coastal processes, significant volumes of shingle are transported towards Dungeness. Historically, to counter these natural processes, the Environment Agency has mechanically recycled material on these frontages to ensure that a high standard of protection is maintained.

Beach recycling also takes place at Folkestone and Hythe where the shingle beach provides vital protection to the old seawall. Significant improvement works were undertaken here in 1996 and 2004 to reduce the risk of flooding and coastal erosion between Hythe and Folkestone. Major sea defence improvement schemes have also taken place at Littlestone, St Mary's Bay and Dymchurch.

The Environment Agency's Folkestone to Cliff End Flood and Erosion Risk Management Strategy, published in November 2008, also recommends significant capital expenditure on sea defence improvement works over the next 10 years. These schemes include the Hythe and Lydd Range frontages. By the time the planned flood defence improvements are implemented, the District will benefit from a significantly improved standard of protection. However, until the final schemes have been completed the level of protection is only as good as its weakest link and consequently this is reflected in the flood risk mapping undertaken as part of this SFRA.

The coastal flood defence assets that surround Shepway's shoreline have been identified on the map in Appendix 3 and all relevant data, including type and construction, standard of protection, crest height, condition etc. has been summarised in Table A.3.

Many of the watercourses within the District have also benefited from flood alleviation schemes in the past and the majority of these works took place as part of the Folkestone to Hythe Flood Alleviation Scheme (1998 to 1999). This was implemented following the major flooding that occurred in August 1996 and addressed many localised flooding issues associated with the numerous watercourses in the Hythe and Folkestone area.

Due to the scale and 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 8.1 below.

| Watercourse | Improvement Works Undertaken |
|---|---|
| Mill Leese (Hythe) | Construction of flood storage reservoir upstream of Station Road. The disused railway embankment bank is utilised as a dam and with the addition of a Hyrdobrake the flows downstream of the flood storage area are reduced. This has improved the standard of protection to 1 in 100. At the same time improvements to the embankments at the Watermill were undertaken. |
| Seabrook Stream (Horn Street) | Improvements to the outfall and increased bank heights resulted in an improved standard of protection of 1 in 25 years. Some small embankments around the old mill pond and weir at Craythorne Close were also constructed. |
| Brockhill Stream (Hythe) | An overflow chamber and large diameter flood relief culvert were constructed and hydraulic improvements made to the open channel increasing the standard of protection to 1 in 25 years. |
| Pent Stream A, B & C (Folkestone) | New chambers were constructed with orifice plates with overflows connected to the Channel Tunnel Public Surface Water Relief Sewer (PSWRS). This allows storm flows from each tributary to be diverted to a sea outfall via the PSWRS. |
| Pent Stream D (Folkestone) | These works included a relief culvert at Park Farm Road Allotments and Park Farm Road. |
| Enbrook Stream (Sandgate) | A new outfall structure was constructed to discharge to the sea at Sandgate and the existing culvert was enlarged. |
| Royal Military Canal (Seabrook) | The Mill Lease, Brockhill Stream and Seabrook stream all outfall into the canal. The existing mechanical control gates at the sea outfall were replaced with a fixed weir arrangement increasing the discharge rate to sea during storm conditions. This arrangement also includes a penstock for emergency use. |

*Table 8.1 – Elements of the Hythe to Folkestone Flood Alleviation Scheme (1998 to 1999)*

## 8.2 Emergency Planning

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 his 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.

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.

## 8.3 Flood Warning

The Environment Agency operate a flood forecasting and warning service in areas at risk of flooding from rivers or the sea, which relies on direct measurements of rainfall, river levels, tide levels, in-house predictive models, rainfall radar data and information from the Met Office. This service operates 24 hours a day, 365 days a year.

The Environment Agency 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 Environment Agency flood warning service now has three types of warnings that will help prepare for flooding and take action (Table 8.2). They are:

- Flood Alert
- Flood Warning
- Severe Flood Warning

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

- River East Stour between Sellindge and Ashford
- Coastal areas from Folkestone to St Mary's Bay
- Coastal areas from Littlestone Golf Course to Dungeness
- Coastal areas from Dungeness to Rye

| | What it means | When it's used | What to do |
|---|---|---|---|
|   | Flooding is possible.<br><br>Be prepared. | Two hours to two days in advance of flooding. | Be prepared to act on your flood plan.<br><br>Prepare a flood kit of essential items.<br><br>Monitor local water levels and the flood forecast on our website. |
|   | Flooding is expected.<br><br>**Immediate** action required. | Half an hour to one day in advance of flooding. | Move family, pets and valuables to a safe place.<br><br>Turn off gas, electricity and water supplies if safe to do so.<br><br>Put flood protection equipment in place. |
|   | Severe flooding.<br><br>**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.<br><br>Be ready should you need to evacuate from your home.<br><br>Co-operate with the emergency services.<br><br>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.<br><br>If you've been flooded, ring your insurance company as soon as possible. |

*Table 8.2 - Environment Agency Flood Symbol Guidance for Residents*

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

# 9 Residual Risk

## 9.1 Breach Analysis

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. Without detailed analysis of flood risk, the only available information is the Environment Agency's Flood Zone mapping; however, this is far too coarse and does not recognise the presence of the existing flood defences. Consequently, as part of the SFRA, detailed hydraulic modelling has been undertaken to analyse the risk of flooding and quantify the impacts of flood events that may occur as a result of a breach or overtopping of the sea defences.

Through discussion with Shepway's Engineering Team, seven locations for potential breaches in the flood defences have been identified. These locations were chosen on the basis of defence type, condition, exposure and the likely consequences of a breach and have been reduced from the original 12 breaches identified in the original 2009 SFRA. This reduction represents the improvements made to the defence infrastructure during this period.

At each breach location the specific characteristics of the defence structure and the immediate hinterland have been examined. This information was then used to determine the size and nature of the breach used in the model. The breach characteristics are summarised in Table 9.1 below for each of the seven locations. The location of each breach is shown on the Hazard Maps included in Appendix 4 of this report.

| Location | | Breach width (m) | Breach depth (m AODN) | Time breach remains open (hours) |
|---|---|---|---|---|
| B1. | Broomhill Sands | 100 | 3 | 30 |
| B2. | Southbrooks Outfall | 100 | 1.5 | 30 |
| B3. | Galloways | 100 | 3 | 30 |
| B4. | Greatstone Dunes | 100 | 5.2 | 56 |
| B5. | St Mary's Bay – Pirate Springs (Flood Gate Open) | 50 | 3.3 | 30 |
| B6. | St Mary's Bay - Dunstall Lane (Flood Gate Open) | 50 | 3.5 | 30 |
| B7. | Hythe Ranges | 200 | 2.3 | 56 |

*Table 9.1 – Breach locations and characteristics*

## 9.2 Wave Overtopping

As well as flooding resulting from a breach in the coastal flood defences, some of the low-lying areas of the District are also at risk from wave overtopping. During an extreme storm event the combination of high water levels and large waves can result in significant volumes of water overtopping the seawalls as waves breach against and over the defences. In the past, before the

1996 and 2004 sea defence schemes at Hythe and Folkestone, wave overtopping caused flooding of roads and localised areas seaward of the defences on a regular basis.

In order to ensure that the flood risk modelling undertaken as part of this SFRA is representative, it is therefore necessary to include the impacts of wave overtopping within the overall breach and flood propagation modelling. Analysis locations were chosen on the basis that they would be subjected to wave overtopping under extreme conditions and were generally areas where breaching of the sea defences would be unlikely because of the nature of the defences and hinterland.

Given that the storm conditions that would cause the failure or breaching of the sea defences would also result in wave overtopping, it has been necessary to include the effects of wave overtopping within the hydraulic model. Peak wave overtopping volumes have therefore been calculated using joint probability wave and water level data for the identified overtopping locations at Hythe, Hythe Ranges, Dymchurch, St Mary's Bay and Littlestone.

Beach and structure profiles were derived using survey data taken from the Southeast Strategic Regional Coastal Monitoring Programme. The peak overtopping rate was then used to derive an input hydrograph of overtopping volume. This was then applied along a linear boundary equivalent to the length of frontage over which overtopping was modelled. The locations of the overtopping frontages are shown on the Hazard Maps included in Appendix 4 of this report.

## 9.3 Modelled Scenarios

As well as identifying the location and characteristics of each breach and overtopping site, the likelihood of combined events was also considered. Whilst a comprehensive probabilistic assessment has not been undertaken, a pragmatic and precautious approach has been adopted based on two dominant storm sectors. Shepway's shoreline has two predominant orientations; south facing and east facing, and therefore when one shoreline is subject to an incident storm, the other will benefit from the relative shelter provided by the other.

Whilst the NPPF promotes a precautionary approach to flood risk management, it is also necessary to ensure that the SFRA presents a realistic appraisal of risk and this ethos is important when considering the number of breaches that could occur concurrently.

In order to achieve the correct balance between precaution and realism, the likelihood of combined failures and overtopping events has been discussed with both Environment Agency and Shepway's Engineers. The outcome of this process was a matrix of combined events that were considered to be representative of the worst case scenario that could occur as a result of storms from the two different direction sectors. Table 9.2 below identifies the individual breach and overtopping events that have been combined to produce the 8 modelled scenarios used to assess the risk of flooding under extreme storm events.

| ***BREACH LOCATION*** | ***SOUTHERLY EVENT*** | | | ***EASTERLY EVENT*** | | | | |
|---|---|---|---|---|---|---|---|---|
| | ***SCENARIO*** ***Tested for each time epoch [2015/2075/2115]*** | | | | | | | |
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **OT** |
| **B1. Broomhill Sands** | ✓ | | | | | | | |
| **B2. Southbrooks Outfall** | | ✓ | | | | | | |
| **B3. Galloways** | | | ✓ | | | | | |
| **B4. Greatstone Dunes** | | | | ✓ | | | | |
| **B5. St Mary's Bay – Pirate Springs (Flood Gate Open)** | | | | | ✓ | | | |
| **B6. St Mary's Bay - Dunstall Lane (Flood Gate Open)** | | | | | | ✓ | | |
| **B7. Hythe Ranges** | | | | | | | ✓ | |
| ***OVERTOPPING LOCATION (Tested for independent frontages)*** | | | | | | | | |
| **OT1. Littlestone** | | | | | | | | ✓ |
| **OT2. St Mary's Bay** | | | | | | | | ✓ |
| **OT3a. Dymchurch West** | | | | | | | | ✓ |
| **OT3b. Dymchurch East** | | | | | | | | ✓ |
| **OT4a. Hythe Ranges West** | | | | | | | | ✓ |
| **OT4b. Hythe Ranges East** | | | | | | | | ✓ |
| **OT5a. Hythe West** | | | | | | | | ✓ |
| **OT5b. Hythe Centre** | | | | | | | | ✓ |
| **OT5c. Hythe East** | | | | | | | | ✓ |
| ***OVERFLOW LOCATION*** | | | | | | | | |
| **OT6. Folkestone Harbour** | | | | | | | | ✓ |

*Table 9.2 –Breach/Flood Gate and Overtopping Scenarios*

## 9.4 2D Hydraulic Model Set-up

The software package that has been used to undertake the breach and wave overtopping analysis was TUFLOW (version 2012-05-AB-iDP-w64), which is a two-dimensional finite difference flood simulation model. The TUFLOW model operates within the Surface Water Modelling System (SMS v11.0.12), which is a comprehensive environment for one, two, and three-dimensional hydrodynamic modelling.

The TUFLOW model utilises a three dimensional digital elevation model (DEM) that is created from spot height data and uses this to model the propagation of floodwater across a defined landscape. The data used to create the original DEM in this instance was the Environment Agency's LiDAR data, which was supplied at a 2m resolution for the entire study area. Figure 9.1 illustrates the quality and topographic definition that is achieved through the use of this data.

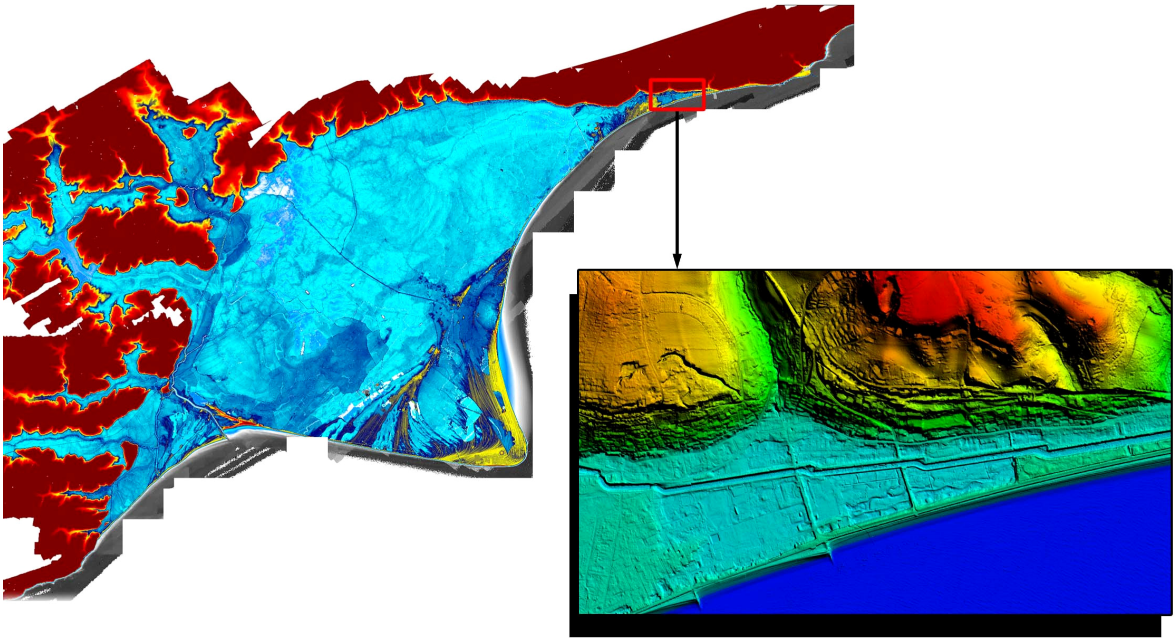

*Figure 9.1 – Image showing extent and resolution of the Digital Elevation Model*

The model boundaries were set to include the entire area shown within Environment Agency's Zone 2 flood risk area within Shepway's district boundaries. To ensure that the model boundaries were representative, the coverage was extended to include parts of the Rother District as shown by Figure 9.1. From the DEM, a 2D grid with points every 25m was then created for use in the TUFLOW model. This resolution gives a reasonable representation of the geographical features within the model and was considered to be the optimum balance between model performance and computer processing time.

Each model was run to represent a total of 56 hours real time; however, depending on the type and nature of the defence structure, the time that the breach remained open was varied according to the Environment Agency's guidance. This information is summarised in Table 9.1.

## 9.5 Modelling Outputs

Each of the above scenarios has been modelled for three individual time epochs; these comprise 2015 (current day); 2075 (to include 60 years of climate change to appraise Commercial Development); and 2115 (to include 100 years of climate change to appraise Residential Development). These three time epochs for all 8 scenarios yield a total of 24 separate outputs.

In the context of a strategic document it has not been considered appropriate to include flood maps for each of these individual scenarios. In addition, the outputs from the modelling have shown that there are many locations within the study area that are at risk under more than one breach or overtopping scenario. Consequently, in order to establish the risk to a specific site or location it would be necessary to reference a large number of flood maps to establish which of the 24 modelled scenarios represented the worst case.

For each of the 25m grid cells, information on flood depth and velocity has been recorded for every 10 second interval throughout the entire 56 hour model simulation. However, due to the sheer size and complexity of the flood compartment, it is not possible to show the predicted depth and velocities within the SFRA at a scale that will allow this data to be interpreted at a site-specific scale. Consequently, in order to maximize the value of this information and facilitate the appraisal of flood risk at a strategic level, the use of hazard mapping has been adopted for use as part of the SFRA.

The Hazard Maps provide a graphical representation of the hazards associated with flooding, expressed as a function of depth and velocity. In the report 'Flood Risks to People' (R&D output FD2320/TR2) a methodology for quantifying flood hazard is set out using the following equation:

$$HR = ((v + 0.5)\ d) + DF$$

where, $HR$ = flood hazard rating

$d$ = depth of flooding (m)

$v$ = velocity (m/sec)

$DF$ = debris factor

The depth and velocity outputs from the breach analysis have therefore been processed for every one of the 24 modelled scenarios to give a hazard rating for each of the 25m grid cells contained within the model. The value associated with each cell is then used to assign a Hazard Rating based on the four hazard classifications shown in Table 9.3.

| 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 2.5 | Significant | Dangerous for most people – deep fast flowing water |
| > 2.5 | Extreme | Dangerous for all – extreme danger with deep and fast flowing water |

*Table 9.3 – Classification of Hazard Rating Thresholds*

Assessing the risk of flooding as a degree of hazard allows a simple and robust method of risk analysis across the entire flood compartment. Also, because of the way in which the hazard classifications are derived, it is possible to combine the outputs of all modelled scenarios to give a single hazard map that is representative of hazards associated with each of the modelled scenarios. Whilst this process allows the flood risk information from all scenarios to be collated into a single map, it does not result in the hazard rating being increased as a consequence of two exclusive events affecting a single site.

For instance, if a particular site has a hazard rating of 1.0 from Scenario A and 1.0 from Scenario B, the maximum hazard rating is 1.0. However, if the same site were to be affected by a third scenario which resulted in a hazard rating of 1.5, the worst case hazard value of the three scenarios combined would be 1.5.

The Hazard Maps for both the current day and future climate change conditions are included in Appendix 4.

# 10 Guidance for Site Specific FRAs

## 10.1 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 the Environment Agency has developed a web-based tool that can be accessed from their website.

***Flood Zones 1 –*** Low probability of flooding – This zone is assessed as having less than a 1 in 1000 annual 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 either the Critical Drainage Zone or the Overtopping Hazard Zone, or if it is identified by the Council as being a site with 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 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 the Planning Practice Guidance: Flood Risk and Coastal Change, paragraphs 30 – 32 and 68.*

***Flood Zone 3*** – High probability of flooding - This zone comprises land assessed as having a 1 in 100 or greater annual 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 the Planning Practice Guidance: Flood Risk and Coastal Change, paragraphs 30 – 32 and 68.*

***Overtopping Hazard Zone*** - As a District that has approximately 41km 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. For example, some areas are raised above the 1 in 1000 year sea level and are therefore located in Zone 1 and consequently the risk of floodwater ponding to any significant depth is extremely low. Notwithstanding this, some of these coastal frontages are subject to wave overtopping under storm conditions.

This is illustrated by the photograph in Figure 10.1 below, which shows waves overtopping onto an area that is classified as a Zone 1 flood risk area.

*Figure 10.1 - Wave Overtopping at Sandgate, December 2000*

For development within this wave overtopping zone there are hazards associated with localised flooding, structural integrity of buildings and safe access and egress to and from 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 Environment Agency that the SFRA should put in place measures to ensure that development in these locations is appropriate.

Given that most areas that are subject to wave overtopping are also located within Zones 2 or 3, the issues of wave overtopping will be dealt with as part of the site specific FRA. However, for development sites located within 50m of the landward crest of the seawall, it will be necessary for a FRA to be prepared that focuses on the hazards specifically associated wave overtopping.

*A site-specific FRA will be required and this will need to be prepared in accordance with the requirements set out in the Planning Practice Guidance: Flood Risk and Coastal Change, paragraphs 30 – 32 and 68. In particular this will need to examine the impacts of wave overtopping on the proposed development under current and future climatic conditions.*

***Critical Drainage*** – There are large areas within Shepway's District where the management of surface water run-off is critical to reducing the risk of flooding. The Romney, Walland and Denge Marshes cover well over 50% of the District and all of these areas are drained by man made watercourses that discharge to the sea via a network of sewers. This drainage network is maintained and managed by the Romney Marshes Area Internal Drainage Board (RMAIDB). All IDB watercourses discharge into Main Rivers before discharging to sea and therefore the IDB is totally reliant on the Environment Agency to maintain its watercourses and supporting infrastructure to a satisfactory standard.

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 marshes will be exceeded. This will exacerbate the risk 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 Folkestone, Hythe, Seabrook and Sandgate. 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 planning policy has been developed.

*The IDB wish to be consulted on all applications that take place within its District which may affect drainage (notwithstanding where adopted IDB watercourses are directly involved i.e. the consenting process). The IDB also wish to be consulted on applications outside of its District to ensure that run-off does not have an adverse impact on its watercourses (only residential development with 10 or more dwellings or commercial development >250m$^2$).*

***Sites larger than 1 hectare –*** In accordance with the guidance set out in the NPPF, planning applications for development on sites greater than 1 hectare will need to be accompanied by a site-specific FRA even if it is outside of 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.

*The application will need to be accompanied by a site-specific FRA. This will need to include a Surface Water Management Strategy and will also need to demonstrate that, where possible, a sustainable drainage (SuDS) approach has been adopted.*

**Development within 20m of a Main River** – Application containing culverting or obstruction to the flow of a watercourse, or works within 20m of the top of the bank of a Main River.

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

**Development within 15m of the landward toe of a tidal defence** – Application containing works within 15m of the landward toe of one of the Environment Agency's tidal defence structures.

> *Such works will require Land Drainage consent from the Environment Agency*

**Development within 8m, or Connection to an IDB Watercourse** – Application containing culverting or obstruction to flow of a watercourse, or works within 8m of the top of the bank of an IDB watercourse. Applications that include proposals to discharge surface water into any IDB watercourse.

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

## 10.2 FRA Requirements

The minimum requirements for flood risk assessment are provided in *Planning Practice Guidance: Flood Risk and Coastal Change* (DCLG, 2014). 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.

One of the requirements of the Exception Test is that the FRA demonstrates that the development will be safe, without increasing flood risk elsewhere. To be classed as safe, there are a number of key requirements that need to be satisfied. These are as follows:

- That a dry access route above the design flood level, with allowances for climate change, to and from any residential development can be provided.
- Living accommodation should be set 300mm above the design flood level.
- Sleeping accommodation should be set 600mm above the design flood level.

For fluvial flooding, the design flood level should be taken as the 1 in 100 year predicted flood level, for tidal and coastal flooding the 200 year return period event should be used. In either case the impacts of climate change should be included.

In most areas of the low-lying Romney, Walland and Denge Marshes, when the predicted extreme sea levels shown in Table 7.2 are compared with the level of the land, there is a significant difference. However, it is generally not appropriate to use these open sea extremes to predict flood levels in locations that are protected by defences. Consequently, for all coastal flooding scenarios it is recommended that the outputs from the breach and wave overtopping modelling are used to define the design flood level at individual sites.

This information can be provided at a site-based scale and would include depth, velocity and water surface elevation. To obtain site specific outputs from the hydraulic model, please contact Shepway District Council's Planning Team on 01303 853000 for further details.

## 10.3 Specific FRA Guidance

***Dry Islands***

As discussed in the previous section, in a great many locations on Shepway's low-lying marsh areas it will not be possible to demonstrate that a safe dry access to areas outside of the floodplain can be achieved. For example, parts of the existing towns of Lydd and New Romney are raised well above the predicted flood levels. Nevertheless, the Environment Agency's FRA Guidance Note 1 (issued April 2012) suggests that these should be treated as 'dry islands'.

However, when the areas of Lydd and New Romney that are raised above the extreme flood level are considered, it can be seen that a substantial proportion of these towns lie outside of the floodplain. Whilst in the event of a major flood it is likely that these areas would be cut off for a number of days and would in effect be dry islands, when the facilities available within the towns are taken into account, it is considered that there would be sufficient supplies and resources to safely sustain these communities for this time. Consequently, for the purposes of emergency access, the towns of Lydd and New Romney are not considered to be dry islands.

***Floor Levels –*** Whist the use of breach and overtopping modelling has shown that inland flood depths will be much less than those predicted using open sea extremes, in some cases it will not be possible to raise ground floors above the 1 in 200 year (plus climate change) flood level. This can generally be overcome by opting for a 3 storey town house style dwelling with garage, utility and storage areas located on the ground floor.

***Flood Resilient Construction -*** During a flood event, floodwater can find its way into properties through a variety of routes including:

- Ingress around closed doorways.
- Ingress through airbricks and up through the ground floor.
- Backflow through overloaded sewers discharging inside the property through ground floor toilets and sinks.
- Seepage through the external walls.
- Seepage through the ground and up through the ground floor.
- Ingress around cable services through external walls.

Since flood management measures only manage the risk of flooding rather than eliminate it completely, flood resilience and resistance measures may need to be incorporated into the design of the buildings. The two possible alternatives are:

*Flood resistance* or 'dry proofing', where flood water is prevented from entering the building. For example using flood barriers across doorways and airbricks, or raising floor levels. Such measures are generally only considered appropriate for some 'less vulnerable' uses and where the use of an existing building is to be changed and it can be demonstrated that no other measure is practicable.

*Flood resilience* or 'wet proofing', accepts that flood water will enter the building and allows for this situation through careful internal design for example raising electrical sockets and fitting tiled floors. The finishes and services are such that the building can quickly be returned to use after the flood.

In most cases the risk of new development being affected by flooding is very low, nevertheless, by incorporating flood resilience into the design of the building it is possible to increase its resilience to flooding and thereby reduce the impact of such an event. Details of flood resilience and flood resistance construction techniques can be found in the document 'Improving the Flood Performance of New Buildings; Flood Resilient Construction', which can be downloaded from the Communities and Local Government website.

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 (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.

## 10.4 Surface Water Management Strategy Requirements

The purpose of these assessments is to ensure that the post-development run-off regime does not increase flood risk either on-site or elsewhere within the catchment. Re-development of existing sites also offers an opportunity to improve the existing run-off regime and reduce flood risk. The key objectives of the Surface Water Management Strategy are:

- If the site is a greenfield site then the strategy will need to demonstrate that the maximum rate of surface water run-off from the site is controlled such that it does not exceed the pre-developed greenfield run-off rate.

- Where brownfield sites are to be re-developed, it will be necessary to demonstrate that the post-developed site will not increase the rate of surface water run-off. Developers are, however, strongly encouraged to reduce run-off rates from previously-developed sites as much as is reasonably practicable.

- For sites less than 1 hectare, surface water flows associated with the 100 year event (including an appropriate allowance for climate change), should preferably be contained within the site at designated temporary storage locations, either located above or below ground. On-site storage may not be required if it can be shown that above ground flooding will have no material impact in terms of nuisance or damage, or increase river flows during periods of river flooding. For previously undeveloped sites, the maximum rate of surface water run-off will need to be controlled such that it does not exceed the pre-developed greenfield run-off rate. For brownfield sites the rate of run-off shall not exceed the existing rate.

- For sites greater than 1 hectare it will be necessary to demonstrate that all surface water flows associated with the 100 year event (including an appropriate allowance for climate change) can be contained within the site. For previously undeveloped sites, the maximum rate of surface water run-off will need to be controlled such that it does not exceed the pre-developed greenfield run-off rate. For brownfield sites the rate of run-off shall not exceed the existing rate.

- For all development, the Surface Water Management Strategy should demonstrate that no flooding of property will occur as a result of a one in 100 year storm event (including the appropriate allowance for climate change)

# 11 Policy Recommendations

The Council'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. Using the planning process to steer more vulnerable development to areas of lower risk and ensuring that new development is appropriately designed will help to manage residual risk throughout the lifetime of the development.

This approach fully supports the overarching objectives of the NPPF and wider government policy. The specific policy recommendations that are made by this SFRA to enable the Council to deliver these objectives are as follows:

- To ensure that new residential development does not take place in areas identified as 'extreme' flood hazard risk by the SFRA climate change hazard maps. Notwithstanding this, the Council will need to ensure that specific provisions are made for residential development to cater for the sustainable development of Romney Marsh. Sites will only be allocated for development within Flood Zone 3a where it can be shown that they meet the requirements of the Sequential Test and potentially, both stages of the Exception Test.

- To ensure that replacement dwellings located within Flood Zones 2 and 3 reduce risk to life to residents through the adoption of appropriate design.

- To ensure that flood risk is not increased within the District any new development will need to be designed such that the peak rate and volume of surface water run-off from the site is not increased above the existing surface water run-off rate. In line with the NPPF and the supporting Planning Practice Guidance, for development within Zones 2 or 3 and for sites greater than 1 hectare, a surface water management strategy will also need to be incorporated within the site-specific FRA. The requirements for this are set out in Section 10.4 of the SFRA.

- To help reduce the rate and volume of surface water run-off and to improve the quality of the water passed on to watercourses, new development should incorporate the principles of SuDS in its drainage design wherever practically achievable.

- Development in some of the District's seafront areas could be located very close to the shoreline and will therefore be subjected to an increasing risk of flooding and damage from severe wave overtopping, even if located outside of the Flood Zones 2 and 3. Consequently, any development that is proposed to take place within 50m 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 the supporting Planning Practice Guidance and also address the specific issues of wave overtopping.

- To ensure that all development in Flood Zones 2 and 3 incorporates flood resilient construction techniques. This will reduce the time and cost to recover the building to a habitable standard following a flood event. Specific details are set out in Section 10 of the SFRA.

- To ensure that any new development does not have an adverse impact on drinking water resources. This can be achieved through the reference to the Source Protection Zone maps published by the Environment Agency and by encouraging the use of rainwater harvesting and grey water recycling systems.

# 12 Sustainable Drainage Systems (SuDS)

## 12.1 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 rainfall generated surface water is considered an essential element for reducing future flood risk to both the site and its surroundings. Indeed maintaining the existing rate of discharge from urban sites, even after climate change has occurred, is one of the most effective ways of reducing and managing flood risk in watercourses.

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 to watercourses or into the groundwater table. This is known as source control and is a fundamental part of the SuDS philosophy.

## 12.2 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 discharge from the site will be managed and the options that are available to achieve this without increasing the risk of flooding. One factor that is key in this decision making process is the type of superficial and underlying geology, as this has a fundamental impact on the approach to be followed for the SuDS system. There are two fundamental variations in SuDS, these are:

- Infiltration within the attenuation facilities to partly or fully dispose of run-off
- Not using any infiltration techniques but providing attenuation facilities that maintain the discharges at pre-development levels

Either of these approaches balances the increase in run-off due to climate change and hence minimises the effect of any development work on the receiving watercourses.

Large increases in impermeable area contribute to significant increases in surface run-off volumes and peak flows and could increase flood risk elsewhere unless adequate SuDS techniques are implemented. It is relatively simple to avoid the increase in peak flows by providing attenuation or detention storage that temporarily stores the required amounts of run-off within the site boundary. SuDS elements may also be able to prevent increases in surface run-off volumes where significant infiltration is practicable.

## 12.3 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 to a watercourse. Only if neither of these options are achievable should the site discharge rainwater to a sewer.

A range of typical SuDS components that can be used to reduce flood risk and improve the environmental impact of a development is listed in Table 12.1 below along with the relative benefits of each feature and the appropriateness for different site specific variables.

| SuDS Feature | Biodiversity enhancements | Water quality improvement | Suitability for low permeability soils ($k<10^{-6}$) | Ground-water recharge | Suitable for small / confined sites? |
|---|---|---|---|---|---|
| Wetlands | ✓ | ✓ | ✓ | ✗ | ✗ |
| Retention ponds | ✓ | ✓ | ✓ | ✗ | ✗ |
| Detention basins | ✓ | ✓ | ✓ | ✗ | ✗ |
| Infiltration basins | ✓ | ✓ | ✗ | ✓ | ✗ |
| Swales | ✓ | ✓ | ✓ | ✓ | ✗ |
| Filter strips | ✓ | ✓ | ✓ | ✓ | ✗ |
| Rainwater harvesting | ✗ | ✓ | ✓ | ✓ | ✓ |
| Permeable paving | ✗ | ✓ | ✓ | ✓ | ✓ |
| Green roofs | ✓ | ✓ | ✓ | ✗ | ✓ |

*Table 12.1 – Environmental improvements achievable through SUDS*

A description of the key benefits of the above listed SuDS features is given below:

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

***Retention ponds*** – These open water bodies can significantly enhance the visual amenity of a development and provide wildlife habitat improvement opportunities.

***Detention basins*** – These provide treatment by detention and can be designed as an amenity or wildlife habitat.

***Infiltration basins*** - Treatment by detention and filtration. Potentially compatible with dual-use e.g. sports pitches, play areas, wildlife habitat. Can be any shape, curving or irregular, with scope for improved visual amenity.

***Swales*** – Generally used to convey water to storage facilities and provide treatment by infiltration. 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 groundwater recharge, treatment by detention, and filtration where ground conditions permit.

***Porous and pervious paving*** – These can provide large areas of permeable surface and promote infiltration. They can attenuate run-off at source and discharge it after a significant delay. On all sites that are suitable for infiltration, unlined systems are to be encouraged as these pavements can infiltrate large amounts of water due to the large surface area contact with the ground.

***Green roofs*** – As well as providing improved biodiversity opportunities, vegetated roofs reduce the volume and rate of surface water run-off and remove pollution.

From the soil and geology information provided in Section 2, it can be seen that the ground conditions across the District vary greatly. Consequently the applicability of different types of SuDS will be very much dependent on the site location. Where ground conditions are suitable, infiltration should be the first choice for surface water discharge. The benefits of using infiltration as part of a sustainable drainage system include:

- 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 under the development process

- Significant flow attenuation may be provided

However, the vast majority of development for which a FRA or Surface Water Management Strategy will be required is likely to be in the lower-lying parts of the Romney, Walland and Denge Marshes.

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 may not appropriate for site-specific decision making. Consequently it may be necessary to investigate ground conditions in greater detail before ruling out infiltration as an option.

## 12.4 Constraints on Discharges to Ground

There are a number of locations within the District that are shown by the Environment Agency's Groundwater Source Protection Zone map to be within areas where infiltration is controlled. These are primarily located around Dungeness and the higher areas of the District such as Lyminge, Elham and Hawkinge.

The nature of an aquifer body and the groundwater within it provide significant constraints when considering the potential of SuDS that rely on infiltration to the ground to provide the means of surface water drainage, storage and flow attenuation. The main constraints associated with infiltration in these areas include contamination from brownfield sites and road drainage and seepage from poor quality surface water bodies.

It is possible to check whether a site is within a groundwater source protection zone by referencing the Environment Agency's 'What's in your backyard?' section of their website. If a particular site is shown to be within a groundwater source protection zone then whilst this does not preclude the use of infiltration, the following design issues will need to be taken into account:

- soakaways must be constructed such that they do not exceed 3m in depth below the existing ground level.

- In order for water to be discharged to the ground, it must be demonstrated that an unsaturated zone will be available between the discharge point and the groundwater table at all times of the year.

- 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 accidental/unauthorised contaminated liquids into the soakaway.

- All discharge must be into a clean, uncontaminated area of natural ground.

# 13 Conclusions

Shepway's District is diverse in many ways and its exposure to flood risk is no different. The risk of coastal flooding to the low-lying parts of the District does, however, dominate much of this SFRA, even though there is a strong history of fluvial flooding that should not be overlooked.

Through the full and proper implementation of the NPPF, the forthcoming Local Development Framework and site-specific FRAs, it will be possible to manage flood risk in a sustainable manner. The re-development of brownfield sites will provide opportunities to reduce overall flood risk, principally through the use of sustainable drainage systems and allowing space for flood storage, overland flows and the future maintenance and upgrade of flood defences.

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 also benefits from an extensive array of coastal flood defences as well as an adopted Shoreline Management Plan and Coastal Flood and Erosion Flood Risk Management Strategy, both of which promote and support the long-term investment in the flood defences in this area. Notwithstanding this, the NPPF requires the SFRA to adopt a precautionary approach to the appraisal of risk and this has meant that the impacts of residual risk events have been examined in great detail. This process has resulted in the analysis of breach and overtopping scenarios and the production of comprehensive Hazard Maps. These will be key in applying the Sequential Test to sites within the District.

This SFRA has also provided specific planning recommendations for areas that are not included within the Environment Agency's Flood Zones, such as critical drainage areas and locations that could potentially be at risk from wave overtopping. There are also specific design issues related to the low-lying areas of the Romney, Walland and Denge Marsh areas that have been addressed within this document.

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. It is therefore recommended that the Council review their adopted flood risk response plan in light of the findings of the SFRA.

It is also recommended that the Shepway District SFRA is reviewed once every 12 months, with the first review commencing in June 2016. This 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 or the supporting Planning Practice Guidance been released since the previous review and will these impact upon the SFRA?
- Has the Environment Agency 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 Flood Risk Management Strategy?
- 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?

# 14 Appendices

**Appendix 1 -** **Flood Zone Map (current climate conditions)**

**Appendix 2 -** **Historic Flood Map**

**Appendix 3 -** **Existing Defence Infrastructure & Main Rivers**

**Appendix 4 -** **Flood Hazard Maps**

# Appendix 1 - Flood Zone Map (current climate conditions)

## Appendix 2 - Historic Flood Map

# Appendix 3 - Existing Defence Infrastructure & Main Rivers

# Appendix 4 - Flood Hazard Maps