Thanet District Council

Thanet District Strategic Flood Risk Assessment

Volume 1 – Thanet SFRA Report

24 April 2009

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Document Revisions

No.	Details	Date
1	Draft SFRA report	10.07.2008
2	Final SFRA report for client comment	09.02.2009
3	Final Issue	24.04.2009

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Thanet District Strategic Flood Risk Assessment

Volume 1 – Thanet SFRA Report

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Doc Reg No. c016-22266

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Executive Summary

This report has been produced for the purpose of providing a Strategic Flood Risk Assessment (SFRA) for Thanet District. The SFRA has been produced by Entec UK ltd in close consultation with Thanet District Council and the Environment Agency. The SFRA has been prepared in accordance with the requirements of Planning Policy Statement 25 *Development and Flood Risk* (PPS25).

The Nature of the SFRA

The data interpretation and information processing undertaken in this SFRA has been geared towards the production of two digital GIS (Geographical Information Systems) datasets, these being the Attribution Database and the Site Specific Database. These two datasets, which are supplied as ESRI shapefiles on the accompanying CD-ROM, are the essence of the SFRA. The two datasets provide the information needed to inform the PPS25 Sequential Test and comprise:

- **Attribution Database**: – This dataset contains every one of the identified potential development sites. These sites are attributed with the highest risk flood zone that poses a risk to them, providing a means of focusing the Council's attention on sites with significant flood risks. Each site is also assessed on the basis of whether it will be impacted by the anticipated impacts of climate change on tidal and fluvial flooding extents. Information on the requirements of an FRA, historic flooding, proximity to a Main River and any defences are also presented. The dataset also categorises the infiltration potential and runoff potential for each site;

- **Site Specific Database**: – This dataset just contains those sites identified as being in Flood Zones 2, 3a or 3b (as defined by PPS25). The dataset details the variation of flood risk across each site, thereby identifying those parts of each site where PPS25 (Planning Policy Statement 25 – Development and Flood Risk) restricts the development of certain uses of land.

These datasets allow the Council to navigate to a particular potential development site and interrogate the Attribute Database and establish what the results of the SFRA are for that site. A more detailed description of the Key Urban Areas is presented in Chapter 7.

The Assessment of Flood Risk

The following sections briefly describe the nature of the assessments undertaken in this SFRA.

Tidal

Tidal flooding poses the greatest risk to the study area. The Environment Agency and the Council saw the SFRA as an opportunity to refine the existing Flood Zone 3 outline in the District. It was considered essential that the highest quality and most up to date data be used to define flood risk zones. To achieve this, the SFRA has remodelled the tidal floodplain using a TuFLOW model. This model enabled flood flow routes to be visualised, flood depths and flow velocities to be quantified and areas of standing water to be identified. The hydraulic modelling undertaken in this SFRA has provided detailed flood risk information at the site specific level. The Environment Agency has approved the Isis-TuFLOW model and its output for use in the SFRA.

Fluvial

The SFRA has considered flooding from the River Stour. Within the Stour Valley, the tidal extent of the river provides a greater risk than a fluvial flood event; therefore the combined fluvial and tidal flood zone is used to determine the greatest level of risk.

Other Sources

Groundwater flooding was not concluded to be an issue of strategic concern. A detailed assessment of drainage has not been undertaken as part of this SFRA, but it is recommended that subsequent FRAs assess the potential for flooding from the surface water and foul water drainage networks at the site specific level. Some coastal areas have been identified as areas potentially affected by wave energy. The Council and the Environment Agency must be consulted regarding any new development in these areas to determine the scope of more detailed assessment of wave impact.

Recommendations for Management and Inclusion in LDF

The key message of PPS25 is to avoid inappropriate development and to locate development away from flood risk whenever possible. The approach it adopts to do this is to assess risk so it can be avoided and managed. This is summarised in the PPS25 Practice Guide (2008) as following a Flood Risk Management Hierarchy: assess – avoid – substitute – control – mitigate. The management and mitigation of flood risk within Thanet should aim to follow this hierarchy where possible, and this approach forms the basis of the assessment and recommendations in this report. A wide area of the District lies within the lowest flood risk zone, and development should be guided into these areas wherever possible. In the main coastal towns if this is not feasible, developments should complete an appropriate scale, site specific Flood Risk Assessment, considering all forms of flood risk and ensuring that the development is safe from flooding, does not increase flood risk else where and aims to reduce the flood risk where possible.

The following represent a summary of the recommendations that have been put forward in the SFRA which the Council should consider for inclusion in the LDF:

- Aim to principally manage flood risk through avoidance whereby sites are allocated in lower flood risk zones in preference to higher flood risk zones, unless regeneration aspirations are met and exceptions demonstrated. The Sequential Test provides the Council with a framework for undertaking this screening process to inform site allocations;

- Development in higher flood risk zones must pass the Exception Test;
- When determining the requirement for a FRA and the scope of a FRA the 2115 predicted climate change extents for Flood Zone 2 and 3 should be used. This represents a more sustainable and precautionary approach;
- Seek to see betterment of the requirement of PPS25 which states that only sites in Flood Zone 2 and 3 or sites larger than 1 hectare in Flood Zone 1 should be accompanied by a FRA addressing surface water runoff rates. This could be achieved by, for example, requiring all new developments of all sizes to, where possible, sustainably manage surface water on site to reduce the potential for off site increases in flood risk;
- Adopt resilient or resistant design practices for all development that must be placed in zones of flood risk; and
- Site Specific FRAs in tidal Flood Zone 3 should incorporate an assessment of the potential impacts of wind and wave action for developments lying within this risk zone (Volume 2). Through consultation with the Environment Agency, agree the necessary mitigation measures to facilitate 'safe' development.

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1. Introduction

1.1 Introduction

This Strategic Flood Risk Assessment (SFRA) has been undertaken to assess flood risks in Thanet, and in particular the flood risks associated with areas being considered for future development as part of the emerging Local Development Framework (LDF). National planning legislation and policy guidance have been considered throughout the SFRA.

Planning process is driven by legislation and guidance developed at a national, regional and local level. Flood risk is just one of many factors to consider when making decisions relating to land use. The challenge for a SFRA is to develop pragmatic principles for steering future sustainable development without conflicting with the requirements of the different planning policies. The '*Making Space for Water*' report published by DEFRA (2005) identified that the severe flooding in mainland Europe in 2000 acted as a catalyst for the Government to provide robust guidance for flood risk management. Further, a new approach to managing surface water promoting sustainable drainage through better coordination and planning is presented in the more recent '*Future Water'* publication by DEFRA(2008), and the principles and recommendations have been set out in the Pitt Review of the 2007 floods (2008). The Review promotes a risk based approach to investment in flood risk management, not simply focussed on the areas impacted by last summer's floods. The Review also promotes natural processes to manage surface water.

These recently published documents, in combination with recent high-profile flood events across the United Kingdom, have kept flood risk in the public eye and have made effective consideration of flood risk in the planning process even more important.

1.2 The Purpose of the SFRA Report

Thanet District Council appointed Entec to undertake a Strategic Flood Risk Assessment. The SFRA is intended to provide the Council with a better understanding of:

- Flood risks;
- The delineation of the PPS25[1] Flood Risk Zones, and;
- The implications of how the Flood Zones interact with the Council's Potential Development Sites.

[1] Planning Policy Statement 25 *Development and Flood Risk* (2006)

In its role as a strategic planning tool the SFRA has been presented to provide clear advice to the planning process. Throughout the delivery of the SFRA process, Entec and the Council have liaised closely with and consulted the Environment Agency. It provides information to inform the Sequential Testing of sites made available for assessment in the SFRA. It also includes sufficient evidence for Thanet District Council to process additional sites not identified in the SFRA.

1.3 SFRA Structure

1.3.1 General

The SFRA is a reference facility, to be accessed when the Council are presented with questions or situations that require an appreciation of flood risk. The report should be read in conjunction with the GIS dataset which provides all the required spatial information on flood risk in the District (described in Section 8). The report is comprised of the following sections:

- Section 1 – Introduces the SFRA. The introduction is also designed to provide guidance on how to extract the most information from the SFRA;
- Section 2 – Provides context for the SFRA and sets it within national planning policy;
- Section 3 – Provides an appreciation of the district wide flood risk issues and a discussion of possible management and mitigation measures;
- Section 4 – Defines the flood risk zones that are used by PPS25 to steer the location of new developments;
- Section 5 – Outlines the importance of Sustainable Drainage Systems (SuDS) and describes how the SFRA has provided recommendations for the suitability of different SuDS techniques;
- Section 6 – Discusses the need to assess the potential impact of climate change and it presents the findings of the fluvial and tidal assessments;
- Section 7 - The potential development sites have been grouped into 5 Key Urban Areas (KUAs) and each has been addressed separately so as to offer a synopsis, at the KUA level, of all the data that has been collated and produced in this SFRA;
- Section 8 – Outlines the two key GIS datasets that have been produced which form the *Key Stones* of the SFRA;
- Section 9 – Outlines possible flood risk mitigation and management measures that could be implemented;
- Section 10 – Presents the conclusions and recommendations of the SFRA.

1.3.2 Data Organisation and Using the SFRA

This SFRA is structured around two key databases that have been produced and supplied on the accompanying SFRA CD-ROM (see Section 8 for full details):

- The Potential Development Site Attribute database, (hereafter referred to as the Attribute Database); and
- The Site Specific Flood Risk Definition database (hereafter referred to as the Site Specific Database).

All the data on the CD-ROM needs to be installed onto a computer which has ESRI ArcMap capability. The digital datasets enable the user to visit any potential development site in the district and access an array of attribute data about each site (see Section 8). For information on flood risk related to the potential development sites in the KUAs (Key Urban Areas), the reader should consult the maps in Volume 2.

The SFRA Flood Zone mapping can be broadly used to inform which sites are suitable and which are not suitable for particular developments. To get an appreciation of the different flood risk zones present in each site then the Site Specific Database must be consulted. These two databases provide the information to support the Sequential Test as they depict the flood risks posed to each site and each is attributed with what PPS25 states as being appropriate uses of land for each flood risk zone. At the KUA level these databases and Figures for each KUA in Volume 2 can be used to inform the application of the Sequential Test. The flood risk assertions made in the Attribute Database are refined in the Site Specific Database, as a range of flood risks are defined for the same potential site. This level of flood risk detail makes it possible to perform the Sequential Test at the site specific scale. Section 7.3 describes the process in more detail and outlines the significance of the different Flood Zone designations.

Sustainable drainage is a key requirement of PPS25's guidance as it states that surface water runoff from a given site cannot be increased as a result of development. This means that infiltration SuDS provide a viable alternative to mitigate runoff. There are, however, some situations where these techniques are not appropriate. The Attribute Database indicates the locations where this surface water runoff management technique is and is not appropriate. Full details and methodology of this process can be found in Section 6.

1.4 Summary Guide to Processing Windfall Sites

The following is provided as an illustration of the process that the LPA may wish to work through when presented with a *Windfall Site* application. A Windfall Site being a site that was not identified in the land availability assessment and thus not specifically assessed in the SFRA.

Step 1 – Locate development on the OS map

Step 2 – Define which flood zone site lies in

Steps 1 and 2 can be undertaken using the ArcMap GIS layers that accompany the SFRA. The GIS shows the extent of the Environment Agency Flood Zones, the possible impact climate change may have on the extent of these Flood Zones and it provides information that can inform the selection of appropriate SuDS solutions. Figure 1a illustrates example locations of three windfall sites; the recommended approach for each case study is explained in Table 1.1.

Figure 1a Examples of Potential Windfall Site Locations

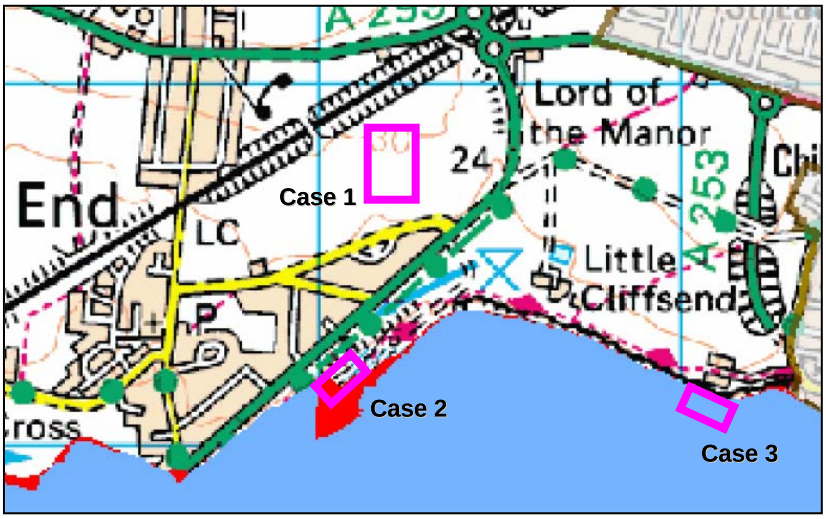

Table 1.1 Recommended Approach for processing each of the Three Windfall Site Case Studies

Case Example	Flood Zone	PPS25 Requirements	Suitable Developments (refer to Table D2 in Appendix B for Development Types)
1	Development in FZ1	Proceed to allocation If site area > 1ha, FRA required. Consider surface water drainage (see Section 5) and climate change (see Section 6 – the GIS layers illustrating the potential extent of Flood Zone 2 and 3 in the future time horizons)	All development types are suitable
2	Development in FZ2	FRA required. Consider site drainage (see Section 5), climate change (see Section 6 - see Section 6 – the GIS layers illustrating the potential extent of Flood Zone 2 and 3 in the future time horizons) and potentially raise floor levels If Development Type = Highly Vulnerable, Exception Test* required. If development type is not Highly Vulnerable proceed to allocation	Essential Infrastructure Water Compatible More Vulnerable Less Vulnerable

Table 1.1 (continued) Recommended Approach for processing each of the Three Windfall Site Case Studies

Case Example	Flood Zone	PPS25 Requirements	Suitable Developments (refer to Table D2 in Appendix B for Development Types)
3a	Development in FZ3a	FRA required. Consider site drainage (see Section 5), climate change (see Section 6 - see Section 6 – the GIS layers illustrating the potential extent of Flood Zone 2 and 3 in the future time horizons) and potentially raise floor levels Highly Vulnerable developments should not be permitted. If Development Type = Essential Infrastructure or More Vulnerable, Exception Test* required.	Water Compatible Less Vulnerable

*Exception Test	Demonstrate that the development provides a wider sustainability benefit to the community that outweighs flood risk
	Development should be on developable previously developed land. If not on previously developed land, demonstrate no other alternative sites exits
	FRA must demonstrates development will be safe, without increasing flood risk elsewhere

Implications of Climate Change

The climate change Flood Zone 2 and 3 outlines for the years 2026, 2080 and 2115 should be consulted when processing windfall site applications. The Environment Agency Flood Zones should be the first data set to review in the process, but this should be followed by the potential future extents as a site may currently be in Flood Zone 2 but based on the climate change predictions the site may be in Flood Zone 3 in 2080. The PPS25 Companion Guide (2008) recommends that climate change be considered up to the 100 year horizon for all residential developments unless it can be demonstrated that the development will have a lifespan of less than 100 years. As such the SFRA recommends that the LPA adopt a precautionary approach and consult the predicted 2115 Flood Zone 2 and 3 extents when determining if a FRA is required for a planning application. Consulting Figures 16a and 16b provide a District overview of the predicted climate change extents, but a more detailed assessment can be undertaken using the SFRA GIS layers.

The Flood Zones provided with the SFRA are the latest version dated February 2009. It should be remembered that the Environment Agency update the Flood Zone mapping on a quarterly basis, and it is recommended that they issue the updates to the Council to load onto the SFRA GIS database.

Drainage Implications

Figures 19 and 20 in Volume 2 provide an indication of the potential for surface water run off generation (and thus the potential risk associated with surface water run-on to a site) and an indication of the appropriateness of infiltration SuDS techniques. Section 5 of the SFRA details how these sections were undertaken and provides information, along with Appendix A, on how to assess the appropriateness of SuDS techniques. These factors should be addressed at the site specific Flood Risk Assessment (FRA) level, where an FRA is required. Table 1.1 identifies where PPS25 requires a FRA to be undertaken.

2. Planning Context

2.1 National Planning Policy

The SFRA has taken place when planning authorities have been implementing the provisions of the Planning and Compulsory Purchase Act 2004 and accompanying planning guidance, including PPS 1 (*Planning Policy Statement 1- Delivering Sustainable Development*) and PPS 12 (*Planning Policy Statement - Local Development Frameworks*). These affect all tiers of the planning system and have necessitated major changes at both the regional and local level which will impact on the way in which planned development is reflected in the regional strategy and delivered locally.

The Government has set in motion changes to the planning policy process, which will see the Local Plan replaced by a Local Development Framework (LDF). The LDF comprises a framework of documents including the Core Strategy, Development Plan Documents (DPDs), Site Specific Policies and Proposal Maps, Statements of Community Involvement and Supplementary Planning Documents. The SFRA will form part of the evidence base of the LDF.

Planning Policy Statement 25: Development and Flood Risk

This SFRA has been undertaken in accordance with the guidance provided in PPS25 (*Planning Policy Statement 25 – Development and Flood Risk*) and it's accompanying Practice Guide (*Development and Flood Risk – A Practice Guide Companion to PPS25 "Living Draft*). The aim of PPS25 is to ensure that flood risk is taken into account at a regional and local planning level to deliver sustainable development and to avoid inappropriate development in flood risk areas. Box 1 summarises the key planning objectives.

Central to the policy statement is a sequential risk-based approach to guide development into areas of lowest flood risk where possible, which should be applied at all levels of the planning process. The 'Sequential Test' in Annex D of PPS25 should be applied to show that no other suitable sites in lower flood risk areas are available when considering individual planning applications. PPS25 also sets out the need to consider other sources of flood risk (such as groundwater, overland flow and sewer) in addition to the main fluvial and tidal sources. The implications of climate change on flood risk also require consideration in the interest of sustainable development.

Box 1	**Summary of PPS25 Objectives**
The key planning objectives as stated in PPS25 are that: "Regional Planning Bodies (RPBs) and LPAs should prepare and implement planning strategies that help to deliver sustainable development by: • APPRAISING RISK *Identifying land at risk and the degree of risk of flooding from river, sea and other sources in their areas;* *Preparing Regional Flood Risk Assessments (RFRAs) or Strategic Flood Risk Assessments (SFRAs) as appropriate, as freestanding assessments that contribute to the Sustainability Appraisal of their plans;* • MANAGING RISK *Framing policies for the location of development which avoid flood risk to people and property where possible, and manage any residual risk, taking account of the impacts of climate change;* *Only permitting development in areas of flood risk when there are no reasonably available sites in areas of lower flood risk and benefits of the development outweigh the risks from flooding;* • REDUCING RISK *Safeguarding land from development that is required for current and future flood management e.g. conveyance and storage of flood water, and flood defences;* *Reducing flood risk to and from new development through location, layout and design, incorporating sustainable drainage systems (SuDS);* *Using opportunities offered by new development to reduce flood risk to reduce the causes and impacts of flooding e.g. surface water management plans; making the most of the benefits of green infrastructure for flood storage, conveyance and SuDS; re-creating functional floodplain; and setting back defences;* • A PARTNERSHIP APPROACH *Working effectively with the Environment Agency and other stakeholders to ensure that best use is made of their expertise and information so that decisions on planning applications can be delivered expeditiously; and Ensuring spatial planning supports flood risk management and emergency planning*.	

PPS25 introduces the Exception Test which allows some scope for departures from the sequential approach where it is necessary to meet the wider aims of sustainable development. The criteria for exception include where the development makes a positive contribution to sustainable communities or redevelopment of brownfield land. Exceptions can be permitted where it can be demonstrated that the residual flood risks are acceptable and satisfactorily managed.

The Town and Country Planning (Flooding) (England) Direction 2006 has made the Environment Agency a Statutory Consultee on all applications for development in flood risk areas, including areas with critical drainage problems and for developments exceeding 1 hectare outside of flood risk areas. After discussion with the Agency LPAs are required to notify the Secretary of State if they remain minded to approve a planning application contrary to a sustained objection from the Environment Agency.

This SFRA describes what land uses are permitted for each site based upon the vulnerability classification presented in Annex D of PPS25. However, it is not the intention of this SFRA to encourage the development in higher flood risk zones. It is considered that the most effective method of flood risk management is to avoid the risk. As such, it is recommended that sites in Flood Zone 1 be considered for development ahead of higher risk zones. The planning process will therefore be inline with the Sequential approach outlined by PPS25.

2.1.1 Planning Policy Statement 1: Delivering Sustainable Development

This document sets out the overarching planning policies for the delivery of sustainable development across the planning system. PPS 1 explicitly states that development plan policies should take account of flooding, including flood risk and proposes that new development in flood risk areas should be avoided. Planning authorities are also advised to ensure that developments are sustainable, durable and adaptable.

PPS 1 also places an emphasis on *spatial planning* in contrast to the more rigid *land use planning* approach which it supersedes. It will be important for the Core Strategies and accompanying supplementary planning documents, to recognise the contribution that non-structural measures can make to effective flood management.

2.2 Regional Planning Policy

South East Plan (2006 – draft)

At the time of publication of this SFRA, the South East Plan had yet to be officially approved, however the plan is well advanced in the planning policy process and it is anticipated that it will be published and adopted in Spring 2009. When approved, it will establish the level of housing provision to be made.

In June 2001 the South East England Regional Assembly published its strategy, entitled "A Better Quality of Life in the South-East", with a vision of a prosperous region delivering a high quality of life and environment for everyone, now and in the future.

Thanet lies within the East Kent and Ashford Sub-region, described in the South East Plan as playing a '*nationally significant role as a key gateway to mainland Europe*'. However the relative remoteness from London and the remainder of the south east means that this area includes some of the least economically buoyant areas. The plan recognises that all the urban areas require new employment and new dwellings, mainly concentrated in Ashford but in partnership with the coastal towns. In particular, deprived areas of Thanet require the delivery of affordable housing.

The Kent and Medway Structure Plan (KMSP – adopted 2006) will continue the general strategic approach to Thanet, and recognise the need to cater for development that will reduce the District's reliance on other centres for employment, retail and other economic and social needs.

Future Housing in the District of Thanet (Local Plan 2006)

Despite its location in the south-east of England and its attractive environment, Thanet has suffered from long-term economic and social problems. The Thanet District Adopted Local Plan (2006) Plan proposes a new approach that looks at Thanet as a single opportunity and not as a collection of individual towns and villages, which aims to promote necessary development that has not been previously recognised. The Plan is designed to give guidance for development to 2011 to accommodate needs for sustainable economic and other essential development whilst safeguarding and enhancing the built and natural environment. A subsequent Ministerial statement indicated that housing provisions should be made for the period up to 2016, therefore the Plan also anticipates the need to provide for a total of 6,000 new dwellings over the period 2001 – 2016. This will contribute towards the total of 48,000 new dwellings required across the East Kent and Ashford sub-region between 2006 and 2026. The emerging Local Development Framework (LDF) will provide opportunity to review housing land provisions in the longer term, taking account of housing requirements through the Structure Plan and Regional Spatial Strategy, looking ahead to 2021.

Thanet District Council's Corporate Plan (2007 – 2011)

Within Theme 1 (economy) of the Corporate Plan, the need to agree regeneration plans of the Dreamland and Arlington sites in Margate with the site owners is set out. Arlington is a major site on Margate's seafront and with appropriate development including a mix of uses will contribute to the retail and commercial redevelopment of the town. The Dreamland amusement park site is set back from the seafront in Margate and it is aimed to develop the centre for both visitors and residents to provide a structured link between the seafront and the town centre.

3. Level 1 SFRA - Overview of Flood Risks

3.1 Flood Risk Assessment Rationale

This SFRA defines the zones of flood risk to be used to inform the Council's site allocation process and for use in processing windfall site applications. The report presents a robust evidence base to support the application of the Sequential Test at both the District wide and area specific level. District wide flood risk zones were delineated and in the key urban areas the focus of the SFRA moved from a general discussion of the flood risk zones to a more detailed area specific delineation of flood risk thus enabling area specific recommendations to be made.

Site specific flood risk information is presented, made possible because Thanet District Council have prepared a large dataset of potential development sites. These were identified in the Regulation 25 (R25) public consultation and the H1 Housing Site Survey. These consist of sites put forward by landowners as potentially available for development (R25 sites), together with various other sites with existing permission or allocation (H1). Moreover, there is no possibility that all sites will necessarily be released for development. The sites addressed in this SFRA are therefore plots of land identified as having potential for development. It must be noted that the SFRA only addresses the suitability of the sites from a flood risk perspective. It will be for the Local Development Framework Process to determine which sites will ultimately be allocated/released for development. The SFRA includes information to enable sites other than those specifically addressed in the SFRA to be processed by the Council.

The two primary sources of flooding in the district are fluvial and tidal. The greatest amount of data also exists for these two sources. Flood risks from groundwater and surface water are considered to be less significant and as such are addressed in proportionately less detail. This section of the report provides an overview of the identified flood risk at the District wide level, Section 3.6 summarises the risks and ranks them according to the risk they pose.

3.2 Fluvial Flooding

When a river's discharge exceeds the capacity of the channel, out of bank flow occurs and the river's floodplain is inundated. Flooding is an important ecological and geomorphological process. Over centuries man's relationship with the floodplain has changed. It has evolved from one where the seasonal inundation and formation of transient wetlands instigated cyclic shifts in land use and agricultural practice. This relationship has evolved into one of constant struggle to control the forces of nature in order to make way for more sedentary and permanent uses of our rivers' floodplains. This shift in floodplain use has necessitated the need to develop an understanding of the floodplain dynamics and flood risks. Measures to avoid flood risk are currently superseding the older more reactive approaches to flood management which tended towards defending against an identified risk.

The River Great Stour's floodplain forms the western boundary of the District. This floodplain occupies the Wantsum channel, which is a broad low lying feature separating the *Isle* of Thanet from the rest of Kent.

Historically the Wantsum Channel was a tidal channel that totally separated the *Isle* of Thanet from the *mainland*. The Wantsum Channel is now protected by sea walls along its North Sea and English Channel boundaries and it is no longer flooded as part of the daily tidal cycles. Nonetheless there remains a tidal flood risk that results in the Wantsum Channel being defined as a zone of Fluvial/Tidal flood risk. The Environment Agency's Lower Stour Modelling project (2003)[2] produced a combined Fluvial/Tidal Flood Zone 3 extent for the Wantsum channel (refer to Box 2 Section 4.1) for definition of flood zones).

The Environment Agency does not hold any fluvial flood extents for any other part of the District. This is because there are no watercourses designated as Main River. The absence of surface water bodies in the District is a product of the Chalk geology and the relatively low groundwater levels within these strata (groundwater levels are discussed in Section 3.4).

3.3 Tidal Flooding

3.3.1 Overview

The delineation of the tidal flood risk zones is presented in Section 4. Tidal flooding results when the amplitude of the daily astronomical tides increases. The driver for such increases is meteorological conditions. Meteorologically induced sea level rise is the term used to describe the phenomena of deep low pressure weather systems causing the surface of the sea beneath the centre of the depression to dome upwards. The sea surface is raised because the centre of the deep low pressure system is applying less downward force on the sea surface than is being applied by the atmosphere outside the low pressure system. This *dome* of water advances with the progression of the storm and when the storm makes landfall so does the dome of water or 'storm surge'. If meteorological conditions coincide with astronomically controlled flood tides (Spring tides) then the resultant water level can be even higher and thus flooding can be even more extensive. One of the most notable examples of this type of flooding recorded in the UK was the 1953 event which caused destruction along the coasts of Norfolk, Essex, Kent and in the Thames Estuary.

3.3.2 Residual Tidal Flood Risk

In undefended tidal floodplains, the extreme tide levels resulting from a storm surge cause an increased landward progression of the flood tide. In defended areas, the land behind the defences is protected so long as the sea level remains below the level of the tide. Flooding occurs behind the defences when either the defences fail or if they are over topped. This risk is called the *residual flood risk* which exists despite the protection offered by the defences. The Thanet SFRA has focused on three areas of residual risk (Margate Old Town, Margate Dreamland and Birchington) and a detailed discussion of the modelling work is presented in Section 4. The tidal modelling

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[2] River Great Stour Catchment Flood Risk Mapping – Great Stour Report (November 2003) – *Project Ref: 10509/051*

undertaken for this SFRA has enabled Areas Benefiting from Defences (ABDs) to be defined. The results of this assessment are presented in Section 4.

3.3.3 Historic Flooding

On the night of 31 January 1953, the east coast of England suffered one of the worst floods in living memory and one of the biggest environmental disasters ever to have occurred in this country. Throughout the evening, freak winds and a swelling tide pushed the sea to dangerous levels. Flood defences were breached by huge waves and coastal towns in Lincolnshire, Norfolk, Suffolk, Essex and Kent were devastated as sea water rushed into the streets. Over 300 people lost their lives and over 24,000 houses were flooded. Around 40,000 people were evacuated from their homes. Many of these had to sit the night out on their rooftops, awaiting rescue by fire brigades, the police, military personnel and the RNLI. The subsequent clean up operations took weeks to complete at a huge cost. A map of the recorded extent of this flood event in Thanet District is shown in Figure 1 in Volume 2.

3.4 Groundwater Flooding

The Environment Agency does not consider the District of Thanet to be in a zone of strategic groundwater flood risk. Although the District predominantly overlies a chalk aquifer, ground elevations are generally high and so the water table is at significant depths from the surface. Figure 3 in Volume 2 presents an extract of the Environment Agency’s dataset of the groundwater contours in the Kent and Sussex Chalk formation. These contours were interpolated from recordings taken in the wet winter 2001.

The Environment Agency holds a database of groundwater flooding incidents. This database is not a comprehensive account of all incidents of groundwater flooding as it requires each event being reported. It does however contain six recorded events in the District of Thanet. Figure 4 in Volume 2 illustrates the location of these incidents and identifies the date when each occurred. Five of the six points are located over the Thanet Sand Formations. The recorded basement flooding was attributed to rising water levels in Head Deposits[3] which are found over the Thanet Sand Formations. Six points are not considered sufficient for the formation of District wide conclusions; however it does appear that elevations across the majority of the District are sufficiently high to remain above the water table in the chalk and that flooding only occurs in perched deposits which are sufficiently thin to become saturated and cause groundwater levels to rise.

[3] Head Deposit = the term used to describe Quaternary (last 10,000 years) deposits weathered from surrounded parent rock material.

3.5 Surface Water Flooding

Surface water flooding occurs when drainage systems become blocked or exceed capacity during excessive rainfall, or when the rainfall intensity is greater than the infiltration rate of the soils. Therefore the only route for rainwater to take is over the surface. Incidents are usually isolated and difficult to predict owing to the complex interaction of local infrastructure and circumstance, the impacts of which are often localised with potentially only low flood depths being attained. There is a likelihood of overland flow from one area of ponded surface water towards local low points in the topography, which is typically the river channel.

Surface water flooding has been linked to some of the flooded properties in the District. It is not clear whether these events were caused by water not being able to enter the drainage network or by surface water that is yet to reach the catchments of the local drainage network. The list below presents the locations where the council have recorded surface water related flooding issues:

- Fleet Road (Cliffs End, Ramsgate);
- Nash Lane (Margate/Broadstairs);
- Ebbsfleet Lane (Ramsgate);
- Watchester Lane (Minster).

Southern Water is reportedly investing £1m into a scheme to manage the flood risk from its infrastructure at Watchester Lane.

The localised and site specific nature of these flooding incidents does not lend them to being assessed at the strategic level. Section 5 of the report discusses surface drainage and surface runoff in more detail. A discussion of mitigation and management techniques that will potentially reduce the risk of surface water flooding for new developments is presented in Section 9.

The occurrence of flooding generated by insufficient capacity of the drainage system is related to the probability of a given rainfall event over a given area. The likelihood of flooding is dependant on the condition of the surface drainage network, as well as the rates of surface water run off generation. The likelihood of flooding may change over time; due to increases in development, changes in impermeable area and climate change. As a result, flooding related to surface drainage may become more frequent in the future. Every new development proposal[4] must include an FRA inclusive of a consideration of surface water drainage and measures to mitigate against any potential increase run off.

[4] PPS25 requires a FRA if the site is within Flood Zones 2 or 3 or if it has an area of more than 1 hectare.

3.6 Summary of Flood Risks

A risk matrix is used to combine the assessment of probability and consequence into an indicative risk level for each flooding source. In order to categorise the qualitative likelihood (probability), terminology from a paper presented at the 2004 DEFRA Flood and Coastal Management Conference was used and adapted for this specific case[5]. This terminology is defined in Table 3.1.

Table 3.1 Definitions of Qualitative Flooding Probability Categories

Qualitative Probability Category	Definition
Likely	Events of common occurrence that an individual may experience a few times in their lifetime. This corresponds approximately to an annual probability of 10% - 4% (i.e. return periods of between 10 and 25 years)
Infrequent	Events that an individual may experience once in a lifetime, approximately equivalent to the 1% annual probability event (i.e. return period of 1 in 100 years)
Possible	Events that may be seen once in every few lifetimes. These correspond to approximately a 0.1% annual probability (1 in 1000 year event). This category may also include the combination of an infrequent event (1% annual probability) in combination with a failure of flood defences designed to protect against such an event.
Remote	Events that are of a low order of likelihood (approximately 0.1% annual probability), but combined with a failure of flood defences designed to protect against such an event.
Very Remote	Extreme flood events with an annual probability of less than 0.1%.

Standard qualitative definitions of flooding consequences are also used to derive an indicative level of flood risk. These define consequence in terms of potential damage to property, flood depths and velocities, and risks of injury or loss of life. These definitions are presented in Table 3.2.

Table 3.2 Definitions of Qualitative Flooding Consequence Categories

Qualitative Consequence Category	Definition
High	Serious damage to property and high risk of injury and loss of life. High depths of floodwater (>1m) and high flood flow velocities
Medium	Moderate damage to property, moderate flood depths (<1m) and flow velocities. Some risk of injury.
Low	Minor damage to property, low depths of floodwater (<0.5m) and low flow velocities. Minor risk of injury
Negligible	No damage to property or risk of injury

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[5] Hother, J., *Applying Reliability Risk Analysis to Flood Risk Management*, 39th DEFRA Flood and Coastal Management Conference, 2004.

The Probability and Consequence categories are combined in a risk matrix to determine the level of risk (risk = probability x consequence). The risk matrix used for this study is presented in Table 3.3.

Table 3.3 Risk Matrix

		Likelihood (probability)				
		Likely	**Infrequent**	**Possible**	**Remote**	**Very Remote**
Consequence	**High**	Very High	Very High	High	High	High
	Medium	High	High	Medium	Medium	Medium
	Low	Medium	Medium	Low	Low	Negligible
	Negligible	Low	Negligible	Negligible	Negligible	Negligible

Table 3.4summarises the flood risks identified in Thanet and based on the likelihood and consequence assessments, provides a risk classification.

Table 3.4 Summary of Flood Risks in Thanet

Source of Flooding	Area at Risk	Risk
Tidal	All coastal areas	Very High
Fluvial	Low lying areas in the Wantsum Channel	High
Surface water	All areas, especially local topographic depressions	Low
Groundwater	The low lying areas in the Wantsum Channel and the areas of perched Head Deposits over Thanet Sand Formations.	Negligible

4. Level 1 SFRA - Definition of Flood Risk Zones

4.1 Overview of Flood Zones

Flood Zones are described throughout this SFRA and they refer to flood extent datasets held by the Environment Agency. The Flood Maps are the successor to the Indicative Flood Plain Map (IFM) and have been in the public domain in their current format since October 7th 2004. Since their initial publication the Agency has worked with consultants to refine these maps through the commissioning of detailed hydraulic modelling projects. Updates to the published datasets are made on a quarterly basis. Box 2 outlines the different Environment Agency Flood Zones.

Box 2 Introduction to the Environment Agency's Flood Zones

Flood Zone 1

This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%)

Flood Zone 2

This zone comprises land assessed as having a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% - 0.1%) in any year.

Flood Zone 3a

This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.

Flood Zone 3b

This zone comprises land where water has to flow or be stored in times of flood. This Flood Zone is land which would flood with an annual probability of 1 in 20 (5%) or greater in any year.

Additional Information

- The Flood Zones are mapped using a 'no defences' scenario which has necessitated areas of floodplain know to be defended to be identified on the Flood Map as benefiting from defences.
- The Flood Zone extents, regardless of whether the area benefits from a defence, are used to determine when Flood Risk Assessments are required to support a planning application.

The Environment Agency Flood Zones 2 and 3 are presented in Figure 2 in Volume 2.

4.1.1 Flood Zones, PPS25 and the SFRA Process

The Flood Zones are spatial datasets indicating the area of land likely to be inundated in the event of an extreme flooding event with a given probability of occurrence. The four zones described in Box 2 are listed in order of decreasing extent but of increasing probability of occurrence. PPS25 defines development types on a basis of vulnerability to flooding. The aim of PPS25 is that the most vulnerable development types should be located in the lowest flood risk zones. Vulnerability classifications are specified in Table D2 – Annex D PPS25. The alignment of vulnerability and risk is detailed in Table D3 – Annex D PPS25. For ease of reference, Annex D of PPS25, including tables; D1 *Flood Zones*; D2 *Flood Risk Vulnerability Classification* and; D3 *Flood Risk Vulnerability* *and Flood Zone 'Compatibility'* are reproduced in Appendix B of this report. It is advised to reference the notes attached to Table D2 in Appendix B. Despite a potential development being able to *tick* the appropriateness of use in a particular Flood Zone, available areas of lower flood risk should be encouraged for consideration in preference.

Landuse Vulnerabilities and Flood Zones

Flood Zone 1

PPS25 states that all uses of land are appropriate in this zone.

Flood Zone 2

The appropriate uses of land specified by PPS25 for this zone include, water-compatible, less vulnerable, more vulnerable and essential infrastructure. The vulnerability classifications are detailed in Table D2 of Annex D – PPS25 which is reproduced in Appendix B. Highly vulnerable uses of land are only appropriate in this zone subject to the Sequential Test, which is detailed in Section 0, being passed and only if the Exception Test is passed.

Flood Zone 3a

PPS25 states that water–compatible and less vulnerable uses of land (as defined in Table D2 of Annex D PPS25, see Appendix B) are appropriate in this zone. The more vulnerable and essential infrastructure uses in Table D2 should only be permitted in this zone if the Exception Test is passed. Essential infrastructure permitted in this zone should be designed and constructed to remain operational and safe for users in times of flood.

Flood Zone 3b (Functional Floodplain)

This zone comprises land where water has to flow or be stored in times of flood; SRFAs should identify this Flood Zone (land which would flood with an annual probability 1 in 20 (5%). PPS25 states that only water compatible uses and the essential infrastructure listed in Table D2 that has to be there should be permitted in this zone. No Functional Floodplain has been identified in the District of Thanet.

4.2 TuFLOW Modelling in Margate and Birchington

This section of the SFRA addresses the requirements of Paragraph E.6 in PPS25 which involves the increased scope of addressing the role of flood defence infrastructure. Section 4.2.1 discusses the revision of the Flood Zone Extents, Section 4.2.2 discusses the nature of the residual risk that exists behind the defences to inform the Exception Test and Section 4.2.3 presents a discussion of the performance of the defences by identifying the areas benefiting from the defences.

The Environment Agency and the Council viewed the SFRA as an opportunity to refine the extent of the flood zones in Margate and Birchington. Detailed TuFLOW modelling was undertaken in accordance with the Environment Agency's guidance on mapping Flood Zones. The modelling has been approved by the Environment

Agency. TuFLOW is a fully 2-dimensional hydrodynamic flood modelling software package and was used to simulate overtopping scenarios. Several scenarios were modelled at two locations detailed in Table 4.1. A ‘with defences’ and a ‘without defences’ scenario was run at each location for both the 1 in 1000 year (equivalent to the Environment Agency’s Flood Zone 2) and 1 in 200 year (equivalent to the Environment Agency’s Flood Zone 3) tidal events. To produce Flood Zones, the present day predictions of tide levels had to be used (the year 2010 was used) and to simulate the potential impact of climate change, the 2115 predicted levels were also simulated. A full description of the modelling process, the input data, formulation of tidal hydrographs and the modelling assumptions made can be found in Volume 3

The TuFLOW modelling was undertaken to provide revised Flood Zone extents. Environment Agency Flood Zone mapping involves the simulation of tidal inundation (flat sea levels) and not the impact of wind and waves. This approach has limitations, but has been used for the Thanet SFRA to follow this standard approach used by the Environment Agency.

Table 4.1 Details of the Modelling Scenarios Undertaken in this SFRA

Location	Defences in the Model	Return Period (years)	Year of Simulation	Figure Number of Mapped Output in Volume 3
Margate	No	1000	2115	1
	No*	1000	2010	2
	No	200	2115	3
	No*	200	2010	4
	Yes	1000	2115	5
	Yes	1000	2010	6
	Yes	200	2115	7
	Yes	200	2010	8
Birchington	No	1000	2115	9
	No*	1000	2010	10
	No	200	2115	11
	No*	200	2010	12
	Yes	1000	2115	13
	Yes	1000	2010	14
	Yes	200	2115	15
	Yes	200	2010	16

* Denotes the model simulations used to define the revised Flood Zone 2 and 3 extents.

4.2.1 Undefended Scenarios (The Flood Zones)

The undefended scenarios have been agreed with the Environment Agency to provide revised Flood Zone 2 and 3 extents. These are the outlines that have been used to define the flood risk to the potential development sites and they are the Flood Zone Extents that local authorities should use when undertaking the Sequential Test. The revised Flood Zones in Margate are presented in Figures 7 and 8 and the revised Flood Zones in Birchington are presented in Figures 11 and 12 in Volume 2. The Flood Zone modelling does not account for climate change; it represents the present day conditions. For the purposes of this SFRA 2010 has been used as the present day. The modelling accounts for the surge effect but it does not account for wind and wave action. Throughout the following sections, these remodelled Flood Zones are referred to as *'revised Flood Zone 2'* and *'revised Flood Zone* 3' to distinguish between Flood Zones modelled for this SFRA that have not yet been formally accepted by the Environment Agency and those existing on the Environment Agency's Flood Map.

Margate

Flood Zone 2

The TuFLOW modelling has revealed that the extent of the revised Flood Zone 2 in the Old Town and Dreamland is significantly less than the existing Environment Agency Flood Zones. The existing Flood Zones in Margate are the product of anecdotal evidence gathered after the 1953 event. When the data was recorded there could have been some uncertainty as to whether all the flooding was from the sea or if some flooding was the product of blocked drains and surface water flooding. Part of the difference could also be the result of the fact that the configuration of the Tivoli Brook was different in 1953 (i.e. the outlet was in a different location and it is understood that there was no closure flap at the end of the pipe).

The flooding extent at Dreamland from the 1957 outline is very extensive, significantly more so than the revised Flood Zone 2 in 2010 (without defences). This is primarily because the revised modelling does not show overtopping of the defences. To ensure that all possible flow routes were accounted for a 1-Dimentional (1-D) pipe network model of the Tivoli Brook was incorporated into the model to account for potential backflow of sea water up the pipe network into the Dreamland site. In the model, the Tivoli Brook pipe network had to be simplified as the survey of the pipe network, made available to the SFRA, was incomplete. The pipe network was modelled as a flat system (all pipes at the same level as the outfall on Margate Beach) and used the largest measured pipe dimensions throughout. This is a conservative approach to produce the maximum amount of potential flooding. Full details of the 1-D network model can be found in Volume 3.

Flood Zone 3

The revised Flood Zone 3 extent in the year 2010 (undefended scenario) in both the Old Town and Dreamland is also less extensive than the existing Environment Agency Flood Zones. The Dreamland revised Flood Zone 3 extent is very similar to the revised Flood Zone 2 extent as it is only a product of flooding from the pipe network. No overtopping of the Dreamland defences occurs. There is a marked difference between the revised Flood Zones 2 and 3 extents in the Old Town with the revised Flood Zone 3 being considerably smaller.

Birchington

Flood Zone 2

In the revised Flood Zone 2 only a small amount of flooding occurs in the vicinity of the water front play area. The flooding occurs because for a very short period at the peak of the surge the water level is *c*.0.1m higher than the sea wall (minus defence). This constitutes a small increase in the extent of the Environment Agency's Flood Zone 2.

Flood Zone 3

No flooding was produced during the simulation of the revised Flood Zone 3 in Birchington. This is because the top of the sea wall is higher than the peak of the 1 in 200 tide level. There is no revised Flood Zone 3 in Birchington; the existing Environment Agency's Flood Zone 3 extent in Birchington has thus not been altered.

4.2.2 Defended Scenarios (Residual Risk)

Residual flood risk is that which exists despite the presence of the flood defences. A flood defence reduces the risk to a site, but it does not totally remove the flood risk as the defence can fail in one of two ways, 1) it can structurally fail (defence breach), or 2) it can be a failure of the design standard (defence overtopping). Even in the event of a defence failing, the structure can, in some circumstances, reduce the risk from what it would have been had the structure not been there at all. The extent to which this occurs is largely due to the area of the floodplain that a defence structure is protecting. The risk reducing effect is greater when the area being defended is large. The principal is outlined in Box 3.

Box 3 Definition of Residual and Actual Flood Risk

Actual Flood Risk (Tidal)

In the event of a storm surge in an undefended situation, the water level seaward of the mean high water and the water level landward of the mean high water mark are more or less the same.

Residual Flood Risk (Tidal)

If the same tidal surge were to occur in the same location after flood defences had been constructed then the resultant pattern of flooding would be different. Firstly, if the storm surge was below the crest level of the defence then flooding would only occur if the defences failed. The other mechanism for flooding is if a tidal surge occurs which is higher than the crest level of the defences. In either of these two scenarios water would flow into the defended floodplain. The extent and water surface level of the resultant flood water behind the defences is a factor of the size of the floodplain and the volume of water that is able to pass through/over the defences. If sufficient water can pass through/over the defence line during one tidal cycle then the water level at both sides of the defence will be more or less the same. In these circumstances the extent of flooding is the same as if there were no defences. This is more likely to occur when the floodplain is small.

When the floodplain is large and insufficient volumes of water passes through/over the defence in one tidal cycle to result in equal water surface levels both sides of the defence line, the flood depths and extents behind the defences are reduced. This reduced risk, associated with the defences is the Residual Risk.

This represents a gross simplification of reality. It is intended to provide an appreciation for the role played by flood defences. This interpretation is only valid for tidal flooding and is not transferable to rivers as there is a finite volume of water in a fluvial system.

It was agreed with the Environment Agency that the failure of the Margate and Birchington defences was not a realistic scenario as there was no mechanism for this to occur. The risk associated with the defences being over topped was therefore agreed to be the most appropriate means of assessing residual risk. In Margate the road which runs at the back of the beach (Marine Terrace and The Parade) is not classed as a defence. It may act as a defence, but it is only the concrete flood wall that was placed on top of this (post 1953) which is classed as the defence. The same applies in Birchington.

Margate

The modelled residual flood risk in Margate is presented in Figure 9 in Volume 2. When the defences are modelled there is no flooding in the Old Town, during the 1 in 200 and 1 in 1000 year events (present day 2010). This is because the predicted water levels are below the defence crest line. It must be noted that the difference between the 1 in 1000 year level in 2010 and the crest of the defence is only 0.08m with the defence crest at its lowest being 4.9m AOD and the tide at its highest being 4.82m AOD. The modelling does not account for the action of wind and waves which, despite the sheltered harbour location, would most likely cause water to pass over the defences. At the Dreamland site there is flooding during the 1 in 200 and 1 in 1000 year scenarios (with defences). This flooding is not a result of over topping but rather a product of the water backing up Tivoli Brook and flowing out of manhole covers.

The entire revised Flood Zone 2 extent modelled in this SFRA (without defences) is the zone of residual risk as this is the zone where the defences reduce the risk of flooding.

Birchington

The sea defences at Birchington are sufficiently high to prevent flooding under present day conditions (2010) in the event of the 1 in 200 and 1 in 1000 year tidal surges events. It must be noted that the modelling did not account for the action of wind and waves which are likely to cause localised flooding behind the defences. The sea defences have been surveyed as being around 5.6m AOD and the 1 in 1000 year peak tide in 2010 is 4.8m AOD.

The undefended scenario modelling highlighted a small area of the sea front which flooded during the 1 in 1000 year event. Birchington's flood defences prevent this flooding therefore this extent of flooding is considered to be a zone of residual risk (see Figure 12 in Volume 2).

4.2.3 Areas Benefiting from Defences

Understanding the role of flood defences in coastal towns is very important, not only for informing planning decisions but for existing development. The Areas Benefiting from Defences (ABDs) are those areas which benefit from the protection of a flood defence and would flood if defences weren't present. The ABDs in Margate are illustrated in Figure 10 and in Birchington in Figure 14 (in Volume 2).

Margate

Under present day conditions, all of the revised Flood Zones 2 and 3 in the Old Town are considered to be ABDs as they do not flood when the defences are simulated in the modelling. In the Dreamland area, the sea defences do not have any influence as the flooding is related to the culverted Tivoli Brook. No ABDs in Dreamland have been defined.

Birchington

Under present day conditions there is no flooding during the 1 in 200 year event with or without defences. There is however a small area of the revised Flood Zone 2, which does not flood during the defended scenario. This is therefore classified as an ABD.

4.3 Wave Overtopping

This SFRA provides information relating to tidal flooding based upon still water flood levels. No assessment has been made of the potential for flooding as a result of wave overtopping.

Figure 42 indicates Areas at Risk from Other Sources of Flooding – Wave Overtopping. These are areas most likely to be vulnerable to wave action overtopping as a result of their proximity to the coast and height above sea level. Irrespective of whether a Flood Risk Assessment is otherwise required applicants proposing development within such areas shall be required to carry out a site specific Flood Risk Assessment to model the impact of wave and wind action upon those sites and assess the suitability of the site for development based upon that modelling.

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5. Level 1 SFRA – Surface Water and Drainage Assessment

5.1 Introduction

This section reviews the potential for surface water flooding across the district, which is typically caused by exceedance of surface water drains following heavy rainfall events. The nature of surface water flooding generally results in flood events in built up areas and is therefore often referred to as *urban flooding.* Recommendations on how to reduce the potential for such flooding and an assessment of ground conditions for natural drainage are presented below.

5.2 Surface Water Flooding

Historically developments have used piped drainage systems to convey surface water away from development into rivers and sewage systems as quickly as possible. These systems have the potential to cause flooding problems as rivers receive peak flows at a faster rate than in the natural setting. Furthermore, the capacities of piped drainage systems are not enlarged in parallel with increasing rates of development so that the potential risk of urban flooding also increases. In many areas, drains are designed for both surface water and foul water, and should these reach capacity ahead of heavy rainstorms, the risk of sewage flooding can be high. The introduction of impermeable surfaces such as roofs, roads and parking areas associated with new developments therefore have the potential to increase surface water runoff compared with the natural undeveloped surfaces and also may reduce the natural recharge of groundwater.

Records of surface water related floods are presented in Section 3.5, involving two areas in Ramsgate, one in Margate/Broadstairs and one in Minster. Such records are not widely available due to the sensitive nature of the information. Investment into the infrastructure in Minster is reportedly taking place to manage flood risk in this area.

For these reasons, surface runoff is an important consideration in the assessment of flood risk. PPS25 states that post development rates of runoff must not exceed pre-development runoff rates and those developments greater than 1 hectare must undertake a Drainage Assessment to demonstrate that it will not result in urban flooding. It promotes the use of Sustainable Drainage Systems (SuDS) that mimic natural drainage processes, thereby reducing the peak flow rates and volumes from developments. SuDS do this by controlling runoff at source, improving water quality by removing pollutants prior to discharge off site, encouraging groundwater recharge, enhancing the amenity value of a development and integrating with the environmental surroundings.

In addition, site specific FRAs should consider the flood risk associated with surface water run-on. That being surface water that is generated off site and has the potential to run on to a site and result in flooding.

5.3 Sustainable Drainage Systems

SuDS are designed to reduce the potential impact of new and existing developments with respect to surface water drainage by using more natural processes to convey surface water away from development. Many SuDS techniques rely on infiltration of the collected surface water runoff into the ground. Filter strips, soakaways, swales, infiltration basins and wetlands are examples of SuDS techniques at all scales that use infiltration to manage surface water. SuDS are not limited to infiltration. Green roofs, rainwater harvesting, wetlands and detention basins are examples of non-infiltration techniques, although the scope and impact of these are far more limited without infiltration. Often referred to as attenuation techniques, these examples reduce the rate of surface water runoff by holding back peak flows.

The suitability of SuDS for use on potential development sites should be based on an assessment of the following key influences put forward by CIRIA (2007)[6]:

- **Land use characteristics** – favour different SuDS techniques. For example, industrial sites where pollution is an issue are best managed with attenuation SuDS over infiltration SuDS, with multiple treatment stages;
- **Site characteristics** – soils, topography, depth to groundwater, and land availability all influence the choice of SuDS;
- **Catchment characteristics** – may have a bearing of the choice of SuDS, as particular catchments may be regulated for sensitivity to flooding or pollution and may potentially be aggravated by one SuDS technique compared to another;
- **Quantity and quality performance** – would guide the choice of a particular SuDS technique and is dependant upon the design requirements;
- **Amenity and environmental requirements** – flood risk mitigation is the primary aim and when satisfied, options to add ecological value could be considered.

Land use is considered to be a dominant factor, as it influences the volume of water required to be attenuated, the likelihood of pollution and contaminants and the potential for infiltration to occur. Indications of the most suitable techniques for each site cannot be made as part of a strategic level assessment. Site specific Flood Risk Assessments and Drainage Assessments will provide the required recommendations. Therefore the applicability of SuDS techniques in the SFRA can only be assessed through the consideration of regional characteristics relating to the hydrology and geology. Table A1 (in Appendix A) CIRIA (2007) provides a summary of influential site characteristics which should be assessed at the site specific level.

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[6] The Construction Industry Research and Information Association (CIRIA) *The SuDS Manual - CIRIA Report C697* (2007) CIRIA London, UK

5.3.1 Potential for Infiltration SuDS

A high level review of the infiltration potential of soils across the district is presented within this section. This method provides an indication of the potential for infiltration techniques, which is given priority over drainage to watercourses and sewers, as set out in the Building Regulations 2000 and reinforced in PPS25 (paragraph F8). In addition to the capability of soils, the sensitivity of the groundwater environment can also be assessed district wide, and is presented below. It should be noted that without knowledge of site specific soil types and depths, it is not possible to fully assess the infiltration potential, and a more detailed review of the soils will be required at a site specific level to determine the potential for use of infiltration techniques.

Infiltration Potential

The Environment Agency holds maps showing groundwater vulnerability that classify the 'leaching potential' of soils at a national scale into high, intermediate and low. This classification described the ability of soils to transmit liquid discharges and pollutants to the groundwater, and can be used as an indication of infiltration capacity. The coverage of groundwater vulnerability across the District is presented in Figure 5 in Volume 2.

The groundwater vulnerability map also classifies the underlying geology into aquifer types, which indicates the ability of the underlying strata to absorb water infiltrating from the overlying soil layer. As such, the underlying aquifer type (and its permeability) may limit the infiltration potential and thus the applicability of infiltration SuDS. Three aquifer types exist as defined by the Groundwater Vulnerability map (NRF, 1995):

- Major Aquifers (Highly Permeable);
- Minor Aquifers (Variably Permeable); and
- Non-Aquifers (Negligibly Permeable).

A matrix relating soil infiltration (leaching) potential and aquifer type (permeability) to SuDS infiltration potential is presented in Table 5.1. Those areas classified as '*Non_Aquifer*' by the Groundwater Vulnerability map have no soils information and therefore have been classified as having a Low Infiltration Potential.

Table 5.1 Infiltration Potential Derived from Aquifer Vulnerability Classification

Aquifer Type Soil Leaching Potential	Description	Infiltration Potential
Non_Aquifer	Regarded as containing insignificant quantities of groundwater. No soils data.	Low
Minor_Low	Variably permeable groundwater with low leaching potential	Low
Minor_Intermediate	Variably permeable groundwater with intermediate leaching potential	Low

Table 5.1 (continued) Infiltration Potential Derived from Aquifer Vulnerability Classification

Aquifer Type Soil Leaching Potential	Description	Infiltration Potential
Major_Low	Highly permeable groundwater with low leaching potential	Low
Minor_High	Variably permeable groundwater high leaching potential	Medium
Major_Intermediate	Highly permeable groundwater with intermediate leaching potential	Medium
Major_High	Highly permeable groundwater with high leaching potential	High

For all sites in the Attribute Database, an infiltration potential has been assigned. Figure 17 (in Volume 2) will potentially be of use when processing windfall sites.

Groundwater Vulnerability

To protect the groundwater resource that contributes to public water supply abstractions, three levels of Source Protection Zones (SPZ) are delineated around groundwater abstractions (Figure 6, Volume 2). Each of these zones has different requirements for the quality of the water that can be discharged to it and consequently the types of development from which runoff may infiltrate. Table 5.2 shows the development types that are permissible in each zone and the techniques required to control pollution before it is discharged, based on recommendations from the CIRIA Report 156 Infiltration Techniques (1996).

Table 5.2 Recommended discharges for Source Protection Zones

Impermeable Area	Zone I (Inner Zone)	Zone II (Outer Zone)	Zone III (Total Catchment)
Roof Drainage	No objection (provided for sole use of roof drainage)	No objection	No objection
Public/Amenity	Not acceptable	Acceptable	Acceptable
Large Car Parks	Not acceptable	Acceptable (with interceptor)	Acceptable (with interceptor)
Lorry Parks	Not acceptable	Presumption Against	Acceptable (with interceptor)
Garage Forecourts	Not acceptable	Presumption Against	Acceptable (with interceptor)
Major Roads	Not acceptable	Presumption Against. Acceptable only in exceptional circumstances	Acceptable only if investigation favourable and with adequate precautions
Industrial Sites	No objection	Presumption Against	Acceptable only if investigation favourable and with adequate precautions

Suitability of Infiltration SuDS

For the majority of the town centre sites, there is limited information on the opportunity for the incorporation of integrated SuDS techniques. This is because urban areas on the groundwater vulnerability map do not have soils classifications. Furthermore, integrated drainage systems, which provide an overarching site drainage strategy, require variations in site elevations and suitable land availability. On reviewing publicly available web-based data, the soils across the District are indicated as being freely draining loam soils overlying Chalk, which suggests that with the approval of other considerations such as land availability, infiltration SuDS are likely to be applicable. This is reflected in the central areas of the District where groundwater vulnerability information classifies the infiltration potential as Medium. Techniques such as permeable paving, swales, soakaways and infiltration basins should be considered where possible.

Figure A1 in Appendix A, outlines how individual SuDS techniques can be integrated to provide effective solutions for larger sites. Owing to the SPZ designations in the centre of the District, it is likely that infiltration techniques which discharge to groundwater will require specific consideration to be appropriate in some of these zones, with a multi-tiered level of treatment possibly required. Solutions that attenuate runoff and discharge to surface water are likely to be the most appropriate techniques for the Inner SPZs. Such schemes will require consultation with the sewage undertaker (Southern Water) to determine discharge rates and with the Environment. Ground surveys should be undertaken to establish the infiltration rates of soils and to determine if there are any land contamination issues which need to be addressed. Contaminated land impacts the nature of suitable SuDS techniques.

PPS25 requires surface runoff to not be increased post development. For most of the sites, which are already intensely developed, the required attenuation volumes will be small. Nonetheless Thanet District Council and the Environment Agency want to achieve additional reductions in runoff wherever possible. Rainwater butts and green roofing are techniques which can be incorporated into designs where space is limited.

This section provides an introduction to SuDS and the considerations required for implementation in relation to the general characteristics of Thanet District. Detailed site investigations are required for each development to assess the suitability of SuDS. It is recommended that where possible, SuDS techniques should be used for all developments.

5.3.2 Potential for Surface Water Runoff

Where ground conditions allow infiltration to occur, the natural permeability results in reduced ponding, sheet flow and runoff across surfaces and generally river flows in Chalk areas are small. Conversely, an area where infiltration potential is low provide indication that runoff is likely to occur in greater proportion. To determine where runoff potential is high, therefore, the infiltration potential as classified from the groundwater vulnerability map has been reversed and is presented in Figure 20 (Volume 2). Table 5.3 presents how the classifications have been derived.

Table 5.3 Runoff Potential Derived from Aquifer Vulnerability Classification

Aquifer Type_Soil Leaching Potential	Description	Runoff Potential
Non_Aquifer	Regarded as containing insignificant quantities of groundwater. No soils data.	High
Minor_Low	Variably permeable groundwater with low leaching potential	High
Minor_Intermediate	Variably permeable groundwater with intermediate leaching potential	High
Major_Low	Highly permeable groundwater with low leaching potential	High
Minor_High	Variably permeable groundwater high leaching potential	Medium
Major_Intermediate	Highly permeable groundwater with intermediate leaching potential	Medium
Major_High	Highly permeable groundwater with high leaching potential	Low

For all sites in the Attribute Database, a runoff potential has been assigned.

The preliminary categorisation of runoff potential can be used as a guide to inform subsequent site specific FRA's and to indicate where surface water flooding may be considered to be more likely. At the strategic level a simplified qualitative assessment was considered appropriate as any subsequent FRA's will have to provide drainage assessments to calculate the runoff rates and required attenuation to limit runoff from the site.

5.4 Drainage Requirements and Policy Recommendations

The reader is asked to refer to Section 9.2.2.

6. Level 1 SFRA – District Wide Climate Change and Tide Levels

6.1 Rationale for Inclusion in the SFRA

Climate change is frequently cited as being one of the most significant threats to the long term sustainability of our environment. A fluctuating climate is not a modern phenomenon. It is well documented that the earth's climate has been through a repeating cycle of warmer (interglacial) and colder (glacial) periods for the last 2 million years. Climatic records indicate that there has been a huge transition in the climate over the last 10,000 years (a period of time known as the Holocene) following the end of the last glacial period.

Despite an element of disagreement about the precise impacts of climate change on the environment within academic debates, it is widely accepted that the climate in Northern Europe is becoming warmer and there is little evidence to suggest this trend will not continue. It is essential that the likely impact of climate change on the extent of the future Flood Zones is considered if development is to be sustainable over the long term. Thanet District is relatively unique in the UK in that it is surrounded by tidal Flood Zones, thus making the issue of sea level rise one of critical concern.

PPS25 and DEFRA Guidance

DEFRA stated in October 2006 in their '*Supplementary Note to Operating Authorities – Climate Change Impacts*' that climate change impacts on flooding are a challenge to Local Authorities. The impacts are stated to include sea level rise and the potential increase in intensity and frequency of coastal storms. It is also predicted that rainfall events affecting flooding in fluvial catchments and urban surface water systems will increase in regularity and intensity. DEFRA's October 2006 supplementary note to Operating Authorities is designed to support the publication of PPS25 and states that; DEFRA's response to climate change impacts is to promote policy guidance based on appropriately precautionary allowances and sensitivity testing to enable Operating Authorities to take climate change impacts into account in planning appraisal, decision making and operations.

Sustainability Implications

The revised Flood Zones 2 and 3 extents for the present day are critical to the site allocation process, but a view as to how these extents may change in the future is of importance. PPS25 (Paragraph B10) notes that the implications of climate change could mean that a site currently located within a lower risk zone could be reclassified as lying within a higher risk zone at some point in the future.

6.2 Impact of Climate Change on the Coastal Domain

The extensive tidal Flood Zones and the perceived risk posed by sea level rise necessitated the need to carry out detailed tidal climate change modelling for the whole District. The methodology adopted is detailed in Section 6.2.1.

6.2.1 Approach and Methodology

The tidal Flood Zone polygons for the SFRA were derived by projecting an extreme sea level onto a digital terrain model (DTM). The DTM used for this original mapping was Interferometric Synthetic Aparture Radar (IfSAR) data. Higher resolution more accurate Light Detecting and Ranging (LiDAR) data is held by the Environment Agency for the whole of the District coastline and so was used in the modelling process for this SFRA. LiDAR topographic data is known by the Agency to produce flood outlines of a superior quality to those produced from using IfSAR.

The extreme sea level values used in the Environment Agency's original flood mapping project have also been superseded in the SFRA's coastal modelling. The coastline of the District was subdivided into two coastal zones (see Figure 15 in Volume 2). These zones are based upon the location of tidal gauges used in the 'Extreme Sea Level Report'[7]. Each coastal zone was attributed with the 1 in 1000 and 1 in 200 predicted tide levels for the years 2005 (present day), 2026 (LDF term length), 2080 (indicative lifespan of commercial landuses) and 2115 (DEFRA's climate change prediction limit – a conservative approach for the 100 year climate change consideration advocated by PPS25). The levels were calculated by using the Extreme Sea Level Report (to obtain base sea levels) and PPS25 was used to calculate the impact of climate change. The net sea level rise allowances incorporate thermal expansion of the oceans; melt from ice caps and land glaciers and vertical adjustment of the land (isostatic rebound and subsidence). PPS25 recommends that the allowances for the regional rates of sea level rise shown in Table 6.1 should be used as a starting point for considering flooding from the sea. The year 2005 levels had to be calculated so as to provide a like for like extent, against which the 2026, 2080 and 2115 could be compared. The existing Environment Agency Flood Zones could not be used for this purpose as they were derived using less detailed digital terrain data.

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[7] Environment Agency, '*Extreme Sea Levels – Kent, Sussex, Hampshire & Isle of Wight Updated Summery Report*' (2004)

Table 6.1 Recommended Rates of Net Sea Level Rise

Administrative Region	Net Sea Level Rise (mm/yr) Relative to 1990			
	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

Reproduced from Table B1 '*Recommended contingency allowances for net sea level rise*' – Annex B in PPS25.

The extreme sea levels used in the modelling are detailed in Table 6.2. They have been calculated by adding the incremental sea-level rise figures specified by PPS25 (see Table 4.1) to the base 2000 sea levels presented in the Extreme Sea Level Report (2004). The resultant levels are therefore derived from probabilistic storm surge heights, but do not account for wind or wave action.

Table 6.2 Extreme Tide Levels Used in the Tidal Climate Change Modelling

Coastal Zone	1 in 200 year tide level (mAOD)				1 in 1000 year tide level (mAOD)			
	2005	2026	2080	2115	2005	2026	2080	2115
Northern Zone	4.42	4.51	5.03	5.56	4.82	4.91	5.45	5.96
Southern Zone	4.52	4.6	5.13	5.66	5.02	5.11	5.65	6.16

See Figure 15 in Volume 2 for location of the coastal Zones

* Please note that these values and return time horizons were applied in the District wide mapping program. They do not necessarily correlate with those used in the detailed TuFLOW modelling in Margate or Birchington. For details of the levels used in the TuFLOW modelling please consult Volume 3.

Horizontal Projection Modelling

The PPS25 Companion Guide (June 2008) states that as a minimum the impact of climate change on residential developments should be assessed for a minimum of 100 years unless there is specific reasoning to assess a shorter period of change. For other development types the effects of climate change must reflect the proposed lifetime for the development use. As such a range of climate change horizons were modelled. It was decided that the 2115

horizon be mapped instead of 2108 as it represents the upper limit of the DEFRA sea level rise predictions and thus the longest available time horizon.

The extreme tidal flood extents for the years 2005, 2026, 2080 and 2115 were produced by performing a series of calculations within the GIS software package ESRI ArcGis. The calculations turned a polygon assigned with a tide level into flood depth grids which were then turned into flood extent polygons. The nature of Horizontal Projection Modelling results in all areas of the DTM, within the calculation area, which have elevations less than the tide level becoming part of the resultant flood extent. As such it is possible for a topographic depression completely separated from the coastline to become part of the flood extent. To eliminate these potential errors from the results, a process of manual cleaning of the data was required. This involved the removal of a small number of tiny areas of the flood extent which were considered not to be hydrodynamically linked to the sea (i.e. no route exists for water to flow into these areas). This was established through an assessment of the topography and the Master Map data.

The methodology used to produce these outlines is in accordance with guidance prepared by the Environment Agency. The outlines are unique to the SFRA and should be used as indicative extents of future flood risk zones rather than be considered for Environment Agency Flood Zones. However, the Environment Agency has agreed that the SFRA output is more than adequate to inform the SFRA.

The extent of the modelling in the Wantsum channel has been limited by the extent of the digital terrain data made available for use in this SFRA. The Wantsum channel is covered by photogrammetry data (in which elevations are determined from photographic images.), but it does not extend to high enough elevations, in all places, to fully cover the potential extent of the more distant climate change scenarios. The most noticeable example of this is at Hale, 2.6km south west of the centre of Birchington. No potential Development Sites fall within the affected area.

6.2.2 Results - Sensitivity to Climate Change in the Coastal Domain

Maps of the years 2005, 2026, 2080 and 2115 Flood Zone 2 and 3 outlines for each of the key urban areas can be found in Figure 16a and 16b in Volume 2. If significant differences exist between the year 2005 and the year 2115 extents in any of the urban areas then it is discussed in the Climate Change sections in Section 7.

There are no areas covered by the tidal climate change modelling which exhibit large increases in area, which implies that the tidal floodplains are well defined. A well defined tidal floodplain is bounded by relatively steep topography meaning that an increase in surface water level does not dramatically increase the extent of flooding. Despite the extent of flooding not increasing by much, the depth of flooding will increase. Most of the coastline of the District is steep and rocky and so climate change is predicted to have little impact in these areas. The only exceptions to this are in Birchington and the Wantsum Channel. In Birchington the 1 in 1000 year tide level in 2115 is sufficiently high to flood a large portion of the western part of the town. The Wantsum channel is where the most visible differences between today’s and future flood extents can be seen. The differences are still only small compared to other coastal regions of England. The largest differences are in the St Nicholas at Wade, Monkton and Minster areas.

The tidal climate change flood risk zones should be used to provide an indication of the likely possible extent of future flood zones. They are not however definitive and are subject to change should the Environment Agency or the Council undertake further modelling work. The outlines are considered to be sufficient to inform the Council of where the long term sustainability of developments may potentially be compromised. These modelled extents identify where site specific FRAs should include mitigation measures to demonstrate how the risk of flooding will not be increased as a result of the impacts of climate change. The potential development sites which are intersected by tidal climate change polygons are attributed with details of the time horizon outline which is predicted to impact the site first. For example, if a potential site is within the extents of the 2026, 2080 and 2115 then it will be attributed as being included within the flood risk zone in the year 2026.

6.3 Climate Change and Areas Benefiting from Defences

Section 4.2 describes the TuFLOW modelling that was undertaken in Margate and Birchington to produce revised Flood Zones and ABDs. The modelling also included climate Change scenarios. The increased sea levels predicted for the year 2115 have a significant impact on the extent of flooding in Margate and Birchington - these are presented below.

Margate

Figure 17 in Volume 2 illustrates the difference in extents of flooding that are predicted to occur as a result of climate change in Margate. The water levels are sufficiently high in both the 1 in 200 year and the 1 in1000 year to result in flooding of the Old Town. Flooding occurs during both the defended and undefended scenarios. There is very little difference between the 1 in 200 year event for with and without defences scenarios. The same applies to the 1 in 1000 year event. This is because during the tidal surge the water surface level on either side of the sea wall is more or less the same regardless of the defences (see Box 3 for details as to how this can occur).

The higher water levels predicted for the year 2115 reduce the level of protection offered by the defences. The results of the 2115 modelling suggest that in 2115, if the defence heights are not increased, there will be no areas benefiting from defences and no zones of residual risk. The 2115 (without defences) scenarios are an indication of the likely extent of Flood Zone 2 and 3 as a result of climate change. The planning implications of this are discussed in Section 9.

Birchington

Figure 18 in Volume 2 illustrates the difference in extents of flooding that are predicted to occur as a result of climate change in Birchington. The flood defences in Birchington are higher than in Margate and as such in 2115 there is no flooding from the 1 in 200 year tidal surge when the defences are modelled. A small portion of Minnis Bay floods during the 1 in 200 year event when the defences are removed. This demonstrates how Flood Zone 3 is likely to expand as a result of the predicted impacts of climate change. The extent of Flood Zone 2 is predicted to

significantly increase as a result of climate change. The flooding extends within the western edge of Birchington as far as Ingoldsby Road. The planning implications of this are discussed in Section 9.

7. Level 2 SFRA - Flood Risk in Key Urban Areas

7.1 Introduction

This section of the Report addresses each of the five Key Urban Areas (KUAs) which were established through consultation with the Council. The KUAs (See Figure 21 in Volume 2) is the term used in this SFRA to broadly define the main centres of development. The KUAs take their name from the principal town. 'Potential Development Sites' is the term used in this SFRA to describe plots of land in the District identified in the R25 Land Survey and the H1 Housing Site Survey as being potential development sites, supplied to Entec by the Council in 2008. The sites discussed in this section should not be inferred as being 'preferred' development sites nor should they be considered as sites which the council necessarily wish to develop. The potential sites are comprised from several different datasets supplied to Entec by Thanet District Council. There was an element of overlapping between the constituent datasets and so to overcome this, the three datasets were merged together to produce one site outline per location.

This section takes the focus of the SFRA from the District wide level to the individual town level. The Level 2 assessment follows on from the Level 1 assessment which is presented in Sections 3 to 6. The Level 2 assessment of flood risk, at the town and site specific level, utilises the GIS datasets described in Section 7. Six towns are discussed in this section; these include Birchington, Westgate-on Sea, Margate, Broadstairs, Ramsgate and Minster. Where data is available the following information will be provided for each KUA:

- The extent of the PPS25 flood Zones (Fluvial / Tidal);
- Any other sources of flooding;
- Sequential Test Guidance;
- Drainage and SuDS recommendations.

7.1.1 Methodology

A two staged assessment of the flood risk to potential development sites has been used in this SFRA. The first stage is to inform the Sequential Test at the District level. The SFRA categorises sites based on whether the site is in a flood risk zone (Zones 2 or 3) or not in a flood risk zone (Zone 1) and identifies all sites where PPS25 imposes and does not impose land use restrictions (see Figure 22 in Volume 2). The second stage focuses on each site that has restrictions and identifies the range of flood risks facing them, and is designed to inform a sequential approach to land use planning at the site level.

Stage 1 - Classification of Flood Risk

The Flood Zone polygons were interrogated within GIS to attribute all of the 330 sites with a qualitative probability of flooding ranging from Likely to Highly Unlikely. Table 7.1 details the classification process.

Table 7.1 Qualitative Flood Risk Classifications

Classification	Flood Zone Intersection	Definition
Likely	Site intersects with Flood Zone 3a but not 3b	Events that an individual may experience once in a lifetime, approximately equivalent to the 1% to 0.5% annual exceedance probability event (i.e. return periods of 1 in 100 years to 1 in 200 years)
Unlikely	Site intersects with Flood Zone 2 but not 3a or 3b	Events that are of a low order of likelihood, approximately 0.1% annual exceedance probability.
Highly Unlikely	Site does not intersect with either Flood Zone 2, 3a or 3b	Extreme flood events with an annual probability of less than 0.1%.

If a potential development site falls within a range of flood risk zones, the whole site was attributed with the highest probability of flood risk. Figure 22 in Volume 2 presents the results of this assessment for the whole District. All the sites that are not green will form the basis of assessment for Stage 2.

The adopted methodology is in line with the guidance outlined in PPS25 for the application of the Sequential Test. PPS25 describes the test as a tool to steer development to Flood Zone 1. This level of assessment aims to highlight all the potential sites which fall within Flood Zone 1.

Stage 2 - Site Specific Definition of Flood Risk

Stage 2 refines the flood risk posed at each site. Of the 330 sites assessed in Stage 1, only 26 sites are partially or fully within Flood Zone 2 or 3a. Each potential site is divided up using the extent of the PPS25 flood risk zones defined in Section 3 and separately attributed. These sites are discussed in Section 7.4 to 7.9.

7.2 Birchington

All referenced figures are in Volume 2.

The Extent of the PPS25 Flood Zones (Fluvial / Tidal)

The existing Environment Agency Flood Zones do not cover any part of Birchington. The Flood Zone revisions undertaken as part of this SFRA has identified a small Flood Zone 2 extent along the sea front (see Figure 11). Only one site in Birchington falls within the extent of Flood Zones 2 and 3 is located on the extreme western edge of the town.

Any Other Sources of Flooding

Only tidal flooding has been identified as posing a risk to Birchington.

Sequential Test Guidance

See Figures 23 and 24.

All sites in Birchington (other than the site at the western edge of town) are in Flood Zone 1 and are therefore suitable for all land use vulnerabilities. The western site is partially within Flood Zone 3 and is therefore not considered suitable for ‘more vulnerable’ land uses. If required, ‘more vulnerable’ land uses would need to pass the Exception Test to demonstrate development is safe. It is recommended that ‘more vulnerable’ land uses be placed, as part of the site allocation process, in the many sites located in Flood Zone 1.

Site Specific Guidance

The large site at the western edge of town is partially within tidal Flood Zone 3, with a small band of Flood Zone 2 passing through the middle of the site (see Figure 24). The eastern half of the site is in Flood Zone 1. The range of Flood Zones means that there is the potential for a range of land use vulnerabilities on the site. It is considered that the safest way to develop the site would be to ensure that land use types are matched to flood risk zones, in accordance with Tables D1 and D2 in Annex D of PPS25.

Drainage and SuDS Recommendations

The small sites, less than 1 ha, in the town centre do not require drainage assessments to be undertaken. The principal of PPS25 is to not increase flood risk and where possible reduce flood risk. In line with these principals, every effort should be made to ensure that new development in Flood Zone 1 does not increase surface runoff. The larger sites on the edge of town are over 1ha in size and will require a FRA to ensure that surface water is effectively managed. Birchington is situated over a major chalk aquifer and the Groundwater vulnerability map suggests that the soils are potentially suitable for the implementation of infiltration SuDS techniques. The larger sites present the opportunity to implement integrated surface water management systems. Developers should be encouraged to include integrated schemes in favour of small scale localised systems (e.g. infiltration trenches and swales opposed to rainwater butts). This is because integrated schemes have to be centrally managed and maintained, thus providing more confidence in them performing effectively over time than small private devices. Any drainage scheme that will discharge to groundwater should be discussed with the Environment Agency and groundwater contamination risk assessments should be undertaken.

Climate Change

It is predicted that the Flood Zones 2 and 3 will have advanced eastward, across the Western Site, by about 30 to 40m (see Figures 25 and 26) by the year 2115. Part of Minnis Bay, Birchington is predicted to be in Flood Zone 2 and 3 by the year 2115 (see Figure 25 and 26). These Flood Zone extents should be taken into consideration when preparing FRAs to ensure that developments remain safe for a minimum of 100 years. A conservative, risk averse approach to flood risk management, would be to apply the same planning restrictions PPS25 imposes on Flood Zone 3 to the areas covered by Flood Zone 3 in 2115.

7.3 Westgate-on-Sea

All referenced figures are in Volume 2.

The Extent of the PPS25 Flood Zones (Fluvial / Tidal)

The existing Environment Agency Flood Zones were used to define flood risk in Westgate-on-sea. There is only one area affected by Flood Zones 2 and 3 in the St Mildred's Gardens part of the town. This is at the eastern edge of the Westgate-on-sea promenade.

Any Other Sources of Flooding

No sources of flooding other than tidal have been identified.

Sequential Test Guidance

All the potential development sites, with the exception of the site in the St Mildred's Gardens area, are in Flood Zone 1 (see Figure 27). These sites are therefore suitable for all land use vulnerabilities. The site in St Mildred's Gardens is not considered suitable for 'more vulnerable' land uses. For 'more vulnerable' land uses to be permitted on this site, the Exception Test would have to be passed to demonstrate development is safe. It is recommended that 'more vulnerable' land uses be placed, as part of the site allocation process, in the many sites located in Flood Zone 1.

Site Specific Guidance

The St Mildred's Gardens site is completely with in Flood Zone 3 (see Figure 28). This site should be used for 'less vulnerable' uses.

Drainage and SuDS recommendations

The small sites, less than 1 ha, in the town centre do not require drainage assessments to be undertaken. The principal of PPS25 is to not increase flood risk and where possible reduce flood risk. In line with these principals, every effort should be made to ensure that new development in Flood Zone 1 does not increase surface runoff. The larger site in St Augustine's Park in the middle of the town will require a FRA to ensure that surface water is effectively managed. Westgate-on-sea is situated over a major chalk aquifer and the Groundwater vulnerability map suggests that the soils are potentially suitable for the implementation of infiltration SuDS techniques. The larger site in St Augustine's Park presents the opportunity to implement integrated surface water management systems. Developers should be encouraged to include integrated schemes in favour of small scale localised systems (e.g. infiltration trenches and swales opposed to rainwater butts). This is because integrated schemes have to be centrally managed and maintained, thus providing more confidence in them performing effectively over time than small private devices. Any drainage scheme that will discharge to groundwater should be discussed with the Environment Agency and groundwater contamination risk assessments should be undertaken.

Climate Change

The predicted extents of Flood Zones 2 and 3 in the year 2115 show there to be little difference along most of the sea front (see Figures 29 and 30). The only area affected is in the St Mildred's Gardens area. This situation supports the recommendation that the potential development site in this area should be allocated for less vulnerable uses only. A conservative, risk averse approach to flood risk management, would be to apply the same planning restrictions PPS25 imposes on Flood Zone 3 to the areas covered by Flood Zone 3 in 2115.

7.4 Margate

All referenced figures are in Volume 2.

The Extent of the PPS25 Flood Zones (Fluvial / Tidal)

The current Environment Agency Flood Zones show there to be a tidal flood risk in the Old Town and the Dreamland parts of the town. These flood zone extents are the product of recorded flooding that occurred during the 1953 flood event. There are no fluvial flood zones identified in the town. The TuFLOW modelling undertaken as part of the SFRA refined the Flood Zones in Margate. The modelling, which has been approved by the Environment Agency, indicates that the extents of Flood Zones 2 and 3 are actually much less than what was recorded in 1953 (see Figures 7 and 8).

Any Other Sources of Flooding

There is a surface water drainage flood risk associated with the culverted Tivoli Brook. Insufficient data has been made available to quantify this risk. Groundwater flooding is not considered to be a risk in the town.

Sequential Test Guidance

The majority of Margate lies in Flood Zone 1. Despite this the flood zones in Margate are more extensive than other parts of the District and result in there being more potential development sites identified as being at risk of tidal flooding (see Figure 31). The most significantly impacted areas are the Old Town and the Dreamland area. These areas are more at risk as they are the lower lying parts of the town. Where possible the 'more vulnerable' land uses should be directed towards flood zone 2 and 1. Such an approach is more practical in towns where there are very small flood Zone extents. To regenerate Margate, including the Old Town, Arlington and Dreamland sites, development will have to occur in the Flood Zones. For this to occur the Exception Test must be passed (unless only 'less vulnerable' land uses are proposed) to demonstrate that the developments are safe and that they fully account for the impact of climate change. Where possible the 'most vulnerable' land uses should be steered away from the higher risk flood zones. Placing 'less vulnerable' land uses on the ground floor and placing 'more vulnerable' above ground floor level is a potential means of incorporating 'more vulnerable' land uses within higher risk areas.

Site Specific Guidance

When the sites are analysed in detail, it can be seen that there are wide ranges of flood risks across many of the sites (see Figure 32). The range of Flood Zones across sites like the large Dreamland site means that there is the potential for a range of land use vulnerabilities on the site. It is considered that the safest way to develop the site would be to ensure that land use types are matched to flood risk zones, in accordance with Tables D1 and D2 in Annex D of PPS25 (Appendix B). The Dreamland site presents a complex flood risk situation in that the primary risk is from sea water backing up the Tivoli Brook culvert. The SFRA has not been able to fully replicate the drainage network as the available survey data is incomplete. Therefore the SFRA cannot offer a definitive flood extent in Dreamland. The site specific FRA that accompanies the development of this site should include a detailed drainage model of the Tivoli Brook and be produced following a re-survey of the existing piped network. It is recommended that an inspection of the flap valve at the outlet of the culvert is undertaken as part of the site specific FRA for Dreamland. Measures may be required to ensure that the valve works at all times, is well maintained, and is not at risk of failing or being permanently blocked open.

The Council's Local Plan has highlighted some of the flood risk areas as being central to the regeneration of Margate. 'More vulnerable' land uses within the redevelopment can be included if evidence is put forward in the execution of the Sequential Test which demonstrates that the socio-economic advantages outweigh the flood risks. For any development proposal of this nature to pass the Exception Test it must be designed to be and demonstrated in a FRA to be safe. The Environment Agency should be consulted to establish what is required from the site in terms of flood risk mitigation. Measures are likely to include setting the floor level of residential developments at a higher level than the predicted climate change tidal Flood Zone 3 level with the addition of a wave allowance height. As the flood risk is tidal, compensation storage (where development in flood risk areas should offset risk by providing like for like storage volumes) is not considered necessary as the nature of tidal flooding is widespread inundation.

Drainage and SuDS Recommendations

The small sites, less than 1 ha, in the town centre do not require drainage assessments to be undertaken. The principal of PPS25 is to not increase flood risk and where possible reduce flood risk. In line with these principals, every effort should be made to ensure that new development in Flood Zone 1 does not increase surface runoff. The larger sites (over 1 ha) will require a FRA to ensure that surface water is effectively managed. Margate is situated over a major chalk aquifer and web-based information on soils indicates that they are potentially suitable for the implementation of infiltration SuDS techniques. No groundwater vulnerability class exists over the urban area. The larger sites to the south of the main urban area present the opportunity to implement integrated surface water management systems. Developers should be encouraged to include integrated schemes in favour of small scale localised systems (e.g. infiltration trenches and swales opposed to rainwater butts). This is because integrated schemes have to be centrally managed and maintained, thus providing more confidence in them performing effectively over time than small private devices. Any drainage scheme that will discharge to groundwater should be discussed with the Environment Agency and groundwater contamination risk assessments should be undertaken. SuDS techniques discharging to groundwater may not be suitable for those sites in the lowest lying parts of Margate. This is because the water table may not be far enough below the surface. 1m is generally the required minimum from the base of the soak away to the top of the groundwater when at its highest. In these instances it could be considered appropriate to discharge surface runoff into the sea. There must be stringent pollution control measures and any proposal will have to meet the approval of the Council and the Environment Agency.

Climate Change

Climate change has a significant impact on the extent of flooding in Margate. Under present day conditions the coastal defences protect Margate. The sea level rise associated with climate change results in the Margate defences being overwhelmed. The predicted outcome of the 1 in 1000 year event in 2115 is more extensive than the recorded 1953 event. In Dreamland the modelled extents are less than the recorded 1953 event but this is likely to be the product of the Tivoli Brook culvert being altered post 1953. Present sea levels mean that there are areas of residual risk in Margate (see Figure 33 and 34). In 2115 there are predicted to be no areas of residual risk in the event of the 1 in 200 and 1 in 1000 year tidal surge. A conservative, risk-averse approach to flood risk management, would be to apply the same planning restrictions PPS25 imposes on Flood Zone 3 to the areas covered by Flood Zone 3 in 2115.

7.5 Broadstairs and Ramsgate

All referenced figures are in Volume 2. These two areas have been described together as they exhibit the geology, drainage recommendations and flood risks are the same in both areas.

The Extent of the PPS25 Flood Zones (Fluvial / Tidal)

The tidal flood zones do not extend beyond the top of the beach. All potential development sites are in Flood Zone 1 (see Figure 35 in Volume 2).

Any Other Sources of Flooding

No other sources of flooding have been identified as being a strategic risk in Broadstairs or Ramsgate. The Environment Agency have reports of some basement flooding the parts of Broadstairs and Ramsgate which overly the Thanet Sand Formation (see Figure 4). These are localised incidents as a result of perched Head Deposits becoming saturated. The construction of basements in areas where these deposits are present is not advised. Developers proposing basement uses should be asked to demonstrate as part of the FRA that the potential flood risk associated with saturated Head Deposits has been considered.

Sequential Test Guidance

All identified potential development sites are in Flood Zone 1 and as such all land use vulnerabilities are considered appropriate (see Figure 35).

Drainage and SuDS Recommendations

The small sites, less than 1 ha, in the town centre do not require drainage assessments to be undertaken. The principal of PPS25 is to not increase flood risk and where possible reduce flood risk. In line with these principals, every effort should be made to ensure that new development in Flood Zone 1 does not increase surface runoff. The larger sites (over 1 ha) will require a FRA to ensure that surface water is effectively managed. The eastern half of Broadstairs is positioned over a Minor chalk aquifer and the western half is positioned over a Major chalk aquifer (see Figure 5). This suggests that there is a greater potential for the inclusion of SuDS techniques which discharge to groundwater. A constraint on the implementation of such techniques is presented by the presence of a groundwater source protection zone which covers most of the west of the Broadstairs and Ramsgate areas (see Figure 6). This designation restricts the applicability of infiltration techniques to manage surface water. Any proposal should be discussed with the Environment Agency. In all areas site assessment work will be required to assess the feasibility of infiltration techniques. The risk of basement flooding in areas over perched Head Deposits over the Thanet Sand Formation, infiltration techniques are not considered appropriate as they could exacerbate the risk of flooding. In these instances surface attenuation will be required which is designed to discharge to the surface water drainage infrastructure at rates agreed with the sewage undertaker. Developers should be encouraged to include integrated schemes in favour of small scale localised systems (e.g. infiltration trenches and swales opposed to rainwater butts). This is because integrated schemes have to be centrally managed and maintained, thus providing more confidence in them performing effectively over time than small private devices.

Climate Change

The potential development sites are not impacted by the predicted influence of climate change on the tidal flood zones. Although Figures 36 and 37 clearly shows that the areas around Ramsgate harbour are sensitive to rising sea levels and it is important that any windfall sites in this area fully consider the implications of effect of climate change.

7.6 Minster

All referenced figures are in Volume 2.

The Extent of the PPS25 Flood Zones (Fluvial / Tidal)

Minster is located on the eastern side of the Wantsum channel floodplain. The existing Environment Agency Flood Zone 3 outline is a composite fluvial/tidal extent and the Flood Zone 2 extent is a purely tidal extent. The flood zones impact the southern part of the village and cover a large proportion of the site to the east of Minster.

Any Other Sources of Flooding

The Environment Agency hold three records of basement flooding in Minster (see Figure 4). These occurred during the winter of 2001 and are attributed to saturated perched Head Deposits above the Thanet Sand Formations.

Sequential Test Guidance

All sites, with the exception of the large site to the west of the recreation ground, are in Flood Zone 1 and are therefore suitable for all land uses vulnerabilities (See Figures 38 and 39). ‘More vulnerable’ land uses are not considered appropriate for the site within Flood Zone 3. Owing to the number of potential development sites in the Minster area, development of this site should be resisted. If development is essential then it is recommended that it should only be ‘less vulnerable’ uses that are proposed.

Richborough Power Station

The site currently occupied by the Richborough power station is totally within the extent of Flood Zone 3. ‘More vulnerable’ uses for new development should not be considered for this site as it is completely surrounded by flood waters. Safe escape routes to outside the floodplain cannot be provided. It is not considered appropriate to place ‘more vulnerable’ uses above ‘less vulnerable’ uses on this site either. This is because residents would be stranded in a tidal floodplain with no means of escape. It must also be noted that at this location there is likely to be significant wind and wave action which will increase the flood risk.

Drainage and SuDS Recommendations

Most sites within the Minster area are all over 1 ha in size and the development of any of these sites should be accompanied by a FRA which demonstrates that the surface water will be effectively managed and that development will not result in an increase in surface water runoff. The potential for infiltration SuDS in Minster is limited. In the south (see Figure 5) the ground levels are low and there is the potential for groundwater levels not being sufficiently far beneath the surface, to permit free discharge from infiltration devices. 1m is generally the required minimum from the base of the soak away to the top of the groundwater when at its highest. In addition to this, most of the area is underlain by Thanet Sand Formations which are known to contain perched Head Deposits that have resulted in basement flooding. Discharging surface water to these strata is not advised. The northern part of the Minster area is underlain by a Major aquifer, so there is potential to discharge to groundwater. This is however constrained by the areas being included within a groundwater source protection zone (see Figure 6). Discharge to groundwater within a source protection zone tends not to be the preferred option and any proposals

should be discussed with the Environment Agency and groundwater contamination risk assessments should be undertaken.

Climate Change

It is predicted that climate change will have a significant impact on the extent of the Flood Zones by the year 2115. For example, Flood Zone 3 is predicted to expand by between 120 and 150m in Minster (see Figures 40 and 41). The climate change extents do not increase the number of potential development sites in Flood Zone 3 but do however significantly increase the percentage of the large site to the east of the recreation ground which is in Flood Zone 3. The development of this site will require a FRA which demonstrates to the Environment Agency's satisfaction that the impact of climate change has been accounted for. A conservative, risk-averse approach to flood risk management would be to apply the same planning restrictions PPS25 imposes on Flood Zone 3 to the areas covered by Flood Zone 3 in 2115.

8. The SFRA GIS Datasets

8.1 Source Data Discussion

Many datasets were requested for use in this SFRA, and these were primarily received from Thanet District Council and the Environment Agency.

Each data source has an associated level of precision. The groundwater vulnerability mapping has a reference scale of 1:100,000, whereas LiDAR data has a 2 metre resolution, which means that each 2m by 2m area of land is assigned a single elevation value. Much of the data (e.g. Groundwater Vulnerability Mapping and Source Protection Zones) come from national data sets, the spatial precision of which is low but appropriate for strategic District wide assessments. The individual potential development sites are attributed with values derived from these low precision national datasets (e.g. the generalised classifications of infiltration SuDS suitability, groundwater vulnerability and runoff potential). It must be noted that the precision of the data does not increase despite the analysis being performed on the smaller site specific scale.

It is important that the site specific detail of the datasets covered in the following section be considered in respect to the level of accuracy of the source data. The reference scale of any of the original source data should be deemed as the maximum scale at which the data is considered accurate. A detailed description of each of the source datasets is presented in Appendix C.

8.2 Interactive GIS Datasets – 'The Planning Tools'

For the SFRA to fulfil its role as a strategic planning tool, the Council have to be able to abstract the conclusions of the flood risk and drainage assessments for each potential development site. It is not possible to discuss each of the potential development sites in turn in the report therefore the use of GIS datasets can provide this information. The SFRA report is accompanied by a series of digital datasets on a CD-ROM of which the key information is provided through the Attribute Database and the Site Specific Database which are detailed in Sections 8.2.1 and 8.2.2 below. Through the use of GIS software the Council can interrogate each of the potential development sites and ascertain details of flood risks, climate change implications, historic flooding and the drainage assessment. Moreover, the Site Specific Database provides details of how the flood risks vary across all those sites identified as being at risk of flooding in the Attribute Database. The principals behind these databases (GIS layers) are provided in Section 7.1.

8.2.1 Attribute Dataset

An encompassing dataset for all the potential development sites, supplied for analysis in this SFRA, was created. Table 7.1 lists the attribute fields contained within the Attribute Database. The table is divided into four sections. The topmost section identifies the site and the KUA in which it falls, including the site area. The second section identifies current flood risk to the site and the appropriate uses based on this flood risk. The third section adds detail to the flood risk of the site by identify historical flooding, the sites positioned near a main river and the influence of climate change on the site. The final (forth) section includes those attributes relevant to the drainage of the site, and include the suitability of infiltration SuDS.

It is intended that this database, which can be navigated around in a GIS package, will represent a key tool in the site allocation process as it provides a complete overview of flood risk for each of the development sites. This dataset is an initial flood risk assessment tool. It uses a precautionary approach, such that the highest risk of flooding impacting the site is recorded, the maps illustrating this assessment are presented in Volume 2. The intention is to highlight to the user which sites are in the revised Flood Zones 2 and 3 and then guide the user to the Site Specific Database for an appreciation of the definition of different Flood Zones across each site. Sites in Flood Zone 1 should be considered first for all developments.

8.2.2 Site Specific Flood Risk Definition

This dataset contains some of the same attribute fields as the Attribute Database – for example *SITE_ID* is the unique identifier by which this and the Attribute Database can be cross referenced. This dataset's primary purpose is to provide additional detail about the current flood risk to each site. The Site Specific Database divides a site up according to the flood risk zones in which each part of the site falls. Unlike the Attribute Database, this more detailed dataset has multiple records for a single site. This level of assessment is important as some sites are only fractionally within a Flood Zone and the Council needs to be informed which parts of the site are outside revised Flood Zones 2 and 3 and thus increase the development potentials on the site.

The field names in the GIS Datasets are unfortunately restricted to a limited number of characters by ArcGIS and as such they may be less than clear as to what the field is describing, therefore Tables 8.1 and 8.2 defines each of the fields included in the Attribute Database and Site Specific Database.

Table 8.1 Field Descriptions for the Attribute Database

Field	Description
FID	Feature ID
SITE_ID	Unique identifier for each site
DEV_AREA	The development area within which the site falls
AREA_HA	The size of the area in hectares (ha)
FRA_REQ	Whether or not an FRA is required, further divided according to flood risk and size of the site
FUNC_FP	Identifies whether a site is intersected by the Functional Floodplain (Zone 3b)
FZ3_T	Identifies whether a site is intersected by the Tidal Flood Zone (Zone 3)
FZ3_F	Identifies whether a site is intersected by the Fluvial Flood Zone (Zone 3)

Table 8.1 (continued) Field Descriptions for the Attribute Database

Field	Description
FZ2_T	Identifies whether a site is intersected by the Tidal Flood Zone (Zone 2)
FZ2_F	Identifies whether a site is intersected by the Functional Flood Plain (Zone 2)
PROB_Y	A qualitative assessment of the flood risk posed to each site as defined by PPS25
APP_USES	A basic assessment of the appropriate use of each site as either without restriction or requiring further investigation
HISTORIC	Identifies past historic flooding on the site and lists the month and year of the past flood event
TIDAL_CC_2	The first year in which a site is affected by the future extent of tidal flood zone 2 due to climate change
TIDAL_CC_3	The first year in which a site is affected by the future extent of tidal flood zone 3 due to climate change
SUDS_SUIT	Identifies the suitability of infiltration SuDS techniques
RUNOFF_POT	A qualitative assessment of the likely runoff potential for each site, derived from SPR_HOST

Table 8.2 Field Descriptions for the Site Specific Database

Field	Description
SITE_ID	Unique identifier for each site
DEV_AREA	The development area within which the site falls
PPS25_FZ	The flood risk zone in which that portion of the site fall in as defined by PPS25
PROB_Y	A qualitative assessment of the flood risk posed to each site as defined by PPS25
APP_USES	A basic assessment of the appropriate use of each site as either without restriction or requiring further investigation
S_E_TESTS	PPS25 guidance as mentioned in table D1 of the guide and reproduced in Appendix B of this document

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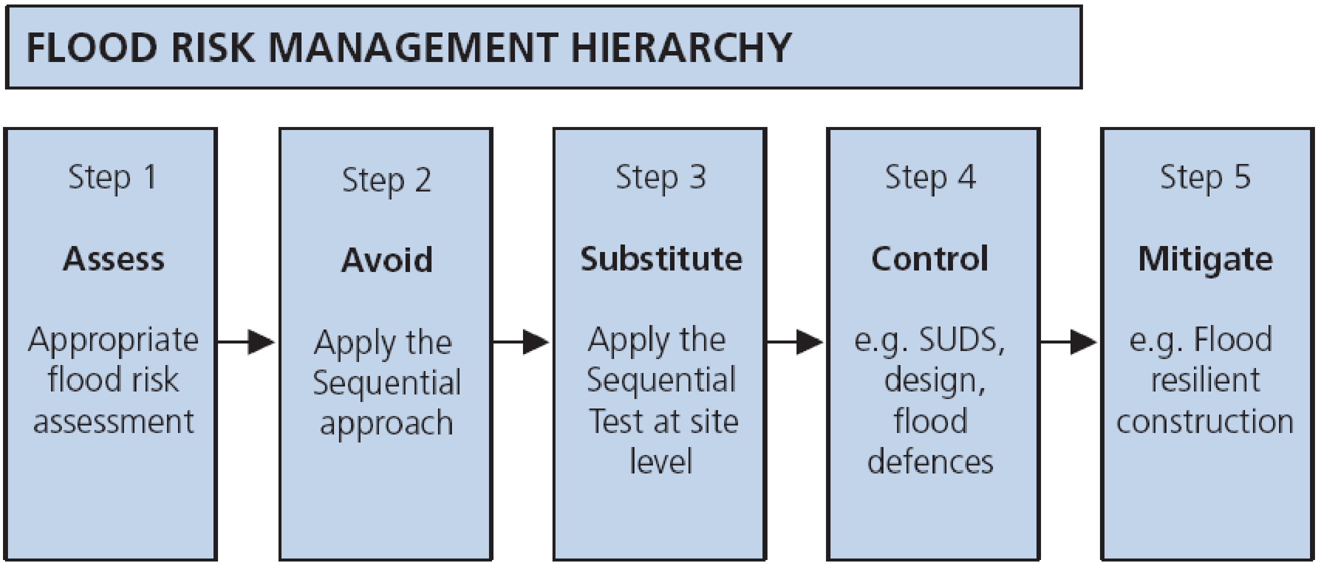
9. Flood Risk Management and Mitigation

The key message of PPS25 is to avoid inappropriate development and to locate development away from flood risk whenever possible. The approach it adopts to do this is to assess risk so it can be avoided and managed. This is summarised in the PPS25 Practice Guide (2008) as following a Flood Risk Management Hierarchy: assess – avoid – substitute – control – mitigate. The management and mitigation of flood risk within Thanet should aim to follow this hierarchy where possible, and this approach forms the basis of the assessment and recommendations in this section. The hierarchy from the practice guide is displayed as follows:



9.1 Flood Risk Management through Avoidance – Sequential Test

The PPS25 Sequential Test provides a framework for managing flood risk using the spatial planning process to avoid risk. The SFRA has identified which potential development sites are outside the flood zones and what land uses are considered appropriate for each site based on the guidance specified in PPS25. There will be occasions where planning permissions will be sought in higher flood risk zones, particularly with respect to the redevelopment of brownfield sites in urban areas, and, for Thanet, key redevelopment strategies within the coastal towns, to remain inline with sustainability and regeneration objectives. If a development, with a vulnerability classification (see table D2 in Appendix B), is sought in a flood risk zone with a higher probability of flooding than that stated in Table D1 (See Appendix B) then the Exception Test must be passed as part of the site specific FRA. This is providing that at the site allocation stage, appropriate justification was given to prove over riding reasons for consideration in line with the PPS25 Exception Test. Flood mitigation measures should be considered as early as possible in the development process to reduce and manage the flood risks associated with development.

Furthermore, development in Zone 1 must still consider other flood risks, particularly secondary sources of flooding and the potential impact that the development's drainage and surface water runoff may have on flood risk elsewhere. It is advised that the Development Control planners at Local Authorities respond to low flood risk applications using the consultation matrix found at http://www.environment-agency.gov.uk/research/planning/33098.aspx. which includes standard paragraphs from the Environment Agency for responding to planning applications.

9.2 Flood Risk Management through Design

9.2.1 Design in Tidal Flood Risk Zones

Data presented within this SFRA demonstrates that many of the potential development sites in the District lie within the lowest flood risk zone (Zone 1). There lies, therefore, opportunities to direct development into low risk flood zones within many of the Key Urban Areas, despite their coastal settings, and still meet the housing needs of the region. Exceptions to this exist in Margate and the necessary regeneration of the Old Town and Dreamland sites. For safe development to proceed in these areas, planning applications must undertake site specific FRAs and demonstrate that the Exception Test can be passed. This includes:

- Demonstration that a wider sustainability benefit is afforded to outweigh the flood risk;
- Development on previously developed land; and
- Plans to ensure that development will be safe, without increasing flood risk elsewhere, and, where possible, reducing flood risk overall.

As identified earlier, detailed modelling of the Tivoli Brook culvert system is required for the Dreamland FRA to fully understand the potential flood risk and flooding extents at this site. Ongoing consultation with the Environment Agency is necessary for developers within high risk flood zones to determine potential mitigation measures. Some generic measures that could be incorporated into designs include:

- Raising of floor levels above the predicted tidal 1 in 200 year flood including climate change and wave height allowances;
- There are no single story ground floor residential apartments below the predicted 1 in 200 year flood water level (plus climate change);
- Ensuring sleeping accommodation of residential developments is above ground floor level of new buildings; and
- Providing safe escape routes out of the floodplain and access for emergency services where possible or provide safe internal evacuation routes to higher floors where refuge can be sought.

9.2.2 Groundwater

Records of basement flooding exist for some areas of the District for Broadstairs and Ramsgate that overlie the Thanet Sand Formation. Building control in shallow groundwater areas is recommended, for example, refusing permission for basements in developments at risk. Should basement uses be proposed for less vulnerable uses or non habitable rooms and be designed with safe internal escape then it might be possible to permit such proposals. Each application should be discussed with the Environment Agency. Site specific analysis should be accompanied by any proposal to demonstrate that a proposed basement does not impact the flow of groundwater in such a way that the risk of groundwater flooding elsewhere is increased.

9.2.3 Building Resilience and Resistance

Where buildings must be located in areas with medium to high levels of flood risk, the incorporation of flood resistance and resilience at the design stage can reduce the impacts should inundation occur. Standard measures include the provision of a minimum freeboard[8] above ground or predicted flood level, and the use of resilient fixtures and fittings within. CIRIA and the Association of British Insurers (ABI) produce guidance on suitable measures of flood protection.

Flood resistance measures prevent water from entering a property and include:

- Buildings constructed with extra freeboard to be above the flood level;
- Fitting one way valves to sewage pipes, or the use of temporary bungs;
- Sump and pump systems to remove water from buildings faster than it enters; and
- Temporary door or air vent flood boards to stop the entry of flood water.

Flood resilience measures minimise the impact of flooding should it enter a property and include:

- Use of concrete floors rather than timber;
- Design of buildings such as townhouses with lower floors occupied by garages and utility areas, minimising the damage caused when flooded;
- Location of boilers, and electrical equipment above the possible flood level;
- No chipboard or MDF kitchen units, instead using plastic and metal alternatives;
- Lime plaster or cement render rather than conventional gypsum plaster.

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[8] Freeboard is a term used to describe a height allowance to cover uncertainties such as wave height

Flood resilience measures also provide a means for individuals in the local community with properties at risk, to protect their property. An array of products such as door and window boards and air brick covers specifically designed to make these openings watertight are commercially available. Given sufficient notice these can markedly reduce the ingress of flood water into properties. It is however recommended that a professional survey is carried out to identify the key ingress points for flood water into properties. Some degree of water ingress may still occur due to the multiple pathways for floodwater to enter an individual property.

Retrofitting flooded properties during the repair procedure with these is common practice. These measures are not necessarily more expensive than conventional techniques, but over repeated flood events will reduce damages, cost and time to repair if properties are flooded. Comprehensive guidance on incorporating flood resilience measures in the repair of flooded building is available from CIRIA at: http://www.ciria.org/flooding/ . Adopting these measures can reduce future flood damages and the disruption caused by flooding, uptake should therefore be encouraged. The ABI gives details of potential cost savings at http://www.abi.org.uk/Display/File/Child/553/Flood_Resilient_Homes.pdf. Importantly these costs do not include the indirect costs of disruption and temporary accommodation whilst repair occurs.

9.3 Surface Water Management

9.3.1 District Wide Management: Recommended Policy

It is recommended that the Council enforces the requirements of PPS25, to ensure that surface water run-off is managed and rates of run-off are not increased for all developments requiring a FRA. It is recommended that the Council consider requiring that run-off rates should not only be not increased, but should be decreased wherever possible. The recent Pitt review of flooding in the UK in the summer of 2007 calls for a more proactive approach for the management and implementation of suitable drainage techniques. Thanet District Council and the Environment Agency are however supportive of reducing runoff rates wherever possible. It may be considered appropriate by the Council to implement policy which states that all new developments should aim to achieve no increase in surface water runoff rates and a reduction where possible through on site surface water management.

9.3.2 Site Specific Considerations

Every new development proposal within Flood Zones 2 or 3 or sites greater than 1 hectare are required by PPS25 to be accompanied by a FRA inclusive of a consideration of surface water drainage. PPS25 requires the SFRA to demonstrate that risks associated with surface water run-on (surface water flooding generated off site, which may impact the site) have been considered along with measures to mitigate against any potential increases run off as a result of development. Site specific FRAs should consider the local drainage infrastructure in detail. When preparing site specific FRAs the impact of blocked drains and the likely consequences should be established. If necessary it might be appropriate to slightly raise ground floor levels to reduce potential damages. This is not a requirement of PPS25, it is just a means of reducing the impact of a potential risk.

Sustainable Drainage Systems (SuDS)

The use of SuDS in the past has been hindered by the reluctance of authorities to adopt SuDS systems, and the additional maintenance required to ensure effective treatment and control of runoff. The DEFRA publication *'Future Water'* recommends a new approach to managing surface water through better coordination and planning and in promoting sustainable drainage. The principles and recommendations have been set out in the Pitt Review of the 2007 floods, which further promotes a risk based approach to investment in flood risk management and natural processes to manage surface water. Thanet Local Plan reflects the policies of surface water management through Policy EP12 that states:

> *Development contributing to an unacceptable flood risk due to surface water run-off will not be permitted. Wherever practicable, the inclusion of sustainable drainage systems will be required to ensure that surface water run-off is not increased*

Sustainable Drainage Systems (SuDS) are a preferred option for the management of surface water since they manage runoff close to its source and have benefits other than flood prevention. The SFRA has identified that where land take and groundwater protection allows, infiltration SuDS have generally a medium potential for implementation across the District. Table A1 (in Appendix A) provides a summary of options for SuDS and their suitability according to subdivisions of water quality, water quantity and environmental benefits. Designers and planners should consider local land use, future management and the needs of local people, when undertaking drainage design.

LPA's are required to promote the application of SuDS, the preferred option in PPS25 being infiltration techniques as opposed to discharging into watercourses. Where this is not possible, preference should be given to the discharge of surface water into watercourses rather than foul water drains. To simulate the natural hydrological processes in a catchment through engineered drainage, a management train of SuDS is required. The following are four objectives of a SuDS treatment train that were presented by Greater Dublin Strategic Drainage Study (2005):

- **Pollution prevention** – spill prevention, recycling, public awareness and participation;
- **Source control –** conveyance and infiltration of runoff;
- **Site Control –** reduction in volume and rate of surface runoff, with some additional treatment provided; and
- **Regional Control –** Interception of runoff downstream of all source and on-site controls to provide follow–up flow management and water quality treatment.

If SuDS are to be fully effective, they need to be managed properly. It is the responsibility of the developer to ensure that the development drainage is maintained for the lifespan of the development. There are a range of

maintenance routes the developer might want to pursue but ultimately the developer has to demonstrate that there is a drainage maintenance plan presented. Section 106 of the Town and Country Act 1990 provides a suitable mechanism whereby properly designed SuDS components can be transferred into the management and maintenance responsibilities of the local authority. This is providing the Council wish to enter into such an agreement and there is no legislation which states they have an obligation to. The '*Interim Code of Practice for Sustainable Drainage Systems*' (NSWG, 2004) endorsed by the Environment Agency can be consulted for further guidance.

Surface Water Management during Site Construction

The management of runoff during the construction period is an important consideration particularly for large sites and details of measures to mitigate for this phase of development are required as part of an FRA. Methods to reduce the volume of solids (and runoff) leaving the site include:

- Phased removal of surface vegetation at the appropriate construction phase;
- Provision of a grass buffer strip around the construction site and along watercourses;
- The covering of stored materials;
- Ensuring exposed soil is re-vegetated as soon as feasibly possible;
- Protection of storm water drain inlets; and
- Silt fences, siltation ponds and wheel washes.

9.4 Flood Warning

There are currently no flood warning areas in the Thanet District. Residents in Flood Zones 2 and 3 should be encouraged to register with the Environment Agency and will be updated as and when the Flood Warning areas are extended to include Thanet.

9.5 Emergency Planning

It is recommended that the council should take the opportunity to review its Emergency Planning procedures in the event of widespread flooding of the Key Urban Areas. In the event of flooding it is the Council's role, supported by the emergency services, to coordinate procedures and responses. Key issues that should be covered in an emergency plan are:

- Responsibilities and roles of key services and communication protocols;

- Susceptibility of key emergency response centres (council offices, fire and police stations and hospitals) to flooding;
- Evacuation routes and reception centres; and
- Contingency plans for the loss of power and/or water.

There is likely to be several days notice of meteorological predictions of storm surges that could cause major flooding along coastline.

Residents in areas of flood risk should be encouraged to sign up to the Environment Agency's Flood Warning System, particularly if located in isolated properties in Flood Zone 3b (functional floodplain), where waters would likely rise most rapidly and access routes may become cut off.

The SFRA can be considered to be a refinement of the Environment Agency Flood Map / Flood Explorer. As such, the SFRA could be used to locate emergency infrastructure and emergency services depots. Where potential development sites are adjacent to these structures and utilities options to reduce the flood risk posed to them could be explored.

10. Summary and Recommendations for LDF

10.1 Summary of Flood Risks

This SFRA has been undertaken to meet the requirements of PPS25 and Thanet District Council. It has been prepared to provide detailed flood risk information across the District and particularly the extensive coastline, as well as site specific levels to inform the Sequential Test and site allocation process.

The assessment of flood risk presented in this SFRA is a sufficiently robust to inform the Sequential Test and the site allocation process. The SFRA has delineated the PPS25 flood risk zones and identified how these impact the potential development sites the Council has put forward for assessment. The GIS dataset of potential development sites, accompanying the SFRA, provide information on what PPS25 states as appropriate for each flood risk zone. The principal of the Sequential Test and PPS25 is to manage flood risk by steering development towards the areas of the lowest flood risk. If regeneration has to occur in a higher flood risk zone (Zone 3a) then, only less vulnerable landuses should be proposed. Any exceptions to this sequential risk based approach (see Annex D in PPS25 or Appendix B of the SFRA) need to pass the Exception Test as part of the site specific FRA process.

10.1.1 Tidal

Tidal flooding poses the greatest risk to the study area. The Environment Agency and the Council saw the SFRA as an opportunity to refine the existing Flood Zone 3 outline in the District. It was considered essential that the highest quality and most up to date data be used to define flood risk zones. To achieve this, the SFRA re-modelled the tidal floodplain using a TuFLOW model. This model enabled flood flow routes to be visualised, flood depths and flow velocities to be quantified and areas of standing water to be identified. The hydraulic modelling undertaken in this SFRA has provided detailed flood risk information at the site specific level. The Environment Agency has approved the Isis-TuFLOW model and its output for use in the SFRA.

10.1.2 Fluvial

The SFRA considered flooding from the River Stour. Within the Stour Valley, the tidal extent of the river provides a greater risk than a fluvial flood event, therefore the combined fluvial and tidal flood zone is used to determine the greatest level of risk.

10.1.3 Other Sources

Groundwater flooding was not concluded to be an issue of strategic concern. A detailed assessment of drainage has not been undertaken as part of this SFRA, but it is recommended that subsequent FRAs assess the potential for flooding from the surface water and foul water drainage networks at the site specific level. Some coastal areas have been identified as areas potentially affected by wave energy. The Council and the Environment Agency must be consulted regarding any new development in these areas to determine the scope of more detailed assessment of wave impact.

10.2 Drainage Recommendations

Sustainable Drainage Systems (SuDS) discharging to groundwater are considered the most appropriate approach for much of the study area. Where infiltration SuDS are not suitable, for example in groundwater Source Protection Zone 1 from industrial sites, discharge to surface water, at rates agreed with the Environment Agency and or the Sewage undertaker, are potentially more appropriate. To achieve the permissible rates of discharge, attenuation devices may be required as part of the scheme. For sites where there are ground elevation changes, the potential for incorporating integrated approaches to managing surface water should be explored. Site specific FRAs should investigate the potential for SuDS even if the development proposal does not necessarily increase the rates of runoff. Reducing surface water runoff is inline with the principals of PPS25, the Council's aspirations and reflects the findings of the Pitt Review (2007)[9].

The key sites within the study area have been assessed in detail and information has been provided which should be taken into consideration in the master-planning process for these sites. Information on the applicability of SuDS and guidance on how the sites could be safely developed has been incorporated in to the site specific discussions.

10.3 Recommendations for Inclusion in LDF

The following represent a summary of the recommendations that have been put forward in the SFRA which the Council should consider for inclusion in the LDF:

- Aim to principally manage flood risk through avoidance whereby sites are allocated in lower flood risk zones in preference to higher flood risk zones. The Sequential Test provides the Council with a framework for undertaking this screening process to inform site allocations;
- Development in higher flood risk zones must pass the Exception Test;
- When determining the requirement for a FRA and the scope of a FRA the 2115 predicted climate change extents for Flood Zone 2 and 3 should be used. This represents a more sustainable and precautionary approach;
- Seek to see betterment of the requirement of PPS25 which states that only sites in Flood Zone 2 and 3 or sites larger than 1 hectare in Flood Zone 1 should be accompanied by a FRA addressing surface water runoff rates. This could be achieved by, for example, requiring all new developments of all

[9] Learning Lessons from the 2007 floods, An independent review by Sir Michael Pitt, 'The Pitt Review', (2007)

sizes to, where possible, sustainably manage surface water on site to reduce the potential for off site increases in flood risk;

- Adopt resilient or resistant design practices for all development that must be placed in zones of flood risk; and

- Site Specific FRAs in tidal Flood Zone 3 should incorporate an assessment of the potential impacts of wind and wave action for developments lying within this risk zone (Figure 42 – Volume 2). Through consultation with the Environment Agency, agree the necessary mitigation measures to facilitate 'safe' development.

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11. References

Communities and Local Government, *Planning Policy Statement 25 – Development and Flood Risk*, (2006)

Communities and Local Government, *Development and Flood Risk – A Practice Guide Companion to PPS25 "Living Draft*, (2008)

Environment Agency, '*Extreme Sea Levels – Kent, Sussex, Hampshire & Isle of Wight Updated Summery Report*' (2004)

Hother, J., *Applying Reliability Risk Analysis to Flood Risk Management*, 39th DEFRA Flood and Coastal Management Conference, 2004.

Learning Lessons from the 2007 floods, an independent review by Sir Michael Pitt, 'The Pitt Review', (2007)

River Great Stour Catchment Flood Risk Mapping – Great Stour Report (November 2003) – *Project Ref: 10509/051*

The Construction Industry Research and Information Association (CIRIA) *The SuDS Manual - CIRIA Report C697* (2007) CIRIA London, UK

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Appendix A
Supporting SuDS Information

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Table A1 SuDS - Suitability According to Subdivisions of Water Quality, Quantity and Environmental Benefits

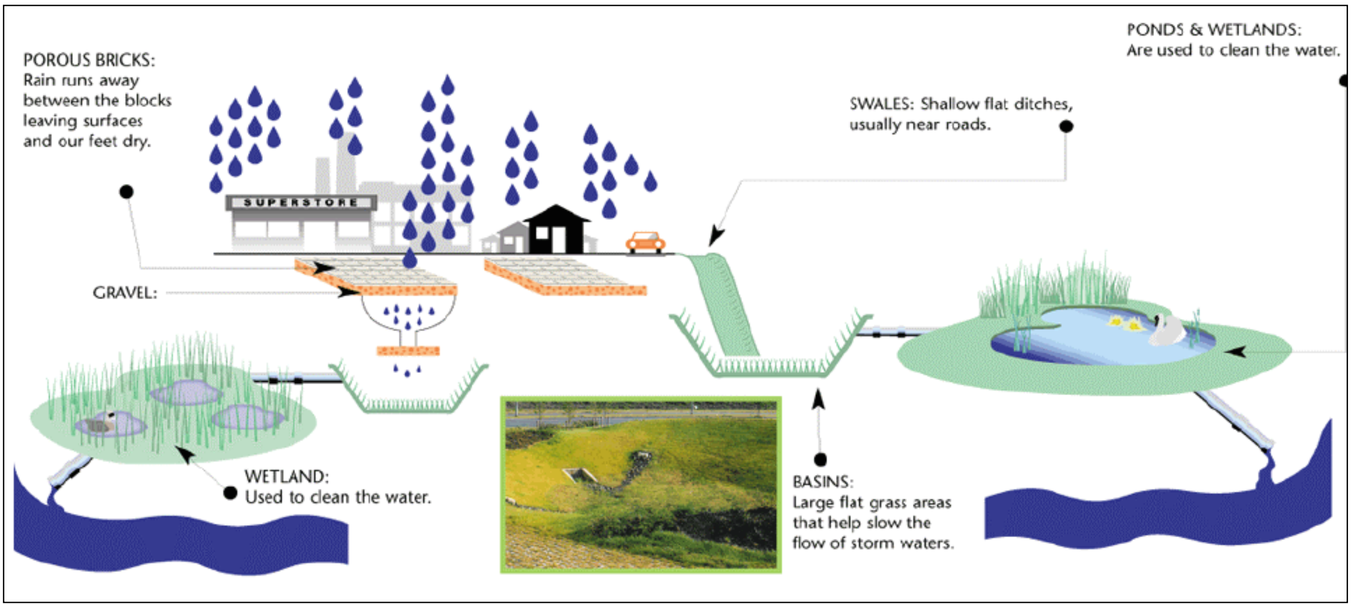
Technique	Description	Water quantity				Water quality								Enviro. benefits		
		Conveyance	Detention	Infiltration	Water harvesting	Sedimentation	Filtration	Adsorption	Biodegradation	Volatilisation	Precipitation	Phytoremediation	Nutrification	Aesthetics	Amenity	Ecology
Water butts, site layout	Good house keeping and design practices	=	=	#	=	=	=	=	=	=	=	=	=	=	=	=
Pervious pavements	Allow inflow of rainwater into underlying construction/soil		#	#	=	#	#	#	#	#				=	=	=
Filter drain	Linear drains/trenches filled with permeable material, often with a perforated pipe in the base of the trench	#	#				#	#	#	#						
Filter strips	Vegetated strips of gently sloping ground designed to drain water evenly from impermeable areas and filter out silt and other particulates	=	=	=		#	#	#	#					=	=	=
Swales	Shallow vegetated channels that conduct and/or retain water (and can permit infiltration when un-lined). The vegetation filters particulates	#	#	=		#	#	#	#			=		=	=	=
Ponds	Depressions used for storing and treating water. They have a permanent pool and bankside emergent and aquatic vegetation		#	=	#	#	#	#	#	#	#	#	#	#	#	#
Wetlands	As ponds, but the runoff flows slowly but continuously through aquatic vegetation that attenuates and filters the flow. Shallower than ponds	=	#	=	#	#	#	#	#	#	#	#	#	#	#	#
Detention basin	Dry depressions designed to store water for a specified retention time		#			#	=	=	#			=		=	=	=
Soakaways	Sub-surface structures that store and dispose of water via infiltration			#			#	#	#							
Infiltration trenches	As filter drains, but allowing infiltration through trench base and sides	=	#	#			#	#	#	#						
Infiltration basins	Depressions that store and dispose of water via infiltration		#	#			#	#	#	#				=	=	=
Green roofs	Vegetated roofs that reduce runoff volume and rate		#				#	#	#	#	#	#	#	#	=	#
Bioretention areas	Vegetated areas for collecting and treating water before discharge downstream, or to the ground via infiltration.		#	#		#	#	#	#	#	#	#	#	#	#	#
Sand filters	Treatment devices using sand beds as filter media		#	=			#	#	#	#	#					
Silt removal devices	Manhole and/or proprietary devices to remove silt					#										
Pipes, subsurface storage	Conduits and their accessories as conveyance measures and/or storage. Water quality can be targeted using sedimentation and filter media.	#	#			=	=									

High/primary process = Some opportunities, subject to design

Information in table modified after CIRIA (2007)

The information presented in Table A1 is based on the assumption that only a single SuDS technique is implemented on a site and is independent of connected SuDS.

Figure A1 Likely Implementation of SuDS Management Train



Source of this Graphic = GDSDS (2005)

Table A2 Influential Site Characteristics on the Applicability of SuDS (Modified after CIRIA 2007)

SuDS Group	Technique	Soils		Area draining to a single SuDS component		Minimum depth to water table		Site slope		Available head	
		Impermeable	Permeable	0 – 2 ha	> 2 ha	0 – 1 m	> 1 m	0 – 5%	> 5 %	0-1 m	1 – 2 m
Retention	Retention pond	Y	Y[1]	Y	Y[5]	Y[2]	Y[2]	Y	Y	Y	Y
	Subsurface storage	Y	Y	Y	Y[5]	Y[2]	Y[2]	Y	Y	Y	Y
Wetland	Shallow wetland	Y[2]	Y[4]	Y[4]	Y[6]	Y[2]	Y[2]	Y	N	Y	Y
	Extended detention wetland	Y[2]	Y[4]	Y[4]	Y[6]	Y[2]	Y[2]	Y	N	Y	Y
	Pond/wetland	Y[2]	Y[4]	Y[4]	Y[6]	Y[2]	Y[2]	Y	N	Y	Y
	Pocket wetland	Y[2]	Y[4]	Y[4]	N	Y[2]	Y[2]	Y	N	Y	Y
	Submerged gravel wetland	Y[2]	Y[4]	Y[4]	Y[6]	Y[2]	Y[2]	Y	N	Y	Y
	Wetland channel	Y[2]	Y[4]	Y[4]	Y[6]	Y[2]	Y[2]	Y	N	Y	Y
Infiltration	Infiltration trench	N	Y	Y	N	N	Y	Y	Y	Y	N
	Infiltration basin	N	Y	Y	Y[5]	N	Y	Y	Y	Y	N
	Soak away	N	Y	Y	N	N	Y	Y	Y	Y	N
Filtration	Surface sand filter	Y	Y	Y	Y[5]	N	Y	Y	N	N	Y
	Sub-surface sand filter	Y	Y	Y	N	N	Y	Y	N	N	Y
	Perimeter sand filter	Y	Y	Y	N	N	Y	Y	N	Y	Y
	Bioretention/filter strips	Y	Y	Y	N	N	Y	Y	N	Y	Y
	Filter trench	Y	Y[1]	Y	N	N	Y	Y	N	Y	Y
Detention	Detention basin	Y	Y[1]	Y	Y[5]	N	Y	Y	Y	N	Y
Open channels	Conveyance swale	Y	Y	Y	N	N	Y	Y	N[3]	Y	N
	Enhanced dry swale	Y	Y	Y	N	N	Y	Y	N[3]	Y	N
	Enhanced wet swale	Y[2]	Y[4]	Y	N	Y	Y	Y	N[3]	Y	N
Source control	Green roof	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
	Rainwater harvesting	Y	Y	Y	N	Y	Y	Y	Y	Y	
	Permeable pavement	Y	Y	Y	Y	N	Y	Y	N	Y	Y

Y = Yes

N = No

Y1 = with liner

Y2 = with surface baseflow

Y3 = Unless follows contours

Y4 = With liner and constant surface baseflow, or high ground water table

Y5 = possible, but not recommended (appropriate management train not in place)

Y6 = Where high flows are diverted around SuDS component

Additional policy and general guidance on SuDS and drainage include the following:

- PPS25 Practice Guide, 2007;
- Water Framework Directive (200/60/EC);
- Highways Act, 1980;
- Town and Country Planning Act, 1990;
- Town and Country Planning Act, 1990 (amended) NB covers S106 Agreements;
- Town and Country Planning Act, 1991;
- Construction, Design and Management Regulations, 1994;
- Building Regulations Part C Approved Document H – Drainage and Waste Disposal of the Building Regulations 2002 Amendment;
- ODPM 2004. Planning Policy Statement 1: *Delivering Sustainable Development*;
- Communities and Local Government, 2006. Planning Policy Statement 25: *Development and Flood Risk*;
- Communities and Local Government, 2007. *Development and Flood Risk: A practice guide companion to PPS25* ;
- BRE Digest 365 Soak away Design BSE EN 752-4: 1998 Drain and Sewer Systems outside buildings, part 4;
- CIRIA. Sustainable Drainage Systems – Hydraulic, Structural and water quality advice (CIRIA 609);
- CIRIA. The SUDS Manual (CIRIA C697);
- CIRIA. *Source control using constructed previous surfaces. Hydraulic, structural and water quality performance issues* (CIRIA 582);
- CIRIA. *Infiltration Drainage – manual of good practice* (CIRIA R156);
- CIRIA. *Review of the design and management of constructed wetlands* (CIRIA R180);
- CIRIA. *Control of pollution from highway drainage discharge* (CIRIA R142);
- CIRIA. *Design of flood storage reservoirs* (CIRIA Book 14);
- CIRIA. *Designing for exceedance in urban drainage systems – good practice* (CIRIA C635);
- CIRIA. *Rainwater and grey-water use in buildings* (CIRIA C539);

- DEFRA, 2004. *Making Space for Water – Developing a new Government strategy for flood and coastal erosion risk management in England: A Consultation Exercise;*
- DEFRA, 2005. *Making Space for Water – Taking forward a new Government strategy for flood and coastal erosion risk management in England: First Government response to the Autumn 2004;*
- DEFRA, 2006. *Urban Flood Risk and Integrated Drainage*. Scoping report and pilot studies;
- Environment Agency, 2003. Harvesting rainwater for domestic uses: an information guide;
- HR Wallingford. Use of SUDS in high density development;
- National SUDS Working Group, 2006. Interim Code of Practice for SUDS; and
- WRc. Sewers for Adoption 6th Edition (SfA6) (published by Water UK).

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Appendix B
Tables D1, D2 & D3 – Reproduced from Annex D PPS25

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Table D.1: Flood Zones

(Note: These Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences)

Zone 1 Low Probability

Definition

This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).

Appropriate uses

All uses of land are appropriate in this zone.

FRA requirements

For development proposals on sites comprising one hectare or above the vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off, should be incorporated in a FRA. This need only be brief unless the factors above or other local considerations require particular attention. See Annex E for minimum requirements.

Policy aims

In this zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage techniques.

Table D.1: contd.

Zone 2 Medium Probability

Definition

This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% – 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% – 0.1%) in any year.

Appropriate uses

The water-compatible, less vulnerable and more vulnerable uses of land and essential infrastructure in Table D.2 are appropriate in this zone.

Subject to the Sequential Test being applied, the highly vulnerable uses in Table D.2 are only appropriate in this zone if the Exception Test (see para. D.9.) is passed.

FRA requirements

All development proposals in this zone should be accompanied by a FRA. See Annex E for minimum requirements.

Policy aims

In this zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area through the layout and form of the development, and the appropriate application of sustainable drainage techniques.

Zone 3a High Probability

Definition

This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.

Appropriate uses

The water-compatible and less vulnerable uses of land in Table D.2 are appropriate in this zone.

The highly vulnerable uses in Table D.2 should not be permitted in this zone.

The more vulnerable and essential infrastructure uses in Table D.2 should only be permitted in this zone if the Exception Test (see para. D.9) is passed. Essential infrastructure permitted in this zone should be designed and constructed to remain operational and safe for users in times of flood.

FRA requirements

All development proposals in this zone should be accompanied by a FRA. See Annex E for minimum requirements.

Table D.1: contd.

Zone 3a High Probability *(continued)*

Policy aims

In this zone, developers and local authorities should seek opportunities to:

i. reduce the overall level of flood risk in the area through the layout and form of the development and the appropriate application of sustainable drainage techniques;

ii. relocate existing development to land in zones with a lower probability of flooding; and

iii. create space for flooding to occur by restoring functional floodplain and flood flow pathways and by identifying, allocating and safeguarding open space for flood storage.

Zone 3b The Functional Floodplain

Definition

This zone comprises land where water has to flow or be stored in times of flood. SFRAs should identify this Flood Zone (land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1%) flood, or at another probability to be agreed between the LPA and the Environment Agency, including water conveyance routes).

Appropriate uses

Only the water-compatible uses and the essential infrastructure listed in Table D.2 that has to be there should be permitted in this zone. It should be designed and constructed to:

– remain operational and safe for users in times of flood;

– result in no net loss of floodplain storage;

– not impede water flows; and

– not increase flood risk elsewhere.

Essential infrastructure in this zone should pass the Exception Test.

FRA requirements

All development proposals in this zone should be accompanied by a FRA. See Annex E for minimum requirements.

Policy aims

In this zone, developers and local authorities should seek opportunities to:

i. reduce the overall level of flood risk in the area through the layout and form of the development and the appropriate application of sustainable drainage techniques; and

ii. relocate existing development to land with a lower probability of flooding.

Table D.2: Flood Risk Vulnerability Classification

Essential Infrastructure	• Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk, and strategic utility infrastructure, including electricity generating power stations and grid and primary substations.
Highly Vulnerable	• Police stations, Ambulance stations and Fire stations and Command Centres and telecommunications installations required to be operational during flooding. • Emergency dispersal points. • Basement dwellings. • Caravans, mobile homes and park homes intended for permanent residential use. • Installations requiring hazardous substances consent.[19]
More Vulnerable	• Hospitals. • Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels. • Buildings used for: dwelling houses; student halls of residence; drinking establishments; nightclubs; and hotels. • Non–residential uses for health services, nurseries and educational establishments. • Landfill and sites used for waste management facilities for hazardous waste.[20] • Sites used for holiday or short-let caravans and camping, **subject to a specific warning and evacuation plan**.
Less Vulnerable	• Buildings used for: shops; financial, professional and other services; restaurants and cafes; hot food takeaways; offices; general industry; storage and distribution; non–residential institutions not included in 'more vulnerable'; and assembly and leisure. • Land and buildings used for agriculture and forestry. • Waste treatment (except landfill and hazardous waste facilities). • Minerals working and processing (except for sand and gravel working). • Water treatment plants. • Sewage treatment plants (if adequate pollution control measures are in place).

[19] DETR Circular 04/00 – para. 18: *Planning controls for hazardous substances*.
www.communities.gov.uk/index.asp?id=1144377

[20] See *Planning for Sustainable Waste Management: Companion Guide to Planning Policy Statement 10* for definition.
www.communities.gov.uk/index.asp?id=1500757

Table D.2: contd.

Water-compatible Development	• Flood control infrastructure. • Water transmission infrastructure and pumping stations. • Sewage transmission infrastructure and pumping stations. • Sand and gravel workings. • Docks, marinas and wharves. • Navigation facilities. • MOD defence installations. • Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. • Water-based recreation (excluding sleeping accommodation). • Lifeguard and coastguard stations. • Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. • Essential ancillary sleeping or residential accommodation for staff required by uses in this category, **subject to a specific warning and evacuation plan**.

Notes:

1) This classification is based partly on Defra/Environment Agency research on Flood Risks to People (FD2321/TR2)[21] and also on the need of some uses to keep functioning during flooding.

2) Buildings that combine a mixture of uses should be placed into the higher of the relevant classes of flood risk sensitivity. Developments that allow uses to be distributed over the site may fall within several classes of flood risk sensitivity.

3) The impact of a flood on the particular uses identified within this flood risk vulnerability classification will vary within each vulnerability class. Therefore, the flood risk management infrastructure and other risk mitigation measures needed to ensure the development is safe may differ between uses within a particular vulnerability classification.

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Table D.3[22]: Flood Risk Vulnerability and Flood Zone 'Compatibility'

Flood Risk Vulnerability classification (see Table D2)		Essential Infrastructure	Water compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone (see Table D.1)	Zone 1	✔	✔	✔	✔	✔
	Zone 2	✔	✔	Exception Test required	✔	✔
	Zone 3a	Exception Test required	✔	✗	Exception Test required	✔
	Zone 3b 'Functional Floodplain'	Exception Test required	✔	✗	✗	✗

Key:

✔ Development is appropriate

✗ Development should not be permitted

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Appendix C
SFRA GIS Datasets

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Source Data Discussion

The following is a short description of the source data GIS data used during the course of the SFRA. Where available, the reference scale of the map has been included in order to indicate the maximum scale of use for which the map was intended.

Ordnance Survey Basemap

A high level topographic map which provides an overview of the District and the KUA's was used as a basemap where detailed ordnance information was not required. This map includes data such as the road network, green areas and contours. The data of this map was captured at 1:50,000 reference scale.

Mastermap

Mastermap data was made available by the Council. This dataset is an accurate source of ordnance survey data that informed the SFRA at KUA and site specific scale. The reference scale of the dataset differs depending on the degree of urbanisation, with urban areas having a capture standard of 1:1,250 while for rural areas detail is reduced.

Potential Development Sites

Potential development sites were supplied the Council and included several different datasets. This dataset identified those areas on the District that were/might be considered for development. The reference scale of this dataset is unknown. Section 7 provides further details of the potential development sites on the District.

Geology

Geological maps of the District were sourced from the British Geological Society (BGS) on behalf of the Council. The datasets included solid (bedrock), drift (superficial), artificial geological maps, as well as linear geological features and areas of mass movement. The reference scale of these maps is 1:63,360.

Groundwater Vulnerability

A digital dataset of groundwater mapping was provided by the Environment Agency. These maps show the vulnerability of groundwater as a combination of aquifer type and soils. The reference scale for this dataset is 1:100,000.

Source Protection Zones

Source Protection Zones were provided by the Agency for the District. The zones show the risk of contamination from activities that might cause pollution to aquifers used for public water supply. The closer the potential contamination activity is to the abstraction point, the greater the risk classification. The reference scale of this dataset is unknown.

Environment Agency Main Rivers

The main rivers in the District were sourced from an Environment Agency dataset of rivers defined as larger streams and rivers, including smaller watercourses of local significance.

Fluvial and Tidal Flood Outlines for Zones 2 and 3

The Environment Agency provided a digital dataset of the District which outlined those areas affected by flooding. The data was divided according to flood zone 2 and 3, as well as fluvial and tidal. This data is sourced from modelling done for the Agency which used Synthetic Aperture Radar (SAR) elevation data.

Environment Agency Flood Model Outlines

The Environment Agency provided flood model outlines of various return periods for River Great Stour.

Historic Flood Outlines

Historic flood outlines were also provided by the Environment Agency for the 1957 event. The reference scale of these outlines is unknown and is dependant on the accuracy of the original data and the scale at which they were digitised.

Flood Defences

The National Flood and Coastal Defence Database from the Agency was the source for the location, extent and level of protection of flood defences in the District. The reference scale of this dataset is unknown.

Datasets Produced by the SFRA

Attribution Database

The purpose of this section is to detail the method by which the potential site attribution dataset was created. Much of the relevant detail is mentioned in previous sections, and therefore the intention is to provide an overview of how a single attribute was assigned to a site which was covered by multiple attribute values. The attribute fields in this dataset were derived as follows:

SITE_ID

A unique identifier was assigned to each site and used the development area for each combined with the Feature ID (FID).

DEV_AREA

In order to retain the major development areas as earlier identified in conjunction with the Council, an attribute relating to the key development area into which the site falls, was included.

AREA_HA

Area for each site was calculated and is represented in hectares (ha). This is important since it enables a site to be classified as requiring a FRA, since all sites over 1ha require a FRA regardless of whether they are vulnerable to flooding.

FRA_REQ

Sites were categorised into those requiring and not requiring a FRA. This was determined by whether or not a site was within any of the flood zones as recorded by the fields (Func_FP, FZ3_T, FZ3_F, FZ2_T and FZ2_F) and whether or not the site was over 1ha. Section 3 provides an overview of the flood risk zones as defined by PPS25.

FUNC_FP, Func_FP, FZ3_T, FZ3_F, FZ2_T and FZ2_F

Each site was attributed as to the flood zones into which it either partially or completely fell. This categorisation was independent of scale, such that a site was accordingly attributed even if only fractionally touched by a flood zone. Details about the flood zones as defined by PPS25 are found in Section 3.

PROB_Y

By assessing whether a site fell within a flood risk area, and the maximum flood risk posed, it was possible to assign a qualitative attribute to each of the affected sites corresponding to the qualitative descriptions used by PPS25. This attribution applied a precautionary approach by identifying the greatest flood risk posed to a site.

APP_USES

The various fields recording flood risk to the sites allowed for an initial assessment of appropriate land uses for each site. Thus a site falling outside the flood zone was attributed as not having any restrictions in terms of suitable uses, while for sites falling within flood risk zone, a precautionary approach was used, identifying the most severe flood risk falling on the site, and specifying appropriate uses accordingly. It is therefore advisable to consult the site specific flood risk definition dataset to determine the site distribution be consulted. Table D2 of Annex D PPS25, as replicated in Appendix B provides further information.

HISTORIC

Historic flood outlines were provided by the Environment Agency for the district. These outlines provided supporting information of those areas already identified at risk of flood as defined by the functional floodplain, flood zone 2 and flood zone 3 as well identifying potential flood risk areas not included in the Environment Agency maps. The sites were therefore attributed with the month and year for each of the historic floods which they intersected. This categorisation was independent of scale, such that a site was accordingly attributed even if it only fractionally passed through a historic flood zone.

TIDAL_CC_2 and TIDAL_CC_3

The impact of climate change on fluvial flood risk was an important component of the SFRA. This is because climate change is expected to cause a rise in sea-levels all around the District. This will have the direct effect of increase the risk of flooding to areas around the coast, and up estuaries. Section 6 discusses this in more detail, and presents the data used and the assumptions made.

The attribution of sites was done for both the future tidal flood zone 2 and 3, since they are not coincident with each other, and have individual bearing on sites with regard to flood risk, and consequently flood risk assessments. For both *TIDAL_CC_2* and *TIDAL_CC_3*, the minimum date from which climate change was predicted to affect the site was recorded. Thus, if a site was overlain by the future flood zones of climate change scenarios 2026, 2080 and 2115, the site would be attributed with the climate change scenario of 2026. A site need only clip the climate change extents for it to be attributed. The site does not have to be completely within the extents.

SUDS_SUIT

The applicability of SuDS on the District was a component of the work undertaken as part of the SFRA. This was done in order to provide a site by site generalisation of the suitability of SuDS as categorised by attenuation vs. infiltration techniques. *SUDS_SUIT* was assigned to each site it describes the suitability of infiltration SuDS techniques. If a site was predominantly in an area of 'high' infiltration suitability, and only a small portion was intersected by a 'low' infiltration suitability area, a worst case scenario was assumed, and the resulting *SUDS_SUIT* attribution for that site was recorded as 'low'. Areas of mass movement were assigned a low suitability.

RUNOFF_POT

A component of all FRA's is the requirement for an assessment of site drainage to be undertaken. This process is site-specific and would be inappropriate for the purposes of a SFRA/ nonetheless, an initial District wide assessment of runoff potential was carried out, since it provides a preliminary indication of runoff.