Adaptation Sub-Committee of the Committee on Climate Change

How Land Use Allocations Decisions are Accounting for the Implications of Climate Change on Flood Risk

Final Report

Issue | 29 June 2012
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Appendix A
Assumptions Log
Executive Summary

Arup was commissioned to examine how decisions on the allocation of land for development are accounting for the implications of climate change on flood risk in England. The research was comprised of two main areas of research:

- Undertake a high-level review of how of local development plans have applied national planning policy on flood risk (referred to in the report as Task 2).
- Consider the weight given to flood risk in a changing climate in decision making and assess the costs and benefits of alternative development scenarios in selected case studies (referred to in the report as Task 3).

Applying national flood risk policy in development plans (Task 2)

The development plan analysis comprised a high level review of the strategic flood risk assessment (SFRA), strategic site allocations, the development plan text and the corresponding narrative in each Inspector’s report for the selection of 42 case study authorities. It was not a full scale and in depth review of the evidence base and development plan making process in each of the Local Authorities considered.

The first part of the development plan assessment focussed on the SFRAs and sought to understand how this key evidence informing development plan production had changed over time and what influence that might be having on land allocation outcomes.

From this analysis the following key conclusions were drawn:

- Since 2006 SFRA production has improved in relation to the range of evidence considered in their production and there is a consistency between Local Authorities in relation to the climate change scenario used.
- The climate change scenarios used conform with National Policy and 90% (29/32) of the SFRAs reviewed accounted for climate change.
- The recommendations made by SFRAs and the policy responses to managing flood risk in development plan lean heavily towards prescribing flood resilience measures and also applying the sequential test again when allocations are bought forward for development to ensure the non water compatible uses are located in the parts of the site least at risk.

The next part of development plan analysis examined on how the 42 local planning authorities have applied the PPS25 tests when making strategic land allocations. Of the allocations studied, 36% (by land area) were in areas at risk of flooding. Of that portion, around half were at risk of pluvial (surface water) flooding and half at risk of coastal/tidal or fluvial (river) flooding, or both.

The third part of development plan analysis sought to understand the other physical constraints which may have influenced decisions whether to allocate land for development in the floodplain. This comprised a high level, GIS based analysis of whether sufficient land outside the floodplain appeared to be available to authorities which allocated land within the flood plain.

The analysis found that 36 of the 42 authorities did appear to have sufficient available land outside the floodplain. These 36 authorities represented 88 of the 104 allocations within the floodplain.
There was a mixed approach taken by Local Authorities to documenting how they applied the sequential test. Less than a quarter (10 out of 42) of the local authorities studied had transparently considered alternative locations in areas of lower flood risk, as required by the sequential test. It was less clear how the remaining 32 authorities had undergone this process. Producing a separate technical note that demonstrates how the sequential test is transparently applied can be considered best practice.

The final part of development plan analysis was to analyse the justifications given by local planning authorities for locating development in the floodplain. The analysis found that, of the 104 strategic allocations at risk of river and coastal/tidal flooding, the justifications used were roughly split in thirds for overriding housing need (39), overriding regeneration need (33) and overriding employment need (26), with a small number being other or not recorded (6).

Separately the analysis of all 200 allocations at some risk of flooding found that there was around a 70-30 split between allocations on previously developed land (139) and those on greenfield sites (61).

**Weighting and costing flood risk (Task 3)**

The aim of the weighting and costing analysis was to explore how local planning authorities weigh up current and future flood risk (in a changing climate) against other factors, influences strategic decisions for accommodating new development. Fourteen case study local authorities were selected from the sample of 42 with the analysis of each authority comprising a multi-criteria analysis (MCA) which drew upon each plan’s sustainability appraisal, and a quantified cost analysis (CA).

The multi-criteria analysis found that:

- ‘Improving Housing Choice’ is a key policy driver and appears across all Core Strategies;
- In those case study local authorities which were most at risk of flooding ‘Minimise impact on Climate Change’, ‘Manage Current and Future Flood Risk, accounting for Climate Change and ‘Protecting and Improving Natural Assets’ were valued MCA objectives; and
- Case study local authorities least at risk of flooding most valued ‘Improving amount and range of Employment’ and ‘Encouraging Growth and Economic Prosperity’.

The impact of new development on flood risk in a changing climate is recognised as an issue by the example local authorities studied and given higher weight in authorities located on the coast or an Estuary. However, other objectives such as improving housing choice frequently outweigh flood risk in deciding how to accommodate development in a local authority area.

For the cost analysis, the shaping question for the cost analysis research was ‘What are the long term economic costs of accommodating development targets in the floodplain?’ The cost analysis quantified the changing pattern of economic costs over the next century for each of the fourteen case study areas. The analysis does not attempt to monetise the additional economic benefits that may be derived from development being located in the floodplain. However, by analysing the potential costs, the research provides insights on the likely pattern of “tipping points,” when the economic costs of locating in the floodplain exceed its benefits.
The findings of the analysis indicate that this tipping point is likely to vary greatly between different locations and development types but in all locations will occur sooner in time (or has occurred already):

- when the effects of climate change are accounted for. Climate change will lead to increases in expected damage to property;
- ; and
- where existing levels of structural flood protection are lower.

**Overall conclusions and recommendations**

Taken together, this research provides evidence that a robust decision making structure exists in England to enable local development plans to take account of current and future flood risk. In spite of that structure, other key planning objectives regularly provide justification for overriding that risk, leading to continued allocation of significant amounts of floodplain land for development. The research also provides an approach to measuring the economic costs of the changing pattern of flood risk from future climate change. The results of this analysis indicate that the full accounting of these costs could lead to more precautionary land use allocation decisions.

We recommend that this research is scaled up to a national level to enable a more comprehensive quantification of the impact of the planning system on future flood risk. We also recommend that further work is needed to develop the cost analysis methodology into a fully worked up and robust cost-benefit analysis method which can be applied by policymakers and planning authorities at different spatial scales, potentially as part of the Sustainability Appraisal process. Finally, we recommend that the best practice approaches to flood risk evidence for planning which are highlighted in this report are incorporated into formal guidance (i.e. from DCLG or the Environment Agency) to local planning authorities.
1 Introduction

In November 2011, The Adaptation Sub-Committee commissioned Arup, to examine how decisions on the allocation of land for development are accounting for the implications of climate change on flood risk in England.

The purpose of this report chapter is to outline:

- The Background to this Study;
- The Requirements of the Project Brief;
- The Approach to the Study; and
- The Local Authorities and Plan Types Selected.

1.1 Background to this Study: The ASC’s Objectives

The Adaptation Sub-Committee’s first report in September 2010 introduced a simple framework “the preparedness ladder” that set out the key steps that they would expect to see implemented if the UK were sufficiently preparing for climate change\(^1\). The report characterised adaptation as progressing from building capacity, to embedding climate change into long-term decisions, and taking timely adaptation action that leads to an adaptation outcome.

The ASC’s second report developed the ladder into a set of indicators against which progress on adaptation can be assessed\(^2\), focussing on the priority areas of land use planning, managing water resources, and the design and renovation of residential buildings.

The ASC’s next progress report (due for publication in July 2012), will focus on the UK’s preparedness for flooding and aims to reach a robust judgement on the UK’s preparedness for flood risk across the ASC’s preparedness ladder. It will report on whether long term strategic decisions are systematically accounting for climate change. To inform this, the research undertaken by Arup examines:

“Have strategic decisions on the allocation of future growth and development at the local plan level explicitly accounted for the implications of climate change on future flood risk?”

1.2 Background to this Study: Land Use Planning and Flood Risk

The requirement for local planning authorities to prepare development plans was first introduced in the Town and Country Planning Act 1947. The law and guidance relating to the production of development plans has evolved in the intervening period. However, the following principles have remained central to development plan making:

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1 Adaptation Sub-Committee (2010) How prepared is the UK for climate change?
2 Adaptation Sub-Committee (2011) Adapting to climate change in the UK – measuring progress
• Identify suitable land to meet a local authority areas future needs;
• Which is informed by an evidence base;
• Conforms with National Policy;
• Responds to community consultation ; and
• Is independently examined prior to adoption.

The development plan production system has been in a transition period since the enactment of the Planning and Compulsory Purchase Act 2004 so there are currently a number of different valid development plan types that make allocations for future development in England, set out below:

• Unitary Development Plans and Local Plans ‘old Plan Types’, which are in the process of being replaced by:
• Site Allocation Development Plan Documents and Area Action Plans which are informed by an overarching Core Strategy and together form a Local Development Framework.

However it is a time of change again. The National Planning Policy Framework refers to Local Plans which can be reviewed whole or in part and a new lower tiers of plans (introduced by the Localism Act 2010) called Neighbourhood Plans. However the central plan making principles described above remain intact.

National Planning Policy is central to the production of development plan policy. The Planning and Compulsory Purchase Act 2004 states that a local planning authority must have regard to national policies and advice contained in guidance issued by the Secretary of State.

When this study was commissioned in November 2011, the national policy on planning and flood risk was contained in Planning Policy Statement 25: Development and Flood Risk. PPS25 was originally issued on 7 December 2006, with a revised edition issued on 29 March 2010. A key aspect of PPS25 was its advocating a strategic spatial planning approach to development and flood risk. Local Planning Authorities were required to adopt policies for the location of development that avoid flood risk to people and property where possible, and manage any residual risk, taking account of the implications of climate change.

All local planning authorities must produce a Strategic Flood Risk Assessment as part of the evidence base informing development plan production. Notwithstanding the importance of flood risk in strategic planning decisions, PPS25 confirmed that LPAs should consider flood risk alongside other spatial planning issues such as transport, housing, economic growth, natural resources, regeneration, biodiversity, the historic environment and the management of other hazards. The allocation of land for strategic development is therefore subject to competing decision making processes.

On 27 March 2012, PPS25 (along with all other Planning Policy Statements and Planning Policy Guidance Notes) was revoked and replaced with the National Planning Policy Framework (NPPF). However the Practice Guides, including the PPS25 Practice Guide were retained The need to apply the Sequential Test and Exception Test to development proposed in the floodplain has been incorporated into the NPPF. A comparison between the content of PPS25 and the NPPF is provided below and it is evident that the main principles of PPS25 have been retained.
## Table 1. The main principles of PPS 25 and the NPPF

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<td>LPAs are required to adopt policies for the location of development that avoid flood risk to people and property where possible, and manage any residual risk, taking account of the implications of climate change.</td>
<td>The NPPF requires that local planning authorities should adopt proactive strategies to mitigate and adapt to climate change, taking full account of flood risk, coastal change and water supply and demand considerations. It states that inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere.</td>
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<td>Required a sequential risk based approach to determining the suitability of land for development in flood risk areas.</td>
<td>The NPPF requires Local Plans to apply a sequential, risk-based approach to the location of development to avoid where possible flood risk to people and property and manage any residual risk, taking account of the impacts of climate change.</td>
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| For the Exception Test to be passed, the PPS required: 
  a) it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA. The benefits of the development should contribute to the Core Strategy’s Sustainability Appraisal; 
  b) the development should be on developable previously-developed land or, if it is not on previously developed land, that there are no reasonable alternative sites on developable previously-developed land; and 
  c) a FRA must demonstrate that the development will be safe, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall. | If, following application of the Sequential Test, it is not possible, consistent with wider sustainability objectives, for the development to be located in zones with a lower probability of flooding; the NPPF requires the Exception Test to be applied if necessary. For the Exception Test to be passed:  
  • it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a Strategic Flood Risk Assessment where one has been prepared; and  
  • a site-specific flood risk assessment must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall. Both elements of the test will have to be passed for development to be allocated or permitted. |
| The PPS sought to ensure that SFRAs are completed and used to inform strategic planning decisions and that good working partnerships are developed and maintained between local authorities and the Environment Agency and other key stakeholders to manage the risk of flooding at the earliest stage. In appraising flood risk, PPS25 states that SFRAs should contribute to the sustainability appraisal of the plan making process. | Local Plans should be supported by Strategic Flood Risk Assessment and develop policies to manage flood risk from all sources, taking account of advice from the Environment Agency and other relevant flood risk management bodies, such as lead local flood authorities and internal drainage boards. |
| PPS25 stated that where climate change is expected to increase flood risk so that some existing development may not be sustainable in the long term, LPAs should consider whether there are opportunities in the preparation of LDDs to facilitate the relocation of | The NPPF states that where climate change is expected to increase flood risk so that some existing development may not be suitable in the long term, seeking opportunities to facilitate the relocation of development, including housing, to more sustainable locations. |
PPS25 | NPPF
---|---
development, including housing to more sustainable locations at less risk from flooding. | Technical guidance on flood risk is published alongside the Framework which sets out how this policy should be implemented. Taking climate change into account; contingency allowances for net sea level rises and sensitivity ranges for peak rainfall intensities, peak river flows, offshore wind speeds and wave heights.

Appendix B of PPS25 focuses on the potential effects of climate change. It provides sensitivity ranges for the impact of climate change on rainfall intensities, river flow, wave height and wind speed which can be factored into SFRAs and the plan making process to help address the implications of climate change on long term flood risk. In addition it states based on sensitivity testing of the flood map produced by the Environment Agency, sites currently located within a lower risk zone could be reclassified as lying within a higher risk zone, thus having implications for the vulnerability of land to flooding as a consequence of climate change.

Notwithstanding the importance of flood risk in strategic planning decisions, PPS25 confirms that LPAs should consider flood risk alongside other spatial planning issues such as transport, housing, economic growth, natural resources, regeneration, biodiversity, the historic environment and the management of other hazards.

Mitigating and adapting to a changing climate is part of the definition of sustainable development provided in the NPPF and roles that the planning system should perform. Supporting the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change is one of the NPPF's 12 core planning principles.

1.3 **Requirements of the Project Brief**

Arup was commissioned to assess how National Planning Policy on flood risk (PPS 25) has been applied and how the implications of climate change on future flood risk has been considered in strategic decisions on the allocation of land for development, through a high-level review of local development plans.

In addition, Arup was commissioned to explore how explicitly weighing up current and future flood risk (in a changing climate) against other factors influences strategic decisions for accommodating new development, to understand the following:

- Whether the longer term risks of flooding in a changing climate are truly considered in the plan making process;
- What weight was given to flood risk and associated climate change implications in comparison to other issues; and
- Where, taking account of monetised costs and benefits, development in the floodplain could potentially justified at the local economy level.

To meet these requirements, the methodology for carrying out this research project has been focussed into three key tasks.
Table 2. Three key tasks and the relevant section of the report

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<td><strong>Task 2</strong>: Undertake a high-level review of how of these local development plans have applied national planning policy on flood risk.</td>
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<td><strong>Task 3</strong>: Consider the weight given to flood risk in a changing climate in decision making and assess the costs and benefits of alternative development scenarios in selected case studies.</td>
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1.4 **Approach to the Study**

This is a research study which has examined one of the many elements considered in the plan production process; flood risk. It represents a review of the evidence base and the resulting decision making relating to flood risk that informed the production of the development plan in pragmatic selection of 42 different local authority areas in England. The selection of these authorities was driven by the desire to review the most up to date plan types that make land allocations: Site Allocations Development Plan Documents produced in accordance with the 2004 Planning Act.

However, coverage of this plan type is limited across England. At November 2011, only 18 Local Authorities had adopted Site Allocation Development Plan Documents and a further 9 Local Authorities had reached examination stage. Local Authorities with other plan types adopted post issue of PPS25 in 2006 were therefore selected to ensure the selection was of sufficient size to draw meaningful results. Therefore a range of plan types adopted between 2006 and to date have been reviewed.

The study has undertaken a high level review of the flooding related evidence base (focusing on all types of flooding) informing the development plans studied. Therefore if a plan were adopted in 2007 the evidence base which informed that plan has been examined. This enables the study to recognise change and improvement in the evidence base and resultant decision making over time. It is however acknowledged that all Local Authorities are progressing with their Local Development Frameworks and this includes producing an improved and updated evidence base to that which informed the adopted development plan reviewed in this study.

The selection of the Local Authorities reviewed has been pragmatic and led by the plan types available to review. The findings therefore do not seek to highlight worst or best practice in England or state if the allocations are compliant with Government policy or not, but provide an insight to how flood risk issues are balanced and valued against other often competing matters that collectively influence the making of land allocations.

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3 The study brief requires the selection of between 30 and 50 Local Authorities in England.
4 With the exception of York where the local plan was adopted in 2005
The study has also identified the strategic allocations\(^5\) made in the development plans reviewed, which are at risk of different types of flooding. It has sought to interpret the justification given by the LPA for locating this development in the floodplain and whether there were any objections to the proposed allocation on flood risk grounds at the Examination of the plan in Public which were considered by an Inspector.

The study has also sought to understand whether other constraints which limit the land available in a local authority area has a bearing on whether land is allocated in the floodplain.

For clarity, the results from this study are based on a high level review of the strategic flood risk assessment, the development plan text and the corresponding narrative in the Inspector's report for 42 Local Authorities across England. It is not a full scale and in depth review of the evidence base and development plan making process in each of the Local Authorities considered.

The outputs of the review have been captured through two assessment proforma (1: Evidence Base and 2: Strategic Allocations) and where possible the findings have been quantified for analysis. The proforma are included in the Technical Annex to this report.

All assumptions made in examining and reviewing the information and presenting the results are set out in Appendix A.

\(^5\) Strategic Allocations are employment and mixed use sites of 5ha or more and housing sites of 50 dwellings or more
1.5 Local Authorities and Plan Types Selected

The study brief required the review of between 30 and 50 development plans. A stepped approach was taken to the identification of the appropriate Local Authorities:

- **Step 1:** The selection of local authorities was driven by the desire to review the most up to date plan types that make land allocations: Site Allocations Development Plan Documents produced in accordance with the 2004 Planning and Compulsory Purchase Act. Across England at November 2011, 27 local authorities had a Site Allocations Development Plan Document (DPD) that has been found sound and adopted or has been submitted to the planning inspectorate for examination. Most of these Local Authorities were located in the south or east of England.

- **Step 2:** review of alternative Plans to complement the identified Site Allocations Development Plan Documents in the following parts of England: East Midlands, North East, North West, South West, West Midlands and Yorkshire and Humber. The options included adopted Core Strategies which made strategic allocations, local authorities which had both an adopted Core Strategy and adopted Area Action Plans and Unitary Development Plans (UDPs) / Local Plans adopted since 2006.

- **Step 3:** Confirmation of the final selection: a) All Site Allocations DPDs which are adopted and have been submitted to the planning inspectorate for examination (as of November 2011) b) one authority with a Core Strategy which made a number of strategic allocations which could be examined in this study c) one authority which had an adopted Core Strategy together with a number of adopted Area Action Plans to include in the study as this provided coverage of the local authority area; and d) a number of local authorities with a range of urban, rural, coastal and inland characteristics with either a Local Plan or Unitary Development Plan adopted after 2006 (with the exception of York adopted in 2005).

This led to a total of **42 local authorities** to be examined. The location of these local authorities and plan types is shown in Figure 1.

An overview of the broad characteristics of the 42 local authorities selected is included in the Technical Annex in support of this report.
Figure 1. Location of the Local Authorities selected for this study by Plan Type
2 Review of Flood Risk Evidence Base Informing Development Plans

The first part of the research focuses on Strategic Flood Risk Assessments (SFRA), the role of evidence in the plan making process; with a summary of the analysis into the evidence base informing SFRAs and whether this in turn is informing the land allocations included in Development Plans.

2.1 Role of Evidence in the Plan Making Process

The National Planning Policy Framework (2012) states that “each local planning authority should ensure that the Local Plan is based on adequate, up-to-date and relevant evidence about the economic, social and environmental characteristics and prospects of the area. Local planning authorities should ensure that their assessment of strategies for housing, employment and other uses are integrated and that they take full account of relevant market and economic signals”.

The NPPF also states that in the examination of Local Plans, to find a plan sound it must be positively prepared, justified, effective and consistent with national policy. To be ‘justified’ the plan should be the most appropriate strategy when considered against the reasonable alternatives, based on proportionate evidence.

National Policy requires the preparation of a strategic flood risk assessment (SFRA) as evidence to inform development plans.

SFRA...
policies and practices required to ensure that development in such areas satisfies the requirements of the Exception Test.

2.2  **Approach to Analysing the Evidence Base**

To draw conclusions from this study it was considered important to first undertake a high level review of the flood related evidence base informing development plan production, to understand how this had changed over time and also ascertain what influence that might be having on land allocation outcomes.

Therefore the first part of the assessment focussed on the strategic flood risk assessment (SFRA). The SFRA is the part of the plan evidence base which forms the main link between national policy on development and flood risk with securing better outcomes on the ground.

An assessment proforma was devised to assess the SFRAs informing the development plans selected for this study. The following indicators / questions were developed to undertake the assessment:

- Was an SFRA produced as part of the evidence base informing the preparation of the development plan?
- Was the SFRA completed to the appropriate level (Level One or Level Two)?
- Has the SFRA included a consideration of all sources of flood risk (river and coastal/tidal, coastal, critical drainage, infrastructure failure)?
- Did the SFRA include the use of national datasets?
- Did the SFRA include information from other stakeholders (e.g. water companies)?
- Did the SFRA incorporate climate change allowances in accordance with the guidance (scenarios explored)?
- Has the SFRA been used to inform policies on flood risk (accounting for climate change) in the development plan?

The proformas have been prepared as part of a database using Microsoft Infopath, which provides a greater degree of flexibility of reporting outputs and can accommodate future extensions or repetitions of the study. The database ensures greater revision control and data consistency with several staff undertaking plan analysis in parallel.

2.3  **Analysis**

The results from the analysis of strategic flood risk assessments (SFRA) have been structured as follows, to examine:

- The evidence base that has been used to inform SFRAs; and
- How SFRAs are in turn informing development plans.
2.3.1 Improvement in the Evidence Base

The Publication of Strategic Flood Risk Assessments (SFRA)

As a benchmark, analysis was carried out into the Strategic Flood Risk Assessments (SFRA) produced to inform Development Plan Documents (DPD), looking specifically at:

- Plan Type
- Year the SFRA was produced
- What level the SFRA was carried out to
- Average number of years between the SFRA being carried out and the DPD being adopted.

The analysis has found that of the 42 local authorities and development plans studied as part of this project:

- In 10 Local Authorities their plans were not informed by an SFRA. These were all Local Plans / Unitary Development Plans adopted between 2005 and 2007 and one Site Allocations DPD adopted in 2008.
- 32 of the development plans for the 42 Local Authority Areas examined were informed by an SFRA.
- Two Local Authorities\(^6\) undertook a pre-PPS25 SFRA in 2002.
- 12 Local Authorities carried out a Level 1 SFRA.
- 18 Local Authorities carried out a Level 2 SFRA.
- The average number of years between an SFRA being carried out and the DPD which it informs being adopted has remained at around 3 years.

Table 3. Average number of years between SFRA production and Plan Adoption

<table>
<thead>
<tr>
<th>Year Plan Adopted</th>
<th>Number of SFRA (from LA Studied)</th>
<th>Average No Years between SFRA production and Plan Adoption</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2007</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>2008</td>
<td>3</td>
<td>1.6</td>
</tr>
<tr>
<td>2009</td>
<td>2</td>
<td>2.5</td>
</tr>
<tr>
<td>2010</td>
<td>7</td>
<td>3.1</td>
</tr>
<tr>
<td>2011</td>
<td>7</td>
<td>3.4</td>
</tr>
<tr>
<td>2012</td>
<td>9</td>
<td>3.75</td>
</tr>
</tbody>
</table>

\(^6\) Leicester and South Holland
The Evidence Informing SFRAs

An important aspect of the assessment into SFRAs was to understand what datasets were being used to inform their production, and how that has changed and evolved over time.

The datasets the assessment sought to identify were:

- Environment Agency Flood Map (this only covers river and tidal flooding);
- SMP: Shoreline Management Plans;
- CFMP: Catchment Flood Management Plans;
- NFRA: National of Flood Risk Assessment (England);
- Historic Flood Maps;
- LCLIP: Local Climate Impacts Profile;
- Areas susceptible to surface water flooding;
- PFRA: Preliminary Flood Risk Assessment; and
- Locally held data e.g. Catchment Topography (LiDAR); Critical Ordinary Watercourse (COW) designations and investigations; Section 105 investigations for watercourses; and Hydrometric data.

Table 4. Data sets used in SFRA production, by year and Level of SFRA

<table>
<thead>
<tr>
<th>Year</th>
<th>SFRA Level</th>
<th>Data sources used</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>SMP</td>
</tr>
<tr>
<td>2006</td>
<td>Pre Guidance</td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>Pre Guidance</td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>Level 1</td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>Level 1</td>
<td></td>
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<tr>
<td>2008</td>
<td>Level 1</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>Level 1</td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>Level 2</td>
<td></td>
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<tr>
<td>2009</td>
<td>Level 2</td>
<td></td>
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<tr>
<td>2010</td>
<td>Level 1</td>
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<td>2010</td>
<td>Level 1</td>
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<tr>
<td>2010</td>
<td>Level 1</td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>Level 1</td>
<td></td>
</tr>
<tr>
<td>Year</td>
<td>SFRA Level</td>
<td>Data sources used</td>
</tr>
<tr>
<td>------</td>
<td>------------</td>
<td>--------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SMP</td>
</tr>
<tr>
<td>2010</td>
<td>Level 1</td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>Level 2</td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>Level 2</td>
<td></td>
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<tr>
<td>2011</td>
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<td>2011</td>
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<td>2011</td>
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<td>2011</td>
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<td>2011</td>
<td>Level 2</td>
<td></td>
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<tr>
<td>2011</td>
<td>Level 2</td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>Level 1</td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>Level 1</td>
<td></td>
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<tr>
<td>2012</td>
<td>Level 2</td>
<td></td>
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<tr>
<td>2012</td>
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<tr>
<td>2012</td>
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<td>2012</td>
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<td>2012</td>
<td>Level 2</td>
<td></td>
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<tr>
<td>2012</td>
<td>Level 2</td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>Level 2</td>
<td></td>
</tr>
</tbody>
</table>
The table above illustrates that of 32 local authorities with a development plan, which was informed by an SFRA:

- The number and range of datasets used to inform SFRAs has increased over time, and a wider range of datasets are used to inform Level 2 SFRA.
- The three key datasets that have been utilised in each year between 2006 and to date are: CFMPs; Historic Maps; and locally held information.
- 72% (23/32) of SFRA were informed by a CFMP.
- 34% (11/32) of SFRA were informed by a SMP.
- The number of datasets used and required is dependent on the location of the local authorities subject to the SFRA, with local authorities at higher risk of flooding from different sources, in coastal and estuary locations likely to draw on a wider number of datasets.
- The two sources of data cited least were Local Climate Impacts Profile (LCLIP) and National Assessment of Flood Risk for England (NAFRA).

**Climate Change Scenarios**

Ensuring an allowance for climate change was a requirement of PPS25 that has been retained in the NPPF. The assessment process sought to whether the SFRA for each local authority had incorporated climate change allowances or not, and if so what scenarios had been explored.

The scenarios outlined in the assessment proforma were:

- UKCIP Projections
- PPS25 Annex B Figures
- EA Guidance
The research into climate change scenarios for the local authorities and development plans as set out in the chart above, illustrates that:

- In the period 2006 – 2007 the only cited source for climate change scenarios was Environment Agency Guidance, with the rest either null i.e. climate change was not taken into account or other/not known.
- In the period 2008 – 2012, there is an increasing trend, with the most cited source of climate change scenarios as PPS 25 Annex B Figures.
- In the light of an increasing trend for the period 2008 – 2012 to using the climate change scenarios set out in PPS 25 Annex B Figures, there are still some SFRAs which use EA Guidance (two in 2011 and one in 2012).
- There was one local authority SFRA which used the climate change scenarios set out in the UKCIP02 Projections (which have now been updated by UKCP09 Projections).

### 2.3.2 How Evidence is Informing Development Plans

**The Evidence Base**

It is clear that between 2006 and to date that SFRA production has improved in relation to the range of evidence considered in their production and there is a consistency between Local Authorities in relation to the climate change scenario used.

---

7 Ashford District Council SFRA (2006)
SFRA Recommendations for the Plan Making Process

SFRA make recommendations to the plan making process which include recommendations which reinforce National Policy (the application of the Sequential and if required, the Exceptions test to bringing forward land for development in the floodplain). Other recommendations include identifying appropriate flood resilience and mitigation measures and in some cases recommending strategic measures such as the need for new or enhanced flood defences.

The table below draws on the qualitative analysis of the review of SFRA produced to inform 32 of the 42 Local Authority Development Plans studied. The recommendations and policy response have been grouped into commonly arising themes.

Table 5. SFRA Recommendations and their Application in the Development Plan

<table>
<thead>
<tr>
<th>Local Authority</th>
<th>SFRA recommendation</th>
<th>Recommendation applied to the Development Plan?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ashford District</td>
<td>flood resilience measures</td>
<td>flood resilience measures Identifies part of the LA area where it is not appropriate to locate development due to flood risk</td>
</tr>
<tr>
<td></td>
<td>flood resilience measures</td>
<td>flood resilience measures Avoid locating most vulnerable uses in areas at risk Developer contributions required for defences and mitigation measures.</td>
</tr>
<tr>
<td>Barking and Dagenham London Borough</td>
<td>flood resilience measures</td>
<td>flood resilience measures Avoid locating most vulnerable uses in areas at risk Developer contributions required for defences and mitigation measures.</td>
</tr>
<tr>
<td>Breckland District</td>
<td>flood resilience measures</td>
<td>flood resilience measures Avoid locating most vulnerable uses in areas at risk Developer contributions required for defences and mitigation measures.</td>
</tr>
<tr>
<td>Brent London Borough</td>
<td>flood resilience measures Avoid locating most vulnerable uses in areas at risk</td>
<td>Avoid locating most vulnerable uses in areas at risk</td>
</tr>
<tr>
<td>Carlisle</td>
<td>Not Known</td>
<td>Not Known</td>
</tr>
<tr>
<td>Central Bedfordshire</td>
<td>Identifies parts of LA area most at risk of flooding Flood resilience measures Avoid locating most vulnerable uses in areas at risk</td>
<td>flood resilience measures Identifies part of the LA area where it is not appropriate to locate development due to flood risk</td>
</tr>
<tr>
<td>Chelmsford District</td>
<td>flood resilience measures Avoid locating most vulnerable uses in areas at risk</td>
<td>flood resilience measures Avoid locating most vulnerable uses in areas at risk</td>
</tr>
<tr>
<td>Local Authority</td>
<td>SFRA recommendation</td>
<td>Recommendation applied to the Development Plan?</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>--------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| City of Peterborough         | flood resilience measures
Avoid locating most vulnerable uses in areas at risk                                     | flood resilience measures
Avoid locating most vulnerable uses in areas at risk                           |
| Colchester District          | flood resilience measures
Avoid locating most vulnerable uses in areas at risk                                     | flood resilience measures
Avoid locating most vulnerable uses in areas at risk                           |
| Hambleton District           | flood resilience measures
Avoid locating most vulnerable uses in areas at risk                                     | flood resilience measures
Avoid locating most vulnerable uses in areas at risk                           |
| Havant Borough Council       | flood resilience measures
Makes recommendations by characteristic of LA area
Avoid locating most vulnerable uses in areas at risk                           | Identifies locations where specific measures are required if development in the floodplain is necessary |
| Havering London Borough.     | flood resilience measures                                                              | flood resilience measures                                                     |
| Horsham District             | Recommended that land in Flood Zone 3 was only used for water compatible uses.        | Yes these recommendations were applied to the allocations in the DPD          |
| Leicester                    | flood resilience measures
Compensatory flood storage                                                        | flood resilience measures
Compensatory flood storage required in some site specific policies             |
| Mid Devon District           | Identified what type of development was appropriate in each flood zone.              | Recommended that land in Flood Zone 3 was only used for water compatible uses. |
| Middlesbrough               | flood resilience measures                                                              | flood resilience measures                                                     |
| North Norfolk District       | Recommends a sequential approach to the allocation of land for development            | Stated as followed in plan                                                   |
| Plymouth                    | Identifies parts of LA area most at risk of flooding
Flood resilience measures
Avoid locating most vulnerable uses in areas at risk                            | flood resilience measures                                                     |
| Poole                       | flood resilience measures
Compensatory flood storage                                                        | Need for defences identified                                                  |
<table>
<thead>
<tr>
<th>Local Authority</th>
<th>SFRA recommendation</th>
<th>Recommendation applied to the Development Plan?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading</td>
<td>Identifies parts of LA area most at risk of flooding</td>
<td>Planning permission will not be granted for development in an area identified as being at high risk of flooding, where development would reduce the capacity of the flood plain to store floodwater, impede the flow of floodwater or in any way increase the risks to life and property arising from flooding.</td>
</tr>
<tr>
<td>Sandwell District</td>
<td>Identified what type of development was appropriate in each flood zone.</td>
<td>Flood resilience measures</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Avoid locating most vulnerable uses in areas at risk</td>
</tr>
<tr>
<td>Slough</td>
<td>Identified areas of district at risk for flooding and highlights the requirement for a Level 2 FRA prior to making allocations here.</td>
<td>Those sites in Flood Zones 2 and 3 which were included in the Site Allocations DPD specifically include the reference to the need to complete a sequential test.</td>
</tr>
<tr>
<td>South Cambridgeshire District</td>
<td>flood resilience measures</td>
<td>Flood resilience measures</td>
</tr>
<tr>
<td>South Holland</td>
<td>Potential need to improve defences</td>
<td>Flood resilience measures</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Developer contributions required for defences and mitigation measures.</td>
</tr>
<tr>
<td>South Tyneside District</td>
<td>flood resilience measures</td>
<td>Flood resilience measures</td>
</tr>
<tr>
<td></td>
<td>Avoid locating most vulnerable uses in areas at risk</td>
<td>Avoid locating most vulnerable uses in areas at risk</td>
</tr>
<tr>
<td>Spelthorne District</td>
<td>flood resilience measures</td>
<td>Flood resilience measures</td>
</tr>
<tr>
<td></td>
<td>Avoid locating most vulnerable uses in areas at risk</td>
<td>Avoid locating most vulnerable uses in areas at risk</td>
</tr>
<tr>
<td></td>
<td>Need relocate existing areas at risk considered (but resolved to be unreasonable)</td>
<td>Developer contributions required for defences and mitigation measures.</td>
</tr>
<tr>
<td>Sunderland</td>
<td>flood resilience measures</td>
<td>Flood resilience measures</td>
</tr>
<tr>
<td>Sutton London Borough</td>
<td>flood resilience measures</td>
<td>Flood resilience measures</td>
</tr>
<tr>
<td>Tonbridge and Malling District</td>
<td>flood resilience measures</td>
<td>Flood resilience measures</td>
</tr>
<tr>
<td></td>
<td>Avoid locating most vulnerable uses in areas at risk</td>
<td>Avoid locating most vulnerable uses in areas at risk</td>
</tr>
<tr>
<td>Wakefield District</td>
<td>flood resilience measures</td>
<td>Flood resilience measures</td>
</tr>
<tr>
<td></td>
<td>Avoid locating most vulnerable uses in areas at risk</td>
<td>Avoid locating most vulnerable uses in areas at risk</td>
</tr>
</tbody>
</table>
It is clear that most SFRA and development plan policies in relation to flood risk are comfortable with prescribing flood resilience and mitigation measures and directing, within specific allocations, how the most vulnerable uses should be located on the parts of the site least at risk of flooding.

The figure below shows that of the 32 development plans informed by an SFRA, the measures that were prescribed in policies in these plans (for example as part of policies relating to the bringing allocated sites forward for development).

<table>
<thead>
<tr>
<th>Local Authority</th>
<th>SFRA recommendation</th>
<th>Recommendation applied to the Development Plan?</th>
</tr>
</thead>
</table>
| Wandsworth London Borough. | flood resilience measures  
Avoid locating most vulnerable uses in areas at risk | flood resilience measures 
Avoid locating most vulnerable uses in areas at risk |
| Waveney District      | flood resilience measures  
Avoid locating most vulnerable uses in areas at risk | flood resilience measures 
Avoid locating most vulnerable uses in areas at risk |
Figure 3. Flood Risk Management Policies in Development Plans Reviewed

The figure above shows that only two local authorities have identified parts of the local authority area where it is not appropriate to develop non water compatible uses in the floodplain. Five Local Authorities seek to address flood risk strategically by identifying the need to contribute to enhanced flood defences. Seventeen local authorities require the sequential test to locating development types within a site to be followed. This is a requirement of national guidance (which is a material consideration in the determination of applications) and local authorities are urged not to repeat national policy in local planning policy.

2.4 Summary

From the review of 42 Local Authorities:

- 32 of the 42 Local Authority Development Plans examined were informed by an SFRA.
- The average number of years between an SFRA being carried out and the DPD which it informs being adopted has remained at around 3 years.
- An increasing range of data sets are now used to inform SFRA production.
- 72% of SFRAs were informed by a CFMP
- 34% of SFRAs were informed by a SMP
- The climate change scenarios used conform with National Policy and 90% (29/32) of the SFRA reviewed accounted for climate change.
The recommendations made by SFRAs and the policy responses to managing flood risk in development plan lean heavily towards prescribing flood resilience measures and also applying the sequential test again when allocations are bought forward for development to ensure the non water compatible uses are located in the parts of the site least at risk.

3 Review of Strategic Allocations at Risk of Flooding

This part of the research focuses on how LPAs have applied the PPS25 tests when making strategic land allocations.

As set out in chapter 1, whilst the National Planning Policy Framework (NPPF) and the Technical Guidance to the NPPF has revoked and replaced PPS 25, it has retained many of its key elements, namely the sequential and exceptions tests. In addition, the PPS25 Practice Guide remains extant and provide more detailed guidance on the application of these tests.

This chapter sets out the approach to reviewing strategic allocations and the presents the headline findings.

3.1 The Purpose of Land Allocations in the Plan Making Process

In terms of making allocations for development as part of the plan making process, The National Planning Policy Framework (para 157) states that Local Plans should:

- Indicate broad locations for strategic development on a key diagram and land use designations on a proposal map;
- Allocate sites to promote development and flexible use of land, bringing forward new land where necessary, and provide detail on form, scale, access and quantum of development where appropriate; and
- Identify land where development would be inappropriate, for instance because of environmental or historic significance.

By allocating land for development, the plan establishes that the principle of that land being developed for the use(s) identified is acceptable.

The review of strategic allocations at risk of flooding examines the key drivers in the decision making process leading to the allocation of sites in flood zones.

3.2 Approach to Reviewing Allocations

Relevant Plan Documents

The research has reviewed a range of plan types which make land allocations across 42 Local Authorities in England. The objective was to review the most up to date plan types (Site Allocation DPDs) and the next best alternatives to comprise a reasonable research basis to provide meaningful results.
<table>
<thead>
<tr>
<th>Plan Type (Status at November 2011)</th>
<th>Number Reviewed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adopted Site Allocations DPD</td>
<td>18</td>
</tr>
<tr>
<td>Site Allocations DPD currently being Examined</td>
<td>9</td>
</tr>
<tr>
<td>Core Strategy which made Strategic Allocations</td>
<td>1</td>
</tr>
<tr>
<td>Core Strategy and Area Action Plans</td>
<td>1</td>
</tr>
<tr>
<td>Unitary Development Plans / Local Plans Adopted from 2006⁸</td>
<td>13</td>
</tr>
</tbody>
</table>

### Identifying Strategic Allocations

The research has focused on a review of strategic allocations made in the development plans of the 42 Local Authorities studied. A strategic allocation for the purposes of this study has been defined as ‘site allocations which are fundamental to the delivery of the development plan’s core aims and objectives’.

To identify strategic allocations, a threshold of 5 ha or greater of land allocated for employment or mixed used and housing allocations of 50 dwellings or more was applied to all the allocations made in development plans of the 42 local authorities studied.

All allocations were reviewed using the proposals maps of the development plans of the 42 local authorities studied and for those meeting the ‘strategic allocation’ threshold the easting and northing reference for the centre of the site was obtained. This enabled the centre point⁹ of the allocations to be plotted using GIS and spatial analysis relating to flood risk data sets to be undertaken. It is acknowledged that since adoption of the development plans studied many of the allocations would have since been developed, however the purpose of this study is to examine the plan making process and the flood related evidence informing that process rather than to understand how an allocation has since been progressed through to development.

Data relating to the following matters has been obtained for the strategic allocations:

- Proposed use (from the development plan);
- Land use status (Greenfield or PDL) using MasterMap natural and manmade layers with a validation exercise checking the actual status of the sites within each LA using the development plan text and satellite imagery from Google Earth;
- The type of flood risk that the strategic allocation is vulnerable to (pluvial or river and coastal/tidal (flood zones 2 and 3 only)¹⁰), with river and coastal/tidal

---

⁸ With the exception of York Local Plan adopted in 2005
⁹ Our preferred approach would have been to obtain the shape file data for the allocations from each of the 42 LA to plot the area of the allocation in addition to its location, but the timescales of the study did not enable this to be pursued.
¹⁰ It is noted that the degree of flood risk can vary across a land allocation. Where over 50% of the land allocation was located in flood zone 3 (established by comparing the proposals map with the EA flood zones) then it is classed as ‘all or majority’ in flood zone 3)
flood risk further categorised as either river and coastal/tidal only, coastal and tidal only; or river and coastal/tidal, coastal and tidal);

- How the sequential test was applied, in terms of identifying alternative sites at lower flood risk;
- Whether the Exception test was applied to the consideration of any of the strategic allocations (from the SFRA and the plan text);
- The justification given for strategic allocations made in areas at risk of flooding was classified under 3 themes¹¹ (the plan text has been used to interpret the justification given by the LPA for locating this development in the floodplain).
- Whether the development plan stated that flood risk issues relating to a Strategic Allocation could be managed when the allocation was bought forward for development (from the plan text)
- Whether any third parties by type had made an objection to a strategic allocation which had been considered by an Inspector in their report¹² of the Plan (from the Inspectors Report where a plan had reached this stage in the process).

An assessment proforma was devised to capture the information on the strategic allocations at risk of all types of flooding.

### 3.2.1 Approach to Presenting the Analysis of Strategic Allocations

A wealth of factual information has been obtained from the review of Strategic Allocations. In order to make the analysis meaningful we have sought to report the results in the following manner:

- Headline facts to provide clarity on the number of strategic allocations, by use found to be at risk of all types of flooding (Section 3.3 below).
- An analysis structured around understanding the other physical constraints which may have influenced decision making relating to allocating land for development in the floodplain in the 42 Local Authorities studied i.e. a high level application of the sequential test (Chapter 4).

### 3.3 Headline Findings

**Strategic Allocations: All identified**

Across the 42 Local Authorities up to total of 15,567 ha¹³ of land was allocated for development in the plans types reviewed. From this 718 strategic allocations were identified totalling 9,677ha of land. Therefore, 62% of the total land allocations made across the 42 local authorities studied were defined as strategic allocations.

---

¹¹ Agreed following Project Steering Group discussion

¹² Inspectors reports on Plans produced in accordance with the 2004 Planning and Compulsory Purchase Act are binding on the local authority

¹³ In 6 Local Authorities the land area was not available for all sites allocated in their development plans, therefore this is as close to the land area as can be examined, excluding those particular sites.
Of 718 strategic allocations identified, 200 were found to be at risk of all types of flooding and comprise a total land area of 3,499ha. This means that 518ha were not at risk of flooding. Therefore 36% of the land area comprising strategic allocations examined was found to be at risk of flooding.

Of the 200 strategic allocations found to be at risk of flooding, 104 allocations were at risk of river and coastal/tidal flooding comprising an area of 1,598ha, with 96 allocations at risk of pluvial (surface water) flooding, accounting for a total land area of 1,857ha.

Table 7. Strategic Allocations at Risk of Flooding

<table>
<thead>
<tr>
<th>Area</th>
<th>Number</th>
<th>Proportions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Land Area Allocated for development across the 42 Local Authorities</td>
<td>15,577ha</td>
<td>-</td>
</tr>
<tr>
<td>Total Land Area defined as a Strategic Allocation</td>
<td>9,677ha</td>
<td>718</td>
</tr>
<tr>
<td>Total Land Area of Strategic Allocations NOT at risk of Flooding (all types)</td>
<td>6,178ha</td>
<td>518</td>
</tr>
<tr>
<td>Total Land Area of Strategic Allocations at risk of Flooding (all types)</td>
<td>3,499ha</td>
<td>200</td>
</tr>
<tr>
<td>Total Land Area of Strategic Allocations at risk of Pluvial and Coastal/Tidal Flooding</td>
<td>1,598ha</td>
<td>104</td>
</tr>
<tr>
<td>Total Land Area of Strategic Allocations at risk of Pluvial Flooding</td>
<td>1,857ha</td>
<td>96</td>
</tr>
</tbody>
</table>

Figure 4. Strategic Allocations – Flood Risk Type
The figure above shows that of the 104 strategic allocations found to be at risk of river (fluvial) and coastal/tidal flooding, over half (54) are at risk of both fluvial and coastal/tidal flooding, 36 Strategic Allocations at risk of coastal/tidal flooding only and 14 Strategic Allocations at risk of fluvial flooding only.

**Strategic Allocations: In the Floodplain**

Of the 104 strategic allocations found to be at risk of fluvial and coastal/tidal flooding, 61 are all or majority located within Flood Zone 3 (High Probability), with the remainder (43) all or majority located in Flood Zone 2 (Medium Probability).
3.4 Summary

From the allocations identified in the 42 Local Authority Development Plans:

- Up to 15,567ha of land was allocated for development in the development plans of the 42 Local Authorities studied.
- Of the 15,567ha allocated for development, the 718 strategic allocations accounted for 9,677ha of land allocated (62%).
- Of the 718 strategic allocations, 200 were at risk of all types flooding, comprising 3,499ha total land area.
- Of the 200 strategic allocations at risk of all types of flooding, 104 were at risk of river and coastal/tidal flooding; with 96 were at risk of pluvial (surface water) flooding.
- Of the 3,499ha of strategic allocations at risk of flooding, 1,598ha is at risk of river and coastal/tidal flooding; with 1,857ha at risk of pluvial (surface water) flooding.
- Of the 104 strategic allocations at risk of river and coastal/tidal flooding, 54 are at risk of both fluvial and coastal flooding, 36 at risk of coastal flooding only and 14 at risk of fluvial flooding only.
• Of the 104 strategic allocations at risk of fluvial and coastal/tidal flooding, 61 are located all or majority in Flood Zone 3, with 43 all or majority located in Flood Zone 2.

• Of the 61 strategic allocations located all or majority in Flood Zone 3, this comprises allocations for mixed use (26); housing (18); and employment (17).

• Of the 43 strategic allocations located all or majority in Flood Zone 2, this comprises allocations for housing (23); employment (13) and mixed use (7).
4 Review of the Application of the Sequential Test

This aspect of the research, is structured around understanding the other physical constraints which may have influenced decision making relating to allocating land for development in the floodplain in the 42 Local Authorities studied i.e. a high level application of the sequential test.

4.1 Requirement to Consider Alternatives to the Flood Plain

The aim of the Sequential Test is to steer new development to areas with the lowest probability of flooding.

The flood zones (Table 1 of the Technical Guidance to the NPPF) are the starting point for this sequential approach:

- Zone 1 - low probability
- Zone 2 - medium probability
- Zone 3a - high probability
- Zone 3b - the functional floodplain

Together with the identifying the vulnerability of different uses to flood risk (Table 2 of the Technical Guidance to the NPPF):

- Essential Infrastructure (transport and utilities infrastructure)
- Highly Vulnerable (Emergency Service stations, basement dwellings, caravans/ mobile homes, Hazardous substance installations)
- More Vulnerable (Hospitals health and education services, residential and hazardous waste landfill)
- Less Vulnerable (Shops, services, offices, business and industry, waste treatment)
- Water compatible development

PPS25 stated that LPA allocating land for development should apply the Sequential Test to demonstrate that there are no reasonably available sites in areas with a lower probability of flooding that would be appropriate to the type of development or land use proposed.

The NPPF Technical Guidance states that where there are no reasonably available sites in Flood Zone 1, LPA allocating land in local plans or determining planning applications for development at any particular location should take into account the flood risk vulnerability of land uses and consider reasonably available sites in Flood Zone 2 applying the Exception Test if required.

Neither PPS25 or the NPPF define how to interpret ‘reasonably available’. The extant PPS25 Practice Guide refers to the deliverable and developable definition provided PPS3: Housing which has now been superseded by the NPPF.
4.2 Approach to Considering Alternatives

Using GIS total land area of 42 Local Authorities studied was calculated. In addition, for each of the Local Authorities the following data sets have been mapped:

- National Designations (SSSI, SPA, SAC, National Park, Ancient Woodland and National Nature Reserve)
- AONB
- Grade 1 and 2 Agricultural Land
- Green Belt (where relevant)
- Extent of the Urban (or Built Up) Area (using census area boundaries)
- Flood Plain (Zones 2 and 3)

This makes it possible to determine the residual amount of land in a local authority area which is not built up, or nationally protected and not in the floodplain.

The National Planning Policy Framework prioritises the re-use of previously developed land which in most cases is located with defined Urban Areas. To acknowledge this best fit data on the amount of PDL in each Local Authority area was sourced.

The National Land Use Database provides a snapshot of the previously developed land available by different types of sub category in each local authority area in England in 2009 (when last collected). Each site within a local authority area is listed together with the area of the site and an assumed centre point based easting and northing reference. This has been plotted using GIS to see which NLUD sites are located outside of the floodplain.

This makes it possible to make an assumption on the proportion of the Urban Area which is previously developed land not at risk of river and coastal/tidal flooding in each of the 42 Local Authorities studied.

This information is compared to the total amount of land allocated for development in the adopted development plans of 42 Local Authorities studied to identify which Local Authorities had sufficient or insufficient alternative land to accommodate this quantum of development.

Acknowledging Limitations

This approach has provided an indication of the alternative land which could be available in each of the 42 local Authority Areas studied. For clarity, (other than the Green Belt) this is based on nationally safeguarded physical characteristics of a local authority area and makes no assumptions on the appropriateness or suitability (in physical, policy or timescale terms) of the alternative land identified to accommodate development.

This exercise acts to indicate which of the 42 Local Authorities decided to locate development in the floodplain when there was alternative land available (and for consideration in the Task 3 report, what other factors were therefore weighted more favourably by such local authorities than the long term implications of climate change on flood risk).
For clarity, this study has not made a judgement of which of the 42 Local Authorities studied has ‘reasonably alternative land available to that in the floodplain’. Whilst PPS25 and the NPPF do not define ‘reasonably available’ land, it is recognised that the following factors may be considered by Local Planning Authorities in forming a judgement:

- other environmental and historic designations of regional and local importance;
- other national and local policy drivers which both set targets for quantum of development (for example future housing requirement) and identify the appropriate locations for this development to be accommodated (for example a priority for the reuse of previously developed land and limiting development in the open countryside); and
- constraints which impact on the deliverability of the land for development (for example, contamination, access requirements, utilities supplies, land values).

### 4.3 Understanding the Land Area Constraints in each Local Authority Area

Of the 42 Local Authorities studied, 36 local authorities have sufficient residual land (outside of the constraints listed above and including previously developed land not at risk of flooding).

![Figure 7. Strategic Allocations Made and if Sufficient Land was Available](image-url)
Two Local Authorities\textsuperscript{14} did not have sufficient residual land and made 2 strategic allocations all or majority in flood zone 3, but neither of these allocations was for the most vulnerable use of housing.

A further four Local Authorities\textsuperscript{15} would have sufficient residual land if the allocations were made in the Green Belt, but none of these local authorities made strategic allocations on land all or majority in Flood Zone 3.

Green Belt is present in 6\textsuperscript{16} of the 7 Local Authorities that made strategic allocations for housing development all or majority in Flood Zone 3.

Using the NLUD data, 3\textsuperscript{17} of the 7 Local Authorities that made strategic allocations for housing development all or majority in Flood Zone 3 had a sufficient amount of previously developed land outside of the floodplain (at 2009) to physically accommodate all of the allocations made in the development plan. It is acknowledged that this previously developed land may not meet the ‘deliverable’ tests set out in paragraph 47 of the National Planning Policy Framework and be suitable for development.

### 4.4 Documenting the Sequential Test

In investigating whether the Local Authorities studied had undertaken the sequential test in informing the strategic allocations they made, it was evident that there was no single format for documenting the sequential test and it could be recorded in a number of different ways. As documented in the table and figure below for the 32 Local Authorities whose development plans were informed by an SFRA, the sequential test (and exception test if required) was undertaken as:

- A separate technical paper which formed part of the DPD evidence base in its own right
- Part of the SFRA
- Part of the Sustainability Appraisal: or
- Not explicitly documented in the published evidence base.

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\textsuperscript{14} South Holland and Wandsworth
\textsuperscript{15} Barking & Dagenham, Slough, Sandwell and Sutton
\textsuperscript{16} Leeds, North Somerset, Spelthorne, Sunderland, Tonbridge and Malling, and York (Hartlepool does not have Green Belt)
\textsuperscript{17} Spelthorne, Sunderland and Tonbridge & Malling
It was not clear in all cases how the fourteen local authorities who referred to the sequential test in either their SFRA or as part of the Sustainability Appraisal had actually applied the test in practice.

The approach taken to applying the sequential test by the ten local authorities who produced a separate technical paper varied. Some authorities undertook a ‘sieving’ type process, excluding alternative locations within constrained areas (such as
green belt) and in some cases applying a criteria-based scoring approach to screen out alternative locations. Others more proactively identified alternative locations and assessed if they were ‘reasonably available.’ In the absence of a clear definition of ‘reasonably available’ in either PPS25 or the NPPF, local authorities generally applied their own interpretation.

The ten local authorities who produced a separate paper generally demonstrated how they had transparently applied the sequential test and as such can be considered as good practice leaders.

4.5 Summary

- Of the 42 Local Authorities Studies, 36 Local Authorities had sufficient residual land, but collectively made 29 strategic allocations all or majority in Flood Zone 2 and 59 strategic allocations all or majority in Flood Zone 3.

- Two local authorities did not have sufficient residual land and did make collectively 2 strategic allocations all or majority Flood Zone 3, but not for the more vulnerable use of housing.

- A further three local authorities did have sufficient land only if they considered releasing land from the Green Belt, but none of these local authorities made strategic allocations all or majority Flood Zone 3.

- Seven Local Authorities made strategic housing allocations all or majority in Flood Zone 3. Six of these local authorities had Green Belt. Three of these Local Authorities had sufficient alternative previously developed land to physically accommodate the development plans’ allocations.

- There was a mixed approach taken by Local Authorities to documenting how they applied the sequential test. Less than a quarter (10 out of 42) of the local authorities studied had transparently considered alternative locations in areas of lower flood risk, as required by the sequential test. It was less clear how the remaining 32 authorities had undergone this process.
5 Meeting the Requirements for Development and Flood Risk

This part of the research seeks to interpret the justification given by local planning authorities for locating development in the floodplain and whether there were any objections to the proposed allocation on flood risk grounds at the plan’s Examination in Public (EiP). The EiP is designed to test the soundness of the development plan prior to adoption.

This section focuses on the exception test, as a requirement of the National Planning Policy Framework, with an analysis of development plan text to interpret why certain strategic allocations are made in areas at risk of flooding.

5.1 Role of the Exception Test in the Plan Making Process

The National Planning Policy Framework (NPPF) and the Technical Guidance in support of the NPPF seeks to avoid inappropriate development in areas at risk of flooding, by directing development away from areas at highest risk, but where development is necessary, making it ‘safe’ without increasing flood risk elsewhere.

Local Plans are required to apply a sequential, risk-based approach to the location of development to avoid where possible flood risk to people and property and manage any residual risk, taking account of the impacts of climate change, by:

- applying the Sequential Test;
- if necessary, applying the Exception Test;
- safeguarding land from development that is required for current and future flood management;
- using opportunities offered by new development to reduce the causes and impacts of flooding; and
- where climate change is expected to increase flood risk so that some existing development may not be sustainable in the long-term, seeking opportunities to facilitate the relocation of development, including housing, to more sustainable locations.

5.1.1 Exception Test

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

For the Exception Test to be passed:

- it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a Strategic Flood Risk Assessment where one has been prepared; and
a site-specific flood risk assessment must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

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

5.2 Approach to Analysing Allocations At Risk Of Flooding

The headline analysis of the strategic allocations presented in chapter 3 highlights that strategic allocation have been made for more vulnerable uses in flood zone 3. The review of Strategic Allocations at risk of all type of flooding has sought to document the justification given by the Local Authority for making an allocation at risk of flooding. This justification is based on an interpretation of the development plan text relating to the site and, to aid quantitative analysis, it has been ordered into three categories which were finalised following initial review of the strategic allocation and refined / validated by the project steering group. The justification categories are as follows:

1. Housing need (driven by targets)
2. Employment need (driven by targets)
3. Overriding regeneration need

5.3 Analysis

The results of the analysis have been structured to:

- Follow the application of the exceptions test; and
- Understand whether there have been any objections to allocations and why they have been retained.

5.3.1 Exceptions Test (1): Wider Sustainability Objectives

To understand the justification of allocations all or majority located within Flood Zone 3 (High Probability), and all or majority located in Flood Zone 2 (Medium Probability), the figure below provides a breakdown of our interpretation from development plan text into the justifications given by local authorities for making certain allocations.
Of the 104 strategic allocations at risk of river and coastal/tidal flooding, the justification interpreted for the location of the strategic allocation in the floodplain is as follows:

- overriding housing need (39);
- overriding regeneration need (33); and
- overriding employment need (26).

There were 2 instances where a local plan allocation was for a ‘bad neighbour use’ and therefore was restricted in its location (clarified as ‘other’ in the chart above).

In addition to this, there were 4 allocations where the local plan didn’t have any text which provided a justification for making the allocation.\(^\text{19}\)

The headline analysis of the strategic allocations presented in chapter 3 found that of the 61 strategic allocations made all or majority in flood zone 3, 18 strategic allocations were for housing (a more vulnerable use) by 7 Local Authorities. The table below explores these 7 Local Authorities in more detail. In 4 of the 7 Local Authorities the development plan was not informed by an SFRA therefore the Sequential and Exceptions test were not explicitly documented. In the remaining 3 local authorities the Sequential and Exception Tests were applied and in all cases wider sustainability benefits (namely regeneration of urban areas and the need to accommodate future development) were considered to outweigh flood risk.

---

\(^{18}\) Hartlepool

\(^{19}\) York
Table 9. Evidence of the Application of the Exception Test

<table>
<thead>
<tr>
<th>Local Authority</th>
<th>Exception Test Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ashford District</td>
<td>Application of the Exception Test not explicitly documented.</td>
</tr>
<tr>
<td>Barking and Dagenham London</td>
<td>Technical Paper sets out reasons why a site meets the Exception Test Criteria</td>
</tr>
<tr>
<td>Borough.</td>
<td></td>
</tr>
<tr>
<td>Breckland District</td>
<td>Application of the Exception Test not explicitly documented.</td>
</tr>
<tr>
<td>Brent London Borough.</td>
<td>Technical Paper sets out reasons why a site meets the Exception Test Criteria</td>
</tr>
<tr>
<td>Carlisle</td>
<td>Application of the Exception Test not explicitly documented.</td>
</tr>
<tr>
<td>Central Bedfordshire</td>
<td>SFRA Level 2 cited as providing information necessary for the application of the Exception Test</td>
</tr>
<tr>
<td>Chelmsford District</td>
<td>Technical Paper sets out reasons why a site meets the Exception Test Criteria</td>
</tr>
<tr>
<td>City of Peterborough</td>
<td>Not required as sufficient housing land found in FZ1 and where development is required in FZ3a it is limited to uses defined as Less Vulnerable</td>
</tr>
<tr>
<td>Colchester District</td>
<td>Not required as there are reasonable available alternative sites within FZ1 and FZ2</td>
</tr>
<tr>
<td>Hambleton District</td>
<td>Application of the Exceptions Test not explicitly documented.</td>
</tr>
<tr>
<td>Havant Borough Council</td>
<td>SFRA informed the application of the Exception Test.</td>
</tr>
<tr>
<td>Havering London Borough.</td>
<td>Application of the Exception Test not explicitly documented.</td>
</tr>
<tr>
<td>Horsham District</td>
<td>To be informed by Level 2 SFRA sites where exception test will be required</td>
</tr>
<tr>
<td>Leicester</td>
<td>Pre Guidance</td>
</tr>
<tr>
<td>Mid Devon District</td>
<td>Part of SFRA</td>
</tr>
<tr>
<td>Middlesbrough</td>
<td>Undertaken as part of Sustainability Appraisal</td>
</tr>
<tr>
<td>North Norfolk District</td>
<td>Undertaken as part of Sustainability Appraisal</td>
</tr>
<tr>
<td>Plymouth</td>
<td>Exception test informed by Level 2 SFRA sites where will be required</td>
</tr>
<tr>
<td>Poole</td>
<td>Part of SFRA</td>
</tr>
<tr>
<td>Reading</td>
<td>Not required as there is no need to allocate housing land in FZ 2 or 3.</td>
</tr>
<tr>
<td>Sandwell District</td>
<td>SFRA</td>
</tr>
<tr>
<td>Slough</td>
<td>Application of the Exceptions Test not explicitly documented.</td>
</tr>
<tr>
<td>South Cambridgeshire District</td>
<td>Considered in the SFRA</td>
</tr>
<tr>
<td>South Holland</td>
<td>Application of the Exceptions Test not explicitly documented.</td>
</tr>
<tr>
<td>South Tyneside District</td>
<td>Technical Paper sets out reasons why a site meets the Exception Test Criteria</td>
</tr>
<tr>
<td>Spelthorne District</td>
<td>Annex E of SFRA</td>
</tr>
</tbody>
</table>
### Local Authority

<table>
<thead>
<tr>
<th>Local Authority</th>
<th>Exception Test Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunderland</td>
<td>SFRA considers likelihood of passing SFRA</td>
</tr>
<tr>
<td>Sutton London Borough.</td>
<td>Technical Paper sets out reasons why a site meets the Exception Test Criteria</td>
</tr>
<tr>
<td>Tonbridge and Malling District</td>
<td>Considered in the SFRA</td>
</tr>
<tr>
<td>Wakefield District</td>
<td>Site Assessment Technical Paper Volume 3: Green Belt review and Flood Risk Sequential Test</td>
</tr>
<tr>
<td>Wandsworth London Borough.</td>
<td>SFRA considers likelihood of passing SFRA</td>
</tr>
<tr>
<td>Waveney District</td>
<td>Technical Paper sets out reasons why a site meets the Exception Test Criteria</td>
</tr>
</tbody>
</table>

### Table 10. Review of Sequential and Exception Test of LA making Strategic Allocations for housing all or majority in Flood Zone 3

<table>
<thead>
<tr>
<th>Local Authority</th>
<th>Plan Type</th>
<th>Number of strategic allocations for housing all/majority FZ3</th>
<th>Evidence of Sequential Test</th>
<th>Evidence of Exception Test /Justification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hartlepoo</td>
<td>UDP 2006</td>
<td>1</td>
<td>SFRA was not part of the evidence informing the adopted development plan</td>
<td></td>
</tr>
<tr>
<td>Leeds</td>
<td>UDP 2006</td>
<td>1</td>
<td>SFRA was not part of the evidence informing the adopted development plan</td>
<td></td>
</tr>
<tr>
<td>North Somerset</td>
<td>Local Plan 2007</td>
<td>10</td>
<td>SFRA was not part of the evidence informing the adopted development plan</td>
<td></td>
</tr>
<tr>
<td>Spelthorne</td>
<td>Adopted Site Allocations DPD 2009</td>
<td>1</td>
<td>Yes: Appendix E of the 2007 SFRA which states it is clear that, following the presumption of the sequential test of housing first being considered in Zone 1, this would not ensure an adequate housing supply. Land in Zone 2 must also be considered</td>
<td>Yes. Appendix E of the 2007 SFRA looks at residential development in flood zone 3 It is unrealistic to relocate main centres in borough. Two sites in Staines (one is identified as strategic) have a residential element but FRAs agreed by the Environment Agency show an acceptable dry route of escape.</td>
</tr>
<tr>
<td>Sunderland</td>
<td>UDP 2007</td>
<td>1</td>
<td>The City Council takes the view that the scale of encroachment of potential flood risk areas onto their substantial allocations, with large areas for development unaffected by flood risk, indicates that a risk-based sequential test is not appropriate to the entirety of each site. Moreover, no alternative sites, on the scale of those required</td>
<td>The SFRA considers the likelihood of passing the Exception test for each of its allocations in the flood plain, with all but the Port achieving ‘high’ probability, the Port being ‘medium’. It is important for the regeneration and economy of the City that the redevelopment of these sites is progressed, whilst taking account of</td>
</tr>
<tr>
<td>Local Authority</td>
<td>Plan Type</td>
<td>Number of strategic allocations for housing all/majority FZ3</td>
<td>Evidence of Sequential Test</td>
<td>Evidence of Exception Test /Justification</td>
</tr>
<tr>
<td>-----------------</td>
<td>-----------</td>
<td>-----------------------------------------------------------</td>
<td>-----------------------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>offering similar development opportunities exist elsewhere in the City. Hence, there are no sequentially preferable sites.</td>
<td>the measures necessary to mitigate the potential impact of partial flooding.</td>
<td></td>
</tr>
<tr>
<td>Tonbridge &amp; Malling</td>
<td>Adopted Site Allocations DPD 2008</td>
<td>2</td>
<td>Yes, in the parts of the borough with the exception of central Tonbridge and Aylesford riverside, growth has been accommodated outside of the floodplain</td>
<td>Exception test applied in Tonbridge where there are no practical alternative sites to the ones allocated deliver wider sustainability benefits for the community and meet other policy objectives.</td>
</tr>
<tr>
<td>York</td>
<td>Local Plan 2005</td>
<td>2</td>
<td>SFRA was not part of the evidence informing the adopted development plan</td>
<td></td>
</tr>
</tbody>
</table>
5.3.2 Exception Test (2): Previously Developed Land (PDL)

One of the twelve core planning principles underpinning both plan making and decision taking in the National Planning Policy Framework is reusing land that has been previously developed (brownfield land).

![Figure 10. Number of Strategic Allocations at Risk of Flooding: Brownfield and Greenfield](image)

Overall, of the 200 strategic allocations at risk of all types of flooding, 139 strategic allocations are located on previously developed land, with 61 located on Greenfield sites.

Of the 104 strategic allocations at risk of river and coastal/tidal flooding:

- 71 strategic allocations are on previously developed land.
- 33 strategic allocations are on Greenfield land.

Of the 96 strategic allocations at risk of pluvial flooding:

- 68 strategic allocations are on previously developed land.
- 28 strategic allocations are on Greenfield land.
Of the 43 strategic allocations located in Flood Zone 2, 27 sites are allocated for development on previously developed land with 16 sites allocated on greenfield sites.

Of the 61 strategic allocations located in Flood Zone 3, there are a high proportion of allocations on previously developed land (44) with the remainder allocated on greenfield sites (17).

5.3.3 Exception Test (3): Make Development Safe

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

In reviewing the development plan text for each of the strategic allocations at risk of all types of flooding, it has been noted (yes or no) if the plan text prescribed measures to manage the risk of flooding on the allocation when later bought forward for development. Examples of the measures prescribed are listed below. The review has not made a judgement as to whether the measures prescribed were sufficient or met the requirements of ‘safe’ as described in National Policy.

Table 11. Example measures suggested for managing flood risk when the strategic allocation was to be developed

<table>
<thead>
<tr>
<th>Proposed Measures</th>
<th>Example</th>
</tr>
</thead>
</table>
| Mitigation measures | • Inclusion of Green Infrastructure space  
• Sustainable urban drainage system  
• Inclusion of a water element as a recreational, ecological and environmental resource  
• Retention of land in the floodplain as informal amenity open space  
• Rainwater harvesting and grey-water recycling should be investigated and implemented wherever practical. |
| Defences | • Ground raising  
• Construction of floodwalls and embankments  
• Construction of diversion channels  
• Removal or modification of existing structures  
• Demountable flood defences  
• Temporary flood defences  
• Undeveloped buffer strip from the river edge.  
• Recreation, Amenity and Ecology  
• Secondary Defences  
• Land Raising  
• Finished Floor Levels |
| Site specific recommendations | • Any development proposal will require a detailed Flood Risk Assessment.  
• Flood Risk Assessment must be carried out which satisfies the requirements of SFRA.  
• Site layout to place development in areas of lowest flood risk.  
• Demonstration of safe access/egress from the site during a flood event.  
• Land drainage issues (standing surface water) to be addressed as part of |
<table>
<thead>
<tr>
<th>Proposed Measures</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a development proposal in consultation with the Environment Agency.</td>
</tr>
<tr>
<td></td>
<td>• Housing with parking beneath deemed acceptable in flood risk terms.</td>
</tr>
<tr>
<td></td>
<td>• Any development should not be in excess of the existing buildings footprint.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Developer Contributions</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Developer contributions will be required to assess whether any improvements to sewerage infrastructure would be needed and to implement them before occupation of a site.</td>
</tr>
<tr>
<td></td>
<td>• Any development proposal would require an assessment to determine the need for local improvements to the sewerage network.</td>
</tr>
<tr>
<td></td>
<td>• Upgrading waste water works.</td>
</tr>
<tr>
<td></td>
<td>• Surface water discharge would be subject to heavy attenuation at the developers expense.</td>
</tr>
</tbody>
</table>
For 60% of the 104 strategic allocations at risk of river and coastal/tidal flooding, specific flood resilience and mitigation measures were prescribed in the development plan text which made the allocation. Such measures were specific to the nature of each site. National Policy and other development plan documents (such as the Core Strategy) also have policy, which require flood resilience and mitigation measures where flood risk is a potential issue, so the remaining 40% of sites are not devoid of guidance.

5.3.4 Objections to Strategic Allocations proposed on Flood Risk Grounds

Consultation is a core principle of the development plan preparation process, the objective of which is to respond to feedback and minimise the number of objections that remain when the soundness of the plan is tested at Examination. Objections which remain unresolved at this stage are considered by an independent Inspector as part of their assessment of the soundness of the plan.

Of the 42 Local Authorities studied, 200 strategic allocations were identified to be at risk of all types of flooding in 39 of these Local Authorities. Of these 39 Local Authorities, 9 had plan types (Site Allocation DPDs) making 43 strategic allocations that at November 2011 were in the process of being examined and the Inspector’s report had not been issued.

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20 No strategic allocations were found to be at risk of pluvial or river and coastal/tidal flood risk in Ashford, Redbridge or Waveney.
Therefore, of the 200 Strategic Allocations at risk of all types of flooding reviewed, 157 had been potentially considered by and Independent Inspector and in the case of 6 allocations (3.8% of all those at risk of flooding considered by an Inspector) objections were made by third parties on flood risk grounds. In all cases the Inspector considered that the wider sustainability benefits of the allocation outweighed flood risk.

Of the 9 local authorities with plan types currently being examined, the Inspectors Report has since been published for 1 of these authorities and objections to 2 strategic allocations were made by third parties on flood risk grounds. Again, the Inspector considered that the wider sustainability benefits of the allocation outweighed flood risk.

Details of the strategic allocations which were subject to objections on Flood Risk Grounds are provided in the table below:

<table>
<thead>
<tr>
<th>Local Authority</th>
<th>Type of Flood Risk</th>
<th>Objection</th>
<th>Why Allocation Retained?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breckland Policy SH1: Coal Yard and Associated Buildings, north of Chapel Street</td>
<td>Pluvial</td>
<td>Objector: Unknown&lt;br&gt;The Core Strategy allocated 100 dwellings to Shipdham but a recent planning permission on land off Parklands Estate reduces the requirement to 85. It is proposed that only one site be allocated in the village to accommodate that growth (SH1). Despite residents’ concerns regarding traffic and drainage infrastructure, there were no objections to development in Shipdham from either the Highways Authority or Anglian Water. The proposed revisions to the allocations at Shipdham, as summarised above, were advertised for public consultation and a significant number of representations were submitted. Many respondents support the original allocation of 85 dwellings to the north of Chapel Road (over 75% of those with an address in Shipdham) and have placed more weight on the sustainability credentials of the site than the impact the development may have on the character of the village.</td>
<td>Unusual scenario in that the residents objected to the original allocation of 100 dwellings on the site. This was reduced to 85 creating an increase in support for the site. The Inspector wanted to empower the community and have regard to the Localism Act. Further, a lack of alternative sites led to the Inspector retaining the allocation. The allocation was retained for the following reasons: no alternatives, support for the site once the number of dwellings on site reduced, improvement to the site and the surrounding area.</td>
</tr>
<tr>
<td>North Norfolk C14 Land West of Roughton</td>
<td>Pluvial</td>
<td>Objector: Water Company&lt;br&gt;In paragraph 4.4.7 in the Allocations DPD the constraint posed by surface water flooding (and the need for attenuation)</td>
<td>It would appear that no objections were raised in regards to flood risk during the Examination of the Site Allocations DPD. Anglian Water raised the points on surface water drainage during the</td>
</tr>
<tr>
<td>Local Authority</td>
<td>Type of Flood Risk</td>
<td>Objection</td>
<td>Why Allocation Retained?</td>
</tr>
<tr>
<td>----------------</td>
<td>-------------------</td>
<td>-----------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>Road</td>
<td></td>
<td>measures) is set out. Anglian Water advised that any surface water discharge would be subject to heavy attenuation and that there are sewers crossing the site and diversion would be at the developer’s expense.</td>
<td>consultation on the Publication Draft of the DPD.</td>
</tr>
<tr>
<td>North Norfolk</td>
<td>Pluvial</td>
<td>Objector: EA Issues surrounding surface water (and sewerage) flooding are raised as constraints affecting the site, which would need to be resolved in order for development to be considered acceptable. In the policy for this site it states that: “f. prior approval of a scheme to prevent the input of hazardous substances to groundwater; h. demonstration that there is adequate capacity in sewage treatment works and the foul sewerage network and that proposals have regard to Water Framework Directive objectives;”</td>
<td>The Inspector stated that they were satisfied that this allocation was sound and that they did not need to make additional comments on this Allocation.</td>
</tr>
<tr>
<td>Leeds</td>
<td>River and coastal/tidal All or majority in Flood Zone 3</td>
<td>Objector: Unknown An objection was raised on flood risk grounds in regards to this allocation, although this was in regards to the need for an FRA for the whole area to be completed to support development here. The nature of the way the Inspector's Report is written means that it is unknown which stakeholder made this comment.</td>
<td>The Inspector concluded on this issue that: As the site lies within the 100 year floodplain the requirement for a flood risk assessment is reasonable in principle, and there could well be benefits of consistency and economy in undertaking such an assessment for the area as a whole rather than for individual sites. Given the scale of regeneration proposed in the area, a coordinated approach is sensible. Even though development around canals may not necessarily face the same risks as that along rivers [as noted in para. 38 of PPG22], there is no good reason to single out the Canal Basin for a separate assessment even if this were practicable. Provided all parties were willing to exercise some flexibility and not re-visit matters already resolved, as I note elsewhere, the requirement should not inhibit or delay development.</td>
</tr>
<tr>
<td>North Somerset</td>
<td>River and coastal/tidal All or majority in Flood Zone 3</td>
<td>Objector: Private Sector Issue was raised with regards to whether the Proposals Map should show the site being located within the Flood Plain.</td>
<td>The Inspector stated in regards to this that the Council state that the extent of the flood plain draws upon information provided by the Environment Agency and accepts that the diagrammatic representation on the Proposals Map may be unclear. The Inspector stated that a note on the key</td>
</tr>
<tr>
<td>Local Authority</td>
<td>Type of Flood Risk</td>
<td>Objection</td>
<td>Why Allocation Retained?</td>
</tr>
<tr>
<td>-----------------</td>
<td>--------------------</td>
<td>-----------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>Road, Weston-super-mare</td>
<td>River and coastal/tidal All or majority in Flood Zone 3</td>
<td><strong>Objector: Private Sector</strong> Questions were raised on if this site should be allocated for development.</td>
<td>to the Proposals Map that the areas are an indication only and not definitive, should be added</td>
</tr>
<tr>
<td>North Somerset E/5 E39 - Land West of Kenn Road, Kenn</td>
<td>River and coastal/tidal All or majority in Flood Zone 3</td>
<td><strong>Objector: Unknown</strong> The Inspector noted in relation to this site the site is within zone 3b where PPG25 advises against development save in exceptional circumstances. Should the allocation be supported, it would have to rely upon such circumstances being made out. A preliminary flood risk assessment has been carried out. The Environment Agency has agreed that if a need for the development is established and in the absence of a sequentially preferable site, protective measures could render the allocation acceptable.</td>
<td></td>
</tr>
<tr>
<td>Reading SA8g Part of Former Battle Hospital</td>
<td>River and coastal/tidal All or majority in Flood Zone 2</td>
<td><strong>Objector: Unknown</strong> Mechanisms to minimise and manage the risk of flooding are included in the policy for this site.</td>
<td></td>
</tr>
<tr>
<td>SA8j Napier Court, Napier Road</td>
<td>River and coastal/tidal All or majority in Flood Zone 2</td>
<td><strong>Objector: Unknown</strong> The site passed the sequential test for inclusion as an allocation for residential development. The Council has, in the past, rejected the proposal to allocate this site for residential development, both in the Reading Central Area Action Plan and in the first version of the Sites and Detailed Policies Document; on solely flooding grounds (the Council has always contended that this site would otherwise have potential for residential development). Since then, the Environment Agency flood zones have been changed, with two changes affecting the site in particular: • The site is no longer wholly in Flood Zone 2, with the building footprints now in Flood Zone 1; and • The site is no longer surrounded by Flood Zone 3, meaning that escape in the event of a flood will be significantly safer. It is now considered that the site can be safely and appropriately developed for residential use, and that there may even be an</td>
<td>The over-riding need for regeneration on the site was identified as the reason for its allocation.</td>
</tr>
</tbody>
</table>

Reading SA8g Part of Former Battle Hospital

Objector: Unknown

Mechanisms to minimise and manage the risk of flooding are included in the policy for this site.
Local Authority | Type of Flood Risk | Objection | Why Allocation Retained?
--- | --- | --- | ---
South Holland Spalding 2011, Holland Park | River and coastal/tidal flood risk | Opportunity for such a use to actively reduce flood risk on site. This would, however, be subject to development not significantly increasing the building footprint on site and therefore potentially increasing flood risk elsewhere. | The Inspectors Report cites the benefits of the scheme, namely the provision of the link road, and the desirability of adopting a sequential approach to site selection.

Objector: EA
The Environment Agency expressed concern about the differing flood risk on the southern part of the site and land earmarked ‘post-2021’, and the desirability of adopting a sequential approach to site selection.

The Inspector considered that the EA’s concerns can be taken into account as part of a planning brief for the site. The benefits of the scheme were attributed greater weight, namely:
- The provision of the western link road,
- 33% affordable housing; and
- A range of community facilities; including: village/neighborhood centre, healthcare facilities, a primary school, a religious centre, leisure facilities and open space.
- Walking/cycling routes and would be served by an extended bus service.
- The possibility of a rail halt is to be safeguarded.

The Inspector concludes that Holland Park should be retained in the Plan as an allocated urban extension, stating that there is no evidence of preferable alternative proposals which would accord with the Plan’s strategy.

5.4 Summary
From the allocations identified in the 42 Local Authority Development Plans:

- Of the 104 strategic allocations at risk of river and coastal/tidal flooding, overriding housing need is the leading reason (38%) interpreted from the plan text for justifying development in the floodplain.
- Seven Local Authorities have made 18 strategic housing allocations all or majority in flood zone 3, of which 3 of the local authorities’ development plans were not informed by SFRA. In the remaining 3 local authorities, the Sequential and Exception Test were demonstrated.
- Of the 104 strategic allocations at risk of river and coastal/tidal flooding 71 were located on previously developed land and 33 of Greenfield land.
- Of the 104 strategic allocations at risk of river and coastal/tidal flooding, development plan text prescribed measures to manage flood risk when the
allocations were bought forward for development for 62 of these strategic allocations.

- Of the 200 strategic allocations at risk of all types of flooding, 157 have been independently examined and objections were made on flood risk grounds for 6 of these strategic allocations, all of which were retained by an Inspector for wider sustainability reasons.
6  Task 2 Conclusions

6.1  Key Findings

Evidence Base: Production

Of the development plans studied, all adopted since 2008 have been informed by an SFRA. Of the 32 Plans that were informed by an SFRA, over half (18) were informed by a Level 2 SFRA. It is evident over time that the range of information used to produce SFRA has improved, although the gap between evidence base production and plan adoption has remained around three years. Working to reduce the gap between evidence base production and plan adoption (or ensuring a regular refresh of the evidence base to ensure it remains fit for purpose) is important to ensure that data and information on which decisions are based remains largely up to date at the point of plan adoption.

Since 2008 an increasing number of Local Authorities have used the PPS25 Annex B Climate Change scenarios which has been carried forward in the Technical Guidance supporting the National Planning Policy Framework.

It is positive that Plans are nationally applying a consistent approach and confirming to National Policy. However, this does highlight the need for National Guidance to keep pace with the latest knowledge on climate change impacts and how this should be applied to the planning system. It is understood that the Technical Guidance accompanying the National Planning Policy Framework may be revised in 2013 which does provide this opportunity. It is also important that National Policy supports Local Authorities to investigate and develop a deeper understanding of climate change scenarios which may have a bearing on their particular geographical locality to enable a specific planning policy response.

Evidence Base – Informing Decision Making

This research has included the most up to date plans making land allocations in England (29 of the 42 plans reviewed are adopted or nearing adoption Site Allocations DPDs)

This research has shown that recommendations made in SFRA (such as identifying the need for flood resilience or mitigation measures) are carried forward to the development plan. This advice primarily relates to how flood risk ought to best be managed on site if a development proposal comes forward. A small number of SFRAs strategically identify where in an LA area development is not appropriate in the flood risk areas.

Strategic Allocations at Risk of Flooding

This study has examined a total of 718 strategic allocations made in the 42 LAs studied. Of these, 200 were found to be at risk from all types of flooding and the remaining 518 allocations were not at risk.
Of the 200 allocations at risk of flooding, 104 were in flood zones 2 and 3 (at risk of river and coastal/tidal flooding) and 96 allocations at risk of pluvial (surface water) flooding. The report has focused on sites at risk of river and coastal/tidal flooding as the application of the sequential and exceptions test mainly relates to this type of flooding. In addition the Maps showing the land in England at risk of surface water flooding were only first produced in 2009 and are heavily caveated. Understanding of the implications of this type of flooding is evolving and understanding the implications of new development on this type of flooding warrant further research in the future.

The Sequential Test

This study has shown that here is no uniform approach as to how Local Authorities demonstrate and document the application of the sequential approach and exceptions test: it can be either a part of the SFRA, part of other evidence base documents such as a site selection paper or the Sustainability Appraisal or part of the Plan text. In addition, other than the Development Plan Examination process, there is no mechanism of validating the justification made by the Local Authority that wider sustainability objectives outweigh current and future flood risk in a changing climate. A small number of local authorities documented the sites that had not passed the Sequential Test and had therefore been rejected as potential allocations.

The study has sought to understand which of the local authorities studied has a land area that was significantly constrained by European and national designations and the Green Belt. Only 6 Local Authorities were constrained in this and none of these local authorities made strategic allocations for more vulnerable uses (housing) in areas most at risk. However, 36 Local Authorities were not constrained by the above, but 7 of these authorities did make strategic allocations in the floodplain for more vulnerable uses in the areas most at risk. Putting this in context however, 4 of these Authorities had older plan types which has not been informed by an SFRA and the remaining three had undertaken the Sequential Test set out how they had met the Exceptions Test for these allocations.

There was a mixed approach taken by Local Authorities to documenting how they applied the sequential test. Less than a quarter (10 out of 42) of the local authorities studied had transparently considered alternative locations in areas of lower flood risk, as required by the sequential test. It was less clear how the remaining 32 authorities had undergone this process.

Exceptions Test: a) Wider Sustainability Objectives

Review of the development plan text was used to ascertain the justification for the allocation of land in the flood plain. Of the 104 strategic allocations in flood zone 2 and 3, overriding housing need was the most commonly used reason to justify development, followed by overriding regeneration need. This indicates that it is a combination of both development pressure and wanting to locate new development in areas where it may be socially and economically beneficial which outweigh flood risk.
Exceptions Test: b) Previously Developed Land

Over 70% of the 104 strategic allocations in flood zone 2 and 3 were also previously developed land. This is in line with national statistics for the amount of Brownfield and Greenfield land that is developed.

Exceptions test: c) Make Development Safe

The study noted if the development plan text prescribed measures to manage flood risk on a strategic allocation when bought forward for development. This was evident in 60% of the strategic allocations made in flood zone 2 and 3. Such measures were specific to the nature of each site which shows that Local Authorities are considering the best approach to manage flood risk on a site early on, prior to it coming forward for development.

National Policy and other development plan documents (such as the Core Strategy) also has policy, which requires flood resilience and mitigation measures where flood risk is a potential issue, so the remaining 40% of sites are not devoid of guidance to ensure they are built out safely.

Indeed when sites are bought forward for development additional scrutiny is provided as both the Local Authority and the Environment Agency review the site specific flood risk assessment.

Objections made to Allocation on Flood Risk Grounds

Of the 200 allocations at risk of flooding, 157 have been independently examined and objections were made on flood risk grounds for just 6 of these allocations to the examination (3 of these sites were at risk of river and coastal/tidal flooding and 3 were at risk of surface water flooding). In all cases the Inspector retained the allocations for wider sustainability reasons.

It is noted that the Environment Agency seeks to work with LAs throughout the plan production process and therefore influencing the policy decisions and allocations made earlier in the process, rather than objecting at the end of the process.

Similarly, the Inspector will only review the issues and matters that they consider to be significant. However, it is acknowledged that a strategic allocation subject to flood risk on is likely to be a matter that would be considered ‘significant’.

6.2 The Implications of this Research

The development plan establishes the principle of development being acceptable when making land allocations. However, this study has shown that it is much more likely to find a development plan and the associated evidence base stating what is required to minimise the impact of flood risk when a land allocation is bought forward for development, rather than stating it is not appropriate to develop in the flood plain.

Therefore, it is often devolved to the development management process to ensure that the development uses, layout and design are appropriate in flood risk terms.
Extending the scope of the research

It is acknowledged that the number of LAs studied (42) in this research was taken from limited number of LAs nationally with the most up to date, adopted plans (90 adopted post 2006). Whilst considering a larger number of local authorities, might help further explore some of the further trends and findings that are emerging from this study, the value of this in relation to the extra work and resource required, would be considered to be limited and skewed towards South East (the region with the highest proportion of up to date / adopted development plans).

Similarly, the research could be expanded to understand ‘minor’ allocations, as this research has been focused on ‘strategic’ allocations, to understand the decision making process of local planning authorities in relation to smaller sites.

Sequential and Exceptions Test

Guidance could be developed for Local Authorities (although recognised that current Government stance is to be less prescriptive regarding planning policy) to be more explicit in terms of documenting, asserting, and assessing the Sequential Test and the Exceptions Test. Indeed, the Separate Technical Papers which form part of the plan making evidence base in their own right and describe the approach to undertaking the Sequential Test, the outcomes of this approach and the Exceptions Test if required would be a good model to take forward.
7 Task 3: Understanding Decision Making and its Long Term Implications

7.1 Introduction

The aim of Task 3 was to explore how weighing up current and future flood risk (in a changing climate) against other factors, influences strategic decisions for accommodating new development. The purpose of which was to understand the following:

- Whether the objective of managing long-term flood risk in a changing climate is being considered in the plan making process;
- What weight was given to managing flood risk in a changing climate in comparison to other objectives; and
- Where, taking account of monetised costs, development in the floodplain could potentially be justified at the local economy level.

This task explored decision making at the local authority wide level by:

- Using case study local authority’s housing and commercial development targets to understand the costs and benefits of locating this development in the floodplain; and
- Referring to the Sustainability Appraisal of case study local authority’s options for delivering these new development targets across the local authority area.

This task has also sought to group Local Authorities into typologies, characterised by their risk of flooding, vulnerability to a flood event and resilience to a flood event. This was to ensure that a range of local authorities, representing different vulnerabilities to flooding, were analysed.

7.1.1 Link with Tasks 1 and 2

Task 3 has been linked to the earlier stages of the study as follows:

Data and Information

An important aspect of Task 3 is to draw upon the body of evidence that has been collated through the data gathered in the previous tasks, to inform case study selection and to enable wider implications to be drawn, specifically:

- Plan type (Task 1);
- Proportion of the Local Authority area at risk of flooding (Task 2);
- Strategic allocations made in the floodplain (Task 2); and
- Interpretation of the justifications for development in the floodplain (Task 2).

Sequential Test and Exceptions Test

Task 2 highlighted that there is no single approach as to how Local Authorities demonstrate and document the application of the sequential approach and
exceptions test; it can be either a part of the SFRA, part of other evidence base documents such as a site selection paper or the Sustainability Appraisal or part of the Plan text. Task 2 also sought to understand the justification given for allocating development in the floodplain. This task seeks to explore this matter further by exploring the wider sustainability objectives that ‘outweigh’ flood risk.

**Use of the Evidence Base**

Task 2 has highlighted that the range of information used to inform strategic flood risk assessments (SFRA) has developed over time and there has been a reduction in the number of allocations being made for more vulnerable uses in areas most at risk of flooding. This task has enabled an understanding of how flood risk evidence is considered alongside the wider evidence base portfolio in informing decision making via review of Sustainability Appraisal of strategic decision relating to delivering new development across a local authority area.

**7.2 Overview of the Method**

The methodological approach to this task is summarised in the box below.

Table 13. Task 3 Methodological Steps

| 1: Identification of **typologies** that characterise risk and vulnerability to flooding. |
| 2: Identification of **local authorities** within those typologies to analyse. |
| 3: Identification of the **development targets** (residential and commercial), the options considered for accommodating these targets and **projected climate change scenarios** for those local authorities. |
| 4: Analysis of the decision making process associated with the options considered for delivering these development targets for those local authorities using the following: |

<table>
<thead>
<tr>
<th><strong>Shaping question(s):</strong></th>
<th><strong>Step activity:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Q.i:</strong> Have local authorities explicitly given value to climate change and its implications in their decision making processes around accommodating future housing and employment growth.</td>
<td><strong>4.1:</strong> Develop a <strong>multi criteria analysis</strong> (MCA) framework to identify the primary sustainability objectives that drive strategic decisions by local authorities on the future growth of their localities.</td>
</tr>
<tr>
<td><strong>Q.ii:</strong> If not explicit, have local authorities <strong>implicitly</strong> given value to climate change and its implications in their decision making processes around accommodating future housing and employment growth. If they have, <strong>what comparative value</strong> was given compared to other considerations?</td>
<td><strong>4.2:</strong> Apply the MCA to LA Core Strategies; determining the explicit/implicit value weighting given to climate change impacts (flooding) compared to the other sustainability objectives through representation in Core Strategy policies.</td>
</tr>
<tr>
<td><strong>4.3:</strong> Use the MCA to translate the Sustainability Appraisal (SA)</td>
<td></td>
</tr>
</tbody>
</table>
undertaken on the development policies from LA Core Strategies to determine the implicit value weighting given to climate change impacts (flooding) compared to the other objectives, where possible in the short, medium and long term

Q.iii: What are the long term costs of accommodating development targets in the flood plain (at the local economy level)?

4.4: Develop and apply a cost analysis (CA) framework; comparing the monetised costs of development targets under projected climate change scenarios.

5: Identify the key implications of the analysis for the implementation of planning policy by local authorities.

7.2.1 Identifying Case Study Local Authorities
To identify appropriate case study local authorities, all local authorities in England were categorised into different typologies. It was assumed that the characteristics of area at risk of flooding, population density and socio-economic circumstance are a proxy for risk of flooding and local authority areas’ vulnerability. Using the datasets listed below, these characteristics shape eight different typologies.

Table 14. Datasets used to define typology characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Dataset</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>More / less area at flood risk</td>
<td>OS British Coastline and % of LA area at risk of fluvial flooding</td>
<td>Incorporates coastal, tidal and fluvial flooding. Presence of coastal denotes ‘More flood risk’ and/or % land in the floodplain (flood zone 2 and 3) above or equal to median denotes ‘More flood risk’. Median of land in the floodplain = 9% of total LA area.</td>
</tr>
<tr>
<td>More/less dense population</td>
<td>Land Area of LA/Population of LA = people per sqm</td>
<td>People/area value above or equal to median denotes ‘More dense’. Median = 0.000549 people/sqm</td>
</tr>
<tr>
<td>Less/More deprived</td>
<td>Indices of multiple deprivation</td>
<td>Index includes income; employment; health and disability; education, skills and training; barriers to housing and services; living environment; crime. Index value below, or equal to median denotes ‘More deprived’ Median ranking is 17903</td>
</tr>
</tbody>
</table>

This assumes that:

- Authorities with greater area at risk of flood, or close to coastal water are more vulnerable than those not.
- More densely populated authorities are more vulnerable than less densely populated authorities.
- More deprived authorities are more vulnerable that less deprived authorities.

The 326 local authorities of England fell into the eight Typologies as illustrated in Figure 12 below. Figure 13 also illustrates how the typologies are mapped throughout England.

The characteristics that define the typologies split the local authorities in the following ways:
- The characteristics of more/less dense and more/less deprived split the local authorities 50/50 due to the split around the median.
- The characteristic of more/less flood risk splits the local authorities as 221 into the ‘More’ category and 133 into the ‘Less’ category.
- Of those in ‘More Flood Risk’ category, 142 are ‘coastal’ and 79 ‘non-coastal’. 44 of the 142 ‘coastal’ fell into the ‘less risk’ end of the flood zone 2 and 3 analysis, so these LAs are only placed in this characterisation due to being ‘coastal’. They are therefore the difference between this characterisation and just using the flood zone 2.

Figure 12. Breakdown of England’s Local Authorities by Typology
Figure 13. Local Authorities of England mapped by Typology

The Annex to this report shows the full listing of England’s local authorities by typology.

At least one local authority per typology was selected as a case study. The local authorities selected needed to be:
• spread throughout the eight typologies;
• geographically distributed;
• have undertaken the newer plan type to produce a Core Strategy with a sustainability appraisal of their preferred and alternative options; and
• for some of them to have made allocations in the floodplain.

Much of this information was drawn from data collected in Tasks 1 and 2. Fourteen Local Authorities were selected from the Task 2 Local Authorities studied, two from each typology with the exception of Typologies LML and LLM.

Table 15. Selected Case Study Local Authorities

<table>
<thead>
<tr>
<th>Typology Code</th>
<th>Local Authority</th>
<th>Plan Type reviewed in Task 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 MMM</td>
<td>Barking and Dagenham London Borough</td>
<td>Adopted Site Allocation DPDs</td>
</tr>
<tr>
<td>1 MMM</td>
<td>Wakefield District</td>
<td>SA DPD Under Examination</td>
</tr>
<tr>
<td>2 MML</td>
<td>Spelthorne District</td>
<td>Adopted Site Allocation DPDs</td>
</tr>
<tr>
<td>2 MML</td>
<td>Poole</td>
<td>SA DPD Under Examination</td>
</tr>
<tr>
<td>3 MLM</td>
<td>City of Peterborough</td>
<td>SA DPD Under Examination</td>
</tr>
<tr>
<td>3 MLM</td>
<td>North Norfolk District</td>
<td>Adopted Site Allocation DPDs</td>
</tr>
<tr>
<td>4 MLL</td>
<td>Colchester District</td>
<td>Adopted Site Allocation DPDs</td>
</tr>
<tr>
<td>4 MLL</td>
<td>Hambleton District</td>
<td>Adopted Site Allocation DPDs</td>
</tr>
<tr>
<td>5 LMM</td>
<td>Brent London Borough</td>
<td>Adopted Site Allocation DPDs</td>
</tr>
<tr>
<td>5 LMM</td>
<td>Sandwell District</td>
<td>SA DPD Under Examination</td>
</tr>
<tr>
<td>6 LML</td>
<td>Sutton London Borough</td>
<td>Adopted Site Allocation DPDs</td>
</tr>
<tr>
<td>7 LLM</td>
<td>Mid Devon District</td>
<td>Adopted Site Allocation DPDs</td>
</tr>
<tr>
<td>8 LLL</td>
<td>Central Bedfordshire</td>
<td>Adopted Site Allocation DPDs</td>
</tr>
<tr>
<td>8 LLL</td>
<td>Breckland District</td>
<td>SA DPD Under Examination</td>
</tr>
</tbody>
</table>
Figure 14. The selected case study local authorities mapped across England
7.3 Examining Decision Making using a Multi Criteria Analysis Framework

7.3.1 Approach to the Multi Criteria Analysis

Developing the Multi Criteria Analysis Framework

**Objective:** To develop a universal framework to shape the analysis

A Multi Criteria Analysis (MCA) framework consists of criteria that are considered important to the decision making process; for the purposes of this study they were referred to as the MCA Objectives. The MCA Objectives needed relate to planning decision drivers that shape a local authorities thinking when it comes to considering a strategy for accommodating new development in the local authority area.

The objectives that define the planning decision drivers were identified through investigating the Sustainability Appraisal Frameworks of Local Authorities (from Task 2) in each typology. From these, 14 objectives became apparent as common to all typologies. The MCA objectives are summarised below.

<table>
<thead>
<tr>
<th>MCA Objective</th>
<th>Social</th>
<th>Environmental</th>
<th>Economic</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Improving Health</td>
<td>Protecting and improving natural Assets</td>
<td>Improving amount and range of employment</td>
</tr>
<tr>
<td>B</td>
<td>Improving Housing Choice</td>
<td>Protecting and improving cultural Assets</td>
<td>Improving resident skills</td>
</tr>
<tr>
<td>C</td>
<td>Improving access to services</td>
<td>Re-using sequentially preferable land (PDL/Urban Area)</td>
<td>Encouraging growth and economic prosperity</td>
</tr>
<tr>
<td>D</td>
<td>Enhancing community participation and civic pride</td>
<td>Minimise loss of productive agricultural land</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td></td>
<td>Mitigation of climate change</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td></td>
<td>Adaptation to the effects of climate change (excluding flooding)</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td></td>
<td>Manage current and future flood risk, accounting for climate change</td>
<td></td>
</tr>
<tr>
<td>H</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>J</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>K</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 16. MCA Objectives
Understanding the explicit/implicit value given to flood risk in a changing climate by Local Authorities

Objective: To understand the value attributed by the local authority to each of the MCA objectives, in particular I, J and K that relate to climate change mitigation, adaptation and flood risk.

‘Value’ was inferred from reference to a local authority’s Core Strategy (as the overarching planning policy document) which was reviewed to see if the MCA objective was reflected in Policies of the Core Strategy. This was reflected in the analysis by determining an average value weighting of each objective for each local authority. The value weightings were between 0 and 3:

- 0: no obvious importance given (no clear link with core strategy policies)
- 1: some importance (inferred/minor reference through core strategy policies)
- 2: important (clearly appears in core strategy policies, has its own dedicated policy)
- 3: very important (clearly appears and further heavy emphasis given throughout core strategy policies)

Understanding the decision making process in considering options for delivering development across the local authority area

Objective: To compare how each local authority assessed their development policy options against the MCA objectives; explore how important objectives I, J and K were in comparison to other objectives.

The sustainability appraisal of the preferred and alternative options for delivering development across the local authority area undertaken by each selected local authority was translated into a universal format using the following key:

| Major Positive Effect | Minor Positive Effect | Neutral Effect | Minor Negative Effect | Major Negative Effect |

7.3.2 Results of the MCA analysis

The Annex to this report contains the Multi Criteria Analysis for the 14 example Local Authorities examined. This section presents a summary of the findings and should be read in conjunction with the MCA for a complete picture.
Value Attributed to MCA Objectives

The table below shows a summary of the MCA objectives that were most valued by the case study local authorities as they are the subject of Core Strategy policies, giving a strong route to implementation of these objectives.

In summary:

- ‘Improving Housing Choice’ is a key policy driver and appears across all Core Strategies
- In those case study local authorities which were most at risk of flooding ‘Minimise impact on Climate Change’, ‘Manage Current and Future Flood Risk, accounting for Climate Change and ‘Protecting and Improving Natural Assets’ were valued MCA objectives.
- Case study local authorities least at risk of flooding most valued ‘Improving amount and range of Employment’ and ‘Encouraging Growth and Economic Prosperity’

Table 17. MCA objectives most valued (value 3) by the case study local authorities

<table>
<thead>
<tr>
<th>Local Authority</th>
<th>MCA objective of most importance</th>
</tr>
</thead>
</table>
| Barking and Dagenham London Borough    | Improving Housing Choice
Enhancing community participation and civic pride
Protecting and improving cultural Assets
Mitigation of climate change
Mitigate against/adapt for the impacts of flooding |
| Wakefield District                     | Improving Housing Choice
Improving access to services
Re-using sequentially preferable land (PDL/ Urban Area) |
| Spelthorne District                    | Improving Housing Choice
Improving access to services
Protecting and improving natural Assets |
| Poole                                  | Improving Housing Choice                                                                        |
| City of Peterborough                   | Improving Housing Choice
Protecting and improving natural Assets
Mitigation of climate change |
| North Norfolk District                 | Improving Housing Choice
Protecting and improving natural Assets
Protecting and improving cultural Assets
Re-using sequentially preferable land (PDL/ Urban Area)
Adaptation to the effects of climate change (excluding flooding)
Mitigate against/adapt for the impacts of flooding |
| Colchester District                    | Improving Housing Choice
Encouraging growth and economic prosperity                                                        |
<table>
<thead>
<tr>
<th>Local Authority</th>
<th>MCA objective of most importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hambleton District</td>
<td>Improving Housing Choice</td>
</tr>
<tr>
<td></td>
<td>Improving access to services</td>
</tr>
<tr>
<td>Brent London Borough</td>
<td>Re-using sequentially preferable land (PDL/ Urban Area)</td>
</tr>
<tr>
<td></td>
<td>Improving amount and range of employment</td>
</tr>
<tr>
<td></td>
<td>Encouraging growth and economic prosperity</td>
</tr>
<tr>
<td>Sandwell District</td>
<td>Improving Housing Choice</td>
</tr>
<tr>
<td></td>
<td>Adaptation to the effects of climate change (excluding flooding)</td>
</tr>
<tr>
<td></td>
<td>Improving amount and range of employment</td>
</tr>
<tr>
<td>Sutton London Borough</td>
<td>Improving Housing Choice</td>
</tr>
<tr>
<td></td>
<td>Improving amount and range of employment</td>
</tr>
<tr>
<td>Mid Devon District</td>
<td>Improving Housing Choice</td>
</tr>
<tr>
<td>Central Bedfordshire</td>
<td>Improving Housing Choice</td>
</tr>
<tr>
<td></td>
<td>Protecting and improving natural Assets</td>
</tr>
<tr>
<td>Breckland District</td>
<td>Protecting and improving natural Assets</td>
</tr>
</tbody>
</table>

Figure 15. MCA objectives most valued (value 3) by the case study local authorities

Across all of the case study local authorities the role of new residential development in improving the range and quality of housing stock available in a local authority area is recognised. Local Authorities that are located on the coast or an estuary have given weight to flood risk and climate change objectives but this is balanced with a number of other objectives which are given equal weight.
Understanding of Flood Risk in a Changing Climate

Three of the objectives examined in the MCA related to flood risk and climate change, as follows:

<table>
<thead>
<tr>
<th>Issue</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Mitigation of climate change</td>
</tr>
<tr>
<td>J</td>
<td>Adaptation to the effects of climate change (excluding flooding)</td>
</tr>
<tr>
<td>K</td>
<td>Manage current and future flood risk, accounting for climate change</td>
</tr>
</tbody>
</table>

In addition to examining the weight that the case study local authorities placed on these objectives, the implied understanding of these issues was also ascertained through examining both the justification for making decisions in relation to these objectives in the Sustainability Appraisal Framework and the policy response set out in the Core Strategy.

The majority of local authorities studied have understood the difference between climate change mitigation and adaptation, with separate objectives outlining measures for each.

In terms of adapting to the effects of climate change, most local authorities focus on managing and mitigating the risks of flooding. Only one LA focused on any other adaptation issue in any detail, which was Sandwell District and had a particular focus on the Urban Heat Island Effect.

However, in all cases the Core Strategy policy and justification provided against climate objectives in the sustainability appraisal of development options related to managing and mitigating the immediate impact of new development on climate change. There was no reference to the need to take into account of the potential long term effects climate change could have on this new development.

Review of the Development Option Decision Making Process

The sustainability appraisal of the preferred and alternative options for delivering and accommodating the future housing and employment needs of a local authority area was reviewed and translated into the MCA framework for 12 of the 14 example Local Authorities (for two the information could not be obtained). The MCA Framework for each local authority is provided in the Annex to this report.

Four of the twelve example local authorities had developed options that were either very clearly shaped by the need to manage flood risk (Spelthorne) or clearly referenced the need to manage and mitigate flood risk and climate change impacts as requirement of that option (Barking and Dagenham, Wakefield and Brent).

When it comes to the decision making process on development options it is the overall picture and performance against other sustainability objectives that influences the selection of the preferred option i.e. options that perform poorly against flood risk, may still be selected due to overall performance against other objectives which are highly valued (such as delivering housing choice).

Of those local authorities where the sustainability appraisal of the preferred option was available, all preferred options were considered by the Local Authorities to have a minor (in some cases major) positive effect on the sustainability objective of ‘Managing and current and future flood risk, accounting for a changing
climates’. In most cases this was a better potential impact than the alternative options.

Some sustainability appraisal frameworks consider the impacts of decisions over the short (0-5 years), medium (5 to 10 years) and long term (10 to 20 years). This is the case for three of the twelve example local authorities studied. In two of these examples, the impact of new development on climate change objectives is not considered to change over time whilst in the remaining authority the impact is considered to become more positive in the long term. Colchester was the only exception where the preferred option performed worse than the alternatives on the flood risk objective (the preferred option performed better or the same than the alternative on all other objectives).

7.3.3 Conclusions on Decision Making Processes

Examining local authority sustainability frameworks and translating them into the MCA for comparison aids explicit understanding of the decision making processes undertaken to selecting the option for accommodating new development in the local authority area. This is the precursor to then finding suitable land allocations that accord with that strategy.

Using an MCA framework has allowed an understanding of the following:

- The objectives that case study local authorities most value;
- How case study authorities understand climate change impacts;
- The transparency of their decision making processes and hence the weight afforded to climate change impacts against other objectives; and
- The consideration of long term impacts in decision making.

Review of the case study local authorities has shown that improving housing choice, protecting and enhancing natural assets, making best use of sequentially preferable land (i.e. PDL) and improving the amount and range of employment are most valued by these local authorities. They have polices in their Core Strategies to direct implementation of these objectives.

The impact of new development on flood risk in a changing climate is recognised as an issue by the local authorities studied and given higher weight in authorities located on the coast or an Estuary. However, other objectives frequently outweigh flood risk in deciding how to accommodate development in a local authority area.

Most of the case study local authorities selected development options that had a positive impact on the MCA objectives relating to flooding and climate change. However it unlikely that a negative impact on these objectives would have changed the development option selected if other valued MCA objectives were scored positively. In effect, a negative impact on flooding and climate change objectives is not valued sufficiently to swing the decision.

Whilst it is evident that the case study local authorities understand the need to ensure that new development does not have a detrimental impact on flooding climate change objectives, the assessment is predicated on the impact the development would have now. Decision making and policy focus on the
immediate impacts of new development on flood risk and do not necessarily consider the impact of this decision over the longer term in a changing climate.
7.4 Examining Implications using a Cost Analysis framework

7.4.1 Approach to CA

Research study objectives

The shaping question for the cost analysis research was:

‘What are the long term economic costs of accommodating development targets in the floodplain?’

The primary aim of the Cost Analysis (CA) exercise was to establish where, taking account of long term monetised costs, development in the floodplain is more likely to be justified at the local economy level. The analysis focussed on the additional costs of flooding when locating development in areas of flood risk. The hypothesis was that the long term additional costs associated with developing in the floodplain would differ according to attributes of a given geographical location and therefore there will be differences in where new development could be justified on economic grounds. In particular, the analysis sought to test to what extent the expected consequences of climate change affects long term economic costs. This is important in understanding the scale of benefits that would be necessary to outweigh these costs, making new development justified on economic grounds.

Spatial development decisions typically take into consideration a broad range of social, environmental and economic impacts. However, it is unclear to what extent potential climate change scenarios are being considered in the decision making process. In particular, to what extent impacts that may occur some distance into the future are being accounted for. The CA exercise was undertaken to explore the impact of factoring in different potential future scenarios for climate change. The analysis assesses the aggregate impact of strategic land allocations across the local authority area.

In summary, we briefly test how local authorities could begin explicitly to account for climate change across a range of scenarios, to understand the costs to society of developing in the floodplain, and the conditions under which development in areas at risk of flooding may be justified. Our approach examines the long-term costs of developing in the floodplain, such as costs of property level flood protection, maintenance of existing community flood defences and potential damage costs in the event of a flood, with an alternative development site outside the floodplain.

Scope and limitations of the research

The analysis concerns the case for new development only and seeks to identify expected long run economic costs and how these may influence decision making on placement of new development. The model explores costs only. It does not attempt to monetise the additional economic benefits that may be derived from residential and commercial development being located in the floodplain.
However, by analysing the cost side of the equation, the analysis elicits the level of economic benefits necessary in order to outweigh costs and justify development in the floodplain.

It is recognised a priori that it is particularly challenging to estimate the additional economic benefits derived from residential and commercial development being located in the floodplain. The approach applied in this research has been developed from the perspective of identifying established economic theories and robust available data sets. It was concluded that sufficiently robust estimates of the economic benefits could not be estimated within the scope of this research. To maintain the robustness of the model, it was therefore decided not to monetise the economic benefits. Some exploratory work was undertaken around potential proxy variables which could be pursued in further depth in future research however. These proxies included land value premiums and agglomeration benefits. Land value premium could potentially be used as a proxy for eliciting the incremental economic value associated with both residential and commercial development - to capture ‘urban externality’ type effects such as labour pooling, reduced transport costs and technological spillovers. A major issue however, is that such factors may not be fully captured within market valuations. Using agglomeration to measure productivity benefits may provide a more accurate picture of the productivity benefits associated with placing commercial development in the floodplain. However, this is requires more comprehensive data and is not applicable to residential development.

The cost analysis is applied to illustrate how changes in costs over the long run may influence the trade off in economic costs and benefits in locating new development in the floodplain. It is based on estimated economic costs only and is not intended to be used to inform decision making in specific geographical areas.

**Steps in the analysis**

The analytical steps undertaken for the cost analysis are illustrated in the following diagram.
The methodology is described in the following sub sections.

**Deriving flood event hazard from climate variables**

The baseline (representing current climate) is drawn from UKCP09. The research has utilised outputs of the Climate Change Risk Assessment to inform assumptions on climate change over the period considered by the model.

The changes in climate over time impact on the economic costs associated with new residential and commercial development that is located in the floodplain. The impact on economic costs is reflected in the model through changes in the potential average annual damages to property and productivity loss through business disruption (for new commercial development).

**Identifying the effects of climate change**

The cost analysis separates new development into two types; residential and commercial. A quantum of each type of development is assumed to be delivered annually. This development quantum is based on an annual average delivery target per typology based on local planning policy. It therefore reflects different levels of development pressure experienced between different typologies. For the purposes of the analysis, it is assumed that the decision is based on the whole of the target development being delivered in the floodplain. It is acknowledged however that authorities may only allocate a proportion of development in the floodplain.

The size of development is assumed to remain constant over time and new development is only added until the end of the plan period for each local authority (as below).
Table 18. Case study local authority plan period end dates

<table>
<thead>
<tr>
<th>Local Authority</th>
<th>Core Strategy plan period end date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barking &amp; Dagenham</td>
<td>2025</td>
</tr>
<tr>
<td>Wakefield</td>
<td>2026</td>
</tr>
<tr>
<td>Spelthorne</td>
<td>2026</td>
</tr>
<tr>
<td>Poole</td>
<td>2026</td>
</tr>
<tr>
<td>Peterborough</td>
<td>2026</td>
</tr>
<tr>
<td>North Norfolk</td>
<td>2021</td>
</tr>
<tr>
<td>Colchester</td>
<td>2021</td>
</tr>
<tr>
<td>Hambleton</td>
<td>2021</td>
</tr>
<tr>
<td>Brent</td>
<td>2026</td>
</tr>
<tr>
<td>Sandwell</td>
<td>2026</td>
</tr>
<tr>
<td>Sutton</td>
<td>2024</td>
</tr>
<tr>
<td>Mid Devon</td>
<td>2026</td>
</tr>
<tr>
<td>Central Bedfordshire</td>
<td>2026</td>
</tr>
<tr>
<td>Breckland</td>
<td>2026</td>
</tr>
</tbody>
</table>

Cost modelling

The cost analysis is undertaken with reference to the counterfactual in which the same development is delivered elsewhere outside of the floodplain. The analysis is therefore concerned with the incremental costs of developing in the floodplain over development not in the floodplain.

The following costs are modelled:

- Property level flood mitigation – The cost of property level flood protection measures was included for new development in areas where the existing level of structural protection is only at a level up to and including a 1 in 75 year flood event. Where existing structural protection is of a higher level than 1 in 75 years, it was assumed that property level measures would not be cost-effective.

- Maintenance of property level defences - An allowance for ongoing maintenance costs of property level flood defences was included on an annual basis. This is equivalent to 2% of the initial capital cost of the defences.

- Replacement of property level defences – An allowance for the replacement costs of property level flood defences was incorporated from 2020 onwards. This assumes a replacement rate of 5% of properties per annum.

- Maintenance of existing structural defences – An allowance for ongoing maintenance costs of existing structural flood defences was included on an annual basis. This is based on NAFRA 2011 maintenance expenditure data.

- Potential Average Annual Damage – The potential average annual damage (AAD) cost of floods in terms of costs associated with damage to property.
This incorporates consideration of the probability of flooding, taking into account existing levels of structural flood protection.

- Productivity loss - The model incorporated estimates of lost productivity arising from business disruption during a flood event. This was calculated for commercial development only. The estimates were based on an annual average of 3 working days per employee of businesses in the floodplain per flood event, as established in the CCRA.

**Analysis context**

**Study areas**

Eight typologies, typifying risk, vulnerability and resilience to flood risk were examined using data for 14 Local Authorities across England.

**Timeframes**

The analysis was undertaken over an 88-year period to 2100 to enable an understanding of the implications of different climate change scenarios. This reflects the actual expected lifetime of development (as opposed to design life) and allows incorporation of climate change cost data from a later epoch (2080s). The appraisal period is the same for both residential and commercial development to enable a consistent comparative analysis to be undertaken. It is acknowledged however, that the lifetime of residential development is likely to be longer than that of commercial development.

**Climate change scenarios**

The analysis takes account of projected changes in three epochs; the 2020s, 2050s and 2080s. Three climate change scenarios were considered across these epochs; Low P10, Medium P50 and High P90.

**Calculations**

**Discounted cash flow analysis**

The costs in the analysis are discounted present values of cash flows over the appraisal period (to 2100).

**Discount rates**

The economic costs have been discounted in accordance with guidance provided by the Treasury Green Book (2003 Edition). The discount rates applied are as follows:

- Years 1-30 - 3.5%
- Years 31-60 – 3.0%
- Years 61-88 – 2.5%

**Discount factors**

The discount factor for the year \( t \) with a discount rate of \( i \) is applied:
Costs

Property level flood mitigation – For areas where the existing level of structural protection is only at a level up to and including a 1 in 75 year flood event, the following formula has been applied:

\[ DF_t = \frac{1}{(1-i)^t} \]

Residential

\[ \text{Mitigation cost (per m}^2) \times \text{commercial delivery target (m}^2) \]

Commercial

\[ \text{Mitigation cost (per m}^2) \times \text{residential delivery target (units)} \]

The property level flood protection costs were derived from information provided by Royal Haskoning as part of a separate but parallel study for the ASC (forthcoming).

Maintenance of property level defences

\[ 0.02 \times \text{one-off capital cost of property level defences} \]

Replacement of property level defences – From 2020 onwards, the following formula is applied:

\[ 0.05 \times \text{one-off capital cost of property level defences} \times \text{no. of years development delivered} \]

Maintenance of existing structural defences – The following formula is applied. Residential units are assumed to be of average size 76 sqm, based on CABE research on average dwelling size.

\[ \text{Maintenance cost (per m}^2) \times \text{no. of years development delivered} \]

The estimates of maintenance cost were derived from Environmental Agency data on maintenance spending in 2010-11.
Potential Average Annual Damage –

\[
(Baseline\ average\ annual\ damage\ per\ (m^2) \times (\%\ increase\ in\ costs \
projected\ from\ climate\ change) \times development\ delivery\ target\ (m^2))
\]

This incorporates consideration of the probability of flooding, taking into account existing levels of structural flood protection.

Productivity loss – Calculated for commercial development only, based on an average of 3 working days lost per employee per flood event (CCRA):

\[
Average\ no.\ of\ staff\ days\ lost\ per\ flood\ event\ \times\ (1/\ existing\ level\ of\ structural 
protection\ in\ years)\ \times\ no.\ of\ employees\ associated\ with\ new\ development 
\times GVA\ per\ worker\ (£)
\]

Data on Gross Value Added (GVA) was derived from Office of National Statistics (ONS) estimates of headline GVA and total employment at NUTS3 level. The average number of staff days lost was derived from the CCRA.

7.4.2 Findings of CA

The Annex to this report contains the key data and outputs from the Cost Analysis (CA) for the 14 example Local Authorities examined. This section presents a summary of the findings, and in particular an examination of the influence of key variables on the long term economic costs of locating new development in the floodplain.

Long term economic costs and vulnerability

The cost analysis has incorporated vulnerability of locations in terms of the existing level of structural flood protection in place and the expected effects of climate change.

There is significant range in the level of vulnerability and resilience to flood events across local authorities in England. The 14 local authorities modelled possessed significantly different levels of existing structural flood protection. The level of existing protection ranged from a 1 in 40 year flood event to a 1 in 200 year flood event.

In the cost analysis, this variable influences the initial one-off costs relating to property level flood mitigation measures for new development and the scale of expected annual damages from a flood event. There will be one-off costs associated with making new development safe and resilient in geographic areas where there is a greater than a 1 in 100 year chance of flooding. In other areas, property level measures may not be cost-effective and alternative site specific approaches for example raising floor or ground levels, may be more appropriate. The annual expected damages arising from flood events represent an ongoing additional economic cost which is accounted for.
For example, assuming that properties with a greater than 1 in 100 year chance of flooding would stand to benefit from property level flood protection measures, the additional costs of developing in the floodplain today are around £3,214-£3,359 per property in the year of construction. Thereafter, the recurring maintenance and replacement costs of property level measures, maintenance of existing community flood defences and potential damage result in additional costs of £399-£544 per property per year in the 2050s. These results relate to the no climate change scenario.

Factoring in the effects of future climate change, this range increases to £3,343-£3,499 per property in the 2020s. This estimate includes the initial cost of a package of property level measures of approximately £3,148, the maintenance of existing community level protection and potential flood damage costs. Thereafter, the recurring maintenance and replacement costs of property level measures, maintenance of existing community flood defences and potential damage result in additional costs of £483-£728 per property per year in the 2050s. These results relate to the medium climate change scenario.

For example, the additional costs of developing in the floodplain, which include the maintenance of existing community flood defences and potential damage costs, were between £128-181 per property per year today, rising to between £138-203 per property per year by the middle of this century as a result of climate change. These results relate to the medium climate change scenario.

Long term economic costs and development type

There is evidence of a difference in the long term economic costs associated with locating new residential and commercial development in the floodplain.

The results of the analysis suggest that there are significantly higher economic costs associated with locating commercial development in the floodplain across all of the 14 Local Authorities examined. This is driven by the potential productivity loss incurred by businesses located in the floodplain arising from a flood event. The disruption to businesses during a flood event can be substantial; resulting in economic costs to the businesses affected and in turn the wider economy. The implication is that the long term benefits of accommodating development targets in the floodplain will need to be sufficiently large to outweigh the estimated costs in order to provide a positive economic return.

The key drivers of the economic case for locating commercial development in the floodplain are the advantages afforded by the location over other alternative areas outside the floodplain. Accordingly, there is a balance between the productivity gains derived from locating in the flood risk area and the expected losses arising from business disruption during flood events.

Implications: Tipping points

The cost analysis has modelled only the additional economic costs associated with locating new development in the floodplain. Whilst economic benefits have not been modelled, the findings of the analysis have implications in considering the potential future ‘tipping points’ in the economic case for locating new development in the floodplain.
Tipping points represent key thresholds in parameters in the decision making process that determine the overall outcome i.e. in this case whether new development in an area of flood risk is justified in economic terms. To define individual tipping points requires judgements concerning tolerable or intolerable levels of risk posed. When the level of perceived risk is judged to be intolerable, it marks a decision point that will require a step change in the management of risk. At the national level, identifying tipping points helps to identify better spatial planning policies and to target residential and commercial development more strategically – away from the regions and areas most vulnerable to the impacts of climate change.

There will be a ‘tipping point’ at which the aggregate economic cost of a major flood event outweighs the aggregate economic benefits arising from permitting more development in the flood risk area. In policy terms, this relates to the trade-off between ‘adapt’ and ‘retreat’ policy approaches.

The findings of the analysis indicate that this tipping point will:

- Occur sooner in time when the effects of climate change are accounted for. Climate change will lead to increases in expected damage to property;
- Occur sooner in time for new commercial development than for residential development, due to the potential productivity losses to businesses located in the floodplain. These economic costs increase over time as a consequence of climate change; and
- Occur sooner where existing levels of structural flood protection are lower;

Figure 17. Costs and Benefits – Hypothetical Tipping Point
It some areas, it might be that climate change may not result in a tipping point at all i.e. that there does not come a point at which new development results in a negative economic value. However, in these cases what might occur is a significant moderation of benefits that accrue from new development. In these circumstances, the overall economic value (taking into account costs and benefits) may remain largely static as new development is added – leading to a ‘plateau’ effect. This means that while no direct economic loss is being incurred from new development, the previously economic gains derived are not being captured. From this perspective therefore, the net benefit of new development is marginal while by adding to the total quantum of development at risk of an overtopping event. This is a significant consideration from a policy perspective.

**Implications: Risk and economic players**

The costs analysis has demonstrated how the long term economic costs of locating new development in the floodplain vary across different geographies and climate change scenarios. This has implications in considering risk and the allocation of economic costs and benefits amongst different economic players. We highlight here some of the critical considerations associated with these issues.

The issues around weighing up flood risk and development scenarios are broad and complex. In relation to the decision making process for development location, there are a number of different actors and decision makers. Benefits and costs may be distributed unevenly across different parties. There are also potential issues arising from externalities, uncertainty and to what extent actors discount the future.

The risk and the time profile of expected costs and benefits are important considerations raised by the analysis. Two aspects are particularly important:

(i) **The scale of loss in the event of an overtopping event escalates with development density**

As more development is added to a given area of flood risk, whilst increased levels of investment in area wide flood protection becomes more economically viable (since it can be split over a greater number of parties), the risk of overtopping in a major event cannot be completely eliminated.

Whilst higher densities of development in areas of flood risk may provide increased economic benefits, as the density of development increases, the potential scale of loss in a major flood event rises exponentially. Because of the small perceived probability of this loss, this may not be reflected in decisions by market players.

(ii) **The allocation of costs and benefits among economic players is uneven, particularly when considering different timeframes**

The time profile of expected costs and benefits has implications for the incentives driving the decisions of different economic players.

The time profile under consideration for developers is dominated by initial and short term costs and benefits only (additional costs of flood mitigation measures in new properties and the additional premium in sale or rental values).
The time profile under consideration at the economy wide societal level is much longer, taking into account the long term costs and benefits at the economy wide level rather than to individual players (additional costs associated with future flood events and the additional economic value of development). This analysis has been undertaken on this basis.

Whilst completed values of development may be higher and therefore developers achieve greater residual value, the costs borne by developers would be limited to the present whilst those to the economy may occur into the future. For example, whilst a developer developing in the flood risk area would bear additional cost associated with incorporating flood mitigation measures, in the event of a major flood event it would be other players in the wider economic (government agencies, business and residents) who would bear this cost.

The key point is that the potential impact of climate change on flood damage costs is therefore only included under the long term time frame – from the local economy wide perspective from which the analysis has been undertaken. These costs will be borne by occupants and the broader economy, not developers. As a consequence, developers may therefore make decisions which are sub-optimal from the economy wide perspective (in the absence of externally imposed restrictions).

<table>
<thead>
<tr>
<th>Costs</th>
<th>Economic players</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flood mitigation</td>
<td>• Private sector developers (Short term)</td>
</tr>
<tr>
<td>Maintenance/replacement of property level measures</td>
<td>• Tenants/Landlords (Long term)</td>
</tr>
<tr>
<td>Post-flood recovery</td>
<td>• Government, business and residents (Long term)</td>
</tr>
<tr>
<td>Productivity loss</td>
<td>• Economy (Long term)</td>
</tr>
<tr>
<td>Benefits</td>
<td>• Private sector developers (Short term)</td>
</tr>
<tr>
<td></td>
<td>• Owners/Landlords (Long term)</td>
</tr>
<tr>
<td></td>
<td>• Tenants (Long term)</td>
</tr>
</tbody>
</table>

Figure 18. Allocation of costs and benefits

**Implications: Policy**

Decisions about the location of new development can involve difficult trade-offs between a range of objectives. Development in the floodplain will be justified if the long term economic, environmental and social benefits of locating the new
development in an area of flood risk outweigh the long term costs of climate change. These decisions are a critical part of the UK’s adaptation efforts, as they set the geographical pattern of economic and social development over a long time horizon.

From a long term adaptation perspective, continued development in the floodplain is likely to be justified in some areas of the UK, but not others. The existing level of structural flood protection and type of development are particularly important in determining whether or not new development in the floodplain is justified from an economic perspective. Also important are the additional economic benefits that are derived from locating in the floodplain (these have not been quantified in this analysis however). In some geographical areas the strength of the economic justification for new development in areas of flood risk will be relatively clear. In others positioned toward the middle of the spectrum however, further new development may be justified economically to a point.

The point in time at which this ‘tipping point’ occurs will become closer as higher impact climate change scenarios are factored in. An issue is that the timeframe over which it is necessary to consider long term costs and benefits is typically beyond that of economic players such as developers, with follow on consequences for the wider economy.

Accordingly, the quantum of new development in areas of flood risk could be considered to be a scarce economic resource which should be utilised in the most efficient manner. There may therefore be an economic case for being selective in terms of the type of new development that is permitted in areas of flood risk. For example, prioritising new development that either must be in that location for operational reasons or that yields the greatest economic benefit in that location versus other competing development types.

For a considerable proportion of development located in the floodplain, the economic value and social benefits generated may outweigh the costs, in terms of damages from future flood events and the new or enhanced flood protection measures required, along with their long term maintenance. Avoiding development altogether in these areas may not be an effective/proportionate adaptation measure. There are however, other long term costs that may potentially outweigh the benefits of development in the floodplain. Continuing to develop an area which in the future becomes unviable due to flooding could result in assets such as infrastructure, as well as in some cases whole communities, having to be relocated at significant economic and social cost.

Continued floodplain development can result in an ‘escalator effect’, whereby progressively higher levels of flood defences are provided to protect against progressively increasing flood damage potential, caused mainly by post-defence development. However, the defences can be breached and when this happens the consequences will be increasingly high due to the escalated flood damage potential. In some areas, developing in the floodplain is likely to be storing up problems for future generations. For the rest of the country, development in the floodplain is likely to be generally acceptable from an adaptation perspective, as long as society is prepared to continue to invest in maintaining flood defences, ensuring that the resulting development is as resilient as possible and allowing the floodplain to continue functioning to at least some degree.
Conclusions

The cost analysis has explored to what extent the long term effects of climate change matter in the decision in locating new development in areas of flood risk. In particular, how the long run economic costs associated with new development differ according to vulnerability and potential future climate change scenarios.

The findings demonstrate that the long term economic costs of new development in the floodplain vary significantly across the local authority areas examined. This reflects differences in a number of parameters. The existing level of structural flood protection and type of development are key determinants. Long term economic costs are significantly higher in areas with a lower level of existing structural flood protection. Commercial development is associated with higher long term economic costs than residential development.

Incorporating the potential impacts of climate change increases the long term economic costs associated with new development located in the floodplain. This is significant in considering how the balance of costs and benefits could change over time having significant implications for decisions in respect of new development in areas of flood risk. The analysis undertaken has been concerned with costs only and in making decisions, local authorities will also need to consider the additional long term benefits conferred by developing in the floodplain. Some suggestions for potential proxies have been identified. The cost analysis has demonstrated that costs are expected to rise significantly over time. Accordingly, the required level of additional benefits derived from locating new development in the floodplain to make development economically justifiable will also have to increase over time.

In summary, if the costs of climate change are not being taken into account, then there is a risk that some development decisions being taken now are inadvertently increasing the potential costs of flooding and costs of adaptation in the future. This will particularly be the case if whole communities and critical infrastructure have to be relocated in the future.
Appendix A

Assumptions Log
A1 Method Development Assumptions

A1.1 Local Authorities and Development Plans

(i) The selection of 42 Local Authorities in this study is informed by the availability of the most up to date development plan types in England that make land allocations.

(ii) The study examines adopted development plans (with the exception of 9 Site Allocations DPDs which had reached the Examination Stage) and the evidence base which informed the development of the adopted plan. It is acknowledged that some Local Authorities have since updated the evidence base to inform emerging development plans.

(iii) A high level qualitative review of the following information sources were reviewed in this the study and where possible the results were quantified: Strategic Flood Risk Assessments; Development Plans making allocations associated Inspector s Reports.

(iv) The study does not seek to make a judgement on whether a Local Authority examined in the study has met the requirements of PPS25 / NPPF in making its land allocations.

A1.2 Review of Strategic Allocations

(i) The study examines Strategic Allocations defined as: ‘site allocations which are fundamental to the delivery of the development plan’s core aims and objectives’. Strategic allocations are housing allocation of >50 dwellings and employment and mixed use allocations of >50 ha.

(ii) 718 Strategic Allocations were identified by reviewing all of the development plan allocations in the 42 Local Authorities studied. The development plan’s proposal map was compared to Street Map identify and easting and northing point for the centre of each Strategic Allocation and this was plotted using GIS.

(iii) Using GIS, the EA flood risk and surface water data sets were used to identify whether the centre of each site was at risk of flooding and what type of flood risk. For those Strategic Allocations identified as at risk, the development plan text was used as a means to validate the type of risk.

(iv) The type of flood risk that the strategic allocation is vulnerable to (pluvial or fluvial (flood zones 2 and 3 only), was categorised with fluvial flood risk further categorised as either fluvial only, coastal and tidal only; or fluvial, coastal and tidal).

(v) For those at risk of fluvial flooding, Strategic allocations have been classified as ‘all or majority Flood Zone 2 and all or majority Flood Zone 3 as the degree of flood risk can vary across a land allocation. This was determined by comparing the development plan proposals...
map with the EA flood zones for each allocation. Where over 50% of the land allocation was located in flood zone 3, this was classed as ‘all or majority’ in flood zone 3.

(vi) The land use status (Greenfield or PDL) was derived using MasterMap natural and manmade layers with a validation exercise checking the actual status of the sites within each LA using the development plan text and satellite imagery from Google Earth.

(vii) Whether the Exception test was applied to the consideration of any of the strategic allocations (from the SFRA and the plan text);

(viii) The justification given for strategic allocations made in areas at risk of flooding was classified under 3 themes. The plan text has been used to interpret the justification given by the LPA for locating this development in the floodplain.

(ix) The study has identified where the development plan text has stated (yes or no) measures to manage the risk of flooding on the allocation when later bought forward for development. It has not made a judgement of whether the measures stated were sufficient or met the requirements of ‘safe’ as described in the NPPF Technical Guidance.

A1.3 Alternative Land

(i) This assessment provides an indication of the alternative land which could be available in each of the 42 local Authority Areas studied. For clarity, (other than the Green Belt) this is based on nationally safeguarded physical characteristics of a local authority area and makes no assumptions on the appropriateness or suitability (in physical, policy or timescale terms) of the alternative land identified to accommodate development.

(ii) The total area of each of the 42 Local Authorities was derived from GIS. The area of land that was not subject to (in combination) National Designations (listed in ‘data used’ section below), Grade 1 or 2 Agricultural Land in the flood plain, in the Green Belt or in the urban area (using census boundaries) was also derived using GIS. The residual land was therefore calculated.

(iii) The amount of PDL not at risk of flooding was derived by using the NLUD data. This included the area of each NLUD site listed in each Local Authority and also an easting and northing reference for the centre of each site. Using GIS, the EA flood risk and surface water data sets were used to identify whether the centre of each site was at risk of flooding. Those sites with a centre point located in the floodplain were removed from the total combined sites area in each local authority. This enables a total PDL land area not in the floodplain to be derived for each local authority in the study.

(iv) Assumptions about whether a Local Authority had ‘sufficient land available’ outside of the floodplain, national designations, Agricultural land, existing urban area and Green Belt was based comparing whether the total amount of land allocated in each of the
local authority’s development plans could be accommodated on the ‘residual land’ plus on PDL outside of the floodplain.
A2 Proforma Entry Assumptions

A2.1 Proforma 1

(i) In some instances it was not straightforward to attribute what level the SFRA was carried out to, especially the SFRA front runners that were carried out pre-PPS 25 being published (December 2006).

A2.2 Proforma 2

(ii) In order to quantify the total amount of land allocated for development in a local authority by type, this information hasn’t always been available. Within older plan types, e.g. Local Plans and Unitary Development Plans, they tended not to explicitly list all allocated sites, rather they tended to present a 'headline figure' for housing, employment and mixed use development targets. Therefore it hasn’t been possible to calculate the complete total number of sites allocated for some local authorities.

(iii) There is a variance in how local authorities have presented allocations for housing. Some authorities have allocated sites with the area in hectares, and others have allocated sites with an approximate number of dwellings for the site. To bring consistency to how this information is presented, an standard density assumption has been applied of 50 dwellings per hectare (a level for what is deemed a sustainable community) to convert a proposed number of dwellings for a site into an area in hectares, e.g. if a site had an allocation for 50 dwellings, this was be assumed to have a site area of 1 hectare.

(iv) For employment and mixed use sites that had no site areas attached to them, this is much more difficult to substitute and apply a standard to. Therefore it has been acknowledged, on a local authority-by-local authority basis what site areas haven’t been included within the total amount of land allocated.

(v) Set out below is an overview of any assumptions that were required for certain local authorities.

A2.3 Local Authority: Assumptions Made

(vi) Ashford

Housing

The Local Authority wide total for housing= 865 dwellings. This has been converted to 17.3ha using a standard of 50 dwellings per hectare.

All strategic allocations for housing= 619 dwellings. This has been converted to 12.38ha using a standard of 50 dwellings per hectare.
(vii) Carlisle

Employment
The total allocations for employment - unsure on the total number of sites. The overall policy is difficult to interpret. The table this data was derived was very difficult to interpret.

(viii) Chesterfield

Housing
LA wide total housing of 1592 dwellings, was converted to 31.84ha.
The total strategic allocations for housing of 1329 dwellings was converted to 26.58ha.
The strategic allocations – total amount of land allocated for development in flood zones:
Pluvial- 1269 dwellings was converted to 25.38ha
Majority Flood Zone 3, minority Flood Zone 2, 150 dwellings was converted to 3 hectares.
Majority Flood Zone 2, minority Flood Zone 3 of 70 dwellings was converted to 1.4 hectares.

(ix) Colchester

The LA wide total allocation housing was 19,000 dwellings (taken from Core Strategy, table Ha1) but hard to define the actual list of housing allocations.
24 sites named in the Site Allocations DPD also included in a number of regeneration areas, further sites also on the proposals map and sites found in the SHLAA and housing trajectory.
Of the strategic allocations for housing, 1874 dwellings was converted to 37.48ha.
Of the sites allocated in flood zones: those at pluvial flood risk, housing allocation for 129 dwellings was converted to 2.58ha.
Of those located Majority Flood Zone 3, minority Flood Zone 2 298 dwellings and 61 dwellings were converted to 3.18ha.

(x) Hartlepool

Housing
LA wide total housing of 4298 dwellings was converted to 85.96ha.
All strategic allocations of 2155 dwellings was converted to 42.5ha.
The amount of land allocated for development in flood zones:
All Flood Zone 2 for housing of which 1425 dwellings were converted to 28.5ha.
Majority Flood Zone 2, minority Flood Zone 3 of which 561 dwellings, were converted to 11.22ha.

(xi) Havant

Mixed Use
LA wide total for mixed use of which 4944 dwellings was converted to 98.88ha.

Housing
LA wide total for housing of which 340 dwellings was converted to 6.8ha.
All strategic allocations for mixed use of which 340 dwellings was converted to 6.8ha that was located within flood zones.
Sites allocated at risk of pluvial flood risk, of which mixed use allocations for 1944 dwellings was converted to 38.8ha.
(xii) Middlesbrough
The total mixed use allocations is comprised of dwellings and hectares (for different sites it is quantified differently) so number of dwellings was converted to hectares and added to sites with hectares for consistency.
(xiii) Plymouth
This was a complex Local Plan to calculate total figures.
Floorspace for retail and employment was in square metres, this was converted into hectares for consistency.
Total strategic allocation for mixed use, of which 6320 dwellings was converted to 126.4ha.
Total allocation for housing, of which 1,677 dwellings was converted to 33.54ha.
(xiv) North Somerset
This was a complex Local Plan to calculate total figures.
For housing allocations, the sites had approximate number of dwellings, which were converted into hectares.
For total housing figures, 5,024 dwellings, was converted to 100.48ha.
For total strategic allocations for housing, 2,941 dwellings was converted to 58.2ha.
For those sites in areas of flood risk:
   1304 dwellings was converted to 26.08ha
   108 dwellings was converted to 2.16ha
   1390 dwellings was converted to 27.8 ha
   1019 dwellings was converted to 20.38ha
   106 dwellings was converted to 2.12ha
(xv) South Cambridgeshire District
Housing:
Excludes site areas or dwelling numbers for:
SP/3 Cambourne
SP/5 Cambourne School Lane Special Policy Area
SSP/11 Fen Drayton Former Land Settlement Association Estates
Mixed Use:
Excludes site area for:
SP/10 Papworth Everard Village Development
Site 1 – Papworth Hospital Site
  (xvi)  South Holland

*Housing*
Total number of sites not explicit within the Local Plan

*Mixed Use*
Site areas not provided for:
Policy EC13 - The Northern Expansion Area, Spalding
Policy EC14 - Land Rear of The White Hart, Spalding
  (xvii)  South Tyneside District

*Retail*
For the one retail allocation made, the area allocated in square metres of floorspace was converted to hectares.
  (xviii)  Spelthorne District

*Other*
Within the allocations for Spelthorne there was an allocation for Public Open Space.
  (xix)  Tonbridge and Malling

*Housing*
No site areas given for the two allocations. The allocated dwelling numbers were converted into hectares by applying the standard of 50 dwelling per hectare.

*Mixed Use*
No site areas were given for the following Mixed Use allocations:
(r) Kings Hill
(s) East Malling Research Station (main site)
(t) Bradbourne, East Malling
These were not accounted for in the total amount of land allocated for Mixed Use development.
  (xx)  Warrington

*Housing*
It is not clear of total number of sites which comprise the headline allocation for housing.

*Employment*
Unsure of exact make up - UDP does not list specific sites, it just presents a 'headline figure' for both housing and employment.
A3 Cost Analysis Assumptions

A3.1 Key underlying assumptions

Time period for appraisal – Based on asset lifetimes for residential and commercial development, assumed 88 years (2012-2100);

Discount rate – Green book compliant rate adopted (3.5% for years 0-30, 3.0% for years 30-60, 2.5% for 60-88);

A3.2 Economic costs

There is a large body of research on the economic assessment of flood risk in the UK. This has mainly been conducted by a research team at Middlesex University (sponsored by Defra and the Environment Agency) who have been undertaking research into flood risk issues for two decades. Their latest relevant guidance is published in the Benefits of Flood and Coastal Risk Management: A Manual of Assessment Techniques, known as the Multicoloured Manual (MCM). The MCM methodology is based on, and used in conjunction with several sources of guidance on appraising flood risk:

(i) HM Treasury ‘Green Book’ which identifies the preferred approach to public sector investment appraisal; and

(ii) Defra Project Appraisal Guidance (PAG) series particularly PAG3 which identifies how a project appraisal and cost-benefit analysis should be completed for flood and coastal erosion risk management projects.

The MCM provides useful guidance on approaches for evaluating economic damages and has been a key reference point in the development of the framework applied for the purposes of this study.

For the purposes of this study, it is emphasised that economic costs differ from financial costs. Financial costs capture the loss incurred to one particular business as a result of flooding (and is broadly related to insurance claims) whereas economic costs refer to opportunity costs. More precisely, flooding results in economic costs only if it decreases the overall welfare of society.

Flood damages can be presented as absolute values for a particular event or a selected return period, such as a 1 in 100 event. Reporting economic damages in this way is limited as it only records the damage from one particular flood event. To understand exposure of an area to the full range of floods that might cause it damage it is necessary to incorporate flood probability into the assessment of flood damages. This approach to estimating flood damages results in the annual average damage (AAD), which is weighted by the appropriate flood exposure.

AAD is a more meaningful way of representing economic damages and is the approach applied within the CBA exercise. It is the average cost of flood damage per year to be caused by flooding over a long period of time, taking into account that in some years there may be no damage, in some, minor damage caused by
small, relatively frequent flood events and in a few years there will be major damage caused by large, rare flood events.

A3.3 Climate Change

There is a clear impact of climate change on flood risk. Through impacts of climate change the risk of flooding is expected to increase significantly in some areas over the next century. This results from predictions that rainfall intensities will increase, leading to higher rates of runoff and more frequent flash flooding, and from an expected acceleration in rates of sea level rise.

Estimated changes in annual flood damage costs are drawn from the Climate Change Risk Assessment for the Floods and Coastal Erosion Sector (January 2012). At the time of the analysis, the full data was not available and therefore some inferences were made from indicative ranges provided in the report. Three scenarios are applied to the analysis (low, medium and high), taking into account projections for the 2020s and 2050s (which are relevant to the time period appraised, 2012-2100).

The uncertainties in climate risk projections are particularly problematic for planning large-scale and long term adaptation projects. Probabilistic projections provide a framework for testing alternative scenarios how they are still subject to considerable uncertainty in their accuracy.
A4 Data Used

(i) Flood Risk (Environment Agency): SV0000_nat_areas_benefit_v2_0_0, SV0000_, Nat_floodzone2_v4_0_0 and SV0000_,Nat_floodzone3_v4_0_0 datasets and Class 1 = Fluvial only, Class 2 = Coastal / tidal only Class 3 = both fluvial and coastal / tidal

(ii) Surface water (Environment Agency): ASTSWF data set

(iii) Agricultural Land classification – Natural England

(iv) Ancient Woodland – Natural England

(v) SSSI – Natural England

(vi) Special Protection Area – Natural England

(vii) Special Area of Conservation – Natural England

(viii) National Parks - Natural England

(ix) National Nature Reserves – Natural England

(x) Green Belt – Dept for Communities and Local Government

(xi) Urban Areas – Census

(xii) Previously Developed Land (Homes and Communities Agency) National Land Use Database (NLUD) (2009)