



**South Bucks District Council
Strategic Flood Risk Assessment (SFRA)
Level 1**

February 2008 (Final)



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EXECUTIVE SUMMARY

Introduction

1. South Bucks District Council is situated to the west of London, bounded by the River Thames to the south and west and River Colne to the east. The risk of river flooding within the District is generally limited, restricted geographically to those areas situated adjacent to the main river corridors. Localised issues have been identified within the District, and whilst these may not influence the allocation of land for future development, it is imperative that these are not exacerbated by careless design.
2. It is important to recognise that some of those areas that are at risk of flooding from rivers within the District are under pressure from future development. It is essential therefore that the Council are in a position to take informed decisions, providing a careful balance between the risk of flooding and other unrelated planning constraints that may place pressure upon 'at risk' areas. The South Bucks SFRA endeavours to provide specific advice to assist the Council in this regard.
3. **This report (and the supporting mapping) represents the Level 1 SFRA¹, and should be used by the Council to inform the application of the Sequential Test.** Following the application of the Sequential Test, it may be necessary to develop a Level 2 SFRA² should it be shown that proposed allocations fall within a flood affected area of the District. The Level 2 SFRA should consider the risk of flooding in greater detail within a local context to ensure that the site can be developed in a safe and sustainable manner.

Why carry out a Strategic Flood Risk Assessment (SFRA)?

4. Flooding can result not only in costly damage to property, but can also pose a risk to life and livelihood. It is essential that future development is planned carefully, steering it away from areas that are most at risk from flooding, and ensuring that it does not exacerbate existing known flooding problems.
5. *Planning Policy Statement (PPS) 25: Development and Flood Risk* has been developed to underpin decisions relating to future development (including urban regeneration) within areas that are subject to flood risk. In simple terms, PPS25 requires local planning authorities to review the variation in flood risk across their district, and to steer vulnerable development (e.g. housing) towards areas of lowest risk. Where this cannot be achieved and development is to be permitted in areas that may be subject to some degree of flood risk, PPS25 requires the Council to demonstrate that there are sustainable mitigation solutions available that will ensure that the risk to property and life is minimised (throughout the lifetime of the development) should flooding occur.
6. The Strategic Flood Risk Assessment (SFRA) is the first step in this process, and it provides the building blocks upon which the Council's planning and development control decisions will be made.

What is a Strategic Flood Risk Assessment (SFRA)?

7. The South Bucks District Council Strategic Flood Risk Assessment (SFRA) has been carried out to meet the following key objectives:
 - To provide appropriate baseline information on flooding and the risk of flooding in the Study Area;

¹ Refer paragraphs 2.32 to 2.35 of the Living Draft of the Practice Guide Companion to PPS25 (February 2007)

² Refer paragraphs 2.36 to 2.42 of the Living Draft of the Practice Guide Companion to PPS25 (February 2007)

- To inform and provide an input into the Sustainability Appraisals of the Core Strategy DPDs, Site Allocations DPDs, and the Generic Development Control Policies DPDs, so that flood risk is taken account of when considering options and in the preparation of land use policies;
- To provide the evidence base and inform the preparation of policies relating to the management of flood risk in the Core Strategy DPDs, Site Allocations DPDs and the Generic Development Control Policies DPDs;
- To inform the preparation of Housing Land Availability Studies for the Study Area;
- To provide sufficient data and information to enable the Local Planning Authorities to apply the Sequential Test to land use allocations, and where necessary the Exception Test;
- To identify the level of detail required for site-specific flood risk assessments in particular locations
- To determine the acceptability of flood risk in relation to emergency planning capability

The Sequential Test

8. The primary objective of PPS25 is to steer vulnerable development towards areas of lowest flood risk. PPS25 advocates a sequential approach that will guide the planning decision making process (i.e. the allocation of sites). In simple terms, this requires planners to seek to allocate sites for future development within areas of lowest flood risk in the initial instance. **Only if it can be demonstrated that there are no suitable sites within these areas should alternative sites (i.e. within areas that may potentially be at risk of flooding) be contemplated.** This is referred to as the Sequential Test.
9. As an integral part of the sequential approach, PPS25 stipulates permissible development types. This considers both the degree of flood risk posed to the site, and the likely vulnerability of the proposed development to damage (and indeed the risk to the lives of the site tenants) should a flood occur.
10. The PPS25 Sequential Test is depicted in Figure 3.1 of the Practice Guide Companion to PPS25 (Draft, February 2007) and Section 6.4.1 of this document.

The Exception Test

11. Many towns within England are situated adjacent to rivers, and are at risk of flooding. The future sustainability of these communities relies heavily upon their ability to grow and prosper. PPS25 recognises that, in some districts, including South Bucks District Council, restricting residential development from areas designated as Zone 3a High Probability may heavily compromise the viability of existing communities within the District.
12. For this reason, PPS25 provides an Exception Test. Where a local planning authority has identified that there is a strong planning based argument for a development to proceed following the application of the Sequential Test, it will be necessary for the Council to demonstrate that the Exception Test can be satisfied.
13. 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 SFRA where one has been prepared. If the DPD has reached the ‘submission’ stage, the benefits of the development should contribute to the Core Strategy’s Sustainability Appraisal;*

- *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 previously developed land; and*
- *a FRA must demonstrate that the development will be safe, without increasing flood risk elsewhere, and where possible, will reduce flood risk overall."*

Outcomes of the South Bucks District Council SFRA

14. South Bucks District Council has been delineated into zones of low, medium and high probability of fluvial flooding, based upon existing available information provided by the Environment Agency. Detailed flood risk mapping has been made available for the River Thames and River Colne (downstream of the A40). The Environment Agency Flood Zone Maps (March 2007) have been adopted as the basis for the SFRA for other watercourses.
15. A proportion of the District is affected by flooding from either the River Thames or the River Colne system and its tributaries, most notably Alder Bourne and the River Misbourne. The spatial variation in flood risk across the District has been delineated in the following manner:

Zone 3b (Functional Floodplain)

16. Areas subject to flooding up to (and including) once in every 20 years on average have been delineated. These areas have been sub-delineated on the basis of current land use, i.e. open space or currently undeveloped areas (i.e. 'Zone 3b Functional Floodplain (Undeveloped)') vs areas that are 'previously developed' (i.e. 'Zone 3b Functional Floodplain (Developed)'). Within the context of the SFRA, 'previously developed' areas are solely existing buildings that are impermeable to floodwaters. The land surrounding these buildings are important flow paths and/or flood storage areas that must be retained.
17. It is important to recognise that all areas within Zone 3b are areas that are subject to relatively frequent flooding, and may be subject to fast flowing and/or deep water. Whilst it may be impractical to refuse all future regeneration within these areas, careful consideration must be given to future sustainability and safety issues. To meet the requirements of the Exception Test, it will be necessary for the Council to demonstrate that the development provides wider sustainability benefits to the community that outweigh flood risk. A suite of spatial planning and development control policies have been developed for Zone 3b Functional Floodplain.

Zone 3a High Probability

18. Areas subject to flooding up to (and including) once in every 100 years on average (i.e. 'Zone 3a High Probability') have been identified. Residential development should be avoided in these areas wherever possible.
19. To meet the requirements of the Exception Test, it will be necessary for the Council to demonstrate that the development provides wider sustainability benefits to the community that outweigh flood risk. The Council must also demonstrate that the development is on developable, previously developed land or if it is not on previously developed land, that there are no reasonable alternative sites on previously developed land.
20. The SFRA has outlined specific development control recommendations that should be placed upon development within Zone 3a High Probability to minimise the damage to property, the risk to life in case of flooding, and the need for sustainable drainage techniques (SuDS) to reduce runoff rates. It is essential that the developer carries out a detailed Flood Risk Assessment to consider the site-based constraints that flooding may place upon the proposed development.

Zone 2 Medium Probability

21. Areas subject to flooding in events exceeding the 100 year event, and up to (and including) once in every 1000 years on average (i.e. Zone 2 Medium Probability) have been identified. 'Highly Vulnerable Development'³, for example emergency services, should be avoided in these areas. There are generally no other restrictions placed upon land use in these areas, however it is important to ensure that the developer takes account of possible climate change impacts to avoid a possible increase in the risk of flooding in future years (achieved through completion of a simple Flood Risk Assessment).

Zone 1 Low Probability

22. There are no restrictions placed on land use within Zone 1 Low Probability (i.e. all remaining areas of South Bucks) by PPS25. It is important to highlight however that those areas affected by flooding within the District in recent years have often fallen within Zone 1. It is essential therefore that the Council establish robust local planning policy that addresses those issues not captured by PPS25 through the delineation of fluvial flood zones. Consideration must be given to the potential risk of flooding from other sources (outlined in 'Localised Flooding Issues' below), ensuring that future development is not inadvertently placed at risk. It is also essential to ensure that future development does not exacerbate the current risk posed to existing homes and businesses.

Localised Flooding Issues

23. In addition to fluvial (river) flooding, properties and infrastructure within South Bucks are also at risk of flooding from other, more localised, sources. These include groundwater flooding, the surcharging of the underground sewer system, the blockage of culverts and gullies (which results in overland flow), and surface water flooding. Evidence of localised flooding of this nature has been captured from Parish Councils throughout the District, as depicted in Figure 33.
24. PPS25 does not address issues of this nature within its delineation of flood zones and what development is acceptable within them. In many instances, localised flooding issues result in only nuisance flooding, and will generally affect only a small number of properties. Incidents of this nature can be often be addressed through the design process, and therefore should not affect decision making with respect the allocation (or otherwise) of sites within South Bucks. The recent flooding throughout England highlights that this is certainly not always the case however, and uncontrolled flooding as a result of particularly heavy rains can create significant damage and disruption.
25. It is difficult to predict the likelihood and anticipated severity of localised flooding. Often incidents of this nature will be as a result of 'on the ground' conditions on any particular day (e.g. litter or leaves on the road may exacerbate a problem). Observed flooding can certainly be captured, however not surprisingly these are generally within areas of existing development. Within other areas of the District, topography and geology have been interrogated in an effort to highlight areas that may be most susceptible to groundwater flooding and/or flash flooding during periods of particularly intense rainfall. These areas of the District have been identified in Figure 29, providing an overview of anticipated overland flow routes. Areas known to have been affected by groundwater and/or localised flooding historically are provided in Figures 2 to 19.

³ Refer Table D2 (Appendix D) of PPS25

26. The PPS25 Practice Guide (A Living Draft, February 2007) advocates the application of a sequential approach when allocating land, taking into consideration *all* sources of flooding. The local drainage related problems identified within South Bucks are generally very localised, and relate to historical incidents, the source of which is often somewhat uncertain. It is important to recognise therefore that these are not a measure of 'risk', but rather problems that have occurred due to a particular set of local circumstances in the past (for example, the blockage of a local gully inlet). These may or may not reoccur in future years.
27. From a spatial planning perspective therefore, it is considered unreasonable to restrict future development within areas that may have suffered a localised flooding incident in years past. It is essential however not to overlook the potential risk of localised flooding during the design process. Whilst the incidents that have been identified will typically not result in widespread damage or disruption, a proactive approach to risk reduction through design can mitigate the potential for damage, both to the development itself and elsewhere. Specific development control recommendations have been provided accordingly.
28. The implementation of sustainable drainage systems (SuDS) must be ensured and careful consideration to overland flow routes (and avoidance of their obstruction), as part of the site design, should be encouraged.
29. Thames Water was approached for information regarding flooding arising from the surcharging and blockage of surface and foul water sewers. This data, known as DG5 flooding data, is subject to confidentiality issues and specific incidences where individual properties were affected cannot be divulged. However, Thames Water is allowed to detail how many properties have been subject to DG5 flooding per postcode area (the first four digits of the postcode are provided only). These are provided in Figures 2 to 19.

A Proactive Approach – Reduction in Flood Risk

30. It is crucial to recognise that PPS25 considers not only the risk of flooding posed to new development, but that it also seeks to positively reduce the risk of flooding posed to existing properties within the District. It is strongly recommended that this principle be adopted as the underlying 'goal' for developers and Council development control teams within South Bucks.
31. Developers should be encouraged to demonstrate that their proposal will deliver a positive reduction in flood risk to the District, whether that be by reducing the frequency or severity of flooding (for example, through the introduction of SuDS), or by reducing the impact that flooding may have on the community (for example, through a reduction in the number of people within the site that may be at risk). This should be reflected through the inclusion of a positive statement within the detailed FRA that clearly and concisely summarised how this reduction in flood risk will be delivered.

The Way Forward

32. A proportion of the South Bucks District is at risk of flooding. The risk of flooding posed to properties within the District arises from a number of sources including river flooding, localised runoff, sewer and groundwater flooding.
33. A planning solution to flood risk management should be sought wherever possible, steering vulnerable development away from areas affected by flooding in accordance with the PPS25 Sequential Test. Specific planning recommendations have been provided for all settlements within the District.
34. Where other planning considerations must guide the allocation of sites following the application of the Sequential Test, it will be essential that a Level 2 SFRA is carried out for all potential allocations that fall within a flood affected area. This will ensure that the Council can allocate the site safe in the knowledge that the risk of flooding can be safely (and sustainably) mitigated over the lifetime of the development.
35. Following application of the Sequential Test, and the decision to proceed with development in areas at risk of flooding due to other planning constraints (that outweigh flood risk), it will be necessary for the Exception Test to be applied. Specific recommendations have been provided to assist the Council and the developer to incorporate design features that will mitigate the potential risks of flooding within the site. These should be applied as development control recommendations for all future development. It is essential that these are applied, not only where there is a direct risk of flooding to the proposed development site, but elsewhere within the District. It is important to recognise that all development may potentially have an adverse impact upon the existing flooding regime if not carefully mitigated.
36. Council policy is essential to ensure that the development control recommendations can be imposed consistently at the planning application stage. This is essential to achieve future sustainability within the District with respect to flood risk management. It is recommended that a DPD is developed to build upon emerging Council policy, in light of the suggested development control recommendations presented by the South Bucks SFRA.
37. Emergency planning is imperative to minimise the risk to life posed by flooding within the District. It is recommended that the Council advises the local Resilience Forum of the risks raised in light of the South Bucks SFRA, ensuring that the planning for future emergency response can be reviewed accordingly.

A Living Document

38. The South Bucks SFRA has been developed building heavily upon existing knowledge with respect to flood risk within the District. A rolling programme of detailed flood risk mapping within the Thames region is underway. This, in addition to observed flooding that may occur throughout a year, will improve the current knowledge of flood risk and may alter predicted flood extents within South Bucks. Furthermore, Communities and Local Government (CLG) are working to provide further detailed advice with respect to the application of PPS25, and future amendments to the PPS25 Practice Guide are anticipated. Given that this is the case, a periodic review of the South Bucks SFRA is imperative.
39. It is recommended that the South Bucks SFRA is reviewed when needed. A series of key questions to be challenged as part of the SFRA review process are set out in Section 7 of this document, providing the basis by which the need for a detailed review of the document should be triggered.

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Glossary

AEP	Annual Exceedance Probability e.g. 1% AEP is equivalent to 1% probability of occurring in any one year (or, on average, once in every 100 years)
Core Strategy	The Development Plan Document within the Council's Local Development Framework, which sets the long-term vision and objectives for the area. It contains a set of strategic policies that are required to deliver the vision including the broad approach to development.
DCLG	Department of Community and Local Government
Defra	Department of Environment, Food and Rural Affairs
Development	The carrying out of building, engineering, mining or other operations, in, on, over or under land, or the making of any material change in the use of a building or other land.
Development Plan Document (DPD)	A spatial planning document within the Council's Local Development Framework, which set out policies for development and the use of land. Together with the Regional Spatial Strategy, they form the development plan for the area. They are subject to independent examination.
EA	Environment Agency
Flood Zone Map	Nationally consistent delineation of 'high' and 'medium' flood risk, published on a quarterly basis by the Environment Agency
Formal Flood Defence	A structure built and maintained specifically for flood defence purposes
Habitable Room	A room used as living accommodation within a dwelling but excludes bathrooms, toilets, halls, landings or rooms that are only capable of being used for storage. All other rooms, such as kitchens, living rooms, bedrooms, utility rooms and studies are counted.
Informal Flood Defence	A structure that provides a flood defence function, however has not been built and/or maintained for this purpose (e.g. boundary wall)
Local Development Framework (LDF)	Consists of a number of documents which together form the spatial strategy for development and the use of land
Planning Policy Guidance (PPG)	A series of notes issued by the Government, setting out policy guidance on different aspects of planning. They will be replaced by Planning Policy Statements.
Planning Policy Statement (PPS)	A series of statements issues by the Government, setting out policy guidance on different aspects of planning. They replace Planning Policy Guidance Notes
PPG25	Planning Policy Guidance 25: Development and Flood Risk Office of the Deputy Prime Minister (ODPM), 2001
PPS25	Planning Policy Statement 25: Development and Flood Risk Department of Community & Local Government, 2006

Previously Developed (Brownfield) Land	Land which is or was occupied by a building (excluding those used for agriculture and forestry). It also includes land within the curtilage of the building, for example, a house and its garden would be considered to be previously developed land.
Residual Risk	A measure of the outstanding flood risks and uncertainties that have not been explicitly quantified and/or accounted for as part of the review process
SEA	Strategic Environmental Assessment
SuDS	Sustainable Drainage System
Supplementary Planning Document (SPD)	Provides supplementary guidance to policies and proposals contained within Development Plan Documents. They do not form part of the development plan, nor are they subject to independent examination.
Sustainability Appraisal (SA)	Appraisal of plans, strategies and proposals to test them against broad sustainability objectives.
Sustainable Development	Development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (The World Commission on Environment and Development, 1987).
Zone 1 Low Probability	This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%)
Zone 2 Medium Probability	This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% – 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% – 0.1%) in any year
Zone 3a High Probability	This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year
Zone 3b Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. Within South Bucks, this has been defined as land which would flood with an annual probability of 1 in 20 (5%) or greater in any year

1 Introduction

1.1 Overview

40. South Bucks District Council is situated to the west of London, bounded by the River Thames to the south and west and River Colne to the east.
41. Planning Policy Statement (PPS) 25: Development and Flood Risk requires that local planning authorities prepare a Strategic Flood Risk Assessment (SFRA) in consultation with the Environment Agency. The primary purpose of the SFRA is to determine the variation in flood risk across the District. Robust information on flood risk is essential to inform and support the Council's revised flooding policies in its emerging Local Development Framework (LDF).
42. Jacobs was commissioned to develop the South Bucks District Council Strategic Flood Risk Assessment (SFRA) in June 2007. South Bucks District is currently reviewing its planning framework, and this SFRA supplements the evidence base that informs this review process. The SFRA is a technical document that will be submitted to the Secretary of State with the submission Core Strategy and supporting Development Planning Document (DPD). This SFRA will be developed and refined over time and will inform the allocation of sites for future development.
43. **This report (and the supporting mapping) represents the Level 1 SFRA⁴, and should be used by the Council to inform the application of the Sequential Test.** Following the application of the Sequential Test, it may be necessary to develop a Level 2 SFRA⁵ should it be shown that proposed allocations fall within a flood affected area of the District. The Level 2 SFRA should consider the risk of flooding in greater detail within a local context to ensure that the site can be developed in a safe and sustainable manner.

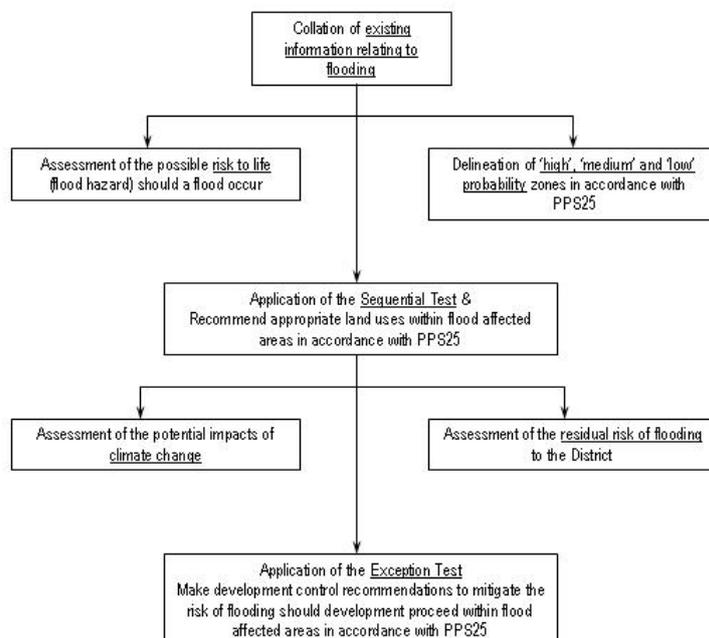
⁴ Refer paragraphs 2.32 to 2.35 of the Living Draft of the Practice Guide Companion to PPS25 (February 2007)

⁵ Refer paragraphs 2.36 to 2.42 of the Living Draft of the Practice Guide Companion to PPS25 (February 2007)

2 SFRA Approach

44. The primary objective of the South Bucks SFRA is to inform the revision of flooding policies, including the allocation of land for future development, within the emerging Local Development Framework (LDF). The SFRA has a broader purpose however, and in providing a robust depiction of flood risk across the District, it can:
- Inform the development of Council policy that will underpin decision making within the District, particularly within areas that are affected by (and/or may adversely impact upon) flooding;
 - Assist the development control process by providing a more informed response to development proposals affected by flooding, influencing the design of future development within the District;
 - Help to identify and implement strategic solutions to flood risk, providing the basis for possible future flood alleviation works;
 - Support and inform the Council's emergency planning response to flooding.
45. Whilst general guidance is available as to what should be presented as an outcome of the SFRA process, the Government provides no specific *methodology* for the SFRA delivery. Therefore, to meet these broader objectives in a pragmatic manner that is 'fit for purpose', the SFRA has been developed in consultation with both the Council and the Environment Agency.
46. A considerable amount of knowledge exists with respect to flood risk within the District, including information relating both to historical flooding, and the predicted extent of flooding under extreme weather conditions (i.e. as an outcome of detailed flood risk modelling carried out by the Environment Agency). The South Bucks SFRA has built upon this existing knowledge, underpinning the delineation of the District into zones of 'high', 'medium' and 'low' probability of flooding, in accordance with PPS25. These zones have then been used to provide a robust and transparent evidence base for the development of flooding related policy, and the allocation of sites for future housing and employment uses.

47. A summary of the adopted SFRA process is provided in the figure below, outlining the specific tasks undertaken and the corresponding structure of the SFRA report.



Cross Boundary Issues

48. Whilst locally the risk of flooding is relatively low, it is important to recognise that planning boundaries do not necessarily coincide with catchment boundaries. There are areas at risk of flooding downstream of South Bucks, and future development within the District could influence the risk of flooding posed to neighbouring areas if not carefully managed. It is imperative that all local authorities clearly understand the core issues that flood risk raises within their respective Districts, and adapt their decision making accordingly. They must be aware of the impact that careless planning may have, not only locally, but upon adjoining Boroughs/Districts.
49. A number of authorities across the Thames Region are beginning to carry out similar strategic flood risk investigations. These will help provide the evidence base for the Core Strategies and Site Specific development allocations that will form part of the Local Development Frameworks that all local planning authorities must now produce.
50. Whilst the delivery teams and programmes underpinning these studies vary from one district to the next, all are being developed in close liaison with the Environment Agency. Consistency in the adopted approach and decision making with respect to the effective management of flood risk throughout the sub region is imperative. Regular discussions with the Environment Agency have been carried out throughout the SFRA process to this end, seeking clarity and consistency where needed.

3 Policy Framework

3.1 Introduction

51. This section provides a brief overview of the strategy and policy context relevant to flood risk in South Bucks District Council.
52. The success of the SFRA is heavily dependent upon the ability of the Council to implement the recommendations put forward for future sustainable flood risk management, both with respect to planning decisions and development control recommendations. A framework of national and regional policy is in place, providing guidance and direction to local planning authorities. Ultimately however, it is the responsibility of the Council to establish 'sound' planning policies that will ensure future sustainability with respect to flood risk.

3.2 National Planning Policy

3.2.1 Overview

53. National planning policy is set out through a number of Planning Policy Statements (PPSs) and Planning Policy Guidance Notes (PPGs). The Government is currently reviewing all PPGs with revised advice being set out in a PPS and, where necessary, accompanying best practice guidance.
54. PPSs and PPGs cover a full range of planning issues drawing on the central issue of sustainable development. Central themes include the re-use of 'deliverable' previously developed land, promoting economic growth, including the intention to steer inappropriate development away from areas at risk of flooding. Under paragraph 4.24 of 'PPS12: Local Development Frameworks' it is a requirement of Regional Assemblies and Local Authorities to ensure their Regional Spatial Strategies (RSS) or Local Development Frameworks (LDFs) are in conformity with the guidance in PPSs and PPGs. The regional and local policy context for SFRA is set out in the next section.

3.2.2 Planning Policy Statement (PPS) 25: Development and Flood Risk

55. Planning Policy Statement 25 (PPS25) was released in December 2006, and underpins the process by which local planning authorities are to account for flood risk as an integral part of the planning process. The overarching principles set out by PPS25 for the management of flood risk at a planning authority level are encapsulated in Paragraph 6 of the document:

“Regional planning bodies (RPBs) and local planning authorities (LPAs) should prepare and implement planning strategies that help to deliver sustainable development by:

56. Appraising risk
 - identifying land at risk and the degree of risk of flooding from river, sea and other sources in their areas;

- preparing Regional Flood Risk Appraisals (RFRA) or Strategic Flood Risk Assessments (SFRAs) as appropriate, as freestanding assessments that contribute to the Sustainability Appraisal of their plans;

57. Managing risk

- framing policies for the location of development which avoid flood risk to people and property where possible, and manage any residual risk, taking account of the impacts of climate change;
- only permitting development in areas of flood risk when there are no reasonably available sites in areas of lower flood risk and benefits of the development outweigh the risks from flooding;

58. Reducing risk

- safeguarding land from development that is required for current and future flood management, e.g. conveyance and storage of flood water, and flood defences;
- reducing flood risk to and from new development through location, layout and design, incorporating sustainable drainage systems (SuDS);
- using opportunities offered by new development to reduce the causes and impacts of flooding, e.g. surface water management plans; making the most of the benefits of green infrastructure for flood storage, conveyance and SUDS; recreating functional floodplain; setting back buildings;

59. A partnership approach

- working effectively with the Environment Agency, other operating authorities and other stakeholders to ensure that best use is made of their expertise and information so that plans are effective and decisions on planning applications can be delivered expeditiously; and
- ensuring spatial planning supports flood risk management policies and plans, River Basin Management Plans and emergency planning.”

60. These broad objectives effectively set the scope for the specific outcomes of the SFRA process. The SFRA in turn then informs planning and development control decisions to ensure that the objectives set out above can be achieved.

61. The guidance in PPS25 also indicates that Sustainability Appraisals should be informed by the SFRA for their area. Under the Town and Country Planning (Local Development) (England) Regulations 2004, a Sustainability Appraisal (SA) is required for all Local Development Documents (LDDs) which form part of Local Development Frameworks (LDFs). The purpose of SA is to promote sustainable development through better integration of sustainability considerations in the preparation and adoption of plans. The Regulations stipulate that SAs of LDFs should meet the requirements of the Strategic Environmental Assessment (SEA) Directive.

62. It is important to reiterate that PPS25 is not applied in isolation as part of the planning process. The formulation of Council policy and the allocation of land for future development must also meet the requirements of other planning policy statements, including (for example) PPS3: Housing.

63. This may introduce some apparent conflict in national policy direction. For example, PPS3 requires that new housing should be built on 'deliverable' previously developed land in preference to Greenfield land. PPS25 reiterates this directive within its Exception Test, however within the Council's administrative area a proportion of the existing Brownfield land is situated within flood affected areas. The PPS25 Sequential Test recommends that residential development should not be permitted in these areas.

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

3.2.3 Development and Flood Risk: A 'Living Draft' Practice Guide Companion to PPS25

65. In February 2007 the companion guide was published as a consultation paper⁶. This document provides additional guidance on the principles set out in PPS25, which should be considered by South Bucks District Council when preparing its LDF. Until the good practice guide is finalised, the level of weight applied to the 'Living Draft' should reflect its current 'consultation draft' status. Notwithstanding this the companion guide is considered to provide a helpful indication of the ways in which the principles of PPS25 might be applied in practice.
66. As highlighted in Section 7, the SFRA should be treated as a living document, and reviewed on a regular basis to reflect both emerging knowledge with respect to flood risk, and changing policy. Future reviews of the SFRA findings and recommendations should explicitly consider the impact (if any) of changes to the policy guidance following publication of the final Practice Guide by CLG. The anticipated date of this publication is unknown at the time of writing.

3.2.4 Planning Policy Statement: Planning and Climate Change

67. The final planning policy supplement on climate change was published in December 2007 following a 12 month consultation period. This is intended to supplement the existing PPS1: Delivering Sustainable Development and the guidance in Annex B of PPS12. The document highlights the issue of climate change, and sets out ways planning should prepare for its effect, which includes managing flood risk.

3.3 Regional Planning Policy

3.3.1 Regional Planning Guidance for the South East (RPG9)⁷

68. Regional Planning Guidance for the South East (RPG9) published in March 2001 is the adopted regional policy, and was written to cover the period up to 2016. RPG9 has been revised and amended a number of times, but these amendments do not relate to flooding.
69. The issue of flooding does not feature heavily in the document, but Policy INF1 states that "*development should be guided away from areas at risk or likely to be at risk in the future from flooding, or where it would increase the risk of flood damage elsewhere*". Although this does not go quite as far as PPS25, it does follow similar principles. The policy continues "existing flood defences should be protected where they continue to be relevant", also in accordance with PPS25. Chapter 10 of RPG9, within which Policy INF1 sits, has been updated, although Policy INF1 has not been changed, and no additional policies relating to flooding have been included.
70. Policy H2 of RPG9 sets out the annual average level of housing provision required in Buckinghamshire as a whole. The policy requires 3,210 dwellings to be provided each year up until 2006. This figure should be viewed with caution as it was determined some years ago and is due to be superseded by the South East Plan.

⁶ Communities and Local Government (2007) Development and Flood Risk: A Practice Guide Companion to PPS25 'Living Draft' A Consultation Paper

⁷ Government Office for the South East, Government Office for East of England, Government Office for London (2001) Regional Planning Guidance for the South East (RPG9)

3.3.2 The South East Plan⁸

71. Under the Planning and Compulsory Purchase Act 2004, regional planning guidance such as RPG9 is to be replaced by new Regional Spatial Strategies (RSSs). The RSS for the South East of England (within which South Bucks is situated) is entitled 'The South East Plan', but has not yet been adopted. The Examination in Public (EIP) was held in spring / summer 2007, and the RSS is expected to be adopted in late summer 2008. The South East Plan sets out the vision for the South East for the next 20 years until 2026.
72. Of most relevance to flooding is Policy NRM3 of the South East Plan which states that authorities should follow the sequential approach to development in flood risk areas. The policy also states that in flood zones 2 and 3, or areas with past groundwater flooding, or where development would increase flooding elsewhere, development is deemed inappropriate and should not be permitted or allocated, unless there are exceptional circumstances. In addition, the policy notes that SFRA's should be prepared, and that existing flood defences should be protected from development. The use of SuDS is also encouraged.
73. Policy CC2 on climate change is also worth considering. It states that the South East region should adapt to the risks and opportunities presented by climate change through a number of measures, which include those relating to flooding. The policy states that strategic development should be guided to locations offering greater protection from impacts such as flooding, SuDS should be incorporated into new developments, flood storage capacity should be increased and the most should be made of opportunities and options for sustainable flood management.
74. The need to increase flood storage capacity is highlighted by Policy NRM1: Sustainable Water Resources, Groundwater and River Water Quality Management. The policy suggests encouraging winter water storage reservoirs, and other sustainable farming practices which diffuse runoff and increase flood storage capacity.
75. Housing targets are set out under Policy H1 of the Plan. There is a target for the south east as a whole to provide on average 28,900 net additional dwellings per annum between 2006 and 2026. The South Bucks' target is 90 dwellings for each year, which would be a total of 1,800 dwellings over the period 2006-2026. . The Panel Report (August 2007) recommended a slightly higher target, indicating an annual figure within South Bucks of 94 dwellings, equating to a total of 1,880 over the 20 year period to 2026. The Government will decide in its subsequent alternations to the Plan if the Panel's recommendations were taken.

3.4 Local Planning Policy

3.4.1 Adopted South Bucks District Local Plan

76. The South Bucks District Local Plan was adopted March 1999. The Plan sets out the Council's policies and proposals for development and land use in the District over the plan period up until 2006. Following recent changes in the planning system, all relevant planning policies are saved beyond 27 September 2007 until they are replaced by policies in the Local Development Framework (LDF)⁹.
77. Policy EP12 in the Local Plan refers to Protection from Flooding. However, the policy was not saved beyond 27 September 2007 as the floodplain areas on the proposed map have been replaced by more recent flood zone mapping. It is regarded that the policy did not add value to PPS25.

⁸ South East Regional Assembly (2006) The South East Plan: A Clear Vision for the South East, Draft Plan for submission to Government

⁹ Government Office for the South East (GOSE) agreed to save all the proposed saved policies in South Bucks District Local Plan beyond 27 September 2007

3.5 Emerging Local Planning Policy

3.5.1 South Bucks Local Development Framework (LDF)

78. South Bucks District Council is currently preparing its LDF, as required under the Planning and Compulsory Purchase Act 2004. Once adopted, this will replace the existing Adopted Local Plan and be used for land use development decisions. The Local Development Scheme (LDS) sets out which Local Development Document's (LDDs) the District Council will prepare to produce its LDF. A revised Local Development Scheme submitted to the Secretary of State via the Government Office for the South East in February 2007 was approved by the Government Office in April 2007. This states that the following LDDs will be prepared:

- Core Strategy DPD to be adopted June 2010
- Generic Development Control Policies DPD to be adopted June 2011
- Land Allocations DPD pre-submission consultation in 2011
- Residential Development Design Guide SPD to be adopted May 2008

79. The Council has already commenced work on the Core Strategy which sets out the vision, aims and strategy for spatial development in the District to 2026. The Core Strategy is to be submitted to the Secretary of State in April 2009 before it is formally adopted in June 2010.

80. The development of the Core Strategy has reached the preferred options stage with public consultation undertaken in September 2006. Further work is being undertaken in which a Revised Preferred Options Document will be published and consulted on in May 2008.

81. The earlier Core Strategy Preferred Options Document (published in September 2006) had a specific preferred policy approach for protecting and enhancing the water environment, which includes managing flood risk.

82. Preferred Policy Approach 20 was to:

- Maintain and enhance water supply and quality through avoiding the adverse effects of development on the water environment;
- Assess proposals against the risk of flooding in line with the approach given in PPS25;
- Require developers to produce a flood risk assessment for major proposals in Flood Zones 2 and 3;
- Promote water conservation and recycling, for example through the use of sustainable drainage systems, in new development wherever possible.

83. These policies broadly incorporate the principles of PPS25, however the Environment Agency has raised some suggested inclusions, particularly regarding the requirement for surface water strategies within Zone 1 Low Probability. More detailed development control policies for flooding are recommended to be included in the Generic Development Control Policies DPD.

4 Data Collection

4.1 Overview

84. A considerable amount of knowledge exists with respect to flood risk within the District, including (but not limited to):
- Historical river flooding information;
 - Information relating to localised flooding issues (surface water, groundwater and/or sewer related), collated in consultation with the District Council, Town & Parish Councils, and the Environment Agency;
 - Detailed flood risk mapping;
 - Environment Agency Flood Zone Maps;
 - Topography (LiDAR).
85. These data have been sourced from the Council and the Environment Agency, forming the core dataset that has informed the SFRA process. The application of this data in the delineation of zones of 'high', 'medium' and 'low' probability of flooding, and the formulation of planning and development control recommendations, is explained in Section 5 below. An overview of the core datasets, including their source and their applicability to the SFRA process, is outlined below.

4.2 Environment Agency Flood Zone Maps

86. The Environment Agency's Flood Map shows the natural floodplain, ignoring the presence of defences, and therefore areas potentially at risk of flooding from rivers or the sea. The Flood Map shows the area that is susceptible to a 1 in 100 (1% annual exceedance probability (AEP)) chance of flooding from rivers, and a 1 in 200 (0.5% AEP) chance of tidal flooding, in any one year. It also indicates the area that has a 1 in 1000 (0.1% AEP) chance of flooding from rivers and/or the sea in any given year. This is also known as the Extreme Flood Outline.
87. The Flood Map outlines have been produced from a combination of a national generalised computer model, more detailed local modelling (if available), and some historic flood event outlines. The availability of detailed modelling for the District is further discussed in Section 4.4. The Environment Agency's Flood Map provides a consistent picture of flood risk for England and Wales.
88. The Environment Agency's knowledge of the floodplain is continuously being improved by a variety of studies, detailed models, data from river flow and level monitoring stations, and actual flooding information. Updates are made on a quarterly basis.

4.3 Historical Flooding

89. Detailed discussions have been held with the District Council, the Environment Agency, the County Council, and Town & Parish Councils to identify those areas within the District that are known to have been exposed to flooding in the past. These have been highlighted in Figures 28 and 33, and (where possible) are summarised below. It is important to recognise that the incidents listed are events in which properties have been affected not only by flooding from local watercourses, but also from issues regarding rising groundwaters, surcharging of the underground sewer system, blockage of culverts and gullies, and/or surface water runoff.

River (Fluvial) Flooding – Lower Thames and Tributaries

- Taplow; Mill Lane and Ellington Road – 1947
- Dorney Reach; Amerden Road and Dorney Reach Road – 1947
- Dorney; Village Road and Boveney Road – 1947
- Boveney Court – 1947 and 1990
- Agricultural areas within the floodplain – 1947, 1974, 1990, 2000 and 2003

River (Fluvial) Flooding – Lower Colne

- Agricultural areas within the floodplain – 1987 and 2003

Groundwater Flooding

- Rising water table levels have flooded properties at Love Green in Iver and St Leonards Walk at Richings Park.
- Rising water table levels have flooded the road network at Burnham, Wooburn, Bangor Road South and Coppins Lane.
- Rising water table levels have flooded the land and fields at Hedgerley, Bulstrode Valley, Fulmer, Stoke Poges, Stoke Common, Wexham and George Green,

Surcharging of Surface Water and Combined Sewers

- Postcode data provided by Thames Water suggests that sewer flooding across the region is sporadic and infrequent.
- Information provided by South Bucks District Council suggests more specific areas that has flooded in the past
 - 2 Iver - Thorney Lane and Stone croft Avenue
 - 2 Shredding Green - Mansion Lane
 - 2 Iver Heath - Heath Way and Pinewood Road
 - 2 Stokes Poges - Bunby Road
 - 2 Burnham - Lincoln Hatch Lane, St Peters Close and Maypole Road
 - 2 Beaconsfield - Upper Riding, Baring Road, Candlemas Mead and Shepherds Lane
 - 2 Gerrards Cross - Windsor Road, Fulmer Drive and Dukes Wood Drive

90. Many properties affected by flooding are situated outside of the delineated high probability flood zones. This is an important reminder that the risk of flooding must always be carefully considered when planning future development, irrespective of the site's proximity to a local river or watercourse. Development control decisions must consider all forms of potential flooding to the site. They must also be made with due consideration to the potential impact that future development may have upon known existing flooding problems if not carefully managed.

4.4 Detailed Hydraulic Modelling

91. Detailed flooding investigations have been carried out by the Environment Agency within the study area¹⁰, encompassing the River Colne (from the confluence with the Thames upstream to the A40) and the River Thames. These studies generally incorporate the development of a detailed hydraulic model, providing a more robust understanding of the localised fluvial flooding regime in line with Section 105 (2) of the Water Resources Act.

¹⁰ completed early 2007

92. It should be noted that the detailed hydraulic models developed on behalf of the Environment Agency assume 'typical' conditions within the respective river systems that are being analysed. The predicted water levels may change if the operating regimes of the rivers involved are altered (e.g. engineering works which may be implemented in the future), culverts are permitted to block, or the condition of the river channel is allowed to deteriorate.
93. The flood extents derived from detailed hydraulic models are generally considered to be more refined and accurate than the existing Flood Zone Map in the study area, which currently shows the flood zones produced from a National Generalised Model. Therefore the extents derived from the detailed hydraulic models (where available) have been used to underpin the delineation of flood risk in this Strategic Flood Risk Assessment, as described in Section 5.2 below.

4.5 Flood Defences

94. Flood defences are typically raised structures that alter natural flow patterns and prevent floodwater from entering property in times of flooding. They are generally categorised as either 'formal' or 'informal' defences. A 'formal' flood defence is a structure that was built specifically for the purpose of flood defence, and is maintained by its respective owner, which could be the Environment Agency, Local Authority, or an individual. An 'informal' flood defence is a structure that has not been specifically built to retain floodwater, and is not maintained for this specific purpose, but may afford some protection against flooding. These can include boundary walls, industrial buildings, railway embankments and road embankments situated immediately adjacent to rivers.
95. The Environment Agency has no statutory responsibility to maintain rivers and/or flood defences within the UK. This remains the responsibility of the riparian land owner. The EA retain 'permissive powers' however, and using these powers the EA carry out a programme of monitoring and maintenance. Government funding is clearly finite however, and the long term structural integrity of the defences can never be fully guaranteed. Homes and businesses within defended areas will always face a residual risk of possible failure, as was graphically demonstrated in New Orleans during Hurricane Katrina (2005).
96. Within defended areas there will always be a residual risk of flooding. This may be due to an extreme event that overtops the design 'height' of the defence, changing climatic conditions that increases the frequency and severity of extreme flooding, a structural failure of the constructed flood defence system, or flooding behind the defences due to local runoff or groundwater. It is incumbent on both the Council and developers to ensure that the level and integrity of defence provided within developing areas can be assured for the lifetime of the development.
97. A formal raised defence has been identified within the Willowbank area, providing localised protection to properties situated within Willow Avenue and Hawthorne Drive. Whilst this is delineated by the Environment Agency as an 'area benefiting from defences' (refer www.environment-agency.gov.uk) the residual risk to property as a result of overtopping and/or breach failure is considered very low in this instance. As can be seen within Figure 16, the estate falls wholly outside of Zone 3a High Probability (which has been mapped assuming the absence of all defences), and therefore these homes are not at risk of flooding in the 1% (100 year) design flood event irrespective of the presence of the raised defences.
98. From a planning perspective, these homes fall within Zone 2 Medium Probability. Any future redevelopment however should be supported by a detailed Flood Risk Assessment that considers the potential residual risk to the site should the defences fail. It will also be important for the FRA to ensure that local drainage is not inadvertently trapped behind the embankments, introducing a possible risk of localised flooding within the 'defended' area.

99. No particular informal *raised* flood defences providing protection from flooding have been identified in South Bucks as part of the SFRA process. It is important to recognise however that local roads and/or rail lines that have been constructed on raised embankments may alter overland flow routes, and as such may have a localised effect upon the risk of flooding. This should be carefully reviewed in a local context as part of the detailed site based Flood Risk Assessment (refer Section 6.6)
100. The Maidenhead, Windsor and Eton Flood Alleviation Scheme was opened in June 2002 and is perhaps best known for its main feature – the 11.6km long flood diversion channel called the Jubilee River. This channel flows through the South Western side of the South Bucks District. The scheme does not offer protection to the major urban areas in South Bucks, however many agricultural areas previously at risk of flooding are now protected.

4.6 Consultation

101. Consultation has formed a key part of the data collation phase for the South Bucks SFRA. The following key stakeholders have been comprehensively consulted to inform the current investigation:

South Bucks District Council

Planning: Consulted to identify areas under pressure from development and/or regeneration

Environmental Health: Consulted to identify areas potentially at risk from river flooding, urban drainage and groundwater

Emergency Planning: Consulted to discuss the District's existing emergency response to flooding

Buckinghamshire County Council

Highways: Consulted to identify historic surface water problems and areas that may cause problems in the future

Environment Agency

The Environment Agency has been consulted to source specific flood risk information to inform the development of the SFRA. The Environment Agency is a statutory consultee under PPS25 and therefore must be satisfied with the findings and recommendations for sustainable flood risk management into the future. For this reason, the Environment Agency has been consulted during the development of the SFRA to discuss potential flood risk mitigation measures and planning recommendations.

Thames Water

Thames Water is responsible for the management of urban drainage (surface water) and sewerage within the District. Thames Water was consulted to discuss the risk of localised flooding associated with the existing drainage/sewer system. Unfortunately the feedback provided was very general in nature, providing simply a summary of the number of recorded incidents per post code. It is not possible therefore to pinpoint known capacity problems and/or infrastructure at risk of structural failure.

It is highlighted that issues associated with failures of the underground drainage/sewer systems are often relatively localised, and should not preclude development. Notwithstanding this however, specific problems have been highlighted by the SFRA process (refer Figures 28 and 33), and careful consideration should be given to the potential impact of future intensification and/or redevelopment.

It is essential to ensure that future development does not exacerbate known existing problems. Planning decisions should be made with due consideration to potential drainage and sewer capacity problems (to be advised by Thames Water as part of the statutory LDF consultation process), and conditions should be placed upon future development to ensure that these capacity issues are rectified before development is permitted to proceed.

British Waterways

British Waterways was consulted to discuss the potential implications that their infrastructure (including the Grand Union Canal) may have upon flood risk, and consequently future development within the District. The response provided is included as Appendix B. Some important issues have been raised however that must be reflected in any detailed site based Flood Risk Assessments within the vicinity of the BW infrastructure. These have been reflected in Section 6.4 below.

Town & Parish Councils

All Town and Parish Councils within South Bucks were consulted as part of the SFRA process. A letter was circulated to all Councils seeking information relating to observed localised flooding. A total of 12 of the Parish Councils responded, and the outcomes of this consultation process is provided in Figure 33.

4.7 Topography & Geology

102. Within a large proportion of the area, detailed flood risk mapping has been carried out, providing a robust means of delineating zones of 'high' probability (i.e. 1% (100 year) design to flooding. Dependence must be placed upon the Environment Agency Flood Zone Map for the 0.1% (1000 year) flood extent however, providing a relatively coarse depiction of flood risk for this more extreme event. Given that this is the case, a 'sensitivity' check has been carried out for those events in which detailed modelling is currently not available. The primary purpose of this check is to ensure that the adopted Environment Agency Flood Zone Map is generally representative of anticipated flooding conditions
103. Indeed it is important to ensure that the Environment Agency Flood Zone Map reflects the fact that water flows downhill, and that water levels across the river (i.e. on either bank of the river at the same location) are equal. The Environment Agency LiDAR data has been used to reflect the topography of the District along the river corridors in this instance, providing a means of checking the predicted Environment Agency flood zones, and reviewing the anticipated extent of the 5% (20 year) design flood (refer Section 5).
104. A susceptibility to surface water and groundwater flooding has been identified throughout the District, and therefore an assessment of potentially 'at risk' areas has been carried out to support the planning process. Overland flow routes have been identified on the basis of coarse available topographic information sourced from OS mapping (refer Figure 29). Finally, the geology of the District has been assessed from published geological maps, as presented in Figure 21.

5 Flood Risk in South Bucks District

5.1 Overview

105. A number of properties within South Bucks are at risk of fluvial flooding from the River Thames and the River Colne. The Alder Bourne and the River Misbourne also pose a potential risk of flooding to some properties within South Bucks. These smaller river systems affect fewer properties within the District than the larger watercourses, however they are far more susceptible to flash flooding resulting from localised intense rainfall. With changing climate patterns, it is expected that storms of this nature will become increasingly common. It is vitally important that planning decisions recognise the potential risk that these watercourses pose to property and plan development accordingly so that future sustainability can be assured.
106. Groundwater flooding has been observed within the District historically. The local geology is susceptible to a rising water table following periods of prolonged rainfall. As the water table rises, localised low points in the local topography are susceptible to inundation. The majority of areas currently at risk are local road networks and fields. A number of localised flooding issues have also been identified, perceived to be a result of localised problems including (for example) the blockage of culverts and/or gullies, or simply intense rainfall falling upon paved surfaces, resulting in ponding.

5.2 Fluvial Flooding - Delineation of the PPS25 Flood Zones

107. It is emphasised that the **risk** of an event (in this instance a flood event) is a function of both the **probability** that the flood will occur, and the **consequence** to the community as a direct result of the flood. PPS25 endeavours to assess the likelihood (or probability) of flooding, categorising the District into zones of low, medium and high probability. It then provides recommendations to assist the Council to manage the consequence of flooding in a sustainable manner, for example through the restriction of vulnerable development in areas of highest flood risk.
108. To this end, a key outcome of the SFRA process is the establishment of the Sequential Test in accordance with Figure 3.1 of the PPS25 Practice Guide. To inform the planning process, it is necessary to review flood risk across the area, categorising the area in terms of the likelihood (or probability) that flooding will occur.
109. The District has been delineated into the flood zones summarised below.

Zone 3b The Functional Floodplain

Areas of the District susceptible to river flooding within which "water has to flow or be stored in times of flood" (PPS25).

Zone 3a High Probability

Land assessed as having a 1 in 100 or greater annual probability of river flooding in any year (i.e. 1% AEP).

Zone 2 Medium Probability

Land assessed as having between a 1 in 100 (i.e. 1% AEP) and 1 in 1000 (i.e. 0.1% AEP) annual probability of river flooding in any year.

Zone 1 Low Probability

Land assessed as having a less than 1 in 1000 annual probability of river flooding in any year (i.e. 0.1% AEP).

110. The delineation of the PPS25 flood zones is discussed in Section 5, and presented in the Figures 1 to 19.

5.2.1 Delineation of Zone 3b Functional Floodplain

111. Zone 3b Functional Floodplain is defined as those areas in which “*water has to flow or be stored in times of flood*”. The definition of functional floodplain remains somewhat open to subjective interpretation. PPS25 states that “*SFRAs should identify this Flood Zone (land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1%) flood, or at another probability to be agreed between the LPA and the Environment Agency, including water conveyance routes).*” For the purposes of the South Bucks SFRA, Zone 3b has been defined in the following manner:
- land where the flow of flood water is not prevented by flood defences or by permanent buildings or other solid barriers from inundation during times of flood;
 - land which provides a function of flood conveyance (i.e. free flow) or flood storage, either through natural processes, or by design (e.g. washlands and flood storage areas);
 - land subject to flooding in the 5% AEP (20 year) flood event (i.e. relatively frequent inundation expected, on average once every 20 years).
112. Detailed modelled flood extents for the 1 in 20 year design event were adopted for the basis of Zone 3b Functional Floodplain delineation along the River Colne (downstream of the A40) and the River Thames. Where detailed modelling of the 1 in 20 year design event has not been carried out to date by the Environment Agency (including the River Misbourne, the River Alder Bourne and Rusholt Brook), additional modelling was undertaken. A simple hydraulic model with river (floodplain) cross-sections based on Digital Elevation Data was established to provide a robust estimation of the 1 in 20 year (Zone 3b) flood extents (refer Appendix C).
113. A small number of existing settlements within the river corridors are affected by flooding in the 5% AEP (20 year) flooding event. The recent release of the Living Draft of the Practice Guide Companion to PPS25 highlights the importance of considering existing land use when delineating areas that are to be treated as ‘functional floodplain’ for planning purposes.
114. Discussions with the Environment Agency have confirmed that, due to the obstructions to overland flow paths posed by existing development within flood affected areas, existing buildings (that are impermeable to floodwater) should not be considered as falling within the functional floodplain. The land surrounding existing buildings form important flow paths and flood storage areas however. These must be protected, and planning decisions should be taken accordingly. For this reason, a sub-delineation within Zone 3b has been provided, making reference to ‘developed’ and ‘undeveloped’ areas as described in Section 6.4 below.
115. It is important to recognise that all areas within Zone 3b are subject to relatively frequent flooding – on average, flooding once in every 20 years. There are clear safety, sustainability and insurance implications associated with future development within these areas, and informed planning decisions must be taken with care. This is reflected in Section 6.4 below.

5.2.2 Delineation of Zone 3a High Probability

116. Zone 3a High Probability is defined as those areas of the District that are situated below (or within) the 1% AEP (100 year) fluvial flood extent. The adopted flood extents are based upon 2007 predictions, and do NOT include the potential impacts of future climate change. Planning policy must consider climate change however, and specific recommendations are provided accordingly within Sections 5.6 and 6.4.

117. The detailed modelling outputs developed by the Environment Agency, where available (River Colne downstream of A40 and River Thames), have been adopted for the delineation of Zone 3a High Probability, superseding the current EA flood zone map (March 2007). Only in those areas within which detailed flood mapping is not available and/or fit for purpose, the Environment Agency's Flood Zone Maps have been adopted to underpin the SFRA process. At these locations, detailed topography has been used to carry out a 'sensitivity check' of the flood zone maps. This check has sought to ensure that the predicted floodplain extents are sensible in light of surrounding ground levels. No alterations have been made to the maps in this instance.

5.2.3 Delineation of Zone 2 Medium Probability

118. Zone 2 Medium Probability is defined as those areas of the District that are situated between the 0.1% AEP (1 in 1000 year) and the 1% AEP (1 in 100 year) flood extents. In this instance, Zone 2 Medium Probability is defined in accordance with the Environment Agency Flood Zone Map.

5.2.4 Delineation of Zone 1 Low Probability

119. Zone 1 Low Probability is defined as those areas of the District that are situated above (or outside of) the 0.1% AEP (1000 year) flood extent. For SFRA purposes, this incorporates all land that is outside of the shaded Zone 2 and Zone 3 flood risk areas (as defined above).

5.3 Fluvial Flood Risk from Local Watercourses

5.3.1 Lower Thames and Tributaries

120. The Lower Thames flows along the south-western boundary of South Bucks from Taplow to Boveney Bridge. Several tributaries to the River Thames also flow through South Bucks district including, Amerden Grove Ditch, Cress Brook, Roundmoor Ditch, Hunter Combe Lane Stream as well as the Jubilee River. The highest risk of flooding comes from the overtopping of the Lower Thames and Cress Brook, exacerbated in the south at the confluence of Cress and the Lower Thames. During times of high flow Cress Brook can not discharge sufficiently into the Lower Thames and subsequently backs up.
121. During high order flood events (100 year plus) the flood envelope of the River Thames inundates the majority of the area south of Burnham, including properties on Village Road, Harcourt Road and Boveney Road in Dorney, as well as Ellington Road at Maidenhead Bridge.

5.3.2 River Colne and Colne Brook

122. The River Colne flows north to south along the eastern edge of the South Bucks District boundary. South of Uxbridge the River Colne splits into the River Colne that continues to flow along the eastern boundary of South Bucks and Colne Brook that flows from Uxbridge through Throny.
123. During high order flood events (100 year plus) properties within New Denham, Iver Lane (Iver) and Thorney are at risk of flooding. Willowbank is protected by a flood alleviation scheme to a standard of protection over the 100 year event.

5.3.3 Alder Bourne

124. Alder Bourne flows west to east from Fulmer to north of Uxbridge. Flood risk increases following periods of prolonged rainfall and increased water levels. Zone 3b Functional Floodplain affects several properties in Fulmer. During high order flood events (100 year plus) the M25 at the junction of the M40 may be at risk of flooding.

5.3.4 River Misbourne

125. The River Misbourne flows west to east from Chiltern to its confluence with the River Colne in Lower Denham. Flood embankments line the River Misbourne through Denham, however the Flood Zones show no risk of flooding.

5.3.5 Grand Union Canal and Grand Union Canal Slough Arm

126. The Grand Union Canal flows north to south along the eastern boundary of South Bucks bypassing Willowbank, with both inflows and outflows to the River Colne at this site which are managed by a series of locks. The Grand Union Canal Slough Arm flows north of Langley. No risk of flooding has been identified.

5.3.6 Un-named Watercourses

127. A small number of un-named watercourses are evident within the District, representing a localised risk of fluvial flooding to adjoining (primarily rural) areas. Particular examples include the watercourses flowing through Fulmer (refer Figure 14) and George Green and Middle Green (Figure 9). The current Environment Agency Flood Zone Map (as reflected in Figure 9) indicates a number of properties potentially at risk of fluvial flooding within George Green from the local unnamed watercourse. It is considered likely that this predicted flood outline is somewhat conservative, and this highlights the importance of a more detailed site based investigation to improve the accuracy of the anticipated flood extents at planning application stage.

5.4 Water Infrastructure (Pond & Canal) Failure

128. A number of water infrastructure facilities have been identified within the District as indicated in Figure 32. A number of large reservoirs are situated within the nearby Boroughs of Spelthorne and Windsor & Maidenhead, however these do not appear to pose a direct risk to communities within South Bucks.

Local Ponds

129. The status of the water storage facilities (ponds) is unknown, however it is understood that no designated reservoirs exist within, or nearby, the District of South Bucks.
130. The risk of potential overtopping and/or failure of these facilities should be considered where future development is planned in close proximity. No specific risk 'envelope' is available for the water storage facilities, and the potential risk of flooding as a result of structural failure and/or overtopping is certainly anticipated to generally be much less than the indicative scenarios set out within PPS25 (i.e. 1% likelihood of occurring in any one year).
131. Notwithstanding this however, this should be considered as a local residual risk within the context of a detailed Flood Risk Assessment.

Grand Union Canal

132. The Grand Union Canal is a key feature of the District, and as a raised conduit in some locations, this may pose a potential risk of flooding should a breach (structural) failure of the structure occur. The geometry of the canal along its length is unknown, and therefore a holistic assessment of the potential impact of structural failure is not feasible within the context of the SFRA. However it is understood through discussion with British Waterways that the likely risk of catastrophic failure is extremely low. Consequently this should not unduly influence spatial planning decisions, however any potential future development within close proximity of the structure should consider the residual risk of failure in a local context (i.e. within the auspice of the detailed Flood Risk Assessment).
133. British Waterways has identified a potential risk of overtopping from the canal during flooding conditions within the River Colne (refer Appendix B). The detailed modelling of flow interactions between the river and the canal system is heavily reliant upon complex operating regimes within both the Environment Agency and British Waterways, and is outside the scope of this strategic investigation. It is essential however that the detailed FRA for any proposed future development within the east of the District (including Iver, Iver Heath, Uxbridge, Richings Park, New Denham, Willowbank, Denham, Denham Green and Higher Denham) consider the potential risk of overtopping in liaison with the EA and BW.

5.5 Local Drainage Issues

134. As discussed in Section 4.6, consultation has been carried out with a number of stakeholders to identify known and/or perceived problem areas. These problems are generally attributed to inundation from groundwater flooding, due to poor maintenance associated with (for example) culvert blockages, and/or surface water flooding. Properties and infrastructure in Gerrards Cross, Beaconsfield, Burnham, Farnham, Stoke Poges and Iver have all been subject to flooding in the recent past.
135. Within the settlements of the District, it is inevitable that localised flooding problems arising from under capacity drainage and/or sewer systems will occur, particularly given the mounting pressure placed upon ageing systems as a result of climate change. Input has been sought from Thames Water to pinpoint known and/or perceived problem areas, however the information provided is very general. Further more detailed information relating to observed localised flooding within the District has been provided by the Council, and this is reflected in the adjoining maps.
136. Given the perceived scale of the potential 'local flood risk' within the District, a broad scale risk assessment has been developed in an endeavour to map those areas that may be most at risk from groundwater and/or surface water flooding. Indicative overland flow routes have been identified, and overlain with incidents of observed groundwater flooding. This is provided in adjoining Figure 29.
137. The PPS25 Practice Guide (A Living Draft, February 2007) advocates the application of a sequential approach when allocating land, taking into consideration *all* sources of flooding. The local drainage related problems identified within South Bucks are generally very localised, and relate to historical incidents, the source of which is often somewhat uncertain. It is important to recognise therefore that these are not a measure of 'risk', but rather problems that have occurred due to a particular set of local circumstances in the past (for example, the blockage of a local gully inlet). These may or may not reoccur in future years.
138. From a spatial planning perspective therefore, it is considered unreasonable to restrict future development within areas that may have suffered a localised flooding incident in years past. It is essential however not to overlook the potential risk of localised flooding during the design process. Whilst the incidents that have been identified will typically not result in widespread damage or disruption, a proactive approach to risk reduction through design can mitigate the potential for damage, both to the development itself and elsewhere.

139. Strict planning conditions should be placed upon developers to ensure that best practice measures are implemented to mitigate any potential increase in loading upon existing drainage system(s). Recommended design measures to mitigate the risk of localised flooding are provided in Section 6.4 accordingly. It is also important for developers to ensure that they consider the potential impact of overland flooding when the capacity of the designed site drainage system is exceeded.
140. The Environment Agency strongly advocates the use of Sustainable Drainage Systems (SuDS). A wide variety of SuDS techniques are available (refer Section 6.6.3), potentially providing both water quality and water quantity improvement benefits on a site by site basis throughout South Bucks. Wherever possible within brownfield areas, the developer should seek to reduce the rate of runoff from the site to the equivalent greenfield runoff rates (i.e. the rate of runoff generated from the site assuming it were an open grassed area). This is usually within the range of 5 to 9 litres per second per hectare (l/s/ha), depending on site slope and soil porosity. Collectively, the effective application of SuDS as part of all future development has the potential to reduce the risk of flooding within South Bucks.

5.6 Groundwater Flooding

141. The risk of groundwater flooding is typically highly variable and heavily dependent upon local conditions at any particular time. There are several recorded incidents of groundwater flooding within the District (refer Figures 28 and 33), and consequently the level of risk of flooding from groundwater sources in this instance is considered relatively high. Those areas known to have been affected by groundwater flooding historically include Burnham, Wooburn Common, Hedgerley, Bulstrode Valley, Fulmer, Wexham Street, Stoke Common, Wexham, George Green, Iver and Richings Park.
142. There is no obvious correlation between the geology and incidents of reported groundwater flooding within the District, and therefore the mapping of 'groundwater flood risk' has relied heavily upon historical problems. It is essential therefore that all future development consider this risk carefully in a localised context as part of the design process. In accordance with PPS25, future development will require an appropriate Flood Risk Assessment (FRA) at the planning application stage, commensurate with the level of flood risk posed to the site. The FRA should incorporate a site based assessment of the potential risk of groundwater flooding to the site, confirming (or otherwise) the absence of this source of flood risk.
143. Where a potential risk of groundwater is identified, it may be appropriate to (for example) incorporate flood proofing measures and/or the raising of entry thresholds to mitigate possible damages. The adopted design will need to ensure that it does not result in any worsening to the risk posed to adjoining properties.
144. Another consideration with respect to groundwater is the effectiveness (or otherwise) of SuDS. The design of proposed developments should carefully consider the impact that raised groundwater levels may have upon the operation of SuDS during periods of heavy rainfall.

5.7 Climate Change

145. A considerable amount of research is being carried out worldwide in an endeavour to quantify the impacts that climate change is likely to have on flooding in future years. Climate change is perceived to represent an increasing risk to low lying areas of England, and it is anticipated that the frequency and severity of flooding will change measurably within our lifetime. PPS25 (Appendix B) states that a 10% increase in the 1% AEP (100 year) river flow can be expected within the next 20 years, increasing to 20% within the next 50 to 100 years.

146. It is essential that developers consider the possible change in flood risk over the lifetime of the development as a result of climate change. The likely increase in flow and/or tide level over the lifetime of the development should be assessed proportionally to the guidance provided by the EA as outlined above.
147. The detailed modelling of the Lower Thames and River Colne system (and tributaries) has considered the potential impact of climate change over the next 100 years. In other locations where detailed modelling is not available, in the absence of a definitive flood outline the anticipated extent of the 1% AEP (100 year) flood affected area in 2106 can be approximated by the current 0.1% AEP (1000 year) flood outline, i.e. Zone 2 Medium Probability.
148. The anticipated impact of climate change upon Zone 3a High Probability is provided in Figures 34 to 51, compiled on the basis of detailed modelling where available (i.e. for the River Thames and River Colne). It is highlighted that, for planning purposes, this is the best information currently available at the time of writing. The SFRA is a living document, and the predicted flood extents may change over time as a result of better information coming to light.
149. The predicted Zone 3a High Probability (including climate change) indicates a very small increase in the number of properties at risk of flooding. In planning terms, it is essential that South Bucks District Council consider their response to the potential impacts of climate change within the District. **Adopting the pragmatic comparison between Zone 3a and Zone 2 above (i.e. where detailed modelling has not been carried out), it is clear that climate change will not markedly increase the extent of flooding.** For this reason, few areas that are currently situated outside of Zone 3 High Probability will be at risk of flooding in future years. This is an important conclusion from a spatial planning perspective. Notwithstanding this however, **those properties (and areas) that are currently at risk of flooding may be susceptible to more frequent, more severe flooding in future years.** It is essential therefore that the development control process (influencing the design of future development within the District) carefully mitigates against the potential impact that climate change may have upon the risk of flooding to the property.
150. For this reason, all of the development control recommendations set out in Section 6.4 below require all floor levels, access routes, drainage systems and flood mitigation measures to be designed with an allowance for climate change. This provides a robust and sustainable approach to the potential impacts that climate change may have upon the District over the next 100 years, ensuring that future development is considered in light of the possible increases in flood risk over time.
151. It is highlighted that PPS25 is currently typically interpreted so that considerations is taken only of the impact that climate change may have upon Zone 3a for planning purposes. Clearly there will also be a potential increase in the extent and depth of Zone 3b Functional Floodplain, and indeed a cursory review of the River Thames hydrology indicates that the current 2% (50 year) design event is roughly equivalent to what can be expected to be the Functional Floodplain in 100 years. In summary therefore, climate change is likely to introduce an increase in the area of land within South Bucks affected by flooding in the 5% (20 year) design event, and an increase in the severity and frequency of flooding to those properties already situated within Zone 3b.
152. Given the high degree of uncertainty surrounding the potential impacts of climate change upon flood risk today, it is not recommended that this unduly influences current planning decisions. It is an important reminder however that areas situated within Zone 3b Functional Floodplain are at considerable risk, and should be protected from future development.
153. Finally, it is emphasised that the potential impacts of climate change will affect not only the risk of flooding posed to property as a result of river flooding, but it will also potentially increase the frequency and intensity of localised storms over the District. This may exacerbate localised drainage problems. It is important therefore that the site based detailed Flood Risk Assessment (i.e. prepared by the developer at the planning application stage as outlined in Section 6) takes due consideration of climate change.

5.8 Residual Risk of Flooding

154. It is essential that the risk of flooding be minimised over the lifetime of the development in all instances. It is important to recognise however that flood risk can never be fully mitigated, and there will always be a residual risk of flooding.
155. This residual risk is associated with a number of potential risk factors including (but not limited to):
 - a flooding event that exceeds that for which the flood risk management measures (for example, upstream storage) have been designed;
 - general uncertainties inherent in the prediction of flooding;
 - the potential risk of structural failure and/or overtopping of a flood defence;
 - the potential risk of structural failure and/or overtopping of water infrastructure (i.e. a reservoir or a canal).
156. The SFRA process has carried out a review of flood risk within the District in accordance with the PPS25 Sequential Test, identifying a number of areas that fall within Zone 3a High Probability. The modelling of flood flows and flood levels is not an exact science. There are limitations in the methodologies used for prediction, and the models developed are reliant upon observed flow data for calibration, much of which is often of questionable quality. For this reason, there are inherent uncertainties in the prediction of flood levels used in the assessment and management of flood risk.
157. It is difficult to quantify uncertainty. Some of the adopted flood zones underpinning the South Bucks SFRA are based upon the detailed flood mapping within areas adjoining the Lower Thames and River Colne. Whilst these provide a robust depiction of flood risk for specific modelled conditions, all detailed modelling requires the making of core assumptions and the use of empirical estimations relating to (for example) rainfall distribution and catchment response.
158. Taking a conservative approach for planning purposes, it is understood that the Environment Agency (Thames Region) generally adopt a 300mm allowance for uncertainty within areas that have been modelled in some detail. The degree of uncertainty in areas reliant upon the Environment Agency's national generalised computer model will clearly be somewhat higher. This allowance is to be added onto the design floor levels for buildings, as discussed in Section 6.6.2 below.
159. It is incumbent on developers to carry out a detailed Flood Risk Assessment as part of the design process. A review of uncertainty, including the residual risk to a site should a structure fail behind which water is stored during flooding conditions (irrespective of the water source), must be undertaken as an integral outcome of this more detailed investigation.

6 Sustainable Management of Flood Risk

6.1 Overview

160. An ability to demonstrate 'sustainability' is a primary government objective for future development within the UK. The definition of 'sustainability' encompasses a number of important issues ranging broadly from the environment (i.e. minimising the impact upon the natural environment) to energy consumption (i.e. seeking alternative sources of energy to avoid the depletion of natural resources). Of particular importance however is sustainable development within flood affected areas.
161. Recent history has shown the devastating impacts that flooding can have on lives, homes and businesses. A considerable number of people live and work within areas that are susceptible to flooding, and ideally development should be moved away from these areas over time. It is recognised however that this is often not a practicable solution. For this reason, careful consideration must be taken of the measures that can be put into place to minimise the risk to property and life posed by flooding. These should address the flood risk not only in the short term, but throughout the lifetime of the proposed development. This is a requirement of PPS25.
162. The primary purpose of the SFRA is to inform decision making as part of the planning and development control process, taking due consideration of the scale and nature of flood risk affecting the District. Responsibility for flood risk management resides with all tiers of government, and indeed individual landowners, as outlined below.

6.2 Responsibility for Flood Risk Management

163. There is no statutory requirement for the Government to protect property against the risk of flooding. Notwithstanding this however, the Government recognise the importance of safeguarding the wider community, and in doing so the economic and social well being of the nation. An overview of key responsibilities with respect to flood risk management is provided below.
164. The Environment Agency exercises permissive powers to provide flood management and defence in England. It assists the planning and development control process through the provision of information and advice regarding flood risk and flooding related issues.
165. The Local Planning Authority is responsible for carrying out a Strategic Flood Risk Assessment. The SFRA should consider the risk of flooding throughout the district and should inform the allocation of land for future development, development control policies and sustainability appraisals. Local Planning Authorities have a responsibility to consult with the Environment Agency when making planning decisions.
166. Landowners & Developers¹¹ have the primary responsibility for protecting their land against the risk of flooding. They are also responsible for managing the drainage of their land such that they do not adversely impact upon adjoining properties.
167. The Environment Agency has developed a guide entitled "Living on the Edge" that provides specific advice regarding the rights and responsibilities of property owners, the Environment Agency and other bodies. The guide is targeted at owners of land situated alongside rivers or other watercourses, and is a useful reference point outlining who is responsible for flood defence, and what this means in practical terms. It also discusses how stakeholders can work collaboratively to protect and enhance the natural environment of our rivers and streams. This guide can be found on the Environment Agency's website at www.environment-agency.gov.uk.

¹¹ Referred to also as 'landowners' within PPS25

6.3 Strategic Flood Risk Management - The Environment Agency

6.3.1 Overview

168. With the progressive development of urban areas along river corridors, particularly during the industrial era, a reactive approach to flood risk management evolved. As flooding occurred, walls or embankments were built to prevent inundation to developing areas. Needless to say, construction of such walls should be carefully assessed so that it does not result in the redistribution of floodwater, inadvertently increasing the risk of flooding elsewhere.
169. The Environment Agency in more recent years has taken a strategic approach to flood risk management. The assessment and management of flood risk is carried out on a 'whole of catchment' basis. This enables the Environment Agency to review the impact that proposed defence works at a particular location may have upon flooding at other locations throughout the catchment.
170. A catchment flood risk management strategy encompasses part of the river systems that influence flood risk within the South Bucks. A brief overview of this investigation is provided below.

6.3.2 Catchment Flood Management Plan (CFMP) - Thames Region

171. *"One of the Environment Agency's main goals is to reduce flood risk from rivers and the sea to people, property and the natural environment by supporting and implementing government policies.*
172. *Flooding is a natural process – we can never stop it happening altogether. So tackling flooding is more than just defending against floods. It means understanding the complex causes of flooding and taking co-ordinated action on every front in partnership with others to reduce flood risk by:*
 - *Understanding current and future flood risk;*
 - *Planning for the likely impacts of climate change;*
 - *Preventing inappropriate development in flood risk areas;*
 - *Delivering more sustainable measures to reduce flood risk;*
 - *Exploring the wider opportunities to reduce the sources of flood risk, including changes in land use and land management practices and the use of sustainable drainage systems.*
173. *Catchment Flood Management Plans (CFMPs) are a planning tool through which the Agency aims to work in partnership with other key decision-makers within a river catchment to explore and define long term sustainable policies for flood risk management. CFMPs are a learning process to support an integrated approach to land use planning and management, and also River Basin Management Plans under the Water Framework Directive.*¹²
174. A CFMP is being developed for the River Thames catchment. A consultation summary document has recently been provided outlining the main messages from the CFMP (January 2007).
175. Four over arching key messages have been highlighted by the CFMP:
 - Flood defences cannot be built to protect everything;
 - Climate change will be the major cause of increased flood risk in the future;
 - The floodplain is our biggest asset in managing flood risk;
 - The ongoing cycle of development and urban regeneration is a crucial opportunity to manage flood risk.

¹² Catchment Flood Management Plans – Volume 1 (Guidance), Version 1.0, July 2004

In summary, the CFMP seeks a sustainable 'planning' led solution to flood risk management within the catchment. The CFMP encourages local authorities (and indeed developers) to strive for a positive reduction in flood risk through future development and regeneration. This is striving to ensure that collectively decisions taken not only avoid the creation of a future legacy of new development at risk of flooding, but also progressively reduces the risk of flooding to existing development. This is a key objective of PPS25.

6.4 Planning & Development Control – South Bucks District Council

6.4.1 Planning Solutions to Flood Risk Management

The Sequential Test

176. Historically urbanisation has evolved along river corridors, the rivers providing a critical source of water, food and energy. This leaves many areas of England with a legacy of key urban centres that, due largely to their close proximity to rivers, are at risk of flooding.
177. The ideal solution to effective and sustainable flood risk management is a planning led one, i.e. steer urban development away from areas that are susceptible to flooding. PPS25 advocates a sequential approach that will guide the planning decision making process (i.e. the allocation of sites). In simple terms, this requires planners to seek to allocate sites for future development within areas of lowest flood risk in the initial instance. Only if it can be demonstrated that there are no suitable sites within these areas should alternative sites (i.e. within areas that may potentially be at risk of flooding) be contemplated. This sequential approach is referred to as **The Sequential Test**, and is summarised in Figure 3.1 of the PPS25 Practice Companion Guide (A Living Draft, February 2007).

It is absolutely imperative to highlight that the SFRA does not attempt, and indeed cannot, fully address the requirements of the PPS25 Sequential Test. As highlighted in Section 6.4.1 and Figure 3.1 of the PPS25 Practice Guide, it is necessary for the Council to demonstrate that sites for future development have been sought within the lowest flood risk zone (i.e. Zone 1 Low Probability). Only if it can be shown that suitable sites are not available within this zone can alternative sites be considered within the areas that are at greater risk of possible flooding (i.e. Zone 2, and finally Zone 3).

178. As indicated by the bottom right hand corner of the flow chart in Figure 3.1 of the Practice Guide, PPS25 stipulates permissible development types. This considers both the degree of flood risk posed to the site, and the likely vulnerability of the proposed development to damage (and indeed the risk to the lives of the site tenants) should a flood occur.
179. The Council must restrict development to the permissible land uses summarised in PPS25 Appendix D (Table D2). This may involve seeking opportunities to 'swap' more vulnerable allocations at risk of flooding with areas of lesser vulnerability that are situated on higher ground. This is discussed further below.
180. It is important to recognise that the principles of the sequential approach are applicable throughout the planning cycle, and refer equally to the forward planning process (delivered by Council as part of the LDF) as they do to the assessment of windfall sites. Where windfall sites come forward for consideration, it is essential that the developer to consider the planning 'need' for the proposed site (adopting a sequential approach in accordance with PPS25). The Council will assist where possible with supporting information. The detailed FRA will be required to demonstrate the careful and measured consideration of whether indeed there is an alternative site available within an area of lesser flood risk, in accordance with the PPS25 Sequential Test.

The Exception Test

181. It is recognised that only a relatively small proportion of South Bucks is situated within Zone 3a High Probability. Prohibiting future residential development in these areas is unlikely to have a detrimental impact upon the economic and social welfare of the District as a whole, although it may have a more significant impact upon individual local communities, and there may be pressing planning 'needs' that may warrant further consideration of these areas. Should this be the case, the Council and potential future developers are required to work through the **Exception Test** (PPS25 Appendix D) where applicable. It is important to remember that the Sequential Test should always be carried out prior to the Exception Test. 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 SFRA where one has been prepared. If the DPD has reached the 'submission' stage, the benefits of the development should contribute to the Core Strategy's Sustainability Appraisal;*
 - *the development should be on developable, previously development land or if it is not on previously developed land, that there are no reasonable alternative sites on previously development land; and*
 - *a FRA must demonstrate that the development will be safe, without increasing flood risk elsewhere, and where possible, will reduce flood risk overall."*
182. The first two points set out in the Exception Test are planning considerations that must be adequately addressed. A planning solution to removing flood risk must be sought at each specific location in the initial instance, seeking to relocate the proposed allocation to an area of lower flood risk (i.e. Zone 1 Low Probability or Zone 2 Medium Probability) wherever feasible.
183. The Level 1 SFRA has been developed to inform the Sequential Test. It will be the responsibility of the Council to carry out the Sequential Test on the basis of this information, allocating potential sites for future development accordingly. Furthermore, the developer will be required to demonstrate within the detailed Flood Risk Assessment that the Sequential Test has been applied¹³, and (where appropriate) that the risk of flooding has been adequately addressed in accordance with PPS25.
184. The management of flood risk throughout the District must be assured should development be permitted to proceed, addressing the third critical element of the Exception Test. The SFRA has provided specific recommendations that ultimately should be adopted as design features, with evidence provided of how they will be fulfilled prior to permission being granted for all future development. It is the responsibility of the prospective developer to build upon these recommendations as part of a detailed Flood Risk Assessment to ensure that the specific requirements of PPS25 can be met.
185. An overview of flood risk throughout the District has been provided in Section 6.5 and the adjoining flood risk maps. **Future planning decisions should consider the spatial variation in flood risk across the District, as defined by the delineated flood zone that applies at the specified site location, and apply the recommendations provided below accordingly.**
186. It is reiterated that PPS25 applies equally to both allocated sites identified within the emerging LDF and future **windfall sites**. The Council has adopted a precautionary approach for the assessment of flood risk within the planning process, considering the potential impact that climate change may have upon Zone 3a High Probability in future years. Consequently, all analyses regarding future windfall sites should adopt Zone 3a High Probability *including climate change* (i.e. Figures 34 to 51) as the starting point for their assessment.

¹³ In the case of an allocated site within the LDF, the developer should be in a position to simply reference the Council's planning framework to demonstrate successful application of the Sequential Test. Further analysis will be required for windfall sites however as these will generally not have been tested as part of the Council's spatial planning process.

6.4.2 A Proactive Approach – Positive Reduction of Flood Risk through Development

187. It is crucial to reiterate that PPS25 considers not only the risk of flooding posed to new development. It also seeks to positively reduce the risk of flooding posed to existing properties within the District. It is strongly recommended that this principle be adopted as the underlying 'goal' for developers and Council development control teams within South Bucks.
188. Developers should be encouraged to demonstrate that their proposal will deliver a positive reduction in flood risk to the District, whether that be by reducing the frequency or severity of flooding (for example, through the introduction of SuDS), or by reducing the impact that flooding may have on the community (for example, through a reduction in the number of people within the site that may be at risk). This should not be seen as an onerous requirement, and indeed if integrated into the design at the conceptual stage, will place no added demands upon the development and/or planning application process.
189. Possible risk reduction measures for consideration may include the following:
- The integration of SuDS to reduce the runoff rate from the site;
 - A change in land use to reduce the vulnerability of the proposed development;
 - A reduction in the building platform area;
 - The raising of internal floor levels and flood proofing (within existing buildings) to reduce potential flood damage;
 - The rearrangement of buildings within the site to remove obstructions to overland flow paths;
 - The placement of buildings to higher areas within the site to limit the risk of flood damage.
190. It is recommended that a clear statement is requested within each and every detailed FRA that concisely summarises how a reduction in flood risk has been achieved within the proposed (re)development. This may be specified as (for example) a reduction in flow from the site, a reduction in water levels within (or adjacent to) the site, or a reduction in the consequences of flooding.

6.4.3 Localised Flood Risk within the Planning Process

191. The PPS25 Practice Guide advocates the application of a sequential approach when allocating land, taking into consideration *all* sources of flooding. The local drainage related problems identified within South Bucks are generally very localised, and relate to historical incidents, the source of which is often somewhat uncertain. It is important to recognise therefore that these are not a measure of 'risk', but rather problems that have occurred due to a particular set of local circumstances in the past (for example, the blockage of a local gully inlet). These may or may not reoccur in future years.
192. From a spatial planning perspective therefore, it is considered unreasonable to restrict future development within areas that may have suffered a localised flooding incident in years past. It is essential however not to overlook the potential risk of localised flooding during the design process. Whilst the incidents that have been identified will typically not result in widespread damage or disruption, a proactive approach to risk reduction through design can mitigate the potential for damage, both to the development itself and elsewhere. Specific development control recommendations have been provided accordingly.

6.4.4 Spatial Planning & Development Control Recommendations

PPS25 Requirement	PPS25 Flood Zone				Zone 1 Low Probability
	Zone 3b Functional Floodplain		Zone 3a High Probability		
	Developed Areas	Undeveloped Areas	Undeveloped Areas	Defended Areas	
SPATIAL PLANNING RECOMMENDATIONS					
Important Considerations	<p>It is important to recognise that within Zone 3b Functional Floodplain, 'specially developed' buildings are important few paths and/or flood storage areas that must be retained.</p> <p>It should be recognised that property situated within Zone 3b Functional Floodplain will be subject to frequent flooding, on average, less than every 20 years. There are clear sustainability implications to be considered in respect of high value buildings and insurance against flooding related damages will be available in the longer term.</p>		<p>Future development within Zone 3a High Probability can only be considered following application of the Sequential Test</p> <p>Relevant for all areas of the District excluding the Willow Avenue estate (Uxbridge)</p> <p>Relevant for properties situated within the Willow Avenue estate (Uxbridge)</p>		<p>It is important to recognise that sites within Zone 2 Medium Probability can only be considered following application of the Sequential Test</p> <p>Land use should be restricted to Water Compatible, Less Vulnerable or More Vulnerable development. Highly Vulnerable development may only be considered if Exception Test can be passed.</p>
Land Use (refer Table 02 of PPS25)	Water Compatible Development				No restrictions
Permitted Development & Property Subdivision	<p>Proactively seek a reduction in risk by reducing the vulnerability of the existing land use</p> <p>There should be a presumption against all building extensions (including out-buildings). Property subdivision may increase the population at risk and should not be permitted</p>		<p>Building extensions (including out-buildings) should be discouraged to avoid raising flood levels elsewhere. Property subdivision may increase the intensity of development, and the population at risk, and should be discouraged</p>		NA
DEVELOPMENT CONTROL RECOMMENDATIONS					
Detailed Flood Risk Assessment (FRA)	Required	Required	Required	Required	Required
Floor Level	To be situated a minimum of 300mm above the 1 in 100 year river flood level, including climate change				No minimum level stipulated by PPS25
Site Access & Egress	<p>For residential property, dry access is to be provided in the 1 in 100 year river flood. For commercial property, access must be 'safe' in accordance with Defra 'Flood Risk to People' (FD2320 & FD2321)</p>	NA	NA	NA	No minimum level stipulated by PPS25
Basements	Not permitted	NA	NA	No restrictions	No restrictions
Site Runoff	Implement SuDS to ensure that runoff from the site (post redevelopment) does not exceed greenfield runoff rates. Any SuDS design must take due account of ground water, and geological conditions (refer Section 6.5.3). Any sites situated within the eastern fringes of the District (including Iwer, Iwer Heath, Riching Parks, Denham, Denham Green, Higher Denham, New Denham and Willow bank) must consider the BW guidance included as Appendix B				
Buffer Zone	A minimum 8m buffer zone must be provided to 'top of bank' within sites immediately adjoining a river corridor. This relates to both open waterways and culverted waterway corridors. Reference should be made to the Environment Agency's 'Living on the Edge' guide (www.environment-agency.gov.uk) that discusses any development situated in, over, under or adjacent to rivers and/or streams.				
Other	Ensure that the proposed development does not result in an increase in maximum flood levels within adjoining properties. This may be achieved by ensuring (for example) that the existing building footprint is not increased, that overland flow routes are not truncated by buildings and/or infrastructure, or hydraulically linked compensatory flood storage is provided within the site (or up stream)				
As an integral part of the government's 'Making Space for Water' agenda, the Environment Agency is actively seeking the renaturalisation of culverted water courses as part of any future development. Realistic opportunities to reinstate the natural open waterway within existing culverted reaches of the river(s) should be promoted					

6.4.5 Building Extensions

193. Concern is mounting throughout England, and particularly within the Thames Region, that valuable floodplain areas are being progressively lost to extensions and/or outbuildings that are below a specified size. These are 'permitted' developments that can take place without specific planning approval. Whilst each individual extension may not result in a measurable impact upon localised flood levels, the cumulative impact of building extensions has the potential to be considerable.

194. It is recognised that permitted development rights heavily limits the ability of a local authority to restrict some developments. Article 4 of the Town and Country Planning General Permitted Development Order provides a possible vehicle for removal of these rights in exceptional circumstances, however this measure has implications for property rights. As such, it may be open to compensation claims from affected landowners. A more pragmatic approach is therefore required on a local level.

195. Notwithstanding this however, the importance of a long term sustainable view on the loss of floodplain to building extensions is widely accepted. A national government initiative is strongly encouraged that will provide a consistent and equitable solution to this mounting problem nationwide

6.5 Overview of Flood Risk & SFRA Interpretation

196. The spatial variation in flood risk across the District is depicted in the adjoining maps, and described below. The South Bucks SFRA (Level 1) should be used by both the Council and prospective developers to meet their obligations under PPS25 throughout the planning cycle. Instructions for use are provided below:

South Bucks District Council (Forward Planning)

Figures 1 to 19 provide an overview of the spatial variation in *fluvial* flood risk throughout the District (i.e. the risk of flooding from rivers), based upon current climate predictions (i.e. 2006). It is necessary to adopt a sequential approach when considering where land should be allocated for future development, and this is described in Section 6.4. These figures should be used to inform this sequential approach. Furthermore, PPS25 provides clear guidance on permissible land use within areas potentially at risk from flooding, and this too is discussed in Section 6.4.

The potential impact of climate change upon Zone 3a High Probability over the next 100 years is depicted in Figures 34 to 51. It is understood that the Council propose to adopt a precautionary approach with respect to the allocation of sites, and therefore these outlines will be used to inform the delivery of the Sequential Test, and the assessment of future windfall sites, as part of the LDF process. It is recognised however that there is a relatively high degree of uncertainty surrounding climate change predictions, and it is likely that the predicted Zone 3a plus climate change outlines will change over time. In the interim, a conservative assessment has been undertaken as outlined in Section 5.7 above, informing the planning process at the current point in time.

Whilst there is no particular constraint placed upon land use within areas of Zone 1 Low Probability within the District, it is strongly recommended that the Council takes due consideration of flooding from other sources (i.e. non fluvial). Overland flow routes are depicted in Figures 29, and development should be oriented to avoid blocking these in any way. Observed incidents of localised flooding are also depicted in Figures 28 and 33, and once again these should be used to inform design to ensure that future development does not exacerbate these existing problems. Many of these localised sources of flooding within South Bucks can be effectively managed through the design process, however it is recommended that advice is taken from the Environment Agency to ensure that the severity of the local issue that may affect (or be exacerbated by) the proposed allocation is fully appreciated.

South Bucks District Council (Development Control) & Developers

It is important that the potential risk of flooding is considered as an integral part of all proposed development within the District. Figures 1 to 19 (fluvial flooding) and Figures 28 to 33 (other sources) provide a measure of the severity of flooding within the proposed development site. These should be used to trigger a more detailed assessment of flood risk related issues within the site, as described in Section 6.4 and Section 6.7. The potential impact of climate change upon Zone 3a High Probability is presented within Figures 34 to 51.

The assessment of localised flooding related issues is imperative for all proposed development, irrespective of its location and/or scale within the District, and the SFRA provides some helpful tools to assist in this regard:

- Figure 29 provides an indication of the route with which overland flow can be expected to take during an intense storm event that exceeds the capacity of the existing drainage system. The blockage of these routes by buildings may result in localised flooding, and consequently this should be avoided wherever possible.

- Figures 28 and 33 provide an indication of areas that have been susceptible to localised flooding historically. This is not a comprehensive record of flooding, and relies upon community reports of flooding made to the Council(s). It is a good indication of areas that may be susceptible however, and reiterates the importance of considering flood risk related issues in areas that are outwith the designated PPS25 flood zones.
- Local water storage and conveyance infrastructure is depicted in Figure 32. Any future development within close proximity of this infrastructure should consider the potential risk of structural failure and/or overtopping, as discussed in Section 5.3.

197. The risk of river flooding within the settlements of the District is outlined below.

6.5.1 Beaconsfield (Figures 6 & 7)

198. There is no fluvial risk of flooding or groundwater problems in Beaconsfield, however a small section of land within the local vicinity of Beaconsfield flooded in 1992 from the local drainage network.
199. A local sewer flooding problem has been highlighted in Beaconsfield, evident from the cluster of observed local incidents. The most recent of these events occurred in Brownwood Road, Lakes Lane and Candlemas Lane in 2006.

6.5.2 Burnham (Figures 3 & 4)

200. Some sections of lower laying areas at South Burnham are within Flood Zone 2 (1 in 1000 year flood) posing a risk of flooding to several properties. However Burnham is not in Flood Zone 3a. Historically some areas of Burnham have flooded, however the Jubilee River has reduced the degree of risk.
201. Rising groundwater has caused flooding problems at Taplow Road and Lent Rise Road in the past where the road goes beneath the railway line. The potential loss of transport routes due to rising groundwater should be considered in site specific flood risk assessments.
202. A sewer flooding problem has been highlighted in Burnham, evident from the cluster of locally observed incidents and the collective information provided by Thames Water. The most recent of these events occurred in Maypole Road in 2007.

6.5.3 Denham (Figure 17)

203. The River Misbourne flows through the northern side of Denham village. A local raised flood defence is evident along this reach of the Misbourne, however this protects only rural land adjoining the river corridor. A small number of properties at Village Road are at risk flooding, situated within Zone 3a High Probability and some within Zone 3b Functional Floodplain.
204. The potential risk of flooding to Denham village is relatively low, however flooding may be exacerbated should blockages occur at Denham Avenue Bridge or Village Road Bridge.

6.5.4 Farnham (Figure 10)

205. There is no fluvial risk of flooding or groundwater problems in Farnham.

206. A sewer flooding problem has been highlighted in Farnham, once again evident from the number of recorded incidents evident within the town. The most recent of these events occurred at Farnham Park Rehab Centre in 2007.
207. Surface water runoff has resulted in a number of problems in the past. Flooding has previously occurred at Farnham Park Lane, Purton Lane and Barn Close where surface water has been unable to join the local sewer network; and at Farnham Royal, Blackpond Lane, Templewood Lane, Church Road and Beaconsfield Road where gullies have become blocked resulting in flood water flowing on the roads.

6.5.5 Fulmer (Figure 14)

208. Fulmer is a small village south of Gerrards Cross situated at the headwater of Alder Bourne. The rear garden areas of several properties are potentially at risk of fluvial flooding on Fulmer Road and gardens at Hay Lane.
209. Groundwater problems have caused flooding problems in the past and should be considered in any site specific flood risk assessments. Flooding problems have been identified in Fulmer from surface water flowing from Stoke Poges, increasing water levels over Alder Bourne Ford making it impassable.
210. Flooding has also been experienced at Windsor Road when the water table is high. The probability of flooding at Windsor Road increases with surface run-off from the M40.

6.5.6 George Green (Figure 9)

211. The southern section of George Green at George Green Road is situated within Flood Zone 3a. The principle watercourses in this area are mainly a local drainage ditches that drain into Datchet Common Brook. During periods of prolonged rainfall these watercourses overtop their banks and flood part of the local area. No topographic or modelling information was available at this site to enable a detailed review of the flood zones. Any future development must be supported by a more detailed site based FRA to review the local risk of flooding.

6.5.7 Gerrards Cross (Figure 14, 15 and 18)

212. There is no fluvial risk of flooding or groundwater problems in Gerrards Cross.
213. A sewer flooding problem has been highlighted in Gerrards Cross, evident by the relatively high number of observed localised flooding incidents. The most recent of these events occurred at Coombe Vale in 2007.

6.5.8 Hedgerley Hill (Figure15)

214. There is no fluvial risk of flooding in Hedgerley Hill.
215. Rising groundwater levels have caused some surface water ponding in the past however these have not caused any flooding issues.
216. One property has flooded due to drain problems at Stevenson Road in 2003.

6.5.9 Higher Denham (Figure 18)

217. The village of Higher Denham is situated on the left bank of the River Misbourne and is not affected by fluvial flooding. One commercial property is situated within Flood Zone 3a on Lower Road.
218. Sewer flooding has occurred in the past, at two properties on Middle Road (2004) and Lower Road (2005).
219. The area to the south of High Denham (across the river) is situated within Flood Zone 3a, areas affecting the Sewage Works and Moor Farm. A number of localised flooding incidents have been observed within the local area.

6.5.10 Iver Village (Figure 11)

220. There is no fluvial risk of flooding or groundwater problems in Iver Village.
221. A sewer flooding problem has been highlighted in Iver Village, reflected by the cluster of localised flooding incidents observed within the local area. The most recent of these events occurred at Grange Way in 2006.

6.5.11 Iver Heath (Figure 12)

222. There is no fluvial risk of flooding or groundwater problems in Iver Heath.
223. A sewer flooding problem has been highlighted in Iver Heath, once again evidenced by the number of local incidents observed. The most recent of these events occurred at Anslow Gardens in 2006.

6.5.12 Lower Thames (Figure 2 and 3)

224. A relatively large proportion of the area to the south of the River Thames is affected by river flooding, encompassing the village of Dorney Reach. Whilst there are clearly areas of higher ground (indeed much of Dorney Reach falls within Zone 2 Medium Probability), these areas will be surrounded by flooded areas on a relatively frequent basis, and therefore the safety of residents should be carefully considered.
225. Areas to the north of the River Thames are affected by a risk of river flooding to some degree, however relatively few properties are affected. The village of Dorney is currently not directly at risk from Cress Brook (with the exception of Village Road) however the risk of flooding is expected to increase with climate change. For this reason, local properties may be at risk in future years.
226. Throughout these areas of the Lower Thames system, it is essential to recognise that any future development may exacerbate the potential risk of flooding to properties already at risk within the Royal Borough of Windsor & Maidenhead downstream. Careful design to mitigate any potential increases in runoff and/or changes to the local flooding regime is imperative.
227. As the Lower Thames overtops its banks, areas to the south of the River Thames can become flooded to depths in excess of 2 metres during the 1% (100 year) event, especially in the vicinity of Ellington Road. This depth of water could cause a significant risk to life in the areas and contingency planning in the area should pay specific attention to this area.

6.5.13 New Denham and Willowbank (Figure 16)

228. New Denham is situated on the left bank of the River Colne, situated within Zone 3a High Probability. During periods of prolonged rainfall, high flows in Rusholt Brook and the River Colne can cause widespread flooding in the area. Much of the area will flood to a depth less than 0.5 metres in the 1% (100 year) event which is unlikely to cause a risk to life.
229. The capacity of Rusholt Brook as recently been increased to hold the water levels predicted under a 100 year event. However during a flood Rusholt Beck will still be unable to discharge into the River Colne when water levels downstream are high, thus exacerbating the flood problem.
230. Willowbank is an island of properties situated between the River Colne and the Grand Union Canal. The area is surrounded by a system of raised defences, and the predicted risk of flooding is no greater than 0.1% (1000 year), as evidenced by the delineation of Zone 2 Medium Probability.

6.5.14 Richings Park (Figure 8)

231. Richings Park is situated north of the confluence where Datchet Common Brook meets the River Thames. This results in a back up of water when Datchet Common Brook cannot discharge into the River Thames during periods of high flow. Most of the area at risk is agricultural however some properties are situated in Zone 3b Functional Floodplain at Old Slade Lane and Poynings.

6.5.15 Stoke Poges (Figure 10)

232. There is no fluvial risk of flooding or groundwater problems in Stoke Poges.
233. A sewer flooding problem has been highlighted in Stoke Poges, as evidenced by the local observed flooding incidents. The most recent of these events occurred at Bunby Road in 2006.

6.5.16 Tatling End (Figure)

234. There is no fluvial risk of flooding or groundwater problems in Tatling End. A property on Skylark Road flooded due to drain problems in 2005.

6.5.17 Remaining Areas of the District

235. All remaining areas are situated on higher ground within Zone 1 Low Probability, and/or are not subject to any future development pressures. Some localised drainage issues may exist, however these should not preclude future development.
236. There are no specific flood risk related constraints placed upon future development within Zone 1 Low Probability (in accordance with PPS25), however a Surface Water Flood Risk Assessment will be required in compliance with PPS25 and current guidance and policy. This will involve the introduction of SuDS techniques. Any SuDS design must take due account of groundwater and geological conditions

6.6 Detailed Flood Risk Assessment (FRA) – The Developer

6.6.1 Scope of the Detailed Flood Risk Assessment

237. As highlighted in Section 2, the SFRA is a strategic document that provides an overview of flood risk throughout the District. Once the Sequential Test has been applied in accordance with Section 6.4 above to determine the allocation of sites for future development, it is imperative that a site-based Flood Risk Assessment (FRA) is carried out by the developer for all proposed developments, as outlined in Section 6.4 above. This should be submitted as an integral part of the planning application. **It is emphasised that, for windfall sites, it will be necessary for the developer to demonstrate that the Sequential Test has been applied (in accordance with PPS25) within the detailed FRA.**
238. The FRA should be commensurate with the risk of flooding to the proposed development. For example, where the risk of flooding to the site is negligible (e.g. Zone 1 Low Probability), there is little benefit to be gained in assessing the potential risk to life and/or property as a result of flooding. Rather, emphasis should be placed on ensuring that runoff from the site does not exacerbate flooding lower in the catchment. The particular requirements for FRAs within each delineated flood zone are outlined below.

It is highlighted that the description of flood risk provided in the discussions above (Section 6.5) place emphasis upon the primary source of flood risk (i.e. river flooding). In all areas, a localised risk of flooding may also occur, typically associated with local catchment runoff following intense rainfall passing directly over the District. This localised risk of flooding must also be considered as an integral part of the detailed Flood Risk Assessment.

239. Proposed Development within Zone 3a High Probability & Zone 3b Functional Floodplain

All FRAs supporting proposed development within Zone 3b Functional Floodplain and Zone 3a High Probability should include an assessment of the following:

- The vulnerability of the development to flooding from other sources (e.g. surface water drainage, groundwater) as well as from river flooding. This will involve discussion with the Council and the Environment Agency to confirm whether a localised risk of flooding exists at the proposed site.
- The vulnerability of the development to flooding over the lifetime of the development (including the potential impacts of climate change) **for all sources of flooding**, i.e. maximum water levels, flow paths and flood extents within the property and surrounding area. The Environment Agency may have carried out detailed flood risk mapping (with respect to fluvial flooding) within localised areas that could be used to underpin this assessment. Where available, this will be provided at a cost to the developer. Where detailed modelling is not available, hydraulic modelling by suitably qualified engineers will be required to determine the risk of flooding to the site. The propensity of culverted systems to block, increasing the risk of flooding, should be considered.
- The potential of the development to increase flood risk elsewhere through the addition of hard surfaces, the effect of the new development on surface water runoff, and the effect of the new development on depth and speed of flooding to adjacent and surrounding property. This will require a detailed assessment, to be carried out by a suitably qualified engineer. It is emphasised that the detailed assessment of potential impacts elsewhere should not be limited (in a geographical sense) to the District of South Bucks. Future development within the District may adversely affect sites within adjoining Boroughs, and it is essential that this is mitigated.
- A demonstration that residual risks of flooding (after existing and proposed flood management and mitigation measures are taken into account) are acceptable. Measures may include flood defences, flood resistant and resilient design, provision for escape/evacuation, effective flood warning and emergency planning.

- Details of existing site levels, proposed site levels and proposed ground floor levels. All levels should be stated relevant to Ordnance Datum
- Details of proposed sustainable drainage systems (SuDS) that will be implemented to ensure that runoff from the site (post redevelopment) does not exceed greenfield runoff rates. Any SuDS design must take due account of groundwater and geological conditions (refer Section 6.6.3);
- The developer must provide a clear and concise statement summarising how the proposed (re)development has contributed to a positive reduction in flood risk within the District;
- Any sites situated within the eastern fringes of the District¹⁴ must consider the BW guidance included as Appendix B, including an assessment of the local risk implications of the possible overtopping and/or failure of the Grand Union Canal (refer Section 5.4).

240. Proposed Development within Zone 2 Medium Probability

- For all sites within Zone 2 Medium Probability, a high level FRA commensurate with the level of risk posed to the site should be prepared based upon readily available existing flooding information, sourced from the EA. It will be necessary to demonstrate that the residual risk of flooding to the property is effectively managed through, for example, the provision of raised floor levels (refer Section 6.6.2) and the provision of a planned evacuation route and/or safe haven.
- The risk of alternative sources of flooding (e.g. urban drainage and/or groundwater) must be considered, and sustainable urban drainage techniques must be employed to ensure no worsening to existing flooding problems elsewhere within the area. Once again, it is reiterated that future development within the District may adversely affect sites within adjoining Boroughs, and it is essential that this is mitigated.
- As part of the high level FRA, the developer must provide a clear and concise statement summarising how the proposed (re)development has contributed to a positive reduction in flood risk within the District.
- Details of proposed sustainable drainage systems (SuDS) that will be implemented to ensure that runoff from the site (post redevelopment) does not exceed greenfield runoff rates. Any SuDS design must take due account of groundwater and geological conditions;
- Any sites situated within the eastern fringes of the District¹⁵ must consider the BW guidance included as Appendix B, including an assessment of the local risk implications of the possible overtopping and/or failure of the Grand Union Canal (refer Section 5.4).

241. Proposed Development within Zone 1 Low Probability

For all sites greater than 1ha in area, a simple Flood Risk Assessment must be prepared. The risk of alternative sources of flooding (e.g. urban drainage and/or groundwater) must be considered. Details of proposed sustainable drainage systems (SUDS) that will be implemented to ensure that runoff from the site (post redevelopment) does not exceed greenfield runoff rates. Any SUDS design must take due account of groundwater and geological conditions.

242. Liaison with the Environment Agency

To assist local planning authorities, the Environment Agency has produced standing advice to inform on their requirements regarding the consultation process for planning applications on flood risk matters. Full details of their Flood Risk Standing Advice can be found on the website: www.pipernetworking.com.

¹⁴ Including Iver, Iver Heath, Uxbridge, Denham, New Denham, Willowbank, Richings Park, Denham Green and Higher Denham

¹⁵ Including Iver, Iver Heath, Uxbridge, Denham, New Denham, Willowbank, Richings Park, Denham Green and Higher Denham

The Environment Agency is an excellent source of information to inform the development of the detailed FRA. The external relations team should be contacted as early as possible to source information relating to (for example) historical flooding, hydraulic modelling and topography (LiDAR). It is emphasised that the information provided within the SFRA is the best available at the time of writing. More up to date information may be available, and contact should always be made with the EA at an early stage to ensure that the detailed site based FRA is using the most current datasets, avoiding unnecessary re-work.

The District of South Bucks falls across two Environment Agency area offices within the Thames Region, and reference should be made to the EA website at www.environment-agency.gov.uk for the appropriate contact details. It is strongly recommended that a draft of the detailed FRA is provided to the EA for review and comment before submitted with the Planning Application, thereby reducing potentially costly delays to the planning process..

6.6.2 Raised Floor Levels & Basements (Freeboard)

243. The raising of floor levels above the 1% AEP (100 year) fluvial flood level will ensure that the damage to property is minimised. Given the anticipated increase in flood levels due to climate change, the adopted floor level should be raised above the 1% AEP (100 year) predicted flood level assuming a 20% increase in flow over the next 100 years, plus an allowance for freeboard (see below).
244. Floor levels should be situated a minimum of 300mm above the 1% AEP (100 year) plus climate change flood level, determined as an outcome of the site based FRA. A minimum of 600mm above the 1% AEP (100 year) flood level should be adopted if no climate change data is available. The height that the floor level is raised above flood level is referred to as the 'freeboard', and is determined as a measure of the residual risks.
245. The use of basements within flood affected areas should be discouraged. Where basement uses are permitted however, it is necessary to ensure that the basement access points are situated 300mm above the 1% AEP (100 year) flood level plus climate change. The basement must be of a waterproof construction to avoid seepage during flooding conditions. Habitable uses of basements within flood affected areas should not be permitted. It must be demonstrated that any below ground construction does not adversely increase the risk of groundwater flooding to adjoining properties.

6.6.3 Sustainable Drainage Systems (SuDS)

246. SuDS is a term used to describe the various approaches that can be used to manage surface water drainage in a way that mimics the natural environment. The management of rainfall (surface water) is considered an essential element of reducing future flood risk to both the site and its surroundings. Indeed reducing the rate of discharge from urban sites to greenfield runoff rates is one of the most effective ways of reducing and managing flood risk within the District. The integration of sustainable drainage systems into a site design can also provide broader benefits, including an improvement in the quality of runoff discharged from the site, the capture and re-use of site runoff for irrigation and/or non potable uses, and the provision of greenspace areas offering recreation and/or aesthetic benefits.
247. SuDS may improve the sustainable management of water for a site by¹⁶:
 - reducing peak flows to watercourses or sewers and potentially reducing the risk of flooding downstream;
 - reducing volumes and the frequency of water flowing directly to watercourses or sewers from developed sites;

¹⁶ Interim Code of Practice for Sustainable Drainage Systems National SuDS Working Group, 2004

- improving water quality over conventional surface water sewers by removing pollutants from diffuse pollutant sources;
- reducing potable water demand through rainwater harvesting;
- improving amenity through the provision of public open space and wildlife habitat;
- replicating natural drainage patterns, including the recharge of groundwater so that base flows are maintained.

248. In catchment terms, any reduction in the amount of water that originates from any given site is likely to be small. But if applied across the catchment in a consistent way, the cumulative affect of a number of sites could be significant.

249. There are numerous different ways that SuDS can be incorporated into a development and the most commonly found components of a SuDS system are described in the following table¹⁷. The appropriate application of a SuDS scheme to a specific development is heavily dependent upon the topography and geology of the site (refer Section 4.7). Careful consideration of the site characteristics must be assured to ensure the future sustainability of the adopted drainage system.

Pervious surfaces	Surfaces that allow inflow of rainwater into the underlying construction or soil.
Green roofs	Vegetated roofs that reduce the volume and rate of runoff and remove pollution.
Filter drain	Linear drains consisting of trenches filled with a permeable material, often with a perforated pipe in the base of the trench to assist drainage, to store and conduct water; they may also permit infiltration.
Filter strips	Vegetated areas of gently sloping ground designed to drain water evenly off impermeable areas and to filter out silt and other particulates.
Swales	Shallow vegetated channels that conduct and retain water, and may also permit infiltration; the vegetation filters particulate matter.
Basins, Ponds and Wetlands	Areas that may be utilised for surface runoff storage.
Infiltration Devices	Sub-surface structures to promote the infiltration of surface water to ground. They can be trenches, basins or soakaways.
Bioretention areas	Vegetated areas designed to collect and treat water before discharge via a piped system or infiltration to the ground

250. For more guidance on SuDS, the following documents and websites are recommended as a starting point:

- Interim Code of Practice for Sustainable Drainage Systems, National SuDS Working Group, 2004
- Planning Policy Statement 25, Annex F, CLG (2006)
- The SUDS Manual C697 (CIRIA, February 2007)
- www.ciria.org.uk/SUDS/

¹⁷ Interim Code of Practice for Sustainable Drainage Systems National SUDS Working Group, 2004

251. Furthermore, the Environment Agency (Thames Region) has issued best practice guidance for Sustainable Drainage Systems (October 2006), available from the Environment Agency development control teams. This provides a clear hierarchy for SuDS, reflecting the degree of sustainability offered by the SuDS application as captured in the table below. Developers should demonstrate within their detailed site based Flood Risk Assessment that this hierarchy has been considered as part of the design process.

Most Sustainable	SUDS technique	Flood Reduction	Water Quality Improvement	Landscape & Wildlife Benefit
	Living roofs	✓	✓	✓
	Basins and ponds - Constructed wetlands - Balancing ponds - Detention basins - Retention ponds	✓	✓	✓
	Filter strips and swales	✓	✓	✓
	Infiltration devices - soakaways - infiltration trenches and basins	✓	✓	✓
	Permeable surfaces and filter drains - gravelled areas - solid paving blocks - porous paving	✓	✓	
	Tanked systems - over-sized pipes/tanks - storms cells	✓		
Least Sustainable				

6.7 Local Community Actions to Reduce Flood Damage

252. A number of properties within the District are potentially at risk of flooding. It is essential therefore to ensure a broad awareness with respect to flood risk, providing the community with the knowledge (and tools) that will enable them to help themselves should a flood event occur.
253. The following 'community based measures' are cost effective solutions that local communities may introduce to minimise the damage sustained to their own homes in the case of flooding. Further guidance is provided by the EA, Defra and CLG¹⁸ (refer the National Flood Forum (www.floodforum.gov.uk)).

6.7.1 Flood Proofing

254. The 'flood proofing' of a property may take a variety of forms:

For new homes and/or during redevelopment

➤ Raising of floor levels

The raising of floor levels above the anticipated maximum flood level ensures that the interior of the property is not directly affected by flooding, avoiding damage to furnishings, wiring and interior walls. It is highlighted that plumbing may still be impacted as a result of mains sewer failure.

➤ Raising of electrical wiring

The raising of electrical wiring and sockets within flood affected buildings reduces the risks to health and safety, and reduces the time required after a flood to rectify the damage.

¹⁸ Improving the Flood Performance of New Buildings – Flood Resilient Construction (May 2007)

For existing homes

➤ Flood boards

The placement of a temporary watertight seal across doors, windows and air bricks to avoid inundation of the building interior. This may be suitable for relatively short periods of flooding, however the porosity of brickwork may result in damage being sustained should water levels remain elevated for an extended period of time. This may lessen the effectiveness of flood proofing to existing properties affected by flooding from larger river systems such as the Thames.

6.8 Emergency Planning

255. The Council is designated as a Category 1 Responder under the Civil Contingencies Act 2004. As such, the Council has defined responsibilities to assess risk, and respond appropriately in case of an emergency, including (for example) a major flooding event. The Council's primary responsibilities are¹⁹:

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

256. The Environment Agency monitors river levels within the main watercourses affecting South Bucks, including the River Colne, the River Misbourne and the River Thames. Based upon a sophisticated in-house forecasting computer model, the Agency makes an assessment of the anticipated maximum water level that is likely to be reached within the proceeding hours (and/or days). Where these predicted water levels are expected to result in the inundation of populated areas²⁰, the Environment Agency will issue a series of flood warnings within defined flood warning areas (refer Figure 31), encouraging residents to take action to avoid damage to property in the first instance.

257. As water levels rise and begin to pose a risk to life and/or livelihood, it is the responsibility of the emergency services to coordinate the evacuation of residents. This evacuation will be supported by the Council. It is essential that a robust plan is in place that clearly sets out (as a minimum):

- roles and responsibilities;
- paths of communication;
- evacuation routes;
- community centres to house evacuated residents;
- contingency plans in case of loss of power and/or communication.

¹⁹ Civil Contingencies Act 2004

²⁰ Restricted to those urban areas situated within Environment Agency flood warning zones

258. Dry access (i.e. above flood level) should be sought wherever possible to ensure that all residents can be safely evacuated in times of flood. 'Safe' access (as a minimum) must be assured during the 1% AEP (100 year) fluvial flood level, defined with due consideration to the emerging Defra research presented in "Flood Risk to People" (FD2320 and FD2321). To inform the assessment of public 'safety', Figures 22 to 27 provide an indication of the depth of flooding anticipated along key local roads during the 1% (100 year) design event.
259. Coordination with the emergency services and the Environment Agency is imperative to ensure the safety of residents in time of flood. A relatively small proportion of South Bucks is at risk of river flooding (as indicated by the shaded PPS25 flood risk zones in the adjoining maps). Flooding of this nature will typically occur following relatively long duration rainfall events, and consequently forewarning will generally be provided to encourage preparation in an effort to minimise property damage and risk to life. It is worth highlighting however that the benefits of flood warning are often compromised to a large degree by the lack of 'take up' within the local community. This emphasises the extreme importance of raising local awareness with respect to the potential risks of flooding.
260. Areas suffering from localised flooding issues will tend to be at greater risk. These areas are susceptible to 'flash' flooding, associated with storm cells that pass over the district resulting in high intensity, often relatively localised, rainfall. It is anticipated that events of this nature will occur more often as a result of possible climate change over the coming decades. Events of this nature are difficult to predict accurately, and the rapid runoff that follows will often result in flooding that cannot be sensibly forewarned.
261. All urbanised areas are potentially at some degree risk of localised flooding due to heavy rainfall. The blockage of gullies and culverts as a result of litter and/or leaves is commonplace, and this will inevitably lead to localised problems that can only realistically be addressed by reactive maintenance.
262. It is recommended that the Council advises the local Resilience Forum of the risks raised in light of the South Bucks SFRA, ensuring that the planning for future emergency response can be reviewed accordingly.

6.9 Insurance

263. Many residents and business owners perceive insurance to be a final safeguard should damages be sustained as a result of a natural disaster such as flooding. Considerable media interest followed the widespread flooding of 2000 when it became clear that the insurance industry were rigorously reviewing their approach to providing insurance protection to homes and businesses situated within flood affected areas. Not surprisingly, the recent widespread flooding of July 2007 has further exacerbated the discussion surrounding the future of insurance for householders and business owners situated within flood affected areas.
264. The following quotations are an extract from the Association of British Insurers (ABI) website, dated August 2007:

"The UK is unique in offering flood cover as a standard feature of household and most business policies. Unlike much of Europe and worldwide, cover is widely available to the UK's 23.5 million householders.

In the long term, this situation could worsen, unless we take action to reduce flood risk to people and property. Climate change will increase winter rainfall, the frequency of heavy rainfall, and sea levels and storm surge heights. With no change in Government policies or spending, climate change could increase the number of properties at risk of flooding to 3.5 million. Furthermore, continued pressure on land could mean even more new developments being situated in floodplains.

By spreading the risk across policy holders, insurance enables householders and businesses to minimize the financial cost of damage from flooding. In the modern competitive insurance market, premiums reflect the risks that customers face. This enables insurance to be offered at very competitive prices to customers living in low flood risk areas.

In 2003 ABI members agreed to extend their commitment to provide flood insurance to the vast majority of UK customers. The result of discussions between Government and insurers was a Statement of Principles, which aims to provide reassurance to the overwhelming majority of insurance customers living in the floodplain about the continued availability of insurance in future.

Individual property owners can do much to increase the resistance and resilience of their properties to flood damage - further information is available. ABI has issued a factsheet for property owners on a range of measures that could be taken by a homeowner to improve the resilience of their property to flood damage."

265. In summary, for the time being, residents and business owners can be assured that insurance will be available to assist in recovery following a flood event. It would appear fair to say however that the future availability of flood insurance within the UK will be heavily dependant upon commitment from the government to reduce the risk of flooding over time, particularly given the anticipated impacts of climate change. Investment is required in flood defence and improving the capacity of sewage and drainage infrastructure, however it is also essential to ensure that spatial planning decisions do not place property within areas at risk of flooding.

7 Conclusion & Recommendations

266. A number of properties within South Bucks are at risk of flooding. The risk of flooding posed to properties within the District arises from a number of sources including river flooding, groundwater and sewer flooding.
267. Planning policy needs to be informed about the risk posed by flooding. A collation of potential sources of flood risk has been carried out in accordance with PPS25, developed in close consultation with both the Council and the Environment Agency. The District has been broken down into zones of 'high', 'medium' and 'low' probability of flooding in accordance with PPS25, providing the basis for the application of the PPS25 Sequential Test.
268. A planning solution to flood risk management should be sought wherever possible, steering vulnerable development away from areas affected by flooding in accordance with the PPS25 Sequential Test. Specific planning recommendations have been provided for all settlements within the District (refer Section 6.4).
269. Where other planning considerations must guide the allocation of sites and the Sequential Test has been applied, specific recommendations have been provided to assist the Council and the developer to address the requirements of the Exception Test. These should be applied as development control recommendations for all future development (refer Section 6.4).
270. Council policy is essential to ensure that the recommended development control recommendations can be imposed consistently at the planning application stage. This is essential to achieve future sustainability within the District with respect to flood risk management. It is recommended that the development control recommendations presented in the SFRA will be incorporated into the forthcoming Development Control DPD (refer Section 6.4).
271. Emergency planning is imperative to minimise the risk to life posed by flooding within the District. It is recommended that the Council advises the local Resilience Forum of the risks raised in light of the South Bucks SFRA, ensuring that the planning for future emergency response can be reviewed accordingly.

A Living Document

272. The SFRA has been developed building heavily upon existing knowledge with respect to flood risk within the district. A rolling programme of detailed flood risk mapping within the South East region is underway. This, in addition to observed flooding that may occur throughout a year, will improve the current knowledge of flood risk within the district and may marginally alter predicted flood extents within South Bucks. Furthermore, Communities and Local Government (CLG) are working to provide further detailed advice with respect to the application of PPS25, and future amendments to the PPS25 Practice Guide are anticipated. Given that this is the case, a periodic review of the South Bucks District SFRA is imperative.
273. It is recommended that the South Bucks District SFRA is reviewed on a regular basis. The following key questions should be addressed as part of the SFRA review process:

Question 1

Has any flooding been observed within the District since the previous review? If so, the following information should be captured as an addendum to the SFRA:

- What was the mapped extent of the flooding?
- On what date did the flooding occur?
- What was the perceived cause of the flooding?
- If possible, what was the indicative statistical probability of the observed flooding event? (i.e. how often, on average, would an event of that magnitude be observed within the District?)
- If the flooding was caused by overtopping of the riverbanks, are the observed flood extents situated outside of the current Zone 3a? If it is estimated that the frequency of flooding does not exceed, on average, once in every 100 years then the flooded areas (from the river) should be incorporated into Zone 3a to inform future planning decision making.

Question 2

Have any amendments to PPS25 or the Practice Companion Guide been released since the previous review? If so, the following key questions should be tested:

- Does the revision to the policy guidance alter the definition of the PPS25 Flood Zones presented within the SFRA? (refer Section 5.2)
- Does the revision to the policy guidance alter the decision making process required to satisfy the Sequential Test? (refer Section 6.4.1)
- Does the revision to the policy guidance alter the application of the Exception Test? (refer Section 6.4.1)
- Does the revision to the policy guidance alter the categorisation of land use vulnerability, presented within Table D2 of PPS25 (December 2006)?

If the answer to any of these core questions is 'yes' then a review of the SFRA recommendations in light of the identified policy change should be carried out.

Question 3

Has the Environment Agency issued any amendments to their flood risk mapping and/or standing guidance since the previous policy review? If so:

- Has any further detailed flood risk mapping been completed within the District, resulting in a change to the 20 year, 100 year or 1000 year flood outline? If yes, then the Zone 3b and Zone 3a flood outlines should be updated accordingly.
- Has the assessment of the impacts that climate change may have upon rainfall and/or river flows over time altered? (refer Section 5.6) If yes, then a review of the impacts that climate change may have upon the District is required.
- Do the development control recommendations provided in Section 6.4 of the SFRA in any way contradict emerging EA advice with respect to (for example) the provision of emergency access, the setting of floor levels and the integration of sustainable drainage techniques? If yes, then a discussion with the EA is required to ensure an agreed suite of development control requirements are in place.

It is highlighted that the Environment Agency review the Flood Zone Map on a quarterly basis. If this has been revised within the District, the updated Flood Zones will be automatically forwarded to the Council for their reference. *It is recommended that only those areas that have been amended by the Environment Agency since the previous SFRA review are reflected in Zone 3 and Zone 2 of the SFRA flood maps.* This ensures that the more rigorous analyses carried out as part of the SFRA process are not inadvertently lost by a simple global replacement of the SFRA flood maps with the Flood Zone Maps. .

Question 4

Has the implementation of the SFRA within the spatial planning and/or development control functions of the Council raised any particular issues or concerns that need to be reviewed as part of the SFRA process?

APPENDIX A

Safe Access & Egress Design Requirements (Environment Agency, June 2007)

'Safe' access and egress is to be designed to meet the following strict criteria:

Developments within Zone 3a High Probability and Zone 2 Medium Probability, and are **NOT** offered protection from raised flood defences:

- Dry escape, above the 100 year flood level taking into account climate change, should be provided for all 'more vulnerable' (including residential) and 'highly vulnerable' development;
- 'Safe' should preferably be dry²¹ for all other uses such as educational establishments, hotels and 'less vulnerable' land use classifications.

Developments within Zone 3a High Probability and Zone 2 Medium Probability, and **ARE** offered protection from raised flood defences:

- 'Safe' access should preferably be dry²² for 'highly vulnerable' uses;
- 'Safe' access should incorporate the ability to escape to levels above the breach water level²³.

In all instances, it will be necessary to ensure that the South Bucks District Council Emergency Planning Team, and the emergency services (consulted via the Emergency Planning Team), accept the proposals.

For *major 'highly vulnerable' development*, 'safety' will also need to be ensured through the development of a robust evacuation plan. This should clearly define routes to dry (i.e. 'unflooded') land. This may include routes through flood waters, providing the depth and speed of flow across the evacuation route are below the risk defined by the "some" threshold in 'Flood Risk to People' (Defra, FD2320)²⁴.

For *infrastructure development*, 'safety' will also need to be ensured through the development of a robust evacuation plan. This should clearly define dry escape routes (above the 100 year plus climate change flood level) to dry (i.e. 'unflooded') land.

In exceptional circumstances, dry access (above the 100 year plus climate change flood level) for 'more vulnerable' and/or 'highly vulnerable' development may not be achievable. In these exceptional circumstances, liaison must be sought with the Environment Agency and the South Bucks District Council Emergency Planning Team to ensure that the safety of site tenants can be satisfactorily resolved.

²¹ Above the 100 year, plus climate change, flood level

²² Above the 100 year, plus climate change, flood level

²³ Defined assuming the full hydrostatic loading of the flood defence upon collapse (as a worst case scenario)

²⁴ Refer Defra Research Paper FD2320 'Flood Risks to People'

APPENDIX B

Response from British Waterways March 2007

Consultation Response

British Waterways

March 2007

“The water level in the canal is controlled to plus or minus 100mm by some over spill weirs and sluices, along with careful monitoring by BW operations staff. We understand that we have had additional water diverted in to the Grand Union Canal (main section) above Uxbridge lock by the Environment Agency, this does seem to be having some impact when we receive heavy rain.

If the developers intend to drain surface runoff into the canal we would need to see drainage design peak flow rates to canal. Generally for small outfalls, e.g. max 150 mm pipe (or 30-40 l/s), we would not require the developer to undertake extensive hydraulic investigation, provided they incorporate all BW’s engineering requirements for the works affecting the canal. A flow rate of no more than 0.3 metres per second should be discharged into the canal, as per the Code of Practice for works affecting British Waterways (October 2005).

Whilst we encourage developers to reduce their drainage peak flow, using attenuation such as SUDS or other on-site flood storage, for large flows we would ask them to undertake canal hydraulic modelling to assess the impact on the canal levels and flood risk. We do not know what exactly the current capacity is until comprehensive modelling is undertaken.

British Waterways has released a fact sheet our position with regard to SUDS. Please also note that any surface water discharge into the navigation would have to be agreed via an annual license with British Waterways – please contact our Estates Team for further information.”

APPENDIX C

Hydraulic Modelling Zone 3b Functional Floodplain

The Environment Agency Flood Zone Maps do not provide an indication of functional floodplain extents. This information is highly pertinent to land development. It was therefore decided that a basic hydraulic modelling methodology should be utilised to provide this data where no existing modelling data is available.

Within South Bucks, detailed modelling of the River Colne and the River Thames has been carried out on behalf of the Environment Agency. No further modelling was required in this instance therefore. Two further watercourses were identified as priority sites for the delineation of functional floodplain zones however, namely:

- River Misbourne
- Alder Bourne

River catchment hydrology was analysed using a statistical pooling group method (FEH WINFAP V1.1 software, NERC CEH Wallingford 2005), to provide the peak catchment runoff for the 100 year, 20 year and mean annual flow events. The ratio of change between the return periods provided an indication as to the relative change between the known mean annual flow (river at full capacity) and the known 100 year flood outline.

LiDAR provided by the Environment Agency was used for topographic information. 100m sub-catchments were created for each of the un-modelled watercourses. The relative ratio of change between the modelled flood events was mapped considering the increase in flow to a relative increase in water level. This was subsequently related to a topographic level and a flood outline for the functional floodplain produced.

A Manning's based analysis was adopted to delineate the predicted Q20 flood extent. Cross sections were taken through the floodplain at selected intervals. Using the Q100 flood extent (based upon the EA flood zone map) and estimated Q100 flow, the hydraulic characteristics of the channel were assessed using Manning's Equation. The Q20 predicted flow was then applied on the basis of these characteristics, and an estimate of the floodplain extent derived.

The assumptions made in order to derive the functional floodplain using this methodology include:

1. The flow is one dimensional;
2. The flow is not influenced by backwater affects at confluences and/or hydraulic constrictions;

It is important to recognise that these assumptions will introduce a degree of uncertainty in the predicted flood extents, however the adopted methodology is considered entirely suitable for the strategic purposes of the SFRA. It is essential to reinforce that a more detailed interrogation of the Zone 3b flood outline should be carried out as part of a site based Flood Risk Assessment at the planning application stage.