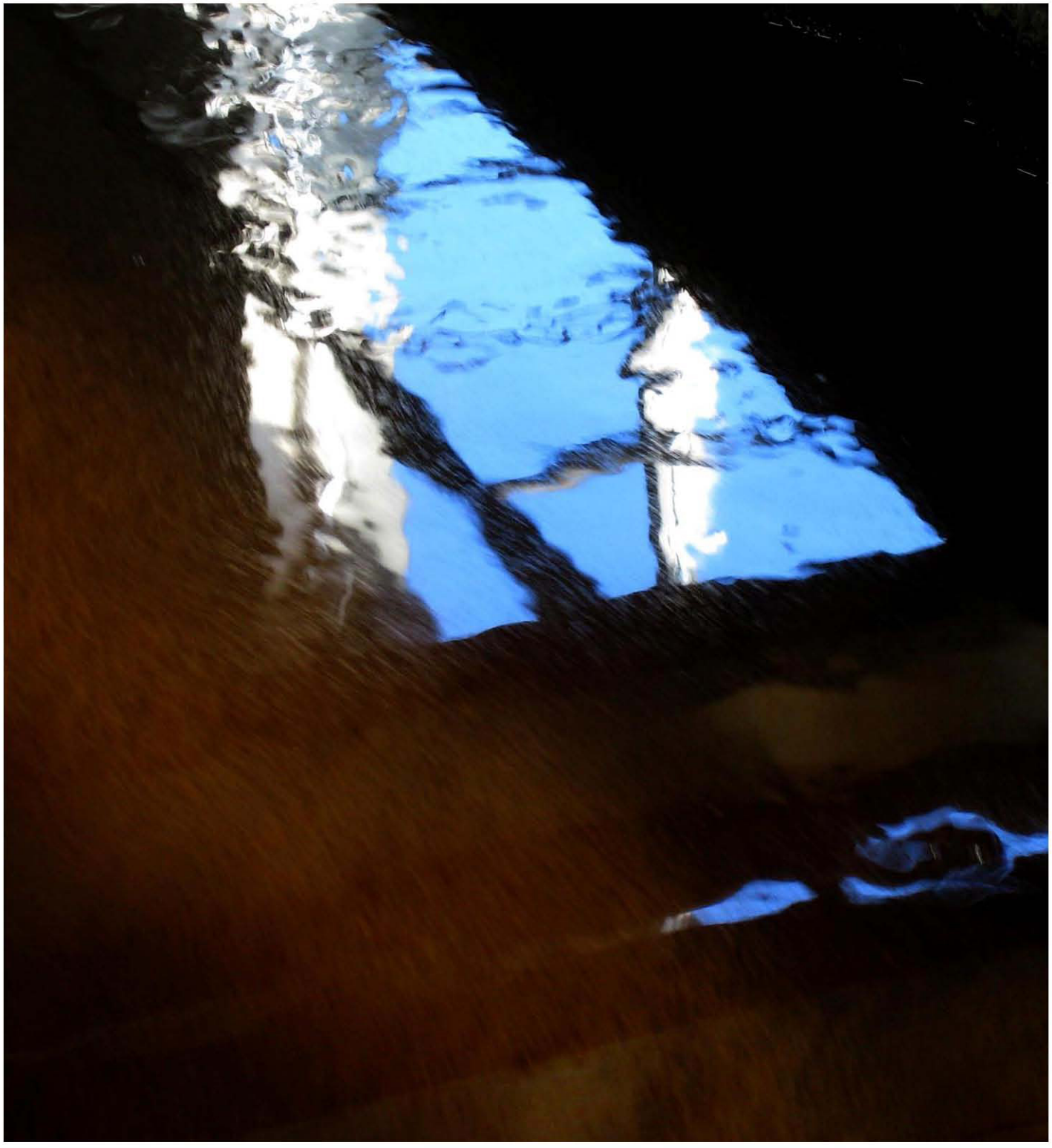

Cambridge and South Cambridgeshire Level 1 Strategic Flood Risk Assessment

Cambridge City Council and
South Cambridgeshire District Council

September 2010

QM

Issue/revision	Issue 1	Revision 1	Revision 2	Revision 3
Remarks	Draft Report	Final Draft	Final	
Date	August 2010	September 2010	September 2010	
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Project number	11501402	11501402	11501402	
File reference	100820-SFRA-R	100920-SFRA-R	100930-SFRA-R	

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Contents

Executive Summary

A 'Level 1' Strategic Flood Risk Assessment (SFRA) has been undertaken for a designated study area defined by the South Cambridgeshire District Council and Cambridge City Council boundaries (see Appendix A). This will provide a comprehensive and robust assessment of the extent and nature of the risk of flooding and its implications for land use planning.

Mott McDonald consultancy initially produced a Level 1 SFRA for South Cambridgeshire District Council in 2005. Mott McDonald also produced an SFRA for Cambridge City Council in 2006. This Level 1 SFRA, supersedes both these studies and provides a current assessment of flood risk within the study area.

The principal aim of the study is to set out flood risk constraints to help inform the preparation of the Local Development Framework (LDF) documents. The study area has been categorised into Flood Risk Zones in accordance with Planning Policy Statement 25: 'Development and Flood Risk' (PPS25).

This Level 1 SFRA report and appendices, provides a sound framework with an appropriate level of detail required at this stage for making consistent and sustainable future planning decisions. Extensive data has been collected to inform this study.

The SFRA evaluates the current (2010) flood risk situation and the future flood risk situation over a 105 year timeframe (2115), incorporating the impacts of climate change in line with PPS25.

An FRA toolkit for each study area has been provided (see Appendix E), to assist SCDC and CCC in considering appropriate flood risk issues, affecting future development proposals.

PPS25 Practice Guidance states that a Level 2 SFRA corresponds to the 'increased' scope of a Level 1 SFRA. The principal purpose of any Level 2 SFRA would be to facilitate the application of the Sequential and Exception Test. This relates to development pressure in areas that are at medium or high flood risk and where there are no other suitable areas for development after applying the Sequential Test.

Any future Level 2 SFRA (if required), will provide a sound framework for making consistent and sustainable future planning decisions throughout the study area.

The Level 1 SFRA uses the Environment Agency's (EA's) up to date Flood Risk and Flood Hazard Mapping provided in their River Cam Mapping study. The Level 1 SFRA will be updated to incorporate the EA's River Ouse Mapping Study in 2011.

One of the key findings of the Level 1 study is that further analysis needs to be undertaken of the standard and condition of existing flood defences. It is also recommended, that further analysis and refinement of the J-Flow hydraulic modelling data for the various watercourses that fall within areas of development pressure (outside of the extents of Bin Brook, Cambridge City and the Cam Lodes), is undertaken. Once the River Ouse mapping is applied to the study area, further modelling may need to be undertaken depending on the development pressure within Flood Zones 2 and 3 in this area.

In the future, there could be changes in the direction of growth **within the SCDC and CCC study area from the currently evolving LDFs. The SFRA should be reviewed annually and updated at least every five years, to reflect any updates in information and future growth proposals.**

As further modelling is conducted and flood defences are created or improved, areas at risk of flooding should be re-assessed based on changes to the Flood Zone Maps. The impact of this on potential development areas should be reappraised.

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).
Awarded Watercourses	Watercourses maintained by a Local Authority and not the Environment Agency or Internal Drainage Board.
CLG	Communities and Local Government.
Catchment	An area drained by a specific river/ watercourse.
Catchment Flood Management Plan	A Catchment Flood Management Plan is a strategic planning tool through which the Environment Agency seeks to work with other key decision-makers within a river catchment, to identify and agree policies for sustainable flood risk management.
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 sustainable development.
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. They are subject to independent examination.
Drift Geology	The unconsolidated sediments at or near the Earth's surface (overlying the bedrock formations) of Quaternary age or more recent.
EA	Environment Agency.

EA Main River	These are all watercourses shown on the statutory main river maps held by the EA and DEFRA listed as a 'Main River'. This may include any structure or appliance for controlling or regulating the flow of water into a channel; the EA has permissive powers to carry out works of maintenance and improvement on these rivers.
Flood Plain	Any area of land over which water flows or would flow or be stored in the absence of flood defences.
Flood Zone Map	Nationally consistent delineation of 'high' and 'medium' flood risk, published on a quarterly basis by the Environment Agency. Shows the areas at risk of flooding based on various return periods.
Fluvial	Relating to a watercourse (river or stream).
Formal Flood Defence	A structure built and maintained specifically for flood defence purposes.
Functional Floodplain	PPS25 Flood Zone, defined as areas at risk of flooding in the 5% AEP (20 year) design event.
Greenfield Site	Land that is usually agricultural and has not been previously developed.
Groundwater	Water occurring below ground in certain geological formations.
Hydraulic Model	A computer simulation of the stages and flows of water within a watercourse.
LIDAR	(Light Imaging Detection and Ranging). A method of detecting distant objects and determining their position by analysis of pulsed laser light reflected from their surfaces.
Local Development Framework (LDF)	Portfolio of local development documents which will provide the framework for delivering the spatial strategy for the area.

Local Plan	A document identifying detailed proposals for the use of land in a local area which interprets the broader policies and proposals of the Structure Plan.
Ordinary Watercourses	This is every river, stream, ditch, drain, dyke, sluice, sewer and passage through which water flows and which does not form part of a main river.
Planning Policy Guidance (PPG)	A series of notes issued by the Government, setting out policy guidance on different aspects of planning. They have been replaced by Planning Policy Statements.
Planning Policy Statement (PPS)	A series of statements issued by the Government, setting out policy guidance on different aspects of planning. They have replaced Planning Policy Guidance Notes.
Pluvial Flooding	Flooding that is directly derived from surface water run-off. It is usually localised in its effects and is caused by rainfall flowing over ground.
PPS25	Planning Policy Statement 25: Development and Flood Risk Department of Communities & Local Government, 2010.
Previously Developed (Brownfield) Land	Land which is or was occupied by a building (excluding those used for agriculture and forestry).
Reach	The extent of a watercourse.
Regional Spatial Strategy (RSS)	Planning strategies developed by the regions. These have now been revoked by the Government.
Residual Risk	An assessment of the outstanding flood risks and uncertainties that have not been explicitly quantified and/or accounted for as part of the review process.
Sustainability Appraisal	Sustainability Appraisal (SA) is an appraisal of plans, strategies and proposals against relevant sustainability objectives relating to environmental, economic and social issues.

Solid Geology (Bedrock)	The consolidated soils and rock exposed at the surface of the Earth or overlain by unconsolidated material, weathered rock or soil.
Source Protection Zone (SPZs)	This is an area where recharge is captured by an abstraction borehole. SPZs are designated by the Environment Agency so as to protect potable water supplies against polluting activities.
SuDS	Sustainable Drainage Systems. These are management practices and control structures designed to minimise the impact of surface water on flood risk and the environment. The overall aim is to imitate the natural hydrological cycle.
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.
Sustainable Development	"Development that meets the needs of the present without comprising the ability of future generations to meet their own needs" (The World Commission on Environment and Development, 1987).
Windfall sites	These are sites that are not specifically allocated for development, but become available for development during the lifetime of a Development Plan.
Zone 1 Low Probability	PPS25 Flood Zone, defined as areas outside of Zone 2 Medium Probability. These areas have less than a 0.1% (1 in 1000) AEP of river or sea flooding in any year.
Zone 2 Medium Probability	PPS25 Flood Zone, defined as areas at risk of flooding in events that are greater than the 1% (100 year) AEP, and less than the 0.1% (1000 year) AEP event or between a 0.5% (200 year) and 0.1% (1000 year) AEP of sea flooding.
Zone 3a High Probability	PPS25 Flood Zone, defined as areas at risk of flooding in the 1% (100 year) AEP design event for river flooding and 0.5% (200 year) or greater AEP of sea flooding.
Zone 3b Functional Floodplain	PPS25 Flood Zone, defined as an area where water has to flow or be stored in times of flooding. This has a 5% (20 year) AEP potential of occurring.

1 Introduction

1.1 BACKGROUND

1.1.1 South Cambridgeshire District Council (SCDC) and Cambridge City Council (CCC) (see Appendix A), are located in the western part of East Anglia.

1.1.2 Both Districts are planning for significant levels of growth. Adopted Development Plans are in place for 12,500 homes to be provided in Cambridge and 20,000 in South Cambridgeshire based on the period 1999 and 2016.

1.1.3 Both districts cover approximately (946 km^2) and extend over approximately a quarter of Cambridgeshire.

1.1.4 In order to plan the implementation of new development in a sustainable manner, SCDC and CCC produce Local Development Frameworks (LDF) containing Development Plan Documents (DPD) and Supplementary Planning Documents (SPD). These take into account the views of key stakeholders, following careful consideration of sustainability issues and constraints to development. One such consideration is flood risk.

1.1.5 WSP Development and Transportation (WSP), have been commissioned by SCDC and CCC to undertake a Level 1 Strategic Flood Risk Assessment (SFRA) to inform their LDF processes.

1.1.6 This Level 1 SFRA has been carried out with the co-operation and support of the Environment Agency (EA), the Ely group of Internal Drainage Boards (IDB) (Waterbeach IDB, Swaffham IDB and Old West IDB), Swavesey IDB, Willingham and Over IDB and the Bedfordshire and Ivel IDB, Anglian Water, Cambridge Water, South Cambridgeshire District Council, Cambridge City Council, Cambridgeshire County Council and other local stakeholders.

1.2 OBJECTIVES

1.2.1 The objectives of the SFRA study are to:

- Assess the risks from all forms of flooding affecting the SCDC and CCC area;
- Provide a reference and policy document to inform the preparation of future LDF documents;
- Ensure that SCDC and CCC meet their obligations under the current PPS25 and Local Development Framework Policy guidelines and standards;
- Inform the Sustainability Appraisal so that flood risk is taken into account when considering options and in the preparation of land use policies;
- Provide a sufficient level of detail to allow SCDC and CCC to undertake the Sequential Test;
- Advise and inform private and commercial developers of their obligations under PPS25 in relation to sustainable development and flood risk.

1.3 SCOPE

1.3.1 This 'Level 1' study forms the first data collection stage of the SFRA process. This comprises the collection and initial review of baseline information collected to carry out the SFRA and an overview of fluvial flood risk issues within the Districts. This is based principally, upon the EA's Flood Zone Maps and modelled outlines provided by the EA for the River Cam Flood Risk Mapping Project (2010). Where possible, detailed modelled flood outlines have also been used in combination with the EA's flood outlines. The Level 1 SFRA also takes into consideration flood risk from all other non fluvial sources of flooding.

1.3.2 The SFRA is essentially a planning tool. It is an assessment of flood risk intended to inform the spatial planning process and, therefore, the level of detail and accuracy should relate to this strategic objective. The SFRA will help to steer future land use in a sequential and holistic manner, taking into consideration sustainability and the requirements of PPS25 (Development and Flood Risk).

1.4 THE SEQUENTIAL TEST

1.4.1 The Sequential Test as set out within Planning Policy Statement 25 aims to steer vulnerable development towards areas of lower flood risk; it is central to PPS25 and should be applied at all levels of the planning process. The Sequential Test should demonstrate whether there are sites available in areas at a lower probability of flooding. A key reason for the completion of the Level 1 study is to provide supporting evidence for SCDC and CCC to undertake this test.

1.5 THE EXCEPTION TEST

1.5.1 PPS25 expands on the Sequential Test by incorporating an Exception Test, whereby if following the Sequential Test it is not possible or consistent with wider sustainability objects, for the development to be located in zones of lower probability of flooding, the Exception Test can be applied. For the Exception Test to be passed it must be demonstrated that;

1) the development provides wider sustainability benefits to the community that outweigh flood risk, informed by an SFRA where one has been prepared.

2) the development should be on developable, previously developed land or if it is not on previously developed land, that there are no reasonably alternative sites that are on previously developed land; and

3) the Flood Risk Assessment must demonstrate that the development will be safe, without increasing flood risk elsewhere, and where possible, will reduce flood risk overall.

1.5.2 Any future Level 2 SFRA (if required), will need to provide supporting information for the Exception Test to be undertaken for potential development sites that fall within areas of medium to high flood risk. As highlighted in the East of England Regional Flood Risk Appraisal (2008);

"where local authorities have identified that it is necessary for development to be located in Flood Zones 2 and 3 then a more detailed Level 2 SFRA should be prepared."

1.6 NATIONAL PLANNING POLICY

1.6.1 Since 1988 the Government has been issuing national guidance in the form of Planning Policy Guidance Notes (PPG's). The Department for Communities and Local Government's (DCLG) Planning Policy Statement 25: Development and Flood Risk (PPS25), replaced PPG25 in December 2006. Paragraph 6 sets out that Local Planning Authorities (LPAs) should prepare and implement planning strategies that help to deliver sustainable development by:

Appraising Risk

- Identifying land at risk and the degree of risk of flooding from river, sea and other sources in their areas;
- Preparing Strategic Flood Risk Assessments as freestanding assessments that contribute to the Sustainability Appraisal of their plans;

Managing Risk

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

Reducing Risk

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

A Partnership Approach

- Working effectively with the EA, other operating authorities and other stakeholders to ensure 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.

1.6.2 The DCLG aims to reduce the risks to people and the developed and natural environment from flooding by discouraging further built development within floodplain areas and by promoting best practice for the control of surface water runoff.

1.6.3 As part of best practice and in line with EA guidance, SCDC and CCC have commissioned a Level 1 SFRA in an effort to define areas suitable for development from a flood risk perspective. This study also provides a reference and policy document to assist consideration of development proposals.

1.6.4 For the purposes of this SFRA, the study has been based upon PPS25 (March 2010) and the supporting Practice Guidance (December 2009).

1.7 REGIONAL AND LOCAL PLANNING POLICY

East of England Regional Flood Risk Appraisal

1.7.1 The overarching aim of the East of England Regional Flood Risk Appraisal (RFRA) was to inform the Regional Spatial Strategy of flood risk issues. The East of England Plan has now been revoked by the Government.

1.7.2 The RFRA (2008) used the results of broad scale assessments of flooding such as existing SFRAs and Catchment Flood Management Plans to provide an appraisal of strategically significant flood risk issues over the region. The RFRA provides Flood Risk mapping for the Cambridge area highlighting the extent of flood defences and the Flood Zone 3 outline for current scenario and the Flood Zone 2 outline for the future scenario.

1.7.3 The outputs provided in this Level 1 SFRA use the most up to date flood mapping outlines available thereby providing the most current understanding of fluvial flood risk within the study area.

1.8 LOCAL PLANNING CONTEXT

Cambridge City Council

1.8.1 Cambridge City Council's Local Development Framework includes the 'saved' policies of the Cambridge Local Plan (2006) and a number of Area Action Plans and Supplementary Planning Documents. For the latest position and contents of the LDF visit the Council's website: www.cambridge.gov.uk.

1.8.2 The City Council is currently in the process of preparing a Core Strategy. The Level 1 SFRA will contribute to the evidence base for the preparation of the Core Strategy and other development plan documents in terms of flood risk issues.

South Cambridgeshire District Council

1.8.3 The South Cambridgeshire District Council Local Development Framework, includes a Core Strategy (adopted in January 2007), Development Control Policies Development Plan Document (adopted in July 2007), as well as a number of Area Action Plans and Supplementary Planning Documents. For the latest position and contents of the LDF visit the Council's website: www.scambs.gov.uk/LDF.

1.8.4 The Level 1 SFRA will contribute to the evidence base for the review of existing and the preparation of new development plan documents.

1.9 GREAT OUSE CATCHMENT FLOOD MANAGEMENT PLAN

1.9.1 The EA has recently finalised the Catchment Flood Management Plan (CFMP) for the Great Ouse catchment; a large proportion of the study area falls within this catchment. This is a high level strategic plan that assess how flood risk might change and be sustainably managed over the next 100 years.

1.9.2 The overall aim and scope of the CFMP is to develop sustainable policies for managing increased flood risk in the long term that may result from climate change and changes in land use and land management. The key aims of the CFMP are set out below;

- reduce the risk of flooding and harm to people, the natural, historic and built environment caused by flooding, where it is economically, environmentally and technically viable to do so;
- increase opportunities to work with natural processes and to deliver multiple benefits from flood risk management, and to make an effective contribution to sustainable development;
- support the implementation of EU directives, the delivery of Government, local plans and other organisations policies and targets and our Environmental vision;
- promote sustainable flood risk management; and
- inform and support planning policies, land use plans and the implementation of the Water Framework Directive.

In order to achieve these aims and objectives, the final CFMP report will;

- present and improve an understanding of flood risk issues in the Great Ouse CFMP area following feedback on the Scoping Report and allow the EA to further analyse the flooding processes in the catchment;
- finalise the EA's future scenarios for the Great Ouse and assess possible changes in flood risk compared to current conditions;
- indentify the opportunities for, and constraints to, flood risk management that the EA have in the Great Ouse and finalise the overall CFMP objectives;
- allow the EA to select their preferred flood risk management policies for the Great Ouse through a policy appraisal process. This will involve assessing flood risk under different future scenarios with different management options, and assessing the potential effect of different options on the CFMP objectives;
- agree an action plan to manage flood risk in the Great Ouse and assign responsibility to the EA, other operating authorities, local authorities, water companies or other organisations.

1.9.3 The CFMP highlights the broad areas of the Great Ouse where the EA need to take specific actions; these are known as Policy Units (see Appendix A). For each Policy Unit the EA will define a specific policy for managing flood risk. The EA will implement policies by carrying out specific actions, and working with other organisations responsible for flood risk management. The six Policy Options (one of which is chosen for each Policy unit), are as follows;

- Policy Option 1- No active intervention (including flood warning and maintenance). Continue to monitor.
- Policy Option 2- Reduce existing flood risk management actions (accepting that flood risk will increase over time).
- Policy Option 3- Continue with existing or alternative actions to manage flood risk at the current level.
- Policy Option 4- Take further action to sustain current scale of flood risk into the future (responding to the potential increases in risk from urban development, land use change and climate change).
- Policy Option 5- Take further action to reduce flood risk (now and/or in the future).
- Policy Option 6- Take action with others to store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits, locally or elsewhere in the catchment (which may constitute an overall flood risk reduction, for example habitat inundation).

1.9.4 Within the CFMP the Great Ouse catchment is divided up into 25 different Policy Units (see Appendix A). Policy Unit 20 (Cambridge), Policy Unit 24 (The Fens) and Policy Unit 18 (Eastern Rivers) relate to the South Cambridgeshire District Council and Cambridge City Council study area.

1.9.5 Policy Unit 18 (Eastern Rivers) is a large and mostly rural policy unit and has experienced extensive flooding in the past. The main driver of increasing future flood risk is climate change which, together with the potential effects from future development, could increase peak flows by up to 20%.

1.9.6 For Policy Unit 18, Policy 3 (continue with existing or alternative actions to manage flood risk at the current level) was chosen. The reason why this policy was chosen is that it is the most pragmatic approach to managing flood risk across the area. It will allow each operating authority to exercise their powers to continue routine maintenance and carry out essential works on watercourses to benefit local communities. Selecting Policy 3 will also give operating authorities flexibility to use their local knowledge and experience to manage flooding either through existing or alternative actions.

1.9.7 Policy 3 has been selected as the current flood risk management responses are considered appropriate for the level of risk. The objectives which are met by this policy (1% AEP future flood impact compared to current baseline) are:

- to minimise flood related risks to the population (up to 950 more people at risk);
- to minimise risks to community facilities (one additional schools at risk);
- to minimise risks to critical infrastructure (one additional electricity substation, one additional telephone exchange, one additional sewage treatment works);
- to minimise community disruption from flooding (up to 396 more residential properties and 44 commercial properties at risk);
- manage flood risk to sites of cultural heritage and landscape (up to 2 more scheduled monuments and 39 listed buildings);
- to minimise economic impacts of flooding (increase of up to £4 million residential damages, £700k commercial damages and £355,790 agricultural damages).
- ensure future investment in the catchment is proportional to the risks (no change in level of investment);
- manage flood risk to habitat and species (no change to RAMSAR sites, but one more SSSI at risk);
- protect and improve hydromorphology and geomorphology in accordance with the objectives in the WFD (no change);
- protect and improve water quality in accordance with the objectives of the WFD (low level decrease).

1.9.8 Policy Unit 20 (Cambridge) is largely urban and is comprised of the city of Cambridge and the villages of Oakington, Histon, Impington, Girton, Milton, Granchester, Trumpington and Great Shelford. The River Cam runs through this unit. The CFMP highlights that Cambridge has an extensive history of flooding; fluvial flooding has been recorded in 1947, 1958, 1978 and 2001.

1.9.9 For Policy Unit 20, Policy 5 (take further action to reduce flood risk was chosen). The reason why this policy has been chosen is that it will focus flood risk management efforts in achieving significant risk reductions within the Cambridge Policy Unit. The CFMP states that there are high numbers of people and property in Cambridge at risk of flooding now and in the future. Within the policy unit for Cambridge, Policy 5 will allow present actions to control flood risk to be continued (channel maintenance and flood warning) and enhanced (the creation of new flood defences). The resulting future flood risk is then reduced below the current level.

1.9.10 Adopting Policy Option 5 supports economic, social and environmental sustainability. The current risks are considered too high, and the EA will prioritise their investment here to reduce these risks. The objectives which are met by this policy (1% AEP future flood impact compared to the current baseline) are:

- to minimise flood related risks to the population (574 less people);

- to minimise risk to critical infrastructure and community facilities (one additional school/college at risk, no critical infrastructure assets at risk);
- to minimise community disruption from flooding (up to 238 fewer residential properties at risk);
- manage flood risk to sites of cultural heritage and landscape (13 more listed buildings and one more scheduled monument);
- to minimise economic impacts of flooding (£6million less property damages);
- ensure future investment in the catchment is proportional to the risk (estimated £2.4million one off cost of works, as well as continued investment of £32,170 each year on our channel and asset maintenance activities delivering approximately £6million reduction in damages (current conditions) and £11.5 million reduction in damages when using the climate change figures for 2010);
- protect and improve the hydromorphology and geomorphology in accordance with the objectives in the WFD (no change from current baseline);
- protect and improve water quality in accordance with the objectives of the WFD (low level increase).

1.9.11 Policy Unit 24 (The Fens) comprises the flat, low lying fenland area of the catchment. The unit is rural with a low population density. The main risk to the Fens is from overtopping or breaching of embankments along high-level watercourses.

1.9.12 For Policy Unit 24, Policy 4 (take further action to sustain the current level of flood risk into the future) was chosen. Policy 4 has been adopted for the short term for this Policy Unit until the completion of flood risk management plans for the Fens have been undertaken. Given the size of the Policy Unit, the current level of flood risk is not relatively high compared to other areas of the catchment. As previously stated, the biggest risk to the Fens in the future is the overtopping of defences.

1.9.13 Adopting Policy 4 for the Fens will allow development of a flood risk management plan for the Fens to investigate how flood risk varies across the area and the best approach to manage this risk. The plan may highlight the need to carry out further work in some areas, while in others the EA may be able to continue with or reduce their flood risk management activities. The objectives which are met by this policy (1% AEP future fluvial flood impact and 0.5% AEP future tidal flood impact, compared to the current baseline) are;

- to minimise flood related risks to the population;
- to minimise risks to critical infrastructure;
- to minimise community disruption from flooding;
- manage flood risk to sites of cultural heritage and landscape;
- to minimise economic impacts of flooding;
- ensure future investment in the catchment is proportional to the risks;
- manage flood risk to habitat and species;
- protect and improve hydromorphology and geomorphology in accordance with the objectives in the WFD;
- protect and improve water quality in accordance with the objectives of the WFD.

1.9.14 The final approved Great Ouse CFMP provides a key strategic insight into the sustainable management of flood risk within the South Cambridgeshire District Council and Cambridge study area.

1.10 NORTH ESSEX CATCHMENT FLOOD MANAGEMENT PLAN

1.10.1 A small part of the study area (see Appendix A), falls within the North Essex Catchment Flood Management Plan. The CFMP gives an overview of flood risk in the study area, and sets out the EA's preferred plan for sustainable flood risk management over the next 50 to 100 years. The part of South Cambridgeshire District Council area which falls within the South Essex CFMP is located within the Blackwater and Chelmer, Upper Reaches and Coastal Streams Policy Unit.

1.10.2 Villages within SCDC that falls within this CFMP area are Carlton, Weston Green, Willingham Green, Carlton Green, Castle Camps and Olmstead Green. The CFMP should be referenced should these areas need to be assessed in greater detail in terms of flood risk and strategic planning/development issues.

2 Study Area

2.1 DESCRIPTION OF STUDY AREA

2.1.1 As previously stated, South Cambridgeshire District and Cambridge City cover approximately a quarter of the total area of Cambridgeshire. The River Cam flows in a south to north direction through the study area and runs through the centre of Cambridge; various tributaries to the Cam such as the River Rhee and the River Granta flow through the southern half of South Cambridgeshire District. The River Great Ouse is located to the north of South Cambridgeshire District and eventually flows into the Wash. Most of the internal drainage boards within the study area (Old West, Swaffham, Waterbeach, Swavesey,Willingham and Over) are located in the northern part of South Cambridgeshire District. The only exception is the Beds and Ivel IDB which maintains a water course in the eastern part of the study area close to Gamlingay (see Appendix B). The City of Cambridge is predominately urban and has a number of watercourses flowing through it such as Coldham's Brook and Hobson's Brook. South Cambridgeshire District is predominately rural and a number of its settlements such as Little Shelford, Great Shelford, Sawston, Duxford, Ickleton, Waterbeach and Linton are adjacent to the River Cam. Fenlands can be found in the northern part of the South Cambridgeshire District.

2.2 TOPOGRAPHY OF THE STUDY AREA

2.2.1 Both Districts are predominately low lying. For the purposes of the SFRA the study area can be divided into two distinct areas as described below;

- The northern and central part of the study area ranges in elevation from approximately 10mAOD to 25mAOD. The City of Cambridge is predominately low lying falling within the River Cam Floodplain. Levels range from between 6mAOD to 17mAOD. The Fenlands delineate the low lying ground in the northern part of the study area, whilst the River Cam and River Rhee catchment delineate the central low lying flood plain areas.
- Parts of the study area to the south, west and east of Cambridge range in elevation from approximately 43mAOD to 129mAOD.

2.3 DESCRIPTION OF DRAINAGE CATCHMENTS

2.3.1 There are two main drainage catchments within the study area, these are the Cam and the Ouse. The River Cam is a tributary of the Ouse and is the largest catchment in the study area. The north east corner of the study area falls within the River Ouse catchment.

RIVER GREAT OUSE

2.3.2 The north west corner of South Cambridgeshire falls within the catchment of the Great Ouse. The River flows through Huntingdon to the north of the South Cambridgeshire District, in a north easterly direction eventually flowing into the Wash at Kings Lynn. This river drains the Fenland area in the northern part of the study area. The Willingham and Over IDB and Swavesey IDB maintain the area of land that falls within this catchment. Swavesey Drain flows into this watercourse. The River Ouse is an EA Main River.

2.3.3 Swavesey IDB have raised concerns regarding the draw mark level along the Ouse set at Earith, which may have an impact in the Swavesey area on agricultural land during wetter spring or summer periods.

2.3.4 The EA have advised water levels in the Great Ouse are tidally influenced downstream of Brownshill Staunch; however, the study area is outside of the area at tidal flood risk.

RIVER CAM

2.3.5 The majority of the study area falls within the River Cam catchment; the catchment within the South Cambridgeshire District is predominantly rural. The City of Cambridge falls within the Cam catchment. The River Cam is a tributary of the River Ouse and converges with this watercourse north of the study area. The Rivers, Granta, Rhee and Bourne Brook are all tributaries of the River Cam. The Rivers Rhee and Bourne Brook rise in the west part of the study area and flow in an easterly direction. The River Granta rises to the east of Cambridge and flows into the River Cam in a westerly direction. The IDB's within the study area that maintain parts of the River Cam and its tributaries are Swaffham, Waterbeach and Old West. The River Cam is an EA Main River.

Cambridge City

2.3.6 The main watercourses that impact on Cambridge are the River Cam, Bin Brook, Cherry Hinton Brook, Coldham's Brook and Hobson's Brook. As previously mentioned the River Cam flows through the city centre (see Appendix B). Hobson's Brook downstream of Long Road is an artificial channel. The City Council is responsible for the overall management and maintenance of this watercourse.

2.4 ADMINISTRATIVE BOUNDARIES

Land Drainage/Flood Risk Management

2.4.1 The Environment Agency's (Anglian Region-Central Area) Office, covers the entire study area from their Brampton office. As previously mentioned, the six Internal Drainage Boards that cover the study area are, Old West, Swaffham, Waterbeach, Swavesey, Willingham and Over and Bedfordshire and Ivel.

2.4.2 There are an extensive network of award drains in the study area which are maintained by SCDC and CCC. Due to the number of channels, these have not been shown on the watercourses plan in Appendix B. Further information can be obtained from SCDC's Drainage Manager on Tel: 03450-450063 or Cambridge City Council's Drainage team on Tel: 01223-457000.

Sewerage

2.4.3 The South Cambridgeshire District Council and Cambridge City Council study area is within the Anglian Water Services Ltd administrative boundary. Cambridge Water provide potable water within the study area.

3 General Approach and Methodology

3.1 DATA SOURCES

3.1.1 Section 4 of this report fully describes the data that was considered in the assessment. In summary, the key sources of data include:

- Environment Agency publications and archive reports e.g. historic flooding records;
- Reports and studies by consultants;
- Hydraulic modelling data including the River Cam Catchment Flood Risk mapping (provided by the EA);
- LIDAR data;
- Flood extent data;
- Flood defence and key asset information;
- Archive and Internet research;
- Local knowledge;
- Local Plan and Local Development Framework policy documents.

3.2 APPROACH AND METHODOLOGY

3.2.1 This SFRA has been conducted in line with the DCLG's *Practice Guide Companion to PPS25* (Dec. 2009), PPS25-*Development and Flood Risk* (Mar. 2010) and SCDC and CCC Brief to Consultants (Feb. 2010), which has been developed in partnership with the EA.

3.2.2 This section outlines the purpose and deliverables associated with the Level 1 SFRA. These have been outlined below as set out in the Council's original brief:

- Address the South Cambridgeshire District Council and Cambridge City Council study area;
- Consider all known sources of flooding including, fluvial, surface water, ground water, sewers, other artificial sources and combination events;
- Identify and review all data sources available;
- Include maps of the flood risk zones as defined in PPS25, including the Functional Floodplain;
- Include climate change maps showing the impact of climate change on flood probability;
- Include flood defences and a 'with defence' scenario. Identify rapid inundation zones;
- Map flood extents and hazard areas in settlements where existing data is available;
- Include historic flood mapping;
- Collate information on previous surface water and ground water flood events from a range of sources;
- Identify existing areas covered by flood warning schemes;
- Provide guidance on the application of SuDS across the study area;

- Provide guidance on what should be addressed within site specific Flood Risk Assessments;
- Provide guidance on the application of the Sequential and Exception Test;
- Provide links to other related studies.

3.2.3 The SFRA seeks to provide a reference and policy document for SCDC and CCC to help to steer future development towards areas at low risk of flooding over the lifetime of the proposed developments. The SFRA pays regard to the future redevelopment of both greenfield and brownfield sites throughout the study area. The SFRA also seeks to set out general guidance on requirements for specific Flood Risk Assessments.

3.2.4 EA Flood Zone Maps illustrate the extent of the flooding and land at risk during the critical flood flows for the rivers and watercourses. These do not take into consideration the presence of defences. Areas covered by detailed hydraulic modelling and the EA's River Cam Catchment flood risk mapping have been used with the EA flood outlines to provide up to date flood risk maps of the entire study area. These can be found in Appendix D. These maps provide the basis for the Level 1 assessment.

3.3 POTENTIAL SOURCES OF FLOODING

3.3.1 The principal sources of flooding within the study area that have been focussed upon include:

- Fluvial (river) flooding resulting from 'out of bank' flows from rivers and watercourses;
- Groundwater flooding, including groundwater-fed watercourses;
- Sewer flooding;
- Localised surface water flooding, including from highway drainage; and
- Surface runoff/overland flow.

3.3.2 Fluvial flooding is the dominant source of flood risk within the study area and will clearly have the greatest influence upon sustainable land-use planning. Surface water flooding is also likely to be a key issue; reference should be made to the Cambridgeshire Surface Water Management Plan once it is issued.

3.3.3 Overtopping and breaching of flood defence structures (including flood storage and alleviation facilities), should be included as part of any Level 2 study (if required). This would relate to development areas that fall within Flood Zones 2 and 3. Where available, Hazard Mapping of breach locations has been provided (see Appendix D). The location of Reservoirs within the District has been provided in Appendix B.

3.3.4 There are no canals in the study area.

3.4 CLIMATE CHANGE

3.4.1 Annex B of PPS25 takes into account the impacts that climate change may have on flooding issues and sustainable development. PPS25 states that the nature of climate change at a regional level will vary. Projections for the UK predict a greater frequency of short duration, high intensity rainfall and more frequent periods of long-duration rainfall. Sea levels will continue to rise. Winters are predicted to become wetter in the UK by as much as 20% by the 2050s. Summer and autumn are predicted to become much drier. These effects will need to be incorporated into site specific Flood Risk Assessments (FRAs) (see FRA Toolkit in Appendix E). When assessing climate change, PPS25 encourages an integrated approach across various sectors such as land use, water resources and biodiversity.

3.4.2 SCDC have stated in the Sustainable Development section of their Design Guide (2010) that climate change should be mitigated against through the location, form and design of buildings.

3.4.3 Cambridge City Council's SuDS Design and Adoption Guide (2009), highlights that SuDS will become increasingly important to control surface water as rainfall increases because of climate change.

3.4.4 To help organisations (including local authorities) to assess their vulnerability to climate change, the Government established the UK Climate Impacts Programme (UKCIP). One of UKCIP's responsibilities is to produce predictions of future climate change in the UK. Climate change predictions may be revised as a result of UKCIP and this may result in the figures in Annex B of PPS25 being reviewed. Until any such revision, the figures from Annex B that are included in this Level 1 SFRA will remain applicable.

3.4.5 Where available, climate change outlines have been provided for the various watercourses within the study area (see Appendix D). At the site specific scale (within an FRA), climate change outlines should be taken into consideration in relation to the lifetime of a development which is typically 60 years for commercial and 100 years for residential. Extents for both defended and undefended scenarios have been provided. Adopting a precautionary approach, undefended scenarios are used within the context of planning decisions.

3.4.6 Table B.2 of PPS25 gives a direction on how impacts of climate change should be calculated and applied. The contents of Table B.2 from PPS25 are reproduced below:

Recommended national precautionary sensitivity ranges for peak rainfall intensities, peak river flows, offshore wind speeds and wave heights *(From Table B.2 of PPS25);*

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

Notes:

1. *Refer to Defra FCDPAG3 Economic Appraisal Supplementary Note to Operating Authorities – Climate Change Impacts. October 2006 for details of the derivation of this table.*
2. *For deriving peak rainfall, for example between 2025 and 2055, multiply the rainfall measurement (in mm/hour) by 10 per cent between 2055 and 2085 multiply the rainfall measurement by 20%. Therefore, if there is a 10mm/hour event, this would equate to 11mm/hour for the '2025-2055' period; and for the '2055-2085' period, this would equate to 12mm/hour. Other parameters in Table B.2 are treated similarly.*

3.4.7 The 1 in 100 year climate change outlines produced by detailed hydraulic modelling have been provided for the River Cam study area (Including Defences). Undefended climate change outlines have also been provided for the 1 in 100 year event along Longstanton Brook. Where no modelling data is available to assess the impact of the climate change factors, it is recommended that design flows used in hydraulic modelling (for the 1 in 100 and 1 in 20 year plus climate change events) have an additional 20% added. It is also recommended that 30% is added to rainfall intensity (see table B.2 of PPS25).

3.4.8 Where hydraulic modelled outlines do not provide the 1 in 100 year climate change extent, then a precautionary approach should be adopted whereby Flood Zone 2 should be taken as the 1 in 100 year plus climate change extent (see appendix D).

3.4.9 Climate change extents should be taken into consideration when making planning decisions at both the site specific and strategic level.

4 Level 1 Data Collection and Review

4.1 FLOOD ZONE MAPS

4.1.1 The EA publishes Flood Zone Maps (FZM), which show areas potentially deemed to be at risk of fluvial (river) flooding. The FZM have been produced using appropriate good quality mapping and modelling data, where available, supplemented with data derived from national generalised modelling and appropriate good quality local data which conform to the EA's acceptable criteria. The nationally generalised modelling utilises a Digital Terrain Model (DTM) which excludes the presence of man-made features such as flood defences and road and rail embankments. Fluvial flood zone outlines were produced using a 2D raster floodplain model (Jflow) and show the probability of flooding without the presence of defences.

4.1.2 Whilst the modelling methodology used to produce FZMs excludes the presence of flood defences, in order to ensure that the extent of the functional floodplain is delineated, the FZM also show the area of benefit provided by flood defences where they are present. They show areas deemed to be at risk of flooding for all watercourses with a catchment area greater than 3 km^2 in the UK.

4.1.3 Flood Zone Maps are updated periodically – typically every 3 months.

4.1.4 The probability or likelihood of flooding is described as the chance that a location will flood in any one year. This can either be expressed as a percentage or a ratio. It is important to note that if an area is classified as having a 1 in 100 year chance of flooding for example, it does not mean that if it floods one year it will definitely not flood for the next 99 years. In the same token, if it has flooded for 99 years it may not necessarily flood this year. A description of the different Flood Zones is provided below:

- **Flood Zone 1** is classified as land where the risk of flooding is less than 1 in 1000 years (i.e. less than 0.1% annual probability of occurring). It is classed as an area of ***'low probability'*** risk of fluvial flooding.
- **Flood Zone 2** is classified as land having between 1 in 100 and 1 in 1000 year annual probability of fluvial flooding (i.e. 1%-0.1% annual probability of occurring). It is classed as an area of ***'medium probability'*** risk of fluvial flooding.
- **Flood Zone 3a** is classified as land having a potential to flood for storm events greater than 1 in 20 year return period and up to 1 in 100 year annual probability (i.e. greater than 1% annual probability of occurring). It is classed as an area of ***'high probability'*** risk of fluvial flooding.
- **Flood Zone 3b** is classified as land having the potential to flood for storm events up to 1 in 20 year return period (i.e. 5% annual probability of occurring). It is classed as ***'functional floodplain'***.

4.1.5 FZM data illustrating EA Flood Zones 2 (shown in green) and Flood Zone 3 (shown in blue) have been provided by the EA (Anglian Region), in electronic format, for all of the main rivers and watercourses within the study area. These outlines have been shown in Appendix D where they are not superseded by detailed hydraulic modelling.

4.1.6 Across the study area, FZM data would generally appear to shadow the routes of the rivers and watercourses. However, off-setting of the EA's mapping layers was noted to the south and west of Little Wilbraham to the east of Cambridge. Outside of this area, there would appear to be no other obvious deficiencies in the graphical representation of flood risk areas. The FZM currently available for the study would appear to be fit for purpose.

4.1.7 Where possible, the EA's FZM outlines have been superseded with more detailed hydraulic modelling (where available) and the EA's River Cam Catchment Flood Risk Mapping (see Appendix D). Hydraulically modelled outlines are shown for a variety of defended and undefended return periods and are more accurate than the EA's FZM extents.

4.1.8 As previously stated, the EA will require undefended outlines to be used for the purposes of strategic and site specific planning decisions.

4.1.9 The River Cam mapping study has been combined (based on its extents), with the EA's FZM outlines along the following watercourses; tributaries to River Rhee (around Bassingbourn), River Mel (around Melbourn), River Cam (north of Whittlesford), tributary to Hobson's Brook (east of Trumpington) and the River Granta (east of Abington). The EA's outlines have also been combined with the Cam mapping study around Fulbourn and to the east of Fen Ditton and Horningsea. FZM outlines have also been combined with the Cam study mapping to the north of Waterbeach along the Cam.

4.1.10 Individual hydraulic models that have been combined with the EA's outlines are along the following watercourses; the River Ouse (Royal Haskoning 2001 and Atkins 2005), Longstanton Brook (Faber Maunsell 2006), Swavesey Drain (Royal Haskoning 2003) and Cottenham Lode (Halcrow 2003). This has been illustrated on the flood maps in Appendix D.

4.2 RIVER CAM CATCHMENT FLOOD RISK MAPPING

4.2.1 The Environment Agency have undertaken modelling and mapping of the River Cam catchment. This project has been managed by the EA's Central Area (Anglian Region). In addition to Flood Risk Mapping, the Cam mapping project also provides hazard mapping; this has been used in the SFRA where available (see Appendix D). This illustrates the spatial variation of depth, velocity and hazard rating across the floodplain. Climate change allowances as set out in PPS25 have been used. The Cam study is comprised of a variety of modelling techniques ranging from J-Flow through to 1D/2D hydrodynamic modelling. This has been discussed in greater detail in section 4.10.

4.3 RIVER OUSE CATCHMENT FLOOD RISK MAPPING

4.3.1 In addition to the River Cam study, the EA have also commissioned a study along the River Great Ouse, which is due to be issued in 2011. This project has also been managed by the EA's Central Area (Anglian Region), and is comprised of modelling and mapping of the entire catchment. Once this mapping information has been issued, then the individual hydraulic models (outside of the Cam study) and EA FZ2 and FZ3 outlines in the fenland area of the South Cambridgeshire District, will be replaced with the mapping provided in the Ouse study.

4.3.2 Specifically, this study is expected to replace the existing flood zone outlines along Longstanton Brook, Cottenham Lode, Swavesey Drain and the previous EA Flood Zone outlines for the River Great Ouse around Swavesey. It is also expected to replace the EA's Flood Zone 2 and 3 outlines along the Cam to the north of Waterbeach in the North Fen area.

4.4 STAKEHOLDER INFORMATION

South Cambridgeshire District Council

4.4.1 Information relating to the SFRA was sought from officers at SCDC; disciplines ranging from Planning through to Emergency Management were consulted.

Cambridge City Council

4.4.2 As with SCDC, information for the SFRA was sought from officers at CCC; disciplines ranging from Planning through to Emergency Management were consulted.

Environment Agency

4.4.3 Regular meetings have been held with various stakeholders including the EA, to establish contact and to set out a schedule of data requirements. Extensive liaison with the EA has ensued in order to obtain, or confirm the availability of, relevant data for the study. The EA have been provided with frequent updates, so as to keep them involved with the progress of completing the Level 1 SFRA.

Internal Drainage Boards

4.4.4 Information was obtained from the following Internal Drainage Boards (IDBs), which impacted on the study area; Ely Group of Drainage Boards (Waterbeach, Swaffham and Old West); Swavesey IDB, Bedfordshire and Ivel IDB and Willingham and Over IDB. The jurisdictions of each of these IDBs are illustrated in Appendix B.

4.4.5 The role of the drainage boards is to maintain a network of watercourses within the South Cambridgeshire District and to provide drainage. This responsibility is brought about through Acts of Parliament (Land Drainage Acts), to provide flood protection and water level management services. All drainage boards have the power to undertake works on any watercourse within its district, other than 'Main Rivers' which are maintained by the EA.

4.4.6 The Land Drainage Acts of 1991 and 1994 require IDBs to provide for;

- general supervision over all aspects of land drainage within its District;
- improving and maintaining the drainage system, including the operation of pumping stations;
- regulating activities in and alongside the drainage system, other than on those waterways designated as main river and under the EA's control;
- duties to conservation;
- raising income to support land drainage works.

Other Stakeholders

4.4.7 Cambridgeshire County Council and Cambridgeshire Horizons have also been involved in steering the study, providing links to the Cambridgeshire Flood Risk Management Partnership. Contact was made with the Clerks of the Parish Councils for numerous parishes, in order to obtain further historic and anecdotal information relating to significant flood events. Residents Associations were also contacted. Information received on historic flooding from Parish Councils and Residents Associations, has been collated and presented within Tables 4A and 4B (see Appendix C). Hobson's Conduit Trust was also consulted. Information was also provided by Anglian Water Services Ltd relating to sewage treatment works and historical flooding within the study area. Cambridgeshire County Council have also provided data on historical flooding.

4.4.8 Cambridge Water were unable to provide any relevant records on historical flooding within the study area.

Records Search

4.4.9 A variety of other data sources were investigated as part of the Level 1 study. These included:

- Parish Councils and Residents Associations;
- Water companies- Cambridge Water and Anglian Water Services Ltd;
- Internal Drainage Boards;
- Hydraulic modelling studies;
- Historical flooding reports;
- Hydrochronology Database;
- Website research;
- South Cambridgeshire District Council and Cambridge City Council Archive data.

4.5 HISTORIC FLOODING

Fluvial / Groundwater

4.5.1 Historic flooding information has principally been obtained from desk studies and archive research. These incidents have been broken down into the following categories; fluvial; ground water; pluvial (surface water flooding emanating directly from rainfall) and sewer flooding. Historic fluvial flooding locations have been shown graphically and are also tabulated (table 4A) in Appendix B. These locations are an approximation and are not linked to individual properties. Historical flood outlines for the River Cam and other watercourses within the study area have been obtained from SCDC and CCC and are provided in Appendix B.

4.5.2 Due to the complexity of coordinating and recording historical flooding data, the list in Appendix B is not completely comprehensive, and information may be added in the future. Additional data for the EA's October 2001 Survey and October 2001 flooded locations have also been provided in with the mapping in Appendix B.

4.5.3 Information relating to return periods of historic events is inherently subjective, largely anecdotal, and scarcely available. Negligible recorded flood level information has been established to date. Information relating to the 2001 flood survey/locations was provided by the EA (see Appendix B). Appendix B shows the historical outlines for 1947, 1968, 1978, 1981, 1993, 1998 and 2001. Historical flooding reports were also provided by the EA for these events.

Sewers

4.5.4 Historic flooding information for the majority of the study area has been obtained from a variety of different sources including the Highways Agency, Parish Councils and Anglian Water Services Ltd. In many cases differentiating the various sources of flooding for the same event at the same location is a difficult task, due to the lack of detailed data. Anecdotal information from various Parish Councils and Residents Associations has been vital in building up a comprehensive picture of sewer flooding issues.

4.5.5 Details of historic sewer flooding locations have been shown graphically and are also tabulated (table 4B) in Appendix B. As stated in PPS25, sewer flooding can occur when a system is overwhelmed by heavy rainfall, becomes blocked or is of inadequate capacity.

4.5.6 DG5 (Historical) sewer flooding records have been provided by Anglian Water Services Ltd. These flooding records take into consideration if flood water entered an individual property and what the estimated return period was for the event. Historic

sewer flooding information provided to us by Anglian Water Services Ltd did not provide details on the specific locations of the sewer flooding, due to the implications that this may have for the current property owners. This information has been provided in Appendix B.

4.5.7 Due to the complexity of recording and coordinating historical flooding data, Table 4B in Appendix B is not completely comprehensive, and information may be added in the future.

4.6 TOPOGRAPHICAL DATA

LiDAR Data

4.6.1 Light Detection and Ranging (**LiDAR**) is an airborne mapping technique which uses a laser to measure the distance between the aircraft and the ground. For the production of this report LiDAR data was only available for certain parts of the study area from the EA's Geomatics Group. Sufficient data was obtained for most of Cambridge and the large area of the northern part of the South Cambridgeshire District. Swathes of land around Bourne Brook, River Cam, River Rhee and the River Granta are also covered by LIDAR. This information is available to complement any Level 2 SFRA hydraulic modelling and flood mapping that may be conducted (if required).

4.6.2 The vertical tolerance of LiDAR data typically ranges from between +/- 0.25m. The LIDAR data provided by the EA has a 2m resolution using 1Km2 LIDAR tiles.

4.6.3 The Environment Agency have provided indicative Surface Water Flooding Maps (see Appendix B), showing areas that may be susceptible to surface water flooding. This mapping provides a general indication of areas which may be more likely to suffer from surface water flooding; these maps have been produced using a mixture of LIDAR data and cruder Digital Terrain Mapping (DTM) techniques. Further information on how this map can be used is provided in section 4.11.

Topographical Data

4.6.4 Ordnance Survey (OS) Mapping information provided on 1:50,000 and 1:10,000 scale OS maps for both Districts, was available in digital format. This has been used to describe the topography of the study area within Section 2.2. OS Mapping to a 1:10,000 scale has been provided in digital format.

4.7 WATER BODIES

4.7.1 Refer to the Watercourses Plan provided within Appendix B for details of Main Rivers, Ordinary Watercourses (including Awarded Watercourses) and IDB watercourses. As previously stated, there are no canals within the study area.

4.7.2 Based on information provided by the EA, there are six raised reservoirs within the District that would fall under the classification of the Reservoirs Act (1975) (see Appendix B).

4.7.3 The Flood and Water Management Act (2010) introduces an improved risk based approach to reservoir safety. This will reduce the burden on regulated reservoirs where people are not at risk and introduce regulation for reservoirs at risk which are currently outside of the system. The implications of this Act on reservoir safety should be reviewed in greater detail as part of any Level 2 SFRA that may need to be undertaken.

4.8 HYDRAULIC STRUCTURES AND DEFENCES

National Flood and Coastal Defence Database (NFCDD)

4.8.1 Details of hydraulic structures such as sluices and weirs etc, have been provided by the EA in GIS format for the study area (See Appendix C). A detailed list of all these structures is also provided with this appendix. Such features are designed to manage or stop the flow of water. It is important to note that the NFCDD is a live database produced and managed by the Environment Agency, and will be subject to future updates.

4.8.2 Structure and defences details from the EA's NFCDD records show a range of defences and structure arrangements throughout the study area. The EA define a structure as a control device in, or an entity which spans the watercourse.

4.8.3 Raised flood defences can be seen in the northern part (Fenland area) of the South Cambridgeshire District. An extensive network of raised flood banks can be seen along the River Great Ouse. Cambridge does not benefit from any significant raised defences. However, properties at Riverside in Cambridge are defended by a flood wall which has been designed with a level of protection up to the 1 in 100 year event. The design criteria for a flood defence can change over time due to updated hydrological information, for example, that would alter statistical predications. Under such circumstances, the design standard in some cases can reduce. This should be assessed in greater detail if a Level 2 SFRA is required.

4.8.4 Where required, detailed surveys of key hydraulic structures should be undertaken to supplement any future hydraulic modelling and hydraulic assessments.

4.9 FLOOD RISK MANAGEMENT ASSETS

Flood Alleviation Schemes

4.9.1 A range of flood defence arrangements and hydraulic structures are shown on the EA's National Flood and Coastal Defence Database (NFCDD) (see Appendix C).

Swavesey Drain Study

4.9.2 Swavesey is located in the north of the South Cambridgeshire District Council boundary between the villages of Fen Drayton and Over, to the north west of Cambridge City (see Appendix B).

4.9.3 Swavesey Standard of Protection report identifies the Swavesey Drain network as being defended to a greater than 1:150 year standard. The Swavesey Drain Network, as modelled for the Standard of Protection study consists of four watercourses; Uttons Drove Drain, Swavesey Drain, Church End Drain and Chain Dyke.

4.9.4 Uttons Drove Drain is at the upstream end of the network which is close to the village of Over; this feeds into the Swavesey Drain which then forms a tributary into the River Great Ouse outside the study area at Earith. The Swavesey Drain is itself tributaried by Chain Dyke and Church End Drain.

4.9.5 The report identifies the Bedford Level Corporation Bank (the defence on the River Great Ouse west of Over also known as the South Level Barrier Bank) as being well over the 1 in 100 year level'. This bank protects Over and Willingham Fen and Over Village north against flooding from the River Great Ouse.

4.9.6 There are also a series of embankments along the Swavesey Drain System from Ramper Road to the east of Swavesey up to Webbs Hole Sluice. At this point the drain discharges into the River Great Ouse (apart from at times when the sluice closes and the Drain becomes tide-locked during high levels in the river). These embankments are designed to contain Swavesey Drain Catchment flows only.

4.9.7 The major flood risk at Swavesey is from the River Great Ouse, where, to the north west of Swavesey, Middle Fen Floodbank along the River Great Ouse from the confluence of Covell's Drain to Webbs Hole Sluice currently only has a standard of protection of 1 in 8 years.

4.9.8 The Swavesey Standard of Protection report also indicates that Mare Fen at the North of Swavesey and West of Over, floods in return period events of 1:10 or greater.

Fen Drayton Lakes Study

4.9.9 The Fen Drayton Lakes improvement study was completed by Atkins for the Environment Agency in 2007, and looked at the flood mitigation options around Fen Drayton Lakes, which are located outside the study area to the north of Fen Drayton. However, these lakes provide a degree of flood protection to Swavesey and Fen Drayton which are inside the South Cambridgeshire District boundary.

4.9.10 This study was commissioned to provide a preliminary assessment for the potential flood alleviation/improvement options to Fen Drayton Lakes. We are not aware of any alleviation work occurring as a direct result of this study, to date.

Cottenham Lode Alleviation Study

4.9.11 This is a quasi 2D model constructed as a pre-feasibility study for a potential flood alleviation on the Cottenham Lode.

4.10 HYDRAULIC MODELS

4.10.1 The EA have confirmed that hydraulic modelling studies have been undertaken for the following watercourses. All of these models have provided various flood outlines for the Flood Risk Constraints Mapping provided in Appendix D:

Cam Catchment Study Models (JBA-2010)

4.10.2 This model is part of the latest updating of Planning Policy Statement 25 Flood Zone mapping being undertaken by the Environment Agency. This study covers the entire River Cam catchment through both the Cambridge City Council and South Cambridge District Council boundaries. This model is to represent the principal flood modelling for the region and will be supplemented by a similar model for the River Great Ouse catchment, scheduled for completion in 2011.

4.10.3 The Cam Catchment model covers all of Cambridge and most of the southwest, southeast and northeast quadrants of the South Cambridgeshire District Council boundary. The Great Ouse catchment model is expected to cover most of the remaining northwest part of the South Cambridgeshire District municipal boundary, west of Swavesey and Fen Drayton.

4.10.4 The Cam Catchment study was undertaken by JBA Consulting, using their JFlow software. The Lower Great Ouse study is being undertaken by Mott MacDonald.

4.10.5 JBA have augmented the JFlow outlines with ISIS-TUFlow models through 'sensitive' areas; namely, areas with flood defences and urban areas that could be at risk from flooding. ISIS-TUFlow is more accurate than JFlow in terms of flood flow routing and physically modelling defences and has been used where JFlow outlines would not be accurate enough.

4.10.6 The additional 1D-2D ISIS-TUFlow models are the Bin Brook Model, the Cam Urban Model and the Cam Lodes model. A further 2D only TUFLOW model was carried out for flood defence breaches through the Cam Lodes (see Appendix D). The locations and detail of all these individual models are discussed later in this section.

Cam Catchment - Overarching JFlow model (JBA – 2010)

4.10.7 The main Cam Catchment model was conducted in JFlow, this model reassessed the hydrology of the catchment and defined the Planning Policy Statement 25 (PPS 25) Flood Zones 1,2,3a and 3b.

4.10.8 The mapping for this model was primarily used for the large predominantly rural areas of the River Cam Catchment to the South of Cambridge.

4.10.9 The modelling also included hazard mapping for the 1:100 and 1:1000 year events both with and without climate change. The hazard mapping intervals are defined as per DEFRA FD2320/TR2 guidance (see Appendix E).

4.10.10 The JFlow modelling produced defended outlines for the 1:20 year, 1:100, 1:100 plus climate change and the 1:1000 year events on the River Cam. Undefended outlines were provided for the 1:100 and 1:1000 year events. These have been used in the SFRA.

Cam Catchment - Bin Brook Model (JBA- 2010)

4.10.11 The Bin Brook model is a 1D-2D ISIS-TUFlow model created by JBA for use in the Cam Catchment study. This model is for the Bin Brook which flows into Cambridge from the west before becoming a tributary of the River Cam at Jesus Green.

4.10.12 This model covered an array of defended return periods including 1:20, 1:100, 1:100 plus climate change and 1:1000 year events. Undefended outlines for the Bin Brook for the 1:100 and 1:1000 return periods were based on the overarching JFlow model.

Cam Catchment - Cam Urban Model (JBA- 2010)

4.10.13 This model is of the reach of the River Cam that flows through Cambridge. It forms part of JBA's modelling for the Cam Catchment study and is a 1D-2D ISIS-TUFlow model.

4.10.14 This model covered an array of defended return periods including, 1:20, 1:100, 1:100 plus climate change and 1:1000 year events. Undefended outlines for the Cam Urban Model for the 1:100 and 1:1000 year extents are based on the overarching JFlow model.

Cam Catchment – Cam Lodes Model (JBA- 2010)

4.10.15 This model is another part of the Cam Catchment Study and was conducted as a 1D-2D model in ISIS-TUFlow. This model looked at the defended reach of the River Cam as it flows northeast out of Cambridge from Baits Bite Lock to its confluence with the River Great Ouse. The River Cam through this reach is tributaried by several smaller watercourses known as the Cambridgeshire Lodes (Bottisham, Burwell, Reach and Swaffham Lodes). The River Cam also has defences on both sides protecting the lower lying Fenland along this reach.

4.10.16 This study examined the existing defended scenario looking at several return periods from 5 years to 1000 years including the 1:20, 1:100 and 1:100 plus climate change extents. Undefended outlines for the Cam Lodes Model for the 1:100 and 1:1000 year extents are based on the overarching JFlow model.

Cam Catchment – Cam Lodes Breach Model (JBA – 2010)

4.10.17 The Cam Lodes Breach model was another part of the Cam Catchment modelling (see Appendix D). This model mapped flood risk zones in the event of flood defence failures along the Cam, as it flows through the Cambridgeshire Lodes.

4.10.18 This model is complimentary to the Cam Lodes model, and utilises the results of the Cam Lodes model for the input hydrographs. This model is a full 2D model created in TUFlow, and was schematised as a set of six smaller models, each of a single isolated, defended area along the River Cam through the Lodes. A stage-time hydrograph was extracted from the ISIS-TUFlow model at each breach location and then put into the breach model at each breach point of the defences.

4.10.19 These models only looked at 1:100 and 1:1000 year events with and without climate change.

4.10.20 The breach scenarios modelled were for the closing of the breach at 36 hours after the initial failure and 3 days after the initial failure. The 36 hour scenarios, have been provided with this SFRA.

Longstanton Brook Model (Faber Maunsell- 2006)

4.10.21 A model of the Longstanton Brook was created by WSP as a 1D-ISIS model for use in a site specific Flood Risk Assessment. This model was audited by Faber Maunsell for the Environment Agency and was subsequently imported into Infoworks RS to create a quasi-2d model to include the floodplain.

4.10.22 This model produced 1:100 year return period and 1:100 year plus climate change events. The undefended outlines have been used in this SFRA.

Offord D'arcy to Earith model (Royal Haskoning- 2001)

4.10.23 This model was part of an earlier Environment Agency flood risk mapping along the Great Ouse. This model was constructed in 2001 using HEC-RAS 1D software for the main Great Ouse channel, the results of which were extended into the floodplain by means of projecting the 1D water level across LiDAR mapping. This model produced an undefended 1:100 year return period flood outline, which has been used in the flood zone mapping.

St Ives and the Hemmingford's Flood Alleviation Scheme model (Atkins 2005)

4.10.24 This model was constructed by Atkins in 2005 to assess the potential implementation and efficacy of the St. Ives and the Hemmingford's flood alleviation scheme following the Easter 1998 Floods and further flood events in Jan 2003. This model was constructed in MIKE11 as a quasi-2d model using LiDAR to map the floodplain storage. This model provided a 1:100 year defended and undefended outline for use in the flood zone mapping.

Swavesey Drain Standard of Protection Study (Royal Haskoning- 2003)

4.10.25 This model was constructed in 2003 by Royal Haskoning for the Swavesey Standard of Protection Study which is a flood alleviation scheme. The model is a quasi 2D model constructed in Isis, which extrapolated a 1D level across the floodplain extents. This model provided defended 1 in 100 and 1:25 year returns periods which has been illustrated in the flood zone mapping.

Cottenham Lode Flood Alleviation Model (Halcrow- 2003)

4.10.26 This model was constructed as a pre-feasibility study for potential flood alleviation on the Cottenham Lode. This is a quasi 2D model built using ISIS and LIDAR interrogated storage reservoirs on the floodplains. The model included the flood defences along the Cottenham Lode which are only present downstream of Cuckoo Bridge, which is due east of Longstanton. The embanked channel was assessed as being defended to less than a 1 in 50 year standard in the report.

4.10.27 This model was used to map the defended 1 in 20 year and 1 in 100 year return periods.

4.11 AREAS SUSCEPTIBLE TO SURFACE WATER FLOODING MAPS

4.11.1 The Environment Agency have provided surface water mapping for the study area which provide a 'crude' indication of the extents of surface water flooding (see Appendix B). The EA define a surface water flood event as one that results from rainfall generated by overland flow before the runoff enters any watercourse or sewer.

4.11.2 One of the key findings of the Pitt Review; "*Learning lessons from the 2007 floods."* was that the EA, supported by local authorities and water companies, should urgently identify areas that are at highest risk from surface water flooding. This surface water flood mapping is the first deliverable from the EA's national project set up to respond to this recommendation. The surface water flooding maps were originally produced as a preliminary output to provide Local Resilience Forums with an initial indication of areas that may be susceptible to surface water flooding.

4.11.3 It is expected that further improvements will be made to these maps that will refine these extents of surface water flooding. It is important to note that these maps should not be used to guide the site allocation process within the context of this Level 1 SFRA.

4.11.4 The intention of these maps is to act as a starting point to highlight areas where the potential for surface water flooding needs particular assessment and scrutiny.

4.11.5 The EA have highlighted that because of the way the maps have been produced and the fact that they are indicative, **the maps are not appropriate to act as the sole evidence for any specific planning decision at any scale without further supporting studies or evidence. Further guidance on their application to site specific planning applications is provided in the FRA toolkit in Appendix E.**

4.11.6 The maps provided in Appendix B, have been produced using a simplified method that excludes;

- Underground sewerage and drainage systems, and smaller over ground drainage systems;
- Buildings.

4.11.7 The mapping uses a single rainfall event; therefore it only provides a general indication of areas which may be more likely to suffer from surface water flooding. The map provides three bandings, indicating 'less' to 'more' susceptible areas prone to surface water flooding. The maps do not show the susceptibility of individual properties to surface water flooding.

4.11.8 Assessing and managing all forms of flooding to development is a key theme of PPS25. The Surface Water Management Plan that is currently being undertaken for Cambridge and the Flood Risk Management Plan for Cambridgeshire, will provide further insight into surface water flooding issues within the study area.

4.12 SEWERAGE INFRASTRUCTURE

Sewer Records

4.12.1 Sewer records and network plans for the region have not been acquired at this stage. These should be collected as part of any Level 2 study (if required) in order to view the extent and layout of the public sewerage network, and to assess the likely impact of future growth upon the sewerage system.

4.12.2 Anglian Water Services Ltd have stated that they maintain twenty five sewage treatment works in the study area.

4.12.3 See Appendix B for extent of sewer treatment works. Reference should be made to the emerging Phase 2 study of the Water Cycle Strategy, that is currently being undertaken for the major growth areas in and around Cambridge. This will cover issues relating to capacity at these works and planned levels of growth.

4.12.4 A comprehensive set of sewer records for the South Cambridgshire District and Cambridge can be viewed at SCDC and CCC's offices.

4.13 GEOLOGY, HYDROGEOLOGY & ENVIRONMENT

Geological Maps

4.13.1 British Geological Survey (BGS) maps were obtained for review during the Level 1 study as part of the initial SuDS infiltration feasibility assessment (see Appendix C).

4.13.2 The following BGS 1:50,000 Solid and Drift additions maps 204 (Biggleswade); 205 (Saffron Walden), 206 (Sudbury), 187 (Huntingdon), 188 (Cambridge) and 189 (Bury St Edmunds) have been consulted to give the geological summary of the site area.

4.13.3 The viability of SuDS has been assessed with reference to the surface geology, including both the superficial and outcropping bedrock geology. It should be noted that if deeper soakaways are required, the information presented within this document may not be representative of the geology at depth.

4.13.4 Where cohesive strata are noted, for example, Gault clay and West Melbury Marly Chalk, there is a low potential for soakaways. Where a predominately granular or fractured strata is noted, for example, Glacial Sand and Gravel, there is potential for soakaways. Where a variation in consistency is likely, for example the Alluvium or River Terrace Deposits, there is an uncertain potential for soakaway.

4.13.5 The River Terrace Deposits and Alluvium can be seen following the historical routes of the main watercourses within the study area such as the Cam, Granta, Rhee and the Ouse. These deposits have been classified as uncertain in relation to their infiltration potential, as (especially with the Alluvium), ground water is likely to be present.

4.13.6 Areas that have been classified as having a low suitability for infiltration SuDS techniques are comprised of the following geology; Peat, Glacial Till, Unfractured Marly Chalk, Clay and Mudstone. These geological sequences cover the central and northern parts of the study area. They are also found in the easterly part of the district around West Wratting.

4.13.7 Areas that have been classified as having a high potential for infiltration are predominately found in a band running in an east to west direction to the south of Cambridge. These formations are made up of the following geology; Sand, Gravel and Fractured Chalk with Marl seams. A small band running in an East to West direction around Cottenham, is also classified as having high infiltration potential.

4.13.8 The SuDs Infiltration Feasibility Plan provided in Appendix C should be referenced as well as the tables in Chapter 8 of this SFRA. It is imperative that site specific ground investigations are undertaken before that application of SuDs techniques are considered. Ground water levels should also be taken into consideration over a period of time, to reflect seasonal variations.

Source Protection Zone Maps

4.13.9 Source Protection Zones (SPZ's) relate to groundwater supplies used for drinking, and the risk of contamination through pollution. SPZs are defined around large and public potable groundwater abstraction sites. The EA classify them into three main zones; Zone 1 (Inner Protection Zone), Zone 2 (Outer Protection Zone), Zone 3 (Total Catchment) and Zone of Special Interest. Source Protection Zone boundaries and the location of licensed abstraction points have been provided in Appendix C.

4.13.10 The purpose of a SPZs is to provide additional protection to safeguard drinking water quality through constraining the proximity of an activity that may impact on drinking water abstraction.

4.13.11 The location of Source Protection Zones in the study area should be taken into consideration when assessing the application of SuDS techniques based on infiltration. The Source Protection Zone plan should be read in conjunction with the SuDS Infiltration Feasibility Plan in Appendix C. Policy NE/8 (Groundwater) of SCDC Development Control Policies, highlights the importance of maintaining ground water quality.

Contaminated Land Issues

4.13.12 Due to the ongoing release of new studies and data, together with the potentially sensitive nature of this type of information, it was deemed appropriate to assess SuDS feasibility independently of this data source. Land contamination in relation to SuDS infiltration feasibility should be assessed in greater detail as part of any planning application. In general, it is recommended that any development site being brought forward through the planning process, assess the feasibility of SuDS on a site by site basis taking into account underlying ground conditions and previous site uses.

4.14 FLOOD WARNING & EMERGENCY PLANNING

4.14.1 Within the SCDC and CCC study area, as elsewhere in England, the responsibility for flood warning rests primarily with the EA. The EA provides flood warnings for designated Flood Warning Flood Risk Areas (see Appendix C). Details of EA flood warning coverage zones are described later in this document. This information can also be viewed on the EA's website.

4.14.2 The aim of the South Cambridgeshire District Council Emergency Planning Manual (2010) is to detail the arrangements that are in place, which maybe required to be activated in times of Civil Emergency or Disaster. An incident of this type is defined as;

> *"A situation arising, with or without warning, causing or threatening death, injury or serious disruption to normal life, for numbers of people in excess of those which can be dealt with by the public services operating under normal conditions and requiring the special mobilisation and organisation of those services".*

4.14.3 The plan covers what to do in the event of extensive flooding.

4.14.4 The plan sets out the responsibilities of the Council in relation to Civil Protection. The Council's Emergency Management Function or 'District Emergency Management Team' (DEMT) is divided into five main areas of responsibility;

- Accommodation and Welfare;
- Works;
- Health;
- Support and Business Continuity;
- Communication and Information.

4.14.5 The main role of the DEMT is to;

- Evaluate incoming information normally received via the 'Emergency Operations Control Centre' (EOCC);
- Ensure adequate communication and liaison exists with the relevant Emergency Services and any other neighbouring Local Authorities who may be affected by the incident;
- Formulate plans and strategies to mitigate the effects of the emergency on the community and the environment as far as practicable;
- Task the relevant Council departments with the implementation of such plans and monitor the performance and effectiveness of the actions taken to restore normality as soon as possible.

4.14.6 Cambridge City Council also have an Emergency Planning team who are responsible for responding to major emergencies such as extensive flooding. In addition, CCC have an Activation and Major Emergency Response Plan (2009) which sets out arrangements for responding to emergencies such as flooding within Cambridge.

4.14.7 The broad aim of this plan is to set out procedures, which will enable CCC to respond in a coordinated and flexible manner to any such threat or incident. It also sets out procedures that will help CCC to return its services to normal in the quickest possible time and to mitigate the consequences.

4.14.8 The plan provides a framework within which those responsible can work together to achieve a successful outcome.

4.14.9 The plan states that the City Council is responsible for managing the local authority response, or where the scale of the incident overwhelms the Council's resources and the Council considers a County lead to be preferable. In these circumstances the County Council will coordinate the Local Authority response and will be the lead Council responder.

4.14.10 The overarching policy influence on both these local emergency plans is the government's Civil Contingencies Act (2004). This Act provides a single framework for civil protection in the UK which is capable of meeting the challenges of the 21st century.

4.14.11 An additional policy document that influences emergency management procedures within the study area is the Cambridgeshire Multi-Agency Flood Plan (2010).

4.14.12 The Cambridgeshire Multi-Agency Flood Plan aims to provide a coordinated response to the threat or incidence of flooding in Cambridgeshire. The objectives of this document are as follows;

- Document the coordinated response to a flood threat for the emergency services, local authorities and other partner agencies in Cambridgeshire;
- Define the responsibilities of the emergency services, local authorities and other partner agencies to flood warning alerts;

- Outline the arrangements that have been put in place to help mitigate and minimise the effects of a flooding incident.

4.14.13 The SCDC and CCC websites have a comprehensive section relating to Emergency planning and flooding. Detailed information is provided on topics relating to flood warnings, flood prevention and emergency contact numbers. It is recommended that this is reviewed by all residents living in flood risk areas. Both these websites are listed below;

Cambridge City Council:

http://www.cambridge.gov.uk/ccm/content/community-and-living/community-safety/emergency-planning/planning-for-flooding.en

South Cambridgeshire District Council:

http://www.scambs.gov.uk/PolicingAndPublicSafety/EmergencyPlanning/flooding.htm

4.14.14 Further considerations in relation to flooding and Emergency Planning should be taken into consideration at a more detailed level as part of a Stage 2 SFRA (if required).

4.15 MAJOR GROWTH SITES

4.15.1 Appendix A illustrates the already approved major growth sites included in existing development plans within the study area; Northstowe, Cambourne, Cambridge University Site, National Institute of Agricultural Biology (NIAB) Cambridge City and South Cambridgeshire, Orchard Park, Cambridge East (North of Newmarket Road, Cambridge Airport and North of Cherry Hinton), Southern Fringe (Bell School, Clay Farm, Glebe Farm and Trumpington Meadows) and Addenbrooke's Biomedical Research Campus. These developments have been tested through the plan making process. They have been addressed in detail through the Cambridge Area Water Cycle Strategy, and most have already been subject to site specific FRAs by developers. This information is not duplicated in this Level 1 SFRA. Some of these sites are discussed in greater detail below:

Cambourne

4.15.2 The Cambourne development has been developed by the Cambourne Consortium of developers. The development currently consists of approximately 3,300 dwellings. A further application has been made for an additional 950 units and is generally referred to as the Cambourne Enhanced Development.

4.15.3 The existing Cambourne development is experiencing some foul sewer flooding events local to the downstream end of the foul water network at School Lane, where the system is pumped to Uttons Drove sewage treatment works (see Appendix B). This failure of the foul network has been identified by Anglian Water Services Ltd and the developers as being primarily due to the ingress of surface water into the foul water network. Anglian Water Services Ltd and the developers have prepared a strategy for remediation works and the matter is currently being addressed.

Northstowe

4.15.4 Northstowe is a proposed major development for a new town to the north of Cambridge. The Northstowe Area Action Plan, adopted in July 2007, identifies the site for a sustainable new town with a target size of 10,000 dwellings and associated development as well as the off-site infrastructure needed to deliver and serve the town.

4.15.5 Northstowe has been identified as an 'eco-town' and will be required to achieve a high level of sustainability, in line with Planning Policy Statement: Eco-towns- A supplement to Planning Policy Statement 1.

4.15.6 The development will look to link its foul sewerage to the Uttons Drove sewage treatment works.

Uttons Drove Drain Network and Sewage Treatment Works

4.15.7 The Uttons Drove network of drainage channels is located to the north east of Cambridge, and flows broadly south to north, from the A14 at the north of Bar Hill in a corridor between Longstanton, Swavesey and Over. The network outfalls into the River Great Ouse south of Bluntisham, outside the north boundary of the study area.

4.15.8 The drainage network is formed of three drains; Chain Dyke, which forms the downstream section to the outfall to the River Great Ouse, the central Swavesey Drain and the Uttons Drove Drain which is the upstream reach adjacent to the Uttons Drove Sewage Treatment Works (STW). This drainage network is part of the Swavesey Internal Drainage board. The Uttons Drove Drainage system outfalls into the River Great Ouse.

4.15.9 This area served by Uttons Drove STW has been identified as a growth area in the Local Development Framework and has seen new development in recent years such as at Cambourne, with more development expected in the medium to long term such as at Northstowe. The Uttons Drove sewage treatment works, which discharges into the Uttons Drove drain, was identified by Anglian Water as the treatment facility best suited for improvement in order to receive the increased effluent associated with any new development in this area.

4.15.10 It was considered by both the Environment Agency and Swavesey Internal Drainage Board (IDB) that the existing final treated effluent discharge into Uttons Drove drain from the treatment works, was causing significant erosion and deposition in the channel. This was having a detrimental effect on the conveyance of the channel and increased the flood risk in these channels. This flood risk would be exacerbated by the increase in discharge from new development, unless appropriate remediation work was undertaken.

4.15.11 Following recent discussions between key parties (Gallaghers, the Homes and Communities Agency, the Cambourne Consortium, the Environment Agency, local authorities and Cambridgeshire Horizons), a solution for the various issues at Uttons Drove has been agreed. This will involve a full in-channel scheme and upgrading of the existing pump, provisionally, that will allow effluent from 2,000 new homes to be accommodated. This will provide sufficient capacity for 950 new houses at Cambourne and an additional 1,050 in other areas.

4.15.12 The costs of the works will be funded by Anglian Water Services Ltd and the Cambourne Consortium. It is intended that a replacement pump will be installed in the winter of 2010 and channel works on Uttons Drove will be carried out in the summer of 2011. Future development (above a further 2000 dwellings) will trigger the need for additional works.

4.16 REVIEW OF DATA

Limitations of the Level 1 Study

4.16.1 This Level 1 report provides a review of baseline information collected to carry out the SFRA. A general assessment has been made of the principal sources of flood risk associated with the study area as set out in the SFRA brief (2010). The potential effects of climate change have been assessed.

4.16.2 Further detailed information is required on the extent of flood defences within the districts. This may be undertaken for specific development areas as part of a Level 2 SFRA (if required).

4.16.3 WSP are of the view that the necessary level of data has been provided within the Level 1 SFRA for SCDC and CCC to undertake the Sequential Test.

4.16.4 The hydraulic modelling outlines along the River Cam, Bin Brook, Swavesey Drain, Longstanton Brook, River Ouse and Cottenham Lodes have been combined with the EA's flood outlines to produce flood risk and flood hazard maps (where available) within Appendix D. Flood outlines indicating the climate change extent and functional flood plain, have also been provided where possible.

4.16.5 The existing hydraulic modelling undertaken for the River Cam study that has not been completed using ISIS/TUFLOW software, needs refinement for any development sites that are allocated in Flood Zones 2 and 3. This would fall within the remit of a Level 2 SFRA (if required).

4.16.6 Hydraulic modelling should also be undertaken around Gamlingay, West Wratting and areas to the north and east of Fulbourn; this will provide a clearer understanding of the detailed nature of fluvial flood risk. This has been set out within the list of recommendations in Section 11.

5 Sources of Flooding

5.1 OVERVIEW

5.1.1 The SFRA gives, as its name implies, a strategic overview of flood risk in the South Cambridgeshire and Cambridge City Districts. It should be noted that:

- this SFRA reflects current national planning policies and guidance at the time of writing;
- policies may change; and
- flood levels / flood zone classifications may change.

5.2 DATA SOURCES

5.2.1 Through detailed data collection and analysis, it is concluded that a sufficient amount of information has been gathered to complete the Level 1 SFRA.

Hydraulic modelling

5.2.2 Hydraulic models (as described earlier in section 4) have been provided by the EA.

5.2.3 Assessments of the flood risks associated with the main river and ordinary watercourse networks within the study area, have been based principally on a combination of available modelled flood extents (based on various return periods) and the EA's FZM. The hydraulic modelling outlines have been combined with the EA's flood zone outlines and are shown in Appendix D.

5.2.4 It is important to note that the EA's Lower Great Ouse Catchment Flood Risk and Mapping project is due to be issued in 2011. This will replace many of the existing flood outlines shown in the fenland area (i.e. area to the north of Cambridge), of the South Cambridgeshire District.

5.2.5 Where detailed hydraulic modelling has been undertaken, the flood outlines provided by the EA have been replaced. EA J-Flow modelling software (as shown on the EA's website), has a lower level of accuracy than detailed hydraulic modelling. EA flood outlines using J-Flow cover areas where no detailed hydraulic modelling has been completed. However, the EA's flood outlines in the study area are sometimes based on detailed hydraulic modelling. This is the case for the Flood Zone 3 outline along Cottenham Lode both upstream and downstream of Cuckoo Bridge; under these circumstances the EA's outline remains. This also applies to Flood Zones 2 and 3 to the north of Over and Willingham.

5.2.6 The EA have also advised that parts of the Flood Zone 3b outline, relating to defended areas along the Cottenham Lode, are based on historic data with flood levels projected beyond the defences and onto the low level land. This is overly conservative and is due to be remodelled.

5.2.7 The EA's Cam study (2010), produced by JBA is a refined J-Flow output for areas outside of Cambridge and the Cambridge Lodes (River Cam north of Cambridge). The Cam Urban, Cam Lodes and Bin Brook model have been produced using ISIS and TUFLOW software which has a higher level of accuracy as a 1D/2D model. Flood Hazard mapping has only been provided for areas along the Cam and Bin Brook (Cambridge) that have been modelled using ISIS/TUFLOW software.

5.2.8 Flood Zone maps show areas potentially deemed to be at risk from fluvial (river) flooding and provide the extent for various return periods.

5.2.9 Flood Hazard maps take into consideration the velocity and depth of flood water for a various return period, and link this as a hazard to people based on (Defra guidance FD2320/TR2-Extended version). This table has been provided in Appendix E; this relates to Low (Very low hazard-caution), Moderate (Danger for some-including children, the elderly and the infirm), Significant (Danger for most-including the general public) and Extreme (Danger for all-including the emergency services) levels of risk shown on these plans. The potential for debris in flood water is also taken into consideration within these hazard ratings. An area not covered by Flood Hazard mapping, does not mean that there is no hazard in that area.

5.2.10 Flood Risk and Flood Hazard maps, in combination allow a detailed assessment to be made in terms of sustainable development and fluvial flood risk (see Appendix D).

5.2.11 It is important to take flood hazard mapping extents (where available), into consideration when considering emergency planning issues.

Flood Alleviation Schemes

5.2.12 The Swavesey Drain Flood Alleviation Scheme has been discussed in section 4.9 along with the Fen Drayton Lakes Improvement study and Cottenham Lode Flood Alleviation study. These are all pre-feasibility studies.

5.2.13 Accoring to the EA, any improvements to Swavesey Drain and Uttons Drove Drain as a result of development at Cambourne (see section 4.15) and Northstowe, will improve the situation with regards to maintaining channel defence standards in this area. Any future upgrades in the capacity of Uttons Drove Sewage Treatment Works will also assist in alleviating flooding.

5.2.14 The EA have advised that investigations undertaken along Bin Brook determined that no viable flood defence scheme could be implemented.

5.2.15 The EA have also advised that a flood defence scheme for Oakington, is still a long term aspiration of the Environment Agency, however the viability of any such scheme will be dependent on the development proposals for Northstowe.

5.2.16 The Old West IDB were unable to provide any further information on the Cottenham Lode Flood alleviation Schemes.

Hydraulic Structures

5.2.17 Information on hydraulic structures throughout the study area has been provided by the EA (see Appendix C). The potential for hydraulic structures to block or fail causing flooding to upstream or downstream areas should be assessed in greater detail as part of any Level 2 study (if required).

Sewer Infrastructure

5.2.18 Details of flooding from the sewerage systems were obtained from Anglian Water Services Ltd and other sources. This has been provided in table 4b and shown on the historical flood maps in Appendix B.

5.2.19 Anglian Water Services Ltd maintain 25 sewage treatment works within the study area. Details relating to discharge consent and scope for expansion of local sewage treatment works (in relation to the development of specific sites), should be assessed in greater detail as part of any Level 2 SFRA (if required).

5.3 GROUNDWATER

5.3.1 Information on groundwater flooding was provided by the EA relating to the following locations; Fowlmere Nature Reserve; Cambridge and Barrington. These incidents are shown on the historical flood map in Appendix B. Groundwater flooding is a material consideration which should be taken into consideration as part of a site specific

FRA. Ground water levels should be taken into consideration over a period of time, to reflect seasonal variations.

5.3.2 Additional anecdotal information was provided by Parish Councils and other sources; this has been provided in the historical flooding record tables in Appendix B. Historical groundwater flooding events as highlighted in the tables have occurred at the following locations; Barrington, Bassingbourn, south east Cambridge, Fulbourn, Great Eversden, Little Eversden, Madingley, Stow Cum Quy, Thriplow and Waterbeach. The EA have stated the groundwater flooding is often confused with poor surface water drainage, therefore they cannot guarantee the source of water in any groundwater flooding records that they hold.

5.3.3 The EA have also stated that in 1998 and 2001 their borehole hydrographs confirmed that ground water levels were exceptionally high within the chalk formations of the study area. Information on these levels was not available.

5.3.4 SCDC have advised that due to a reduction in groundwater abstraction in the area, water table levels have begun to rise above the surface around Shepreth and Fowlmere in the south of the South Cambridgeshire District. This however, has not caused any issues in terms of flooding to properties.

5.4 OTHER SOURCES

5.4.1 Potential sources of flood risk from overland flow, sewers and water mains would need to be assessed by developers at the planning stage as part of a site specific Flood Risk Assessment. For the purposes of a strategic level study, incidents of pluvial and sewer flooding have been provided in Tables 4A and 4B and graphically illustrated in Appendix B. Reference should also be made to the EA's surface water flood risk maps provided in Appendix B.

5.4.2 The ability for individual developments to increase flood risk to off site areas should be assessed at a site specific FRA level.

5.4.3 Based on the principles of SuDS, greenfield development will be required to manage surface water runoff in a sustainable way so as to mimic the existing (pre-development) situation. Development on brownfield land, will be required to manage surface water runoff mimicking the existing situation or providing a reduction in runoff rates (betterment). These measures reduce the level of flood risk to the site and to off site areas.

5.4.4 The clustering of sewer flooding incidents in Elsworth, Papworth Everard, Longstanton, Willingham, Bassingbourn, Fowlmere, Rampton, Kneesworth and Comberton may be as a result of capacity issues. However, this is difficult to establish without more detailed records of these events. The records provided in table 4B (Appendix B) indicate that sewer flooding is also an issue in Cambridge.

5.4.5 Records relating to pluvial flooding are difficult to record, as they are often combined with flooding relating to surface water runoff from other sources.

5.4.6 As illustrated in table 4A (Appendix B), pluvial (surface water) flooding events are noted in several locations throughout the study area including Cambridge. The effects of pluvial flooding tend to be localised and can be reduced at a site specific level by the correct application of SuDS. Surface water sewer networks that are blocked or do not have the necessary capacity, can exacerbate this problem. Research findings on the impacts of overland flooding are continuously being produced. It is imperative that the risks of pluvial flooding are taken into consideration at the early stages of future land use planning decisions. The Cambridge Surface Water Management Plan (SWMP) and Flood Risk Management Plan for Cambridge (5.6) will be key in assessing these issues in greater detail.

5.5 FLOOD AND WATER MANAGEMENT ACT

5.5.1 The Governments Flood and Water Management Act (2010), provides a better and more comprehensive management of flood risk for people, homes and business.

5.5.2 The Act sets out local flood risk management strategies for England and defines the lead local authority for an area as the Unitary Council or County Council.

" A lead local flood authority for an area in England must develop, maintain, apply and monitor a strategy for local flood risk management in its area ('a local flood risk management strategy')."

5.5.3 The lead local authority will be responsible for ensuring the strategy is put in place however local partners can agree how to develop it in a way that suits them best. Local flood risk as quoted above, takes into consideration all forms of flooding and includes surface runoff, groundwater and ordinary watercourses (including lakes and ponds).

5.5.4 Local authorities will need to consider the full range of measures consistent with a risk management approach in developing their local flood risk strategy. Resilience and other approaches which minimise the impact of flooding are expected to be a key aspect of the measures proposed.

5.5.5 To ensure greater co-ordination of information and avoid situations where bodies do not accept responsibility, the lead local flood authority will;

- investigate flooding incidents in its area (where appropriate or necessary) to identify which authorities have relevant flood risk management functions and what they have done or intend to do. The lead local authority will then be required to publish the results of any investigation, and notify any relevant authorities;
- maintain a register of structures or features which they consider have a significant effect on flood risk in the area, at a minimum recording ownership and state of repair. The register must be available for inspection and the Secretary of State will be able to make regulations about the content of the register and records.

5.5.6 In addition to the Flood and Water Management Act, the Flood Risk Regulations (2009) have been made to implement the Floods Directive in England and Wales. These regulations outline the roles and responsibilities of the various authorities consistent with the Flood and Water Management Act. It is envisaged that initially the local and national strategies (which will coordinate Catchment Flood Management Plans, Shoreline Management Plans and Surface Water Management Plans), will help to shape the work to be done on the Floods Directive outputs.

5.6 SURFACE WATER MANAGEMENT PLANS

5.6.1 As defined by DEFRA, a SWMP is a framework through which key local partners with responsibility for surface water drainage in their area, work together to understand the cause of surface water flooding, and agree the most cost effective way of managing surface water flood risk. The overall purpose of a SWMP is to make sustainable urban surface water management decisions that are evidence based, risk based, future proofed and inclusive of stakeholder views and preferences.

5.6.2 PPS25 Practice Guidance states that a SWMP should allow Local Planning Authorities to;

- Undertake a comprehensive assessment of surface water flooding as part of their SFRA and predict where it could happen;
- Make informed land use planning decisions on the basis of such an assessment;
- Clarify responsibilities and co-ordinate investment in drainage systems to manage the risk more effectively and with greater use of sustainable drainage systems;

- Improve emergency plans for surface water flooding; this approach is pro-active and risk-based, and therefore delivers resources where they are most needed.

5.6.3 The Flood Risk Management Plans for Cambridgeshire will outline the preferred flood risk management strategy for the County, taking into account areas at significant risk of flooding. The Environment Agency will be responsible for fluvial flood risk and the County Council, as lead local flood authority, will be responsible for surface water flooding. In this context surface water flooding covers flooding from sewers, drains, groundwater and run off from land, small water courses and ditches that occur as a result of heavy rainfall. The Flood Risk Management Plan for Cambridgeshire will be undertaken in three phases.

5.6.4 The first phase (Preliminary Flood Risk Assessment) to be undertaken between Sep. 2010 and Feb. 2011, will identify flooding 'wet spots' within the County; they will also provide a prioritised list based on significant risk. Subsequent phases will involve detailed assessments of some of these 'wet spots' and the creation of individual management plans to mitigate potential risk. This SFRA will form part of the evidence base for Flood Risk Management Plans for Cambridgeshire.

5.6.5 The Surface Water Management Plan for Cambridge and Milton will be undertaken between Sep.2010 and Feb.2011. This study will assess the risk posed by surface water flooding within the study area, by firstly identifying the areas with the highest risk of surface water flooding. These areas will be subject to a detailed assessment; stakeholder options will be proposed to mitigate the flood risk.

6 Assessment of the Impact of Climate Change

6.1.1 No specific allowance for climate change is currently incorporated within the information illustrated in the EA Flood Zone Maps, shown on their web-site. Hydraulically modelled climate change extents for the 1 in 100 year event have been provided for Longstanton Brook, Bin Brook, Cambridge and Lodes and the wider Cam study area (see Appendix D). Climate Change scenarios have also been shown for the breach Hazard Mapping.

6.1.2 PPS25 recommends a precautionary approach that involves allowance for specific and quantified climate change factors based on currently available evidence. This approach is particularly relevant where a development site could result with multiple landowners as in the case of a residential development.

6.1.3 As mentioned in section 2.3, the tidal effects of the Ouse do not impact on the study area. .

6.1.4 PPS25 (Annex B- table B.2) (see 3.4.6), provides indicative sensitivity ranges for different parameters affecting the likely severity of projected flooding.

6.1.5 This Level 1 SFRA should be used to assist SCDC and CCC in performing the Sequential Test to steer development towards sites of least flood risk (Flood Zone 1). Where available, climate change extents have been taken into consideration.

6.1.6 Any detailed flood modelling and mapping to be undertaken as part of any Level 2 SFRA (if required) or site specific FRA, will need to account for climate change over the expected lifetime of the development. Residential development is typically expected to have a lifetime of 100 years and commercial development a lifetime of 60 years.

6.1.7 Hydraulically modelled climate change outlines will illustrate where potential sites fall within these extents. Where doubt remains, a precautionary approach should be taken whereby the extent of Flood Zone 2 should be taken as being the extent of the 1 in 100 year outline incorporating climate change.

6.1.8 The Pitt Review: Lessons learned from the 2007 floods (2008) recommended, that priority should be given to both adaptation and mitigation, when coping with the effects of climate change. Climate change should be taken into consideration and mitigated against within any new development proposals.

6.1.9 The Flood and Water Management Act (2010), highlights that the Environment Agency must develop, maintain, apply and monitor a strategy for flood and coastal erosion risk management in England. The Act highlights that the strategy must specify, the current and predicted impact of climate change on flood and coastal erosion risk management.

7 Flood Management Areas

7.1 STANDARD OF PROTECTION OF FLOOD DEFENCES

7.1.1 Further investigations (as part of a site specific FRA or Level 2 SFRA) are required in consultation with the EA, to confirm the Standard of Protection (SoP) provided by their flood risk management defences. This also relates to any information they have regarding key third party defences. According to the NFCDD database, the majority of defences within the study area are 'soft' and come in the form of earth embankments; these can predominately be found in the Fenland areas to the north of Cambridge. The River Ouse mapping study, should assist in providing further clarification on the current level of defence in this area, with modelled outlines that take into consideration the extent of these defences. According to the Great Ouse CFMP flooding in the Fenlands is usually restricted to low lying agricultural land or from the threat of the potential failure of defences. The Hydraulic Structures and Defences plan provides the various defences levels throughout the study area where available (see Appendix C).

7.1.2 According to the NFCDD (see Appendix C), in some places the standard of protection along the defences is only adequate to protect against the 1 in 5 year event. Areas benefiting from raised defences are illustrated in the hydraulic structures and defences plans provided in Appendix C.

7.1.3 According to the Great Ouse CFMP, choosing Policy Option 5 for Policy Unit 20 (Cambridge), allows the option to create new flood defences within the highest risk areas. These defences would have 1% AEP standard of defence. Areas identified that would benefit from defences are Bin Brook around Lynfield Lane and Newton Road along Hobson's Brook.

7.1.4 The Great Ouse CFMP also highlights that for Policy Unit 24 (Fens), choosing Policy 4 makes the assumption the flood defences in this area will be improved in the future.

7.1.5 Advice should be sought from the EA regarding their projected future Flood Risk Management investment plans, for the provision of new or improvements to existing flood defences. Reference should be made to the most recent Catchment Flood Management Plan for the area of interest. This process should continue throughout the life of the SFRA document to ensure that all changes to the Standard of Protection against flooding, are taken into account when assessing potential development.

Maintenance Programmes

7.1.6 The EA are responsible for maintaining their Main Rivers and flood defences on a regular basis; this assists in reducing the level of flooding to an area. The EA's ongoing river maintenance programmes for the study area, can be found at the following weblink;

http://www.environment-agency.gov.uk/homeandleisure/floods/112688.aspx

7.1.7 Much of the maintenance of river channels involves weed control and the upkeep of grass embankments. Cumulatively, these measures assist in reducing the level of flood risk. Maintenance programmes should be taken into consideration when assessing the overall level of defence provided by 'engineered' channels.

7.2 TRANSPORT INFRASTRUCTURE

7.2.1 Engineered earth embankments relating to highways and railways etc. within the study area, would provide a degree of protection to areas against flooding. These embankments act as a barrier to the passage of flood waters in extreme events or in the event of a breach to a major flood defence. The degree of protection that these 'de facto' defences provide needs to be determined. Existing hydraulic models/studies should be assessed to extract information wherever possible as part of any Level 2 study (if required). A detailed analysis of the EA's NFCDD database should be undertaken during any Level 2 study (if required), to extract all available information.

7.2.2 The function, performance and integrity of any flood risk protection provided by transport infrastructure, should also be assessed by developers at the planning stage, as part of a site specific Flood Risk Assessment.

7.3 FLOOD ALLEVIATION SCHEMES

7.3.1 These have been discussed in sections 4.9 and 5.2. Flood Alleviation Schemes should be assessed in greater detail as part of any Level 2 study (if required).

7.4 FLOOD WARNING AND EVACUATION

7.4.1 Within South Cambridgeshire and Cambridge, as elsewhere in England, the responsibility for flood warning rests primarily with the EA. The EA provides flood warnings for designated Flood Warning Flood Risk Areas across the study area; these warnings only cover fluvial flooding. Primarily the EA issue flood warnings by loudhailer, telephone and emergency officers on the ground. Further information can be obtained from the EA's Floodline telephone number: 0845 988 1188.

7.4.2 The following table provides a summary of the Flood Warning Catchment Areas in the vicinity of the River Ouse, Cam and Rhee;

EA Region	River	South Cambridgeshire District Towns & Villages and Cambridge
Anglian Region	River Cam from Gt Chesterford to Hauxton	Ickleton, Hinxton, Duxford, Whittlesford, Pampisford, Sawston, Lt.Shelford, Gt.Shelford,Hauxton and Harston.
Anglian Region	River Granta from Linton to Stapleford	Linton, Hildersham, Great Abington, Little Abington, Babraham and Stapleford.
Anglian Region	River Cam from Cambridge to Upware	Granchester, Cambridge, Milton, Waterbeach and Upware.
Anglian Region	Old West Flood Defence	Chittering, Haddenham, Cottenham, Stretham, Wilburton and Willingham

7.4.3 As stated in section 4.14, South Cambridgeshire District Council and Cambridge City Council both have produced emergency plans which cover flooding.

7.4.4 Both councils provide details on their websites on how to prepare for and mitigate against the impact of flooding. Both these websites should be read by residents who live in areas prone to flooding.

7.5 POTENTIAL ZONES OF RAPID INUNDATION

7.5.1 Many parts of the study area do not rely upon, or benefit from, raised flood defences. This is especially true of Cambridge and the southern half of the South Cambridgeshire District. As a result, many of these areas are not at risk from rapid inundation in the event of defence failure. According to information provided by the EA, there are six raised reservoirs in the District that would act as hydraulically significant impounding structures (see Appendix B). It is important to note that defence failure is considered to be a residual risk when assessing flood risk and development.

7.5.2 The Flood and Water Management Act 2010 introduces new arrangements for reservoir safety based on risk rather than the size of the reservoir. This relates to breaching and zones of rapid inundation. For the first time, reservoirs with a capacity of between 10,000 and 25,000 cubic metres will be brought within the scope of the Reservoirs Act 1975. However, where a reservoir does not represent a risk to public safety, routine supervision and inspection requirements under that Act will not apply.

7.5.3 Regulatory and other burdens will be proportionate to the risk – "The Act" will require all reservoirs which are 10,000 cubic metres or more to register. Implementation of "the Act" is expected to begin subject to Ministerial Direction from 2011 starting with the reservoirs already within the 1975 Act.

7.5.4 Development situated behind flood defences such as raised embankments (see Appendix C) may be at risk of falling into a Zone of Rapid Inundation in the event of defence failure. According to the NFCDD the maximum height of the flood banks in the area are no more than 4 metres high. Typically a Zone of Rapid Inundation is defined as being within 500-1000m of a raised flood defence such as an earth embankment (refer to DEFRA Guidance FD2320/TR2) (see Appendix E). The area of rapid inundation will depend on variables such as topography and the height of the defences. DEFRA guidance states that for small defences (2m high or less) the Zone of Rapid Inundation will only extend for the first few hundred metres in the event of a breach.

7.5.5 The primary areas benefitting from raised defences are within the northern area of South Cambridgeshire District, along the Cam, Cottenham Lode, and Great Ouse. The majority of these defences are in excess of 2m in height. Swavesey Drain is listed as having raised flood defences, although some defences are listed as being 0 metres in height and others have no height details listed.

7.5.6 From a desk based study potential areas at risk of rapid inundation have been identified as follows; the area to the north of Over and Willingham, the area to the north of Cottenham, the area to the east of Longstanton, areas to the east of Waterbeach, and areas to the east of Cambridge / north of Fulbourn. The stretches of land that are at risk of rapid inundation are primarily undeveloped.

7.5.7 The Flood Hazard mapping for the Cam study undertook breach scenarios for the area around the Cambridge Lodes. This area is to the north of Waterbeach along the River Cam (see Appendix D). The various breach scenarios were based on the following return periods; 1 in 100, 1 in 100 (plus CC), 1 in 1000 and 1 in 1000 (plus CC). Breach closer based on the 36 hour scenario has been provided with this SFRA. These hazard outlines should be taken into consideration when reviewing Zones of Rapid Inundation and proposed development in these areas.

7.5.8 The potential for defences within the area to breach should be assessed in greater detail as part of any stage 2 SFRA (if required).

7.5.9 The potential for specific failures in flood defences would need to be assessed by developers as part of a site specific Flood Risk Assessment. This will be prepared to support their proposals with a planning application.

8 Sustainable Drainage Systems (SuDS)

8.1 BACKGROUND ON SUDS

8.1.1 Sustainable Drainage Systems (SuDS) are the preferred approach to managing rainfall runoff generated from impermeable surfacing and should be used at any proposed site. They can be used to reduce the rate and volume of surface water discharges from sites to the receiving environment (i.e. natural watercourses or public sewer etc), as well as reduce pollutants, maintain recharge to groundwater and provide a natural amenity and green space within a development. SuDS also provide an effective means to deal with the effects of climate change.

8.1.2 The Cambridge Sustainable Drainage Design and Adoption Guide states; *"A successful SuDS scheme will deliver many community benefits, enhancing the quality of life of people living there, increasing biodiversity whilst reducing the risk to residents and their homes from flooding and providing greater resistance to the impacts of climate change. The SuDS will ensure that local watercourses and rivers, such as Hobson's Brook and The Cam, will not suffer any detrimental water quality effects or increased flood risk due to the new developments discharging into them"*.

8.1.3 There are various SuDS techniques that are available and should be investigated for a proposed site, however the techniques operate on two main principles;

- Infiltration
- Attenuation

8.1.4 Infiltration SuDS rely on discharging to ground, where suitable ground conditions allow. Infiltration methods include the use of permeable pavements, infiltration trenches, soakaways and other techniques that are generally located below ground such as geocellular systems.

8.1.5 Where site ground conditions are deemed unsuitable for the widespread implementation of infiltration techniques, surface water runoff will need to be attenuated using on-site attenuation storage. On site 'above ground' storage measures include basins and ponds, with 'below ground' facilities generally following the more engineered forms of underground storage. In other cases a combination of both infiltration and attenuation methods could be applied.

8.1.6 In a well designed SuDS scheme a number of different features should be provided in sequence, referred to as the management train. The South Cambridgeshire District Council, District Design Guide states *"Applicants developing SuDS should be aware that certain conventional landscape design and planting practices may require modification to facilitate an effective management train, account for different soil / moisture profiles, reduce soil erosion, and promote nature conservation. Access to an appropriate degree of SuDS engineering expertise will be an important issue for applicants – especially for larger schemes".*

8.1.7 The underlying ground conditions of a site will need to be determined through intrusive ground investigations; these will assess the permeability of the underlying soil strata. Where the results of the ground investigation show the underlying soil to be conducive to infiltration, infiltration tests will need to be conducted in accordance with BRE 365. The number of tests and locations on any given site will need to be agreed with the Environment Agency and Local Planning Authority.

8.1.8 Further testing guidance for infiltration tests can be found in the Cambridge Sustainable Drainage Design and Adoption Guide, where it states *"Each site should be evaluated on its own merits by undertaking comprehensive soil Standard BS 5930: 1999, Code of practice for site investigations, including infiltration testing and groundwater level monitoring. This will identify any opportunities for infiltration".*

8.1.9 The hierarchical approach to SuDS selection should be used at the site investigation stage to help determine the most sustainable drainage techniques for a site. Land should be set aside specifically for SuDS. Evidence must be given that all potential SuDS options have been considered and suitable justifications given where SuDS options have been discounted.

8.1.10 SuDS infiltration feasibility mapping has been provided in Appendix C. This illustrates the ground conditions found in the Cambridge and South Cambridgeshire District in terms of permeability and the appropriateness for the use of Infiltration SuDS techniques. These definitions are based on a desk study review of available information and our experience; this must not supersede site-specific data and ground investigations. The location of Source Protection Zones (Appendix C) should also be taken into consideration.

8.1.11 An initial assessment of a site's suitability to the use of SuDS infiltration techniques can be obtained from the review of the available soils / geological survey of the area presented in Tables 8A and 8B. The information presented in the Tables 8A and 8B is provided as a guide and should not be used to accept or refuse SuDS infiltration techniques.

8.2 GEOLOGICAL CONDITIONS

8.2.1 Tables 8A and 8B below give a general description of each of the underlying geological strata encountered in the study area and of the strata's drainage potential. A 'broad brush' simplified indication of SuDS infiltration feasibility has been depicted geographically in Appendix C.

Table 8A: Superficial Geology

Geology Name	Generic description	Infiltration potential
Peat	Organic-rich clay, humic deposits. Groundwater is likely to be close to the ground surface.	Low
Alluvium	Normally soft to firm consolidated, compressible silty clay, but can contain layers of silt, sand, peat and basal gravel. A stronger, desiccated surface zone may be present. Groundwater is likely to be present at shallow depth.	Uncertain
River Terrace Deposits	Sand and gravel, locally with lenses of silt, clay or peat. River Terrace Deposits vary in consistency from granular to cohesive deposits.	Uncertain
Glacial Sand and Gravel	Undifferentiated Chalky sand and gravel.	High
Glacial Till	Interbedded clay and silty clay, pebbly with rare sand.	Low

Table 8B: Solid Geology

Geology Name	Generic description	Infiltration potential
New Pit Chalk Member	Principally blocky, white firm to moderately hard chalk with numerous marls or paired marl seams.	High*
Holywell Nodular Chalk Member	Generally hard nodular chalks with thin marls and significant proportions of shell debris in part. Base marked by the interbedded coloured marl and chalk succession. The Melbourn Rock Member above the base can be distinguished by its lack of shell material.	High*
Zig Zag Chalk Member	Mostly firm, pale grey to off-white blocky chalk with a lower part characterised by rhythmic alternations of marls and marly chalks with firm white chalk.	High*
West Melbury Marly Chalk Member	Buff, grey and off-white, soft, marly chalk and hard grey limestone arranged in couplets.	Low*
Gault Formation	Pale to dark grey or blue-grey clay or mudstone, with a sandy base. Discrete bands of phosphatic nodules, some pyrite and calcareous nodules	Low
Woburn Sands Formation	Fine to coarse-grained rounded marine quartz sand, glauconitic in part.	High
West Walton and Ampthill Clay	Mudstone, mainly smooth or slightly silty, pale to medium grey with argillaceous limestone.	Low
Oxford Clay	Silicate-mudstone, grey, generally smooth to slightly silty, with sporadic beds of argillaceous limestone nodules.	Low

***** *Note - The outcropping chalk sequence in the Cambridge area comprises of New Pit Chalk (formerly Middle Chalk) to West Melbury Marly Chalk (formerly Lower Chalk). It should be noted that a Marly Chalk, such as the West Melbury Marly Chalk, will be cohesive in nature, and act in a hydrogeologically similar way to a clay. Further to this, the hydrogeological properties of the chalk vary depending on strata, weathering and dissolution features. Therefore the properties of the chalk can vary on a regional and local scale and testing would be required prior to the drainage design being finalised.*

8.2.2 Although some soils will prevent a complete infiltration solution it will still be possible to use other SUDS features such as ponds, wetlands and swales. It is also possible to use systems such as permeable paving for the purpose of water quality control and areas where infiltration is not viable.

8.2.3 Refer to Appendix E for the site specific FRA Toolkit to help select suitable SuDS methods for a site.

8.3 GUIDANCE DOCUMENTS

8.3.1 Reference should be made to the following guidance documents when undertaking SuDS assessments and design for a proposed scheme.

- CIRIA SuDS Manual (C697)

http://www.ciria.com/suds/index.htm

- Sustainable Drainage, Cambridge Design and Adoption Guide (June 2009)

http://www.cambridge.gov.uk/public/docs/SUDS-Design-and-Adoption-Guide.pdf

- Water Cycle Strategy, Major Growth Areas in and around Cambridge, Phase 1 Outline Strategy (October 2008)

http://www.cambridgeshirehorizons.co.uk/our_challenge/environment_sustainability/water_cycle_strategy.aspx

- The South Cambridgeshire District Council , District Design Guide (Adopted March 2010)

http://www.scambs.gov.uk/environment/planning/districtplanning/localdevelopmentframework/spds/districtdesignguidespd.htm

8.4 FLOOD AND WATER MANAGEMENT ACT 2010

8.4.1 The Flood Water Management Act 2010 provides duties on the Environment Agency, Local Authorities, Developers and other bodies to manage flood risks. The Act establishes a SuDS Approving Body (SAB) at county or unitary local authority level.

8.4.2 The Act requires SuDS to be designed, constructed, maintained and operated in accordance with National Standards. One of the key features of the act, is to encourage the uptake of sustainable drainage systems by removing the automatic right to connect to sewers and providing for unitary and county councils to adopt SuDS for new developments and redevelopments.

8.4.3 The sustainable drainage strategy produced as part of a site specific PPS25 compliant FRA will need to be submitted to the relevant SuDs Approval Body for consent in accordance with the requirements of the Act. Details on how the scheme shall be maintained and managed after completion must also be included.

9 Strategic Infrastructure

9.1 WATER CYCLE STRATEGY

9.1.1 A Water Cycle Strategy (WCS) is currently being undertaken for the Major Growth Areas in and around Cambridge. Currently, the Phase 1 Outline Strategy (2008) has been produced and is available for review. Phase 1 looks at the various issues across the whole study area, identifying any major constraints to growth. The Phase 2 study, once it has been issued, will look at detailed infrastructure requirements for specific growth sites, providing the solutions to constraints identified in the Phase 1 report. The major growth areas are illustrated in the Planned Major Development plan in Appendix A.

9.1.2 The overall objective of a Water Cycle Study is to review Water Services Infrastructure implementation through an assessment of the environment and infrastructure capacity for:

- water supply;
- sewage disposal;
- flood risk management;
- surface water drainage;
- ecological constraints and opportunities.

9.1.3 The Phase 1 study found no insurmountable constraints to the proposed level of growth in the study area. It identified a number of important issues which will need to be addressed as part of the Phase 2 study. The phase 2 study will examine the sites in more detail, examining the infrastructure that will be required to deliver the developments, and exploring how greater levels of water efficiency can be achieved, including the potential to achieve water neutrality.

Sewage Treatment Infrastructure

9.1.4 The location of key sewerage infrastructure has been shown in Appendix B. Anglian Water Services Ltd have advised that there are Sewage Treatment Works (STW) at the following locations; Arrington; Balsham; Bassingbourn; Bourn; Cambridge; Camps (nr. Shudy Camps); Coton; Duxford; Foxton; Gamlingay; Guilden (nr. Guilden Morden); Haslingfield; Hatley St George; Linton; Litlington; Melbourn; Over; Papworth Everard; Royston; Sawston; Tadlow; Teversham; Uttons Drove; Waterbeach and West Wickham.

Capacity Issues

9.1.5 Confirmation of sewer capacity is a policy requirement of the SCDC Development Control Policies (Policy NE/9- Water and Drainage Infrastructure). Similarly, Policy 8/18 of the Cambridge Local Plan (2006), does not allow planning permission where there is inadequate water supply, sewerage or land drainage system available to meet the demands of development. This is unless there is an agreed phasing agreement between developer and relevant service provider to ensure the provision of necessary infrastructure in time to serve the development.

9.1.6 It would need to be demonstrated at a site specific FRA level, that development can take place without increasing the risk of sewer flooding and that there is adequate capacity in the receiving sewage treatment works.

9.1.7 Anglian Water Services Ltd have advised that where sites may require an increase in discharge rates and volume, then it is crucial that the environmental impact of increasing flows into any receiving watercourse is fully understood. Any potential Waste Water Treatment Works (WwTW) upgrades needed as a result of these increases, would need to consider these impacts at the appropriate time; these considerations and timings will be for Anglian Water to make. Reference should be made to the Water Cycle Strategy for further details.

9.1.8 Any further analysis of the potential for upgrades to be undertaken at STW, relating to additional planned growth, should be completed as part of any Level 2 SFRA (if required).

9.1.9 Improvements to Cambridge STW and Uttons Drove are planned in order to meet the needs of the major growth areas planned around Cambridge. The WCS for the Major Growth Areas in and around Cambridge provides further information on this issue.

10 Planning and Development Issues

10.1 FLOOD RISK MANAGEMENT HIERARCHY

10.1.1 When assessing a site's development potential, careful attention should be paid to the Flood Risk Management Hierarchy set out in the PPS25 Practice Guidance. This hierarchy emphasises the importance of assessing flood risk management in five steps;

- Step 1- Assess (appropriate flood risk assessment);
- Step2- Avoid (apply the Sequential approach);
- Step 3- Substitute (apply the Sequential Test at site level);
- Step 4- Control (e.g.; SuDS design);
- Step 5- Mitigate (e.g. flood resilient construction).

10.2 SEQUENTIAL AND EXCEPTION TEST

10.2.1 A sequential risk-based approach to determining the suitability of land for development in flood risk areas is central to PPS25 and should be applied at all levels of the planning process.

10.2.2 SCDC and CCC as part of the LDF process of allocating land for development should apply the Sequential Test. The aim of the test is to demonstrate that there are no reasonably available sites in areas of lower probability of flooding that would be appropriate to the type of development or land use proposed.

10.2.3 Table D.1, Annex D of PPS25 (below) provides definitions for the flood zones, referring to the probability of fluvial and tidal flooding, ignoring the presence of defences.

PPS25 Table D.1: Flood Zones & Appropriate Land Uses

Zone 1 Low Probability

Definition

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

Appropriate uses

All uses of land are appropriate in this zone.

FRA requirements

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

Policy aims

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

Zone 2 Medium Probability

Definition

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

Appropriate uses

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

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

FRA requirements

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

Policy aims

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

Zone 3a High Probability

Definition

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

Appropriate uses

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

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

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

FRA requirements

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

Policy aims

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

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

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

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

Zone 3b The Functional Floodplain

Definition

This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their SFRAs areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. But 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, should provide a starting point for consideration and discussions to identify the functional floodplain.

Appropriate uses

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

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

– result in no net loss of floodplain storage;

– not impede water flows; and

– not increase flood risk elsewhere.

Essential infrastructure in this zone should pass the Exception Test.

FRA requirements

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

Policy aims

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

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

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

10.2.4 The principal aim of the Sequential Test is to steer new development to areas at the lowest probability of flooding. If there are no reasonably available sites in Flood Zone 1, then the flood vulnerability of the proposed development can be taken into account in locating development in Flood Zone 2 and then Flood Zone 3. Reference should be made to table D2 (PPS25) Flood Risk Vulnerability classification in relation to the vulnerability of various land uses. Reference should also be made to the Flood Risk Vulnerability and Flood Zone Compatibility classifications as set out in Annex D of PPS25. Both these tables are provided on the next page;

PPS25 Table D.2: Flood Risk Vulnerability Classification

Essential Infrastructure	• Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk. • Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood. • Wind turbines.
Highly Vulnerable	• Police stations, Ambulance stations and Fire stations and Command Centres and telecommunications installations required to be operational during flooding. • Emergency dispersal points. • Basement dwellings. • Caravans, mobile homes and park homes intended for permanent residential use. • Installations requiring hazardous substances consent. (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as 'Essential Infrastructure').
More Vulnerable	• Hospitals. • Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels. • Buildings used for: dwelling houses; student halls of residence; drinking establishments; nightclubs; and hotels. • Non–residential uses for health services, nurseries and educational establishments. • Landfill and sites used for waste management facilities for hazardous waste. • Sites used for holiday or short-let caravans and camping, **subject to a specific warning and evacuation plan.**

Less Vulnerable	• Police, ambulance and fire stations which are ***not*** required to be operational during flooding. • Buildings used for: shops; financial, professional and other services; restaurants and cafes; hot food takeaways; offices; general industry; storage and distribution; non–residential institutions not included in 'more vulnerable'; and assembly and leisure. • Land and buildings used for agriculture and forestry. • Waste treatment (except landfill and hazardous waste facilities). • Minerals working and processing (except for sand and gravel working). • Water treatment works which do **not** need to remain operational during times of flood. • Sewage treatment plants (if adequate measures to control pollution and manage sewage during flooding events are in place).
Water-compatible Development	• Flood control infrastructure. • Water transmission infrastructure and pumping stations. • Sewage transmission infrastructure and pumping stations. • Sand and gravel workings. • Docks, marinas and wharves. • Navigation facilities. • MOD defence installations. • Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. • Water-based recreation (excluding sleeping accommodation). • Lifeguard and coastguard stations. • Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. • Essential ancillary sleeping or residential accommodation for staff required by uses in this category, **subject to a specific warning and evacuation plan.**

PPS25 Table D.3. Flood Risk Vulnerability and Flood Zone 'Compatibility'

Flood Risk Vulnerability Classification (see Table D.2)		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone (See Table D.1)	Zone 1	✔	✔	✔	✔	✔
	Zone 2	✔	✔	Exception Test required	✔	✔
	Zone 3a	Exception Test required	✔	X	Exception Test required	✔
	Zone 3b 'Functional Floodplain'	Exception Test required	✔	X	X	X

Development Type is permitted under PPS25. A Site based FRA is required in accordance with the SFRA.

Development Type is permissible under PPS25, only if the Exception Test is passed. It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk. A Site based FRA is required in accordance with the SFRA.

Development Type is not permitted under PPS25

10.3 EXCEPTION TEST

10.3.1 PPS25 expands on the Sequential Test by incorporating an Exception Test whereby if, following application of the Sequential Test, it is not possible, consistent with wider sustainability objectives, for the development to be located in zones of lower probability of flooding the Exception Test can be applied.

10.3.2 The Exception Test is appropriate when there are large areas in Flood Zones 2 and 3, where the Sequential Test alone cannot deliver acceptable sites, but where some continuing development is necessary for wider sustainability reasons. This would take into account the need to avoid social or economic blight and the need for essential civil infrastructure to remain operational during floods. It may also be appropriate to use it where restrictive national designations (e.g. Sites of Special Scientific Interest) prevent the availability of unconstrained sites in lower flood risk areas.

10.3.3 The Exception Test provides a mechanism for managing flood risk whilst still allowing necessary development to occur. It should not, however, be used to justify 'highly vulnerable' development in Flood Zone 3a, or 'less vulnerable', 'more vulnerable, and 'highly vulnerable' development in Flood Zone 3b. Where required, a Level 2 SFRA should provide key supporting information for undertaking this test.

10.3.4 For development to be allocated or permitted, all three elements of the Exception Test criteria (set out below) will have 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 (see p21 of PPS12: Local Development Frameworks) 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 developable previously-developed land; and
- An FRA must demonstrate that the development will be safe, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall (see FRA toolkit in Appendix E).

10.3.5 This SFRA study takes no account of other socio-economic or sustainability factors other than flood risk and drainage infrastructure. These wider issues are to be considered by SCDC and CCC as part of their Sequential Test and Exception Test procedure, as required.

10.3.6 In relation to Flood Hazard mapping extents provided in Appendix D, the Flood Hazard to People Classification table (Appendix E) should be taken into consideration. When assessing a site's overall developability in areas where Flood Hazard mapping is provided, this type of information is an important tool that assists in assessing the overall sustainability of a site.

10.4 SITE SPECIFIC FRA TOOLKIT

10.4.1 A Flood risk Assessment toolkit has been set out in Appendix E. This document provides guidance on the appropriate treatment of climate change impacts, control of surface water runoff, implementation of appropriate SuDS techniques and consideration of residual risks. These have been offered to assist SCDC, CCC and future developers of sites in the study area.

10.4.2 Site specific FRA requirements are offered as guidance only and will be subject to EA approval and current policy, at the time of submission of a planning application.

10.5 WINDFALL SITES

10.5.1 Windfall sites are classified as those that are not specifically allocated for development in a development plan but become available for development during the lifetime of the plan. The Sequential Test is applicable throughout the planning lifecycle and should equally apply to windfall sites as much as it does to the forward planning process. A sequential approach should be adopted when reviewing these sites in terms of flood risk, referencing the SFRA.

11 Recommendations

11.1 RECOMMENDATIONS

11.1.1 South Cambridgeshire District Council and Cambridge City Council are required to carry out the Sequential Test for allocating land for future development. This should be based on supporting evidence and information set out in Section 5 of this report and the Flood Zone and Flood Risk Maps provided in Appendix D. The Sequential test should be undertaken in relation to the test criteria set out within Section 10.2. The following key recommendations should be taken into consideration;

- SCDC and CCC should ensure developers and their consultants make reference to this SFRA study prior to the formulation of development proposals and planning applications. This is to ensure that the key requirements of PPS25 (supplemented by recommendations within the SFRA) are met. Reference should also be made to the Cambridge Surface Water Management Plan, Flood Risk Management Plan for Cambridgeshire and the Water Cycle Strategy for the Major Growth Areas in and around Cambridge.
- SCDC and CCC should ensure developers carry out site specific FRA's for their proposals in line with the EA's latest standing advice on flood risk and the requirements of a site specific FRA. Reference should be made to the FRA 'Toolkit' provided in Appendix E and the requirements of PPS25.
- SCDC and CCC should seek to implement strategic flood mitigation opportunities such as areas of Green Infrastructure (where possible), by way of developer contributions, planning conditions, or S106 agreements. This should be assessed in greater detail as part of a Level 2 SFRA (if required).
- SCDC and CCC should maintain an up to date Emergency and Flood Evacuation Plan for the District.
- SCDC and CCC should support the implementation of SuDS by way of robust planning conditions and / or Section 106 (S106) agreements.

11.1.2 To safeguard the future operation and function of flood defences and flood risk management related infrastructure, responsibility and management for any new facilities should be adopted by the relevant Internal Drainage Board or maintenance body within the study area. Under the Flood and Water Management Act (2010), there is the ability to 'designate features,' which is to ensure flood defences and flood risk management related infrastructure are unable to be removed or altered without the approval of the designating authority. Designating authorities can be the EA, the County Council, District Council or IDB.

11.2 AREAS OF FURTHER INVESTIGATION

11.2.1 Areas of further investigation following the completion of the Level 1 Strategic Flood Risk Assessment study, principally focus on refinements to the existing hydraulic modelling and include the following key elements;

- The overarching River Cam model completed using JFLOW software, should be updated with 1D or 2D hydraulic modelling for development sites that fall into Flood Zones 2 and 3. This could be undertaken at a site specific scale as part of the Flood Risk Assessment process. The JBA report that accompanies this study highlights areas that would benefit from further modelling as being; Bassingbourn cum Kneesworth, Fowlmere, Linton, Little Shelford, Orwell, Newton and Bourn.
- It is also recommended in the JBA study, that additional modelling would be beneficial along Vicar's/Hobson's Brook and Coldham's/Cherry Hinton Brook.
- Once the River Great Ouse Catchment study is issued (2011), this updated modelling will replace the existing flood zone outlines to the north and north east of Cambridge. Much of the existing data in this area as shown (Appendix D) will be superseded. Specifically this study is expected to replace the existing Flood Zone outlines along Longstanton Brook, Cottenham Lode, Swavesey Drain and the previous EA outlines for the Great Ouse and Swavesey Drain. However, the validity of keeping the existing 1D and 2D models in this area should be assessed in relation to the methodology of the modelling used in the updated Ouse study.
- Based on development proposals, Flood Zones 2 and 3 should be modelled along watercourses to the north and east of Fulbourn; north, west and east of West Wratting; and to the south of Gamlingay. This modelling should replace the existing EA Flood Zones in these areas and should be based on requirements of PPS25.
- The extent and level of protection of flood defences should be assessed in greater detail in relation to any key development areas within the SCDC and CCC study area. Potential Zones of Rapid Inundation should be assessed relating to any development sites that fall within Flood Zones 2 and 3. This could be investigated further as part of any Level 2 SFRA (if required).
- If required, a Level 2 SFRA should assess land contamination issues within the study area in relation to the application of SuDS infiltration techniques.
- Ongoing consultation should be undertaken with the EA with regards to the future delivery of Flood Alleviation Schemes. These schemes could potentially affect flood outlines as shown on the EA's flood maps. Such schemes could offer the potential to release more land for development. Flood Alleviation Schemes should be assessed in light of any modelling that maybe undertaken as part of any Level 2 study.

11.2.2 If required, a Level 2 SFRA should provide key supporting information for the Exception Test to be undertaken (see section 10.3). This relates to any sites that fall within areas of medium to high flood risk i.e. Flood Zones 2 and 3.

12 Conclusion

12.1 SUMMARY

12.1.1 A 'Level 1' strategic assessment of flood risk has been carried out across the SCDC and CCC study area as defined in Appendix A. This is to assist SCDC and CCC with their risk-based approach to the allocation of land for development as part of the LDF process.

12.1.2 Particular reference should be made to the Flood Risk Constraints maps in (Appendix D), which provide a review of Fluvial Flood Risk across the study area. Where available, Flood Hazard mapping has also been provided as taken from the River Cam mapping study. For planning purposes, both the Flood Risk and Flood Hazard maps should be used to guide sustainable land use planning decisions.

12.1.3 Land allocations must be made with reference to the Sequential and where appropriate, the Exception Test, as set out in PPS25. A Level 2 SFRA (if required) would be a key document in helping to assess flooding in relation to any sites that fall under the Exception Test.

12.1.4 Recommendations should be set out as part of any Level 2 SFRA (if required), that highlight areas (i.e. green open spaces), that potentially offer strategic flood mitigation opportunities and wider community benefit. This should draw on the findings made in the Green Infrastructure Strategy for Cambridgeshire.

12.1.5 A site specific FRA 'toolkit' (Appendix E) has been provided to assist SCDC, CCC the EA and future developers in identifying the key flood risk issues within the study area. This will also help to assist with the formulation of solutions to the management of flood risk and surface water runoff that are of benefit strategically rather than locally.

12.1.6 This Level 1 SFRA has been based upon planning policies and information available at the time of the report issue (Sept. 2010). Flood Risk classifications may be subject to change in line with future planning policy. Flood zoning may be subject to change following consideration of detailed topographical information and investigation of site specific Flood Risk Assessments accompanying planning applications.

12.1.7 If allocated sites fall within Flood Zones 2 and 3 then it is recommended that a Level 2 SFRA is undertaken to inform land allocation decisions made in the near future.

12.1.8 This Level 1 SFRA will be updated in due course to include the Flood Risk and Flood Hazard mapping outputs provided in the River Great Ouse catchment study. This study is due to be issued in 2011.

12.1.9 All stakeholders involved in the production of the SFRA have provided the necessary information and guidance in order to complete this detailed study.

13 Key Data Sources

Areas Susceptible to Surface Water Flooding, Environment Agency, 2009

C697: The SuDS Manual, CIRIA, 2007

Cambridge City Council Activation and Major Emergency Response Plan, Cambridge City Council, 2009

Cambridge Local Plan and associated documents, Cambridge City Council, 2006

Cambridge Sustainable Drainage Design and Adoption Guide, Cambridge City Council, 2009

Cambridgeshire Multi Agency Flood Plan, Cambridgeshire County Council, 2010

Civil Contingencies Act, Cabinet Office, 2004

Cottenham Lode Flood Alleviation Scheme, Pre-Feasibility Report, Halcrow, 2003

East of England Regional Flood Risk Appraisal, East of England Regional Assembly / Capita Symonds, 2009

Environment Agency, Flood Risk Mapping, Central Area Program 2000-2001, River Great Ouse, Offord D'arcy to Earith, Royal Haskoning, 2001

Environment Agency – Anglian Region, River Cam Flood Mapping, JBA, 2010

Great Ouse Catchment Flood Management Plan - Final, Environment Agency, 2010

North Essex Catchment Flood Management Plan – Summary Report, Environment Agency, 2009

Floods and Water Management Act 2010, Cabinet Office, 2010

Longstanton Brook Model Audit Review, Faber Maunsell, 2006

Planning Policy Statement 25: Development and Flood Risk, Department for Communities and Local Government, 2010

Planning Policy Statement 25: Practice Guide, Department for Communities and Local Government, 2009

South Cambridgeshire Development Control Policies Development Plan Document, South Cambridgeshire District Council, 2007

South Cambridgeshire District Council Emergency Planning Manual, South Cambridgeshire District Council, 2010

South Cambridgeshire District Council District Design Guide, South Cambridgeshire District Council, 2010

South Cambridgeshire Local Development Framework Core Strategy, South Cambridgeshire District Council, 2007

St. Ives and The Hemingford's Flood Alleviation Scheme, Project Appraisal Report, Atkins, 2005

Sustainable Drainage, Cambridge Design and Adoption Guide, Cambridge City Council, 2009

Surface Water Management Plan Technical Guidance, DEFRA, March 2010

Swavesey Drain Standard of Protection Study, Royal Haskoning, 2003

The Pitt Review – Learning Lessons from the 2007 Floods, Cabinet Office, 2008

Water Cycle Strategy (Major Growth Areas in and around Cambridge), Outline Phase 1 Cambridgeshire Horizons / Halcrow ,2008

Appendices, Figures & Tables

Appendix A Assessment Area, Planned Major Developments, CFMP Areas and Policy Units

Appendix B Existing Watercourses, Reservoir Locations, Historical Flooding, Surface Water Flood Risk Mapping and Sewage Treatment Works

Appendix C Hydraulic Structures and Defences, SuDS Infiltration Feasibility Plan, Source Protection Zones and EA Warning Areas

Appendix D Flood Risk Constraints Mapping (including Fluvial Hazard Mapping)and Breach Hazard Mapping

Appendix E Site Specific Toolkit, DEFRA (FD2320/TR2) and Data Register