Fenland District Council

Strategic Flood Risk Assessment

Level 1 SFRA

July 2011

Prepared for

Fenland CAMBRIDGESHIRE

Fenland District Council

Cambridgeshire Horizons

driving forward sustainable communities

Revision Schedule

Level 1 Strategic Flood Risk Assessment

Rev	Date	Details	Prepared by	Reviewed by	Approved by
01	May 2010	Draft SFRA for comment pending EA Meeting	**Helen Judd** Assistant Hydrologist **Gemma Hoad** Assistant Water Scientist	**Elizabeth Gent** Principal Consultant	**Jon Robinson** Associate Director
02	December 2010	Level 1 SFRA for sign off	**Elizabeth Gent** Principal Consultant **Gemma Hoad** Assistant Water Scientist	**Carl Pelling** Principal Consultant	**Jon Robinson** Associate Director
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04	July 2011	FINAL Level 1 SFRA	**Elizabeth Gent** Principal Consultant **Gemma Hoad** Assistant Water Scientist **Helen Judd** Senior Assistant Hydrologist	**Carl Pelling** Principal Consultant	**Carl Pelling** Principal Consultant

Scott Wilson
Scott House
Alençon Link
Basingstoke
Hants
RG21 7PP

Tel: 01256 310200
Fax: 01256 310210

www.scottwilson.com

Acronyms and Abbreviations

Abbreviation	Description
AONB	Area of Outstanding Natural Beauty
BAR	Broad Areas for Regeneration
BGS	British Geological Society
CAMC	Creating Asset Management
CFMP	Catchment Flood Management Plan
CLG	Communities and Local Government
Defra	Department for Environment, Food and Rural Affairs
DPD	Development Plan Document
DTM	Digital Terrain Model
FRA	Flood Risk Assessment
GIS	Geographical Information System
IDB	Internal Drainage Board
LLFA	Lead Local Flood Authority
LDDs	Local Development Documents
LDF	Local Development Framework
LDS	Local Development Scheme
LiDAR	Light Detection and Ranging
LPA	Local Planning Authority
mAOD	Metres Above Ordnance Datum
NFCDD	National Flood and Coastal Defence Database
PCPS 2004	Planning and Compulsory Purchase Act 2004
PPS	Planning Policy Statement
RBMP	River Basin Management Plan
RFRA	Regional Flood Risk Appraisal
RPG	Regional Planning Guidance
RSS	Regional Spatial Strategy (East of England Plan)
SA	Sustainability Appraisal
SAB	SuDS Approving Body
SFRA	Strategic Flood Risk Assessment
SPA	Special Protection Area
SPD	Supplementary Planning Document
SPZ	Source Protection Zone
SuDS	Sustainable Drainage Systems

Abbreviation	Description
WFD	Water Framework Directive

Glossary

Term	Definition
1 in 100 year event	Event that on average will occur once every 100 years. Also expressed as an event, which has a 1% probability of occurring in any one year.
1 in 100 year design standard	Flood defence that is designed for an event, which has an annual probability of 1%. In events more severe than this the defence would be expected to fail or to allow flooding.
Aquifer	Layers of rock sufficiently porous to hold water and permeable enough to allow water to flow through them in quantities that are suitable for water supply. The Environment Agency has defined 'primary' (previously major) and 'secondary' (previously minor) aquifers.
Aquitard	Formations that permit water to move through them, but at much lower rates than through the adjoining aquifers.
Aquicludes	Formations that may be sufficiently porous to hold water, but do not allow water to move through them.
Catchment Flood Management Plan	A high-level planning strategy through which the Environment Agency works with their key decision makers within a river catchment to identify and agree policies to secure the long-term sustainable management of flood risk.
Culvert	A channel or pipe that carries water below the level of the ground.
Diamicton	Poorly sorted sediment showing great lateral and vertical variations in thickness, composition and texture.
Drift geology	All material of glacial origin found anywhere on land or at sea, including sediment and large rocks (glacial erratic).
Floodplain	Area adjacent to river, coast or estuary that is naturally susceptible to flooding.
Flood storage	A temporary area that stores excess runoff or river flow often ponds or reservoirs.
Fluvial flooding	Flooding by a river or a watercourse.
Freeboard	Height of flood defence crest level (or building level) above designed water level
Groundwater	Water that is in the ground, this is usually referring to water in the saturated zone below the water table.
Head Deposit	Head deposit describes ground deposits at the very top of the geological succession, that could not be classified more accurately
Inundation	Flooding
Local Development Framework (LDF)	The core of the updated planning system (introduced by the Planning and Compulsory Purchase Act 2004). The LDF comprises the Local Development Documents, including the development plan documents that expand on policies and provide greater detail. The development plan includes a core strategy, site allocations and a proposals map.
Mitigation measure	An element of development design which may be used to manage flood risk or avoid an increase in flood risk elsewhere.
Risk	The probability or likelihood of an event occurring.
Sewer flooding	Flooding caused by a blockage or overflowing in a sewer or urban drainage system.
Solid geology	Bedrock (not drift)

Term	Definition
Surface Water flooding	Flooding caused when intense rainfall exceeds the capacity of the drainage systems or when, during prolonged periods of wet weather, the soil is so saturated such that it cannot accept any more water.
Sustainable drainage system	Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques.

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1 Non-Technical Summary

1.1 SFRA Background

1.1.1 Scott Wilson Ltd was commissioned by Cambridgeshire Horizons to undertake a review of the Strategic Flood Risk Assessment (SFRA) as well as a Water Cycle Strategy for Fenland District Councils administrative area. This report addresses the SFRA only as the Water Cycle Strategy is covered in a separate report. This project has been carried out in collaboration with the Environment Agency's Anglian Region.

1.2 SFRA Planning Objectives

1.2.1 The primary objective of the study is to enable Fenland DC to undertake the Sequential Test in line with the Government's flood risk and development policy document - Planning Policy Statement 25 (PPS25): 'Development and Flood Risk'[1] - to inform the development of their emerging Local Development Framework (LDF) documents. In particular this study will form part of the evidence base for the development of the Core Strategy DPD and the Site Specific Allocations and Policies DPD.

1.2.2 PPS25[1] requires Fenland DC to review flood risk across their district, steering all development towards areas of lowest risk. Development is only permissible in areas at risk of flooding in exceptional circumstances where it can be demonstrated that there are no reasonably available sites in areas of lower risk, and that the development provides wider sustainability benefits that outweigh the risk of flooding. Such development should incorporate mitigation/management measures to minimise risk to life and property should flooding occur.

1.2.3 The SFRA is the first step in this process. It will assist with the development of LDF documents by identifying flood risk areas and outlining the principles for sustainable development policies, informing strategic land allocations and integrating flood risk management into the spatial planning of the area. The SFRA thereby forms an essential reference tool providing the building blocks for future strategic planning.

1.3 SFRA Report Layout

1.3.1 In accordance with recommendations within the PPS25 Practice Guide[2], this SFRA has been structured in two phases. This report forms a Level 1 SFRA, which provides an overview of the flood risk issues throughout Fenland in order to facilitate a sequential approach during the allocation of sites for future development.

1.4 Fenland District Council Considerations

1.4.1 The Fenland District is primarily rural, with land use being largely agriculture outside of the main settlements of Wisbech, March, Whittlesey and Chatteris. Food processing also forms a major component of industry across the area.

1.4.2 The topography of the area is flat and low lying, with large areas of fenland where the landscape is dominated by drainage channels managed by Internal Drainage Boards. These channels are crucial to maintain the system of agriculture. The largest rivers flowing through the

study area are the River Nene and Great Ouse/Bedford River. These have large upstream catchments and are heavily influenced by activities outside the study area, particularly discharges from Peterborough, Kettering and Northampton which lie along the River upstream of the study area. Likewise the Ouse System is designed to accommodate flows from Bedford and Milton Keynes. The study area contains several important wetlands which are remnants of the original fenland landscape; these include the Ouse and Nene Washes, which are important flood storage areas, as well as Ramsar status habitats for wildfowl.

Flood Risk

1.4.3 Fenland District has significant areas which lie within the fluvial and/or tidal flood zone, with the market towns of Wisbech, March, Whittlesey and Chatteris being located on 'islands' of high ground above the fens. The district is mostly pumped drained, and is reliant on flood defences to minimise flood risk to the existing development and agricultural land. Due to the historical drainage of the area, the majority of the land lies below the higher level arterial drainage channels, creating a significant residual risk if defences were to be breached or overtopped.

The Sequential Test

1.4.4 The Sequential Test outlined in PPS25[1] aims to steer development to areas of lowest flood risk. The SFRA aims to facilitate this process by identifying the variation in flood risk across Fenland and allowing an area-wide comparison of future development sites with respect to flood risk.

1.4.5 Fenland has been delineated into the Flood Zones outlined in PPS25[1] as Flood Zone 1, low probability, Flood Zone 2, medium probability, Flood Zone 3a, high probability and Flood Zone 3b functional floodplain. Table D.1 of PPS25[1] provides information on which developments might be considered appropriate in each Flood Zone, subject to the application of the Sequential Test and the Exception Test, as well as a site-specific Flood Risk Assessment (FRA).

1.4.6 Areas of washland are identified as Flood Zone 3b, functional floodplain where water has to flow or be stored in times of flood, within the Fenland District these are the Ouse Washes and Nene (Whittlesey Washes). The drainage systems in the District are maintained to a range of levels of protection, but are at a minimum of a 1 in 20 year standard. Therefore under present conditions there is no associated functional floodplain with the drainage channels and main river systems in the area (other than the two washland areas.

1.4.7 The Sequential Test identifies the flood risk and vulnerability of various proposed developments in order to assess the suitability of each development location, and where possible to steer more vulnerable developments to areas of lower flood risk.

The Exception Test

1.4.8 Where the Sequential Test demonstrates that it is necessary to locate a particular development in a flood zone because no land of a lesser flood risk exists, there will be some circumstances when the Exception Test will also need to be applied. Table D.3 of PPS25[1] summarises the instances in which the application of the Exception Test is necessary. All three elements of the Exception Test, as set out in paragraph D9 of PPS25[1] must be passed in order to establish the principle of development and satisfy the requirements of PPS25[1].

1.4.9 The purpose of the Exception Test is to ensure that new development is only permitted in medium and high flood risk areas in exceptional circumstances i.e. where flood risk is clearly

outweighed by other sustainability factors and where the development will be safe during its lifetime, taking the impacts of climate change into account.

1.5 Way Forward

1.5.1 The risk of flooding posed to development within the study area arises from a number of different sources including tidal flooding, river flooding, groundwater, surface water flooding as well as flooding from sewers.

1.5.2 A spatial planning solution to flood risk management should be sought wherever possible. It is necessary for Fenland DC to consider, through the application of the PPS25[1] Sequential Test, how to steer vulnerable development away from areas affected by flooding. This should also take into consideration other relevant strategies and studies in the area seeking to reduce flooding to those already at risk.

1.5.3 Where other planning considerations must guide the allocation of sites and the Sequential Test has been satisfied, further studies can be carried out to assist Fenland DC and developers to meet the Exception Test. These will be detailed in a Level 2 SFRA following completion of the Sequential Test.

1.5.4 Engagement with the Emergency Planning Team, Local Resilience Forum and emergency services is imperative to minimise the risk to life posed by flooding within Fenland. It is understood that Fenland DC are in the initial stages of preparing a flood risk response plan for the District. We recommend that the findings and recommendations from the Level 1 SFRA are taken into consideration during the preparation of the flood risk response plan.

1.6 A Living Document

1.6.1 The SFRA has been completed in accordance with PPS25[1] and its supporting Practice Guide[2].

1.6.2 With respect to flood risk within the study area the SFRA has been developed by building upon existing knowledge. Further modelling may significantly improve current knowledge of flood risk within the area over time, and may alter predicted flood extents. This may therefore influence future development control decisions within these areas.

1.6.3 In summary, it is imperative that the SFRA is adopted as a 'living' document and is reviewed regularly in light of emerging policy directives and an ever improving understanding of flood risk across Fenland DC.

2 Introduction

2.1 Overview

2.1.1 The Planning and Compulsory Purchase Act 2004 (PCPA)[3] requires Local Development Documents (LDDs) to undergo a Sustainability Appraisal (SA), which assists Planning Authorities in ensuring that their policies fulfil the principles of sustainability.

2.1.2 Strategic Flood Risk Assessments (SFRAs) constitute a component of the SA process and should be used in the review of LDDs or in their production.

2.1.3 The introduction of Planning Policy Statement 25 (PPS25): '*Development and Flood Risk*'[1] promotes a positive approach to planning, taking due consideration of flood risk, in order to deliver appropriate sustainable development in suitable locations. PPS25[1] and its supporting Practice Guide[2], emphasise the active role that Councils should have in ensuring that flood risk is considered in strategic land use planning.

2.1.4 To assist in strategic land use planning, the SFRA should present sufficient information to enable Fenland DC to apply the Sequential Test to their proposed development sites. The Sequential Test seeks to guide development to areas of lowest flood risk or, where necessary, to ensure development vulnerability is appropriate to the flooding probability of an area. To achieve this, SFRAs should have regard to river catchment-wide flood issues and also involve a – '*process which allows the Local Planning Authority to determine the variations in flood risk across and from their area as the basis for preparing appropriate policies for flood risk management for these areas'.*

2.1.5 In addition, where development sites cannot be located in areas of lesser flood risk, "the scope of the SFRA should be increased to provide the information necessary for the application of the Exception Test."

2.2 Growth in Fenland

2.2.1 Fenland is expected to experience a significant increase in housing and employment provision over the period to 2031. The Regional Spatial Strategy (RSS) for the East of England[1] (the East of England Plan or EEP) stated that a minimum of 11,000 houses and 11,000 jobs are to be provided in the administrative area of East Cambridgeshire District Council (ECDC) and a minimum of 11,000 new houses and 8,600 new jobs in the administrative area of Fenland District Council (FDC). The RSS is likely to be revoked by the forthcoming Localism bill; however, the level of growth in Fenland will be established through the Shaping Fenland Study currently underway, and due for completion in March 2011. This will inform FDC's emerging Core Strategy, but until then the Council will be relying on figures included in the RSS as growth targets. The SFRA may be used for locating other development such as travellers' sites, tourist and holiday accommodation etc.

[1] http://www.gos.gov.uk/goee/docs/Planning/Regional_Planning/Regional_Spatial_Strategy/EE_Plan1.pdf

2.3 The Aim of Fenland DC SFRA

2.3.1 The existing Level 1 SFRA (SFRA) for Fenland DC was published in 2005. The existing SFRA was prepared in full accordance with the prior flood risk management guidance, Planning Policy Guidance 25 (PPG25) Development and Flood Risk.

2.3.2 The overall aim of this study is to prepare an SFRA for the council in accordance with PPS25, which identifies local flooding constraints, sufficient to assist them in the formulation of planning policies, and the variation in flood risk across their administrative area for current climatic conditions and accounting for the predicted effects of climate change.

2.4 Level 1 SFRA Objectives

2.4.1 The objective of the Level 1 SFRA is to:

- collate and review all existing available information on flood risk for the study area from a variety of stakeholders including the Environment Agency, and other flood risk consultees such as IDBs, sewerage undertakers, highways authorities and local authority;
- map the flood zones based on existing model information and updated outlines available from the Environment Agency, including climate change and functional floodplains;
- identify areas at risk of flooding from all potential sources within the study area;
- provide an assessment of surface water flood risk including the spatial variation for the suitability for the application of SUDS across the study area;
- include a summary of flood risk issues including Flood Zone maps to enable application of the Sequential Test; and
- advise Fenland DC on suitable polices to address flood risk management in line with PPS25[1] for inclusion in their Local Development Documents.

2.5 SFRA Structure

2.5.1 The PPS25 Practice Guide[2] recommends that SFRAs are completed in two consecutive stages. This provides Fenland DC with tools throughout the LDF and SFRA process sufficient to inform decisions regarding development sites.

Level 1 SFRA – Study Area, Flood Source Review & Data Review

2.5.2 This Level 1 SFRA draws on past data and presents sufficient information to enable the council to apply the Sequential Test to potential development sites and to assist in identifying if application of the Exception Test will be necessary. The Level 1 SFRA also provides background information and a review of local policies and the potential for application of Sustainable Drainage Systems (SuDS). The review of polices is allied to guidance on the requirements for site-specific FRAs.

2.5.3 One of the objectives of the Level 1 SFRA is to collate and review available information on flood risk for the study area. The information to complete this report has been sourced from a variety of stakeholders that have included the Environment Agency, Fenland District Council, Cambridgeshire Fire and Rescue Service, the Highways Agency, Middle Level Commissioners,

North Level Drainage Board and Anglian Water. Draft versions of the document were issued for comment to the Environment Agency, Middle Level Commissioners and the North Level Drainage and where possible the comments received have been addressed in the final issue.

2.5.4 The information presented in this Level 1 report should not be considered as an exhaustive list of all available flood related data for the study area. The Level 1 report is a presentation of the data collected following consultation with and input from the Local Authorities and agencies within the timeframe available.

2.5.5 This report presents the findings of a Level 1 SFRA study. A Level 2 SFRA study has not been proposed as part of the revised SFRA update scope of works.

3 Fenland DC SFRA Study Area

3.1 Fenland SFRA Boundary

3.1.1 The Fenland District Council study area is presented in Figure 1 (Appendix C). The study area encompasses the entire Fenland DC administrative boundary. It is bordered by the districts of East Cambridgeshire to the south-east (for which a parallel SFRA is being undertaken by Scott Wilson); Huntingdonshire District to the southwest; the City of Peterborough to the west; South Holland District to the north; and, Kings Lynn and West Norfolk to the north east. The principal watercourses in the district are the River Nene; the Great Ouse/Bedford River system between Denver and Earith; the Middle Level arterial drainage network and the North Level arterial drainage network. This results in a study area of 545.5 km^2.

3.1.2 This SFRA includes the town of Wisbech, although a revised Level 2 SFRA for Wisbech is currently being undertaken by WSP, and due for completion in May 2011. Overtopping and breach hazard mapping along the Tidal Nene between Guyhirn and Sutton Bridge being produced for the Environment Agency by Hyder Consulting Ltd will also be incorporated into this report. To aid strategic planning it has been agreed with Cambridgeshire Horizons that mapping produced as part of this study will include the presentation of Wisbech.

3.1.3 In parallel to this study, Scott Wilson is undertaking an SFRA for the East Cambridgeshire District. The same methodology has been followed for both districts but will be reported separately to allow for easier use by the local authorities.

3.2 Fenland Study Area Characteristics

3.2.1 The study area includes the market towns of March, Whittlesey and Chatteris which are historically built upon the agricultural industry and more recently food related processing, storage, packaging and distribution.

3.2.2 The fenland area was once a large marshland area with some dry islands of smaller settlements. In the 17th century the first two phases of a large-scale drainage project funded by venture capitalists, resulted in large areas of farmland being created from the drained marshlands. This was known as Vermuyden's Scheme and watercourses such as the Forty Foot, Sixteen Foot and Twenty Foot well as the New and Old Bedford, or Hundred Foot Rivers were cut as part of Vermuydens scheme. In addition, since at times the rivers would not be able to contain the flows coming down them, the Ouse or Hundred Foot Washes were constructed between the two Bedford rivers, to contain these flows. The newly constructed drainage network that served the Great Level needed an organisation to maintain it and, as it crossed several counties, it was decided to create a new organisation, the Bedford Level Corporation, to have jurisdiction over the system. Originally established under the Commonwealth, the Corporation was subsequently recreated in 1663, following the accession of Charles II.

3.2.3 The Corporation evidently considered that the construction of the drainage system marked an end to the need for significant capital works, with routine maintenance only being the required order of the day. However, by the end of the seventeenth century, problems with gravity drainage was becoming more difficult and suggestions began to be made that the rivers were 'rising'. However, it was not the rivers were rising but that the land was shrinking. Within a matter of forty years, windmills and occasionally 'donkey mills' were being established and, as

the shrinking peat exposed roddens, clay ridges and other areas less prone to shrinkage, individual catchments within the Level developed, which prompted groups of landowners to erect larger more communal pumps, usually under Acts of Parliament, which set up local Commissioners, with powers to levy taxes to pay for the upkeep of the pumps and watercourses. These in time became the internal drainage boards that still exist today, see section 3 and 4.

Topography

3.2.4 Light Detecting and Ranging Data (LIDAR) has been obtained for this study from the Environment Agency. LiDAR data is an airborne survey technique that uses a laser to measure the distance between an aircraft and the ground surface. The LiDAR technique records an elevation accurate to ±0.3m every 2m. The technique records elevations from the majority of surfaces and includes features such as buildings, trees and cars. The raw data is processed to remove these features to give values for the ground surface. The LiDAR data can then be merged to create a Digital Terrain Model (DTM) of the ground surface. The available LiDAR data covers all of the study area and is presented in Figure 2.

3.2.5 As mentioned the drainage of the fens has meant that the area is being subjected to continual peat shrinkage. The majority of the study area lies around 0mAOD and is relatively flat. Although not noticeable on the ground there is a slight increase in the fen elevations from the southwest to the north east. The elevation on Flag Fen (south of Whittlesey) is approximately -0.5mAOD, whereas the elevations to the east of Friday Bridge are approximately at 2mAOD. The main road networks are typically raised above the adjacent land which would act as a defacto flood defence (see Photograph 1).

Photograph 1: A141 from Chatteris to March

3.2.6 Most of the towns and villages within the study area have been developed on “islands” of relatively high elevations that vary between 2 – 10mAOD. Notable islands within the study area are Whittlesey between 5 -7mAOD; Coates at approximately 5mAOD; Chatteris between 5 – 10mAOD; Manea between 4 – 5mAOD; Doddington between 7 – 8mAOD; Wimblington between 4 – 5mAOD and March between 4 – 5mAOD.

Geology

3.2.7 Figure 3 and sheets 159 (Wisbech), and 158 (Peterborough) of the British Geological Survey (BGS) 1:50,000 Scale Geological Series provide geological information on the Fenland District Council and the surrounding area.

Solid Geology

3.2.8 Within the Council area the solid geology comprises Oxford Clay, which is in turn overlain by the West Walton Formation (mudstone and siltstone) and the West Walton and Ampthill Clay Formations (undifferentiated).

3.2.9 The geological cross section presented on the Peterborough geological map suggest that the Oxford Clay at Whittlesey in the west of the district is approximately 30m thick and dips to the east. The Wisbech geological map indicates that in the Wisbech area to the northeast of the district, the West Walton and Ampthill Clay Formations are approximately 30-40m thick and underlain by around 50m of Oxford Clay. This can be seen in Figure 3.

Drift Geology

3.2.10 The majority of the district is covered by drift deposits with the exception of a few exposed areas of solid geology on higher ground in the south. Figure 2 (Digital Terrain Model) and 3 (Geological Map) show that the majority of the lowlands are blanketed by tidal flat deposits (clay and silt) and / or peat. Issues regarding peat shrinkage / wastage are described in greater detail below, which have implications for surface water flood depths. There also exists significant deposits of sand and gravel and till in the areas of Whittlesey, March, Doddington and Chatteris.

Peat Shrinkage/Wastage

3.2.11 Peat soils develop under anaerobic conditions (such as marshes) where the vegetation is inhibited from decaying fully. Many areas have two layers of peat as a result of differing historical environmental conditions in the area. There are a few components to peat wastage[4]:

- Shrinkage – the initial drainage of peat causes rapid shrinkage;
- Compression – as the peat is drained it looses its buoyancy which causes the peat to compress under its own weight;
- Oxidation – as the organic carbon content of the soil is exposed to the air it decomposes and is released as Carbon Dioxide;
- Other factors include:
    - Wind erosion;
    - Removal of soil along with the harvesting of root crops; and,
    - Accidental burning of dry peat.

3.2.12 The Holme Fen post is an important record of the rate of peat wastage that shows since 1851[5] the soils of Holme Fen have lowered by approximately 4m. It should be appreciated that the post was first installed approximately 200 years after large scale drainage projects were completed and therefore a significant amount of peak shrinkage has not been recorded. There are other areas of the fens that have thought to have lowered more than at Holme Fen.

3.2.13 The wastage of peat is greatest where it is deepest, which, overtime is in fewer and fewer places. As the depth of peat is an important factor when considering its wastage rate it has been split in previous studies to: -

- 'Deep' peat – peat soils that generally exceed 100cm in thickness;
- 'Thin' peat – peat soils that are generally less than 100cm in thickness;
- Localised peat – a mixture of peat and non-peat soils with the non-peat soils having a humus to peaty topsoils;
- Peat at depth – soils containing peat layer that is covered by more than 30cm of generally alluvial material; and,
- Remnant peat soils – that were original peat soils that have wasted to humus or mineral soils, localised areas of thin peat soils may remain.

3.2.14 In Fenland the deep peat soils are confined to the washes and nature reserves. A large proportion of the soil is remnant peat soil with some localised peat. For the surviving areas of deep peat and peat soils the average wastage rate has been estimated at 1.5cm/year. The areas of peat are presented in Figure 3.

3.2.15 "Fen Blows" or soil storms whereby the light peaty soil is blown away when dry, also helps to increase the lowering or loss of peat and silt land in the area.

3.2.16 The main risk posed by peat is settlement of the flood defences which require regular raising to counter the physical changes. The lowering of soil levels can generally be accommodated within the IDB systems by re-profiling channels and lowering pumping parameters, but ultimately it may require the lowering of the intake sump or the construction of a new station.

3.2.17 Therefore the peat shrinkage could be viewed as having a minor long term impact on flood risk, through effectively lowering the land by 1.5cm a year. Thereby increasing the potential flood depths on washlands and also increasing the consequences of residual risk to areas defended from flooding through the risk of breach or overtopping of defences. However it is uncertain if the Washes lower by this amount each year as they are primarily wet and silt is deposited on them throughout the year..

Hydrogeology

3.2.18 The hydrogeological significance of the various geological units within the study area is provided in Table 3.1.

Table 3.1: Geological Units in the Study Area and Hydrogeological Significance

Geology	Geological Unit	Hydrogeological Significance
Drift Geology	Tidal Flats	Variable (but probably an aquitard)
	Peat	Variable (but probably an aquitard)
	Till (diamicton)	Variable (but probably an aquitard)
	Head (clay, silt, sand & gravel)	Variable (but probably an aquifer)
	Sand & Gravel	Aquifer
Solid Geology	Oxford Clay Formation	Aquiclude
	West Walton & Ampthill Clay Formations	Aquiclude
	West Walton Formation (mudstone and Siltstone)	Aquiclude

Solid Hydrogeology

3.2.19 The Oxford Clay Formation, West Walton & Ampthill Clay Formations and the West Walton Formation are aquicludes and do not permit groundwater flow.

3.2.20 There are no Environment Agency observation boreholes or public water supply abstraction boreholes within the Fenland District Council.

Drift Hydrogeology

3.2.21 The sand and gravel drift deposits are likely to behave as aquifers, containing perched groundwater tables where they overlie aquitards or aquicludes. The role of the head deposits is uncertain and is likely to be variable, although they probably allow some groundwater flow. The peat, tidal flats and till are expected to behave as aquitards i.e. relative to the aquifer units, they do not permit significant groundwater flow.

3.3 History of Flooding in Fenland

3.3.1 Since the area has been drained and managed flooding in the Fens is rare, but when it does occur it can have catastrophic and fatal consequences. Table 3.2 below summarises flooding incidents that have occurred in the study area directly or from watercourses feeding into the study area. Those that directly affected the study area are highlighted in bold.

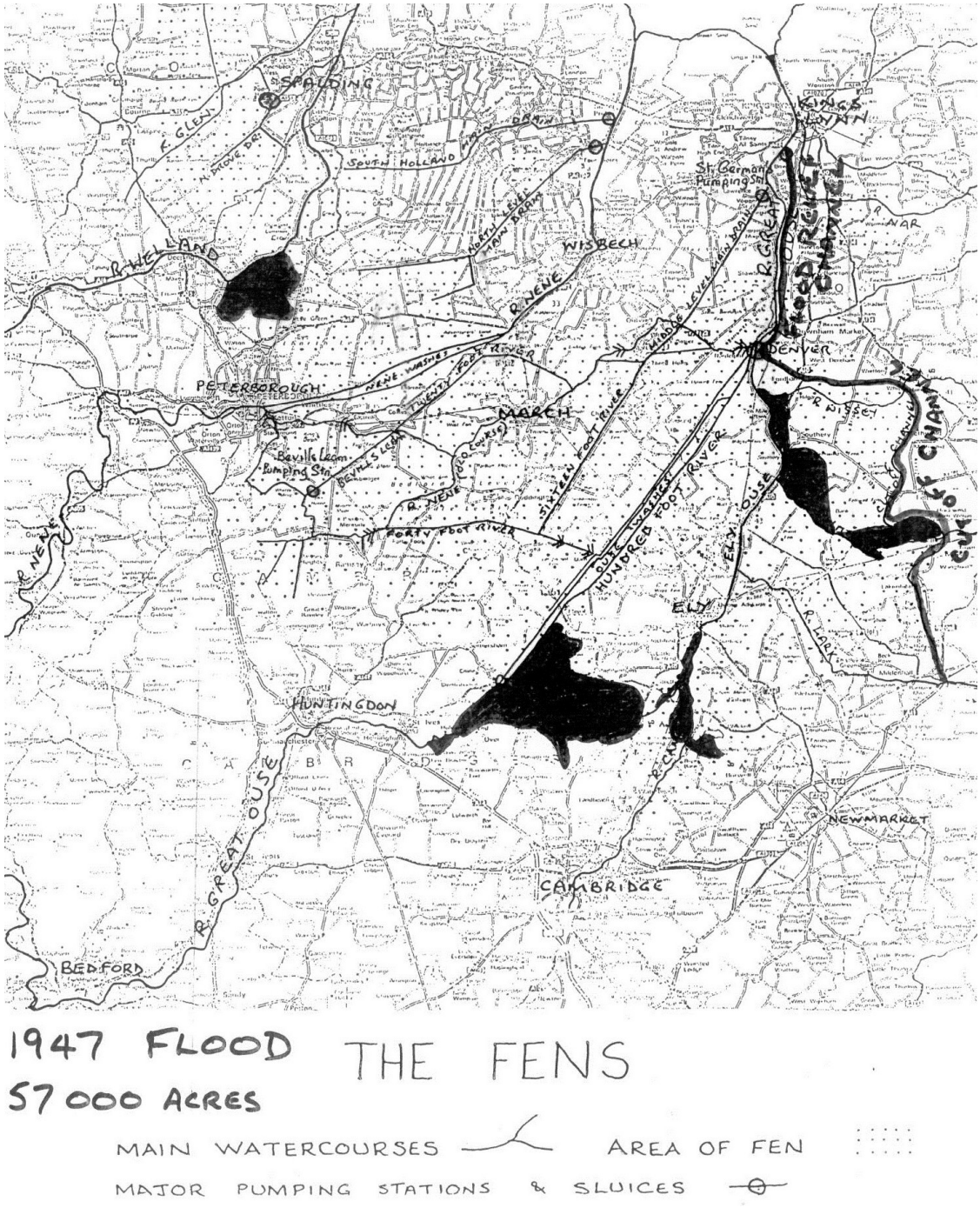
Table 3.2: Historic flood events in the Fenland area or experienced in the catchments connected to the Fenland District

Date	Location	Details
1912	**Ramsey**	
1937	**Widespread across the Great Ouse catchment**	**Widespread flooding, mostly farmland (excess of 2300 acres)**
1947	Nene from Northampton to Peterborough	Heavy rain and snowmelt caused flooding of the Nene, which was exacerbated by failure of an embankment on the River Welland
1947	**Great Ouse, River Cam, Bedford**	**Lowlands of Great Ouse, Welland and Nene**

Date	Location	Details
	Ouse, Wissey and Cottenham Lode	
1950	River Nene	Seven flood peaks with sustained high discharge
1950	River Ouse	Catchment wide surface water flooding
1960	River Nene	Localised flooding caused by fluvial and high tide
1974	River Nene	Shallow inundation of the floodplain. No major flooding reported
1978	**Surface water flooding in Wisbech and Sutton Bridge**	**Discharge of surface water impeded by high tides**
1978	**River Nene**	**Breach in the Wash primary sea defence at Ingleborough on the right bank, approximately 5km downstream of Wisbech. The tide reached near to the 1 in 200 year level and was accompanied by strong winds and wave action. Defences were overtopped at Wisbech and 1 life was lost.**
1981-1982 (winter)	River Nene	Agricultural land flooded, but few roads and no properties were flooded
1983	River Nene	Navigation on River Nene closed. Flood storage areas put to effective use to keep flows within bank other than at isolated low spots
1998	**Middle Level catchment**	**Total of approximately 2800 properties affected, nearly 90% residential and about 90% in Northampton. Commissioners system experienced high water levels, all pumping stations discharging into system were turned off for 24hrs to protect raised defences all alleviate flooding by allowing peak flows to pass.**
1998	River Great Ouse and tributaries including Alconbury Brook and the River Kym	600 buildings, 9000 ha farmland affected, disruption caused to gas and electricity supplies.

3.3.2 The historical flood outlines of the January 1978 floods from the tidal River Nene and the Easter 1998 from the River Nene downstream of Northampton were provided by the Environment Agency and are presented in Figure 9.

3.3.3 The extent of the 1947 floods in near Fenland is presented in the extract below that was provided by the MLC.



Extract 3-1: 1947 flood extent provided by the MLC

River Nene Catchment Board (RNCB)

3.3.4 When the River Nene Catchment Board (RNCB) was formed in 1931 under the Land Drainage Act 1930, with the aim of '… getting rid of floodwater in the shortest possible time ….and so saving the area from serious damage.' The work included:

- flood relief schemes to protect the borough of Northampton, comprising the construction of the defences and a flood relief channel through Northampton.
- the rebuilding of locks and controlling water levels in the Middle Nene by 'A considerable number of new cuts…to straighten the river… All along its length, the river was excavated and improved considerably… bridges rebuilt… banks repaired'.
- setting a tidal limit in the Lower Nene by constructing the tidal sluice at Dog-in-a-Doublet;
- developing the Nene Washes, which allow floodwater in the River Nene through Peterborough to be diverted into the Nene Washes during high tide where it is detained until the tide ebbs; and,
- conveyance of floodwater through Wisbech was improved.

3.3.5 The RNCB left a legacy of flood defences designed to contain flood flow and pass flood risk downstream. The RNCB's successors realised that a different way of managing flood risk was required and began a new approach to flood risk management with the construction of the Northampton Washlands in the 1970s.

3.3.6 The Great Ouse River Board (GORB) was also formed in 1931 under the Land Drainage Act (1930).

3.4 Sources of Flooding

Fluvial/Tidal

3.4.1 The Main River catchments within the study area are:

- River Nene;
- Moreton's Leam;
- Bedford River/Great Ouse (Ely Ouse); and
- River Delph

3.4.2 These are under the control of the Environment Agency. The locations of the main rivers/drains are presented in Figure 4 of Appendix A.

3.4.3 The Fenland Internal Drainage Boards include

- Middle Level Commissioners (MLC); and,
- North Level District IDB.

River Nene

3.4.4 The River Nene rises outside the study area to the north of Northampton, from there it flows towards Peterborough. Approximately 8km downstream of Peterborough and north of Whittlesey, is the Dog-in-a-Doublet sluice, at which point the fluvial River Nene meets the tidal reaches of the River Nene. The tidal River Nene flows from here for about 40km until it outfalls into The Wash. The flood defences along the entire stretch of the tidal River Nene consist of raised earth embankments, with the exception of the reach through Wisbech. In Wisbech the defences consist

of raised concrete walls on both the north and south banks. A Level 2 SFRA for Wisbech is currently being prepared that assesses the residual risk of a breach in these defences.

3.4.5 The narrow strip of land between the Nene and South Barrier Bank (which encompasses Moreton's Leam - described below), is known as the Whittlesey (or Nene) Washes Flood Storage Reservoir (FRS). The Washes FSR is used as a fluvial flood storage area by the Environment Agency as fluvial flood water is diverted from the River Nene into this FSR that lies between Peterborough and the Dog-in-a-Doublet, through Stanground Sluice. When the flood peak has receded, the stored water is released from the washland into the tidal channel of the river at Rings End Sluice, near Guyhirn. This area has been defined as functional floodplain.

3.4.6 As the Washes FSR can store up to 25,000m^3 of water above the surrounding land, it is subject to the Reservoirs Act 1975 and is routinely inspected by an independent engineer.

Moreton's Leam

3.4.7 Moreton's Leam is an Environment Agency Main River and runs between Peterborough and Guyhirn a subsidiary drainage channel of medieval origin, running on a parallel course south of the Nene. This Main River drains the water off the Whittlesey washes through the Nene Washland Commissioners area.

Counter Drain/Cranbrook Drain

3.4.8 The Cranbrook Drain drains relatively high land around Somersham, Earith and Colne, and discharges by gravity into the Counter Drain at Black Sluice to the north east of Earith. The Counter Drain then flows in a north-easterly direction alongside the Middle Level Barrier Bank (MLBB) and receives flows from six pumping stations. This is also known as the Old Bedford River that is discussed in the next section. Fluvial evacuation of the of the drainage system is through the Old Bedford Sluice, when tide levels in the tidal River Ouse are favourable; but during times of flood evacuation is mainly though Welches Dam Pumping Station[6]

3.4.9 Welches Dam pumping station is nearing the end of its useful life and 'The Cranbrook/Counter Drain Flood Risk Management Strategy[7] was commissioned to identify short, medium and long term strategies.

Bedford River/Great Ouse (Ely Ouse)

3.4.10 The Bedford River/Great Ouse has a large upstream catchment including Huntingdon, Bedford and Milton Keynes. It flows into the study area at Earith where a sluice controls its flow. The old course of the Great Ouse, (locally known as the Ely Ouse) flows outside of the Fenland District and into East Cambridgeshire.

3.4.11 However, as part of the flood alleviation in the Fens two new drainage channels were cut one of which (Old Bedford) forms the majority of the south eastern boundary of the Fenland District. The first was the drain now known as the Old Bedford River that was created in the 1630s from Earith to Denver. The second was the New Bedford River (Hundred Foot Drain) that was created from Earith to Denver, parallel to the Old Bedford River and approximately 600 m to the east.

3.4.12 When necessary flow is directed by the Environment Agency through the two Bedford Rivers to Denver Sluice. The New Bedford River (Hundred Foot Drain) is tidal where as the Old Bedford River (separated from the tidal Ouse by the Old Bedford Sluice) remains fluvial to Denver Sluice (see Photograph 3).

Photograph 2: Denver Sluice

3.4.13 During flood conditions, the Environment Agency Earith Sluice directs flood water into the Counter Drain and River Delph which overtops and fills the Ouse Washes (in between the Old and New Bedford Rivers) and stores the flood water prior to release at low tide to the tidal Ouse at Denver. The A1101 crosses the washes at Welney and although raised is subjected to occasional flooding, however it is usually passable by vehicles with high ground clearance (see Photograph 4) and is normally closed under flood conditions.

Photograph 3: A1101 road that crosses the Washes at Welney

River Delph

3.4.14 The River Delph flows immediately adjacent to the Old Bedford River and flows into the New Bedford River approximately 2km downstream of Denver Sluice.

Middle Level

3.4.15 Between 1810 and 1862, a series of Acts of Parliament were passed which initially gave more powers, including fund raising, to the Middle Level and finally legally separated the Middle Level

from the Bedford Level, thus creating the present Middle Level Commissioners as a legally separate entity.

3.4.16 The Middle Level Commissioners are a statutory corporation which also operates under the Land Drainage Act 1991, the Flood and Water Management Act 2010 and the Nene Navigation Act 1753.

3.4.17 The Middle Level Commissioners are responsible for 120 miles (192 km) of major watercourses the majority of which are embanked. A continued programme of bank surveying and, where necessary, raising, is undertaken to ensure that the standard of protection (SoP) provided by the Commissioners' system of watercourses is a flood with a 1% Annual Exceedance Probability (AEP) - 1 in 100 chance of a flood event occurring in any year.

3.4.18 The Middle Level is a large-scale artificial drainage system that is almost entirely operated by the MLC. It is comprised of 33 Internal Drainage Boards (IDBs) that are responsible for the individual drainage within their district; the IDBs that fall within the study area are (also shown in Figure 5):

- March East
- Warboys, Somersham and Pidley
- Whittlesey
- Benwick
- Drysides
- March & Whittlesey
- Ransonmoor
- Botany Bay*
- March 3rd
- March 6th
- Nightlayers
- Curf & Wimblington Combined
- Euximoor
- Waldersey**
- White Fen.
- Sears Farm*
- Hobbs Lot*
- Upwell
- Ladus Fen
- Hundred of Wisbech**
- Needham Buriel & Birdbeck
- March 5th
- Stitches*
- Farm Care Ltd*
- Manea & Welney**
- Sutton & Mepal**
- Feldale**
- Hundred Foot Washes
- Creek Farms*

* Not IDBs but private drainage districts usually operated by one landowner.

** Not within the Middle Level catchment area but with the exception of Feldale they are administered by the MLC.

3.4.19 Occupiers of agricultural property receive a rate demand direct from the Commissioners. The "rates" on non-agricultural properties, such as houses and factories, are paid through a special levy issued to the District Councils within the Commissioners' area. These Councils, Fenland DC, Huntingdonshire DC and the Borough Council of King's Lynn and West Norfolk are, therefore, able to appoint representatives as Commissioners in respect of the payment made in relation to these properties.

3.4.20 All of the Middle Level area is dependent on artificial pumped drainage to evacuate excess rainfall.

3.4.21 Discharge directly to the high-level MLC drainage system is generally not permitted unless there is no alternative outfall point to an IDB area.

3.4.22 There are many pumping stations that are located at the edges of fields that pump water from the fields (via drainage ditches) into the larger rivers. The water level in the larger rivers is managed by larger pumping stations, locks and sluices where it is eventually pumped out to sea (The Wash). There are two areas within the Middle Level known as “ponds”; “St. Germans Pond” in the east and “Bevills Leam Pond” in the west (which is outside the Fenland study area). St. Germans Pond is at a higher level and water in the Bevills Leam Pond is pumped up to the St. Germans Pond.

3.4.23 The St Germans Pumping Station is located outside the study area but is the principal outfall from the Middle Level system into the tidal River Ouse at Wiggenhall St Germans; south east of Kings Lynn. A new pumping station at St Germans is now operational and includes six pumps that are designed to a 0.5% (1 in 200 year) annual probability event. The previous pumping station is currently being demolished.

3.4.24 Within the MLC area, a few of the larger rivers are navigable watercourses e.g. Well Creek. They are therefore responsible for maintaining the water level within this watercourses. In order for this to be achieved during the summer it is sometimes necessary for them to abstract water from the Back River (tributary of the R. Nene). However, during long hot summers it has been noted that the abstracted water from the River Nene contains a high percentage of effluent and in the past it has been agreed with the Environment Agency that abstraction should be aborted. During these conditions transfer would be halted due to the lack of available water in the River Nene system.

3.4.25 The Commissioners' watercourses are designated rivers under the Middle Level Acts, however, they are not Main Rivers. Otherwise the watercourses within the Commissioners' area are all designated ordinary watercourses.

3.4.26 The main watercourses within the Middle Level area are:

- Forty Foot Drain (also known as Vermuyden’s Drain) – flows for approximately 17.5km from Wells Bridge near Ramsey Forty Foot to Welches Dam Lock where it joins the Counter Drain (later the Old Bedford River). The eastern end of the Forty Foot River between

Horseway Lock and Welches Dam Lock is an Environment Agency watercourse, the western extent is a Middle Level watercourse;

- Bevills Leam – flows for approximately 8 km from the River Nene (Old Course) near Pondersbridge to Whittlesey Dyke at Angle Corner; as it crosses the Whittlesey Dyke it turns in to the Twenty Foot Drain;
- Sixteen Foot Drain – flows for approximately 15.5 km from the Forty Foot Drain to Three Holes where it (along with Popham's Eau) join to form the Middle Level Main Drain;

Photograph 4: Sixteen Foot Drain looking downstream from Boot's Bridge

- Middle Level Main Drain – flows for approximately 16.8km from Three Holes (where the Sixteen Foot Drain and Popham's Eau join) to St Germans pumping station (outside the study area. This drain receives most of the surface water in the Fenland District and at St Germans Pumping Station it is pumped into the tidal outfall channel of the River Great Ouse. Along its course it flows under Well Creek at Mulicourt Aqueduct to the east of Outwell;
- Kings Dyke – flows in the study area for approximately 4.2km from Stanground to Whittlesey at Ashline Lock. It is part of the Nene-Ouse Navigation Link;
- Whittlesey Dyke – flows for approximately 10km from Ashline Lock in Whittlesey to meet the River Nene (Old Course) at Floods Ferry. It is joined by Bevill's Leam at Angle corner;
- Well Creek – flows for approximately 8.5 km from the River Nene (Old Course) to Salters Lode Lock. Well Creek is at a higher level than the main drainage system and consequently receives little drainage flow and is primarily used for navigation. To maintain levels, where required Well Creek can overspill into Old Popham's Eau. Well Creek, at Salters Lode Lock is the entrance to the Middle Level system from the tidal Great Ouse.

North Level Drainage System

3.4.27 The North Level drainage system covers the area within the study boundary that is north of the River Nene (new course); north of Guyhirn and west of Wisbech. This is an artificial drainage system similar to the Middle Level drainage system although most of the North Level pumps discharge into tidal watercourses and therefore are not limited by the capacity of the receiving

watercourse. The predominantly agricultural land is drained by a network of drainage ditches that are pumped into larger rivers that outfall into The Wash. This system is managed by the North Level District Internal Drainage Board.

- The North Level District Internal Drainage Board is currently awaiting completion of an amalgamation with the Nene Washland Commissioners.

3.4.28 The principle drain that lies within the study boundary is the North Level Main Drain, which enters the study area at Cloughs Cross and flows in a north east direction for approximately 14km to a sluice at Tydd Gote where it meets the tidal River Nene.

Sewers

3.4.29 All sewer systems are typically designed to accommodate rainfall events up to a 1 in 30 year return period (although this could be as low as a 1 in 2 Standard of Protection). Consequently, rainfall events with a return period greater than 1 in 30 years would be expected to result in flooding of some parts of the sewer system. Sewers are known to cause flooding in the district.

3.4.30 Towns within the study area utilise combined sewers. Some of these, particularly those in March and Chatteris, approach capacity and result in surcharging of the system.

3.4.31 In addition, as towns and villages expand to accommodate growth, the original sewer systems are rarely upgraded and may become overloaded. This problem is compounded by climate change, which is forecast to result in milder wetter winters and increased rainfall intensity in summer months. The combination of these factors will increase the pressure on existing sewer systems, effectively reducing their design standard and increasing the frequency of flooding.

3.4.32 As part of an ongoing performance checking process associated with delivery during the AMP Period, each year OFWAT require Water Companies to report on the current number of properties in their areas at risk of flooding. This is reported under a series of returns to the Director General (DG) of OFWAT known as the June Return. OFWAT describe this process as “our main source of information…….in which each company sets out its levels of service to customers, the investment it has made and the outputs delivered”. Sewer flooding is the fifth measure and hence known as the DG5 Register.

3.4.33 Figure 6 shows the DG5 information, as provided by Anglian Water. For reasons of confidentiality and to protect individual householders, this information has not been provided on a property-specific basis, rather it indicates approximate location where sewer flooding has been recorded in the past, to give broad areas where sewer capacity may be an issue.

Groundwater

3.4.34 Groundwater flooding occurs as a result of water rising up from the underlying aquifer or from water flowing from abnormal springs. This tends to occur after much longer periods of sustained high rainfall, and the areas at most risk are often low-lying where the water table is likely to be at shallow depth. Groundwater flooding is known to occur in areas underlain by principal aquifers, although increasingly it is also being associated with more localised floodplain sands and gravels.

3.4.35 Groundwater flooding tends to occur sporadically in both location and time, and tends to last longer than fluvial, pluvial or sewer flooding. When groundwater flooding occurs, basements and tunnels can flood, buried services may be damaged, and storm sewers may become ineffective,

exacerbating the risk of surface water flooding. Groundwater flooding can also lead to the inundation of farmland, roads, commercial, residential and amenity areas.

3.4.36 Most cases of groundwater flooding in the area relate to perched water tables either as a result of extreme pluvial events or the failure of water to drain properly.

3.4.37 The Environment Agency Catchment Flood Management Plans (CFMP) present the status of flooding and can often provide locations that have experienced past flooding. Neither, the River Nene or Great Ouse CFMP indicate groundwater flooding problems within the Fenland DC area.

Surface Water

3.4.38 Surface water flooding typically arises because of intense rainfall, often of short duration, that is unable to soak into the ground and/or enter drainage systems. It can run quickly off land and result in localised flooding. The Pitt Review[8] revealed that two-thirds of the flooding in summer 2007 was a result of surface runoff in urban areas, as rainwater runs over the surface of the ground or ponds in low lying areas, and there is a growing likelihood of similar flooding in the future.

3.4.39 The key factors for surface water flooding are the volume of rainfall, its location and its intensity.

3.4.40 In urban areas, overland flow typically occurs during sudden and intense rainfall events when surface water cannot enter conventional drainage systems quickly enough, or where the finite design capacity of these systems is overwhelmed. There is therefore an inherent link between sewer flooding and overland flow/surface water flooding. This form of flooding is likely to occur in the urban parts of Fenland DC. Strategic mapping and historic records of surface water flooding events are detailed further in Section 6.

3.4.41 Large areas of impermeable surfaces, such as car parks and paving areas, are likely to be created during future development and these will generate large volumes of surface water runoff during rainfall events unless suitable mitigation measures, such as flood routing are implemented. Potential mitigation for this form of flooding is the incorporation of adequate drainage and SuDS as part of developments. Section 10 of this report outlines potential options and their suitability across the study area.

Surface water management in Fenland

3.4.42 As described in section 3.4.19, the majority of the Fenland district is artificially drained as a result of historical land reclamation and ongoing management for agricultural purposes as well as protection of settlements and infrastructure.

3.4.43 Aside from settlements on ‘dry clay islands’ and infrastructure on raised embankments, the majority of land is at or below sea level and in some areas has been subject to lowering over many years largely as a direct result of the active drainage through peat shrinkage. Therefore, in order to prevent flooding of land from accumulating surface water, rainwater falling in both the Middle Level and North Level systems has to be actively managed via a network of drainage channels, main drains (or cuts) via gravity or pumping in order to move water out of the two catchment levels in a controlled way.

3.4.44 There is a finite capacity to both the existing urban drainage system and the system as a whole where pump capacity and capacity of low gradient channels is physically constrained at key points in the catchment.

3.4.45 Flooding from surface water in Fenland is therefore a key consideration, and whilst there is active management of surface water via the drainage system, there is a finite capacity to the systems currently in operation which if exceeded, would result in increased flood risk within the drainage area. Uncontrolled development has the potential to increase both the rate and volumes of runoff and has the potential to alter the pathways that surface water takes in entering the drainage system if not controlled; therefore, location of development and control of runoff from it is an important factor in spatial planning to ensure that flood risk is not increased in both the Middle Level and North Level drainage systems.

Artificial Sources

3.4.46 Artificial sources include any water bodies not covered by the previous categories. This typically includes canals, lakes, water mains and reservoirs etc. All of these artificial features can give rise to flooding if a breach (failure in containment) occurs.

3.4.47 Within the Fenland District there are no large-raised reservoirs although there are many smaller reservoirs used for agricultural purposes that can be seen on detailed OS mapping.

3.4.48 Due to the large nature of the artificial drainage system, it has been considered as a fluvial/tidal flood source for this project rather than a man-managed system.

3.4.49 The Nene and Ouse Washes are considered flood storage reservoirs and have been classified as functional floodplain.

3.5 Operating authorities

Internal Drainage Boards

3.5.1 Internal Drainage Boards are statutory flood defence bodies created within areas of special flood defence need, usually low lying areas, that derive direct benefit from drainage operations and which provide a flood defence service within those areas, which are called 'Districts'. The Board's District is a statutory area, within which the Board provides a service to confer benefit or avoid danger through appropriate water level management operations. The role of the IDBs, who undertake works under the permissive powers conferred by the 1991 Land Drainage Act and, in some cases, older private legislation, is to provide a more local flood defence and water level management service.

3.5.2 Each of the Boards designates from their local knowledge the watercourses which they consider most important for the arterial drainage of their District and on which they will normally carry out work required. These watercourses are designated on the Board's District Plan.

3.5.3 As well as the statutory District, (which is sometimes also called the "rateable area") the IDBs are sometimes also able to control certain operations in the catchment area draining to, but outside the statutory District. This part of the catchment area is called "the highland area". To provide this service they maintain and improve watercourses and operate other assets, such as pumping stations and sluices.

3.5.4

Environment Agency

3.5.5 The Environment Agency is a governmental organisation whose overarching objective is to protect and enhance the environment in England and Wales. Further information on the roles and responsibilities of the is described in section 4.2.

4 Policy Context

4.1.1 This section provides an overview of the planning policy framework relevant to the SFRA for Fenland DC. Information contained in the SFRA on flooding and flood risk will enable the preparation of sustainable policies for flood risk management. The SFRA should be used to inform the Sustainability Appraisal of LDDs and will facilitate informed decision-making relating to land use and development allocation within the DPDs.

4.1.2 The RSS for the East of England stated that Fenland must accommodate a further 7,660 new homes by 2021. In satisfying these growth targets Fenland DC must consider a raft of planning policies (of which flooding is one) to ensure developments are sustainable. In consideration of these polices the council must decide on the 'weight' to attribute to each policy in determining the suitability of development in their areas.

4.2 Role and Responsibilities

Environment Agency

4.2.1 The Environment Agency is a governmental organisation whose overarching objective is to protect and enhance the environment in England and Wales. The Environment Agency has permissive and statutory duties to:

- Maintain or improve any watercourses which are designated as Main Rivers;
- Maintain or improve any sea or tidal defences;
- Responsible for issuing Flood Defence Consents for works, in, under, over or within 9m of the bank of a Main River, for any works affecting the flow of an ordinary watercourse (outside an IDB area) and for ground raising in Main River floodplain;
- Install and operate flood warning equipment; and,
- Control actions by riparian owners and occupiers which might interfere with the free flow of watercourses;

4.2.2 Additionally, following the amendment to the Town and Country Planning Act[9] in October 2006, the Environment Agency became a statutory consultee for the LPA for all planning applications within areas of flood risk (except minor developments). The Environment Agency's Standing Advice sets out when the Environment Agency should be consulted on planning applications (consultation matrix), it includes the following planning application scenarios:

- Householder development and alterations within 20m of the top of a bank of a Main River and/or includes culverting or control of flow of any river or stream;
- Non-residential extensions with a footprint of less than 250m² that is within 20m of the top of bank of a Main River and/or includes culverting or control of any river or stream;
- Change of use FROM 'water-compatible' TO 'less vulnerable' development within 20m of the top of bank of a Main River AND if the site falls within Flood Zone 3;
- Change of use RESULTING IN 'highly vulnerable' development within 20m of the top of bank of a Main River AND if the site falls within Flood Zone 2 or 3; and,

- Operational development of 1 hectare or greater if the development includes culverting or control of flow of any river or stream and/or the development is within Flood Zone 2 or 3.

4.2.3 In addition to the above, for certain development which may affect systems under their control, written consent is required from the Internal Drainage Boards for certain development and activities and may also require adequate supporting evidence via site specific FRAs to prove that a viable scheme for appropriate water level/flood risk management exists, and that it could be constructed and maintained for the lifetime of the development without adversely affecting their systems or the local water environment (see IDB section below).

4.2.4 Section 9 and the Environment Agency's standing advice provides further information on when the Environment Agency should be consulted in the planning application process. This section also provides advise as to when the MLCs or North Level District IDB should be consulted,

4.2.5 The study area falls entirely in the Environment Agency's Anglian Region.

Internal Drainage Boards

4.2.6 Internal Drainage Boards' (IDB) main responsibility is to maintain the watercourses designated to each IDB to prevent flooding within the board's district. IDBs are formed by members elected from the agricultural ratepayers together with representatives from the Special Levy paying Local Authorities. They have permissive powers to undertake maintenance and choose to exercise their powers on Designated Main Drains. Permissive powers means that the IDBs are permitted to undertake works on ordinary watercourses but the responsibility remains with the riparian owner as the IDB are not obligated.

4.2.7 The MLC and North Level District Internal Drainage Board operate the IDBs within the study area. The North Level District IDB has 14 elected farmer representatives plus six Fenland District Council representatives with a further five from Peterborough City and three from South Holland District Council. The boundaries of the IDBs are presented in Figure 5.

4.2.8 Under the Land Drainage Act 1991, the MLC and North Level District have bye-laws for governing the watercourses they are responsible for. The Land Drainage Act (1991)[10] states that: 'these are considered necessary for securing the efficient working of the drainage system in their district'. A separate document is available from the North Level District Internal Drainage Board (2006) which includes over 33 byelaws. The byelaws include reference to control systems, operations, obstacles, set back distances and safety.

4.2.9 The IDBs therefore have a role in the development control process and pre-application discussions and under the bye-laws, written consent is required from the IDB where development or an activity may have an impact on the effective operation of watercourses or the drainage system under their control (see section 9 of this report).

4.2.10 Standard Advice is provided by the MLC for IDBs under their management jurisdiction and Board requirements are provided by the North Level District IDB which summarise the conditions when written consent (or bye-law consent) is required from them under the bye-laws. Both the MLC Standing advice and Board requirements are available on the respective organisation's websites.

4.2.11 In addition to where written consent is required for certain development/activities the MLC's Standard advice on Development Control, sets out when they should be consulted on proposals

for development[1] and where they may request a site specific FRA is carried out. These requirements are in addition to where an FRA is required under PPS25. Further guidance is provided in Section 9 of this report. Copies of the detailed MLC and North Level bye-laws can be viewed on their websites.

4.2.12 The Commissioners encourage pre-application engagement with developers in the preparation of site plans. This is promoted in the Pitt Review (2008)[8], PPS25[1] and PPS1[21].

Award Drains

4.2.13 An Award Drain is a protected watercourse for which the District Council have responsibility – in a similar manner to IDBs having powers over certain watercourses. Within the study area a significant eastern part of Chatteris is served by an Award Drain.

Lead Local Flood Authority

4.2.14 In April 2010, the Flood and Water Management Act gained Royal Assent and with it came a number of responsibilities for unitary authorities and County Councils in two tier areas, defined as Lead Local Flood Authorities (LLFAs), which for Fenland District is Cambridgeshire County Council. In relation to Fenland DC, Cambridgeshire County Council are required to:

- Investigate and record flooding incidents;
- Produce an asset register of all flood risk related assets;
- Develop a preliminary flood risk assessment;
- Be responsible for controlling actions by riparian owners and occupiers which might interfere with the free flow of watercourses outside an IDB rateable area; and,
- Adopt and maintain SuDS.

Local Planning Authority

4.2.15 Following the amendment to the Town and Country Planning Act, for some planning applications it is the responsibility of the council to consult the Environment Agency. There are three guidelines as to when the LPA should consult the Environment Agency that have been summarised in Table 4-1.

1

'development' refers to any proposed change to land, either permanent or temporary, that:
- Affects, or is situated within, a watercourse whether open, piped, sewered or culverted;
- Affects the existing groundwater system;
- Encroaches upon or affects access to existing maintenance access strips provided under the Byelaws; or
- Increases surface water or groundwater discharges to the downstream systems.

Table 4-1: Table to show the circumstances in which the LPA has the responsibility to consult the Environment Agency

PPS25[1]	Town and Country Planning Act	Environment Agency Standing Advice[11]
On all planning applications in areas of flood risk	On all planning applications in areas of flood risk	Householder development and alterations within 20 m of the top of a bank of a Main River and/or includes culverting or control of flow of any river or stream;
On all planning applications in areas with critical drainage problems, other than minor developments[2]	On all planning applications that are in areas where there are critical drainage problems, other than minor developments[2]	Non-residential extensions with a footprint of less than 250 m² that is within 20 m of the top of bank of a Main River and/or includes culverting or control of any river or stream;
For all developments of sites of more than 1 hectare elsewhere	For all developments of sites of more than 1 hectare elsewhere	Change of use FROM 'water-compatible' TO 'less vulnerable' development within 20 m of the top of bank of a Main River AND if the site falls within Flood Zone 3
-	-	Change of use RESULTING IN 'highly vulnerable' development within 20 m of the top of bank of a Main River AND if the site falls within Flood Zone 2 or 3
-	-	Operational development of 1 hectare or greater if the development includes culverting or control of flow of any river or stream and/or the development is within Flood Zone 2 or 3

4.2.16 In addition, the Local Authority should consult with the relevant IDB for certain development as set out in section 9 of this report.

Sewerage Undertakers

4.2.17 Sewerage undertakers are responsible for surface water and foul drainage from developments, where this is adopted via adopted sewers. Under the Water Industry Act 2003 sewerage undertakers are legally obliged to take on both surface and foul water from new developments. Additionally, they have a role of providing information to LPA's so that an SFRA takes into account any areas of critical drainage problems. Anglian Water is the only sewerage undertaker within the study area. There are some recent changes to the role and duties with respect to right to connect surface water to adopted sewers through the Flood and Water Management Act 2010 although these have yet to be formalised.

[2] "minor development" means – i) development of an existing dwelling-house, or development within the curtilage of such a dwelling house, for any purpose incidental to the enjoyment of the dwelling-house as such; ii) the extension of the existing building used for non-domestic purposes where the floorspace created by the development does not exceed 250 square metres; and, iii) the alteration of an existing building where the alteration does not increase the size of the building

Highways Agency

4.2.18 The Highways Agency is responsible for maintaining major roads throughout England; this includes the upkeep of the stormwater drainage infrastructure associated with the road network.

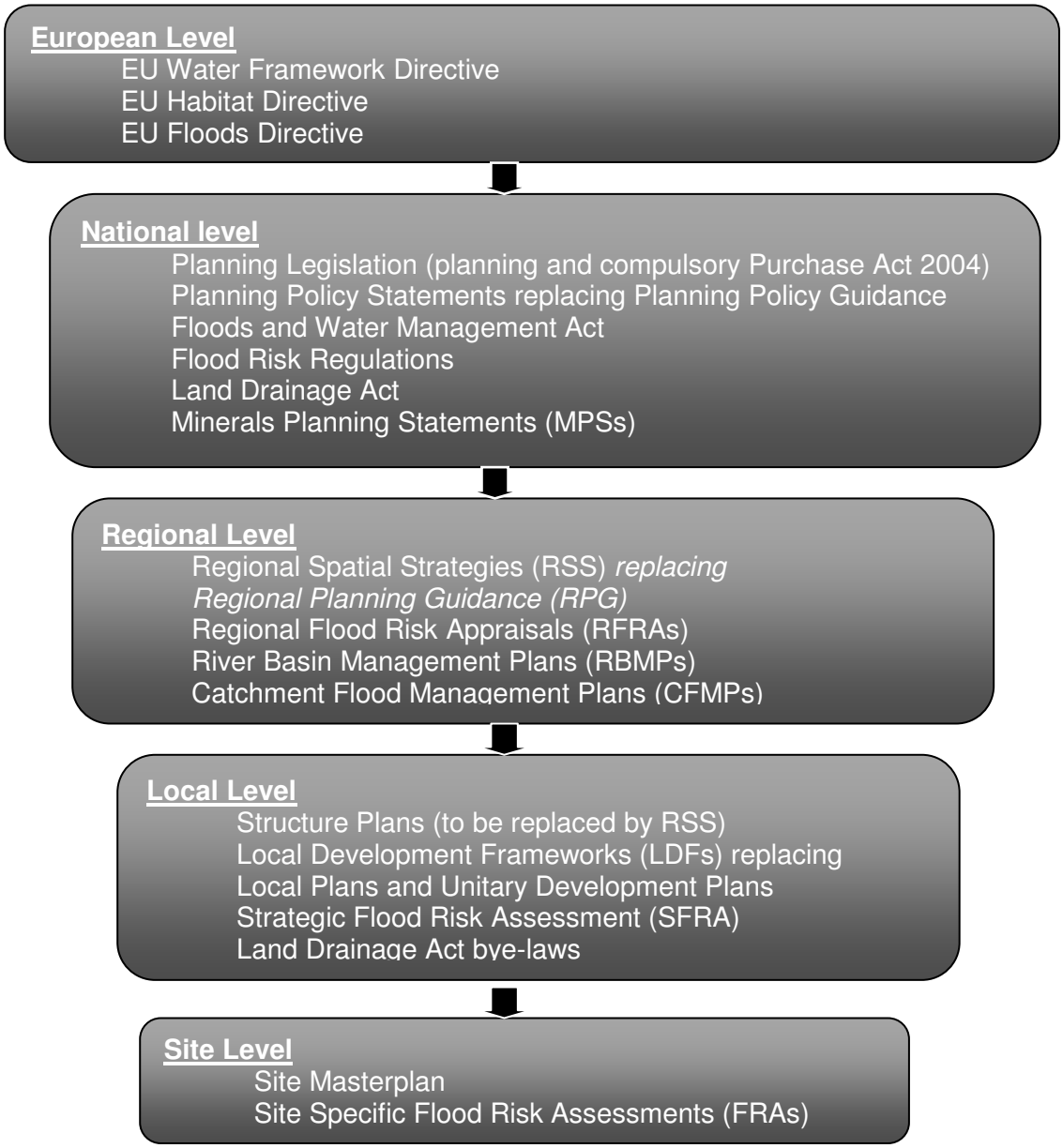
Landowners

4.2.19 Landowners are responsible for safeguarding their land and other property against natural hazards, such as flooding. It is also the responsibility of landowners to manage the drainage of their land in such a way to prevent, as far as practicable, adverse impacts on neighbouring properties.

4.3 Flood Risk Policy

4.3.1 Figure 4-1 outlines the structure of the current planning system including supporting documents such as the River Basin Management Plans and Catchment Flood Management Plans. It should be noted that the Regional Spatial Strategies (RSS) introduced in 2004 are likely to be revoked by the forthcoming Localism Bill. Further information is provided in Section 4.6 Regional Policy.

Figure 4.1 Planning System Structure



4.3.2 Appendix A contains more detail on European and National Policies that relate to flooding and should be considered in context to flood management. The main policy for consideration of flood risk is PPS25 which is outlined in brief below.

Planning Policy Statement 25: Development & Flood Risk[1]

4.3.3 Planning Policy Statement 25 (PPS25)[1] requires that local planning authorities achieve the following when preparing the local development framework:

- Set out policies that seek to avoid flood risk wherever possible and manage it elsewhere;
- Seek opportunities to relocate particularly vulnerable developments to locations at less risk of flooding, taking into account the impacts of climate change;
- Safeguard land from development that is required for current and future flood management.
- Allocate all proposed development sites in accordance with the 'Sequential Test', reduce the flood risk and ensure that the vulnerability classification of the proposed development is appropriate to the Flood Zone classification;
- Require site-specific FRAs to be submitted for all developments within Flood Zones 2 and 3 or over 1 hectare in size in Flood Zone 1 and for sites with identified flood sources, to assess the risk of flooding to the development and identify options to mitigate the flood risk to the development, site users and surrounding area;
- Flood Risk to development should be assessed for all forms of flooding;
- Where floodplain storage is removed, the development should provide compensatory storage on a level for level and volume for volume basis to ensure that there is no loss in flood storage capacity.

4.3.4 PPS25 aims to ensure that flood risk is taken into account at all stages in the planning process from the inception of regional and local policy through to individual development control decisions.

4.3.5 The document seeks to avoid inappropriate development in areas at risk of flooding and to direct development away from areas of high risk through the application of the sequential approach and the precautionary principle. It is acknowledged that, in some exceptional circumstances, it might not be possible to deliver available sites in lower risk zones through the sequential approach. Here policy will aim to ensure that the development will be safe, without increasing flood risk elsewhere and, where possible, reducing flood risk overall.

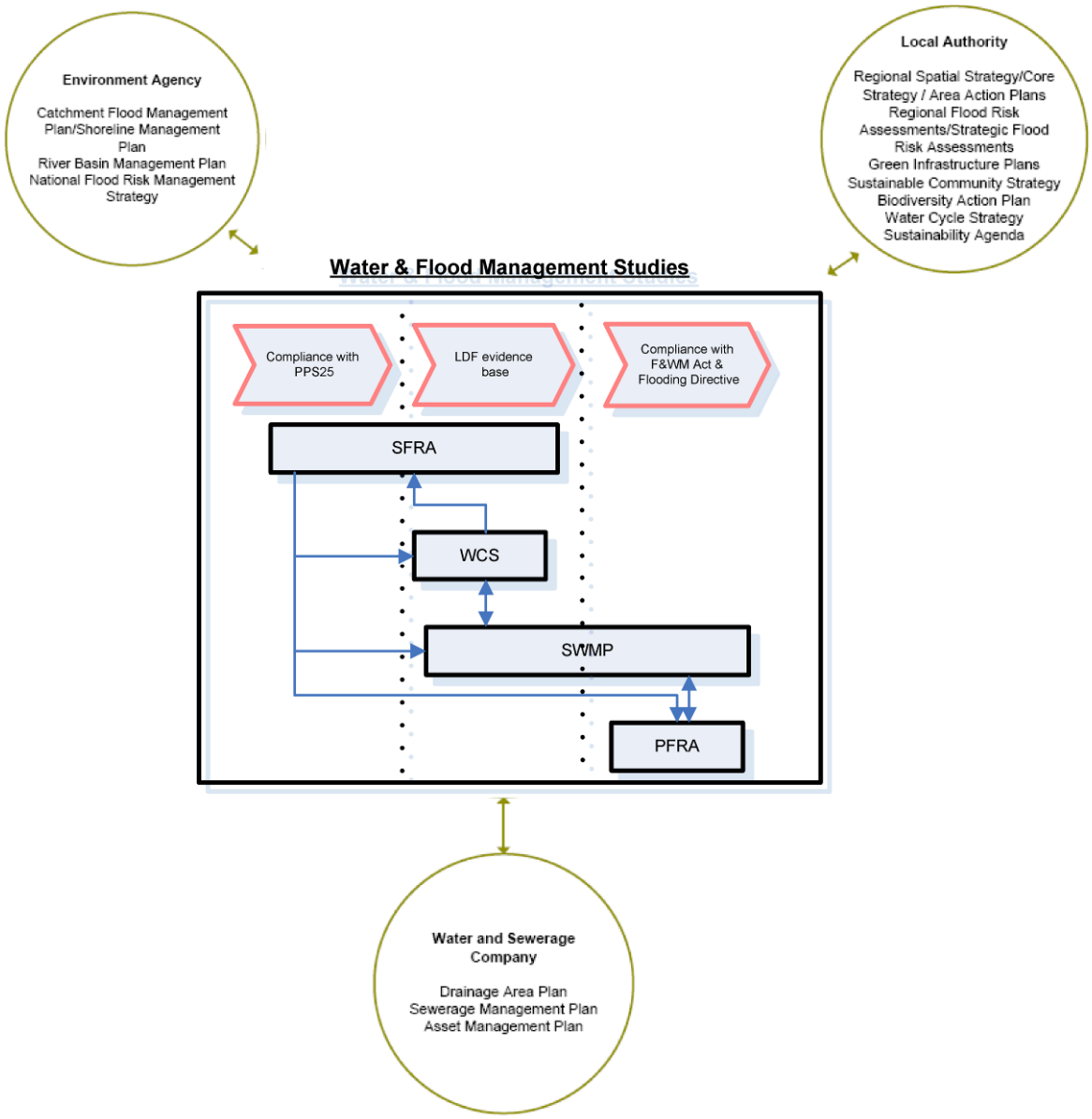
4.4 Cambridgeshire Flood & Water Management Studies

4.4.1 In line with policy and legislation requirements, there are several flood and water management studies either completed or ongoing in the study area that are interlinked with the SFRA.

4.4.2 Other water management studies are currently being undertaken around the County include a Surface Water Management Plan and SFRAs for East Cambridgeshire District Council, Cambridge City Council and South Cambridgeshire District Council.

4.4.3 Figure 4.2 shows the inter-linkages between these study reports and the SFRA.

Figure 4.2: Linkages between a LPA's water and flooding management studies[34]



4.5 Studies Progress

4.5.1 The Surface Water Management Plan (SWMP) for Cambridgeshire Council is due to commence upon completion of the Outline WCS (Sept 2010). This Outline WCS will therefore inform the initial stages of the county wide SWMP, whereas the Stage Detailed WCS will both inform and be informed by the ongoing SWMP.

[3] adapted from Surface Water Management Plan Technical Guidance, DEFRA 2010

[4] IDB plans should also be referred to in the preparation of these documents.

4.5.2 The Level 1 SFRA for East Cambs and Fenland is due for completion at the same time as the Outline WCS (Sept 2010). The Outline WCS has been informed by the developing SFRA in terms of flood risk to development areas and management of surface water. The Level 1 SFRA will feed into the initial stages of the SWMP.

4.6 Regional Policies

4.6.1 The RSS published by the Communities and Local Government (CLG) provided a broad development strategy for the region for a 15 to 20 year period. It also informed the preparation of Local Development Documents (LDD) and regional and sub-regional strategies.

4.6.2 Following the election of a coalition government in May 2010, a Devolution and Localism Bill has been confirmed which intends to *'shift power from the central state back to the hands of individuals, communities and councils'.* This Bill includes legislation to revoke the RSSs.

4.6.3 Until a replacement is confirmed, the previous Regional Spatial Strategy still forms the basis of the strategic planning and development decisions in the study area that formed the evidence for the Core Strategy. Therefore a summary of the East of England Plan is included in Appendix A for reference.

4.7 Local Policies

Local Plans

4.7.1 Fenland District Council is empowered by law to exercise planning functions. This includes the preparation of strategic planning documents that set out the planning vision for the administrative area, with due regard to national and regional policies.

4.7.2 Currently Fenland DC are involved in the process of preparing their Local Development Framework, this is comprised of:

- Development Plan Documents (which form part of the statutory development plan);
- Supplementary Planning Documents;
- the Statement of Community Involvement;
- the Local Development Scheme; and,
- the Annual Monitoring Report

4.7.3 Until such a time as the LDF is adopted, the saved policies of the Local Plan and Interim Statement of Proposed Changes SPG 2001, and the Cambridgeshire and Peterborough Structure Plan, remain the statutory development plan for the district.

Fenland Local Plan

4.7.4 The Fenland District-Wide Local Plan was adopted in 1993 covering the period up to 2006. The following polices are relevant to this SFRA:

Policy PU1

4.7.5 The district council will expect new developments to make satisfactory arrangements for water supply, sewerage and sewage disposal, land drainage and flood protection matters.

Local Development Framework (LDF)

4.7.6 The production of the LDF for Fenland DC is underway, and will be made up of Local Development Documents (LDDs). This SFRA forms part of the evidence base to support the emerging LDDs in particular the Core Strategy Development Plan Document. It will also be used to inform the Sustainability Appraisal of the Core Strategy Policies.

Fenland Core Strategy

4.7.7 A Shaping Fenland Study is currently underway which is due for completion in November 2010. This will inform FDC's emerging Core Strategy. A Preferred Options document of the Core Strategy is intended to be available for public consultation in mid 2011. The previous draft version of the Core Strategy – Preferred Options 2 in 2007, highlighted the following:

- Development should not take place in areas at risk of flooding, unless suitable flood management and mitigation measures can be agreed and implemented not increase the risk of flooding of properties elsewhere (e.g. through additional surface water run-off, or by impeding the flow or storage of flood water).
- Development should not have a detrimental effect of existing flood defences or inhibit flood control and maintenance work.
- Development should be accompanied by a FRA for sites located in areas where there are a 0.1% or greater annual probability of flooding, or where there are particular issues relating to other sources of flooding and/or drainage issues. The FRA should be appropriate to the scale and nature of the development and the risks involved.
- Development should make use of Sustainable Urban Drainage Systems (SUDS) wherever practicable.

5 Data Collection and Review

5.1 Data Collection

5.1.1 One of the objectives was to 'collect, collate and review available information on flood risk for the study area'. This section describes the data collection process, presents the available data and discusses its benefits and limitations.

Stakeholder Consultation

5.1.2 In the preparation of this Level 1 SFRA, the following stakeholders were contacted to provide data and information:

- Environment Agency;
- Highways Agency;
- Internal Drainage Boards – North Level District IDB and MLC;
- Anglian Water;
- East Cambridgeshire District Council; and,
- Fenland District Council.

Data/Information Requested

5.1.3 Information and data requested from the stakeholders was based on the following categories:

- Terrain Information e.g. LiDAR, SAR;
- Hydrology e.g. the main and ordinary watercourses;
- Hydrogeology e.g. groundwater vulnerability zones;
- Flood Defence e.g. flood walls/embankments, sluices;
- Environment Agency Flood Levels e.g. at flood monitoring points;
- Environment Agency Flood Zone Maps;
- Local Authority Information e.g. Local Development Schemes, Minerals and Waste sites;
- Internal Drainage Board information ;
- Historic Flooding Records and areas of known surface water flooding problems/restrictions; and,
- Geological Information.

5.2 Data Review

Topographic Data

5.2.1 The Environment Agency has provided Light Detection and Ranging (LiDAR) data for the study area. LiDAR is an airborne mapping technique, which uses a laser to measure the distance between the aircraft and the ground. The data varies in accuracy depending on the nature of the terrain such as in woodlands, complex urban areas and near lakes, where the accuracy reduces

due to the limitations in the technique. However, LIDAR is generally recognised to have an accuracy of +/- 300mm. The data set covers 100% of the study area and is presented in Figure 2.

5.2.2 This data is important because an accurate and up to date Digital Terrain Model (DTM) is required in order to produce high-resolution flood risk mapping.

5.2.3 The majority of the fenland area (approximately half of the Fenland district) lies below 0mAOD and is relatively flat. Most of the towns and larger villages within the study area have been developed on "islands" of relatively high elevations that vary to around 5m AOD. This includes Wisbech, March, Whittlesey and Chatteris.

5.3 Environment Agency Flood Zone Maps

5.3.1 PPS25[1] Flood Zones subdivide the spatial variation of flood probability from rivers and the sea into 4 zones; the functional floodplain and the High, Medium and Low probability Flood Zones.

5.3.2 The Environment Agency has provided present day Flood Zone extents for Flood Zones 2 and 3 for the watercourses within the study area. The Environment Agency Flood Mapping is presented in Figure 7.

5.3.3 The Flood Map shows the estimated extent of Flood Zones 2 and 3 (ignoring the presence of flood defences) for all main rivers and/or watercourses with identified critical drainage problems and provides a good indication of the areas at risk of tidal and fluvial flooding in the study area. However, it does not provide detail on individual properties, or information on flood depth, speed or volume of flow. It also does not show flooding from other sources, such as groundwater, direct runoff from fields, or overflowing sewers.

Table 5-1: PPS25[1] Flood Zone classifications

Flood Zone	Definition	Probability of Flooding
Flood Zone 1	At risk from flood event greater than the 0.1% (1 in 1000 year) annual probability storm event	Low Probability
Flood Zone 2	At risk from flood event between the 1% (1 in 100 year) and 0.1% (1 in 1000 year) annual probability storm event	Medium Probability
Flood Zone 3a	At risk from a flood event less than or equal to the 1% annual probability (1 in 100 year) storm event	High Probability
Flood Zone 3b	At risk from a flood event less than or equal to the 5% annual probability (1 in 20 year) storm event	Functional Floodplain

5.3.4 The Environment Agency's Flood Map has been developed using a combination of detailed information from appropriate hydraulic models (where available) and outputs from the Environment Agency's National Generalised Model (JFLOW). Hydraulic models use detailed topographic data and rigorously derived flow estimates to derive flood extents. The National Generalised Model outputs are derived from less accurate topographic data (SAR/LiDAR data) and national data for river flows.

5.3.5 The flood maps are reviewed every 3 months and where there has been additional hydraulic modelling the flood extents are incorporated into Flood Zones 2 and 3.

5.4 Fluvial/Tidal Data

5.4.1 GIS layers were provided by the Environment Agency, the MLC and the North Level IDB to show the locations of their Main rivers and main drains, respectively.

5.5 Hydraulic Modelling

5.5.1 Hydraulic models have been developed for some watercourses to enable the delineation of flood plains and flood depths based on detailed topographic data of river channels including structures (bridges, culverts etc) and flood defences. Detailed hydrological analysis provides a range of flow estimates for use in the models enabling the estimation of flood extents for a range of flood return periods.

5.5.2 Hydraulic models have been developed for watercourses within the Fenland DC SFRA study area. Hydraulic modelling outputs were requested from and provided by the Environment Agency. Table 5-2 shows the watercourses for which hydraulic model results are available.

5.5.3 The Environment Agency are currently undertaking overtopping and breach hazard mapping along the Tidal Nene between Guyhirn and Sutton Bridge, the 'Tidal Nene Hazard Mapping Project'. These outputs were not available for this study, but should be used in any future revisions of this report or in a further detailed Level 2 study if it is considered necessary.

5.5.4 A Level 2 SFRA is being undertaken for Wisbech that includes hydraulic modelling. The results of the modelling however have not been reviewed as part of this report, but may be used by Fenland District Council in the application of the Sequential and Exception Test, if necessary (see Section 7 & 8).

5.5.5 The IDBs have commissioned a number of studies on the watercourses within their rateable area, These include, but not limited to:

- Bullen Consultants (2004) *'Middle Level Commissioners Middle Level Strategy Study',* Bullen Consultants: Peterborough.
- Scott Wilson (2006) *'Nightlayers IDB Catchment Study',* Scott Wilson: Basingstoke.
- Scott Wilson (2007) *'March Third DDC Catchment Study'.*

Table 5-2: Summary table showing the hydraulic model data available for the Fenland SFRA study area

Main River	Study Name	Modelled By	Date Completed	Modelling Software	All Model Runs	Including Defences	Excluding Defences
Counter Drain/Cranbrook	Cranbrook/Counter Drain FRM Strategy		March 2006		Unavailable		
River Delph	Unavailable				Unavailable		
Forty Foot	Unavailable	Bullen Consultants	March 2004	ISIS	Easter 1998, 25yr, 50yr, 100yr, 150yr, 200yr and runs including the effects of climate change.		
Twenty Foot	Unavailable	Bullen Consultants	March 2004	ISIS	Easter 1998, 25yr, 50yr, 100yr, 150yr, 200yr and runs including the effects of climate change.		
Sixteen Foot	Unavailable	Bullen Consultants	March 2004	ISIS	Easter 1998, 25yr, 50yr, 100yr, 150yr, 200yr and runs including the effects of climate change.		
Well Creek	Unavailable				Unavailable		
Kirtling Brook	Unavailable				Unavailable		
Morton's Leam	Nene Strategic Model	Halcrow	September 2008	ISIS	2yr, 5yr, 10yr, 25yr, 50yr, 75yr, 100yr, 200yr, 1000yr, 100yr+cc, 200yr +cc, 1000yr+cc Only node points from Stanground to Dog-in-a-Doublet (no extents)	Yes	Yes
Old Popham's Eau	Unavailable	Bullen Consultants	March 2004	ISIS	Easter 1998, 25yr, 50yr, 100yr, 150yr, 200yr and runs including the effects of climate change.		
New Popham's Eau	Unavailable	Bullen Consultants	March 2004	ISIS	Easter 1998, 25yr, 50yr, 100yr, 150yr, 200yr and runs including the effects of climate change.		
Bevill's Leam	Unavailable	Bullen Consultants	March 2004	ISIS	Easter 1998, 25yr, 50yr, 100yr, 150yr, 200yr and runs including the effects of climate		

MAIN RIVER	Study Name	Modelled By	Date Completed	Modelling Software	All Model Runs	Including Defences	Excluding Defences
					change.		
Old River Nene	Unavailable	Bullen Consultants	March 2004	ISIS	Easter 1998, 25yr, 50yr, 100yr, 150yr, 200yr and runs including the effects of climate change.		
River Nene Dog-in-a-Doublet to Northampton (fluvial)	Nene Strategic Model	Halcrow	September 2008	ISIS	2yr, 5yr, 10yr, 25yr, 50yr, 75yr, 100yr, 200yr, 1000yr, 100yr+cc, 200yr +cc, 1000yr+cc Only node points from Stanground to Dog-in-a-Doublet (no extents)	Yes	Yes
River Nene (tidal)	Nene SFRA			JFlow	2yr, 5yr, 10yr, 25yr, 50yr, 75yr, 100yr, 200yr, 1000yr, 100yr +cc, 200yr+cc, 1000yr+cc (no extents)	Unknown	Unknown
Whittlesey Dyke	Unavailable	Bullen Consultants	March 2004	ISIS	Easter 1998, 25yr, 50yr, 100yr, 150yr, 200yr and runs including the effects of climate change.		

5.6 Historical Flooding Events

Environment Agency Data

5.6.1 Historical flood extents have been provided by the Environment Agency as a GIS layer and have been mapped in Figure 9. Table 3-2 in Chapter 3 provides a summary of the historical flood extents and a description provided by the Environment Agency. No point data has been provided by the Environment Agency.

5.6.2 Further information on Historical Flooding events from the councils are being collated as part of the Surface Water Management Plan for Cambridgeshire which is currently being undertaken.

5.7 Surface Water

5.7.1 Surface water flooding typically arises following intense rainfall, often of short duration, that is unable to soak into the ground or enter receiving drainage systems. It can run quickly off land and result in local flooding. In developed areas, surface water flow tends to occur when it cannot enter overloaded drainage systems during significant rainfall events. There is therefore an inherent link between sewer flooding and overland flow/surface water flooding. Cambridgeshire County Council is currently preparing a Preliminary Flood Risk Assessment (PFRA) and county-wide Surface Water Management Plan (SWMP), which will identify areas at risk of surface water flooding.

5.7.2 As described in section 3.4.42, surface water flooding in the Fenland District is managed and controlled via a network of managed drainage channels, main drains (or cuts) and pumping stations to move water out of the two catchment levels in a controlled way. There is a finite capacity to both the existing urban drainage system and the system as a whole where pump capacity and capacity of low gradient channels is physically constrained at key points in the catchment.

5.7.3 Information was sought from the IDBs for areas of known surface water flooding problems or areas where disposal of surface water is restricted,

National Environment Agency Mapping: Flood Map for Surface Water

5.7.4 Following the summer 2007 flood events, the Environment Agency has undertaken broad scale surface water mapping in order to provide an indication of areas susceptible to surface water flooding. The mapping for Fenland has been supplied by the Environment Agency and is shown in Figure 10A and 10B, for the 1 in 30 year and 1 in 200 year return periods.

5.7.5 The maps have been produced using a simplified method that excludes urban sewerage and drainage systems, excludes buildings, and uses a single rainfall event. The mapping is primarily intended for use by Local Resilience Forums (LRFs) and to inform emergency planning, but has recently been released for use in SFRAs to inform the most strategic levels of land use planning. It is not intended for use in allocating individual sites or determining individual planning applications. This mapping has the following limitations:

- The mapping does not show the interface between the surface water network, the sewer systems and the water courses;

- It does not show the susceptibility of individual properties to surface water flooding;
- The mapping has significant limitations for use in flat catchments with managed drainage, which is important in Fenland.

5.7.6 In the light of these limitations, it is recommended that the mapping be used only as an initial review of surface water flooding. More detailed assessments are required at site specific level to fully represent the risk of surface water flooding in relation to the managed drainage system. Known problem areas are highlighted for the Middle Level catchment in Figure 15.

5.8 Groundwater

5.8.1 Geological mapping is a useful tool for identifying areas where there is a potential for groundwater flooding. For instance, groundwater flooding is often associated with Chalk catchments.

5.8.2 Information on the solid and drift geology of the study area has been obtained from the British Geological Survey (Figures 3). This provides an overview of the geology and is useful for identifying areas which may be affected by groundwater flooding issues at an SFRA level.

5.8.3 Observation borehole records and groundwater flooding incident records were requested from the Environment Agency. However, these do not exist owing to a lack of aquifers at outcrop within the area.

5.9 Sewer Flooding

5.9.1 As mentioned previously, sewer systems are typically designed and constructed to accommodate rainfall events with a 30-year return period or less, depending on their age. Consequently, rainfall events with a return period greater than 30 years would be expected to result in surcharging of some parts of the sewer system.

5.9.2 Records of sewer flooding have been obtained from Anglian Water via a query of their DG5 registers. In order to fulfil statutory commitments set by OFWAT, water companies maintain verifiable DG5 registers which record flooding arising from public foul, combined or surface water sewers and identify where properties suffered internal or external flooding.

5.9.3 It is recommended that information regarding localised sewer flooding issues is requested when preparing site-specific FRAs.

5.10 Artificial Sources

5.10.1 Artificial sources of flooding can include reservoirs, canals and lakes where water is retained above natural ground level. Failure of such a structure could result in rapid inundation of the surrounding area with little or no warning. These artificial sources can be identified on Ordnance survey mapping along with the presence of any embankments, which would retain water above ground level.

5.11 Current Flood Risk Management Practices

5.11.1 Flood management measures are those measures put in place to reduce the risk to people and property from the hazard of flooding. These management measures can be divided in to six types:

- Flood Defences;
- Flood Risk Management;
- Flood Warning;
- Flood Alleviation Techniques;
- Flood Risk Management Strategies; and,
- Emergency Plans.

Flood Defences

5.11.2 Flood defences are typically engineered structures designed to limit the impact of flooding. Flood defences take several forms including bunds/embankments, canalised channels, culverts, retaining walls, pumping stations, weirs and flood storage areas among others.

5.11.3 Flood defences are typically designed and constructed to protect people and property from a given magnitude of flood. This is referred to as the standard of protection (SOP) and may vary depending on the age of the structure, the value attributed to the people and property it is designed to serve and the scale/cost of works necessary to construct the defence. For new defences, these issues and others are balanced through a cost benefit analysis to determine if investment in defence schemes can be justified.

5.11.4 Information on defence structures within the study areas has been provided by the Environment Agency and from their National Flood and Coastal Defence Database (NFCDD). The NFCDD is used as a repository for information relating to flood defences including their location, type, condition and design standard. . Details of all NFCDD flood defences in the study area are presented in Figure 8. It should be noted that the NFCDD only relates to Environment Agency assets and other features that are not designated flood defences or flood defences that are managed by other operating authorities have not been identified on this figure.

5.11.5 The Standard of Protection for some of the defences has been provided through the NFCDD, as well as separately from the Environment Agency, which is also illustrated in Figure 8.

5.11.6 From a review of the information presented in the NFCDD it can be seen that there are defences along the Old Bedford River and River Delph, which form the south eastern boundary of the study area. These are defended to differing standards, as shown in Figure 8, on the north-western bank only. The area between the Old Bedford River and Delph, and the New Bedford River, the 100 Foot Washes, is used for flood storage and is therefore classified as functional floodplain.

5.11.7 The areas benefiting from the flood defences (as defined by the Environment Agency) have not been used in this SFRA. The current information does not include the benefit afforded by all of the defences and subject to funding, further catchment modelling of the River Great Ouse will be undertaken to update the information layer. The area is also more widely defended by the operation and maintenance of watercourses under the control of the various IDBs who maintain a

varying defence standard for areas under their jurisdiction. It is recommended that individual planning applications refer to both the Environment Agency and the relevant IDB to gain information on the most recent standard of protection for the area in question.

5.11.8 As many of these defences in the study area are raised above the adjacent land, although they are well maintained, there is a residual risk of a breach in the defences.

5.11.9 It should be noted that the Environment Agency is working on a new asset management system as part of their Creating Asset Management Capacity (CAMC) project to replace the NFCDD. The aim of this project is to produce an easier to use system that will allow linear watercourse features to be easily recorded on a database, alongside fixed point assets such as pumping stations, weirs, sluices and other flood defences. This system is due to go live in April 2012.

Flood Warning

5.11.10 Ensuring people in areas of flood risk are aware of potential flooding is key to ensuring they are prepared, facilitating the protection of property and evacuation where necessary.

5.11.11 The Environment Agency operates a flood warning service in all areas at risk of flooding. It consists of four flood warning codes from 'All Clear' to 'Severe Flood Warning' that indicate the level of danger. The flood warnings are disseminated through a variety of mediums that include TV, radio, an automated voice messaging service direct to a phone/fax/pager, the Internet and/or loudhailer. There is also an emergency Floodline number (0845 988 1188) and a quick dial number for individual rivers.

5.11.12 MLC are on the Environment Agency's Flood Warning Direct system and are advised of flood warnings in accordance with the Environment Agency's protocol's. There is Quickdial number specifically for "Rivers, dykes and drains in the Middle Level Commissioners' Drainage Area". The MLC are also stakeholders in the Cambridgeshire and City of Peterborough Flood Incident Management Planning Group.

5.11.13 The Nene CFMP[27] identifies areas of the Fenland District that fall within Environment Agency flood warning areas. The Flood Warning areas cover virtually the entire study area, with the exception of higher areas (March, Whittlesey and Chatteris) and the functional floodplain (Ouse Washes)

5.11.14 It should be noted that flood warnings are only provided for flooding from fluvial and tidal sources, they do not include warnings of flooding from other flood sources. For example no flood warnings are issued when drains are surcharged or for flooding from overland flow.

Flood Alleviation Schemes

Wisbech tidal flood walls and gates

5.11.15 The town of Wisbech is protected from tidal flooding up to the 1-in-200 year flood event, by a system of flood defences mainly comprising flood walls and flood gates. Some of the walls are set within the busy port area of the town, where access to the quayside and related properties and businesses is required. Access is provided via a number of flood gates, with vehicular and pedestrian access built into the walls. Under normal circumstances the flood gates are left open, but when the predicted tidal water level reaches a trigger level, they are closed by Environment Agency staff.

5.11.16 In addition to the above, the Tidal River Nene Strategy identified the need for the Wisbech Flood Risk Management (FRM) Scheme, which received approval from Defra in 2007. The study gave a preferred option to maintain the standard of protection against tidal flooding to the 1-in-200 year flood event, capital maintenance work to the existing flood walls. The work will include raising the defences to ensure that the standard of protection is effective over the design life of the scheme and this work is currently being undertaken.

Flood Risk Management

5.11.17 In addition to the flood defences and warning services provided by the Environment Agency, the Environment Agency and IDBs are also involved in an ongoing programme of maintenance and management of water levels and watercourses throughout the study area. The Environment Agency maintenance and operations department carry out channel clearances, maintain defences and structures and ensure that water levels are maintained. The Local Authorities and the Internal Drainage Boards also undertake work on smaller, ordinary watercourses to ensure that culverts are clear of debris.

5.11.18 These activities form an important part of the overall flood risk management of the area and ensure that flood defences and flood warning assets operate as designed. No information was available from the Environment Agency or the Local Authority of the maintenance programmes in the study area, although it is understood the Councils maintenance budget for the Award Drains is limited.

5.11.19 The Commissioners and Boards monitor, in accordance with respective policy statements, the condition of their respective pumping stations, structures and watercourses, particularly those watercourses overspilling which could affect urban property. Consistent with the established need, a routine maintenance programme is in place to ensure that the condition of the Commissioners' and Boards' assets is commensurate with the SoP which is sought. Where standards are not at the policy level, improvement works are considered and undertaken where it is appropriate to do so. The Board actively maintains and undertakes improvements to its systems to ensure that it is able to serve the urban area.

Emergency Planning

5.11.20 Fenland DC has also provided a GIS layer of the refuge centres used in the event of an emergency as well as a GIS layer of those buildings deemed more vulnerable according to PPS25[1] vulnerability classifications. These include hospitals, adult care homes, special schools, secondary schools and primary schools.

5.11.21 Fenland DC's Flood Action Plan is based upon the concept of a "single point of contact" which is normally the District Council's Emergency Planning Coordinating Officer (EPCO) or, in his or her absence, a reserve EPCO. The Flood Action Plan covers both tidal and fluvial flood events, receiving and disseminating warnings received from the Environment Agency. More detail on Emergency Planning is presented in Section 13.

6 Level 1 Assessment

6.1.1 The Level 1 SFRA assessment methodology is based on available existing information and data. This section forms the main results of the Level 1 SFRA; it describes the data used in the production of mapping and GIS deliverables for the project, as well as a summary of the results presented.

6.2 Requirements of PPS25

6.2.1 PPS25[1] and its accompanying Practice Guide[2] require an SFRA to present sufficient information on all flood sources to enable LPAs to apply the Sequential Test within the administrative area. In order to apply the Sequential Test information is required on the probability associated with flooding from the different flood sources. In addition, the assessment of probability should also account for the effects of climate change on a flood source for the lifetime of any development that would be approved through the emerging LDF.

6.2.2 For all but fluvial and tidal flood sources the current paucity of data makes definition of robust classifications of probability unreliable. For example to define high, medium and low probabilities for groundwater flooding within the study area based on one reported incident (with no corresponding record of the severity of that flood) is not robust. Consequently for all flood sources other than fluvial sources, where only anecdotal evidence of flooding is available subjective assessments of probability have been made where the data allows.

6.2.3 The sources of flooding should also be investigated through a site specific assessment of flood risk submitted as part of a planning application. Details of the requirements for FRAs are presented in Section 8.1.

6.2.4 The follow section explains how the available data has been used to achieve the requirements of PPS25[1] and the Practice Guide[2].

6.3 GIS Layers and Mapping

6.3.1 Geographical data such as flood extents and watercourse routes have been presented as maps and published through Geographical Information System (GIS) layers.

6.3.2 GIS is an effective management tool for the coordinated capture, storage and analysis of data of a geographical nature. GIS handles data in a hierarchical manner by storing spatial features within various layers, which are allied to an underlying database. GIS is an increasingly valuable resource for Local Planning Authorities for informing planning decisions.

6.3.3 A summary of GIS layers generated for use in this SFRA is presented below including a summary to identify which GIS layers have been used in the production of the maps and figures presented with this Level 1 SFRA.

Table 6-1: GIS Layers

Name	Details	Presented within Figure Nos
Council_boundary	Study area boundary, Fenland DC	1
Main_Rivers	EA designated main river centrelines	4
Bedrock	British Geological Survey solid geology, 1:50,000 scale	3A
Drift_geology	British Geological Survey drift deposits geology, 1:50,000 scale	3B
LiDAR_DTM	LiDAR Topographic Data	2
Flood_Zone_2	EA Flood Zone 2 extents - 2010	7
Flood_Zone_3	EA Flood Zone 3 extents - 2010	7
Flood_defences_NFCDD	EA national flood and coastal defences database	8
Rest_centres	Emergency planning rest/reception centres	12
Sewer_flooding	Known sewer flooding hotspots	6
Flood Map for Surface Water	Areas susceptible to surface water flooding	10
Attenuation areas	areas where MLC and associated boards have particular concerns regarding flooding and surface water disposal systems within the Middle Level catchment	15
Historic Flooding	Historic flooding outlines	9
IDB and assets	IDB and asset map	5

6.4 Fluvial Flooding

Requirements

6.4.1 In order for the Level 1 SFRA to assist in the completion of the Sequential Test, PPS25[1] requires definition of the following fluvial/tidal Flood Zones:

Table 6-2: Fluvial/Tidal Flood Zone Definitions (as defined in PPS25[1], Table D.1)

Flood Zones	Definition	Probability of Flooding
Flood Zone 1	Land at risk from flood event less than the 1 in 1000 year event (less than 0.1% annual probability of flooding each year)	Low Probability
Flood Zone 2	Land at risk from flood event between the 1 in 100 fluvial flood event or 1 in 200 year tidal flood event and 1 in 1000 year event (between 1.0% (fluvial) or 0.5% (tidal) and 0.1% annual probability of flooding each year)	Medium Probability
Flood Zone 3a	Land at risk from flood event equal to, or greater than, the 1 in 100 year fluvial flood event (greater than 1.0% annual probability of flooding each year) or greater than, the 1 in 200 year tidal flood event (greater than 0.5% annual probability of flooding each year)	High Probability

Flood Zones	Definition	Probability of Flooding
Flood Zone 3b	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 its functional floodplain should take account 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.	Functional Floodplain

6.4.2 PPS25[1] states that functional floodplain should be determined considering the effects of defences and other flood risk management infrastructure. The functional floodplain relates only to river and coastal flooding, it does not include areas at risk of flooding solely from other sources of flooding (e.g., surface water, sewers).

Functional Floodplain

6.4.3 The practice guide to PPS25[1] provides more guidance on the delineation of functional floodplain. It states that *'Areas which would naturally flood with an exceedance probability of 1 in 20 (5%) or greater, but which are prevented from doing so by existing infrastructure or solid buildings, will not normally be defined as functional floodplain*[2].

6.4.4 Although a large amount of the lowland Fenland area would naturally flood, the existing infrastructure of the Middle and North Level prevents this to a standard that is greater than 1 in 20 year (5%). Therefore, two areas have been identified as functional floodplain (presented in Figure 7):

- Ouse Washes – between the River Delph and New Bedford (Hundred Foot Drain) Rivers from Earith to Denver Sluice. These washes are partly within the study area near to Welches Dam; and,
- Nene (Whittlesey Washes) – between Morton's Leam and the River Nene from Peterborough to Dog-in-a-Doublet Sluice.

Climate Change

6.4.5 The Flood Zones should be defined considering the effects of climate change. For fluvial systems, PPS25 requires an increase of 20% in peak flows to be used when mapping climate change Flood Zones up to 2115.

6.4.6 Whilst some detailed modelling for climate change has been undertaken, mapping of climate extents was not available for inclusion in this SFRA.

6.5 Tidal Flooding

Requirements and Data

6.5.1 The tidal limit of the Great Ouse is at Brownshill Staunch near St Ives which lies to the south of the study area. The tidal limit of the Nene is at Dog-in-a-Doublet Sluice, to the north of

Whittlesey. The majority of the Nene within the study area is therefore tidal. On the MLC system the tidal interface is at Salters Lode Lock. The tidal interface on the Old Bedford system is the Old Bedford Sluice. The failure of either system could have significant consequences on the study area.

Climate Change

6.5.2 As a result of climate change, it is predicted that global sea levels will rise and an allowance should be made for this when assessing the impacts of flood risk from tidal sources. Annex B of PPS25[1] gives figures for the allowances that should be made for regional rates of sea level rise, as shown below in Table 6-3, an extract from Table B.1 of Annex B.

Table 6-3: PPS25[1] recommended contingency allowances for net sea level rise

Administrative Region	Net Sea Level Rise (mm/year) relative to 1990			
	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
East of England, East Midlands, London, SE England (South of Flamborough Head)	4.0	8.5	12.0	15.0

6.5.3 Consequently there may be a reduction in the standard of protection that defences provide against tidal flooding as the 0.5% (1 in 200 years) annual probability storm event becomes more frequent. It is therefore likely that flood risk to the study area from tidal flooding will increase with climate change.

Data Sources & Mapping

6.5.4 A summary of the fluvial and tidal data sources and how these have been used to map the flood zones is summarised in Table 6-4.

Table 6-4: Fluvial/Tidal Flood Zone Mapping Data Sources

Watercourse	Current Flood Zones (2008)			Climate Change Flood Zones (2115)		
	Flood Zone 2	Flood Zone 3a	Flood Zone 3b	Flood Zone 2	Flood Zone 3a	Flood Zone 3b
Counter Drain/Cranbrook	EA Flood Zone 2	EA Flood Zone 3	Unavailable	Unavailable	Unavailable	Unavailable
River Delph	EA Flood Zone 2	EA Flood Zone 3	Unavailable	Unavailable	Unavailable	Unavailable
Forty Foot	EA Flood Zone 2	EA Flood Zone 3	Unavailable	Unavailable	Unavailable	Unavailable
Twenty Foot	EA Flood Zone 2	EA Flood Zone 3	Unavailable	Unavailable	Unavailable	Unavailable
Sixteen Foot	EA Flood Zone 2	EA Flood Zone 3	Unavailable	Unavailable	Unavailable	Unavailable
Well Creek	EA Flood Zone 2	EA Flood Zone 3	Unavailable	Unavailable	Unavailable	Unavailable
Morton's Leam	EA Flood Zone 2	EA Flood Zone 3	Unavailable	Unavailable	Unavailable	Unavailable
Old Popham's Eau	EA Flood Zone 2	EA Flood Zone 3	Unavailable	Unavailable	Unavailable	Unavailable
New Popham's Eau	EA Flood Zone 2	EA Flood Zone 3	Unavailable	Unavailable	Unavailable	Unavailable
Bevill's Leam	EA Flood Zone 2	EA Flood Zone 3	Unavailable	Unavailable	Unavailable	Unavailable
Old River Nene	EA Flood Zone 2	EA Flood Zone 3	Unavailable	Unavailable	Unavailable	Unavailable
River Nene Dog-in-a-Doublet to Northampton (fluvial)	Modelled 1000yr present day (using a methodology to be agreed with EA)	Modelled 200 yr present day (using a methodology to be agreed with EA)	Unavailable	Modelled 1000yr + CC (using a methodology to be agreed with EA)	Modelled 200 yr + CC (using a methodology to be agreed with EA)	Unavailable
River Nene (tidal)	Modelled 1000yr present day (using a methodology to be agreed with EA)	Modelled 200 yr present day (using a methodology to be agreed with EA)	Unavailable	Modelled 1000yr + CC (using a methodology to be agreed with EA)	Modelled 200 yr + CC (using a methodology to be agreed with EA)	Unavailable

6.6 Sewer Flooding

Requirements and Data

6.6.1 Areas at risk from sewer flooding have been determined through a review of the records from the DG5 registers provided by Anglian Water. The DG5 register records flooding incidents as a result of temporary works, as well as ongoing hydraulic capacity problems.

6.6.2 As per fluvial flooding, areas with high, medium and low probability should be defined based on the available data. The definition of functional floodplain is not required for flooding from sewers.

6.6.3 Due to the lack of resolution of the data and the relatively short period for which the records are available (≤10 years), definition of flooding probability cannot currently follow the same approach as that used for fluvial flooding. DG5 points are shown in Figure 6 in Appendix A.

Water Cycle Study

6.6.4 A Water Cycle Study has been commissioned by Cambridgeshire Horizons jointly for Fenland DC and East Cambridgeshire DC to identify whether sufficient water supply and waste water infrastructure is in place to support the growth and development projected for their study areas. The scope of the Water Cycle Study encompasses a more detailed assessment of sewer flooding and measures required to improve the infrastructure. This document should therefore be used in conjunction with the SFRA when considering this form of flooding.

Climate Change

6.6.5 Climate change is predicted to result in an increase in short duration high intensity rainfall and more frequent periods of long duration rainfall, with peak rainfall intensities predicted to increase by 30% by 2115. Consequently there will be a reduction in the standard of protection that sewers provide against surcharging as the 3.3% (1 in 30 years) annual probability storm event becomes more frequent. It is therefore likely that flood risk to the study area from sewer flooding will increase with climate change.

6.7 Surface Water Flooding

Requirements and Data

6.7.1 Overland flow and surface water flooding results from rainfall that fails to infiltrate the surface and travels over the ground surface. This is exacerbated by low permeable urban development or low permeability soils and geology (such as clayey soils). Overland flow is likely to occur at the base of an escarpment and low points in terrain.

6.7.2 Local topography and built form can have a strong influence on the direction and depth of flow. The design of development down to a micro-level can influence or exacerbate this. Overland flow paths should be taken into account in spatial planning for urban developments. In addition, surface water flooding can be exacerbated if development increases the percentage of impervious area. An assessment of overland flow must be undertaken and the risks assessed as part of a site-specific FRA.

6.7.3 The SFRA only provides a summary of existing and available data on surface water flooding and does not include probabilistic modelling of surface water flooding.

Topographic Data

6.7.4 Figure 2 shows the variation in the topography of the Fenland area. The area is generally very low lying and flat, with the settlements of Wisbech, March, Whittlesey and Chatteris generally at higher elevations than the surrounding area.

6.7.5 The watercourses within the majority of the study area are embanked above the surrounding land. This can be caused by various mechanisms including, peat shrinkage caused by the drying out of the land following the creation of the drainage channels; and the regular overtopping of historical watercourses. The A1101 to the north west of Welney is on the former embankment of the River Ouse, as is a section of Whittlesey Road between March and Turves. There is evidence that embankments were raised prior to the drainage of the fens to prevent overtopping from both fluvial and tidal sources. Roman Bank at Leverington and Mount Pleasant Bank in Wisbech are examples of the latter. The regular deposition of vegetation and silt when undertaking maintenance on a watercourse can also result in an embankment being formed. Today most embankments used as flood defences are engineered structures.

National Environment Agency Mapping: Flood Map for Surface Water

6.7.6 The Environment Agency has undertaken broad scale, national mapping of areas susceptible to surface water flooding which is shown in Figures 10 A and 10 B. Due to the high level nature of this mapping, it is not considered suitable as a basis for strategic planning within Fenland; however it provides a useful overview to identify those areas that will require further investigation in relation to surface water flooding sources and pathways.

6.7.7 In the south of the study area, the areas are associated with watercourses only, reflecting the topography and nature of the catchments in this area. Across the majority of the District however, the areas susceptible to surface water flooding are more widely spread and not necessarily associated with a particular watercourse. This shows how the flat topography does not encourage surface water flows.

Surface Water Drainage System

6.7.8 Information has been provided by the MLC for areas where they and associated boards have particular concerns regarding flooding and surface water disposal systems that could be exacerbated by development. These are shown in Figure 15.

6.8 Groundwater Flooding

Potential for Groundwater Flooding

6.8.1 Based on the hydrogeological conceptual understanding of the study area, there is potential for three mechanisms of groundwater flooding. These mechanisms are:

6.8.2 Sand and gravel drift aquifers (central, south and west areas): Groundwater flooding can also be associated with substantial sand and gravel drift aquifers, where they are in hydraulic continuity with surface watercourses. Stream levels may rise following high rainfall events but still remain “in-bank”, and this can trigger a rise in groundwater levels in the associated drift deposits. The properties at risk from this type of groundwater flooding are probably limited to those with basements, which have been constructed within the drift deposits. For this type of flooding to occur, the drift deposits must behave as aquifers.

6.8.3 Sand and gravels drift aquifers (central, south and west areas): Groundwater flooding is also associated with substantial drift deposits, but occurs where they are not hydraulically connected to surface watercourses but overlie clays. Perched groundwater tables can exist within these deposits, developed through a combination of natural rainfall recharge and artificial recharge e.g. leaking water mains.

6.8.4 Made Ground (north of March; west of Whittlesey): Groundwater flooding could occur where the ground has been artificially modified to a significant degree. If this 'made ground' is of substantial thickness and permeability, then a shallow perched water table may exist. This could potentially result in groundwater flooding at properties with basements. However, this may also be regarded as a local drainage issue as opposed to groundwater flooding. Areas mapped by the BGS as containing made ground are shown in Figure 3, aquifers are shown in Figure 11 and 14.

Evidence of Groundwater Flooding

6.8.5 The Environment Agency was contacted for records of groundwater flooding but no groundwater flooding incidents have previously been reported in the study area. This is partly owing to a lack of aquifers within the Council area. Nontheless, site-specific FRAs should include full consideration of the ground conditions on site and assess the risk of groundwater flooding occurring. This is particularly important for potential development sites where basement areas or underground infrastructure are proposed. It is also important that the development does not create a groundwater flow barrier, which could increase the risk of groundwater flooding at adjacent properties.

6.9 Artificial Sources

Requirements and Data

6.9.1 PPS25[1] requires that artificial water sources within the study area are identified as part of a SFRA. These include canals, reservoirs, ponds, and any feature where water is held above natural ground level.

Data Sources & Mapping

6.9.2 Due to the large nature of the artificial drainage system (and despite its managed and maintained operation) it has been considered as a fluvial flood source for the purposes of this study.

6.9.3 The Whittlesey Washes FSR is raised reservoir and is designated under the Reservoir Act 1975. At the time of publication of this report, the Environment Agency were investigating options to ensure the safety of the South Barrier Bank, which will include embankment works and facilities to allow safe discharge of water during an extreme flood.

6.9.4 Works are due to be completed by December 2012; however, depending on the options taken forward for ensuring the safe discharge of water during an extreme flood, development to the north of Whittlesey could be affected by discharge routes and this should be taken into account through site specific FRAs.

6.9.5 Throughout the Fenland District there are several smaller reservoirs used for agricultural purposes that can be seen on detailed OS Mapping, and which may need to be taken into

consideration when carrying out site-specific FRAs for individual development sites in close proximity.

6.9.6 None of the stakeholders contacted throughout this study hold any records of flooding arising from artificial sources and/or infrastructure failures.

6.10 Summary of Settlement Areas

6.10.1 The settlement areas across the study area are generally located in Flood Zone 1 and islands of Flood Zone 1. Therefore in accordance with PPS25 future development should be steered to these lower risk areas. A summary of the flood zones, SuDS suitability and considerations for future development locations is outlined in Table 6-5 below. Figures 7A-7E show the zoomed in flood zone extents for each of the main settlement areas.

Table 6-5: Summary of Flood Risk for Settlement Areas

Settlement Area	Flood Zones (Figure 7)	Development considerations	SuDS (Figure 11 and 14)
Chatteris	This settlement although largely in Flood Zone 1 forms an island surrounded by floodplain. Northern and western extents are Flood Zone 2 and 3.	Any development in this area should be directed to Flood Zone 1, consideration is needed for refuge and emergency measures in the event of a flood as it may be cut off from other larger areas with respect to emergency services and services. Disposal of Surface water runoff is a current concern or has caused flooding in the IDBs of Nightlayers and Warboys Somersham & Pidley. Proposals for development to the East and West of Chatteris should be discussed with the MLC to determine specific surface water runoff attenuation requirements of allocations in these areas.	Areas of low and medium-high infiltration. Where infiltration SuDS proposed infiltration tests should be provided.
Wisbech	The western and northern extent of this settlement area is Flood Zone 2 and 3.	Development should be focused in the areas of Flood Zone 1 or around southern and eastern extents which are also Flood Zone 1. Disposal of Surface water runoff is a current concern or has caused flooding in the IDB of Hundred of Wisbech. Proposals for development to the South of Wisbech should be discussed with the MLC to determine specific surface water runoff attenuation requirements of allocations in this area.	Low infiltration for most of the area. Therefore retention SuDS such as swales and ponds more suitable. Infiltration such as soakaways unlikely so infiltration tests should be provided where these are proposed.

Settlement Area	Flood Zones (Figure 7)	Development considerations	SuDS (Figure 11 and 14)
March	This settlement although largely in Flood Zone 1 forms an island surrounded by floodplain. The western and eastern extents are Flood Zone 2 and 3.	Any development in this area should be directed to Flood Zone 1, consideration is needed for refuge and emergency measures in the event of a flood as it may be cut off from other larger areas with respect to emergency services and services. Disposal of Surface water runoff is a current concern or has caused flooding in the IDBs of March 3rd, 5th and 6th, March East & March & Whittlesey. Proposals for development to the South, North and East of March should be discussed with the MLC to determine specific surface water runoff attenuation requirements of allocations in these areas.	Areas of low and medium-high infiltration. Where infiltration SuDS proposed infiltration tests should be provided.
Whittlesey	This settlement although largely in Flood Zone 1 forms an island surrounded by floodplain. Northern extents are Flood Zone 3.	Any development in this area should be directed to Flood Zone 1, consideration is needed for refuge and emergency measures in the event of a flood as it may be cut off from other larger areas with respect to emergency services and services. Development to the north of Whittlesey could be affected by works to the Whittlesey washes FSR and this should be taken into account through site specific FRAs.	Medium to high infiltration likely. Therefore infiltration SuDS possible. Infiltration tests should be provided where these are proposed.
Doddington/ Wimblington	This settlement although largely in Flood Zone 1 forms an island surrounded by floodplain. Southern extents are Flood Zone 3.	Any development in this area should be directed to Flood Zone 1, consideration is needed for refuge and emergency measures in the event of a flood as it may be cut off from other larger areas with respect to emergency services and services although links to March are likely in the event of a flood.	Areas of low, medium and high. Therefore range of SuDS measures suitable. Where infiltration SuDS proposed infiltration tests should be provided.

7 Guidance on Applying the PPS25 Sequential Test

7.1 What is the Sequential Test?

7.1.1 The PPS25[1] Sequential Test is a process by which the precautionary principle is applied to the strategic land allocation process. PPS25[1] requires local planning authorities to review flood risk across their districts, steering all development towards areas of lowest risk. Development is only permissible in areas at risk of flooding in exceptional circumstances where it can be demonstrated that there are no reasonably available sites in areas of lower risk, and the benefits of that development outweigh the risks from flooding. Such development is required to include mitigation/management measures to minimise risk to life and property should flooding occur, and wherever possible identify opportunities to reduce the overall flood risk posed to the local community.

7.1.2 A Level 1 SFRA is designed to be sufficiently detailed to allow the application of the Sequential Test to the Core Strategy Document, on the basis of PPS25[1] Table D.1 (reproduced as Table 6-2) and Figure 4.1 of its Practice Guide[2].

7.1.3 PPS25[1] acknowledges that some areas will (also) be at risk of flooding from sources other than tidal and fluvial. Consequently all sources of flooding must be considered when looking to locate new development. The other sources of flooding requiring consideration when situating new development allocations include:

- Surface Water / Overland Flow;
- Groundwater;
- Sewers; and
- Artificial Sources.

These sources are typically less well understood than tidal and fluvial sources and as a result, data only exists as point source data or through interpretation of local conditions. In addition, there is conflicting guidance on suitable return periods to associate with floods arising from these sources. For example, modern surface water drainage systems are constructed to a 1 in 30-year standard (1 in 100 year for MLC surface water drainage systems). Any rainfall event in excess of the 30-year (or 1 in 100 year) return period would be expected to result in some flooding through insufficient capacities. Consequently when assessing these sources through the Sequential Test, where a location is recorded as having experienced repeated flooding from the same source, or is highlighted as a problem area (e.g. MLC attenuated areas for surface water) this should be investigated further in a site-specific FRA.

7.2 Development Vulnerability Classifications

7.2.1 PPS25[1] classifies developments according to their vulnerability. Five vulnerability classifications are defined, these are:

- Essential Infrastructure;
- Highly Vulnerable;
- More Vulnerable;

- Less Vulnerable; and,
- Water Compatible.

7.2.2 Table 7-1 shows the types of development that fall under these different classifications.

Table 7-1 : Flood Risk Vulnerability Classification (from PPS25[1], Appendix D, Table D2)

Vulnerability Classification	Development Uses
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 operating 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[5].
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 located such installations for bulk storage of materials with port and 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 works (if adequate measures to control pollution and manage sewage during flooding events are in place).

[5] It should be noted that PPS25 doesn't currently provide a classification for other forms of renewable energy. The vulnerability classification will vary on a case by case basis (e.g. landtake for solar farms may require specific flood protection measures) and should be discussed with the Environment Agency with regards scope of FRA required at the earliest opportunity.

Vulnerability Classification	Development Uses
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**.

7.3 How should the SFRA be used to apply the Sequential Test?

7.3.1 Using the information documented and mapped within this Level 1 SFRA, the Sequential Test should be undertaken for proposed new development within Fenland. This process should be accurately documented to ensure decisions can be transparently communicated and reviewed where necessary.

7.3.2 The Sequential Test should be carried out on all development sites, to guide development to the lowest flood risk areas. Only where there are no reasonably available alternative sites to accommodate the development should sites in Flood Zones 2 or 3 be considered.

7.3.3 The Level 1 SFRA mapping provides the tools for the Sequential Test to be undertaken. This is achieved by presenting information to identify the variation in flood risk across the administrative area and allowing an area-wide comparison of future development sites with respect to flood risk considerations.

Table 7-2: Flood Risk Vulnerability and Flood Zone Compatibility' from PPS25.

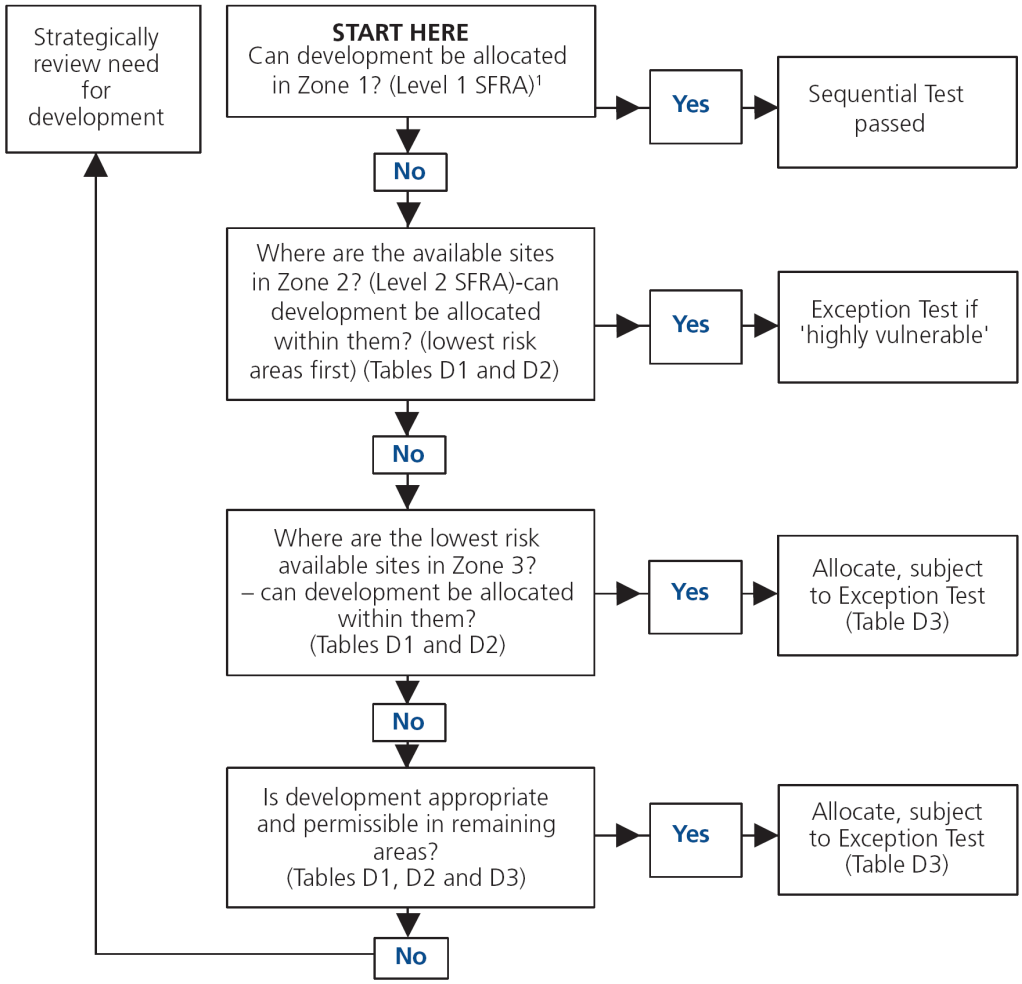
Flood Risk Vulnerability Classification		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone	1	✓	✓	✓	✓	✓
	2	✓	✓	Exception Test Required	✓	✓
	3a	Exception Test Required	✓	✗	Exception Test Required	✓
	3b	Exception Test Required	✓	✗	✗	✗

✓ - Development is appropriate ✗ - Development should not be permitted

7.4 Guidance

7.4.1 The following flow diagram (Figure 7-1) is taken from the PPS25[1] Practice Guide[2] and illustrates how the Sequential test should be undertaken. The full process is described in Chapter 4 of the PPS25 Practice Guide[2].

Figure 7-1: Application of the Sequential Test (from Figure 4.1 of PPS25: Practice Guide[2])



7.5 Additional Guidance

7.5.1 The sequence of steps presented below, coupled with Figure 7-1 above, provides a guide for the application of the Sequential Test and, where necessary, that the requirement for the application of the Exception Test is clearly identified.

7.5.2 Recommended stages from PPS25 Practice Guide[2] for application of the Sequential Test:

1. The developments (i.e. housing, hospitals, industrial etc) that need to be accommodated should be assigned a vulnerability classification in accordance with Table D.2 "Flood Risk Vulnerability Classification" in PPS25[1];
2. The Flood Zone classification of all development sites should be determined based on a review of the Environment Agency Flood Zones and the Flood Zones presented in this SFRA. This should consider the effects of climate change on Flood Zone definition for the design life of any development that the site may be suitable for, i.e.:
    - 75 years – up to 2085 for commercial / industrial developments; and
    - 100 years – up to 2110 for residential developments
3. In the first instance the 'highly vulnerable' developments should be located in those sites identified as being within Flood Zone 1. If the 'highly vulnerable developments' cannot be located in Flood Zone 1, because the identified sites are unsuitable or there are insufficient sites in Flood Zone 1 then sites in Flood Zone 2 can be considered but will be subject to the Exception Test. According to PPS25[1] 'highly vulnerable' uses would not be permitted in Flood Zone 3.
4. Once all 'highly vulnerable' developments have been allocated to a development site, Fenland DC can consider development types defined as 'more vulnerable'. In the first instance 'more vulnerable' development should be located in any unallocated sites in Flood Zone 1. Where these sites are unsuitable or there are insufficient sites, sites in Flood Zone 2 can be considered. If there are insufficient sites in Flood Zone 1 or 2 to accommodate the 'more vulnerable' development types, sites in Flood Zone 3a can be considered but will require the application of the Exception Test. When allocating in Flood Zone 3a the hazard rating of the site, as defined in the Level 2 SFRA, must also be considered with development being preferentially steered to those sites of least hazard. Evidence to support parts 'a' and 'b' of the Exception Test should be established before 'part c' is tackled. 'More vulnerable' developments are not permitted in Flood Zone 3b.
5. Once all 'more vulnerable' developments have been allocated to a development site, Fenland DC can consider those development types defined as 'less vulnerable' which can be located in any remaining unallocated sites in Flood Zones 1, 2 or 3a. Again, sites with the highest hazard rating should be avoided wherever possible. 'Less vulnerable' development types are not permitted in Flood Zone 3b.
6. 'Essential infrastructure' developments should also be preferentially located in the lowest flood risk zones, however this type of development can be located in Flood Zones 3a and 3b subject to the Exception Test being passed. Where these types of developments are required in Flood Zones 3a or 3b, evidence to support parts 'a' and 'b' of the Exception Test should be established before part 'c' is tackled.
7. Water compatible development typically has the least flood risk constraints and it is therefore recommended to consider these types of development last when allocating development sites.
8. For decisions made through stages 4 to 7 it will also be necessary to consider the risks posed to the site from other flood sources, in particular, areas with known surface water flooding and disposal problems (see Figure 15).

8 Guidance on Applying the PPS25[1] Exception Test

8.1 Why is there an Exception Test?

8.1.1 The aim of the Sequential Test is to steer all development towards areas of lowest risk. However, PPS25[1] recognises that in some exceptional circumstances, it may not be possible to locate development in areas of low or appropriate flood risk with respect to the vulnerability classification of the development. Where the Sequential Test has been carried out and it is shown that there are no reasonably available sites in lower flood risk areas, the Exception Test will then be required in some circumstances.

8.1.2 Through the application of the Exception Test any additional wider sustainability benefits resulting from development can be taken into account in order to demonstrate that the benefits for development of a site outweigh the flood risks to the development and its occupants.

8.2 What is the Exception Test?

8.2.1 The Exception Test is a series of three criteria as shown below, all of which must be satisfied for development in a flood risk area to be considered acceptable. For the Exception Test to be passed:

- It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA. For this criteria to be passed, the site/broad area must be shown to positively contribute to the aims and objectives of the Sustainability Appraisal. Where this is not the case, it must be considered whether the use of planning conditions or S106 agreements could make it do so. If neither of these are possible, the site is not deemed to pass part 'a' and the allocation should be refused;
- The development should be on developable previously developed land or, if not, it must be demonstrated there is no such alternative land available; and
- A FRA must demonstrate that the development will be safe, without increasing flood risk elsewhere, and, where possible, reducing flood risk overall. At the level of strategic planning the SFRA must be used in order to assess the potential feasibility of providing flood risk management measures for site allocations/broad development locations.
- All three parts of this test must be satisfied in order for the development to be considered appropriate in terms of flood risk. There must be robust evidence in support of every part of the test.

8.2.2 This report is intended as a Level 1 SFRA to inform the application of the Sequential Test. Should the Exception Test be required for sites in Fenland, a Level 2 SFRA will need to be produced to inform this process.

9 Site Specific Flood Risk Assessment Guidance

9.1.1 Site-specific FRAs are required to assess the flood risk posed to proposed developments and to ensure that new developments do not increase flood risk elsewhere. They need to show, where necessary and appropriate, suitable mitigation measures can be incorporated. This section presents recommendations for FRAs prepared for submission with planning applications in Fenland. The guidance presented within this chapter has been based on:

- recommendations presented within PPS25[1] and the accompanying Practice Guide[2];
- Standing Advice from MLC on when an FRA is required to ensure compliance with the relevant Land Drainage Act bye-laws;
- The Environment Agency's Standing Advice on when an FRA is required and when consultation with the Environment Agency is required;
- a review of Fenland DC's local policies; and,
- information provided to enable preparation for this Level 1 SFRA.

9.2 When is a FRA Required?

9.2.1 PPS25[1] outlines when there is an absolute requirement under to provide a FRA for new development which is when:

a) The development site is located in Flood Zones 2 or 3;

b) The area of the proposed development site area is 1 hectare or greater in Flood Zone 1. This is to ensure surface water generated by the site is managed in a sustainable manner and does not increase the burden on existing infrastructure and/or flood risk to neighbouring property. Surface water management will also need to be considered as part of the FRA for sites of 1 hectare or greater in Flood Zone 2 and 3;

c) The development or change of use to a more vulnerable class may be subject to other sources of flooding; or

d) The development site is located in an area known to have drainage problems[6].

9.2.2 In addition to the above points, both the Environment Agency and the IDBs have additional requirements for when they need to be consulted on a development or when a FRA is required). In the main this is largely related to governance under the Land Drainage Act and associated bye-laws or to ensure no increase in flood risk from changes in surface water runoff as a result of development. These additional requirements are to ensure that flood risk elsewhere is not increased as a result of development due to:

- development directly reducing hydraulic capacity in a Main River or watercourse or adversely affecting the effectiveness of a drainage system;
- changes in runoff rates, volumes and pathways to a watercourse, Main River or area of land as a result of changing land use; and

[6] Drainage problems as indentified by the Environment Agency, IDB or other bodies.

- development preventing access to main rivers or watercourses for purposes of maintenance of the channel, flood defences or associated structures.

9.2.3 The Environment Agency provides flood risk standing advice for applicants and agents on their website http://www.environment-agency.gov.uk/research/planning/82587.aspx. This includes information on when a FRA is required in relation to PPS25[1] and their responsibilities for Main Rivers and advice on the contents of FRAs for various development types in Flood Zones 1, 2 and 3.

9.2.4 The Environment Agency's Standing Advice demonstrates that in addition to the three conditions in PPS25[1] (set out in section 9.2.1 above), the Environment Agency also require consultation and potentially an FRA for certain development where:

- built development is within 20m of the top of a bank of a Main River; and/or,
- where culverting or control of flow of any river or stream is proposed for the purposes of issuing flood defence consent under the Land Drainage Act.

9.2.5 In situations where the above applies to non-Main River, then in most cases it is the responsibility of the relevant IDB as nearly all 'non main river' watercourses are under the jurisdiction of the IDBs within Fenland[7]. As outlined in Section 4, IDBs also need to provide written consent (or bye-law consent) under the Land Drainage bye-laws for certain development and activities and in some cases, they also require information to be provided in the form of a FRA before this consent can be issued.

9.2.6 Standard Advice is provided by the MLC for IDBs under their management jurisdiction which summarise the conditions when written consent (or bye-law consent) is required from them under the bye-laws. Board Standard Requirements from the North Level IDB also reflect these conditions and includes:

- *Maintenance Access Strips for Board's drains* – consent required for development within a set distance of a watercourse or drain (distances varies according to the watercourse and IDB or DDC) to ensure access for maintenance is not impeded by development;
- *Piping and Filling of Watercourses* – to protect the natural environment and ensure hydraulic capacity of drains and systems, proposals to: pipe; culvert; bridge; or pass any pipe or cable over any watercourse in the MLC rateable area requires consent;
- *Works within a channel* – this includes the construction of culverts, dams, or other structures that may affect the flows within the channel, requires bye-law consent;
- *Outfalls to Board's Drains* – any outfall into a board's watercourse requires prior written consent
- *Disposal of Surface or Foul Water from development*– increases in the rate or volume of surface water or foul water directly or indirectly (via another watercourse, sewer or other system) require written consent.

[7] The Flood & Water Management Act now gives consenting responsibility to Lead Local Flood Authorities for non-Main rivers which are not the responsibility of IDBs. In this case it would be Cambridge County Council; however, the majority of the non-Main River watercourses in the study are controlled and managed by the IDBs.

9.2.7 In addition the MLC's Standard Advice on Development Control, sets out when they should be consulted on proposals for development[8] and where they may request a site-specific FRA. These are set out as follows:

- being either within or adjacent to a Board's drain/watercourse, and/or other flood defence structure;
- being within the channel of any other Ordinary Watercourse;
- where a direct discharge of surface water or treated effluent is proposed;
- for any development affecting more than one watercourse and having possible strategic implications;
- in an area of known actual flood risk;
- being within the maintenance access strips provided under the Byelaws; or,
- any other application that, in the opinion of the MLC' Chief Engineer, has material drainage implications.

9.2.8 The above requirements are in addition to where an FRA is required under PPS25[1] and by the Environment Agency's Standing Advice.

9.2.9 For all other development not meeting the above criteria, Standing Advice is provided on the MLC website.

9.2.10 When considering who to consult for review of developments with respect to flood risk, Development Control officers at the LPA should be aware that whilst the Environment Agency will review and comment on FRAs for:

- compliance with respect to flood risk *to* the development; (PPS25);
- the requirement for no increase in surface water runoff rates or volumes from the development (PPS25) irrespective of the who's jurisdiction the watercourse is under; and
- compliance with land drainage bye-laws for Main Rivers.

9.2.11 The Environment Agency response will not cover:

- the specific surface water management requirements of watercourse other than Main River; and
- land drainage bye-law requirements of watercourses other than Main River.

9.2.12 In addition to the Environment Agency, the MLC or NLIDB hould therefore be consulted on FRAs (or the requirement for an FRA) where development has the potential to require written bye-law consent.

8

'development' refers to any proposed change to land, either permanent or temporary, that:
- Affects, or is situated within, a watercourse whether open, piped, sewered or culverted;
- Affects the existing groundwater system;
- Encroaches upon or affects access to existing maintenance access strips provided under the Byelaws; or
- Increases surface water or groundwater discharges to the downstream systems.

9.2.13 A check list of when an FRA may be required and who to consult is included in Appendix B

9.3 FRA Requirements

9.3.1 The Practice Guide to PPS25 sets out a staged approach to site-specific FRA with the findings from each stage informing both the next level and the site Master Plan, throughout the development process. The staged approach comprises:

- Level 1 Screening Study;
- Level 2 Scoping Study;
- Level 3 Detailed Study.

Table 9-1 Stages of site-specific FRA, PPS25 Practice Guide[2]

FRA Level	Description of Report Content
Level 1 Screening Study	The Level 1 FRA is intended to identify any flooding or surface water management issues related to the development site that may require further investigation. The study should be based on readily available existing information, including: SFRA, Environment Agency Flood Maps, Standing Advice (EA and IDB) The Level 1 FRA will determine the need for a Level 2 or 3 FRA.
Level 2 Scoping Study	Where the Level 1 FRA indicates that the site may lie in an area at risk of flooding, or may increase flood risk elsewhere due to runoff, a Level 2 FRA should be carried out. This report will confirm sources of flooding which may affect the site and should include the following; Appraisal of available and adequacy of existing information; Qualitative appraisal of the flood risk posed to the site, the potential impact of the development on flood risk on and off the site; An appraisal of the scope of possible measures to reduce the flood risk to acceptable levels. This Level may identify that sufficient quantitative information is already available to complete a FRA appropriate to the scale and nature of the development.
Level 3 Detailed Study	Undertaken if the Level 2 FRA concludes that further quantitative analysis is required in order to assess flood risk issues related to the development site. This Level should include: Quantitative appraisal of the potential flood risk to the development; Quantitative appraisal of the potential impact of development on the site under investigation on flood risk on and off the site; Quantitative demonstration of the effectiveness of any proposed mitigation measures.

9.3.2 At all stages Fenland DC, and where necessary the Environment Agency, Anglian Water and the relevant IDB should be consulted to ensure the FRA provides the necessary information to fulfil the requirements for Planning Applications and where appropriate the issue of flood defence consent or bye-law consent. The IDBs may require adequate supporting evidence within any site specific FRA to prove that a viable scheme for appropriate water level/flood risk management exists, and that it could be constructed and maintained for the lifetime of the development without adversely affecting their systems or the local water environment.

9.4 FRA Guidance

9.4.1 Both the the Environment Agency and the MLC provide flood risk standing advice for applicants and agents on their websites which for the Environment Agency includes a matrix to determine the level of assessment that is required based on Flood Zone classification and development

type. Within this matrix are links to FRA Guidance notes and advice for applicants as to which data they will need to purchase from the Environment Agency in order to carry out their FRA. The MLC advice makes it clear where they must be consulted for written consent or via an FRA depending on the location and surface water disposal proposals of the development

9.4.2 PPS25[1] Annex E also provides guidance on the coverage of an FRA.

Risks of Developing in Flood Risk Areas

9.4.3 Developing in flood risk areas can result in significant risk to a development and site users. Issues to consider include the following:

- failure to consider wider plans prepared by the Environment Agency, IDBs or other operating authorities may result in a proposed scheme being objected to;
- failure to identify flood risk issues early in a development project could necessitate redesign of the site to mitigate flood risk;
- failure to adequately assess all flood risk sources and construct a development that is safe over its lifetime could increase the number of people at risk from flooding and/or increase the risk to existing populations;
- failure to mitigate the risk arising from development may lead to claims against the developer if an adverse effect can be demonstrated (i.e. flooding didn't occur prior to development) by neighbouring properties/residents;
- properties may be un-insurable and therefore un-mortgageable if flood risk management is not adequately provided for the lifetime of the development; and,
- by installing SuDS without arranging for their adoption or maintenance, there is a risk that they will eventually cease to operate as designed and could therefore present a flood risk to the development and/or neighbouring property.

9.4.4 Developers may be required to carry out hydraulic modelling of a breach scenario to establish the risks to a potential site from a failure in the flood defences. This should be agreed with the Environment Agency and the exact scope of the FRA determined through consultation.

9.4.5 A particular area where breach modelling may be a requirement is Guyhirn, where there is some development along High Road which runs adjacent to raised flood defences, yet is considered to be Flood Zone 1 (Figure 9-1).

9.4.6 This area has been highlighted as being incorrect, and at the time of writing (December 2010) the Environment Agency is carrying out further work to assess the Flood Zones in and around the Guyhirn area. Until this has been undertaken the area should be considered to fall within Flood Zone 3. This area has been highlighted in green on Figure 7 and in more detail in Figure 7F.

9.4.7 Development in Guyhirn should be subject to discussions with the Environment Agency with respect to FRA requirements. A photograph of the area and Flood Zone is outlined below (Figure 9-1).

Figure 9-1 Photograph of Guyhirn and the associated Environment Agency Flood Map

9.4.8 Therefore to ensure potential implications of defence failure are taken into consideration Fenland Council should agree to consult the Environment Agency on proposed developments that are adjacent to flood defences but within Zone 1 on the Flood Maps.

9.4.9 There are several other areas shown as Flood Zone 1 which may be due to errors in LiDAR data or processing of the results used in the flood mapping. The Middle Level Commissioners have also identified that Land adjacent to Paragon Labels site, off Cromwell Road in Wisbech as being potentially erroneous, therefore Fenland Council should agree to consult the Environment Agency on proposed developments that are within Flood Zone 1 within this area also:

Safe Development

9.4.10 Furthermore, the following items should be addressed as part of a FRA in order to demonstrate that proposed developments are 'safe' in line with PPS25[1]. The Environment Agency has specified that the following should be achieved for all development vulnerability types in order to demonstrate safe development:

- Dry access and egress should be provided for all development where possible. Dry escape for residential dwellings should be up to the 1 in 100-year event for fluvial events and 1 in 200 year event for a tidal event, taking into account climate change for the lifetime of the development.
- Where suitable, finished floor levels should be set at or above the 1 in 100 year plus climate change level (fluvial) and 1 in 200 year plus climate change level (tidal) with a 300mm freeboard allowance. It should be noted that raising floor levels or ground re-shaping may not be the most suitable option and agreement should be reached with the Environment Agency and relevant IDB that flow paths will not be adversely affected.
- Where floodplain compensation is undertaken, the Environment Agency requires that this is provided on a 'Level for Level, Volume for Volume Basis'.
- Flood flow routes should be preserved.
- Flood resilient constructions measures should be incorporated into new developments where required.
- Safe refuge should be provided for all developments, and in areas at high risk of flooding sleeping accommodation should be located above the flood level.

9.4.11 It should be noted that the Environment Agency are constantly reviewing their guidance based upon experience, increasing knowledge and the findings of new research and therefore the above criteria are subject to change in the future.

9.4.12 The specific definition of a 'safe' development will vary for each individual site, based on location and development vulnerability. The Environment Agency encourages pre-application discussions and it is therefore recommended that developers for individual sites consult with the Environment Agency and the councils Emergency Planner at an early stage to establish an appropriate definition of 'safe' development for their specific site.

SuDS adoption and FRAs

9.4.13 The MLC state in their Standing Advice, that in addition to fulfilling the general requirements of an FRA, the Boards may require adequate evidence including test results to prove that soakaways or other infiltration devices and SuDS systems, where proposed, will be adequately maintained by an accountable body and will work effectively at the chosen location. Cambridgeshire County Council as the LLFA will also require this evidence in order to adopt any system as part of their requirement under the Flood and Water Management Act.

10 Sustainable Drainage Systems

10.1 Background

10.1.1 Sustainable Drainage Systems (SuDS) are surface water drainage systems developed in accordance with the ideals of sustainable development. The philosophy behind SuDS is to mimic as closely as possible the the runoff processes that occur at a site prior to development. Wherever possible, SuDS techniques should seek to contribute to each of the three goals identified below, with the preferred solution contributing significantly to each objective. SuDS solutions for specific sites should seek to:

- Reduce flood risk (to the site and neighbouring areas);
- Reduce pollution and improve water quality, and;
- Provide wildlife and landscape benefits.

10.1.2 The SuDS Manual 2007[12], produced by CIRIA outlines how these goals can be achieved through the implementation of a chain of techniques. Each component adds to the performance of the overall system, whereby techniques are applied right through from site management procedures to consideration of a wider catchment as outlined below:

- Prevention - the use of good site design and management measures to reduce run-off and pollution (e.g. reducing impermeable areas, regular pavement sweeping) and encourage rainwater harvesting;
- Source control – control of run-off at/near source e.g. rainwater harvesting, green roofs, permeable pavements, soakaways and other infiltration methods;
- Site control – water management from several different catchments e.g. route water from roofs and impermeable areas to single infiltration/attenuation point;
- Regional control – integrate run-off from multiple sites e.g. use of detention pond or wetland.

10.1.3 Local authorities should encourage the use of SuDS, which are a requirement of Approved Document Part H of the Buildings Regulations[30]. This chapter presents a summary of the SuDS techniques available and a non-specific overview of the types of techniques that may be appropriate for development sites in Fenland. SuDS are also required under the aspirations of PPS25[1].

10.1.4 In addition to the aforementioned SuDS chain of techniques, both developers and development control officers need to consider the specific nature of the surface water management system in Fenland and consider that individual IDBs may have a preference for surface water to be discharged from a site more quickly, rather than holding it back. This requirement could arise to allow water to be pumped from managed systems prior to peak flood flows arriving in the middle level and north level systems from the fluvial watercourses or from high tidal levels.

10.1.5 Therefore, as a first step developers should consider including SuDS to mimic the rate and volume of runoff that would occur from the site prior to development taking place; however a second step should occur whereby developers or development control officers seek the advice of the relevant IDB to determine whether retention of surface water is preferable to a faster (but controlled) rate of runoff.

10.2 Regulatory Position

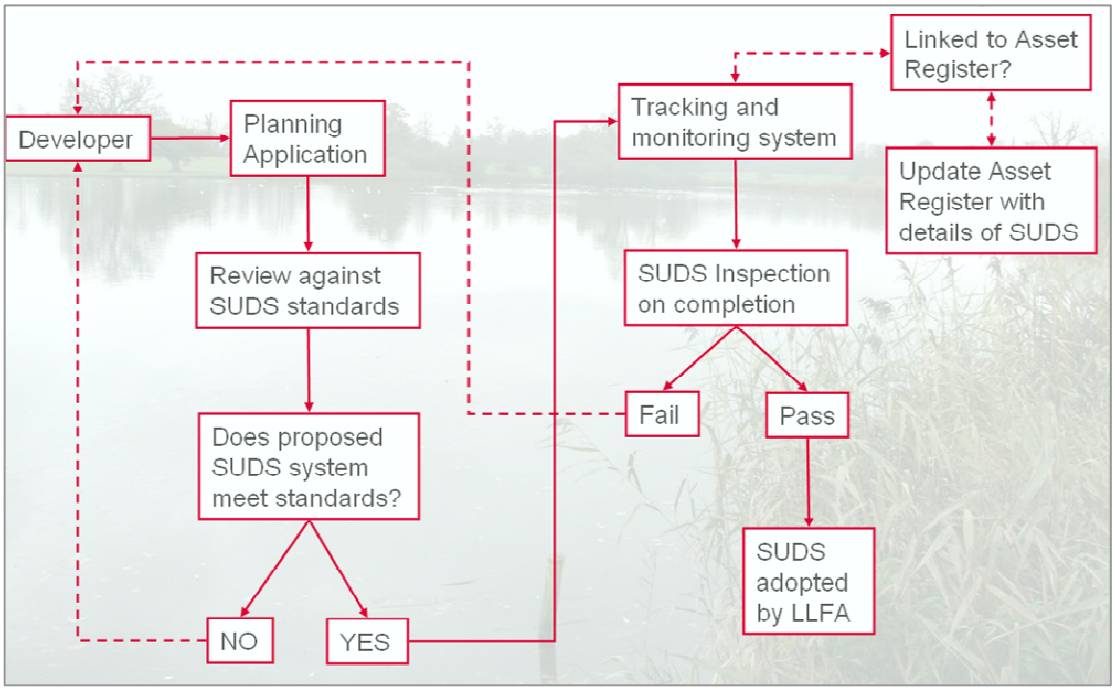
10.2.1 Until 2010 there were no legally binding obligations relating to the provision and maintenance of SuDS. In April 2010, the Flood and Water Management Act gained Royal Assent and with it came a number of responsibilities for unitary authorities and County Councils in two tier areas, defined as Lead Local Flood Authorities (LLFAs), which in this case is Cambridgeshire County Council. In relation to Fenland DC, Cambridgeshire County Council are required to:

- Investigate and record flooding incidents;
- Produce an asset register of all flood risk related assets;
- Develop a preliminary flood risk assessment; and,
- Adopt and maintain SuDS.

10.2.2 One of the key features of the bill, 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

10.2.3 At the time of writing, the organisational arrangements for SuDS adoption were still unclear as new National Standards are currently being produced by Defra for release in December 2010. However, it is anticipated that when a planning application is submitted a process similar to that outlined in Figure 10-1 will be followed:

Figure 10-1 Suggested SuDS approval process for use through the planning system



10.2.4 In addition, Anglian Water, the local waste water provider has set out adoption standard for SuDS.

10.3 Why use SuDS

10.3.1 Traditionally, built developments have utilised piped drainage systems to manage storm water and convey surface water run-off away from developed areas as quickly as possible. Typically these systems connect to the public sewer system for treatment and/or discharge to local watercourses. Whilst this approach rapidly transfers storm water from developed areas, the alteration of natural drainage processes can potentially impact on downstream areas by increasing flood risk and reducing water quality.

10.3.2 Due to the difficulties and inconvenience associated with up grading sewer systems it is uncommon for sewer and drainage systems to keep pace with the rate of development/re-development. As development progresses and/or urban areas expand, the drainage systems become inadequate for the volumes and rates of storm water they receive, resulting in increased flood risk and/or pollution of watercourses. Allied to this, the implications of climate change on rainfall intensities leads to more responsive catchment/site responses and surcharging of piped systems.

10.3.3 Appropriately designed SuDS offer a method for managing surface water on site by maximising the amount of rainwater which is returned to the ground through infiltration techniques and holding back, or attenuating excess surface water on-site, and potentially releasing it into the sewer systems over a longer time period. Infiltration techniques enable the recharging of aquifers. A preference for the use of SuDS is highlighted in Planning Policy Statement 25 and its associated Practice Guide and is also a requirement of Approved Document Part H of the Buildings Regulations. Further details regarding water resources available to Fenland are discussed within the Water Cycle Study Report.

10.3.4 As the study area is considered to be water stressed, it would be appropriate, where possible, to “think outside the box” and allow for SuDS devices to form part of a hydrological train where the retained water could be used for water harvesting and irrigation purposes

10.3.5 In addition, SuDS offer wider sustainability advantages within Fenland, such as creating opportunities for landscaping within development sites and incorporating habitats for wildlife as well as encouraging the recharging of aquifers. Care needs to be taken to ensure that a water level management/flood defence system does not suffer because of biodiversity/"green" issues. An example of how these issues can affect what was originally intended as a flood defence, although on a much larger scale, is the Ouse Washes where concerns have been raised about the adverse impact on biodiversity due to flooding.

10.4 SuDS Techniques

10.4.1 Where possible SuDS techniques can be used to reduce the rate and volume and improve the water quality of surface water discharges from sites to the receiving environment (i.e. natural watercourses or public sewers etc). Various SuDS techniques are available and they operate under two main principles; infiltration and detention/attenuation.

10.4.2 Infiltration techniques rely on discharges to the ground and therefore their success is dependent on the local ground conditions, such as the permeability of the soils and geology, the groundwater table depth and the importance of underlying aquifers as water resources.

10.4.3 Detention/attenuation techniques result in a reduction in the rate of discharge from the site through storing water on the site. Clearly the volume of water leaving the site will still remain the

same and therefore it will be necessary to assess the volume of on-site storage available as well as the impact the storage may have on development proposals and risks to neighbouring properties. The volume of on-site storage required should be calculated through hydrological analysis using industry-approved procedures to ensure that a robust design storage volume is provided.

10.4.4 Due consideration should be given to appropriate SuDS techniques throughout preparation and development of the overall drainage strategy for individual development sites. An investigation into ground conditions will be required in order to determine whether infiltration techniques are feasible or whether attenuation techniques are more appropriate.

10.4.5 The application of SuDS is not limited to a single technique per site. In fact, the most successful SuDS solutions often utilise a combination of techniques, in order to provide flood risk, pollution and landscape/wildlife benefits. In addition, SuDS can be implemented on a strategic scale, for example with a number of sites, contributing to large scale jointly funded and managed scheme. It should be noted that each individual development site must provide storage to offset its own increase in runoff and attenuation cannot be 'traded' between developments. A strategic solution requires considerable master-planning together with the resolution of funding and maintenance issues. Prior funding from an external source, for example the proposed Community Infrastructure Levy, may be required if this is to work correctly

10.4.6 A summary of available techniques and their suitability to meet the three goals of sustainability is provided in Table 10-1.

10.5 Drainage Strategy Requirements

10.5.1 A drainage strategy should be provided by the developer to demonstrate to the Environment Agency/LPA and IDB that a site can be drained in a sustainable manner. It should show that through redevelopment flood risk to properties and water environment downstream of the site will not be exacerbated. A drainage strategy should include the following information:

- Permitted discharge rates derived in consultation with the Environment Agency/LPA and also with the relevant IDB where discharge is made to an IDB system;
- Storm water runoff calculations from parcels of land on the site including allowances for climate change for the lifetime of the development;
- Attenuation required on each parcel of land to restrict runoff to permitted discharge rates;
- Proposed means of attenuation;
- Distribution of storm water attenuation across the site;
- Design standards and parameters of the proposed storm drainage techniques;
- To demonstrate control of flooding up to the 1% annual probability storm event including the effects of climate change; and,
- Details of the proposed future ,maintenance of the drainage system should be provided/

10.5.2 This list should not be considered as exhaustive and may require additional elements depending on the nature and scale of the proposed development and mitigation required.

10.5.3 Further Information can be found in the following guidance documents:

- Code for Sustainable Homes 2010;
- Building Regulations 2000 Approved Document H3 Rainwater Drainage;
- BRE 365 Soakaway Design;
- Sustainable Construction in Cambridgeshire – A good practice guide;
- Sustainable Drainage – Cambridge Design and Adoption Guide;
- AWSL guidance; and,
- CIRIA C697 The SuDS Manual.

Table 10-1: Summary of SuDS Techniques and their Suitability to meet the three goals of sustainable drainage systems

Management Train	Component	Description	Water Quantity	Water Quality	Amenity Biodiversity
Source – Prevention	Green roofs	Layer of vegetation or gravel on roof areas providing absorption and storage.	●	●	●
Source – Prevention	Rainwater harvesting	Capturing and reusing rainwater for domestic or irrigation uses.	●	○	○
Source – Prevention	Permeable pavements	Infiltration through the surface into underlying layer.	●	●	○
Source	Filter drains	Drain filled with permeable material with a perforated pipe along the base.	●	●	
Source	Infiltration trenches	Similar to filter drains but allows infiltration through sides and base.	●	●	
Source	Soakaways	Underground structure used for store and infiltration.	●	●	
Source	Bio-retention areas	Vegetated areas used for treating runoff prior to discharge into receiving water or infiltration	●	●	●
Source	Swales	Grassed depressions, provides temporary storage, conveyance, treatment and possibly infiltration.	●	●	○
Site	Sand filters	Provides treatment by filtering runoff through a filter media consisting of sand.	●	●	
Site	Basins	Dry depressions outside of storm periods, provides temporary attenuation, treatment and possibly infiltration.	●	●	○
Regional	Ponds	Designed to accommodate water at all times, provides attenuation, treatment and enhances site amenity value.	●	●	●
Regional	Wetland	Similar to ponds, but are designed to provide continuous flow through vegetation.	●	●	●

Key: ● – highly suitable, ○ - suitable depending on design

10.6 SuDS Design

10.6.1 Detailed guidance for the design of SuDS is available in the CIRIA SuDS Manual C697[12], and the associated document 'Site Handbook for the Construction of SuDS, (C698)[13]. Reference should also be made to the following reports 'Sustainable Construction in Cambridgeshire – A good practice guide' and 'Sustainable Drainage – Cambridge Design and Adoption Guide'. These publications provide best practice guidance on the planning, design, construction, operation and maintenance of SuDS, to ensure effective implementation within developments.

10.6.2 The design of SuDS measures should be undertaken as part of a drainage strategy and design for a development site to be submitted as part of a planning application. A ground investigation should form part of the SuDS assessment to determine ground conditions and the most appropriate SuDS technique(s). Hydrological analysis should be undertaken using industry approved procedures, to ensure an appropriate design is developed. This should account for the effects of climate change over the lifetime of the proposed system/development and based on an agreed permitted rate of discharge from the site.

10.6.3 During the design process, liaison should take place with the authority responsible for the receiving water body and any organisations involved in the long term maintenance of the system. This may include liaison with Fenland DC, the Environment Agency, IDB, Anglian Water the Lead Local Flood Authority and the SuDS Approving Body. Liaison with these organisations should focus on establishing a suitable design methodology, any restrictions and provision for the long-term maintenance of the SuDS system.

10.6.4 The Flood and Water Management Act 2010[25] also encourages 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.

10.7 Where can SuDS be utilised?

10.7.1 The underlying ground conditions of a development site will often influence the type of SuDS technique suitable at an individual site. While this will need to be determined through ground investigations carried out on-site, an initial assessment of a site's suitability to the use of SuDS can be obtained from a review of the available soils/geological survey of the area.

10.7.2 The potential suitability of infiltration or attenuation SuDS techniques for the various soils and strata throughout the study area are tabulated in Tables 10-2 and 10-3. Figure 11 shows the solid and drift geology in the context of which are likely to be of a high permeability or a low permeability and therefore good or bad for infiltration methods.

10.7.3 IDB comments on experience with the use of infiltration devices in the area identified that suitable infiltration layers are often too thin for infiltration devices and suffer from perched water tables. Therefore, on the whole they do not work unless there is a significant amount of space to install them. It can also be difficult to provide infiltration methods on smaller sites. However, alternative methods, such as green roofs and rainwater harvesting (as described in Table 10-1) might be suitable for such developments.

Table10-2: Specific Drift Deposits within Fenland District Council

Drift Deposit	Permeability	General Characteristics	Locations	SUDs
Peat	Low permeability	Peat	Central and southern areas of the Council district.	Attenuation systems e.g. basins and ponds, green roofs, tanks, rainwater harvesting etc
Tidal Flats	Low permeability	Clay and silt	Widespread over much of the Council area.	Attenuation systems e.g. basins and ponds, green roofs, tanks, rainwater harvesting etc
Till	Low permeability	Diamicton	Limited outcrop around March.	Attenuation systems e.g. basins and ponds, green roofs, tanks, rainwater harvesting etc
Head	Variably Permeable	Clay, silt, sand & gravel	Very limited outcrop in the south near Chatteris.	Infiltration/attenuation systems and attenuation systems e.g. permeable surfaces, sub surface infiltration, basins and ponds, swales and filter strips i.e. a combined system
Sand and Gravel	Permeable	Sand and gravel	Central, southern and western areas of district near Whittlesey, March, Doddington and Chatteris.	Infiltration/attenuation systems e.g. permeable surfaces, sub surface infiltration, swales and filter strips i.e. a combined system.[9]

Table10-3: Specific Solid Geology within Fenland District Council

Solid Geology	Permeability	General Characteristics	Locations	SUDs
Oxford Clay Formation	Impermeable	Mudstone	Western half of district	Attenuation systems e.g. basins and ponds, green roofs, tanks, rainwater harvesting etc
West Walton Formation	Impermeable	Mudstone, silty mudstone and siltstone	Northern edge of district	Attenuation systems e.g. basins and ponds, green roofs, tanks, rainwater harvesting etc
West Walton & Ampthill Clay Formations	Impermeable	Mudstone, silty mudstone and siltstone.	Central and Eastern half of district	Attenuation systems e.g. basins and ponds, green roofs, tanks, rainwater harvesting etc

[9] Recent permeability tests undertaken within Doddington, Coates and Whittlesey indicate that infiltration devices designed to accommodate the 1% annual probability event including the effects of climate change will not provide an efficient means of surface water disposal for the lifetime of the development.

10.7.4 The Solid and Drift Deposits Geology throughout the Fenland District Council area has been determined through analysis of BGS geological mapping at 1:50,000 scale.

10.7.5 The solid geology within the Fenland DC area is a sequence of clays, which are impermeable. Therefore, it would be appropriate to consider using attenuation techniques as part of the drainage systems.

10.7.6 Figure 11 highlights the sand and gravel or head drift deposits that are expected to have a high or medium infiltration capacity. These deposits may have a variable permeability, but combined attenuation / infiltration systems may prove feasible in these locations depending on the thickness of the aquifer.

10.7.7 In general, the conclusion of the geological mapping review is that attenuation systems are likely to be the most feasible SuDS system throughout the district apart from where significant permeable drift deposits are present (Figure 11). In these areas attenuation and combined attenuation / infiltration systems may be considered appropriate following further site investigations to establish depth of deposits and groundwater (FRA level investigations).

SuDS Constraints

10.7.8 During the design process, in addition to considering the properties of the underlying soils and strata, it is necessary to consider the sensitivity of the receiving waterbody and any previous uses of the site.

10.7.9 The use of SuDS can be limited based on a number of issues, which include:

- Groundwater vulnerability and potential contamination of an aquifer;
- Current or aspirational water quality of a receiving watercourse;
- The presence of groundwater Source Protection Zones and potential contamination of a potable water source;
- Restrictions on infiltration on contaminated land to prevent the spread of contamination; and,
- Restricted area on development sites where housing densities are high.

Groundwater Vulnerability

10.7.10 Groundwater resources may be vulnerable to contamination from both direct sources (e.g. into groundwater) or indirect sources (e.g. infiltration of discharges onto land). Groundwater vulnerability within the study area has been determined by the Environment Agency, based on a review of aquifer characteristics, local geology and the leachability of soils.

10.7.11 The vulnerability of the groundwater is important when advising on the suitability of SuDS. Groundwater vulnerability is shown on Figure 13 and in Table 10-4.

Table 10-4: Groundwater vulnerability by area

Vulnerability Classification	Vulnerability Description	Typical Location
MINOR AQUIFER HIGH (H1, H2, H3, HU)	Variable permeability aquifer; high soil leaching potential.	Minor areas around Whittlesey, March and Chatteris (associated with sand and gravel drift deposits).
MINOR AQUIFER INTERMEDIATE (I1, I2)	Variable permeability aquifer; intermediate soil leaching potential.	Significant areas around Whittlesey, March and Chatteris (associated with sand and gravel drift deposits).
MINOR AQUIFER LOW	Variable permeability aquifer; low soil leaching potential.	Minor areas north of March and northwest of Chatteris (associated with sand and gravel drift deposits).
NON AQUIFER	Negligibly permeable.	Majority of the council area.

Source Protection Zones

10.7.12 In addition to groundwater vulnerability, the Environment Agency also defines groundwater Source Protection Zones around groundwater abstraction points. Source Protection Zones (SPZ) are defined to protect areas of groundwater that are used for potable supply, including public/private potable supply, (including mineral and bottled water) or for use in the production of commercial food and drinks.

10.7.13 SPZs are defined based on the time it takes for pollutants to reach an abstraction point. Depending on the nature of the proposed development and the location of the development site with regards to the SPZs, restrictions may be placed on the types of SuDS appropriate to certain areas.

10.7.14 There are no SPZs within the Fenland DC area.

Water Quality

10.7.15 Under the Water Framework Directive all member states are required to take steps to achieve good ecological status of water bodies by 2015. To achieve this, discharges to watercourses draining development areas will require pre-treatment to remove oils and contaminants. Appropriately designed SuDS can assist developments improve water quality discharges through passive treatment, whilst additionally providing ecological benefit to a development or local area.

Contaminated Land

10.7.16 Previous site uses can leave a legacy of contamination that if inappropriately managed can cause damage to local waterbodies. During the design of SuDS it is essential to have regard to the nature of potential ground contamination.

10.7.17 Particular restrictions may be placed on infiltration bases SuDS, forcing consideration of attenuation based systems. An alternative is the remediation of contamination prior to the installation of SuDS to reduce risks of the pollution pathways associated with contaminated land.

High development densities

10.7.18 Where developments are required to achieve high development densities it is essential that the requirement for SuDS and their constraints are identified early in the site master planning process. High development densities can restrict the land area available for SuDS, which if mandatory can affect the ability of a site to gain planning permission and therefore its viability.

10.7.19 Early consideration of SuDS enables the drainage requirements to be integrated with the design, limiting the impact they have on developable area and development densities.

11 Future Flood Risk Management

11.1.1 Current flood risk management practices within Fenland DC SFRA study area have been described in Section 5.11. This section describes the practises that are planned for the area or can be incorporated into new developments.

11.2 Flood Defences

River Nene Catchment Flood Management Plan[14]

11.2.1 The River Nene Catchment Flood Management Plan (CFMP)[14] is a high level strategic plan that idenitifies future flood risk management policies. Through an appraisal process 'Policy 4' has been selected for The Fens. Policy 4 is defined as *'take further action to sustain the current scale of flood risk into the future, for example local actions – improve existing flood defences to make sure the current standard of protection is maintained; remote action – increase upstream flood storage remote from the source of flood risk'.*

Great Ouse Catchment Flood Management Plan[15]

11.2.2 Version 2 of this CFMP is currently under consultation following a draft issue in March 2010. This study area is within Policy Unit 24 a draft of which is summarised in Table 11-1.

Table 11-1: Summary of Policy Unit 24 Fens in Draft Great Ouse CFMP

Policy Unit 24: Fens	
Policy Unit 24 - Fens	Policy unit 24 comprises the flat, low-lying fenland area of the catchment. The unit is rural with a low population density. Urban areas consist of scattered towns and villages including the towns of Wisbech, Ely, March, Chatteris, Ramsey and Littleport. Heavily regulated watercourse systems drain the Fens for agricultural production and protect the population from flooding.
Problem / Risk	The Fens policy unit is comprised of two discrete sub-catchments; the Middle Level and the South Level, all of which are managed predominantly by the Middle Level Commissioners, made up of 30 IDBs. **Middle Level** The Middle Level sub-catchment consists of high grade (and high value) agricultural land bisected by drains and isolated settlements. Apart from the Old Bedford River and Bury Brook, all the other watercourses are drains. These include the Sixteen Foot, Forty Foot and Well Creek Drain; all of which are managed by the Middle Level Commissioners. The Ouse Washes, between the Old and New Bedford Rivers, is used for floodwater storage. At times when high river levels coincide with high tides the drainage from the low-lying watercourses into The Wash is impeded and the washes can be used to store the excess water until tide levels drop. The Ouse Washes also provide an important wetland habitat. **South Level** The South Level also consists of low-lying, high-grade agricultural land drained by an extensive network of land drains and pumps. The South Level sub-catchment is almost wholly drained via pumps into the Ely Ouse river system. The Ely Ouse Flood Protection Scheme was built to protect the South Level from flooding; the system includes the Cut-off Channel, the Relief Channel and three flood storage reservoirs. The Relief Channel has a large storage capacity and can store water that cannot be discharged due to high tides and the breaching sections allow water from the Relief Channel and Cut-off Channel to flood farmland owned by us. The main risk to the Fens is from the drainage channels and from potential overtopping or breaching of embankments along high-level watercourses. The IDB drains are also constrained by the rate at which water can be discharged into main rivers (via pumping) and therefore large areas of the Fens can become waterlogged resulting in standing water covering the fields. This risk will increase in the future due to rising sea levels and increased river levels. Should these defences overtop, the lowest lying properties will be severely affected. There are also issues of subsidence and land shrinkage throughout the Fens area. Risks in the Fens are not just to people, property and environmental assets but also to the high-grade agricultural land which is vital to the regional economy and it is important that we work to protect this from future flooding. Significant flooding has been recorded in the Fens in March 1947, 1978 and February 1953. Our analysis suggests that a 1% AEP fluvial flood would affect 672 people and 377 properties, causing £10.5million in property damage and £5.3million in agricultural damages. One surgery/health centre would be at risk in a 1% AEP flood as well as three sewage treatment works and three electricity sub-stations. 1.6km of A-roads (including the A1101 and A1123) and 5.5km of railway are also at risk from a current 1% AEP fluvial flood.

	A 0.5% AEP tidal flood would affect 230 people and 108 properties, causing £3.1million in property damage and £414,845 in agricultural damage. No community facilities and one sewage treatment work would be at risk in a current 0.5% AEP flood. The main driver of increasing future flood risk is climate change which, together with potential effects from future development, could increase peak flows by up to approximately 21%. Our analysis suggests that a 1% AEP future fluvial flood would affect 1,951 people and 991 properties causing £31million in property damages and £12.7 million in agricultural damages. Additionally, one surgery/health centre and one school/college will be at risk from the future 1% AEP fluvial flood, as well as three sewage treatment works, three electricity substations, and 1.6km of A-road (including the A1101 and A1123) and 7.3km of railway. A future 0.5% AEP tidal flood would affect 1,154 people and 508 properties, causing £12.5million in property damage and £1.3million in agricultural damages. One sewage treatment works and two electricity sub-stations will be at risk from a future 0.5% AEP tidal but no community facilities will be at risk. A future 0.5% AEP tidal flood will also affect 1.1km of A-road and 0.9km of railway.
Chosen Policy	**Policy four - take further action to sustain the current level of flood risk into the future** The social and economic impacts within the Fens are sustained at the current level by offsetting future impacts from climate and development change. This policy also removes the significant risk of defence breaching and overtopping. The aim of Policy 4 is to take action to sustain the current level of flood risk into the future. Across the Fens there are currently 454km of fluvial defences, 80 of fluvial/tidal defences and 35km of tidal defences. These are owned and maintained by a variety of organisations; ourselves, local authorities and private individuals. For Policy 4 we assumed that these can be improved into the future so that the additional flood risk can be offset. Therefore our Policy 4 risk values show no change from the current baseline.
Justification	Adopting policy 4 will focus efforts on sustaining the current level of flood risk into the future, avoiding any rise in risk to the Fens policy unit. Policy 4 will allow present actions to control flood risk to be continued and enhanced (for example, maintaining the washlands, maintenance of the watercourse, and other defences, and flood warning). The resulting future flood risk then remains at the current level, avoiding the increase in risk, particularly to people and the economy, if no further action were taken. This also avoids an increase in the serious residual risks arising from defence failure. Currently, due to the presence of defences, there is not considered to be a significantly high level of flood risk in the Fens. The increase of risk in the future is associated with overtopping of these defences as river and tidal levels increase. If we did not mitigate against the effects of climate change many more people would be at risk. In addition, the area (and associated economic damages) of high grade agricultural land at risk would increase. The Fens is a critically important agricultural area on a national level, and there would be many indirect impacts if flooding were to increase. The level of risk figures we have found from our modelling do not take account of the risk of defences breaching. The risk of breaching could increase in the future if more fluvial and tidal flood water was contained within the system. The flood risks from breaching are high, and this supports our Policy 4 action to improve the defences to take account of climate change. Adopting Policy 4 also allows us to undertake a Fens Strategy. This will allow us to fully explore flood risks and the most appropriate mitigation measures, in line with the policies that are dropping out of the Tidal River Strategy. This is important as our broad scale modelling could be improved on to better understand flood risks in this

	area of high grade agricultural land. If we were to withdraw or reduce our flood risk management then risks to people, property and the economy would become excessively high in the future. By sustaining the current level of flood risk across this policy unit, the risks to society, the economy and the environment do not increase over the next 100 years. Adopting policy 4 for the Fens supports economic, social and environmental sustainability by sustaining the current high standard of protection. It aims to offset future impacts, from climate change and development. The objectives which are met by this policy (1% AEP future fluvial flood impact and 0.5% AEP future tidal flood impact, compared to current baseline) are: • to minimise flood related risks to the population (no change); • to minimise risks to critical infrastructure (no change); • to minimise community disruption from flooding (no change to number of residential properties and commercial properties at risk); • manage flood risk to sites of cultural heritage and landscape (no change • in risk from tidal or fluvial sources); • to minimise economic impacts of flooding (no change to residential, commercial and agricultural damages); • ensure future investment in the catchment is proportional to the risks (continued investment of £619,830 (EA), £2.2 million (Middle Level Commissioners) per annum); • manage flood risk to habitat and species (no change in risk from tidal or fluvial sources); • protect and improve 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 decrease in quality).
Alternative Policies Considered	Other policies were rejected for the Fens due to (1% AEP future fluvial flood impact and 0.5% AEP tidal flood impact compared to current baseline): Policy 1 - no active intervention; this would cause very high risk to people, property and the economy (increases of 48,768 people, 22,046 properties, £1,102million property damages and £30million agricultural damages from fluvial sources, and increases of 4,458 people, 1,944 properties, £86million property damages and £8.08agricultural damages from tidal sources). Policy 2 - reduce existing flood risk management actions; this would cause very high risk to people, property and the economy (increases of 36,553 people, 16,604 properties, £767.8million property damages and £121.6million agricultural damages from fluvial sources, and increases of 4,458 people, 1,944 properties, £86million property damages and £8.08million agricultural damages from tidal sources). Policy 3 - continue with existing or alternative actions to manage flood risk at the current level; allowing flood risk to rise with future change would lead to significant increases in risk to people, property and the economy (increases of 1,279 people, 614 properties, £20.5million property damages and £7.37million agricultural damages from fluvial sources, and increases of 924 people, 400 properties, £9.4million property damages and £919,484 agricultural damages from tidal sources). Policy 5 – take further action to reduce flood risk; this is not a cost-beneficial approach as the level of investment required would not be proportional to the benefits. Policy 6 - take action with others to store water or manage runoff in locations that provide overall flood risk reduction or environmental benefits, locally or elsewhere in the catchment; there is no scope for this because making additional space for water would result in more people becoming at risk.

Catchment-wide opportunities & constraints	**Main opportunities** • manage the increased risk of existing flood defences from breaching; • improve integration of flood risk management; partnership between ourselves, IDBs, local authorities, Anglian Water, and private landowners; • review FWAs being considered for inclusion in the EDW service, as Heacham and Snettisham, for example, have not currently been put forward; • improve understanding of risk and set sustainable long term policies for the area; • the CFMP will support land use planning by identifying, and discouraging development in existing and future flood risk areas and directing development to other more suitable areas; • The future management of the fens should incorporate the use of natural processes linked to the objectives of the GOWV, the 50th Wetland Vision, and include existing projects such as the Great Fen Project, Wicken Vision, Regional Habitat Creation; • The Fenland Management Plan (Fenland Strategy) should promote the extension of agri-environment schemes, improve management of drainage ditches for landscape and wildlife; • to maintain, enhance and create wetlands to contribute to the delivery of UK Biodiversity Action Plan targets and the preservation of landscapes, cultural and archaeological features; to build a strong sense of local pride in the area's wetland past and positive support for the creation of new wetlands; to ensure that wetland resources play their full part in social and economic development; • opportunities to enhance the watercourse for fisheries to achieve WFD objectives e.g. fish/eel passes at structures, rock riffles, in-stream habitat; • opportunities for wetland creation / restoration, including the creation of semi-natural buffers around sites vulnerable to diffuse pollution (e.g. Ouse Washes); • opportunity for FRM activities to contribute towards achieving the water level objectives and requirements for Wicken Fen SSSI, Woodwalton Fen SSSI, Berry Fen SSSI, Ouse Washes SSSI, Cam Washes SSSI, Lakenheath Poors Fen SSSI and Boughton Fen SSSI as outlined in the WLMPs for these sites; • reduce frequency, durations and severity of flooding to high grade agricultural land. The agricultural land in the Fens policy unit is important for the region and should be safeguarded to protect the regions economy. **Main constraints** • certain flood risk management options may be economically or technically unfeasible in some locations. FRM activities may be constrained by the water level objectives and requirements for Wicken Fen SSSI, Woodwalton Fen SSSI, Berry Fen SSSI, Ouse Washes SSSI, Cam Washes SSSI, Lakenheath Poors Fen SSSI and Boughton Fen SSSI as outlined in the WLMPs for these sites; • landscape character and local designations may constrain work in some locations; • the presence of Scheduled Monuments and other heritage features may constrain the choice of options in some locations; • conflicting views from different organisations of how the Fens should be managed into the future; • conflicting polices in the Tidal River Strategy; • the Fens covers several CFMPs, and modelling techniques will be variable; • sustaining pumping capacities to manage future increases in river levels.
Risks, uncertainties & dependencies	The greatest uncertainty we think there is in our estimates of future flood risk is in the approach we have adopted for increasing future river flows in our final future scenario. Although we have consulted the relevant planning documents and spatial strategies for this area, and have looked at how climate change could influence rainfall and rivers flows, there is still much uncertainty in how rivers will respond in the future.

Also, we have developed broad scale river models for this CFMP. Whilst this allows us to examine flood risk across the whole of the CFMP area, we must recognise that the results are only 'indicative' and there is likely to be a degree of uncertainty in our estimates. The way in which we have undertaken this river modelling has meant that we are not able to quantify velocities; these are considered qualitatively. Also, we have used a multiplier of 2.4 people for each residential property at risk to calculate the number of people at risk.

Although there are some limitations of the approach we have adopted we are confident that our modelled risks and damages for policy unit 24 are accurate enough to confirm that the correct policy option should be Policy 4. We will have the opportunity through undertaking the Fens Strategy to model and better understand the system in more detail.

Great Ouse Tidal River Strategy[16]

11.2.3 The Great Ouse Tidal River strategy[17] area stretches approximately 51 km along the Great Ouse from Earith in the north to King's Lynn, and from Wisbech in the west to Marham and Ely in the east.

11.2.4 The strategy appraised a long-list of options in terms of technical, economic (including indicative costs and damages), environmental and health & safety aspects. Further appraisal of these options allowed a long-list of management strategy options to be reduced to a short-list of options at certain locations for more detailed analysis.

11.2.5 The short-listed options for different locations were combined to provide overall alternative options for the whole study area, see below. These options included core-engineering elements and management measures. These options are presented in Table 11-2, below.

Table 11-2: Short-listed long term management options for the Great Ouse

Option Number	FRM Option	Description
F 1	No Active Intervention (Do Nothing) - Base Case	No further investment or involvement in maintaining the existing defences. Defences are abandoned and natural processes are allowed to continue. The Standard of Defence would deteriorate.
F 2	Do Minimum (Maintain)	Maintenance is undertaken and breach repairs are carried out until it is not economically unsustainable to do so. The standard of the defence would gradually reduce with time due to sea level rise.
F 3	Hold the Line	The existing line of defence is held by investment to provide an agreed standard of defence, which may differ from the present one. This will include bank reinforcement (F3), crest wall replacement (F23) and bank raising.
F 5	Bank Reinforcement on the riverward side	Erosion protection to avoid structural defence failure.
F 10b	Flood Storage behind South level Barrier Bank (Without a back bank)	Reinforce the SLBB crest at some point between Earith to the A142 to control and limit overflow. Crest not lowered to avoid increasing flood risk to the area behind the SLBB.
F 15	Bank Reinforcement on the riverward side	Major repairs / replacement of erosion protection on the Tidal River to avoid structural defence failure.
F 19	Managed re-alignment of East Bank	Utilise storage capacity of the Flood Relief Channel and land between the flood relief channel and the tidal river.

Option Number	FRM Option	Description
F 20	Tidal Barrier (South of King's Lynn)	A tidal barrier south of King's Lynn would shut when extreme surge tides occurred to prevent tidal flooding. The tidal barrier would also separate fluvial from tidal waters, thus reducing saline intrusion and silt migration.
F 23	Replacing crest walls	Local works to replace isolated bank-top defences in due course

11.2.6 The consultation period for the draft Strategy and the Environmental Report was 21st September to 16th November 2009. The results of the consultation and the decision on the final scheme for the Great Ouse have not yet been published.

Middle Level Strategic Study and St. Germans Pumping Station.

11.2.7 The IDBs in the area also continue to maintain and improve the flood defence systems which provide protection from surface water flooding. This includes schemes to ensure the minimum standard of protection is maintained as a result of climate change.

11.2.8 The major event of Easter 1998, which was contained within the Commissioners area with no flooding, prompted a review and an opportunity to investigate the potential/actual effects of climate change, land shrinkage, increased run off and social (development) changes on its system.

11.2.9 To justify the long term benefit of the high cost of implementing and sustaining these major improvements, a Strategic Study was carried out. This looked at the whole cost of providing, and continuing to provide, a satisfactory flood defence system in the area over the next 100 years.

11.2.10 To ensure that all the possible effects and options for long term requirements were properly considered, a mathematical model, using much more sophisticated equipment and techniques than were available in the 1970's when the last major assessment was carried out, was commissioned.

11.2.11 Up-to-date data of the channels obtained from new surveys, and rainfall and run-off information from the Flood Estimation Handbook, were incorporated in an ISIS model, which computed flows within the various channels, and the required capacities of pumping facilities, for a variable range of scenarios and determined the improvement measures associated with each. The model showed that significant benefit would be gained from larger capacity pumps at St Germans in addition to other improvements.

11.2.12 A further full assessment of the standard of service that the St Germans station could provide, and its likely remaining useful life concluded that major improvements were required. The replacement of the station in its entirety was recommended and demonstrated that the financial commitment was well justified with a benefit/cost ratio of 18.5:1.

11.2.13 Following consideration of various options a new St Germans pumping station was therefore built just downstream of the original facility with a discharge capacity of up to 100 cumecs (7,830 tonnes per minute). Construction work on site began in December 2006 and the station came on line in April 2010, at a cost of £40 million. The new station contains 6 concrete volute type pumps powered by electricity but each with a diesel powered generator since because of the size of the pumps only up to 3 pumps can be run from the mains electricity at any one time.

11.2.14 The new station currently protects 26,000 properties as well as high grade agricultural land, transport systems and utilities. Photograph 5 shows the new St Germans pumping station.

Photograph 5: New St Germans Pumping Station opened April 2010

11.3 Flood Warning

11.3.1 Flood Warning is an essential component of the strategy to reduce flood risk. The current flood warning systems provided by the Environment Agency are:

Severe Flood Warning

Severe flooding. Danger to life.

Flood Warning

Flooding is expected. Immediate action required.

Flood Alert

Flooding is possible. Be prepared.

11.3.2 Flood Warning is an essential component of the strategy to reduce flood risk. The current flood warning systems provided by the Environment Agency are described in Section 5.12. However, it should be noted that the flood warning system only operates for fluvial or tidal flooding. The majority of flooding within the Fenland area occurs from an exceedance in capacity of the managed IDB systems and surface water, therefore most flooding incidents are likely to occur without any warning. Although the MLC are on the Environment Agency's Flood Warning Direct system and are advised of flood warnings in accordance with the Environment Agency's protocol's. There is Quickdial number specifically for "Rivers, dykes and drains in the Middle Level Commissioners' Drainage Area".

11.3.3 Sir Michael Pitt's review of the summer 2007[8] floods stresses the importance of developing a flood warning system for surface water flooding. One of the reports interim conclusions (IC3) was "the Environment Agency further develops tools and techniques for predicting and modelling river flooding, especially to take account of extreme multiple events; and takes forward work to develop similar tools and techniques to model surface water flooding."

11.4 Flood Alleviation Schemes

11.4.1 The potential for flooding can be increased in areas where flood alleviation measures are not maintained regularly and/or adequately. Breaches in flood defences for example are most likely to occur where the defence has been degraded or not maintained to its design standard. Drainage infrastructure in urban areas can also frequently become blocked with debris which, if not removed, can lead to blockages in culverts and backing up of a watercourse resulting in flooding of property.

11.4.2 It is therefore an essential aspect of flood risk management practise that all flood alleviation schemes are regularly maintained to a specified design standard. It is the responsibility of the riparian land owner to maintain the watercourses or defences to a suitable standard. The Local Authority, IDB or Environment Agency has permissive powers to act should the riparian not satisfy their maintenance requirements.

11.5 Flood Mitigation on site

11.5.1 Flood mitigation measures can also be incorporated within a development and are usually more appropriate in areas of residual flood risk. The Pitt Review recognised the importance of flood resilient and resistant techniques and came to an interim conclusion (IC11) that "no new building should be allowed in a flood risk area that is not flood-resilient, and that Government should work with organisations such as the Royal Institute of British Architects and the building industry to encourage flood-resilient building and development design."

Flood Avoidance

11.5.2 This is defined as:

- 'Constructing a building and its surrounds (at site level) in such a way to avoid it being flooded (e.g. by raising it above the flood level, re-siting outside flood risk area etc.)'.

11.5.3 This is used to restrict the pathway between the flooding source and the receptor. The preferential option is to locate the building outside a flood risk area through rearranging the site layout if possible. Alternatives within this category could include a permanent or temporary defence such as raised kerbs to contain and route flood water through a site or demountable barriers. A site specific FRA would need to demonstrate these options did not affect current flow paths.

Flood Resistance

11.5.4 This is defined as:

- 'Constructing a building in such a way to prevent floodwater entering the building and damaging its fabric'.

11.5.5 Floodwaters will enter buildings through the weakest points in the construction which maybe in the brickwork, party walls of terraced or semi-detached buildings, expansion joints between walls where different construction materials meet, vents, door thresholds, seepage from below ground through floors and basements and/or sanitary appliances from backflow from surcharged drainage systems.

11.5.6 Flood resistance techniques are employed within the fabric of the buildings. They include the use of low permeability materials in the construction of the building and are likely to only be effective for short duration flood events and of low flooding depths (less than 0.3 m). They may be used in conjunction with flood resilience techniques when the predicted flood level is between 0.3 - 0.6 m.

Flood Resilience/Repairable

11.5.7 This is defined as:-

- 'Constructing a building in such a way that although floodwater may enter the building its impact is reduced (i.e. no permanent damage is caused, structural integrity is maintained and drying and cleaning is facilitated)'.

11.5.8 Flood resilience techniques are also employed on buildings within the floodplain. This type of approach is often more appropriate when the predicted depth of flooding is greater than 0.3 m or flooding is expected to last for a long time. In these cases the use of more durable materials that will not be easily damaged by floodwaters as well as the use of construction materials that are more effective at draining and drying are recommended.

11.5.9 There is currently no guidance with the UK Building Regulations for appropriate means of construction for properties in flood risk areas. For more information on flood resistant construction please refer to DCLG (2007) 'Improving the Flood Performance of New Buildings: Flood Resilient Construction'.

12 Policy Recommendations

12.1 Flood Risk

12.1.1 PPS25[1] aims to guide new development to those areas at lowest risk of flooding, both now and in the future (allowing for the effects of climate change) and to ensure development does not increase the risk of flooding elsewhere.

12.1.2 The settlement areas across the study area are generally located in Flood Zone 1 and islands of Flood Zone 1. Therefore in accordance with PPS25[1] future development should be steered to these lower risk areas. A summary of the flood zones, SuDS suitability and considerations for future development locations is outlined in Table 12-1 below. Figures 7A-7E show the zoomed in flood zone extents for each of the main settlement areas.

Table 12:1 Summary of Flood Risk for Settlement Areas

Settlement Area	Flood Zones (Figure 7)	Development considerations	SuDS (Figure 11 and 14)
Chatteris	This settlement although largely in Flood Zone 1 forms an island surrounded by floodplain. Northern and western extents are Flood Zone 2 and 3.	Any development in this area should be directed to Flood Zone 1, consideration is needed for refuge and emergency measures in the event of a flood as it may be cut off from other larger areas with respect to emergency services and services. Disposal of Surface water runoff is a current concern or has caused flooding in the IDBs of Nightlayers and Warboys Somersham & Pidley. Proposals for development to the East and West of Chatteris should be discussed with the MLC to determine specific surface water runoff attenuation requirements of allocations in these areas.	Areas of low and medium-high infiltration. Where infiltration SuDS proposed infiltration tests should be provided.
Wisbech	The western and northern extent of this settlement area is Flood Zone 2 and 3.	Development should be focused in the areas of Flood Zone 1 or around southern and eastern extents which are also Flood Zone 1. Disposal of Surface water runoff is a current concern or has caused flooding in the IDB of Hundred of Wisbech. Proposals for development to the South of Wisbech should be discussed with the MLC to determine specific surface water runoff attenuation requirements of allocations in this area.	Low infiltration for most of the area. Therefore retention SuDS such as swales and ponds more suitable. Infiltration such as soakaways unlikely so infiltration tests should be provided where these are proposed.
March	This settlement although largely in Flood Zone 1 forms an island surrounded by floodplain. The western and eastern extents are Flood Zone 2 and 3.	Any development in this area should be directed to Flood Zone 1, consideration is needed for refuge and emergency measures in the event of a flood as it may be cut off from other larger areas with respect to emergency services and services. Disposal of Surface water runoff is a current concern or has caused	Areas of low and medium-high infiltration. Where infiltration SuDS proposed infiltration tests should be provided.

Settlement Area	Flood Zones (Figure 7)	Development considerations	SuDS (Figure 11 and 14)
		flooding in the IDBs of March 3rd, 5th and 6th, March East & March & Whittlesey. Proposals for development to the South, North and East of March should be discussed with the MLC to determine specific surface water runoff attenuation requirements of allocations in these areas.	
Whittlesey	This settlement although largely in Flood Zone 1 forms an island surrounded by floodplain. Northern extents are Flood Zone 3.	Any development in this area should be directed to Flood Zone 1, consideration is needed for refuge and emergency measures in the event of a flood as it may be cut off from other larger areas with respect to emergency services and services. Development to the north of Whittlesey could be affected by works to the Whittlesey washes FSR and this should be taken into account through site specific FRAs.	Medium to high infiltration likely. Therefore infiltration SuDS possible. Infiltration tests should be provided where these are proposed.
Doddington/ Wimblington	This settlement although largely in Flood Zone 1 forms an island surrounded by floodplain. Southern extents are Flood Zone 3.	Any development in this area should be directed to Flood Zone 1, consideration is needed for refuge and emergency measures in the event of a flood as it may be cut off from other larger areas with respect to emergency services and services although links to March are likely in the event of a flood.	Areas of low, medium and high. Therefore range of SuDS measures suitable. Where infiltration SuDS proposed infiltration tests should be provided.

Study Area Wide Policy Recommendations

12.1.3 To achieve the aim of PPS25[1] the following policy considerations are recommended:

- Have regard to the cumulative impact of development on flood risk;
- Determine decisions for all new development through application of the Sequential Test, where necessary. Where this is not practical Fenland DC should assess the flood risk in accordance with the companion guide to PPS25[1];
- Consider the wider sustainable benefits of addressing flood risk;
- Engage with stakeholders throughout the LDF process to investigate initiatives for the reduction of flood risk where appropriate;
- Ensure FRAs prepared for developments conform to national policy and the additional elements identified in this SFRA, where considered suitable by Fenland DC, IDBs and the Environment Agency; and,
- Have regard to the role development sites could have to alleviate flood risk elsewhere.

12.1.4 Through integration of these recommendations, it is considered that the emerging LDF will comply with PPS25[1] and the aspirations represented in following and presented in Section 4:

- East of England Plan Policy WAT4;

- Regional Planning Guidance for the East of England (RPG6); and,
- Fenland Local Plan Policy PU1.

12.2 Conventional Drainage Systems

12.2.1 Due to expansion of developed areas, the conventional drainage systems designed to serve the original settlements can become overloaded leading to flooding. In addition the design standard of newer sewer systems is typically to accommodate the 3.3% annual probability (1 in 30 year) storm event, with events in excess of this expected to result in flooding. With the impacts of climate change the effective design standard of the sewer system is expected to decrease leading to more frequent flooding and more severe flooding within the design standard of the defence.

12.2.2 The Commissioners and associated IDBs require all new development to be designed to accommodate the worst case scenario up to 1 in 100 year event and allow for climate change.

12.2.3 In addition, conventional drainage systems typically discharge storm water to nearby watercourses. As urbanisation and intensification of catchments increases, storm water inputs can impact on water quality. With the incorporation of the Water Framework Directive into UK law the councils should seek opportunities to contribute to the goal of improving the quality of local watercourses.

Study Area Wide Policy Recommendations

12.2.4 The following study wide policies are recommended:

- Surface water flooding should be investigated in detail as part of FRAs for developments located in high and medium risk areas (identified from the Sequential Test Maps) and where FRAs are required by the IDBs as part of Land Drainage bye-laws requirement, and comprehensive surface water runoff calculations undertaken. Planning applications for developments in these areas should submit a FRA that considers:
  - impact of the layout of the development on current drainage flow paths and drainage systems;
  - how surface water attenuation or infiltration will be provided to ensure no increase in runoff rates or volumes to IDB or Environment Agency controlled waterbodies[10];
  - the consequences of a failure of the drainage system through blockage; and
  - risk of flooding from the sewer system.
- Fenland DC should also seek opportunities through development to deliver schemes to alleviate flooding from surface water runoff to existing properties.
- Sustainable drainage design should consider the impacts of climate change for the lifetime of the development;
- The potential benefits of an appropriately designed SuDS should be considered in terms of biodiversity improvements, amenity value, water quality and resource value of a development and/or surrounding area;

[10] This policy recommendation may vary depending on the local IDB preferences please see sections 10.1.4 and 10.1.5 for further discussion on this.

- The vulnerability and importance of local water resources should be taken into account when determining the suitability of drainage strategies/SuDS; and,
- Discharge rates from new developments should not increase following redevelopment, including allowances for climate change and preferably restrict discharge rates to greenfield runoff rates in areas known to have a history of sewer flooding.
- All operating authorities in the area with an interest or role in managing flood risk should work more closely to agree lines of communication, share information and educate operational staff in key flood risk issues in the area. It is recommended that officers from FDC, the EA, MLC and NLIDB meet on a quarterly basis to discuss flood risk issues.
- Pre-application discussions with MLC, NLIDB and EA should be encouraged on all relevant planning applications to ensure that FRAs are produced were required (both for PPS25 and for Land Drainage Consent) and at the appropriate level.
- Given the complexity in management of surface water in the study area, it is recommended that all planning applications that require an FRA include a drainage strategy in addition to the requirements of PPS25[1] to ensure that an adequate evidence base has been provided and suitable consideration has been given to water level/food risk management
- Watercourses should be maintained as open channels and culverting of watercourses should be avoided.
- Development that impedes overland flow paths should not be granted permission owing to the increase in flood risk that this can create elsewhere.

Area Specific Policies

12.2.5 The majority of urban settlements within the study area have the capacity to suffer from flooding as a result of lack of capacity in the existing drainage infrastructure and/or the speed at which storm water is delivered to watercourses as well as blocked watercourses and poor maintenance.

12.2.6 Fenland DC should ensure all proposed developments in these areas restrict their discharge rates to greenfield rates (in discussion with the relevant IDB to ensure that this will not cause issues for siltation downstream from reduced flow). The Government's preferred method to achieve this is through the use of Sustainable Drainage Systems (SuDS). PPS25 notes that regional planning bodies and local authorities should promote the use of SuDS for the management of runoff. Whilst the PPS25 Practice Guide recognises the significance of SuDS in controlling the impact of development on local flood risk in step four of the 'Flood Risk Management Hierarchy' discussions should be held with the IDB to agree a drainage strategy where relevant, as some types of SuDS may not always be suitable in parts of the study area.

12.2.7 Any development proposals that incorporate a drainage strategy should also include a maintenance programme.

12.3 Flood Risk & Environment

12.3.1 As the population increases and climate change leads to hotter drier summers, the prospect of droughts will increase. New development can tackle this by incorporating water efficiency measures, such as greywater recycling, rainwater harvesting and water use minimisation

technologies. In doing so, knock-on benefits could be felt by the sewer system which will receive less wastewater from properties, potentially freeing up capacity during flood events.

12.3.2 In addition, increasing people's awareness of the water environment around them, together with its importance and its hazards, will contribute to their understanding of where floods come from and what they can do to limit the consequences of flooding and resource shortages.

Study Area Wide Policy Recommendations

12.3.3 In terms of flood risk and the environment the following is recommended:

- Ensure that proposed developments can be accommodated by the existing water resource provision. Where a development cannot be met by current water resources, ensure that the phasing of development is in tandem with resource infrastructure investment; and,
- adopt a policy for all development sites, where appropriate, of the routine maintenance of all watercourses ensuring they are clear of debris that could affect flood flow conveyance and water quality (this is generally the landowners responsibility).

12.3.4 Through integration of these suggestions, the emerging LDF should comply with PPS25 and the aspirations and policies represented in following and presented in Section 4 and Appendix A:

- Regional Planning Guidance for the East of England (RPG6) and RSS 2008;
- East of England Plan Policy SS1: Achieving Sustainable Development

12.3.5 Table 6.20 in the River Nene Catchment Flood Management Plan[27] (and summarised in Appendix A: Table 0-1) provides a summary of the flood risk management policies that have been set out by the Environment Agency and assigned to different zones of the study area. The strategies suggested above integrate with these aspirations and if adopted will aid to strengthen the position of Fenland DC's flood risk management.

12.3.6 Adoption of policies to address the recommendations in this section should ensure the emerging LDDs and LDF for Fenland are in agreement with the policy and planning documents presented in Section 4 and Appendix A. In addition the suggested policy recommendations will ensure several of the existing policies are strengthened to ensure flooding is a key consideration for new developments, especially in light of information specific to the study area.

12.3.7 Development Control, Emergency Planning and relevant policy officers within the council should be given training on flood risk and the implications for their district. This should include reference to undertaking the Sequential Test and the future use of the SFRA for future development including windfall sites.

13 Emergency Planning

13.1.1 In Sir Michael Pitt's Review of the 2007[8] floods he recognises the 'dedicated and quick response' of emergency services which prevented the worsening of many situations. However, he also identified a number of failings and opportunities to improve our preparedness for future flood events. In particular he advises that with 'stronger local leadership of flood risk management, clarification of roles, more effective co-operation between responsible organisations, better protection of infrastructure and wider and deeper public engagement' the impact of flooding on communities could be significantly reduced.

13.1.2 If many of these opportunities identified by Sir Michael Pitt are to be achieved, the role local authorities have in planning and responding to flood events must be clearly defined. To assist local authorities in understanding their role it is essential to have a technically sound emergency plan in place to provide clear procedural instructions to the organisations, companies and individuals involved and affected.

13.1.3 The mobilisation and organisation of the emergency services and supporting agencies, for example Cambridgeshire County Council and Fenland DC can be integral in the coordinated rescue, treatment and transport of potentially large numbers of displaced residents or casualties. Similarly during and after a flood event the role of the local authority can include providing transport for the evacuees and safe rest centres in the event of homes being flooded. Further health and welfare issues are inevitable as a result of serious flood events, which may impact on the ability of people to return to their homes or places of business.

13.1.4 Whilst this SFRA is not designed to fulfil that role, it does contain useful information for Fenland DC and other key organisations to assist them in understanding their risks and begin the process of developing an appropriate co-ordinated response.

13.2 Developing an Emergency Flood Plan

13.2.1 The Cambridgeshire Local Flood Warning Plan (March 2007) and the Cambridgeshire and Peterborough Resilience Forum (2007) address some issues related to fluvial and tidal flood plan's for Fenland. A multi agency flood plan is proposed for completion in the next few months therefore some of the information in this section should be addressed as part of the plans development.

13.2.2 To assist the local authority to develop a Multi Agency flood emergency plan it is recommended that a staged approach is followed. This may consist of the following stages:

- Understanding of how a flood might impact on the Fenland area by identifying key infrastructure, buildings and organisations that may be at risk of flooding;
- Liaise with the organisations responsible for at risk infrastructure and buildings to establish what the consequences of a flood would be on them and the individuals who rely on them and what emergency procedures they have in place for dealing with a flood;
- Liaise with the same organisations to establish a coordinated strategy for dealing with flood events; and,
- It is understood that a vulnerable persons database has been completed, new rest centre locations are in the process of being identified and a flood warning system is in place for

existing development. These measures should be included in the production of the multi agency flood emergency plan.

Identifying at Risk Installations

13.2.3 Using the maps provided as part of this Level 1 SFRA, Fenland DC can identify (map) key installations located in flood risk areas. In achieving this Fenland DC may find it advantageous to adopt a tiered approach to identify those installations that are at primary flood risk (i.e. at risk themselves) and those areas at risk as a consequence of an installation being un-operational as a result of a flood. For example a flooded fire station would be a primary impact of flooding; the area served by that fire station would be at a secondary impact of the flooding, due to the potentially limited ability of the fire service to provide adequate coverage in the area.

13.2.4 It is recommended that any flood plan should consider the following installations for mapping of primary and secondary impacts. This list is not exhaustive and it is possible that other strategic facilities may be identified during the production of a plan.

- Police stations;
- Ambulance stations;
- Fire stations;
- Hospitals;
- Command centres;
- Telecommunications installations;
- Emergency dispersal points;
- Water treatment works;
- Sewage Treatment Works;
- Radio Stations; and,
- Electricity sub stations.

13.2.5 Rest Centres already allocated by Fenland DC are presented in Figure 12. New rest centres are currently being identified by Fenland Emergency Planners.

13.2.6 It is also recommended that installations that may be relied on to house displaced residents or from where vulnerable residents may need to be evacuated swiftly are also identified, although care should be taken to ensure the refuge centres are located outside the floodplain. These may include:

- Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels;
- Student halls of residence;
- Non-residential uses for health service, nurseries and educational establishments.
- Leisure centres;
- Churches;
- Schools; and,

- Community Centres.

13.2.7 This list of suggested installations/institutions presented above should not be considered exhaustive. Discussions should be held within Fenland DC and with the emergency services to establish those installations and organisations that should be mapped to assist in developing a robust emergency plan.

Individual Flood Responses/Mitigation Measures

13.2.8 Once at risk installations have been identified, Fenland DC should liaise with the relevant organisations to establish if they are aware of their risk to flooding and if so if they are also aware of the primary and secondary impacts of their flood risk. Discussions should also be held to establish any flood event procedures they maintain and/or mitigation measures.

13.2.9 Using this information it may be necessary to return to the mapping exercise to redefine impact areas, to either account for mitigation measures already in place (i.e. transfer of fire personnel to a secondary facility suitable to maintain an adequate level of cover in the event of an emergency) or to extend secondary impact areas.

14 Where do we go from here?

14.1 Level 1 SFRA

14.1.1 This Level 1 SFRA has drawn on existing information and data to provide a strategic assessment of the flood risk posed to Fenland DC from all sources of flooding.

14.1.2 The Level 1 SFRA presents Flood Zone Maps that delineate the Flood Zones outlined in PPS25 as Flood Zone 1, low probability, Flood Zone 2, medium probability, Flood Zone 3a, high probability and Flood Zone 3b, functional floodplain.

14.1.3 Table D.1 of PPS25 provides information on which developments are considered appropriate in each Flood Zone, subject to the application of the Sequential Test and either the Exception Test or a site-specific Flood Risk Assessment (FRA) to demonstrate safety.

14.1.4 Information regarding flood risk can be used to provide a strategic assessment for the future site allocations across Fenland and to assist with the application of the Sequential Test for these development sites.

14.2 Implications for Policy in Fenland DC

14.2.1 In line with flood risk issues and objectives identified by the Environment Agency, it is suggested that the following strategies and considerations are incorporated into Fenland DC's LDF to strengthen the position of Fenland with respect to flood risk management.

- Ensure the Sequential Test is undertaken for all land allocations. This will ensure that all development is steered towards the areas of lesser flood risk wherever possible and that the vulnerability of proposed developments are appropriate to the defined Flood Zone, thereby reducing the overall flood risk posed to the residents of the borough;
- Consideration of flood risk and development considerations as outlined in section 6.10 for spatial planning options;
- Site-specific FRAs should be carried out for all developments in Flood Zones 2 and 3; all sites in Flood Zone 1 which are greater than 1.0 ha and all sites that are known to have a critical drainage problem, whatever their size;
- the relevant IDB should be consulted to ensure the FRA provides the necessary information to fulfil the requirements for Planning Applications and where appropriate the issue of flood defence consent or bye-law consent;
- Sustainable Drainage Systems should be included in new developments wherever possible to manage surface water through consultation and agreement with relevant stakeholders including IDBs; and,
- Additional rest centres across the district should be identified and included in the emerging Flood Emergency Plan for Fenland.

14.3 Next steps for Fenland DC

14.3.1 Using the information presented in the Level 1 SFRA, Fenland DC is now in a position to carry out the Sequential Test with respect to flood risk. This will enable Fenland to identify those areas

where further information is required regarding the nature of the flood risk as well as those areas where the Exception Test will need to be applied. These requirements may then need to be presented and addressed in a Level 2 SFRA depending on the location of the sites in relation to flood risk.

14.3.2 Training should be provided to relevant council officers to enable application of the Sequential Test and understanding of the SFRA and how to use it for development control, emergency planning, policy and spatial planning decisions.

14.4 Level 2 SFRA

14.4.1 The purpose of a Level 2 SFRA is to inform the application of the Exception Test and this will be required where certain development types are required in Flood Zones 2, 3a or 3b. Parts a) and b) of the test are addressed through sustainability considerations and brownfield site considerations. From a wider review of the available data, and based on Scott Wilson's experience in producing flood risk assessments and SFRAs, we consider it unlikely that the available data will be sufficient to satisfy part 'c' of the Exception Test with respect to being 'safe' from flooding. To satisfy part 'c' of the Exception Test the Practice Guide companion to PPS25 requires the following minimum data to be derived for each development site:

- Flood probability;
- Flood water depth;
- Flood water velocity, and,
- Rate of onset of flooding.

14.4.2 This data can only be determined through hydraulic modelling. The current lack of suitable data from the existing hydraulic models and/or a lack of models for several of the watercourses in the study area will prevent this from being achieved using the existing data set. Although much of this work is currently being undertaken as part of a comprehensive modelling update by the Environment Agency, it is dependent on funding being available.

14.4.3 This greater level of information is useful for emergency planning in helping to determine areas that would be inundated within a short period of time, as well as areas at greatest risk of significant flood depths and potential hazard. This information can help to guide more detailed planning policy considerations such as where ground floor flats should be avoided, sleeping accommodation should be provided on upper levels only and areas where safe refuge is essential.

14.4.4 Therefore should certain development be required in Flood Zones 2, 3a or 3b (as described in Table 7-2) a Level 2 SFRA will be required, and further hydraulic modelling is likely for any sites identified as requiring the Exception Test and potentially adjacent to watercourses where there is insufficient data to define all the PPS25 flood zones including the effects of climate change.

14.5 Living Document

14.5.1 This study has been completed in accordance with PPS25 and its accompanying Practice Guide, published in June 2008 and updated in 2010. The Level 1 SFRA has been developed by building heavily upon existing knowledge with respect to flood risk within the Fenland study area.

14.5.2 These documents have an intended lifespan of 6-10 years, with Local Development Documents and potential development sites typically revised within 3-6 years. Therefore it should be noted that although up-to date at the time of production, the SFRA has a finite lifespan and should be upgraded or revised as required by the Local Planning Authority.

14.5.3 In summary, it is imperative that the SFRA is adopted as a 'living' document and is reviewed regularly in light of emerging policy directives and an improving understanding of flood risk within the district of Fenland DC.

Appendix A

European Policies

European Union Water Framework Directive

The European Union (EU) Water Framework Directive (WFD)[18] was adopted into UK law in 2003 and followed a review of EU water policy. It seeks to restore and improve water quality in rivers, coastal water and groundwater in an integrated manner. It seeks to achieve good ecological status of water bodies through integrated river basin management. This is a method of ensuring all requirements and pressures on the water environment are taken into account within a river basin. River Basin Management Plans are required to be undertaken for each river basin district. These plans are required to include information on both surface waters and groundwater.

European Union Floods Directive

The European Directive on the Assessment and Management of Flood Risks[19] came into force on the 26th November 2007. The Directive requires Member States and the community to consider the potential impacts that domestic policies may have on flood risk and the management of flood risk on neighbouring member states. It recognises that objectives regarding management of flood risk should be determined by the Member States themselves and should be based on local and regional circumstances.

Member States have two years to transpose the Directive into domestic law and a further six years to satisfy its requirements. The Directive requires Member States to designate competent authorities to implement the Directive; for England, this will be the Environment Agency. The Directive requires the following elements to be undertaken:

- preliminary flood risk assessments to identify areas that are at potentially significant flood risk, to be completed by 20 December 2011;
- flood hazard maps (showing the likelihood and flow of the potential flooding) and flood risk maps (showing the impact), to be completed by 20 December 2013;
- flood risk management plans (showing measures to decrease the likelihood or impact of flooding), to be completed by 22 December 2015; and,
- updates every 6 years thereafter that take into account the impact of climate change.

The Environment Agency hope to achieve the requirements of the Directive through the use of existing published information. This may include reference or use of SFRA, CFMP and/or Strategic Flood Risk mapping projects. In some cases the assessments may require new information to be generated to inform the stages of assessment required by the Directive.

National Policies

Making Space for Water

In 2004 the Government's Making Space for Water[20] strategy set out a new national direction for flood risk management planning in England over the next 20 years. The report recognised the requirement for a holistic approach between the various responsible bodies, including flood defence operating authorities, sewerage undertakers and highways authorities, to achieve sustainable development. The report also highlighted the need for a more integrated approach to urban drainage. The protection of the functional floodplain forms an integral aspiration of the strategy.

In February 2009, Defra published a technical guidance document for preparing Surface Water Management Plans (SWMPs) in line with the objectives and principles of the first Government response to Making Space for Water consultation (March 2005) for better integrated urban drainage management.

The guidance also forms part of the Government's response to Sir Michael Pitt's Review[8] of the Summer 2007 floods, in particular recommendation 18 which suggested that "local surface water management plans as set out under PPS25[1] and co-ordinated by local authorities should provide the basis for managing all local flood risk".

A number of SWMPs have been prepared using the Living Draft guidance. Outputs from these initial plans will be used to update the guidance, with a revised version available in the autumn/winter 2009.

Amongst several other key drivers, the Making Space for Water document intended to improve the manner in which land use planning was undertaken. Since 2004, the particular goals alluded to in this document have been achieved. The Environment Agency's role as a statutory consultee has been extended in areas that are at risk of flooding. An integral part of this new direction for flood risk management planning in England was the production of a new Planning Policy Statement (PPS). As discussed within the Making Space for Water document itself, the intention was 'to replace and improve the operational effectiveness of', Planning Policy Guidance Note (PPG) 25. The overriding document PPS25[1] was released in December 2006 and is discussed below.

Planning Policy Statements (PPS) and Guidance Notes

The Government publishes a suite of documents that provide further guidance on various planning subjects. This guidance is a material consideration when determining planning applications.
The PPSs of most relevant to development and flood risk are:

- PPS1: Delivering Sustainable Development[21];
- PPS2: Planning and Climate Change –a supplement to PPS2[22];
- PPS3: Housing[23];
- PPS12: Local Spatial Planning[24]; and,
- PPS25: Development and Flood Risk[1].

PPS1[21] sets out the overarching planning policies on the delivery of sustainable development through the planning system. PPS1 states that in preparing development plans, local authorities should take into account 'the potential impact of the environment on proposed developments by avoiding new development in areas at risk of flooding and sea-level rise'.

PPS: Planning and Climate Change[22] sets out how planning, in providing for the new homes, jobs and infrastructure needed by communities, should help shape places with lower carbon emissions and resilient to climate change. In particular paragraph 44 states that 'in their consideration of the environmental performance of proposed development, taking particular account of the climate the development is likely to experience over its expected lifetime, planning authorities should expect new development to… provide public and private open space as appropriate so that it offers accessible choice of shade and shelter, recognising the opportunities for flood storage, wildlife and people provided by multifunctional greenspaces'.

PPS3[23] underpins the delivery of the Government's strategic housing policy objectives and their goal to ensure that everyone has the opportunity to live in a decent home, which they can afford in a community where they want to live. With regard to the location of new housing development it states that 'any physical, environmental … and flood risk should be taken into account' (paragraph 38).

PPS1224 sets the principles under which the LDF should be developed and places emphasis on a strong evidence base, this includes SFRA.

PPS25[1] requires that local councils must when preparing the LDF:

- Allocate all sites in accordance with the Sequential Test to reduce the flood risk and ensure that the vulnerability classification of the proposed development is appropriate to the flood zone classification;
- Ensure Flood Risk Assessments (FRAs) are undertaken for all developments within Flood Zones 2 and 3 and sites with identified flood sources to assess the risk of flooding to the development and identify options to mitigate the flood risk to the development, site users and surrounding area;
- Ensure FRAs are prepared for all major developments in Flood Zone 1. These are residential developments consisting of sites greater than 0.5 ha or greater than 10 dwellings and commercial developments that are greater than 1 ha; and
- Ensure flood risk to developments should be assessed for all forms of flooding.

Flood and Water Management Act

The Flood and Water Management Act 2010[25] received Royal Assent on the 8th April 2010. It was developed primarily to address the recommendations highlighted in Sir Michael Pitt's review of the 2007 floods. The key features of the bill are:

- To give the Environment Agency an overview of all flood and coastal erosion risk management and unitary and county councils the lead in managing the risk of all local floods.
- To introduce an improved risk based approach to reservoir safety.
- 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.
- To widen the list of uses of water that water companies can control during periods of water shortage, and enable Government to add to and remove uses from the list.
- To enable water and sewerage companies to operate concessionary schemes for community groups on surface water drainage charges.
- To reduce 'bad debt' in the water industry by amending the Water Industry Act 1991 to provide a named customer and clarify who is responsible for paying the water bill.
- To make it easier for water and sewerage companies to develop and implement social tariffs where companies consider there is a good cause to do so, and in light of guidance that will be issued by the Secretary of State following a full public consultation.

Regional Policies

East of England Plan

The Regional Spatial Strategy (RSS) for the East of England[1] (the East of England Plan or EEP) was adopted in May 2008 and sets out the regional strategy for planning and development in the East of England to the year 2021. The Plan provides policy direction for matters such as economic development, housing, the environment, transport, and waste management.

Whilst the RSS covers the period to 2021, it also provides a vision, objectives and core strategy for the longer term. It particularly seeks to reduce the region's impact on and exposure to, the effects of climate change and aims to formulate a development strategy with the capability to support continued sustainable growth beyond 2021.

Policy WAT1: Water Efficiency
The Government will work with the Environment Agency, water companies, OFWAT, and regional stakeholders to ensure that development provided for in the Spatial Strategy is matched with improvements in water efficiency, which will be delivered through a progressive, year on year, reduction in per capita consumption rates. Savings should be monitored against a per capita per day consumption target in the Regional Assembly's monitoring framework.

Policy WAT2: Water Resource and Waste Water Infrastructure Development
The Environment Agency and water companies should work with OFWAT, EERA and the neighbouring regional assemblies, local authorities, delivery agencies and others to ensure timely provision of the appropriate additional infrastructure for both water supply and waste water treatment to cater for the levels of development provided through this plan, meeting agreed surface and ground water standards.

A co-ordinated approach to plan making should be developed through a programme of water cycle studies to address water supply, water quality, wastewater treatment and flood risk issues in receiving watercourses relating to development proposed in this RSS.

Complementing this approach, local development documents should plan to site new development so as to maximise the potential of existing water/waste water treatment infrastructure, minimise the need for new/improved infrastructure.

Policy WAT3: Integrated Water Management
Local planning authorities should work with other partners to ensure that their plans, policies, programmes and proposals take account of the environmental consequences of river basin management plans, catchment abstraction management strategies, groundwater vulnerability maps, groundwater source protection zone maps, and proposals for water abstraction and storage. The Environment Agency and water industry should work with local authorities and other partners to develop an integrated approach to the management of the water environment.

Policy WAT4: Flood Risk Management
Coastal and river flooding is a significant factor in parts of the East of the England. The priorities are to defend existing properties from flooding and locate new development in locations with little or no risk of flooding.

[1] http://www.gos.gov.uk/goee/docs/Planning/Regional_Planning/Regional_Spatial_Strategy/EE_Plan1.pdf

Local development documents should:

- use SFRAs to guide development away from floodplains, other areas at medium or high risk (or likely to be at future risk) from flooding, and areas where development would increase the risk of flooding elsewhere;
- include policies which identify and protect flood plains and land liable to tidal or coastal flooding from development, based on the Environment Agency's flood maps, supplemented by historical and modelled flood data, Catchment Flood Management Plans and emerging policies in Shoreline Management Plans and Flood Management Strategies, including 'managed re-alignment' where appropriate;
- only propose departures from the above principles in exceptional cases where suitable land at lower risk of flooding is not available, the benefits of development outweigh the risks from flooding, and appropriate mitigation measures are incorporated; and,
- require that sustainable drainage systems are employed in all appropriate developments.

Policy SS1: Achieving Sustainable Development
The strategy seeks to bring about sustainable development by applying:

- The guiding principles of the UK Sustainable Development Strategy 2005;
    - living within environmental limits;
    - ensuring a strong, healthy and just society;
    - achieving a sustainable economy;
    - promoting good governance; and,
    - using sound science responsibly.
- The elements contributing to the creation of sustainable communities in Sustainable Communities: Homes for All, which are:
    - active, inclusive and safe (in terms of community identity and cohesion, social inclusion and leisure opportunities);
    - well run (in terms of effective participation, representation and leadership);
    - environmentally sensitive;
    - well designed and built;
    - well connected (in terms of good transport services);
    - thriving (in terms of a flourishing and diverse economy);
    - well served (in terms of public, private, community and voluntary services); and,
    - fair for everyone.

Local development documents and other statutory and non-statutory strategies relevant to spatial planning within the region should:

- assist the achievement of carbon emissions; and,
- adopt a precautionary approach to climate change by avoiding or minimising potential contributions to adverse change and incorporating measures which adapt as far as possible to unavoidable change.

In particular the spatial strategy seeks to ensure that development:

- maximises the potential for people to form more sustainable relationships between their homes, workplaces, and other concentrations of regularly used services and facilities, and their means of travel between them; and,
- respect environmental limits by seeking net environmental gains wherever possible, or at least avoiding harm, or (where harm is justified within an integrated approach to the guiding principles set out above) minimising mitigating and/or compensating for that harm'.

Regional Flood Risk Appraisal (RFRA)[26]

Regional Flood Risk Appraisal for the East of England Plan 2009

The Regional Flood Risk Appraisal (RFRA) for the East of England was commissioned by the East of England Regional Assembly (EERA) and was prepared by Capita Symonds. This document contains information on the approach to assessing flood risk and the evidence that should be used to inform the East of England Regional Spatial Strategy. It draws on flood risk evidence available from Catchment Flood Management Plans (CFMP) and Strategic Flood Risk Assessments (SFRA) that have already been prepared to provide a high level assessment of flood risk across the East of England.

The RFRA's Policy Guide and technical document both focus on the Key Centres for Development and Change (KCDC). However, none of the KCDCs are within the study area, the RFRA does not contain specific policies relating to the Fenland District.

Environment Agency Policies

Catchment Flood Management Plans (CFMP)

CFMPs are primary Environment Agency documents. They are not classed as policy documents but are becoming increasingly influential in planning policy as they inform River Basin Management Plans and SFRAs. The aim of CFMPs is to 'provide a useable, policy-level document that summarises all major catchment wide fluvial flood management issues concerns, opportunities and constraints'. It seeks to influence the flood risk management policies of the catchment for the next one hundred years.

River Nene CFMP[27]
The River Nene CFMP[27] also includes much of the Fenland District SFRA study area. As a result of the technical assessments carried out in the CFMP, the Environment Agency has determined its preferred flood risk management policies to specific areas within the catchment. Table 0-1 details the action plan for 'The Fens' policy area.

Table 0-1: Action Plan from the River Nene CFMP relevant to the Fenland District SFRA

Policy Unit	Actions
Policy Unit Summary – The Fens	The policy unit for The Fens includes the low-lying fenland downstream of Peterborough that is largely drained by pumped drainage. This policy unit extends from Whittlesey in the south to The Wash in the north, and from Wisbech in the east nearly as far as Spalding in the west. It excludes the Nene Washes. The tidal reach is contained between embankments which carry the River Nene above the level of the fenland. The tidal limit is at the Dog-in-a-Doublet Sluice. The Fens contain the largest area of high grade agricultural land in the country. Current flood risk management includes flood warning which is undertaken by the use of our flood warnings direct service, sirens and the media. Maintenance on the Main Rivers includes structure/bank/embankment maintenance and vermin control. Wisbech flood walls and gates have a standard of protection equal to the 0.5% AEP. The embankments currently protect The Fens from flooding up to the 0.5% AEP surge tide.
Chosen Policy	Policy P4 - Take further action to sustain the current level of flood risk into the future The social and economic impacts within the Fens are sustained close to the present level. The increased risk of defence breaching in the future would lead to the significant risk to life presented by high depths and velocities. A P4 is likely to be achieved in the Fens by locally increasing defence crest levels to reduce the risk of defence failure.
Actions and Mechanism	Develop a **Flood Risk Management Strategy** for the Fens. The strategy should investigate how flood risk varies across the Fens and the best approach to manage this risk, which may include making space for water. The strategy may highlight the need to carry out further work in some areas, while in other areas we may be able to continue with or reduce our current flood risk management activities. This may lead to a creation of new policy units and policies. The strategy should also consider breach analysis to identify locations that are most at risk and what impact this would have. As part of this analysis, the strategy should investigate the feasibility of controlled breaching to manage the increased probability of breaching in the future. The strategy must bring together all plans and projects that are being developed across the Fens to create an integrated flood risk management approach. This will include consideration of flood risk from the Rivers Witham, Welland, Nene and Great Ouse along with tidal risk and the policies set within The Wash SMP. It will also include working in partnership with IDBs to gain a better understanding of the level of risk and activities they carry out within their lowland systems.

Draft Great Ouse CFMP[28]

The Draft Great Ouse CFMP[28] covers the catchment of the River Great Ouse, which borders the south-eastern boundary of Fenland DC. As a result of the technical assessments carried out in the CFMP, the Environment Agency has determined its preferred flood risk management policies to specific areas within the catchment, as detailed in Table 0-2

Table 0-2: Action Plan from the Draft Ouse CFMP[28] relevant to Fenland DC SFRA

Policy Unit	Action Proposed	Timescale Year(s)	Priority
The Fens – PU5	The Fens flood risk management study - This study should identify further actions to sustain the current scale of flood risk into the future for some isolated settlements and areas with major defences (P4).	2012-2014	High
	Asset System Management Plan - A detailed plan of works to continue with our existing or alternative actions to manage flood risk at the current level (P3).	2008-2010	Medium
	Asset System Management Plan - This plan should identify specific locations where we can reduce our existing flood risk management actions (P2).	2008-2010	Medium

Other Relevant Policies

The Environment Agency has powers under the Water Resources Act 1991, the Land Drainage Act 1991 and their own Land Drainage Byelaws to control works to or adjacent to watercourses.

Internal Drainage Boards – Bye-laws

Under the Land Drainage Act 1991, the Middle Level Commissioners and North Level District IDB have the following bye-laws within their respectable rateable areas. The Land Drainage Act (1991)[29] states that: 'these are considered necessary for securing the efficient working of the drainage system in their district'. A separate document is available from the North Level District Internal Drainage Board (2006) which includes over 33 byelaws. The byelaws include reference to control systems, operations, obstacles, set back distances and safety. The IDB policies in relation to development control are stated within their planning response. Copies of the IDB byelaws can be viewed on their websites.

Water Utility Policies

Anglian Water is responsible for the management of the wastewater network in the Fenland DC SFRA Study area. One of their objectives is to achieve sustainable development through the following policy:

Sustainable Development Statement of Intent of Anglian Water Services Limited
Anglian Water Services has developed a blueprint for their sustainable development policy, based on a belief in the central elements of sustainable development, as identified by the UK Government from a range of international sources:

- Social - social progress which recognises the needs of everyone;
- Environment - effective protection of the environment;
- prudent use of natural resources; and,
- Economic - maintenance of high and stable levels of economic growth and employment.

Sustainable development to Anglian Water Services is, therefore, an important element in improving future performance, delivering bottom line benefits and enhancing the environment and the communities in which it operates.

Building Regulations

The Building Regulations[30] set out the minimum standards required for buildings. Their aim is to ensure the health, safety and welfare of the people inside or around a building. They were first published in 1984 but

significantly updated in 2002 and further in 2010. Building Regulations are required in the construction of a new or an extension of a dwelling as well as in most cases where there is a change of use to a dwelling.

Within the regulations there is a specific section related to the rainwater drainage (Building Regulations Part H) systems that are installed into new builds.

Policy H3 Rainwater Drainage

- Adequate provision shall be made for rainwater to be carried from the roof of the building;
- Paved areas around the building shall be so constructed as to be adequately drained; and,
- Rainwater from a system provided pursuant to sub-paragraphs 1) or 2) shall discharge to one of the following, listed in order of priority:
    - an adequate soakaway or some other adequate infiltration system; or, where that is not reasonably practicable;
    - a watercourse; or, where that is not reasonably practicable; and,
    - a sewer.

Code for Sustainable Homes

The Code for Sustainable Homes has been implemented since 1st May 2008, with a recent update published in November 2010. All new developments are required to demonstrate whether the ratings prescribed under the Code have been achieved. The Code has been developed to introduce a step-change in sustainable home building practise using a rating system that demonstrates the sustainability performance of a new home. However, it is not yet compulsory to meet any Code levels.

It is designed so that it has benefits to the environment that include reduced greenhouse gas emissions, better adaptation to climate change and a reduced impact on the overall environment. This is in parallel with benefits to the home builder that includes a mark of quality, regulatory certainty and flexibility.

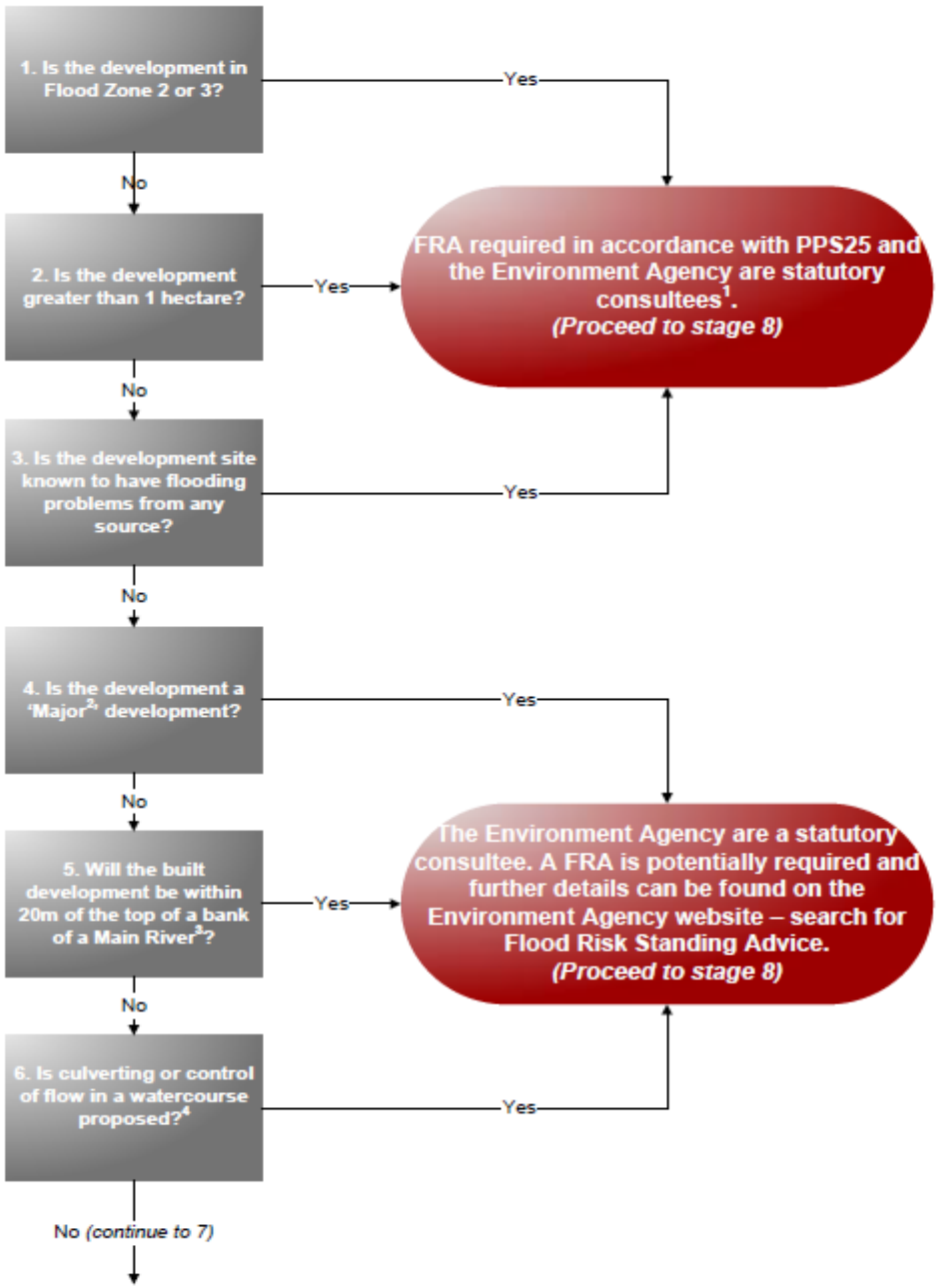
As part of this therefore it will become mandatory for surface water drainage and water efficiency measures to be assessed in all new developments. To achieve the surface water mandatory credit, developments are required to ensure that run-off rates and annual volumes of run-off post development will be no greater than the previous site conditions, and that all additional runoff generated is prevented from leaving the site.

The Code has created a six level rating system to reflect the degree to which sustainable measures have been introduced into a development. Further information on how SuDS can be used as a technique to achieve a higher rating can be found in Section 9.

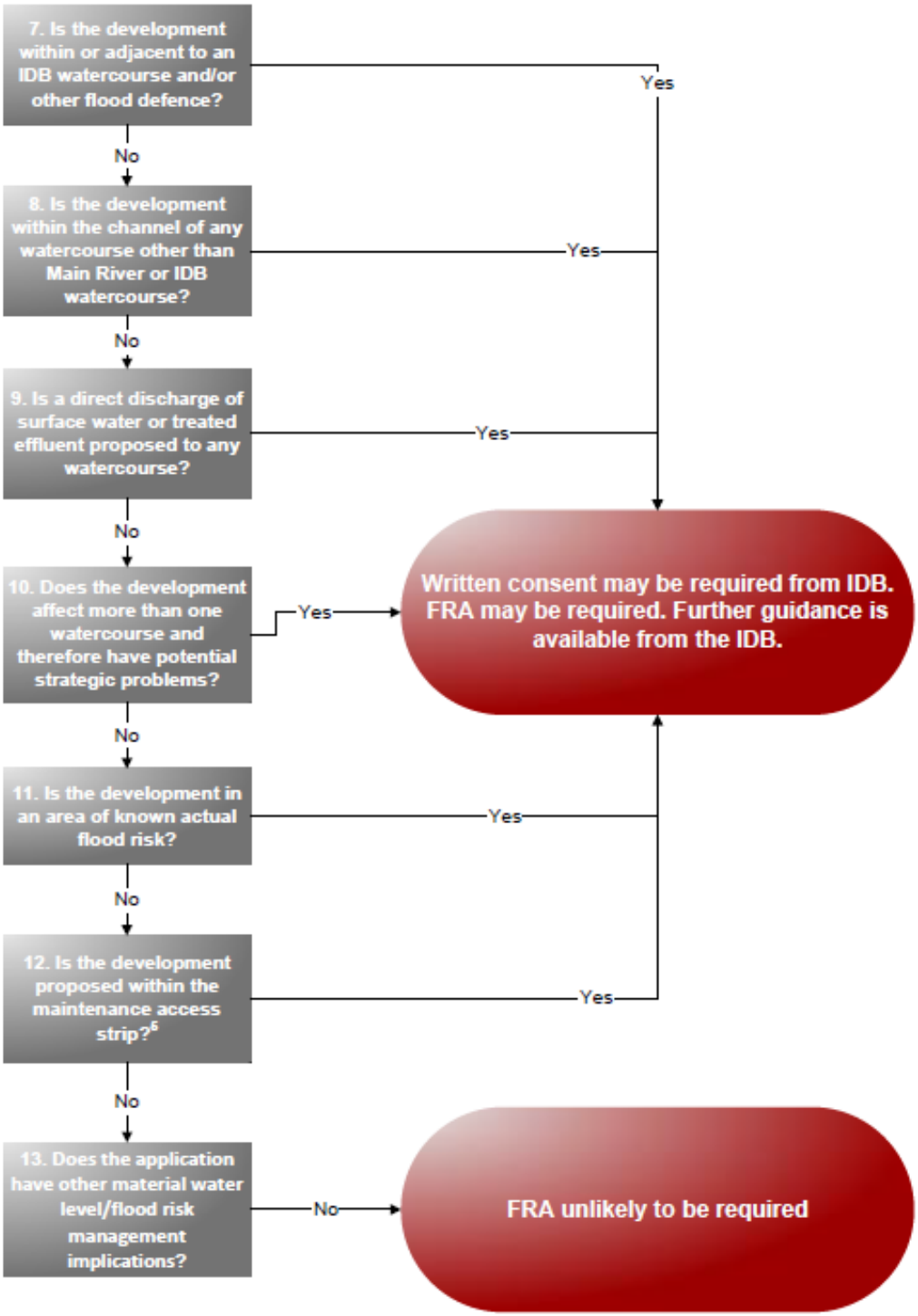
Sewers for Adoption (A Design and Construction Guide for Developers)

The Sewers for Adoption Guide is to be used by developers undertaking new development when planning, designing and constructing conventional foul and surface water gravity sewers, lateral drains and pumping stations intended for adoption under an Agreement made in accordance with Section 104 of the Water Industry Act 1991. The developer should consult the sewage undertaker and all other relevant bodies at the earliest opportunity before a planning application has been made, so that drainage arrangements can be agreed.

Appendix B: FRA Requirement Check-list



1 See PPS25 'Responsibilities' section Paragraph 30
2.A 'Major Development' is defined in The Town and Country Planning (Flooding) (England) Direction 2007 as:
(a) in respect of residential development, a development where the number of dwellings to be provided is 10 or more, or
the site area is 0.5 hectares or more; or, (b) in respect of non-residential development, a development where the new floorspace to be provided is 1,000 square metres or more, or the site area is 1 hectare or more.
3.The Main Rivers are defined in section 3.4 of the SFRA
4 Depending on the watercourse the Environment Agency may not be the relevant authority, although they can advise as to which authority (IDB or LLPA) should be consulted.



5. The width of the Maintenance access strip is 20m for MLC, 6.1m for Manea and Welney DDC, 9m for all other IDBs and DDCs

Appendix C: Figures

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