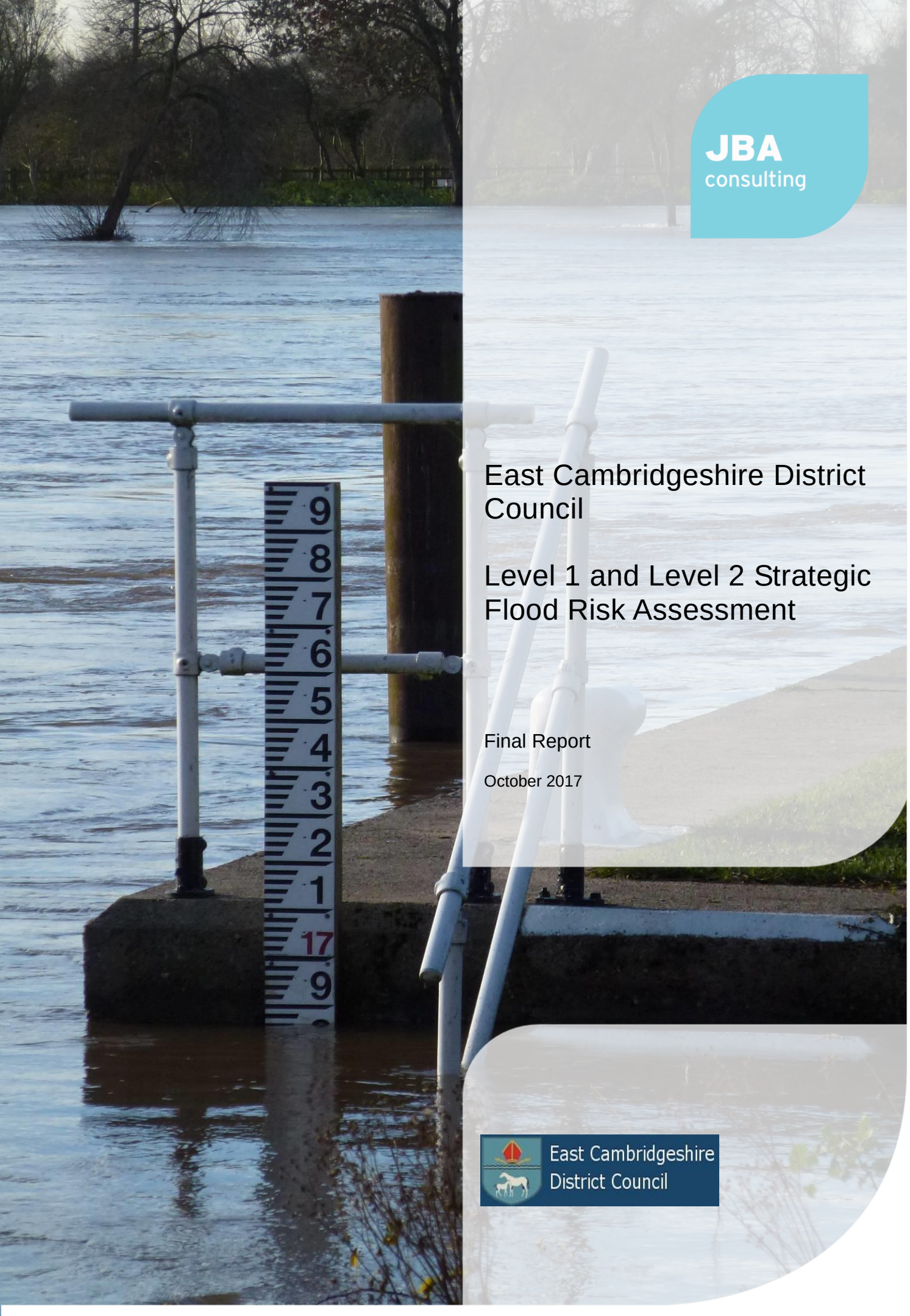

East Cambridgeshire District Council

Level 1 and Level 2 Strategic Flood Risk Assessment

Final Report

October 2017

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Revision History

Revision Ref / Date Issued	Amendments	Issued to
Draft v1.0 / August 2016		Edward Dade (ECDC) Environment Agency Ely Group of IDBs Middle Level Commissioners
Draft v2.0 / March 2017		Edward Dade (ECDC)
Draft v3.0 / September 2017	Inclusion of Level 2 SFRA	Edward Dade (ECDC)
Final v1.0 / October 2017	Amended following review comments	Edward Dade (ECDC)

Contract

This report describes work commissioned by East Cambridgeshire District Council. The Council's representative for the contract was Edward Dade. Rebecca Thrower, Claire Gardner and Thomas Allen of JBA Consulting carried out this work.

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Purpose

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Acknowledgements

We would like to acknowledge the assistance of the following people and organisations:

- Edward Dade (East Cambridgeshire District Council)
- Katrina Shanks (Environment Agency)
- Ben Corne (Environment Agency)
- Elizabeth Mugova (Environment Agency)
- Julia Beeden (Cambridgeshire County Council)
- Graham Moore (Middle Level Commissioners)
- Andrew Newton (Ely Group of IDBs)
- Michael Church (Haddenham IDB)

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Executive Summary

Introduction

This Strategic Flood Risk Assessment (SFRA) 2016 document replaces the Level 1 SFRA originally published by East Cambridgeshire District Council in February 2011. This report also includes a Level 2 SFRA for potential development sites identified within the emerging District Plan.

SFRA objectives

The key objectives of the SFRA are:

- To review the latest flood risk policy, including implications for the council and developers
- To collate and analyse the latest information and data for flood risk from all sources
- To provide guidance and recommendation to the council for flood risk policy and future flood risk management decision making
- To provide supporting evidence to support the Council with the preparation of their Local Plan, allowing the application of the Sequential Test in the allocation of future development sites.
- Provide guidance and information for developers preparing site specific flood risk assessments, including information on Sustainable Drainage Systems (SuDS).
- To provide individual flood risk analysis for potential development sites, identified by the Council, through a Level 2 SFRA.

Level 1 SFRA outputs

- Historical records of flooding in East Cambridgeshire;
- Appraisal of the current condition of flood defence infrastructure and likely flood management policy with regard to maintenance and upgrade;
- Appraisal of probability and consequences of overtopping or failure of flood risk management infrastructure including climate change allowances;
- Mapping showing distribution of flood risk across all flood zones from all sources of flooding including climate change allowances;
- Assessment of future flood risk;
- Identification and formalisation of critical drainage areas; and
- Defined and mapped functional floodplains in the District.

Level 2 SFRA outputs

The Level 2 assessment includes detailed assessments of potential development sites. These include:

- An assessment of all sources of flooding including fluvial flooding, surface water flooding, groundwater flooding, mapping of the functional floodplain and the potential increase in fluvial flood risk due to climate change
- Reporting on current conditions of flood defence infrastructure, including the protection provided by the feature
- An assessment of existing flood warning and emergency planning procedures, including an assessment of safe access and egress during an extreme event
- Advice and recommendations on the likely applicability of sustainable drainage systems for managing surface water runoff
- Advice on appropriate policies for sites which could satisfy the first part of the Exception Test and on the requirements that would be necessary for a site-specific Flood Risk Assessment supporting a planning application, to pass the second part of the Exception Test
- Geo-PDFs to display flood risk mapping for the proposed development sites.

Summary of Level 1 Assessment

Sources of flood risk

- Flood history shows that East Cambridgeshire has been subject to flooding from several sources of flood risk, with the principal risk from fluvial sources.
- The key watercourses flowing through the study area are the Bedford River / Great Ouse system which comprises of the Old West, the River Ten Mile/ Ely Ouse, the two Bedford cut-off channels (Old Bedford River/ River Delph and the New Bedford River / Hundred Foot Drain) which form the Ouse Washes and were created as part of flood alleviation for the Fens, and tributaries, including the Little Ouse river. Another main watercourse in the District is the River Lark, which enters the Ely Ouse at south of Littleport, and tributaries which include the Lea Brook and the River Kennet. The River Cam and its tributaries including the Cambridgeshire Lodes; Bottisham Lode, Swaffham Lode, Reach Lode, Burwell Lode, Soham Lode, Monks Lode, also flow through the southern part of the study area. The majority of recorded fluvial flood events are associated with the River Great Ouse and its tributaries but there are numerous unnamed drains and Ordinary Watercourses also within East Cambridgeshire, many of which rely on pumping stations to drain the low-lying, flat expanses of the South Level area.
- The main urban areas of Ely and Littleport are located along the Ely Ouse, with the towns of Burwell and Soham within close proximity to the Cambridgeshire Lodes. However, the main urban areas are located on higher ground, placing them mostly outside of the floodplains of the main watercourses.
- Other than these higher urban areas, the East Cambridgeshire District consists largely of low-lying land with multiple drainage networks. The District is largely pumped and reliant on flood defences, creating a significant residual risk if the defences were to fail. A high number of flood defences are present in the District, although their condition varies between very poor and very good.
- East Cambridgeshire is largely covered by the Ely Group of IDBs, which aim to provide a general standard of protection against flooding of 1% for developed areas and 5% for agricultural land, although there may be areas where the standard of protection is lower due to local circumstances, notably in the pumped drainage basins.
- East Cambridgeshire is partially covered by the low-lying Middle Level. Watercourses in this area fall under the authority of the Middle Level Commissioners and associated IDBs. They aim to provide a general standard of protection against flooding of 1% and 2-3% AEP respectively, although there may be areas where the standard of protection is lower due to local circumstances.
- East Cambridgeshire has experienced historic surface water / drainage related flood events caused by a number of mechanisms from insufficient storm and combined drainage capacity to poor surface water management. The Risk of Surface Water flooding dataset further shows a number of prominent overland flow routes; these predominantly follow topographical flow paths of existing watercourses or dry valleys with some isolated ponding located in low lying areas. In addition, a number of these follow local road infrastructure.
- The sewers are managed by Anglian Water. The company's sewer flooding register was requested but not provided at the time of publication.
- The risk of inundation to the East Cambridgeshire District as a result of reservoir breach or failure of a number of reservoirs within the area was assessed as part of the National Inundation Reservoir Mapping (NIRIM) study. Five reservoirs are located within the East Cambridgeshire District; however, there are also reservoirs outside of the area whose inundation mapping is shown to affect the district.
- There are no records of flooding from reservoirs impacting properties inside the study area. The level and standard of inspection and maintenance required under the Act means that the risk of flooding from reservoirs is relatively low.

Key flood risk strategic documents and policies

There are a number of relevant regional and local flood risk strategic documents and policies which have been considered within the SFRA, such as the Cambridgeshire Flood and Water Supplementary Planning Document (SPD), Catchment Flood Management Plan (CFMP), River Basin Flood Risk Management Plan (FRMP), the Preliminary Flood Risk Assessment (PFRA) and Local Flood Risk Management Strategy (LFRMS). Other policy considerations have also been incorporated, such as sustainable development principles, climate change and flood risk management.

Development and flood risk

The Sequential and Exception Test procedures for both Local Plans and Flood Risk Assessments (FRAs) have been documented, along with guidance for planners and developers. Links have been provided for various guidance documents and policies published by other Risk Management Authorities such as the Lead Local Flood Authority (LLFA) and the Environment Agency.

Defences

A review of existing flood defences was undertaken and found a number of formal defences in the study area. Defences consist of flood walls and embankments, with most along the Ten Mile / Ely Ouse and along the Bedford Rivers provide protection against a 1% AEP event. Defences are also located around the Cambridgeshire Lodes, although standard of protection varies with parts of the defences providing protection against 10%, 2%, and 1% events. Defences are located on the Main Rivers throughout the District.

Level 1 site screening

Potential development sites within the study area were screened against flood risk information to identify sites which would potentially need to be taken forward to a Level 2 SFRA.

Of the 231 potential development sites

- 183 sites are entirely within Flood Zone 1
- 45 sites are partially located within Flood Zone 3
- 2 sites are partially located within Flood Zone 2
- Of the 183 sites that are 100% in Flood Zone 1
    - 52 sites are partially located within the 30-year surface water flood extents
    - 15 sites are partially located within the 100-year surface water flood extent
    - 71 sites are partially located within the 1000-year surface water flood extent
    - 45 sites are not at risk from surface water flooding

Summary of Level 2 assessment of potential development sites

- 15 proposed development sites were brought forward to undergo a Level 2 assessment
- As part of the Level 2 SFRA, detailed site summary tables have been produced for each of the potential development sites taken forward from the Level 1 assessment. These sites are ones which are shown to be at risk of fluvial flood risk from watercourses running either through or adjacent to the site.
- The summary tables set out the flood risk implications for the sites, as well as guidance for site-specific FRAs. A broadscale assessment of possible SuDS constraints has also been provided, giving an indication where there may be constraints to certain sets of SuDS components.

Key Site Issues

- For all sites, with the exception of LIT.E1, SOH. H1 and SOH. H6, the majority of the sites are located within Flood Zone 1.
- All sites are at least partially located within Flood Zone 3a. Sites located at least partially within Flood Zone 3b include:
    - ELY.M4,
    - FRD.E1(D),
    - FRD. E1(C),
    - SOH. H1,
    - SOH.H5,
    - SOH.H6,
    - SOH.M3, and
    - FRD. E1(G)
- The following sites are at least partially located within IDBs:
    - LIT.M1
    - LIT.E2
    - LIT.E1

- SOH.H1
- SOH.E1
- SOH.M1
- SOH.H6
- WFD.M1

- Development in the near vicinity of a watercourse within an IDB area will require the consent of the relevant IDB.
- It is recommended that detailed hydraulic modelling is undertaken by the developer on the ordinary watercourse that flows up to site LP7's southern boundary before entering into a culvert. This should also assess the risk posed by a blockage.
- All sites have been identified as having surface water flood risk issues. In the 30-year surface water event, all sites except SOH.H5, SOH.H6 and LP7 are affected to some degree by surface water flooding.
- Climate change mapping indicates that the depths, velocities and hazard of flooding may increase as a result of climate change. The significance of the increase tends to depend on the topography of site and the percentage allowance used.
- Four sites are located in Groundwater SPZs (FRD.E1(D), FRD.E1(C), FRD.E1(G) and LP7). This means that special consideration needs to be taken with SuDS. A suitable level of treatment should be ensured prior to discharging, along with establishing an understanding of constraints to sites and how SuDS can be designed to overcome these from relevant bodies (e.g. LLFA).
- A strategic assessment was conducted of SuDS options using regional datasets. Therefore, a detailed site-specific assessment of suitable SuDS techniques would need to be undertaken to understand which SuDS option would be best.
- Many of the proposed allocation sites benefit from the formal flood defences which are currently present within East Cambridgeshire. Flood mitigation measures should only be considered if, after a sequential approach, development sites cannot be located further away from high risk areas.
- For a number of sites, there is the potential for safe access and egress to be impacted by fluvial or surface water flooding. Consideration should be made to these sites to how safe access and egress can be provided during high rainfall events.

Recommendations

Development control

Sequential approach to development

The NPPF supports a risk-based and sequential approach to development and flood risk in England, so that development is located in the lowest flood risk areas where possible; this approach must be adopted for all future developments within the District.

New development and re-development of land should wherever possible seek opportunities to reduce overall level of flood risk at the site

Sequential and Exception tests

Flood Zones show that areas of East Cambridgeshire are at high risk of flooding from both fluvial and surface water sources; however, the area is also largely protected through a series of defences against fluvial flooding, therefore much of the risk is residual. If the defences along the main watercourses were to fail, there may be a high risk of flooding to developments within the floodplain. Therefore, proposed development sites will be required to pass the Sequential and, where necessary, Exception Tests in accordance with the NPPF. East Cambridgeshire District Council should use the information in this SFRA when deciding which development sites to take forward in their Local Plan.

Developers should consult with East Cambridgeshire District Council, Cambridgeshire County Council, the Environment Agency, Anglian Water and, where necessary, relevant IDBs, at an early stage to discuss flood risk including requirements for site-specific FRAs, detailed hydraulic modelling, and drainage assessment and design.

Site-specific flood risk assessments

Developers should, where required, undertake more detailed hydrological and hydraulic assessments of the watercourses to verify flood extent (including latest climate change allowances), inform development zoning within the site and prove, if required, whether the Exception Test can be passed. Where a site-specific FRA has produced modelling outlines which differ from the Flood Map for Planning then a full evidence based review would be required; where this is acceptable to the EA then amendments to the Flood Map for Planning may take place. Where the watercourses are embanked, the effect of overtopping and breach must be considered an appropriately assessed.

All new development within the 1% AEP flood extent including an allowance for climate change (for the lifetime of the development) must not result in a net loss of flood storage capacity. Where possible, opportunities should be sought to achieve an increase in the provision of floodplain storage. Where proposed development results in a change in building footprint, the developer should ensure that it does not impact upon the ability of the floodplain to store or convey water, and seek opportunities to provide floodplain betterment. Similarly, where ground levels are elevated to raise the development out of the floodplain, compensatory floodplain storage within areas that currently lie outside the floodplain should be provided to ensure that the total volume of the floodplain storage is not reduced.

Planning applicants should also consult with the Environment Agency, LLFA, relevant IDB (if in IDB district) and Anglian Water at an early stage to discuss FRA and/or consent requirements.

Drainage strategies and SuDS

- Planners should be aware of the conditions for surface water management and ensure development proposals and applications are compliant with policy. SuDS are approved as part of the planning application for a development. It is the Local Planning Authority's (LPA) responsibility to ensure that the design submitted as part of either an outline or full planning application is robust and contains adequate detail to ensure that the SuDS are appropriate for the development and will be adequately maintained throughout their lifetime. The LPA may also seek expert advice from the LLFA as part of this process.
- A surface water drainage strategy is required to be submitted with a planning application which should contain details of the SuDS. Its scope should be commensurate with the size of development and can range from a paragraph describing the proposed drainage measures with a discharge location for residential extension, to extensive hydrological modelling accompanied by a full report with drawings for a larger site. Section 6.7 of the Cambridgeshire Flood and Water SPD provides further information on developing a surface water drainage strategy.
- The residual risk and maintenance of sustainable drainage and surface water systems must be clearly set out as part of a drainage strategy. Initial agreements should be in place to cover management funding for the lifetime of the development. Section 6.9 of the Cambridgeshire Flood and Water SPD provides further information on adoption and maintenance of SuDS.
- SuDS should be designed by a competent design team that works together from the outset to deliver a successful scheme. In many cases, overall costs savings can be realised where multiple benefits such as improved open spaces, recreational areas and surface water drainage function in one area. Principles governing SuDS design in East Cambridgeshire are discussed in Section 6.3 of the Cambridgeshire Flood and Water SPD.

Windfall sites

Should the Council adopt a windfall policy then the acceptability of windfall applications in flood risk areas should be considered at the strategic level through a policy setting out broad locations and quantities of windfall development that would be acceptable or not in Sequential Test terms.

In the event of there being no windfall policy, it may be possible for the local authority to apply the Sequential Test taking into account reasonably available sites, historic windfall rates and their distribution across the District relative to Flood Zones[1].

Council review of planning applications

The Council should consult the Environment Agency's 'Flood Risk Standing Advice (FRSA) for Local Planning Authorities', last updated 15 April 2015, when reviewing planning applications for

[1]http://webarchive.nationalarchives.gov.uk/20140328084622/http:/www.environment-agency.gov.uk/static/documents/Sequential_test_process_4.pdf

proposed developments at risk of flooding, as well as the Cambridgeshire Flood and Water SPD. The Council will consult the relevant statutory consultees as part of the planning application assessment and they may, in some cases, also contact non-statutory consultees (e.g. IDBs or Anglian Water) that have an interest in the planning application.

Infrastructure and Access

Safe access and egress

Safe access and egress will need to be demonstrated at all development sites; the development should be above the 1% AEP event plus an allowance for climate change, and emergency vehicular access should be possible during times of flood. Finished Floor Levels should be above the 1% AEP event plus an allowance for climate change and an appropriate allowance for freeboard.

Where development is located behind, or in an area benefitting from, defences, consideration should be given to the potential for safe access and egress in the event of rapid inundation of water due to a defence breach with little warning.

Future flood management in East Cambridgeshire

Flood defences

Developers should include an assessment of the residual risk where developments are located in areas benefitting from defences. They should consider both the impact of breach, including the effect on safe access and egress, as well as potential for flood risk to increase in the future due to overtopping. Any improvements to defences should ensure they are in keeping with wider catchment policy.

Strategic solutions

- The construction of new upstream storage schemes as part of upstream catchment-based approaches. Watercourses which are rural in their upper reaches but have high levels of flood risk to urban areas in the downstream reaches are potential candidates, as the open land in the upper reaches can potentially provide the space for an attenuation area, providing benefit to the urban area downstream.
- Floodplain restoration represents the most sustainable form of strategic flood risk solution, by allowing watercourses to return to a more naturalised state, for example by bank stabilisation, re-naturalisation, structure removal/ modification and enhancing outfalls in the riparian environment.

Use of SFRA data

SFRAs are high level strategic documents and, as such, do not go into detail on an individual site-specific basis. The SFRA has been developed using the best available information at the time of preparation.

This relates both to the current risk of flooding from rivers, and the potential impacts of future climate change.

The Environment Agency regularly reviews their flood risk mapping, and it is important that they are approached to determine whether updated (more accurate) information is available prior to commencing a site-specific FRA.

The SFRA should be periodically updated when new information on flood risk, flood warning or new planning guidance or legislation becomes available. New information on flood risk may be provided by East Cambridgeshire District Council, Cambridgeshire County Council (in its role as LLFA), the Highways Authority, IDBs, Anglian Water and the Environment Agency. It is recommended that the SFRA is reviewed internally on an annual basis, allowing a cycle of review, followed by checking with the above bodies for any new information to allow a periodic update.

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Abbreviations and Glossary of Terms

Term	Definition
1D model	One-dimensional hydraulic model
2D model	Two-dimensional hydraulic model
AEP	Annual Exceedance Probability - refers to the probability of a flood event occurring in any given year
Brownfield	Previously developed parcel of land
CC	Climate change - Long term variations in global temperature and weather patterns caused by natural and human actions.
CDA	Critical Drainage Area - A discrete geographic area (usually a hydrological catchment) where multiple and interlinked sources of flood risk (surface water, groundwater, sewer, Main River and/or tidal) cause flooding in one or more Local Flood Risk Zones during severe weather thereby affecting people, property or local infrastructure.
CFMP	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.
CIRIA	Construction Industry Research and Information Association
Cumecs	The cumec is a measure of flow rate. One cumec is shorthand for cubic metre per second; also m^3/s.
Defra	Department for Environment, Food and Rural Affairs
Designated Feature	A form of legal protection or status reserved for certain key structures or features that are privately owned and maintained, but which make a contribution to the flood or coastal erosion risk management of people and property at a particular location.
DTM	Digital Terrain Model
EA	Environment Agency
EU	European Union
FEH	Flood Estimation Handbook
Flood defence	Infrastructure used to protect an area against floods as floodwalls and embankments; they are designed to a specific standard of protection (design standard).
Flood Risk Area	An area determined as having a significant risk of flooding in accordance with guidance published by Defra and WAG (Welsh Assembly Government).
Flood Risk Regulations	Transposition of the EU Floods Directive into UK law. The EU Floods Directive is a piece of European Community (EC) legislation to specifically address flood risk by prescribing a common framework for its measurement and management.
Flood and Water Management Act (2010)	Part of the UK Government's response to Sir Michael Pitt's Report on the Summer 2007 floods, the aim of which is to clarify the legislative framework for managing surface water flood risk in England.
Fluvial Flooding	Flooding resulting from water levels exceeding the bank level of a watercourse.
FRA	Flood Risk Assessment - A site specific assessment of all forms of flood risk to the site and the impact of development of the site to flood risk in the area.
FRM	Flood Risk Management
FWMA	Flood and Water Management Act (2010)
FZ	Flood Zones
GI	Green Infrastructure – a network of natural environmental components and green spaces that intersperse and connect the urban centres, suburbs and urban fringe

Term	Definition
Greenfield	Undeveloped parcel of land
Ha	Hectare
Indicative Flood Risk Area	Nationally identified flood risk areas, based on the definition of 'significant' flood risk described by Defra and WAG.
JBA	Jeremy Benn Associates
LFRMS	Local Food Risk Management Strategy
LIDAR	Light Detection and Ranging
LLFA	Lead Local Flood Authority - Local Authority responsible for taking the lead on local flood risk management
LPA	Local Planning Authority
mAOD	metres Above Ordnance Datum
Main River	A watercourse shown as such on the Main River Map, and for which the Environment Agency has responsibilities and powers
NPPF	National Planning Policy Framework
NRD	National Receptor Database
Ordinary Watercourse	All watercourses that are not designated Main River. Local Authorities or, where they exist, IDBs have similar permissive powers as the Environment Agency in relation to flood defence work. However, the riparian owner has the responsibility of maintenance.
OS NGR	Ordnance Survey National Grid Reference
PFRA	Preliminary Flood Risk Assessment
Pitt Review	Comprehensive independent review of the 2007 summer floods by Sir Michael Pitt, which provided recommendations to improve flood risk management in England.
Pluvial flooding	Flooding as a result of high intensity rainfall when water is ponding or flowing over the ground surface (surface runoff) before it enters the underground drainage network or watercourse, or cannot enter it because the network is full to capacity.
Pound length	Distance of level water impounded between two canal locks.
PPG	National Planning Policy Framework – Planning Practice Guidance
PPS25	Planning and Policy Statement 25: Development and Flood Risk – superseded by the NPPF and PPG
Rapid inundation areas	Areas behind flood defences that are at risk from rapid onset of fast-flowing and deep water flooding, with little or no warning if defences are overtopped or breached.
Resilience Measures	Measures designed to reduce the impact of water that enters property and businesses; could include measures such as raising electrical appliances.
Resistance Measures	Measures designed to keep flood water out of properties and businesses; could include flood guards for example.
Risk	In flood risk management, risk is defined as a product of the probability or likelihood of a flood occurring, and the consequence of the flood.
Return Period	Is an estimate of the interval of time between events of a certain intensity or size, in this instance it refers to flood events. It is a statistical measurement denoting the average recurrence interval over an extended period of time.
Sewer flooding	Flooding caused by a blockage or overflowing in a sewer or urban drainage system.
SFRA	Strategic Flood Risk Assessment
SoP	Standard of Protection - Defences are provided to reduce the risk of flooding from a river and within the flood and defence field standards are usually described in terms of a flood event return period. For example, a flood embankment could be described as providing a 1 in 100-year standard of protection.

Term	Definition
Stakeholder	A person or organisation affected by the problem or solution, or interested in the problem or solution. They can be individuals or organisations, includes the public and communities.
SuDS	Sustainable Drainage Systems - Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques
Surface water flooding	Flooding as a result of surface water runoff as a result of high intensity rainfall when water is ponding or flowing over the ground surface before it enters the underground drainage network or watercourse, or cannot enter it because the network is full to capacity, thus causing what is known as pluvial flooding.
SWMP	Surface Water Management Plan - The SWMP plan should outline the preferred surface water management strategy and identify the actions, timescales and responsibilities of each partner. It is the principal output from the SWMP study.
WFD	Water Framework Directive

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1 Introduction

1.1 Purpose of the Strategic Flood Risk Assessment

> ***"Local Plans should be supported by a strategic flood risk assessment and develop policies to manage flood risk from all sources, taking account of advice from the Environment Agency and other relevant flood risk management bodies, such as Lead Local Flood Authorities and Internal Drainage Boards. Local Plans should apply a sequential, risk-based approach to the location of development to avoid, where possible, flood risk to people and property and manage any residual risk, taking account of the impacts of climate change".*** (National Planning Policy Framework, paragraph 100)

This Strategic Flood Risk Assessment (SFRA) 2016 document replaces the Level 1 SFRA originally published by East Cambridgeshire District Council in 2011. The SFRA study area is shown in Figure 1-1.

The key objectives of the 2016 SFRA are:

1. To review the latest flood risk policy, including implications for the council and developers
2. To collate and analyse the latest information and data for flood risk from all sources
3. To provide guidance and recommendation to the council for flood risk policy and future flood risk management decision making
4. To provide supporting evidence to support the Council with the preparation of their Local Plan, allowing the application of the Sequential Test in the allocation of future development sites.
5. Provide guidance and information for developers preparing site specific flood risk assessments, including information on Sustainable Drainage Systems (SuDS).

1.2 Levels of SFRA

The Planning Practice Guidance advocates a tiered approach to risk assessment and identifies the following two levels of SFRA:

1. Level One: where flooding is not a major issue in relation to potential site allocations and where development pressures are low. The assessment should be of sufficient detail to enable application of the Sequential Test.
2. Level Two: where land outside Flood Zones 2 and 3 cannot appropriately accommodate all necessary development, creating the need to apply the NPPF's (National Planning Policy Framework) Exception Test. In these circumstances, the assessment should consider the detailed nature of the flood characteristics within a Flood Zone and assessment of other sources of flooding.

This update fulfils the requirements of both a Level 1 and Level 2 SFRA.

1.3 SFRA outputs

To meet the objectives of a Level 1 and Level 2 SFRA the following outputs have been prepared:

- Historical records of flooding in East Cambridgeshire;
- Appraisal of the current condition of flood defence infrastructure and likely flood management policy with regard to maintenance and upgrade;
- Appraisal of probability and consequences of overtopping or failure of flood risk management infrastructure including climate change allowances;
- Mapping showing distribution of flood risk across all flood zones from all sources of flooding including climate change allowances;
- Assessment of future flood risk;
- Identification and formalisation of critical drainage areas; and
- Defined and mapped functional floodplains in the District.

- Level 2 assessment, including detailed site summary tables for proposed development sites
- Level 2 Geo-PDFs to display flood risk mapping for the proposed development sites

1.4 SFRA user guide

Table 1-1 sets out the structure and content of the SFRA report and associated mapping.

Table 1-1: SFRA report contents

Section	Contents
1. Introduction	Provides a background to the study, defines objectives, outlines the approach adopted and the consultation performed.
2. The planning framework and flood risk policy	Includes information on the implications of recent changes to planning and flood risk policies and legislation, as well as documents relevant to the study.
3.The sequential, risk based approach	Describes the sequential approach and application of Sequential and Exception Tests.
4. Climate change	Outlines climate change guidance and the implications for East Cambridgeshire.
5. Sources of information used in preparing the SFRA	Outlines what information has been used in the preparation of the SFRA
6. Understanding flood risk in East Cambridgeshire	Gives an introduction to the assessment of flood risk and provides an overview of the characteristics of flooding affecting the district. Provides a summary of responses that can be made to flood risk, together with policy and institutional issues that should be considered.
7. Flood defences	Assessment of residual risk from flood defences, including future protection from climate change.
8. FRA requirements and flood risk management guidance	Identifies the scope of the assessments that must be submitted in FRAs supporting applications for new development. Provides guidance for developers and outlines conditions set by the LLFA that should be followed.
9. Surface water management and SuDS	Advice on managing surface water run-off and flooding
10. Strategic flood risk solutions	Summary of strategic flood risk solutions.
11. Level 1 assessment of potential development sites	Summarise the flood risk from all sources to all sites supplied by East Cambridgeshire District Council for assessment in the SFRA. Outlines which sites have been taken forward to the Level 2 assessment.
12. Level 2 assessment of potential development sites	Summarises the approaches undertaken in the Level 2 assessment to determine the flood risk for the sites taken forward.
13. Summary	Reviews SFRA
14. Recommendations	Identifies recommendations for the council to consider as part of flood risk management policy.
Appendix A: Watercourses in East Cambridgeshire	
Appendix B: Flood Zone Mapping	
Appendix C: Climate Change Mapping	
Appendix D: Flood Risk from Surface Water Maps	
Appendix E: Areas Susceptible to Groundwater Flooding Maps	
Appendix F: Level 2 Detailed Site Summary Tables	

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Appendix G: Level 2 Flood Risk to Site Geo-PDFs Mapping	

1.5 Consultation

SFRAs should be prepared in consultation with other risk management authorities. The following parties (external to East Cambridgeshire District Council) have been consulted during the preparation of this version of the SFRA:

- Environment Agency
- Cambridgeshire County Council (as Lead Local Flood Authority)
- Anglian Water
- Internal Drainage Boards
- Neighbouring local authorities

1.6 Use of SFRA data

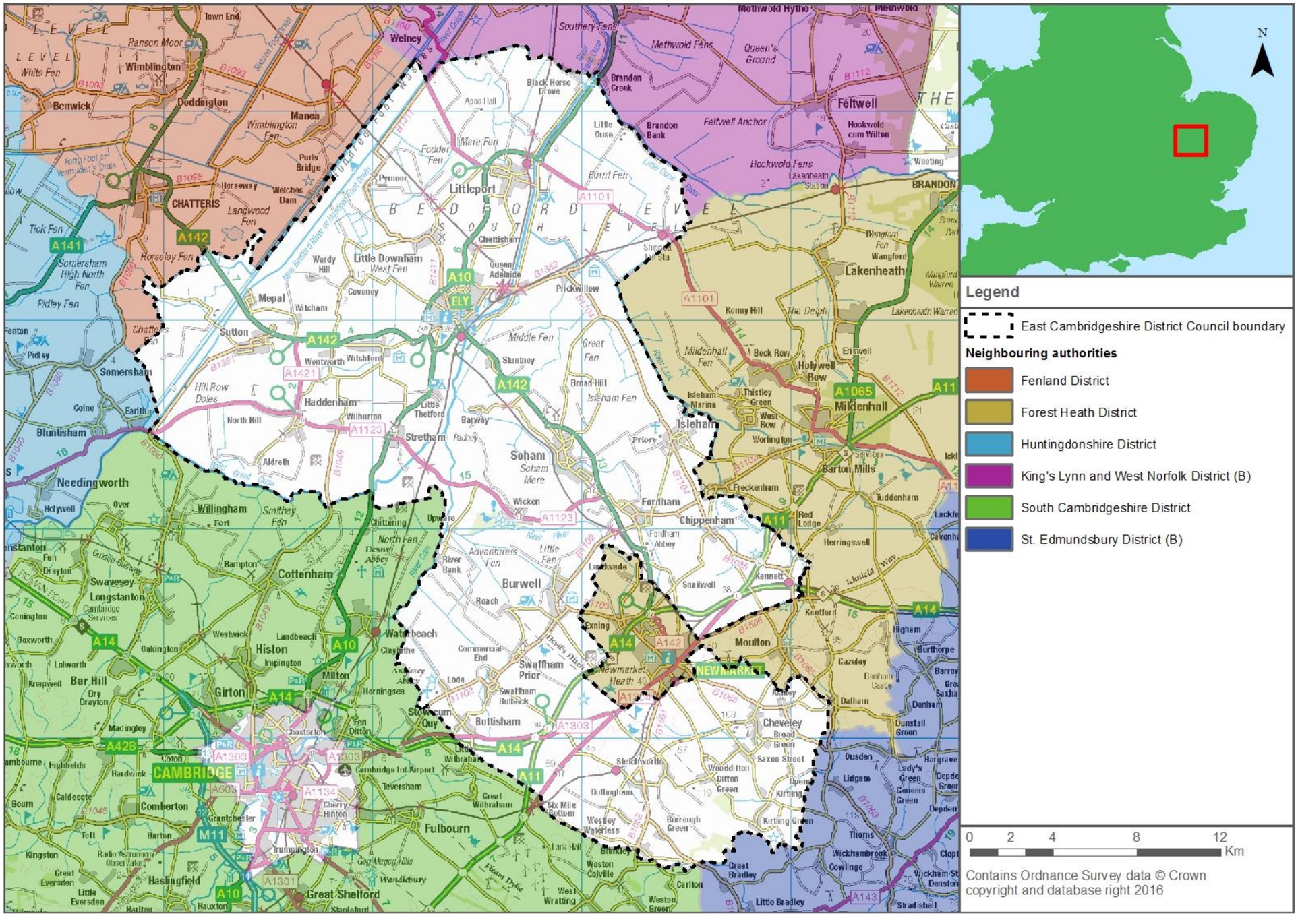
It is important to recognise that SFRAs are high level strategic documents and, as such, do not go into detail on an individual site-specific basis. The SFRA has been developed using the best available information at the time of preparation. This relates both to the current risk of flooding from rivers, and the potential impacts of future climate change.

New information on flood risk may be provided by East Cambridgeshire District Council, the Highways Authority, Cambridgeshire County Council, IDBs, Anglian Water and the Environment Agency. Such information may be in the form of:

- New hydraulic modelling results
- Flood event information following a flood event
- Policy/ legislation updates
- Environment Agency flood map updates
- New flood defence schemes etc.

The Environment Agency regularly reviews their flood risk mapping, and it is important that they are approached to determine whether updated (more accurate) information is available prior to commencing a detailed Flood Risk Assessment.

Figure 1-1: Study area



2 The Planning Framework and Flood Risk Strategic documents

2.1 Introduction

The overarching aim of development and flood risk planning policy in the UK is to ensure that the potential risk of flooding is taken into account at every stage of the planning process. This section of the SFRA provides an overview of the planning framework, flood risk policy and flood risk responsibilities. In preparing the subsequent sections of this SFRA, appropriate planning and policy amendments have been acknowledged and taken into account.

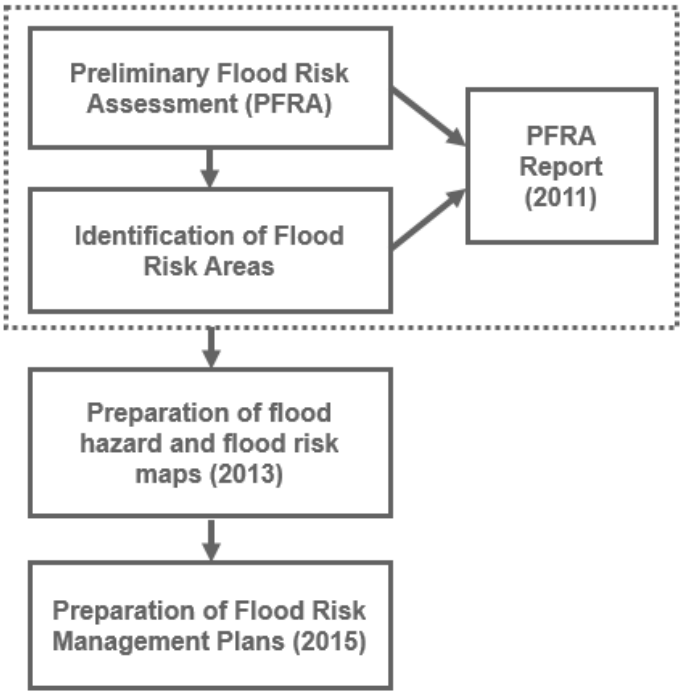
2.2 Flood Risk Regulations (2009) and Flood and Water Management Act (2010)

2.2.1 Flood Risk Regulations, 2009

The Flood Risk Regulations (2009) translate the current EU Floods Directive into UK law and place responsibility upon all Lead Local Flood Authorities (LLFAs) to manage localised flood risk. Under the Regulations, the responsibility for flooding from rivers, the sea and reservoirs lies with the Environment Agency; however, responsibility for local and all other sources of flooding rests with LLFAs. In the instance of this SFRA, the LLFA is Cambridgeshire County Council. Detail on the responsibilities of LLFAs is provided in Section 2.11.

Figure 2-1 illustrates the steps that have / are being taken to implement the requirements of the EU Directive in the UK via the Flood Risk Regulations.

Figure 2-1: Flood Risk Regulation Requirements



The next cycle of the Flood Risk Regulations has now begun (2015 – 2021).

2.2.2 Preliminary Flood Risk Assessments (PFRAs)

Under this action plan and in accordance with the Regulations, LLFAs had the task of preparing a Preliminary Flood Risk Assessment (PFRA) report.

PFRAs report on significant past and future flooding from all sources except from Main Rivers and reservoirs, which are covered by the Environment Agency, and sub-standard performance of the adopted sewer network (covered under the remit of Anglian Water). PFRAs are a high-level screening exercise and consider floods which have significant harmful consequences for human health, economic activity, the environment and cultural heritage. The PFRA document that covers the study area was published by Cambridgeshire County Council in 2011. The

Regulations require the LLFA to identify significant Flood Risk Areas. The threshold for designating significant Flood Risk Areas is defined by Defra and the PFRA is the process by which these locations can be identified.

Of the ten, national indicative Flood Risk Areas that were identified by the Defra/Environment Agency, none encroach on the administrative area of East Cambridgeshire District Council and the indicative designations have been accepted.

No Flood Risk Areas have been identified based on critical infrastructure/access routes, sewer/surface water problems and areas prone to significant ponding.

The PFRA will be reviewed as part of the new cycle of the Flood Risk Regulations. The new / reviewed PFRA will be prepared for June 2017 and is due to be submitted to the European Union (EU) in December 2017. More accurate modelling of surface water (the Flood Risk from Surface Water dataset) has been made available since the 2011 PFRA was published, which means there is more potential for surface water related Flood Risk Areas.

2.2.3 Flood Risk Management Plans (FRMPs)

Under the Regulations the Environment Agency exercised an 'Exception' and did not prepare a PFRA for risk from rivers, reservoirs and the sea. Instead they had to prepare and publish a FRMP. The FRMP summarises the flooding affecting the area and describes the measures to be taken to address the risk in accordance with the Flood Risk Regulations. The final Anglian River Basin District Draft Flood Risk Management Plan (FRMP) was issued in March 2016 and covers the period of 2015 to 2021. The FRMP draws on policies and actions identified in Catchment Flood Management Plans (section 2.8) and also incorporates information from Local Flood Risk Management Strategies (Section 2.2.5). The Plan will be updated as part of the new cycle of the Flood Risk Regulations and is due to be published in December 2021.

2.2.4 Flood and Water Management Act (FWMA), 2010

Following the 2007 floods, Sir Michael Pitt was appointed to chair an independent review into the floods. The final report was published in June 2008. The Flood and Water Management Act (2010) implements Sir Michael Pitt's recommendations and aims to create a simpler and more effective means of managing both flood risk and coastal erosion.

The FWMA established Lead Local Flood Authorities (LLFAs). Cambridgeshire County Council is the LLFA for the East Cambridgeshire District. Further information on the LLFA role and responsibilities are provided in Section 2.11.2.

2.2.5 Cambridgeshire Local Flood Risk Management Strategy (2015)

Cambridgeshire County Council is responsible for developing, maintaining, applying and monitoring a LFRMS for Cambridgeshire, which covers East Cambridgeshire. The Strategy is used as a means by which the LLFA co-ordinates Flood Risk Management on a day to day basis. The Strategy also sets measures to manage local flood risk i.e. flood risk from surface water, groundwater and Ordinary Watercourses.

The high-level objectives proposed in the Strategy for managing flood risk are:

1. Understanding flood risk in Cambridgeshire
2. Managing the likelihood of flooding
3. Helping Cambridgeshire's citizens to manage their own risk
4. Ensuring appropriate development in Cambridgeshire
5. Improving flood prediction, warning and post flood recovery

The Strategy also sets out an action plan of how the LLFA intends to achieve these objectives. The Strategy should be updated regularly or when key triggers are activated. An example of a key trigger would be issues such as amendments to partner responsibilities, updates to legislation, alterations in the nature or understanding of flood risk or a significant flood event.

2.2.6 The National Flood and Coastal Erosion Risk Management Strategy for England (2011)

The National Flood and Coastal Erosion Risk Management Strategy for England provides the overarching framework for future action by all risk management authorities to tackle flooding and coastal erosion in England. It was prepared by the Environment Agency with input from Defra.

The Strategy builds on existing approaches to flood and coastal risk management and promotes the use of a wide range of measures to manage risk. It describes how risk should be managed in a co-ordinated way within catchments and along the coast and balance the needs of communities, the economy and the environment.

The strategy encourages more effective risk management by enabling people, communities, business, infrastructure operators and the public sector to work together to:

- ensure a clear understanding of the risks of flooding and coastal erosion, nationally and locally, so that investment in risk management can be prioritised more effectively;
- set out clear and consistent plans for risk management so that communities and businesses can make informed decisions about the management of the remaining risk;
- manage flood and coastal erosion risks in an appropriate way, taking account of the needs of communities and the environment;
- ensure that emergency plans and responses to flood incidents are effective and that communities are able to respond effectively to flood forecasts, warnings and advice;
- help communities to recover more quickly and effectively after incidents.

2.3 National Planning Policy and Guidance

The National Planning Policy Framework (NPPF) was issued in 2012 to replace the previous documentation as part of reforms to make the planning system less complex and more accessible, and to protect the environment and promote sustainable growth. It replaces most of the Planning Policy Guidance Notes (PPGs) and Planning Policy Statements (PPSs) that were referred to in the previous version of the SFRA. The NPPF sets out the Government's requirements for the planning system and provides a framework within which local people and councils can produce distinctive local and neighbourhood plans to reflect the needs and properties of their communities. The NPPF must be taken into account by local planning authorities when preparing Local Plans and for applicants preparing planning submissions.

National Planning Practice Guidance (NPPG) was published in 2014 and sets out how the NPPF should be implemented. NPPG: Flood Risk and Coastal Change advises on how planning can account for the risks associated with flooding and coastal change in plan making and the application process. It sets out Flood Zones, the appropriate land uses for each zone, flood risk assessment requirements, including the Sequential and Exception Tests and the policy aims for developers and authorities regarding each Flood Zone. Further details on Flood Zones and associated policy is provided in Table 3-1 and throughout this report. The Sequential and Exception tests are covered in greater detail in Sections 3.3 to 3.4.

The Sequential Test

"The Sequential Test ensures that a sequential approach is followed to steer new development to areas with the lowest probability of flooding. The flood zones, as refined in the Strategic Flood Risk Assessment for the area, provide the basis for applying the Test. The aim is to steer new development to Flood Zone 1 (areas with a low probability of river or sea flooding). Where there are no reasonably available sites in Flood Zone 1, local planning authorities in their decision making should take into account the flood risk vulnerability of land uses and consider reasonably available sites in Flood Zone 2 (areas with a medium probability of river or sea flooding), applying the Exception Test if required. Only where there are no reasonably available sites in Flood Zones 1 or 2 should the suitability of sites in Flood Zone 3 (areas with a high probability of river or sea flooding) be considered, taking into account the flood risk vulnerability of land uses and applying the Exception Test if required".

The Exception Test

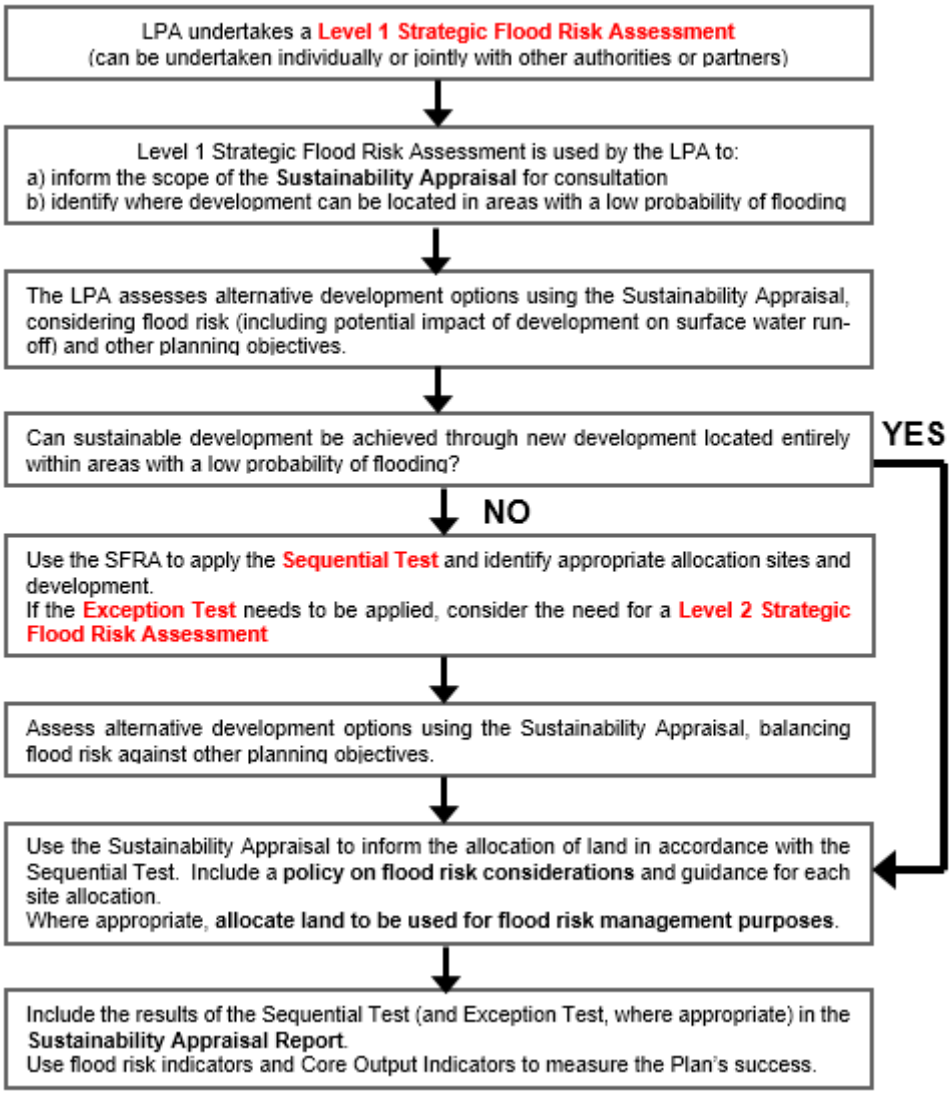
"The Exception Test, as set out in paragraph 102 of the NPPF, is a method to demonstrate and help ensure that flood risk to people and property will be managed satisfactorily, while allowing necessary development to go ahead in situations where suitable sites at lower risk of flooding are not available.

Essentially, the two parts to the Test require proposed development to show that it will provide wider sustainability benefits to the community that outweigh flood risk, and that it will be safe for its lifetime, without increasing flood risk elsewhere and where possible reduce flood risk overall.".

(National Planning Practice Guidance, paragraph 023)

A description of how flood risk should be taken into account in the preparation of Local Plans is outlined in Diagram 1 contained within the Planning Practice Guidance (Figure 2-2).

Figure 2-2: Flood risk and the preparation of Local Plans†



† Diagram 1 of NPPG: Flood Risk and Coastal Change (paragraph 004, Reference ID: 7-005-20140306) March 2014

2.4 Cambridgeshire Flood and Water Supplementary Planning Document (SPD)

Supplementary Planning Documents (SPDs) are intended to expand upon policy or provide further detail to policies in adopted Development Plan Documents (DPDs). When adopted, SPDs form part of the Local Development Framework.

The **Cambridgeshire Flood and Water SPD** has been prepared by Cambridgeshire County Council (as the Lead Local Flood Authority) in conjunction with the other Cambridgeshire local planning authorities, and other relevant stakeholders to support the implementation of flood risk and water related policies.

The SPD provides guidance on the approach that should be taken to design new developments to manage and mitigate flood risk and include sustainable drainage systems. It is a material consideration when considering planning applications. It does not introduce new policy but rather it is intended to elaborate on, and be consistent with, existing and emerging local plan policies.

The SPD contains chapters containing guidance for applications on managing flood risk and the water environment in and around new developments within Cambridgeshire.

- **Chapter 1 Introduction**

  An introduction into the background of the SPD and how it should be used by applicants, consultants, design teams, development management officers and other interested parties
- **Chapter 2 Setting the Scene**

  Overview of European and national context on flood risk and water management, as well as further details on the local plans and policies associated with Cambridgeshire
- **Chapter 3 Working together with Water Management Authorities**

  Details of the key water management authorities that may need to be consulted by the applicant during the planning application, including pre-application and planning application stages.
- **Chapter 4 Guidance on managing flood risk**

  Provides specific advice on how to address flood risk issues within the planning process, including the application of the 'sequential approach' to flood risk and producing site specific flood risk assessments
- **Chapter 5 Managing and mitigating risk**

  Covers ways in which risk can be appropriately addressed through good site design
- **Chapter 6 Surface water and SuDS**

  Looks at a number of design methods and how they can be incorporated into SuDS that form part of a proposed development. Further guidance in given on the adoption and maintenance of SuDS.
- **Chapter 7 Water Environment**

  Discusses the water environment in more detail in relation to Water Framework Directive (WFD) requirements for the protection and improvement of water quality, water habitats, geomorphology and biodiversity.

The SPD should be used by

- Applicants when considering new sites for development
- Applicants when preparing the brief for their design team to ensure drainage and water management schemes are sustainably designed
- Consultants when carrying out site specific flood risk assessments
- Design teams preparing masterplans, landscape and surface water drainage schemes
- Development management officers and their specialist consultees when determining delegated planning applications, selecting appropriate planning conditions, making recommendations to committees and drawing up S106 obligations that include contributions for SuDS
- Other interested parties (e.g. Local Members) who wish to better understand the interaction between development, flooding and drainage issues

2.5 Planning, surface water and SuDS

On 18 December 2014 a Written Ministerial Statement laid by the Secretary of State for Communities and Local Government set out changes to the planning process that would apply for major development from 6 April 2015.

Major developments are defined as

- residential development: 10 dwellings or more, or residential development with a site area of 0.5 hectares or more where the number of dwellings is not yet known; and
- Non-residential development: provision of a building or buildings where the total floor space to be created is 1,000 square metres or more or, where the floor area is not yet known, a site area of 1 hectare or more.

When considering major planning applications, Local Planning Authorities should consult the LLFA on the management of surface water in order to satisfy that:

- the proposed minimum standards of operation are appropriate
- there are clear arrangements for on-going maintenance over the development's lifetime, through the use of planning conditions or planning obligations.

In March 2015 the LLFA was made a statutory consultee which came into effect on 15 April 2015. As a result, Cambridgeshire County Council, is required to provide technical advice on surface water drainage strategies and designs put forward for new major developments.

2.5.1 Defra Non-Statutory Technical Standards for SuDS

On March 23 2015, the Department for Environment, Food and Rural Affairs (Defra) published the Non-Statutory Technical Standards for SuDS. The standards should be used in conjunction with the NPPF and NPPG. These standards cover the following

- Flood risk outside the development
- Peak flow control
- Volume control
- Flood risk within the development
- Structural integrity
- Designing for maintenance considerations
- Construction

2.5.2 Cambridgeshire County Council's Surface Water Guidance

This document is designed to break down the technical requirements of any surface water drainage scheme into small pieces which relate the application of SuDS to various stages of the planning process.

SuDS Concept: the key concepts involved in the application of SuDS.

Planning Application Guidance: this mainly concerns applications for outline planning permission which should detail one workable solution of managing surface water.

Discharge of Surface Water Condition: guidance on the minimum requirement of Cambridgeshire County Council in order to recommend that the LPA discharges a surface water planning condition. As well as listing the points covered within the requirements for outline planning permission it also sets out points that would need to be addressed to remove a surface water planning condition.

2.5.3 Cambridgeshire County Council's Drainage Proforma

This document acts as a checklist for developers wishing to submit a surface water management strategy for consideration by the LLFA. It is suggested that this proforma is completed and sent to the LPA to help streamline the process in assessing surface water drainage proposals and ensure that the correct information is submitted as part of the planning application.

The process of the LPA review of the strategy is detailed as the following:

- Stage 1 – Assess the principles of sustainable drainage by identifying what methods are proposed to manage surface water drainage. This will involve assessing whether water is discharged by the most appropriate means (e.g. infiltration, a surface water body or sewer system).
- Stage 2 – Assess the technical detail of the application against the relevant standards. This relates to elements such as runoff rates, runoff volumes and residual risk.
- Stage 3 – Assess whether enough information is provided to ensure adoption and whether long term maintenance is viable.

2.5.4 C753 CIRIA SuDS Manual (2015)

The C753 CIRIA SuDS Manual (2015) replaces and updates the previous version (C697) providing up to date guidance on planning, design, construction and maintenance of SuDS. The document is designed to help the implementation of these features into new and existing developments, whilst maximising the key benefits regarding flood risk and water quality. The manual is divided into five sections ranging from a high-level overview of SuDS, progressing to more detailed guidance with progression through the document. It is recommended that developers and the LPA utilise the information within the manual to help design SuDS which are appropriate for a development.

2.6 Surface Water Management Plans

Surface Water Management Plans (SWMPs) outline the preferred surface water management strategy in a given location. SWMPs are undertaken, when required, by LLFAs in consultation with key local partners who are responsible for surface water management and drainage in their area. SWMPs establish a long-term action plan to manage surface water in a particular area and are intended to influence future capital investment, drainage maintenance, public engagement and understanding, land-use planning, emergency planning and future developments.

2.6.1 Cambridgeshire County Council SWMP - Countrywide Update (2014)

The Cambridgeshire County Council SWMP was produced in 2011 by the Cambridgeshire Flood Risk Management Partnership. The SWMP was subsequently updated in 2014 by Cambridgeshire County Council, following a countywide update.

The updated Cambridgeshire County Council SWMP takes into account the findings from a number of detailed SWMPs produced to identify priority wetspots through a detailed assessment and hydraulic modelling. The study area is covered by the Ely Surface Water Management Plan, produced by Hyder Consulting in April 2012, and which outlines the preferred surface water management strategy for Ely. This detailed SWMP was published in 2011, after Ely was identified as being one of the highest priority wet spots for Cambridgeshire County Council.

The Ely detailed SWMP was structured in four phases:

Phase 1 – Preparation: This first phase involved identifying the need for the SWMP, establishing partnerships and outlining the scope of the SWMP.

Phase 2 – Risk Assessment: Establishing an evidence base and undertaking the strategic assessment using collated information and direct rainfall modelling to identify key risk areas. Three prioritised wetspots were identified in Ely.

Phase 3 – Options Assessment: This phase involved the identification and the modelling of a number of engineering measures and options to help reduce the likelihood and impact of surface water flooding. This led to a number of preferred options recommended to be investigated further by Cambridgeshire County Council and East Cambridgeshire District Council.

Phase 4 – Implementation and Review: The SWMP sets out the next stages if the SWMP with regards to implementation and review. The next stage will review the evidence and recommendations from the Countywide SWMP and the Ely Detailed SWMP in order to prepare, implement and monitor and Action Plan for identified wetspots.

2.6.2 Reservoirs

The FWMA will also update the Reservoirs Act 1975 by reducing the capacity of reservoir regulation from 25,000m^3 to 10,000m^3. Phase 1 has been implemented in 2013 requiring large raised reservoirs to be registered to allow the Environment Agency to categorise whether they are 'high risk' or 'not high risk'. However, the level and standard of inspection and maintenance required under the Acts means that the risk of flooding from reservoirs is relatively low. The risk of inundation to East Cambridgeshire as a result of reservoir breach or failure of a number of reservoirs within the area was assessed as part of the National Inundation Reservoir Mapping (NIRIM) study. This dataset will be utilised as part of the updated SFRA.

2.7 Water Cycle Studies

Climate Change is predicted to present unprecedented new challenges, such as more frequent and extreme rainfall events and rising global temperatures, which are expected to exert greater pressure on the existing infrastructure. Planning for water management therefore has to take these potential challenges into account. A large number of new homes for instance may cause the existing water management infrastructure to be overwhelmed which would result in adverse effects on the environment, both locally and in wider catchments.

Water Cycle Studies assist Local Authorities to select and develop sustainable development allocations so that there is minimal impact on the environment, water quality, water resources, and infrastructure and flood risk. This can be achieved in areas where there may be conflict between any proposed development and the requirements of the environment through the recommendation of potential sustainable solutions.

A Water Cycle Study is being prepared alongside this SFRA update.

2.8 Catchment Flood Management Plans

Catchment Flood Management Plans (CFMPs) are a high-level strategic plan providing an overview of flood risk across each river catchment. The Environment Agency use CFMPs to work with other key-decision makers to identify and agree long-term policies for sustainable flood risk management.

There are six pre-defined national policies provided in the CFMP guidance and these are applied to specific locations through the identification of 'Policy Units'. These policies are intended to cover the full range of long-term flood risk management options that can be applied to different locations in the catchment.

The six national policies are:

1. No active intervention (including flood warning and maintenance). Continue to monitor and advise.
1. Reducing existing flood risk management actions (accepting that flood risk will increase over time).
2. Continue with existing or alternative actions to manage flood risk at the current level (accepting that flood risk will increase over time from this baseline).
3. Take further action to sustain the current level of flood risk (responding to the potential increases in risk from urban development, land use change and climate change).
4. take action to reduce flood risk (now and/or in the future)
5. Take action with others to store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits, locally or elsewhere in the catchment.

2.8.1 Great Ouse CFMP (2011)

The study area is covered by the Great Ouse CFMP[2]. The East Cambridgeshire area is covered by Sub-area 10, The Fens, which is mainly flat, low-lying fenland with dispersed villages and small towns. This area is covered by Policy Option 4, which is for low, moderate or high flood risk where flood risk is already managed effectively but further actions may be needed to keep pace with climate change. The proposed actions to implement this policy are the following:

- In the short term, continue with current levels of flood risk management on all watercourses.

2 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/288877/Great_Ouse_Catchment_Flood_Management_Plan.pdf

- Continue with, and implement, the recommendations from the Great Ouse Tidal River Strategy.
- Ensure any policies within the Local Development Framework, or any revisions, are in line with the CFMP policy.
- Continue with, and implement, the recommendations of the Earith to Mepal Area action plan along with the Cranbrook / Counter Drain flood risk management strategy.
- Continue with improvements to the flood warning service by extending the current Floodline Warnings Direct service and through the creation of community-based warnings.
- Reduce the consequences of flooding by improving public awareness of flooding and encourage people to sign up to, and respond to, flood warnings.
- Work with partners to develop emergency response plans for critical infrastructure, community facilities and transport links at risk from flooding.

Additionally, parts of the study area are covered by Sub-area 1, Bedford Ouse Rural and Eastern Rivers, a large sub-area which comprises of villages or isolated areas scattered through rural areas. This area is covered by Policy Option 3, which is for areas of low to moderate flood risk where existing flood risk is generally managed effectively. Working in partnership is key to managing flood risk across this sub-catchment, as there are some local communities which have experienced regular flooding while in other areas there may be opportunities for flood risk management activities to be reduced. The proposed actions to implement this policy are the following:

- Investigate opportunities to reduce current levels of flood risk management on the Main Rivers in this sub-area.
- Continue with current levels of flood risk management on all Ordinary Watercourses (including Award Drains) in this sub-area.
- Continue with, and implement, the recommendations from the Cambridgeshire County Council Surface Water Management Scoping Study.
- Ensure any policies within the Local Development Framework or any revisions are in line with the CFMP policy.
- Continue with improvements to the flood warning service by extending the current Floodline Warnings Direct service and through the creation of community-based flood warnings.
- Work with partners to develop emergency response plans for critical infrastructure, community facilities and transport links at risk from flooding.
- Ensure that opportunities are taken within minerals and waste development/ action plans to use mineral extraction sites to store flood water.
- Produce land management plans to explore opportunities to change land use and develop sustainable land use management practices.
- Develop environmental enhancement projects to improve the natural state of the rivers and their habitats.

2.9 River Basin Management Plans

River Basin Management Plans (RBMPs) are prepared under the Water Framework Directive (WFD) and assesses the pressure facing the water environment in River Basin Districts. The WFD aimed to achieve at least 'good' status for all water bodies by 2015. The East Cambridgeshire area falls within the Anglian River Basin District.

The Anglian RBMP[3] was updated in 2015 and identified a number of pressures on the water environment and significant water management issues.

The RBMP describes how development and land-use planning needs to consider a number of issues relevant to the RBMP including sustainable drainage systems, green and blue

3 Anglia River Basin Management Plan (2015) https://www.gov.uk/government/publications/anglian-river-basin-District-river-basin-management-plan

infrastructure, sewage treatment options (tertiary phosphate treatments), water efficiency measures, infrastructure and development locations and the reduction of nutrients from diffuse pollution. The RBMP provides a summary of measures to protect and improve the water environment in the river basin District.

2.10 Riparian ownership

A riparian owner is the person who owns the land on which, or adjacent to, a watercourse flows through. The law presumes, in the absence of any other evidence, that the land adjoining the watercourse includes the watercourse to its mid-point; therefore, there may be more than one riparian owner of a watercourse.

Anyone with a watercourse in or adjacent to their land has rights and responsibilities as a riparian owner. The Environment Agency, LLFA and other risk management authorities have permissive powers to work on watercourses under their jurisdiction, however, they are not required to do so.

Under land drainage law, watercourses cannot be obstructed and the riparian owner must accept water flowing onto their land.

Further information on the rights and responsibilities of riparian owners has been provided in a guidance document prepared by Cambridgeshire County Council and in Living on the edge prepared by the Environment Agency.

2.11 Roles and responsibilities of Risk Management Authorities in East Cambridgeshire

The roles and responsibilities of Risk Management Authorities (RMAs) in East Cambridgeshire are summarised below.

2.11.1 East Cambridgeshire District Council

As a Local Planning Authority, East Cambridgeshire District Council assess, consult on and determine whether or not development proposals are acceptable, ensuring that flooding and other, similar, risks are effectively managed.

The council will consult relevant statutory consultees as part of planning application assessments and may, in some cases, also contact non-statutory consultees, such as IDBs and Anglian Water, which have an interest in the planning application.

East Cambridgeshire District Council also have a responsibility to maintain 'awarded' watercourses, as well as having statutory powers to modify or remove inappropriate structures within channels on ordinary watercourses, along with other flood protection responsibilities they have powers to take action against those whose actions increase flood risk or make management of that risk more difficult.

2.11.2 Cambridgeshire County Council

As a LLFA Cambridgeshire County Council duties include:

- Local Flood Risk Management Strategy (LFRMS): LLFAs must develop, maintain, apply and monitor a LFRMS to outline how they will manage flood risk, identify areas vulnerable to flooding and target resources where they are needed most.
- Flood Investigations: When appropriate and necessary LLFAs must investigate and report on flooding incidents (Section 19 investigations).
- Register of Flood Risk Features: LLFAs must establish and maintain a register of structures or features which, in their opinion, are likely to have a significant effect on flood risk in the LLFA area.
- Designation of Features: LLFAs may exercise powers to designate structures and features that affect flood risk, requiring the owner to seek consent from the authority to alter, remove or replace it.
- Consenting: When appropriate LLFAs will perform consenting of works on ordinary watercourses.

Cambridgeshire County Council is also the Local Highway Authority and manages highway drainage, carrying out maintenance and improvement works on an on-going basis, as necessary, to maintain existing standards of flood protection for highways, making appropriate allowances

for climate change. It also has the responsibility to ensure road projects to no increase flood risk.

2.11.3 Environment Agency

The Environment Agency is responsible for protecting and enhancing the environment as a whole and contributing to the government's aim of achieving sustainable development in England and Wales. The Environment Agency has powers to work on Main Rivers to manage flood risk. These powers are permissive, which means they are not a duty, and they allow the Environment Agency to carry out flood and coastal risk management work and to regulate the actions of other flood risk management authorities on main rivers and the coast.

The EA also has powers to regulate and permit works to Main Rivers. Prior written permission is required from the Environment Agency for any work in, under, over or within nine metres of a Main River or between the high-water line and the secondary line of defence e.g. earth embankment. The Environment Agency also has a strategic overview role across all types of flooding as well as other types of water management matters. For more information on how to apply for permits and when they are required visit the Environment Agency's Flood risk activities: environmental permits page.

2.11.4 Internal Drainage Boards

IDBs are local public authorities that manage water levels. They are an integral part of managing flood risk and land drainage within areas of special drainage need in England and Wales. The following IDBs operate within East Cambridgeshire District

- Ely Group of Internal Drainage Boards

  The Ely Group of IDBs was formed in 2002 and consists of ten IDBs, of which seven lie partially or wholly within the East Cambridgeshire District covering a large proportion of the South Level area. Whilst each District is managed in a similar way owing to broadly similar policies, each Board remains its own legal entity. These IDBs include:

  - Burnt Fen
  - Cawdle Fen
  - Littleport and Downham
  - Middle Fen and Mere
  - Padnal and Waterden
  - Swaffham
  - Waterbeach Level

- Middle Level Commissioner (MLC) administered IDBs

  Although no MLC main drains are located in East Cambridgeshire, three administered IDBs are partially located in the District. These IDBs include

  - Haddenham Level
  - Hundred Foot Washes
  - Sutton and Mepal

  Although the MLC are not, technically, an IDB, the term IDB has been used broadly to refer to all relevant IDBs under its jurisdiction.

Roles and responsibilities for IDBs include the following

- IDBs have permissive powers to undertake work to provide water level management within their Internal Drainage District. They undertake works to reduce flood risk to people and property and manage water levels for local needs, this includes the maintenance of rivers, drainage channels, outfalls and pumping stations
- They input into the planning system by facilitating the drainage of new and existing developments within their districts and advising on planning application. However, they are not a statutory consultee to the planning process
- In some cases, a development meeting the following criteria may be required to submit an FRA to the IDB to support any consent applications

- Development within or adjacent to a drain/watercourse, and/or flood defence structure within the area of an IDB
- Development within the channel of any ordinary watercourse within an IDB area
- Where direct discharge of surface water or treated effluent is proposed into an IDB catchment
- Any development proposal affecting more than one watercourse in an IDBs area and having possible strategic implications
- Development in an IDB that is an area of known flood risk
- Development within the maintenance access strips provided under the IDBs bylaws
- Any other application that may have material drainage implications.

- Some IDBs have other duties, powers and responsibilities under specific legislation.

2.11.5 Water and wastewater providers

Anglian Water is the sewerage undertaker for East Cambridgeshire. They have the responsibility to maintain surface, foul and combined public sewers to ensure the area is effectively drained. When flows (foul or surface water) are proposed to enter public sewers, Anglian Water will assess whether the public system has the capacity to accept these flows as part of their pre-application service. If there is not available capacity, they will provide a solution that identifies the necessary mitigate ion. Anglian Water also comments on the available capacity of foul and surface water sewers as part of the planning application process. Further information can be found on their website.

Anglian Water also supplies potable water to East Cambridgeshire District. Consent, prior to commencing work, is required from the relevant provider if installing water systems, or altering existing systems, is intended.

2.12 When to consult water management authorities

The Cambridgeshire Flood and Water SPD sets out when key water management authorities should be consulted.

Key authority	When to consult
East Cambridgeshire District Council	Pre-application consultation is recommended to identify the range of issues that may affect the site and, following on from the Sequential and, if necessary, Exception Test, determine whether the site is suitable for its intended use. Should be consulted where an awarded watercourse runs within or adjacent to proposed development consultation
Environment Agency	Should be consulted on development, other than minor or as defined in the Environment Agency's Flood Risk Standing Advice document within Flood Zone 2 or 3, or in Flood Zone 1 where critical drainage problems have been notified to the LPA. Consultation will also be required for any development projects within 20m of a Main River or flood defence, and other water management matters.
Cambridgeshire County Council (LLFA)	Where the proposed work will either affect or use an ordinary watercourse or require consent permission, outside of an IDB's rateable area. As of the 15th April 2015 the LLFA should be consulted on surface water drainage proposal for all major developments
Cambridgeshire County Council (Local Highway Authority)	Where the proposed development will either involve a new access to the local highway network or increase or change traffic movements
Highways England	When the quality and capacity of the Highways England (strategic) road network could be affected.
Historic England	Whilst Historic England are not a WMA, they should be consulted where proposals may affect heritage assets and their settings.

Key authority	When to consult
Natural England	Natural England has mapped 'risk zones' to help developers and LPAs determine whether consultation is required. This is likely where water bodies with special local or European designations (e.g. SSSI or Ramsar) exists
Anglian Water	Where connection to surface water sewers is required, or where the flow to public sewerage system may be affected Where new connections to the water supply network are required or if any alterations are made to existing connections
Cambridge Water	Where new connections to the water supply network are required or if any alterations are made to existing connections
Ely Group of IDBs IDBs represented by Middle Level Commissioners	When development is proposed in or close proximity to an IDB district.

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3 The sequential, risk-based approach

3.1 Flood Zones

The NPPF Guidance identifies the following Flood Zones (see Table 3-1). These apply to both the floodplains of Main Rivers and Ordinary Watercourses and coastal areas at risk of flooding from the sea.

Table 3-1: Flood Zone descriptions

Zone	Probability	Description
Zone 1	Low	This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).
		All land uses are appropriate in this zone.
		For development proposals on sites comprising one hectare or above the vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off, should be incorporated in a flood risk assessment.
Zone 2	Medium	This zone comprises land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (0.1% - 1%) or between 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.1% – 0.5%) in any year.
		Essential infrastructure, water compatible infrastructure, less vulnerable and more vulnerable land uses (as set out by NPPF) as appropriate in this zone. Highly vulnerable land uses are allowed as long as they pass the Exception Test.
		All developments in this zone require an FRA.
Zone 3a	High	This zone comprises land assessed as having a greater than 1 in 100 annual probability of river flooding (>1.0%) or a greater than 1 in 200 annual probability of flooding from the sea (>0.5%) in any year Developers and the local authorities should seek to reduce the overall level flood risk, relocating development sequentially to areas of lower flood risk and attempting to restore the floodplain and make open space available for flood storage.
		Water compatible and less vulnerable land uses are permitted in this zone. Highly vulnerable land uses are not permitted. More vulnerable and essential infrastructure are only permitted if they pass the Exception Test.
		All developments in this zone require an FRA.
Zone 3b	Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. SFRAs should identify this Flood Zone in discussion with the LPA and the Environment Agency. The identification of functional floodplain should take account of local circumstances.
		Only water compatible and essential infrastructure are permitted in this zone and should be designed to remain operational in times of flood, resulting in no loss of floodplain or blocking of water flow routes. Infrastructure must also not increase flood risk elsewhere.
		All developments in this zone require an FRA.

3.2 The sequential, risk-based approach

This approach is designed to ensure areas with little or no risk of flooding (from any source) are developed in preference to areas at higher risk, with the aim of keeping development outside of medium and high flood risk areas (Flood Zones 2 and 3) and other sources of flooding, where possible.

The sequential approach can be applied both between and within Flood Zones.

It is often the case that it is not possible for all new development to be allocated on land that is not at risk from flooding. In these circumstances the Flood Zone maps (that show the extent of inundation assuming that there are no defences) are too simplistic and a greater understanding of the scale and nature of the flood risks is required.

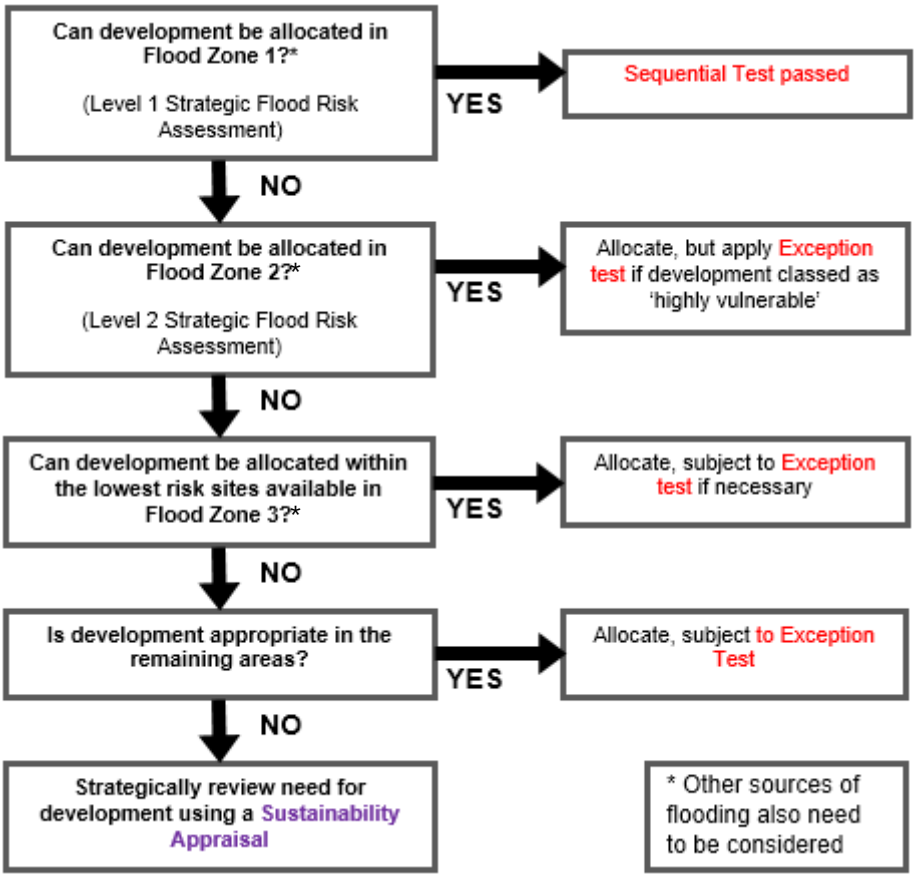
Section 4 of the Cambridgeshire Flood and Water SPD provides more detail on the sequential, risk based approach.

3.3 Applying the Sequential Test and Exception Test in the preparation of a Local Plan

When preparing a Local Plan, the Local Planning Authority should demonstrate it has considered a range of site allocations, using SFRAs to apply the Sequential and Exception Tests where necessary.

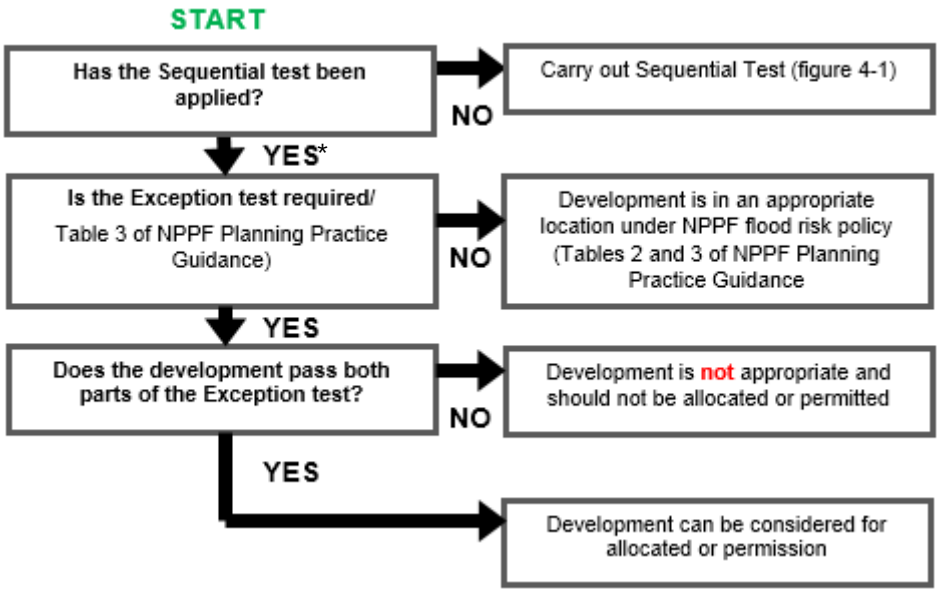
The Sequential Test should be applied to the whole Local Planning Authority area to increase the likelihood of allocating development in areas not at risk of flooding. The Sequential Test can be undertaken as part of a Local Plan Sustainability Appraisal. Alternatively, it can be demonstrated through a free-standing document, or as part of strategic housing land or employment land availability assessments. NPPF Planning Practice Guidance for Flood Risk and Coastal Change describes how the Sequential Test should be applied in the preparation of a Local Plan (Figure 3-1).

Figure 3-1: Applying the Sequential Test in the preparation of a Local Plan



The Exception Test should only be applied following the application of the Sequential Test and as set out in Table 3 of the NPPF Planning Practice Guidance: Flood Risk and Coastal Change. The NPPF PPG describes how the Exception Test should be applied in the preparation of a Local Plan (Figure 3-2).

Figure 3-2: Applying the Exception Test in the preparation of a Local Plan



* Assumes that the sequential test has been passed.

3.4 Applying the Sequential Test and Exception Test to individual planning applications

3.4.1 Sequential Test

Local circumstances must be used to define the area of application of the Sequential Test (within which it is appropriate to identify reasonably available alternatives). The criteria used to determine the appropriate search area relate to the catchment area for the type of development being proposed. For some sites this may be clear, in other cases it may be identified by other Local Plan policies. A pragmatic approach should be taken when applying the Sequential Test.

East Cambridgeshire District Council, with advice from the Environment Agency, are responsible for considering the extent to which Sequential Test considerations have been satisfied, and will need to be satisfied that the proposed development would be safe and not lead to increased flood risk elsewhere.

The Sequential Test does not need to be applied for individual developments under the following circumstances:

- The site has been identified in development plans through the Sequential Test.
- Applications for minor development or change of use (except for a change of use to a caravan, camping or chalet site, or to a mobile home or park home site).

It is normally reasonable to presume and state that individual sites that lie in Zone 1 satisfy the requirements of the Sequential Test; however, consideration should be given to risks from all sources and areas with critical drainage problems.

Section 4 of the Cambridgeshire Flood and Water SPD provides more detail on the sequential, test.

3.4.2 Exception Text

If, following application of the Sequential Test it is not possible for the development to be located in areas with a lower probability of flooding the Exception Test must then be applied if deemed appropriate. The aim of the Exception Test is to ensure that more vulnerable property types, such as residential development can be implemented safely and are not located in areas where the hazards and consequences of flooding are inappropriate. For the Test to be satisfied, both of the following elements have to be accepted for development to be allocated or permitted:

1. It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA where one has been prepared.

   Local Planning Authorities will need to consider what criteria they will use to assess whether this part of the Exception Test has been satisfied, and give advice to enable applicants to provide evidence to demonstrate that it has been passed. If the application fails to prove this, the Local Planning Authority should consider whether the use of planning conditions and / or planning obligations could allow it to pass. If this is not possible, this part of the Exception Test has not been passed and planning permission should be refused[4] .

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

   The site-specific Flood Risk Assessment should demonstrate that the site will be safe and the people will not be exposed to hazardous flooding from any source. The following should be considered[5]:

   - The design of any flood defence infrastructure.
   - Access and egress.
   - Operation and maintenance.
   - Design of the development to manage and reduce flood risk wherever possible
   - Resident awareness.
   - Flood warning and evacuation procedures.
   - Any funding arrangements required for implementing measures.

The NPPF and Planning Practice Guidance provide detailed information on how the Test can be applied and Section 4 of the Cambridgeshire Flood and Water SPD provides more detail on the Exception test.

3.5 Actual flood risk

If it has not been possible for all future development to be situated in Zone 1 then a more detailed assessment is needed to understand the implications of locating proposed development in Zones 2 or 3. This is accomplished by considering information on the "actual risk" of flooding. The assessment of actual risk takes account of the presence of flood defences and provides a picture of the safety of existing and proposed development. It should be understood that the standard of protection afforded by flood defences is not constant and it is presumed that the required minimum standards for new development are:

- residential development should be protected against flooding with an annual probability of river flooding of 1% (1 in 100-year chance of flooding) in any year; and
- residential development should be protected against flooding with an annual probability of tidal (sea) flooding of 0.5% (1 in 200-year chance of flooding) in any year.

The assessment of the actual risk should take the following issues into account:

- The level of protection afforded by existing defences might be less than the appropriate standards and hence may need to be improved if further growth is contemplated.
- The flood risk management policy for the defences will provide information on the level of future commitment to maintain existing standards of protection. If there is a conflict between the proposed level of commitment and the future needs to support growth, then it will be a priority for the Flood Risk Management Strategy to be reviewed.

4 NPPF Planning Practice Guidance: Flood Risk and Coastal Change (paragraph 037, Reference ID: 7-056-20140306) March 2014

5 NPPF Planning Practice Guidance: Flood Risk and Coastal Change (paragraph 038, Reference ID: 7-056-20140306) March 2014

- The standard of safety must be maintained for the intended lifetime of the development. Over time the effects of climate change will erode the present-day standard of protection afforded by defences and so commitment is needed to invest in the maintenance and upgrade of defences if the present-day levels of protection are to be maintained and where necessary land secured that is required for affordable future flood risk management measures.
- The assessment of actual risk can include consideration of the magnitude of the hazard posed by flooding. By understanding the depth, velocity, speed of onset and rate of rise of floodwater it is possible to assess the level of hazard posed by flood events from the respective sources. This assessment will be needed in circumstances where consideration is given to the mitigation of the consequences of flooding or where it is proposed to place lower vulnerability development in areas that are at risk from inundation.

3.6 Impact of additional development on flood risk

When allocating land for development, consideration must be given to the potential cumulative impact of development on flood risk. The increase in impermeable surfaces and resulting increase in runoff increases the chances of surface water flooding if suitable mitigation measures, such as SuDS, are not put in place. Additionally, the increase in runoff may result in more flow entering watercourses, increasing the risk of fluvial flooding downstream.

Consideration must also be given to the potential cumulative impact of the loss of floodplain as a result of development. The effect of the loss of floodplain storage should be assessed, at both the development and elsewhere within the catchment and, if required, the scale and scope of appropriate mitigation should be identified. Further information on floodplain compensation is provided in Section 8.3.4.

Whilst the increase in runoff, or loss in floodplain storage, from individual developments may only have a minimal impact on flood risk, the cumulative effect of multiple developments may be more severe without appropriate mitigation measures.

The cumulative impact of development should be considered at the planning application and development design stages and the appropriate mitigation measures undertaken, within an appropriate FRA, to ensure flood risk is not exacerbated, and in many cases the development should be used to improve the flood risk.

Maintenance and upkeep of SuDS have been neglected in the past as a result of lack of clarity over where responsibility for it lies. Therefore, is it important that maintenance and upkeep for mitigation measures, such as SuDS, has been set out as part of a drainage strategy and that management funding for the lifetime of the development has been agreed.

3.7 Cross boundary considerations

The topography and location of the District means that many of the major watercourses such as the River Great Ouse and its tributaries flow through the study area. As such, future development, both within and outside the district can have the potential to affect flood risk to existing development and surrounding areas, if suitable SuDS and drainage is not implemented. East Cambridgeshire has boundaries with the following Local Authorities:

- Forest Heath District
- St. Edmundsbury District
- South Cambridgeshire District
- Huntingdonshire District
- Fenland District
- Kings Lynn and West Norfolk District

Where possible, Local Plans and SFRAs were reviewed to assess whether there are any proposed developments that may affect flood risk in the District. Details of any known cross-boundary flooding issues were also requested. Based on the available data, there is nothing to suggest there will be any developments proposed in neighbouring authorities that would adversely affect flood risk within East Cambridgeshire.

Development control should ensure that the impact on receiving watercourses from development in East Cambridgeshire has been sufficiently considered during the planning stages and appropriate mitigation measures put in place to ensure there is no adverse impact on flood risk or water quality

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4 Climate change

4.1 Revised Climate Change Guidance

The Environment Agency published updated climate change guidance on 19 February 2016, which must now be considered in all new developments and planning applications. The Environment Agency can give a free preliminary opinion to applicants on their proposals at pre-application stage. There is a charge for more detailed pre-application planning advice. The LLFA should be contacted for advice on flood risk from local watercourses, surface, or groundwater.

4.2 Peak River Flows

The peak river flow allowances show the anticipated changes to peak flow by river basin District which the subject watercourse resides. Once this is determined, guidance on uplift in peak flows are assigned for three allowance categories, Central, Higher Central and Upper End which are based on the 50th, 70th and 90th percentiles respectively. The allowance category to be used is based on the vulnerability classification of the development and the flood zones within which it resides.

These allowances (increases) are provided for three climate change 'epochs':

- Total potential change anticipated for '2020s' (2015 to 2039)
- Total potential change anticipated for '2050s' (2040 to 2069)
- Total potential change anticipated for '2080s' (2070 to 2115)

One or two of the percentiles are provided for each combination of vulnerability and flood zone, which in the latter case provides a 'range' of allowances. The allowances for the Anglian River Basin District are provided in Table 4-1.

Table 4-1: Peak river flow allowances for the Anglian River Basin District

Allowance category	Total potential change anticipated for '2020s' (2015 to 39)	Total potential change anticipated for '2050s' (2040 to 2069)	Total potential change anticipated for '2080s' (2070 to 2115)
Upper end	25%	35%	65%
Higher central	15%	20%	35%
Central	10%	15%	25%

4.2.1 High++ allowances

High++ allowances only apply in assessments for developments that are very sensitive to flood risk and that have lifetimes beyond the end of the century. Further information is provided in the Environment Agency publication, Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities.

4.2.2 Which peak river flow allowance to use?

The flood zone and flood risk vulnerability classification should be considered when deciding which allowances apply to the development or the plan. The guidance states the following

Flood Zone 2

Vulnerability classification	Central	Higher Central	Upper end
Essential infrastructure		✓	✓
Highly vulnerable		✓	✓
More vulnerable	✓	✓	
Less vulnerable	✓		
Water compatible	None		

Flood Zone 3a

Vulnerability classification	Central	Higher Central	Upper end
Essential infrastructure			✓
Highly vulnerable	Development not permitted		
More vulnerable		✓	✓
Less vulnerable	✓	✓	
Water compatible	✓		

Flood Zone 3b

Vulnerability classification	Central	Higher Central	Upper end
Essential infrastructure			✓
Highly vulnerable	Development not permitted		
More vulnerable			
Less vulnerable			
Water compatible	✓		

4.3 Peak rainfall intensity allowance

Increased rainfall affects river levels and land and urban drainage systems. The table below shows anticipated changes in extreme rainfall intensity in small and urban catchments.

For Flood Risk Assessments, both the central and upper end allowances should be assessed to understand the range of impact.

Table 4-2: Peak rainfall intensity allowance in small and urban catchments

Applies across all of England	Total potential change anticipated for 2010 to 2039	Total potential change anticipated for 2040 to 2059	Total potential change anticipated for 2060 to 2115
Upper end	10%	20%	40%
Central	5%	10%	20%

Cambridgeshire County Council set out how they, as LLFA, expect climate change allowances to be used in FRAs and drainage strategies in their Surface Water Guidance document. For SuDS design purposes the central estimate of 20% should be used to assess the performance of the drainage system and ensure it can cope with the critical duration design rainfall event. The 'upper end' of 40% should be used in sensitivity analysis to assess the potential flood risk implications both on and off-site in the critical duration design rainfall event. When using the upper end figure it must be ensured that surface water is wholly contained on site and that flood hazard is within acceptable tolerances.

4.4 Using climate change allowances

To help decide which allowances to use to inform the flood levels that the flood risk management strategy will be based on for a development or development plan allocation, the following should be considered:

- likely depth, speed and extent of flooding for each allowance of climate change over time considering the allowances for the relevant epoch (2020s, 2050s and 2080s)
- vulnerability of the proposed development types or land use allocations to flooding
- 'built in' resilience measures used, for example, raised floor levels
- capacity or space in the development to include additional resilience measures in the future, using a 'managed adaptive' approach

4.5 The impact of climate change in East Cambridgeshire

Climate change modelling for the watercourses in East Cambridgeshire was undertaken based on the new climate change guidance. Existing Environment Agency hydraulic models were run for the 2080s period for all three allowance categories. Mapping of the climate change modelling outputs are provided in Appendix C.

Of the watercourses in East Cambridgeshire, modelling showed the much of the watercourses remains in bank under all three 2080s climate change allowances. The most significant exception is the River Lark. Modelling shows flows in the River Lark remain in bank during the 1% AEP event due to the protection provided by the flood defences. However, under the climate change scenarios, these defences are shown to overtop, flooding Fodder Fen, Great Fen and Isleham Fen.

The River Great Ouse just south of Littleport, the River Lark east of Prickwillow and the Little Ouse at Burnt Fen are shown to overtop defences under the Upper End climate change scenario.

Elsewhere in the district, increases in flood risk as a result of climate change correspond to those areas where defences are already shown to overtop in the 1% AEP event. This includes the Cambridgeshire Lodes, Soham Lode and the River Cam. The increase in flood extent tends to be fairly similar for the Central and Higher Central allowances, with a larger area shown to be at risk with the Upper End allowance.

In the areas where climate change allowances to not result in a significant increase in flood extent due to topography, the modelling shows that the areas are likely to see an increase in flood depths and velocities, and therefore hazard, in the future.

The flat, low-lying nature of the fens, with many areas below sea level, means the area is vulnerable to the effects of climate change. More extreme periods of heavy rainfall in the future may lead to increased flooding as water may not be pumped fast enough.

No, up-to-date, detailed hydraulic models exist of the majority of the IDB watercourses. Given the highly complex nature of the watercourses, 2D modelling techniques and standard Flood Estimation Handbook methodologies are not considered suitable for providing representative flood extents, therefore no climate change outlines have been included for these watercourses. Developers should develop detailed hydraulic models as part of a site-specific flood risk assessment and include climate change in the assessment.

4.5.1 Adapting to climate change

NPPG Climate Change contains information and guidance for how to identify suitable mitigation and adaptation measure in the planning process to address the impacts of climate change. Examples of adapting to climate change include

- Considering future climate risks when allocating development sites to ensure risks are understood over the development's lifetime
- Considering the impact of and promoting design responses to flood risk and coastal change for the lifetime of the development
- Considering availability of water and water infrastructure for the lifetime of the development and design responses to promote water efficiency and protect water quality
- Promoting adaptation approaches in design policies for developments and the public realm for example by building in flexibility to allow future adaptation if needed, such as setting new development back from watercourses
- identifying no or low cost responses to climate risks that also deliver other benefits, such as green infrastructure that improves adaptation, biodiversity and amenity, for example by leaving areas shown to be at risk of flooding as public open space

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5 Sources of information used in preparing the SFRA

5.1 Fluvial flood mapping

5.1.1 Flood Zones 2 and 3a

Flood Zones 2 and 3a, as shown in Appendix C, show the same extent as the Environment Agency's Flood Map for Planning.

5.1.2 Flood Zone 3b

Flood Zone 3b, as shown in Appendix C, has been compiled for East Cambridgeshire District Council as part of this SFRA assessment and is based on the 5% AEP (1 in 20-year) extents produced from Environment Agency detailed hydraulic models. These models include the following hydraulic models

- Lower Ouse
- Fenland
- Soham Lode
- Cam Phase 2
  - Cam Lodes
  - Cam Urban
- Eastern Rivers
  - Lark
  - Kennett
  - Little Ouse

For areas not covered by detailed models, a precautionary approach should be adopted for Flood Zone 3b with the assumption that the extent of Flood Zone 3b would be equal to Flood Zone 3a. If development is shown to be in Flood Zone 3a, further work should be undertaken as part of a detailed site specific flood risk assessment to define the extent of Flood Zone 3b.

For the IDB watercourses, IDB general standard of protection has been reviewed and, in most cases, this is considered to be higher than the 20-year event. Therefore, Flood Zone 3b is restricted to the watercourse channel. Where the standard of protection is lower this has been highlighted in the SFRA report (see Section 6.4.4). Development in IDB districts should, where appropriate, undertake a more detailed assessment to determine the extent of Flood Zone 3b, through detailed modelling and consultation with the relevant IDB.

5.1.3 Watercourses in IDB districts

No, up-to-date, detailed hydraulic models exist for the IDB watercourses. Given the highly complex nature of the watercourses, 2D modelling techniques and standard Flood Estimation Handbook methodologies are not considered suitable for providing representative flood extents. More detailed modelling was outside the scope of this study and therefore no Flood Zone 3b or climate change outlines have been produced for these watercourses.

A detailed hydraulic model of the relevant board system should be produced as part of the evidence base for any associated detailed flood risk assessment in the IDB area. Developers will also have to provide the IDB with adequate evidence to prove that a viable scheme for appropriate water level/flood risk management exists. Breach and overtopping modelling, where relevant, as well as climate change should be included in the assessment. It is recommended the IDBs are contacted at an early stage to ensure the complexity of the system is taken into account.

Further information for planning, consents and contact information can be found on the IDB websites

- Ely Group of IDBs
- Middle Level Commissioners (and associated IDBs)

5.2 Climate change

Climate change modelling for the watercourses in East Cambridgeshire was undertaken based on the new climate change guidance. Existing Environment Agency hydraulic models, as well as the SFRA 2D hydraulic models, were run for the 2080s period for all three allowance categories.

Where no hydraulic models exist, no climate change modelling was undertaken. Developers should develop detailed hydraulic models as part of a site-specific flood risk assessment and include climate change in the assessment.

5.3 Surface Water

Mapping of surface water flood risk in East Cambridgeshire has been taken from the Risk of Flooding from Surface Water dataset published online by the Environment Agency. These maps are intended to provide a consistent standard of assessment for surface water flood risk across England and Wales in order to help LLFAs, the Environment Agency and any potential developers to focus their management of surface water flood risk.

The Risk of Flooding from Surface Water dataset is derived primarily from identifying topographical flow paths of existing watercourses or dry valleys that contain some isolated ponding locations in low lying areas. They provide a map which displays different levels of surface water flood risk depending on the annual probability of the land in question being inundated by surface water (Table 5-1).

Table 5-1: Risk of Flooding from Surface Water dataset risk categories

Category	Definition
High	Flooding occurring as a result of rainfall with a greater than 1 in 30 chance in any given year (annual probability of flooding 3.3%)
Medium	Flooding occurring as a result of rainfall of between 1 in 100 (1%) and 1 in 30 (3.3%) chance in any given year.
Low	Flooding occurring as a result of rainfall of between 1 in 1,000 (0.1%) and 1 in 100 (1%) chance in any given year.
Very Low	Flooding occurring as a result of rainfall with less than 1 in 1,000 (0.1%) chance in any given year.

Although the Risk of Flooding from Surface Water dataset offers improvement on previously available datasets, the results should not be used to understand flood risk for individual properties. The results should be used for high level assessments such as SFRAs for local authorities. If a particular site is indicated in the Environment Agency mapping to be at risk from surface water flooding, a more detailed assessment should be considered to more accurately illustrate the flood risk at a site-specific scale. Such an assessment will use the Risk of Flooding from Surface Water dataset in partnership with other sources of local flooding information to confirm the presence of a surface water risk at that particular location.

5.4 Groundwater

Mapping of surface water flood risk has been based on the Areas Susceptible to Groundwater (AStGW) dataset. The AStGW dataset is strategic-scale map showing groundwater flood areas on a 1km square grid. It shows the proportion of each 1km grid square, where geological and hydrogeological conditions indicate that groundwater might emerge. It does not show the likelihood of groundwater flooding occurring and does not take account of the chance of flooding from groundwater rebound. This dataset covers a large area of land, and only isolated locations within the overall susceptible area are actually likely to suffer the consequences of groundwater flooding.

The AStGWF data should be used only in combination with other information, for example local data or historical data. It should not be used as sole evidence for any specific flood risk management, land use planning or other decisions at any scale. However, the data can help to identify areas for assessment at a local scale where finer resolution datasets exist.

5.5 Groundwater

Mapping of groundwater flood risk has been based on the Areas Susceptible to Groundwater (AStGW) dataset.

The AStGW dataset is a strategic-scale map showing groundwater flood areas on a 1km square grid. It shows the proportion of each 1km grid square, where geological and hydrogeological conditions indicate that groundwater might emerge. It does not show the likelihood of groundwater flooding occurring and does not take account of the chance of flooding from groundwater rebound. This dataset covers a large area of land, and only isolated locations within the overall susceptible area are actually likely to suffer the consequences of groundwater flooding.

The AStGW data should be used only in combination with other information, for example local data or historical data. It should not be used as sole evidence for any specific flood risk management, land use planning or other decisions at any scale. However, the data can help to identify areas for assessment at a local scale where finer resolution datasets exist.

5.6 Sewers

Historical incidents of flooding are detailed by Anglian Water through their sewer flooding register. The sewer flooding register records incidents of flooding relating to public foul, combined or surface water sewers and displays which properties suffered flooding. This data was requested from Anglian Water but was not provided at the time of completing this report.

5.7 Reservoirs

The risk of inundation as a result of reservoir breach or failure of a number of reservoirs within the area has been identified from the Environment Agency's Long Term Flood Risk Information website.

5.7.1 Suite of Maps

All of the mapping can be found in the appendices to this SFRA and is presented in the following structure:

- Appendix A: Watercourses in East Cambridgeshire
    - Main Rivers
    - Ordinary watercourses
    - IDB districts and watercourses
- Appendix B: Environment Agency Flood Map for Planning, including Flood Zone 3b derived for the SFRA
- Appendix C: Climate Change Mapping
- Appendix D: Surface Water Mapping
- Appendix E: Groundwater Mapping
- Appendix F: Level 2 site assessments detailed summary tables
- Appendix G: Level 2 Flood Risk to Site Geo-PDFs

5.8 Other relevant flood risk information

Users of this SFRA should also refer to other relevant information on flood risk where available and appropriate. This information includes:

- Great Ouse Catchment Flood Management Plan (2011).
- Cambridgeshire County Council Preliminary Flood Risk Assessment (2011)
- Cambridgeshire County Council Local Flood Risk Management Strategy 2015-2020 (2015).
- Cambridgeshire County Council Surface Water Management Plan (Countywide Update 2014).
- Anglian Flood Risk Management Plan

- Environment Agency's Asset Information Management System (AIMS) – users should note that recently completed schemes may not yet be included in this dataset.

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6 Understanding flood risk in East Cambridgeshire District

6.1 Historical flooding

East Cambridgeshire has a history of large documented flood events with the main source being from 'fluvial' (river/watercourse networks) sources. Significant historic flood events are highlighted in Table 6-1.

Table 6-1: Documented historic flooding records within East Cambridgeshire

Location	Date	Source	Additional Information
Denver to Ely (Great River Ouse)	1795	Previous SFRA (2011)	25,000 acres flooded
Turvey (Great River Ouse)	1797	Previous SFRA (2011)	Flood levels of 45.61 m reached
Across catchment (Great River Ouse)	1937	Previous SFRA (2011)	Over 2,300 acres of farmland flooded by fluvial and surface water
Catchment wide (Great River Ouse)	1947	Previous SFRA (2011)	Lowlands of Great Ouse, Welland and Nene
North Sea tidal surge along East coast of England	1953	Previous SFRA (2011)	307 people killed, 500 houses damaged and large scale damage to farmland and property
Catchment wide (Great River Ouse)	2003	Previous SFRA (2011)	Fluvial, surface and groundwater flooding affected 196 properties and caused disruption to rail and road networks

6.2 Demographics

The East Cambridgeshire District Council administrative area covers an area of approximately 652km^2 and has a population of approximately 83,818 (2011 census)[6]. The main town is Ely, along with the smaller market towns of Littleport, Soham and Burwell

6.3 Topography, geology and soils

6.3.1 Topography

The topography of East Cambridgeshire District Council administrative area is primarily comprised of higher ground along the south-eastern portion of the study area. Elevations in this area, which is contains a number of very small settlements, reach approximately 115m AOD. Despite slightly higher ground in the central part of the catchment, with elevations reaching approximately 35m AOD at Haddenham, 25m AOD at Sutton and Ely, the topography of the rest of the East Cambridgeshire area is relatively flat and low lying, with large areas of fenland. Figure 6-1 shows the topography of East Cambridgeshire.

[6] Census (2011) http://cambridgeshireinsight.org.uk/census-2011/census-area-data-and-profiles/Districts

Figure 6-1: Topography of East Cambridgeshire

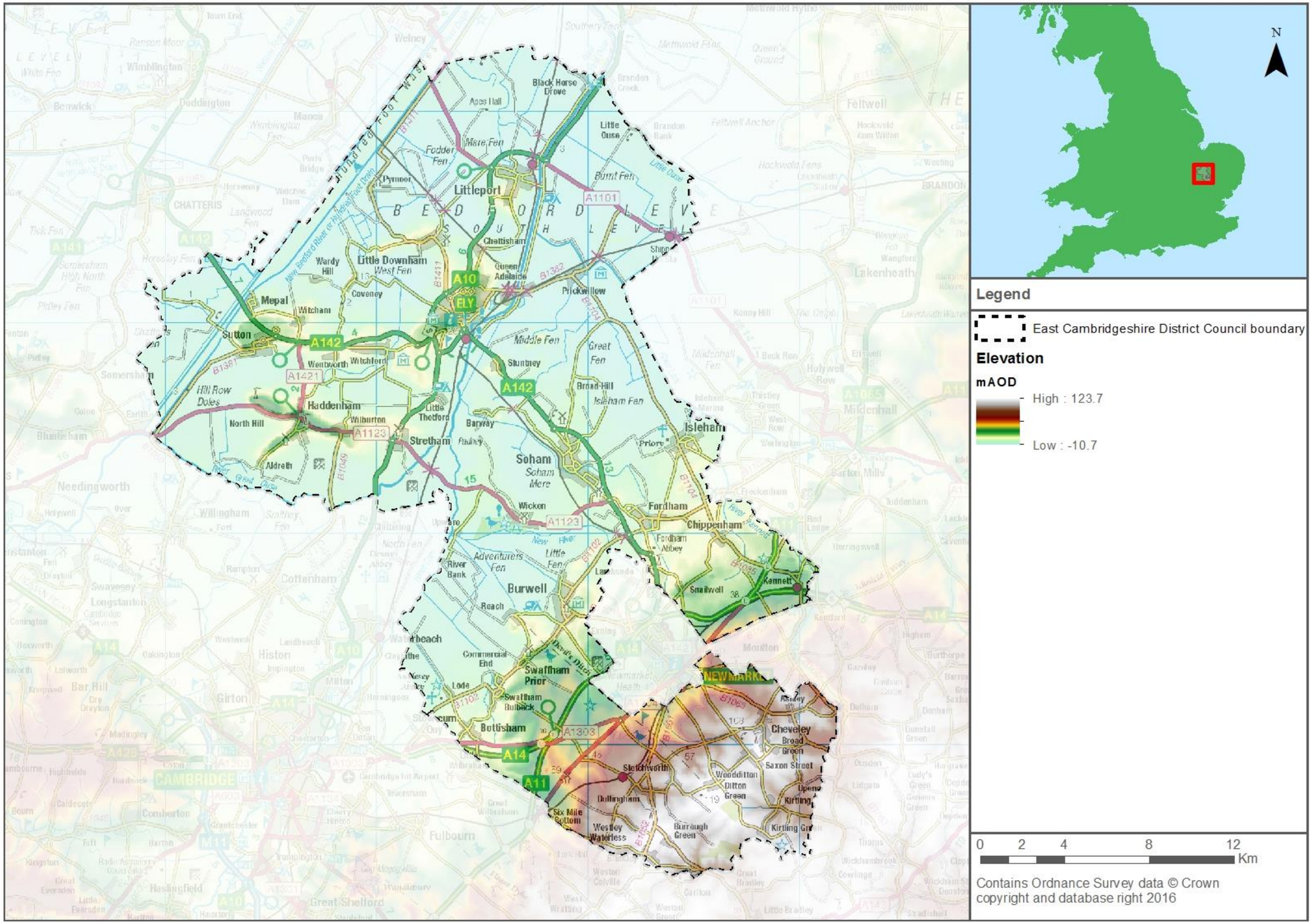


Figure 6-2: Bedrock geology of East Cambridgeshire

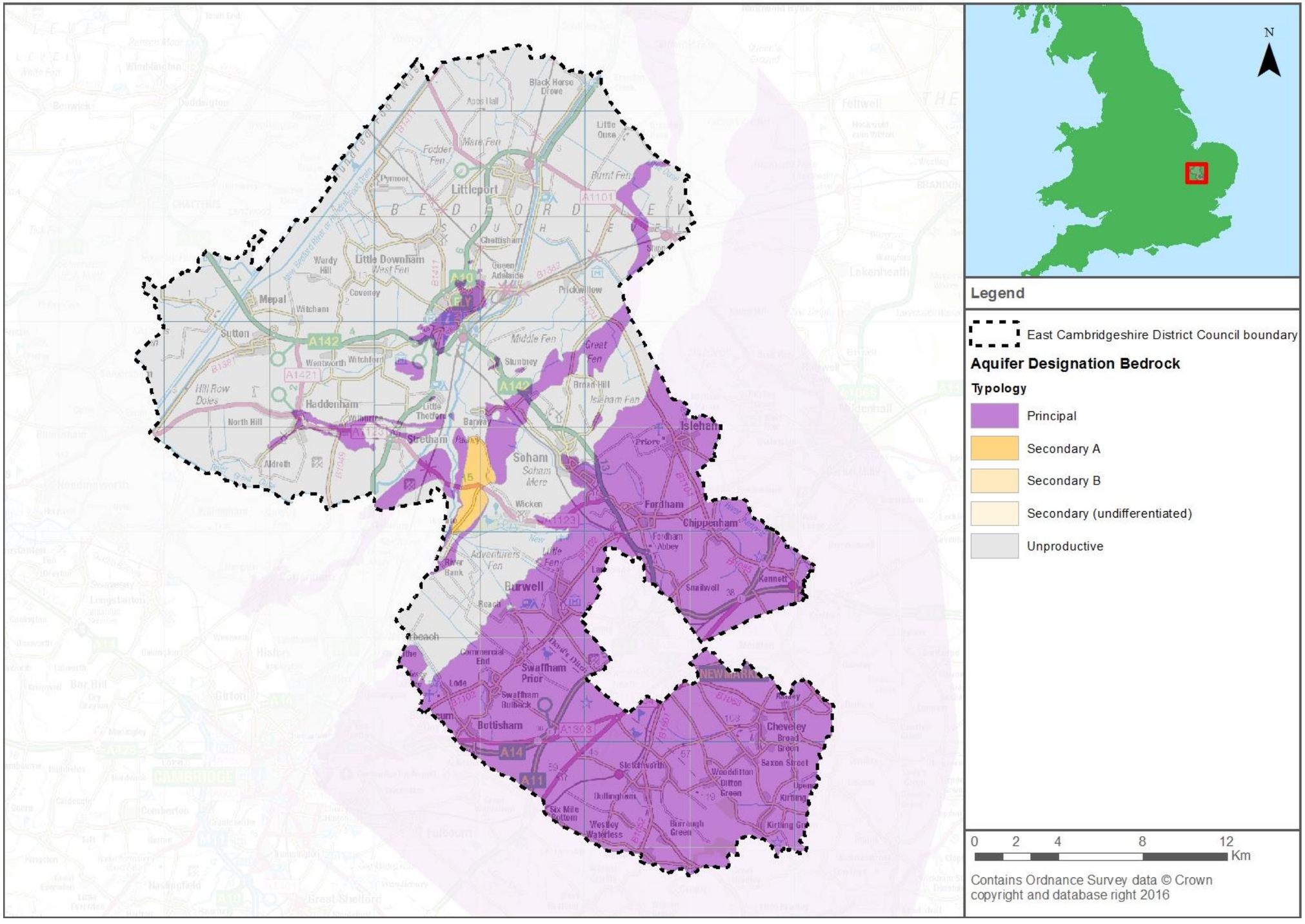
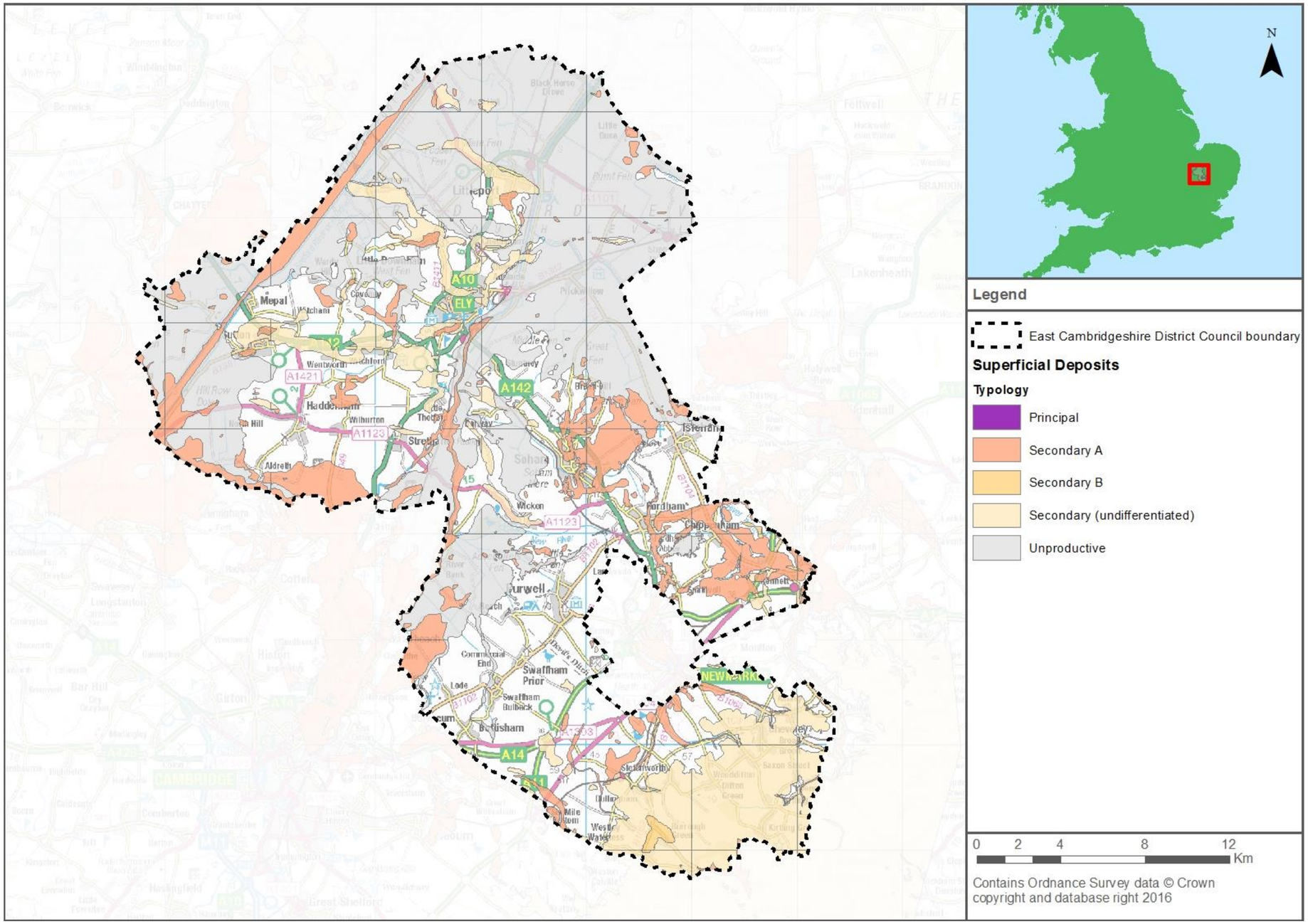


Figure 6-3: Superficial geology of East Cambridgeshire



6.3.2 Geology and soils

The geology of the catchment can be an important influencing factor on the way that water runs off the ground surface. This is primarily due to variations in the permeability of the surface material and bedrock stratigraphy.

Figure 6-2 shows the bedrock (solid permeable) formations in the District and Figure 6-3 shows the superficial (permeable, unconsolidated (loose) deposits. These are classified as the following:

- Principal: layers of rock or drift deposits with high permeability and, therefore, provide a high level of water storage
- Secondary A: rock layers or drift deposits capable of supporting water supplies at a local level and, in some cases, forming an important source of base flow to rivers
- Secondary B: lower permeability layers of rock or drift deposits which may store and yield limited amounts of groundwater
- Secondary undifferentiated: rock types where it is not possible to attribute either category a or b
- Unproductive Strata: rock layers and drift deposits with low permeability and therefore have negligible significance for water supply or river base flow

The bedrock in the south / south east of the catchment is classed as principal strata, indicating high levels of permeability. The superficial deposits across this part of the District are limited and are formed of a mixture of secondary deposits, undifferentiated and secondary A strata. In the north of the District the bedrock is mostly classed as unproductive, with some principal and secondary A strata in areas above the flat valley floors. The superficial deposits across the north/ central areas are again a mixture of secondary A and secondary undifferentiated strata, but with unproductive strata forming the dominant superficial deposit. The higher permeability of the bedrock underlying the southern / south-eastern half of the District will result in lower runoff than the bedrock and superficial deposits will generate in the northern area.

6.4 Watercourses in East Cambridgeshire

6.4.1 Main Rivers

Main Rivers tend to be larger streams and rivers, though some of them are smaller watercourses of local significance. The Environment Agency has permissive powers to carry out maintenance, improvement or construction work on Main Rivers to manage flood risk. Main Rivers in East Cambridgeshire are shown in Appendix B.1. Consultation with the Environment Agency will be required for any development projects within 20m of a Main River or flood defence, and any other water management matters. Main Rivers in East Cambridgeshire are shown in Appendix A.1.

6.4.2 Ordinary Watercourses

Ordinary watercourses are all watercourses not designated as Main River or IDB watercourses. The operating authority (local authority or IDB) has permissive powers to maintain them, but the responsibility lies with the riparian owner. Ordinary watercourses in East Cambridgeshire are shown in Appendix A.2.

6.4.3 Awarded watercourses

Awarded watercourses are those whose maintenance responsibility lies with the relevant local authority. Awarded watercourses in East Cambridgeshire are shown in Appendix A.2. East Cambridgeshire District Council should be consulted where an awarded watercourse runs within, or adjacent to, a proposed development site.

6.4.4 Internal Drainage Board watercourses and drains

In addition to the Main Rivers and ordinary watercourses managed by the Environment Agency and LLFA respectively, numerous smaller watercourses and drains form the Internal Drainage Districts.

IDB boundaries are shown in Appendix A.3.

No detailed models exist of the IDB watercourses. As a result, it has not been possible to map Functional Floodplain (Flood Zone 3b) for these areas. Instead, the IDB policy statements of flood protection and water level management has been used to determine the general standard of flood protection provided to each IDB District. Where this is less than a 5% AEP this has been noted. Otherwise, Flood Zone 3b is presumed to be contained within channel.

Table 6-2: IDB general standard of protection

IDB	General standard of flood protection (% AEP)	Notes
Sutton and Mepal	3-5	-
Hundred Foot Washes	-	Designated Washland and Flood Storage area; designed to flood whenever the designated levels at Earith Sluice are exceeded.
Haddenham Level	5 (agricultural land) 1 (developed areas)	-
Burnt Fen	5 (agricultural land) 1 (developed areas)	The two pumping station basins are more vulnerable due to being in the lowest areas of the District.
Cawdle Fen	5 (agricultural land) 1 (developed areas)	The pumping station basin is more vulnerable due to being in the lowest areas of the District.
Littleport and Downham	5 (agricultural land) 1 (developed areas)	-
Middle Fen and Mere	5 (agricultural land) 1 (developed areas)	The five pumping station basins are more vulnerable due to being in the lowest areas of the District.
Padnal and Waterden	5 (agricultural land) 1 (developed areas)	The five pumping station basins are more vulnerable due to being in the lowest areas of the District.
Swaffham	5 (agricultural land) 1 (developed areas)	The pumping station basin is more vulnerable due to being in the lowest areas of the District.
Waterbeach Level	5 (agricultural land) 1 (developed areas)	The three pumping station basins are more vulnerable due to being in the lowest areas of the District.

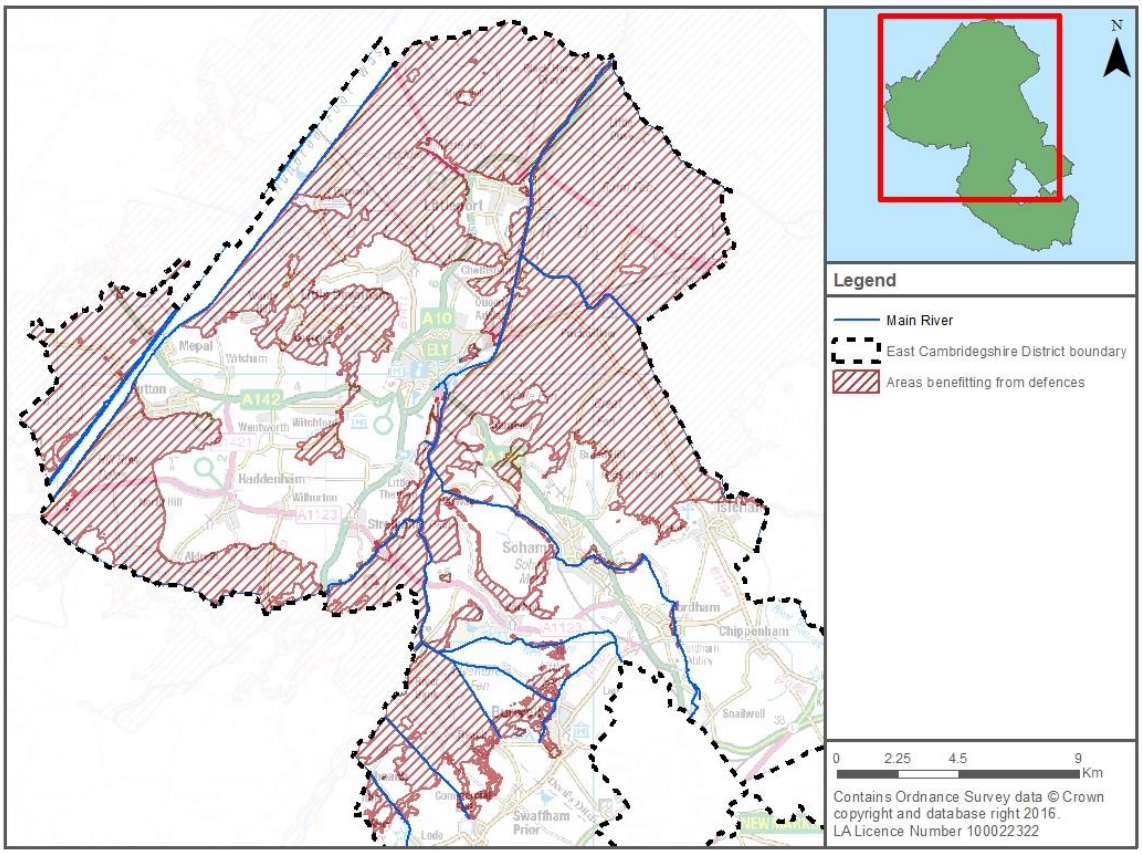
6.5 Fluvial flood risk

The primary fluvial flood risk in East Cambridgeshire is associated with the River Great Ouse and its tributaries. Locations with associated flood risk from the Great Ouse catchments are detailed in Table 6-6.

6.5.1 Flood defences

There are a number of flood defence schemes within East Cambridgeshire, particularly in the flat plains of the Fens. Figure 6-4 shows the areas benefitting from defences in East Cambridgeshire as designated by the Environment Agency. The Environment Agency's Areas Benefitting from Defences dataset shows areas that benefit from flood defences in the event of a river flood with a 1% chance of happening in any one year. If there were no defences, these areas would be flooded. The dataset may not yet include areas benefitting from recently completed schemes. Defences are covered in greater detail in Section 7.

Figure 6-4: Areas benefitting from defences in the East Cambridgeshire District



6.6 Surface water flooding

Flooding from surface water runoff (or 'pluvial' flooding) is usually caused by intense rainfall that may only last a few hours, occurring often where the natural (or artificial) drainage system is unable to cope with the volume of water. Surface water flooding problems are inextricably linked to issues of poor drainage, or drainage blockage by debris, and sewer flooding.

Urban areas at particularly at risk due to the impermeable surfaces and likely drainage issues. The Great Ouse Catchment Management Plan identifies Littleport as being at risk of surface water flooding.

The Risk of Flooding from Surface Water dataset predominantly follows topographical flow paths of existing watercourses or dry valleys with some isolated ponding located in low lying areas. The Risk of Flooding from Surface Water dataset mapping for East Cambridgeshire can be found in Appendix D.

6.7 Groundwater flooding

In comparison to fluvial flooding, current understanding of the risks posed by groundwater flooding is limited and mapping of flood risk from groundwater sources is in its infancy. Under the Flood and Water Management Act (2010), LLFAs have powers to undertake risk management functions in relation to groundwater flood risk. Groundwater level monitoring records are available for areas on Major Aquifers. However, for lower lying valley areas, which can be susceptible to groundwater flooding caused by a high-water table in mudstones, clays and superficial alluvial deposits, very few records are available. Additionally, there is increased risk of groundwater flooding where long reaches of watercourse are culverted as a result of elevated groundwater levels not being able to naturally pass into watercourses and be conveyed to less susceptible areas.

According to the Great Ouse Catchment Management, groundwater flooding has occurred in Burwell, when groundwater levels are high in the underlying chalk rock.

Mapping of the whole District has been provided showing the AStGW dataset and can be found in Appendix E.

6.8 Flooding from artificial sources

6.8.1 Flooding from sewers

Sewer flooding occurs when intense rainfall overloads the sewer system capacity (surface water, foul or combined), and/or when sewers cannot discharge properly to watercourses due to high water levels. Sewer flooding can also be caused when problems such as blockages, collapses or equipment failure occur in the sewerage system. Infiltration or entry of soil or groundwater into the sewer system via faults within the fabric of the sewerage system, is another cause of sewer flooding. Infiltration is often related to shallow groundwater, and may cause high flows for prolonged periods of time.

Since 1980, the Sewers for Adoption guidelines have meant that most new surface water sewers have been designed to have capacity for a 1 in 30-year rainfall event (3.3% AEP), although until recently this did not apply to smaller private systems. This means that, even where sewers are built to current specification, they are likely to be overwhelmed by larger events of the magnitude often considered when looking at river or surface water flooding. Existing sewers can also become overloaded as new development adds to the discharge to their catchment, or due to incremental increases in roofed and paved surfaces at the individual property scale (urban creep). Sewer flooding is therefore a problem that could occur in many locations across the study area.

6.8.2 Flooding from reservoirs

Reservoirs with an impounded volume greater than 25,000 cubic metres are governed by the Reservoir Act 1975 and are listed on a register held by the Environment Agency. The level and standard of inspection and maintenance required under the Act means that the risk of flooding from reservoirs is relatively low. Recent changes to legislation under the Flood and Water Management Act require the Environment agency top designate the risk of flooding from reservoirs over 25,000 cubic metres and at some time in the future to consider the risk from reservoirs with a volume greater than 10,000 cubic metres. The Environment agency is currently progressing a 'Risk Designation' process so that the risk is formally determined.

Reservoir flooding is very different from other forms of flooding. It may happen with little or no warning and evacuation will need to happen immediately. The likelihood of such flooding is difficult to estimate, but it is less likely than flooding from rivers of surface water. It may not be possible to seek refuge upstairs from floodwater as buildings could be unsafe or unstable due to the force of water from the reservoir breach or failure.

The risk of inundation to the East Cambridgeshire District as a result of reservoir breach or failure of a number of reservoirs within the area was assessed as part of the National Inundation Reservoir Mapping (NIRIM) study. Whilst no large, raised reservoirs exist within the East Cambridgeshire District Council area, there are smaller reservoirs used for agricultural purposes. There are also reservoirs outside of the area whose inundation mapping is shown to affect the study area. The largest inundation extent within the East Cambridgeshire District is associated with the Ouse Washes, which are considered a flood storage area and mapped as Flood Zone 3b. Details of the reservoirs are listed in the Table 6-3. Maps of the flood extent can be found on the Environment Agency's 'What's in Your Backyard' website.

The Environment Agency maps represent a credible worst-case scenario. In these circumstances it is the time to inundation, the depth of inundation, the duration of flooding and the velocity of flood flows that will be most influential.

Table 6-3: Reservoirs with potential risk to the East Cambridgeshire District

Reservoir	Location	Reservoir Owner	Environment Agency area	Local Authority	In the District?
Ouse Washes	545831 284570	Environment Agency	Cambridgeshire and Bedfordshire	Cambridgeshire	Yes
Chippenham Park Farm	565866 268090	Chippenham Park Farm	Cambridgeshire and Bedfordshire	Cambridgeshire	Yes
East Fen Farm	560165 274458	East Fen Farms Ltd	Cambridgeshire and Bedfordshire	Cambridgeshire	Yes
Trinity Hall Farm	569844 264662	Godolphin Management Company Ltd	Cambridgeshire and Bedfordshire	Suffolk	No
Lords Ground Farm	552907 266895	Greens Farming Limited	Cambridgeshire and Bedfordshire	Cambridgeshire	Yes
Adventurers Fen	555513 269079	Environment Agency	Cambridgeshire and Bedfordshire	Cambridgeshire	Yes
Hasse Farm	560555 277704	Greens Farming Limited	Cambridgeshire and Bedfordshire	Cambridgeshire	Yes
Putney Hill Farm No1	559948 280854	Waldersey Farms Ltd	Cambridgeshire and Bedfordshire	Cambridgeshire	Yes
Putney Hill Farm No2	560263 280745	Waldersey Farms Ltd	Cambridgeshire and Bedfordshire	Cambridgeshire	Yes
Harlock's Farm	556396 278106	Cole Ambrose Ltd	Cambridgeshire and Bedfordshire	Cambridgeshire	Yes
Settling Ponds Queen Adelaide	556824 281178	The Potter Trust Ltd	Cambridgeshire and Bedfordshire	Cambridgeshire	Yes
Folly Farm	558973 283908	A.L. Lee & Sons	Cambridgeshire and Bedfordshire	Cambridgeshire	Yes
Half Moon	564101 286995	River Fen Farms Ltd	Cambridgeshire and Bedfordshire	Cambridgeshire	Yes
Whitebridge Farm	556430 284291	A.L. Lee & Sons	Cambridgeshire and Bedfordshire	Cambridgeshire	Yes
Hurst Drove	552178 281609	Littleport & Downhan, Internal Drainage Board	Cambridgeshire and Bedfordshire	Cambridgeshire	Yes
Grafham Water	517186 266878	Anglian Water Services Ltd	Cambridgeshire and Bedfordshire	Cambridgeshire	No

The risk to development from reservoirs is residual but developers should consider reservoir flooding during the planning stage.

- Developers should seek to contact the reservoir owner to obtain information which may include
    - reservoir characteristics: type, dam height at outlet, area/volume, overflow location;
    - operation: discharge rates / maximum discharge;
    - discharge during emergency drawdown; and
    - inspection / maintenance regime.
- Developers should apply the sequential approach to locating development within the site. The following questions should be considered
    - can risk be avoided through substituting less vulnerable uses or by amending the site lay-out?

- can it be demonstrated that less vulnerable uses for the site have been considered and reasonably discounted? and
- can layout be varied to reduce the number of people or flood risk vulnerability or building units located in higher risk parts of the site?

- Consult with relevant authorities regarding emergency plans in case of reservoir breach
- In addition to the risk of inundation those considering development in areas affected by breach events should also assess the potential hydraulic forces imposed by the rapid flood event and check that that the proposed infrastructure fabric can withstand the loads imposed on the structures by a breach event.

6.9 Flood warning and emergency planning

This SFRA report demonstrates that the East Cambridgeshire District is not immune to flood risk and challenges remain to managing this risk.

Emergency planning is one option to help manage flood related incidents. From a flood risk perspective, emergency planning can be broadly split into three phases: before, during and after a flood. The measures involve developing and maintaining arrangements to reduce, control or mitigate the impact and consequences of flooding and to improve the ability of people and property to absorb, respond to and recover from flooding.

Flood warnings can be derived and, along with evacuation plans, can form emergency flood plans or flood response plans. The Environment Agency is the lead organisation for providing warnings of fluvial flooding (for watercourses classed as Main Rivers) and coastal flooding in England. Flood Warnings are supplied via the Floodline Warnings Directive (FWD) service, to homes and business within Flood Zones 2 and 3.

Within the East Cambridgeshire District, there are five flood warning areas (FWA) and five flood alert areas (FA). These are detailed in Table 6-4 and Table 6-5, and shown in Figure 6-5 and Figure 6-6.

Table 6-4: Flood Warning Areas within the study area

FWA Name	FWA Code	Description
River Great Ouse at Ely	052FWFEO1EL	River Great Ouse at Ely
River Delph Flood Defences	052FWFGO7DL	River Delph Flood Defences
Hundred Foot River Flood Defences	052FWFGO7HL	Hundred Foot River Flood Defences
Old West Flood Defence	052FWFGO7OL	Old West Flood Defence
River Kennett from Ousden to Freckenham	052FWFKE1DL	River Kennett from Ousden to Freckenham

Table 6-5: Flood Alert Areas within the study area

FA Name	FA Code	Description
Middle Level in the Fens	052WAFBWC	Middle Level in the Fens
Ely Ouse	052WAFELY	Great Ouse and the Cambridgeshire Lodes
Hundred Foot Washes	052WAFHFW	Hundred Foot Washes, also known as the Ouse Washes, including the causeways at Earith, Sutton Gault and Welney
Rivers Lark and Kennett in Suffolk	052WAFLRK	River Lark from Fornham St. Martin to Isleham and the River Kennett from Ousden to Freckenham in Suffolk
Upper Stour and Tributaries	051WAFEF1	Stour & Bumpstead Brooks and the River Stour from Kedington to Sudbury

Figure 6-5: Flood Warning Areas within the study area

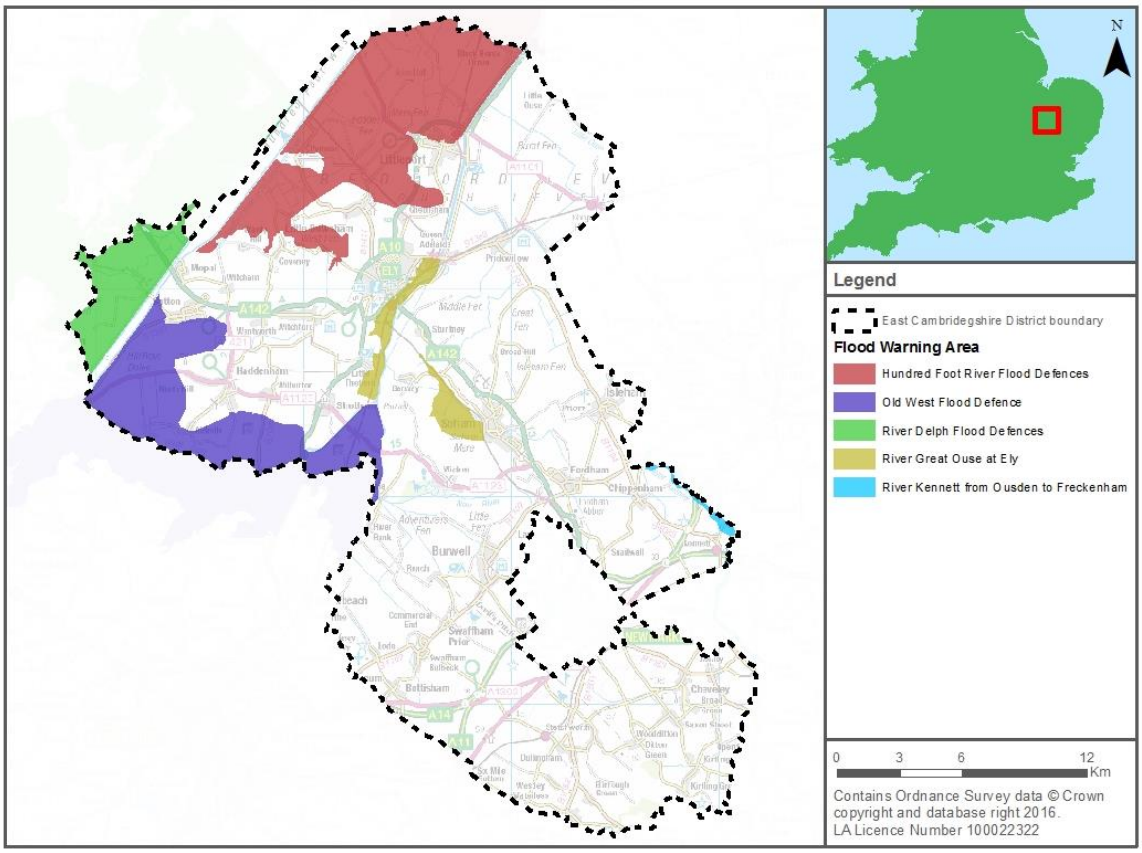


Figure 6-6: Flood Alert Areas within the study area

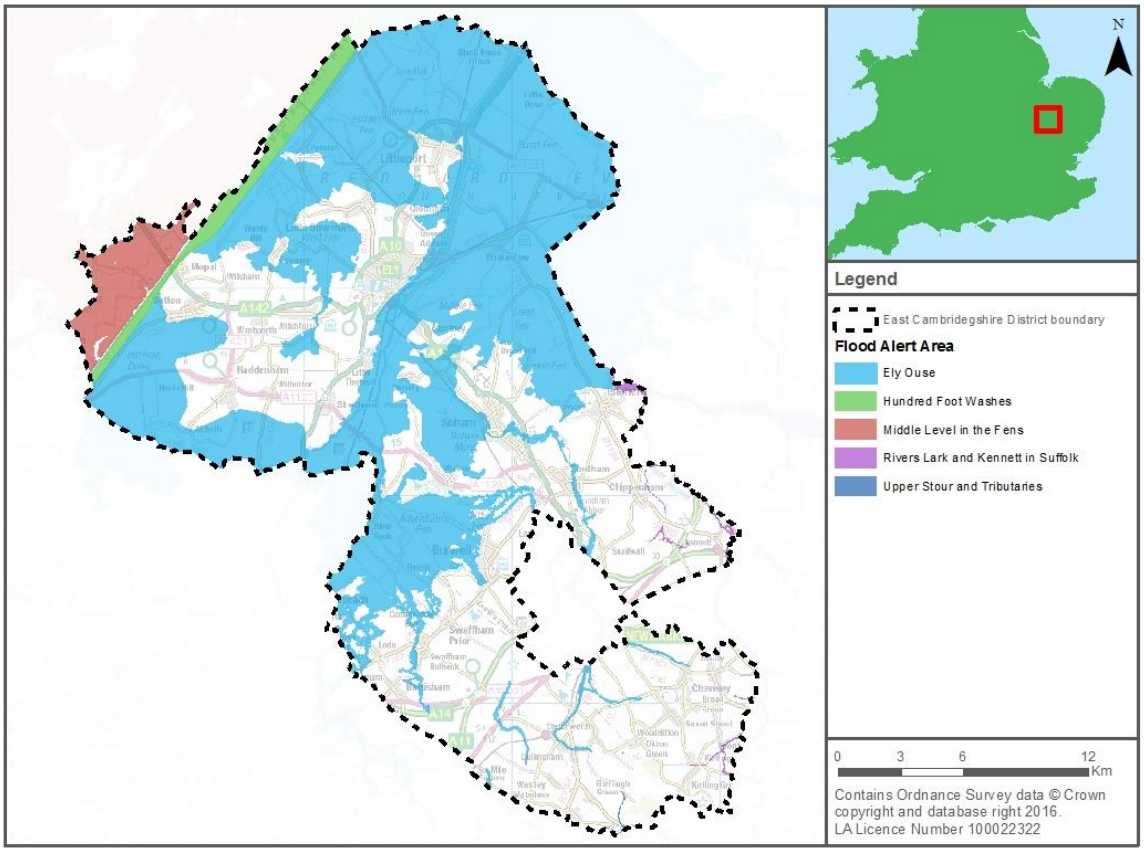


Table 6-6: Flood Risk in the East Cambridgeshire District

Settlement	Fluvial flood risk	Defences	Surface water flood risk	Susceptibility to Groundwater flood risk				Reservoir inundation risk	Historic flood events
				<25%	>=25% <50%	>=50% <75%	>=75%		
Ely	Flood Zones show no fluvial flood risk from Main Rivers to the town. Whilst there are a few drains and small un-named watercourses, given the town's topographical location it is unlikely to flood from fluvial sources.	Yes	Risk is a combination of flow routes along roads and small drains and ponding in gardens and some roads, most notably in north-west Ely at 30 years and beyond. A flow route is shown here, from 30 years, to flow west from Lynn Road, through the College and School grounds, affecting a number of properties and roads east of the A10. Most main roads in and out of Ely are at risk at 1,000 years.	✓	✓			None	None
Littleport	A number of small drains surround Littleport, but none of them are considered Main Rivers of ordinary rivers. However, the town is surrounded by the Ten Mile / Ely Ouse's floodplain, with a number of properties north of Wisbech Road on the northern and north-east extent of the town, within Flood Zone 2 and 3. A few properties around Fishers Bank to the east are also at risk.	Yes	Risk is predominantly confined to roads, with the majority of the risk being at 100 to 1,000 years, most notably in west Littleport along Parsons Lane and through surround properties, and in the north-east around Wellington Street.	✓	✓	✓		Littleport is partially covered by the Ouse Washes FSA inundation extent; a number of properties north of Wisbech Road on the northern extent of the town, are at risk.	None

Settlement	Fluvial flood risk	Defences	Surface water flood risk	Susceptibility to Groundwater flood risk				Reservoir inundation risk	Historic flood events
				<25%	>=25% <50%	>=50% <75%	>=75%		
Soham	The Soham Lode and tributaries flow directly through Soham; a number of properties are at risk around Paddock Street, The Causeway, Regal Lane and Greenhills, from fluvial flooding associated with the Lode and tributaries.	Yes	Risk at 30 years is mostly ponding in gardens and along some roads. At 100 years, risk is a combination of flow routes along roads and small drains and ponding in gardens and some roads, but still predominantly confined to road and ditches. At 1,000 years there is substantial ponding of surface water around Qua Fen Common and east of the railway adjacent to the Soham Lode.	✓		✓	✓	Risk to the A142 road and Bushel Lane from the East Fen Farm reservoir which lies east of Soham. No risk to properties is shown.	May 1978; local drainage caused surface water flooding in Northfield Park and along the Shade.
Burwell	The Burwell Lode and tributaries flow parallel to Burwell, around the outskirts of the town. The majority of properties lie outside of the flooding extent, except for a few isolated farms and the Industrial Estate in south Burwell.		Risk consists of ponding on roads and flow routes following small unnamed drains flowing away from the village towards the Burwell Lode. The majority of the risk is at 100 or 1,000 years, although there are pockets of risk at 30 years scattered across the town.	✓	✓	✓	✓	None	None

7 Flood Defences

7.1 Flood defences

A number of flood alleviation schemes (FAS) have been implemented within East Cambridgeshire District.

Flood alleviation schemes identified within the SFRA area may inform formal defences, initiatives to improve drainage, and/or land management to reduce the risk of high velocity overland surface runoff.

7.1.1 Defence standard of protection and residual risk

One of the principal aims of this SFRA is to outline the present risk of fluvial flooding from watercourses across East Cambridgeshire that includes consideration of the effect of flood risk management measures (including flood banks and defences). The fluvial flood risk presented in the SFRA is of a strategic nature for the purpose of preparing evidence on possible site options for development. In the cases where a specific site risk assessment is required, detailed studies should seek to refine the current, broad, understanding of flood risk from all sources.

Consideration of the residual risk behind flood defences should be considered as part of detailed site-specific flood risk assessments. The residual risk of flooding in an extreme flood event or from failure of defences should also be carefully considered.

Developers should also consider the standard of protection provided by defences and residual risk as part of a detailed FRA.

Standard of Protection

Flood defences are designed to give a specific standard of protection, reducing the risk of flooding to people and property in flood prone areas. For example, a flood defence with a 1% AEP standard of protection means that the flood risk in the defended area is reduced to a 1% chance of flooding in any given year.

Although flood defences are designed to a standard or protection it should be noted that, over time, the actual standard of protection provided by the defence may decrease, for example due to deterioration in condition or increases in flood risk due to climate change

7.1.2 Defence condition

Formal structural defences are given a rating based on a grading system for their condition. A summary of the grading system used by the Environment Agency for condition is provided in Table 7-1. This detail, in addition to descriptions and standard of protection for each, were provided by the Environment Agency for the purpose of preparing this SFRA which reports on the standard of protection using this information.

Table 7-1: Defence asset condition rating

Grade	Rating	Description
1	Very Good	Cosmetic defects that will have no effect on performance.
2	Good	Minor defects that will not reduce the overall performance of the asset.
3	Fair	Defects that could reduce the performance of the asset.
4	Poor	Defects that would significantly reduce the performance of the asset. Further investigation required.
5	Very Poor	Severe defects resulting in complete performance failure.

Source: Condition Assessment Manual – Environment Agency 2006

The condition of existing flood defences and whether they will continue to be maintained and/or improved in the future is an issue that needs to be considered as part of the risk based sequential approach and, in light of this, whether possible site options for development are appropriate and sustainable. In addition, detailed Flood Risk Assessments (FRAs) will need to thoroughly explore the condition of defences, especially where these defences are informal and demonstrate a wide variation of condition grades. It is important that all of these assets are maintained to a good condition and their function remains unimpaired.

A review of key defences across the East Cambridgeshire District, their condition and standard of protection, is included in the following sections.

7.2 Defences: Great Ouse Tidal River Strategy

The Great Ouse Tidal River Strategy covers the New Bedford River (Hundred Foot River) and the Ouse Washes, starting at Earith and stretching 51km along the Great Ouse to King's Lynn. The defences which lie within the study area are shown in Figure 7-1. In 2009, the strategy reviewed a set of options to improve the flood defences, the results of which can be viewed in The Great Ouse Tidal River Strategy report by the Environment Agency[7].

The defences either side of the New Bedford River (Hundred Foot River), which comprise of mostly flood embankments, have been constructed to a 1 in 100-year standard of protection. The flood defences either side of the Old Bedford River, however, vary between a standard of protection of 0, implying they were not designed to a defined standard, up to 1 in 100-years.

The condition of these defences range between 'good' and 'fair', with only one section classed as 'very poor' (a flood gate on the Old Bedford River). However, the defences either side of the Old Bedford River, the river on the north-west side of the Wash, is considered to be in 'very poor' condition when assessing its worst-case condition.

The Bedford River / Great Ouse flows into the district at Earith. There are three different courses for the Bedford River / Great Ouse in the district:

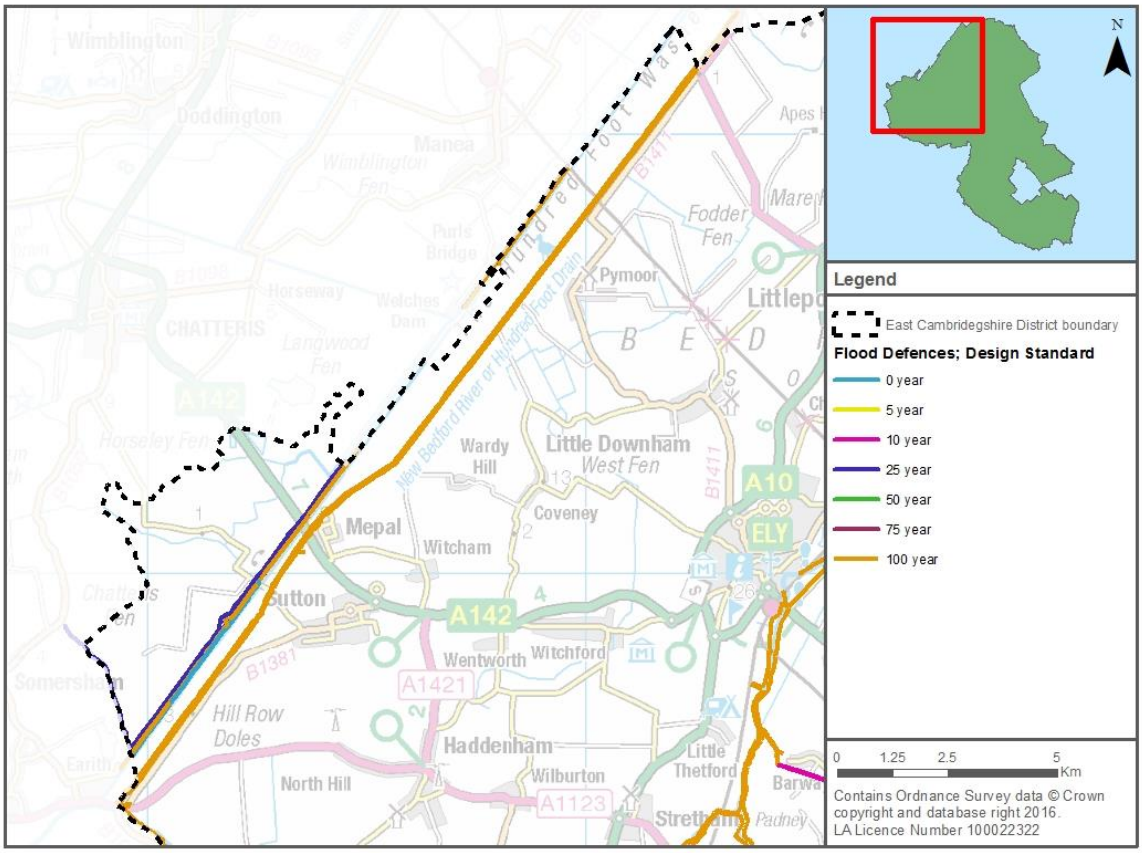
- The Ely Ouse (old course of the Great Ouse), is fluvial and flows through Ely, east of Littleport and Denver Sluice. At this sluice, the river becomes tidal and enters The Wash at King's Lynn.
- The Old Bedford River drainage channel, constructed in the 1630s from Earith to Denvor.
- The New Bedford River (Hundred Foot Drain) was cut from Earith to Denver, 600m to the east of the Old Bedford River.

The Environment Agency can direct flow via the Old and New Bedford Rivers and during flood conditions, the Earith Sluice can direct water into the Old Bedford River to fill the Ouse Washes (the land between the Old and New Bedford Rivers). The Ouse Washes are subsequently classified as a Flood Storage Area. At John Martin Sluice at Welmore Lakes, flood water is released at low tide to the Tidal Ouse.

Consultation with the Ely Drainage Board indicates that the South Level Barrier Bank, which forms part of the Ouse Washes, requires additional funding to maintain the existing defence. Capital investment has so far not met the required funds and local partnership funding is being explored to cover the remaining amount. Even with the funding secured, it will not improve flood risk; with the funding in place the standard of protection will reduce to 1 in 15-years by 2085. As such, the Local Authority is unlikely to ask for s106 developer contributions in this area. This issue is also found across all fenland waterways and a strategy is proposed to investigate this issue.

[7] Environment Agency (2009) *The Great Ouse Tidal River Strategy; Draft for consultation September 2009; Managing flood risk*, http://www.eastcambs.gov.uk/sites/default/files/agendas/sd101109ag_J217Appendix.pdf

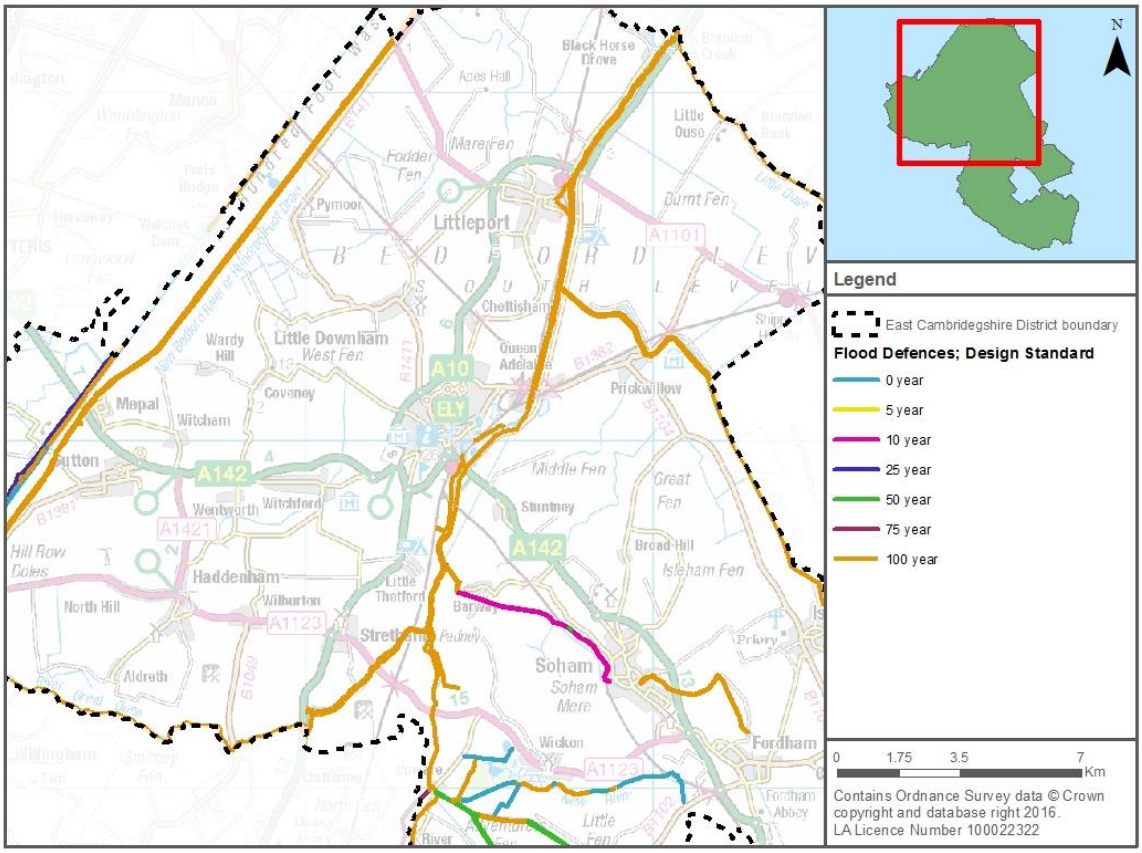
Figure 7-1: Flood defences on the two Bedford Rivers



7.3 Defences: Great River Ouse

Flood defences are shown either side of the Ely Ouse/ Ten Mile river (Figure 7-2). The condition of the defences is variable, ranging from poor to very good; the lowest defence condition grade is the high ground protecting Littleport on its northern side. However, many of the flood defences that are considered in fair condition, have worst condition ratings of good to very poor. A considerable amount of the embankments protecting the lowlands of the Fens are considered very poor by this worst condition grade, which could mean that they have defects that could potentially result in reduced performance.

Figure 7-2: Flood defences on the Ely Ouse/ Ten Mile River

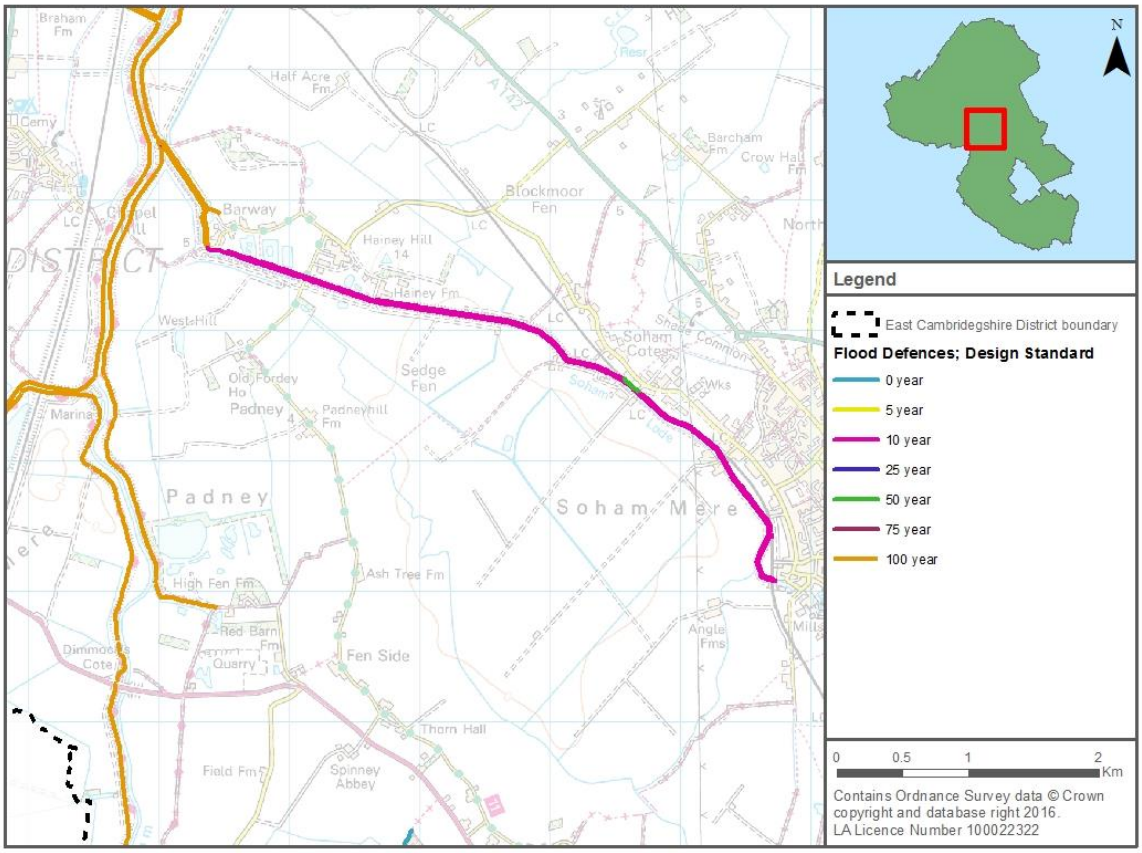


7.4 Defences: Soham Lode

The defences either side of the Soham Lode are mostly embankments or high ground, extending from where the watercourse flows under the railway at Soham, west towards the Soham Lode confluence with the River Ouse (Figure 7-3). These defences are mostly built to a 1 in 10-year design standard, with the lower watercourse upstream of the confluence built to a 1 in 100-year standard.

The condition of the defences is mostly classed as fair, with some considered in good condition, such as on the Soham side near the sewage works. There are a few places where embankments are considered to be in poor or very poor condition when graded with the worst condition scale; notably upstream of the Goose Fen Bridge and downstream of Soham within close proximity to the railway.

Figure 7-3: Flood defences along Soham Lode

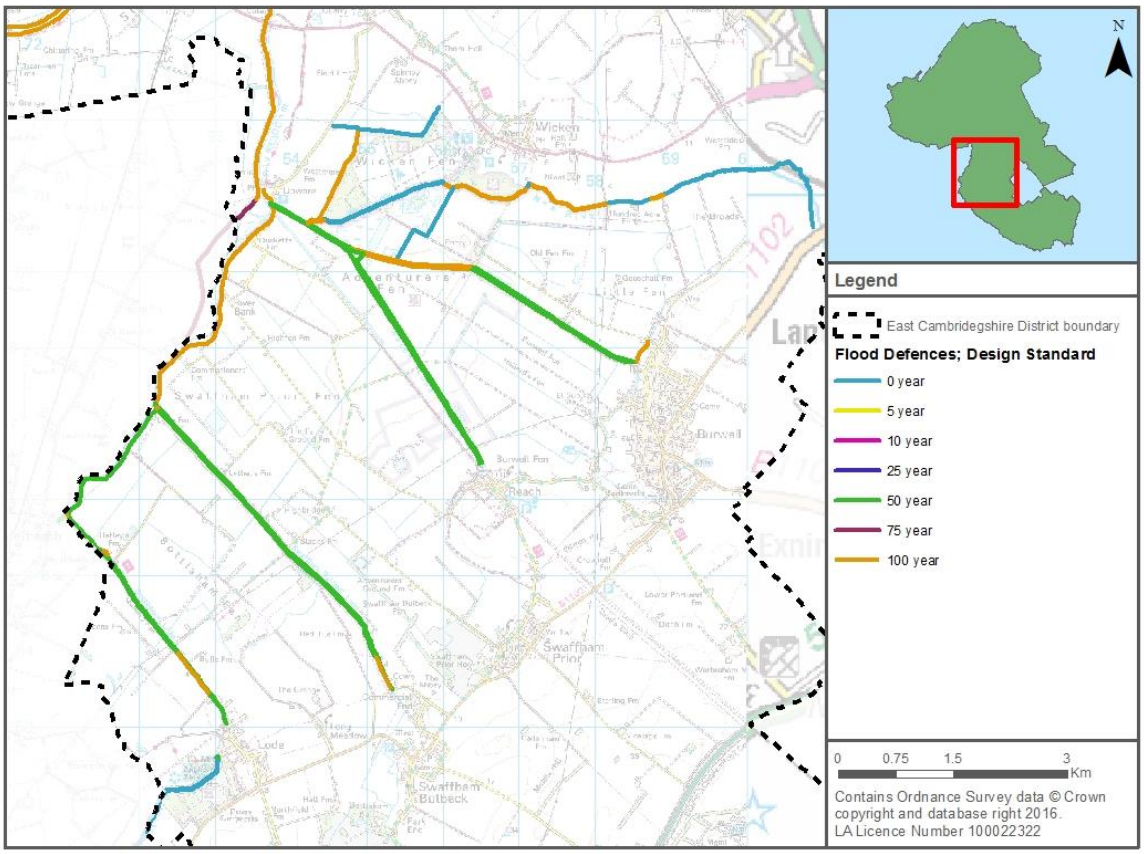


7.5 Defences; Cambridgeshire Lodes

Several flood defences are in place along the Cambridgeshire Lodes and the River Cam, to which the Lodes discharge (Figure 7-4). The standard of protection along the defences is varied, with embankments and high areas built to 0, 1 in 50-year, 1 in 75-year and 1 in 100-year standards.

The condition of the defences is variable, ranging from very poor to good; the lowest defence condition grade is mostly restricted to the defences lining the Reach Lode, the lower reaches of Burwell Lode, and along the unnamed drain flowing along Spinney Drove (path).

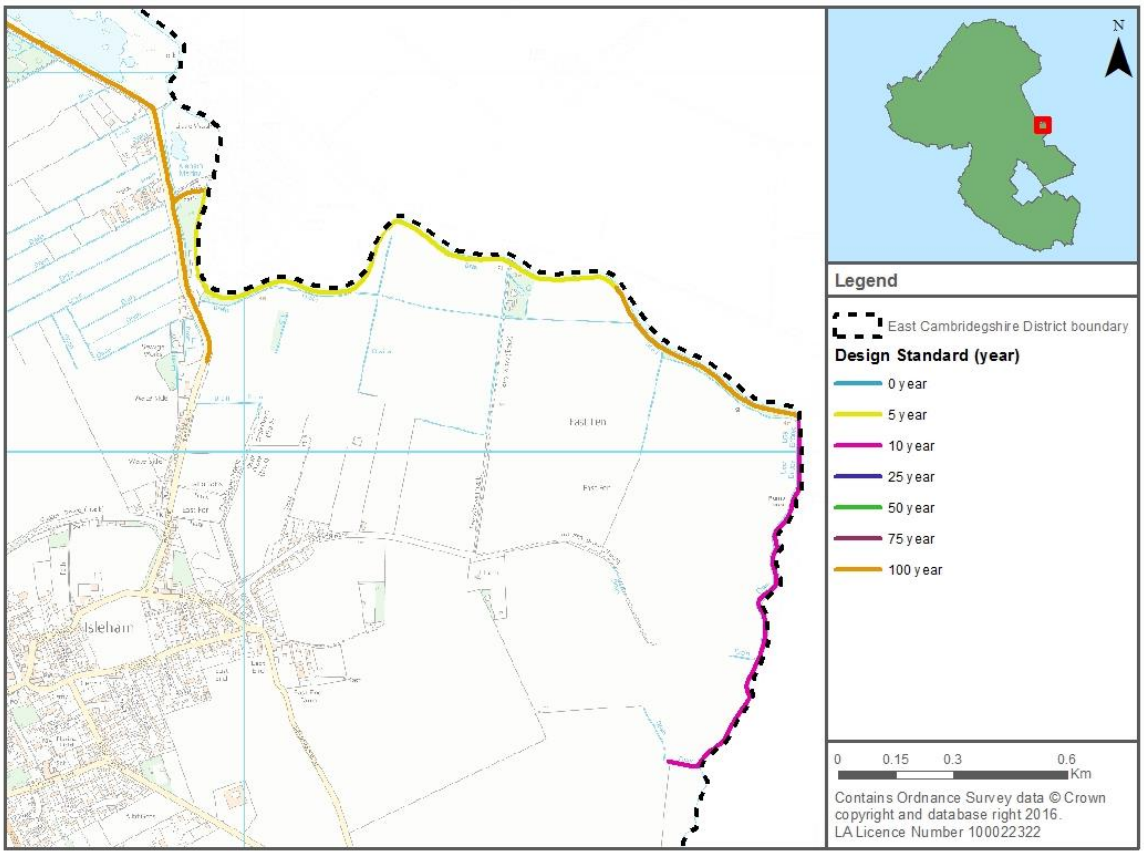
Figure 7-4: Flood defences along the Cambridgeshire Lodes



7.6 Defences; Isleham

Flood defences protect the town of Isleham from the River Lark (Figure 7-5). The defences are mostly embankments designed up to either 1 in 100-year standard, or 1 in 5 and 1 in 10-years. The majority of the defences are in fair condition, with only the embankment running alongside the railway, downstream of Isleham, considered in poor condition according to the worst condition grade. The defences along the River Lark continue until its confluence with the Ely Ouse / Ten Mile River, with either a fair or good condition grade.

Figure 7-5: Flood defences at Isleham on the River Lark



7.7 Flood storage area; The Moors, Littleport

The Moors, Littleport, flood storage area forms part of the Ely-Ouse flood defence scheme, constructed in the late 1950s after the 1947 floods. The flood storage area protects 100+ properties which are at risk of over-topping from the Ely Ouse Embankments. The level of the embankment was raised as part of maintenance work carried out by the Environment Agency in 2013.

The Environment Agency are currently undertaking a preliminary investigation, to identify whether the flood storage area could be designated a reservoir under the Reservoir Act 1975.

7.8 Residual flood risk

Residual risk refers to the risks that remain in circumstances after measures have been taken to alleviate flooding (such as flood defences). It is important that these risks are quantified to confirm that the consequences can be safely managed. The residual risk can be:

- The effects of a flood with a magnitude greater than that for which the defences or management measures have been designed to alleviate (the 'design flood'). This can result in overtopping of flood banks, failure of flood gates to cope with the level of flow or failure of pumping systems to cope with the incoming discharges.
- Failure of the defences or flood risk management measures to perform their intended duty. This could be breach failure of flood embankments, failure of flood gates to operate in the intended manner or failure of pumping stations.

Defences in East Cambridgeshire vary in condition and standard of protection. In the event of a breach, depending on the extent and magnitude of the breach, water could rapidly inundate area behind defences with little warning. Although the majority of areas protected by defences are within the Environment Agency's Flood Warning Service, the service does not provide a warning in the event of a breach.

There is also the potential that the risk of defences overtopping in the future may increase due to increased flows due to climate change.

The Environment Agency have modelled breaches for a number of failure scenarios relating to Earith Sluice and potential breaches of raised defences. Breaches were also modelled on the Middle Level Barrier Bank and South Level Barrier Bank. The breach modelled showed the flat topography of the area means, in the event of a breach, the event has a possibility of rapid inundation and wide-spread flooding of breach floodwater.

7.8.1 Fenland breach modelling

The Fenland Flood Risk Mapping study, completed in 2016 by the Environment Agency, simulated the effects of a breach in raised flood defences within the Fenland catchment. The model report notes that the worst-case scenario is considered, in that the extents represent a catastrophic failure arising from internal erosion. The breach parameters used are set out in the 2016 Fenland Flood Risk Mapping Study report.

Breach modelling was completed at 40 locations for the 100-year event, with 11 breach locations also being run for the 100-year plus climate change scenario. For purposes of the SFRA, the individual breach extents for the 100-year event have been merged to produce a combined outline to show the maximum breach extent (see Figure 7-6). This approach has also been used to map the maximum breach extent for the 100-year plus climate change scenario (see Figure 7-7). The areas predicted should be seen as indicative of the influence of breaches, as the exact location of the breach, failure type, and event at which the breach occurs could all influence the flooding from such an event.

The results show that during the 100-year event, the breach extents along the New Bedford River / Hundred Foot Drain are quite confined and pose little risk to existing communities. However, breach extents were simulated along this reach as part of the Tidal Hazard Mapping (tidal Great Ouse) modelling study and these do pose a risk (see Section 7.8.2 and Figure 7-8).

The breach extents associated with the Ten Mile / Ely Ouse during the 100-year event, affect the existing settlements located in the breach extents, including parts of Black Horse Drove, Littleport, Ely and Prickwillow. The breach extents also affect considerable areas of undeveloped land. The results show that many areas in the district are reliant on defences to offer flood protection.

During the 100-year with climate change event, the breach extents do not affect as large an area. This is because only 11 breaches were simulated during this scenario, compared to the 40 which were simulated during the 100-year event. Existing communities of Littleport and Ely are affected by these extents.

Figure 7-6: 2016 Fenland hydraulic model – 100-year combined maximum breach extent

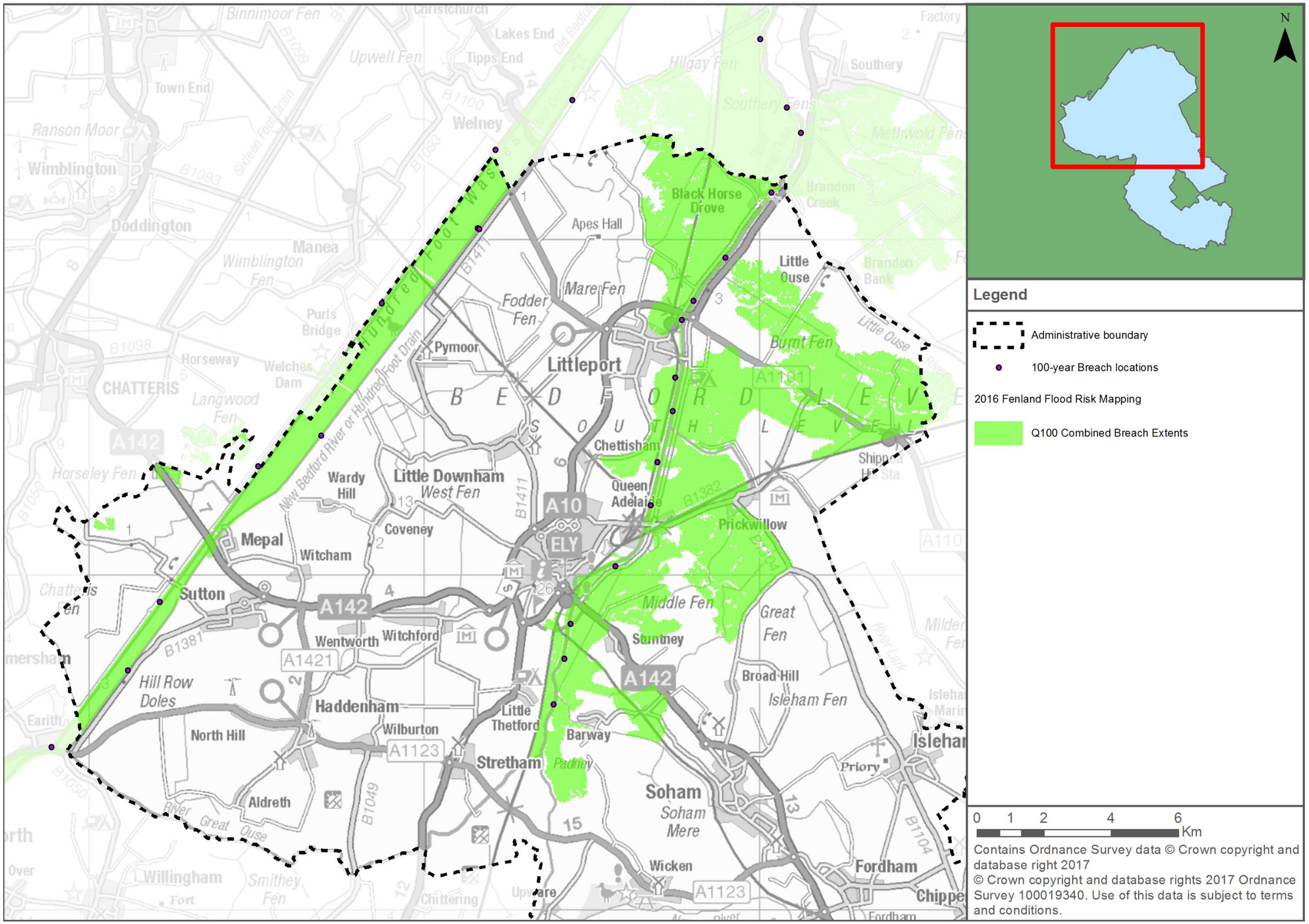
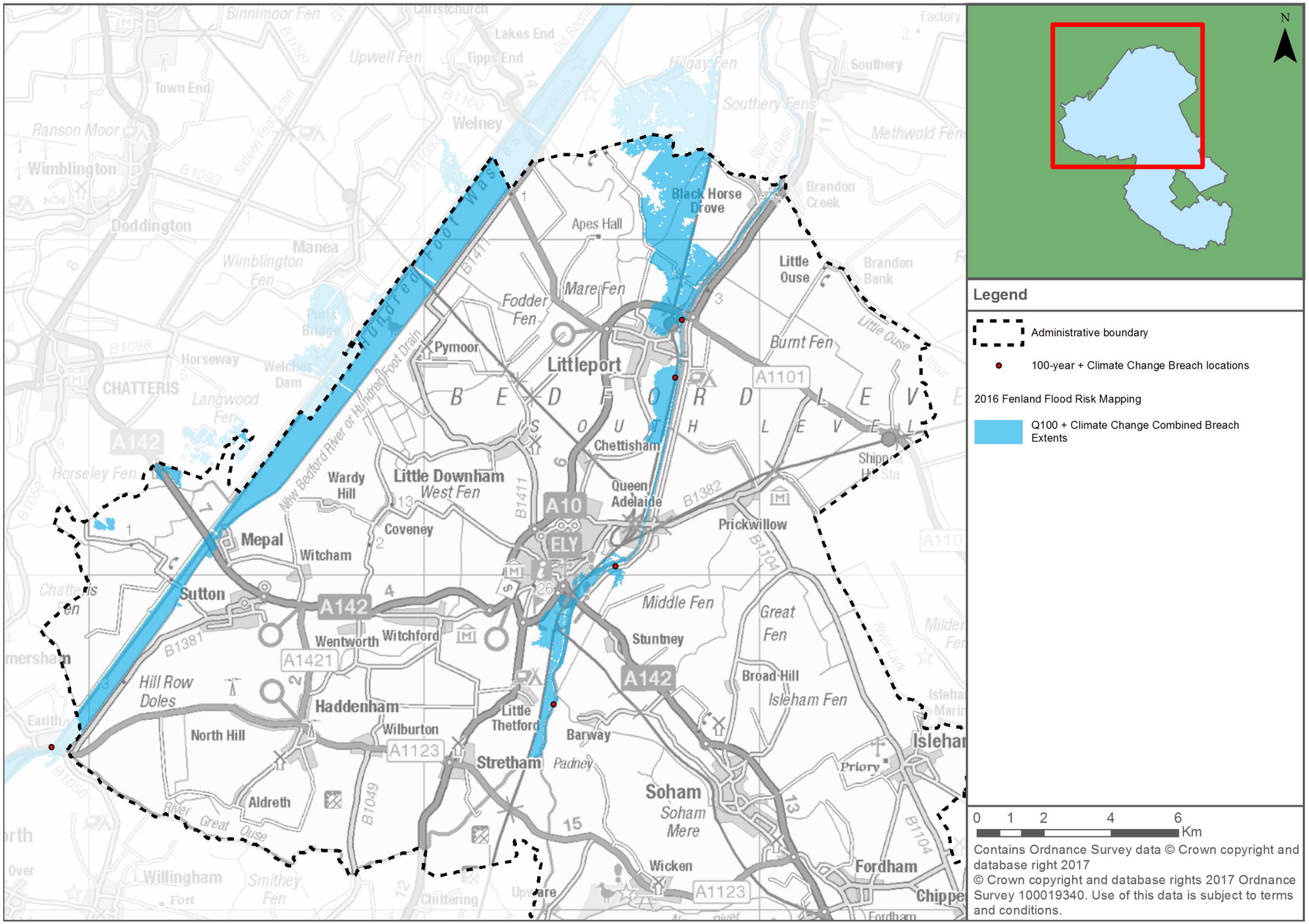


Figure 7-7: 2016 Fenland hydraulic model – 100-year plus climate change combined maximum breach extent



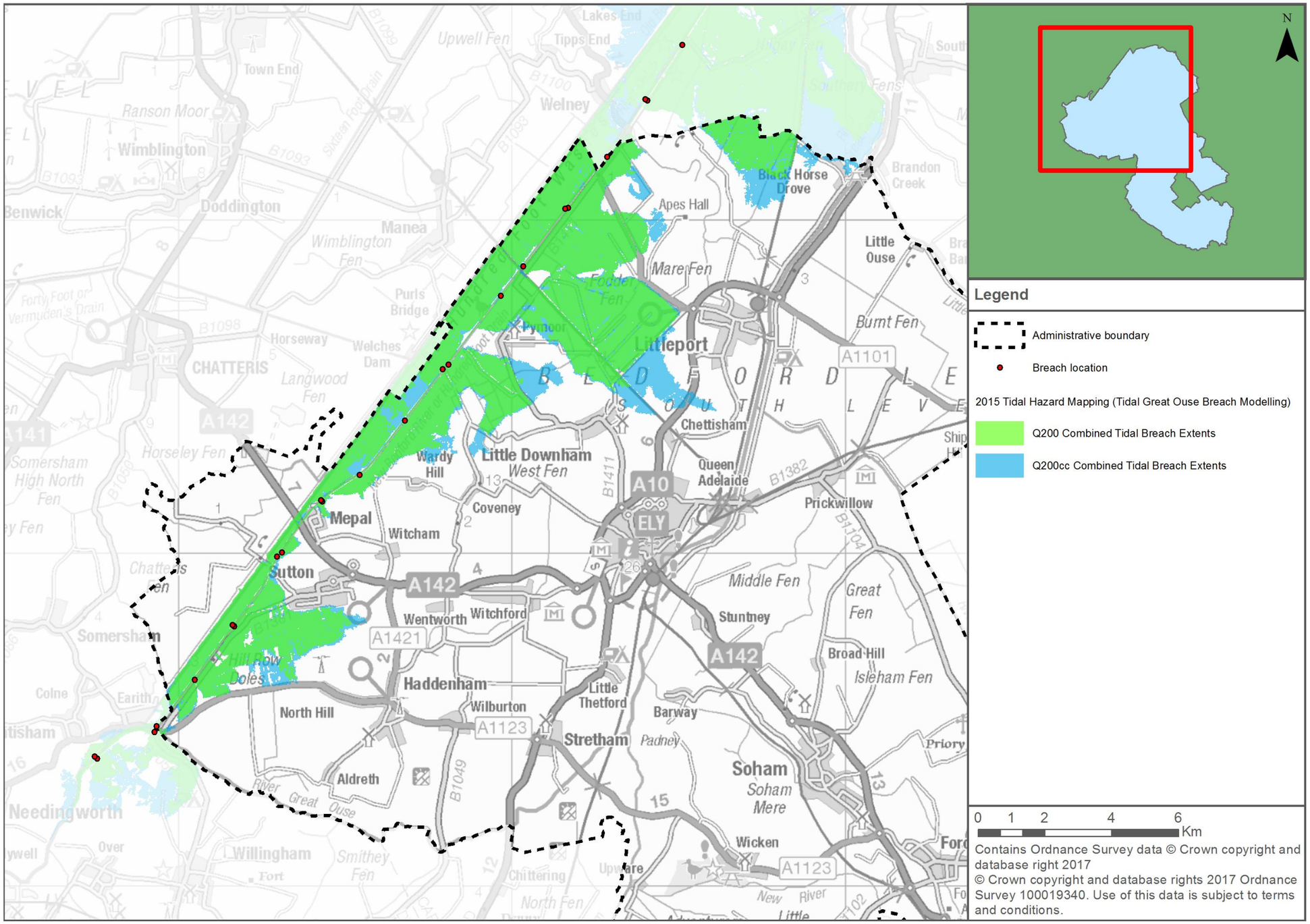
7.8.2 2015 Tidal Hazard Mapping (tidal Great Ouse) breach modelling

The Environment Agency supplied the 2015 Tidal Hazard Mapping (Tidal Great Ouse Breach Modelling) for use in the SFRA. 98 breach locations were assessed as part of the Tidal Great Ouse breach modelling. The breach locations start around Bluntisham in Cambridgeshire, continuing at regular intervals and along both the left and right banks of the Great Ouse, to the coastline. There are also a number of breaches located along the coastline, from Hunstanton in the east to Terrington Marsh / Ongar Hill areas in the west, although these are sited outside of the SFRA study area.

Due to the number of breach scenarios modelled, the extents from the individual breaches have been merged into a single combined extent for the tidal 200-year and tidal 200-year with climate change (2115) scenarios. The resultant flood extents from the combined breach modelling for the Tidal Great Ouse are displayed Figure 7-8. The areas predicted should be seen as indicative of the influence of breaches, as the exact location of the breach, failure type, and event at which the breach occurs could all influence the flooding from such an event.

The breach modelling shows that significant areas of the district are at risk should the defences breach. The risk is predominantly confined to undeveloped land; however, existing communities including Pymoor and Black Horse Drove are at risk. The model results indicate that the model is quite sensitive to climate change.

Figure 7-8: 2015 Tidal Hazard Mapping (Tidal Great Ouse Breach Modelling) combined maximum breach extents



7.8.3 Implications for development

The assessment of residual risk demands that attention be given to the vulnerability of the receptors and the response to managing the resultant flood emergency. In this instance attention should be paid to the characteristics of flood emergencies and the roles and responsibilities during such events. Additionally, in the cases of breach or overtopping events, consideration should be given to the structural safety of the dwellings or structures that could be adversely affected by significant high flows or flood depths.

Developers should include an assessment of the residual risk where developments are located in areas benefitting from defences. They should consider both the impact of breach, including the effect on safe access and egress, as well as potential for flood risk to increase in the future due to overtopping. Any improvements to defences should ensure they are in keeping with wider catchment policy.

At areas susceptible to breach failure, it is expected that more detailed assessment be completed to evidence the severity of the risk. The breach modelling undertaken by the Environment Agency should be used as a starting point for breach modelling, as part of detailed site-specific Flood Risk Assessments. This more detailed assessment should refine the information prepared as part of SFRA assessment and describe how the residual risk will be safely managed at the development site. This more detailed assessment should at least include consideration of the following elements, which may also be included within a site flood risk management plan:

- Extent of flooding
- Depth of flooding
- Velocity of flood water
- Speed of onset of flooding
- Hazard to people
- Duration of flooding
- Warning and evacuation procedures
- Forces on buildings and infrastructure

Any improvements to defences should ensure they are in keeping with wider catchment policy.

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8 FRA requirements and flood risk management guidance

8.1 Over-arching principles

This SFRA focuses on delivering a strategic assessment of flood risk within East Cambridgeshire. Due to the strategic scope of the study, prior to any construction or development, site-specific assessments will need to be undertaken for individual development proposals (where required) so all forms of flood risk at a site are fully addressed. It is the responsibility of the developer to provide an FRA with an application.

It should be acknowledged that a detailed FRA may show that a site is not appropriate for development of a particular vulnerability or even at all. Where the FRA shows that a site is not appropriate for a particular usage, a lower vulnerability classification may be appropriate.

8.2 Requirements for site specific flood risk assessments

8.2.1 What are site specific FRAs?

Site specific FRAs are carried out by (or on behalf of) developers to assess flood risk to and from a site. They are submitted with planning applications and should demonstrate how flood risk will be managed over the development's lifetime, taking into account climate change and vulnerability of users.

Site specific FRAs are required in the following circumstances:

- Proposals of 1 hectare or greater in Flood Zone 1.
- Proposals for new development (including minor development and change of use) in Flood Zones 2 and 3.
- Proposals for new development (including minor development and change of use) in an area within Flood Zone 1 which has critical drainage problems (as notified to the LPA by the Environment Agency).
- Where proposed development or a change of use to a more vulnerable class may be subject to other sources of flooding.

A FRA may also be required for some specific situations:

- If the site may be at risk from the breach of a local defence (even if the site is actually in Flood Zone 1)
- Where the site is intended to discharge to the catchment or assets of a water management authority which requires a site-specific FRA
- Where the site's drainage system may have an impact on an IDB's system
- Where evidence of historical or recent flood events have been passed to the LPA
- In an area of significant surface water flood risk.

In some cases, a development meeting the criteria below may need to submit a FRA to the IDB to inform any consent applications

- Development being either within or adjacent to a drain/ watercourse, and/ or other flood defence
- structure within the area of an IDB
- Development being within the channel of any ordinary watercourse within an IDB area
- Where a direct discharge of surface water or treated effluent is proposed into an IDBs catchment
- For any development proposal affecting more than one watercourse in an IDBs area and having possible strategic implications
- In an area of an IDB that is in an area of known flood risk
- Development being within the maintenance access strips provided under the IDBs by-laws
- Any other application that may have material drainage implications.

8.2.2 Objectives of site-specific FRAs

Site specific FRAs should be proportionate to the degree of flood risk, as well as appropriate to the scale, nature and location of the development. Site specific FRAs should establish:

- The evidence, if necessary, for the Local Planning Authority to apply the Sequential Test
- Whether a proposed development is likely to be affected by current or future flooding from any source
- Whether a proposed development will increase flood risk elsewhere
- Whether the measures proposed to deal with the effects and risks are appropriate
- Whether, if applicable, the development will be safe and pass the Exception Test, if applicable

FRAs for sites located in East Cambridgeshire should follow the approach recommended by the NPPF (and associated guidance) and guidance provided by the Environment Agency and East Cambridgeshire District Council. Guidance and advice for developers on the preparation of site specific FRAs include:

- Cambridgeshire Flood and Water Supplementary Planning Document (2016)
- Cambridgeshire County Council Surface Water Guidance document
- Standing Advice on Flood Risk (Environment Agency)
- Flood Risk Assessment for Planning Applications (Environment Agency)
- Site-specific Flood Risk Assessment: CHECKLIST (NPPG, Defra)

Guidance for local planning authorities for reviewing flood risk assessments submitted as part of planning applications has been published by Defra in 2015 – Flood Risk Assessment: Local Planning Authorities

8.3 Flood risk management guidance – mitigation measures

Mitigation measures should be seen as a last resort to address flood risk issues. Consideration should first be given to minimising risk by planning sequentially across a site. Once risk has been minimised as far as possible, only then should mitigation measures be considered.

8.3.1 Site layout and design

Flood risk should be considered at an early stage in deciding the layout and design of a site to provide an opportunity to reduce flood risk within the development.

The NPPF states that a sequential, risk-based approach should be applied to try to locate more vulnerable land use away from flood zones, to higher ground, while more flood-compatible development (e.g. vehicular parking, recreational space) can be located in higher risk areas. However, vehicular parking in floodplains should be based on the nature of parking, flood depths and hazard including evacuation procedures and flood warning.

Waterside areas, or areas along known flow routes, can act as Green Infrastructure, being used for recreation, amenity and environmental purposes, allowing the preservation of flow routes and flood storage, and at the same time providing valuable social and environmental benefits contributing to other sustainability objectives. Landscaping should ensure safe access to higher ground from these areas, and avoid the creation of isolated islands as water levels rise.

Making space for water

The NPPF sets out a clear policy aim in Flood Zone 3 to create space for flooding by restoring functional floodplain.

All new development close to rivers should consider the opportunity presented to improve and enhance the river environment. Developments should look at opportunities for river restoration and enhancement as part of the development. Options include backwater creation, de-silting, in-channel habitat enhancement and removal of structures. When designed properly, such measures can have benefits such as reducing the costs of maintaining hard engineering structures, reducing flood risk, improving water quality and increasing biodiversity. Social benefits are also gained by increasing green space and access to the river.

The provision of a buffer strip can 'make space for water', allow additional capacity to accommodate climate change and ensure access to the watercourse, structures and defences is maintained for future maintenance purposes.

It also enables the avoidance of disturbing riverbanks, adversely impacting ecology and having to construct engineered riverbank protection. Building adjacent to riverbanks can also cause problems to the structural integrity of the riverbanks and the building itself, making future maintenance of the river much more difficult.

8.3.2 Raised floor levels

The raising of internal floor levels within a development avoids damage occurring to the interior, furnishings and electrics in times of flood.

If it has been agreed with the Environment Agency that, in a particular instance, the raising of floor levels is acceptable finished flood levels should be set a minimum of 300mm above the 1% AEP event plus an allowance for climate change and an appropriate allowance for freeboard. The additional height that the floor level is raised above the maximum water level is referred to as the "freeboard". Additional freeboard may be required because of risks relating to blockages to the channel, culvert or bridge and should be considered as part of an FRA. It is recommended that developers confirm the finished floor levels and amount of freeboard required with the Environment Agency.

Allocating the ground floor of a building for less vulnerable, non-residential, use is an effective way of raising living space above flood levels.

Single storey buildings such as ground floor flats or bungalows are especially vulnerable to rapid rise of water (such as that experienced during a breach). This risk can be reduced by use of multiple storey construction and raised areas that provide an escape route. However, access and egress would still be an issue, particularly when flood duration covers many days.

Similarly, the use of basements should be avoided. Habitable uses of basements within Flood Zone 3 should not be permitted, whilst basement dwellings in Flood Zone 2 will be required to pass the Exception Test. Access should be situated 300mm above the design flood level and waterproof construction techniques used.

It is important to recognise that much of the area is sited below sea level and protected by raised defences. If these defences were to breach, flood depths could be significant. Minimum finished floor levels are typically set above modelled breach depths; where depths are significant, this may not be practical and therefore, amending the building layout and design, by allocating the ground floor to less vulnerable uses, may be a more suitable mitigation measure. Consultation with the Environment Agency and the Council will be required in such instances, to agree the suitability of the proposed mitigation measures.

8.3.3 Development and raised defences

Construction of localised raised floodwalls or embankments to protect new development is not a preferred option, as a residual risk of flooding will remain. Compensatory storage must be provided where raised defences remove storage from the floodplain. It would be preferable for schemes to involve an integrated flood risk management solution.

Temporary or demountable defences are not acceptable forms of flood protection for a new development but might be appropriate to address circumstances where the consequences of residual risk are severe but the time required to install the defences, for example in an overtopping scenario, would be realistic. In addition to the technical measures the proposals must include details of how the temporary measures will be erected and decommissioned, responsibility for maintenance and the cost of replacement when they deteriorate. The storage and accessibility of such structures must be considered.

8.3.4 Modification of ground levels

Modifying ground levels to raise the land above the required flood level is an effective way of reducing flood risk to a particular site in circumstances where the land does not act as conveyance for flood waters. However, care must be taken at locations where raising ground levels could adversely affect existing communities and property; in most areas of fluvial flood risk, raising land above the floodplain would reduce conveyance or flood storage in the floodplain and could adversely impact flood risk downstream or on neighbouring land.

All new development within the 1% AEP flood extent including an allowance for climate change (for the lifetime of the development) must not result in a net loss of flood storage capacity. Where possible, opportunities should be sought to achieve an increase in the provision of floodplain storage.

Where proposed development results in a change in building footprint, the developer should ensure that it does not impact upon the ability of the floodplain to store or convey water, and seek opportunities to provide floodplain betterment. Similarly, where ground levels are elevated to raise the development out of the floodplain, compensatory floodplain storage within areas that currently lie outside the floodplain should be provided to ensure that the total volume of the floodplain storage is not reduced.

For compensatory flood storage to be effective and not require hydraulic modelling, it must be provided on a level for level, volume for volume basis on land which does not already flood and is within the site boundary. Where land is not within the site boundary, it must be in the immediate vicinity, in the applicant's ownership/control and linked to the site. Floodplain compensation should be considered in the context of the 1% annual probability (1 in 100 year) flood level including an allowance for climate change. When designing a scheme flood water must be able to flow in and out unaided. An FRA should demonstrate that there is no loss of flood storage capacity and include details of an appropriate maintenance regime to ensure mitigation continues to function for the life of the development. Guidance on how to address floodplain compensation is provided in Appendix A3 of the CIRIA Publication C62430.

The hierarchy of floodplain compensation measures which developers should aim to implement is as follows:

- Sequential approach onsite – removal of footprint within the floodplain, or;
- Sequential approach onsite – reduction of footprint within the floodplain, or; and then:
- Level for Level, volume for volume (direct) compensation onsite
- Direct compensation off site
- Use of voids to reduce the loss of storage (confirm with the LPA)
- Volumetric compensation (indirect)

Raising ground levels can also deflect flood flows, so analyses should be performed to demonstrate that there are no adverse effects on third party land or property.

Raising levels can also create areas where surface water might pond during significant rainfall events. Any proposals to raise ground levels should be tested to ensure that it would not cause increased ponding or build-up of surface runoff on third party land.

Any proposal for modification of ground levels will need to be assessed as part of a detailed flood risk assessment.

8.3.5 Developer contributions

In some cases, and following the application of the sequential test, it may be necessary for the developer to make a contribution to the improvement of flood defence provision that would benefit both proposed new development and the existing local community. Developer contributions can also be made to maintenance and provision of flood risk management assets, flood warning and the reduction of surface water flooding (i.e. SuDS).

DEFRA's Flood and Coastal Risk Management Grant in Aid (FCRMGiA)[8] can be obtained by operating authorities to contribute towards the cost of a range of activities including flood risk management schemes that help reduce the risk of flooding and coastal erosion. Some schemes are only partly funded by FCRMGiA and therefore any shortfall in funds will need to be found from elsewhere when using Resilience Partnership Funding, for example local levy funding, local businesses or other parties benefitting from the scheme.

For new development in locations without existing defences, or where the development is the only beneficiary, the full costs of appropriate risk management measures for the life of the assets proposed must be funded by the developer.

8 Principles for implementing flood and coastal resilience funding partnerships (Environment Agency, 2012)

However, the provision of funding by a developer for the cost of the necessary standard of protection from flooding or coastal erosion does not mean the development is appropriate as other policy aims must also be met. Funding from developers should be explored prior to the granting of planning permission and in partnership with the local planning authority and the Environment Agency.

The appropriate route for the consideration of strategic measures to address flood risk issues is the LFRMS. The LFRMS should describe the priorities with respect to local flood risk management, the measures to be taken, the timing and how they will be funded. It will be preferable to be able to demonstrate that strategic provisions are in accordance with the LFRMS, can be afforded and have an appropriate priority.

The Environment Agency is also committed to working in partnership with developers to reduce flood risk. Where assets are in need of improvement or a scheme can be implemented to reduce flood risk, the Environment Agency request that developers contact them to discuss potential solutions.

8.4 Flood risk management guidance – resistance measures

There may be instances where flood risk to a development remains despite implementation of such planning measures as those outlined above. For example, where the use is water compatible, where an existing building is being changed, where residual risk remains behind defences, or where floor levels have been raised but there is still a risk at the 0.1% AEP scenario. In these cases, (and for existing development in the floodplain), additional measures can be put in place to reduce damage in a flood and increase the speed of recovery. These measures should not normally be relied on for new development as an appropriate mitigation method. Most of the measures should be regarded as reducing the rate at which flood water can enter a property during an event and considered an improvement on what could be achieved with sand bags. They are often deployed with small scale pumping equipment to control the flood water that does seep through these systems. The effectiveness of these forms of measures are often dependant on the availability of a reliable forecasting and warning system to user the measures are deployed in advance of an event. The following measures are often deployed:

Permanent barriers

Permanent barriers can include built up doorsteps, rendered brick walls and toughened glass barriers.

Temporary barriers

Temporary barriers consist of moveable flood defences which can be fitted into doorways and/or windows. The permanent fixings required to install these temporary defences should be discrete and keep architectural impact to a minimum. On a smaller scale temporary snap on covers for airbricks and air vents can also be fitted to prevent the entrance of flood water.

Non-return valves

Non-return valves can be installed to prevent waste water from being forced up sewer/waste water pipes and into bathrooms, kitchens or lavatories.

Community resistance measures

These include demountable defences that can be deployed by local communities to reduce the risk of water ingress to a number of properties. The methods require the deployment of inflatable (usually with water) or temporary quick assembly barriers in conjunction with pumps to collect water that seeps through the systems during a flood.

8.5 Flood risk management guidance – resilience measures

Flood-resilient buildings are designed and constructed to reduce the impact of flood water entering the building. These measures aim to ensure no permanent dame is caused, the structural integrity of the building is not compromised and the clean up after the flood is easier. Interior design measures to reduce damage caused by flooding include:

- Electrical circuitry installed at a higher level with power cables being carried down from the ceiling rather than up from the floor level
- Water-resistant materials for floors, walls and fixtures

- Front doors that reduce ingress of water all the time with no further installation required. Such methods must consider hydrostatic pressure and that water may still come in through the floor. Such methods offer time and reduce damage but may not remove flood water from entering the house completely
- If redeveloping existing basements for non-residential purposes, new electrical circuitry installed at a higher level with power cables being carried down from the ceiling rather than up from the floor level to minimise damage if the development floods

8.6 Reducing flood risk from other sources

8.6.1 Groundwater

Groundwater flooding has a very different flood mechanism to any other and for this reason many conventional flood defence and mitigation methods are not suitable. The only way to fully reduce flood risk would be through building design (development form), ensuring floor levels are raised above the water levels caused by a 1% AEP plus climate change event, or where high ground water levels are known. Site design would also need to preserve any flow routes followed by the groundwater overland to ensure flood risk is not increased downstream.

Infiltration SuDS can replenish groundwater supplies from which drinking water is obtained. However, the potential increased in groundwater levels may also increase flood risk on or off of the site. Developers should provide evidence and ensure that this will not be a significant risk.

When redeveloping existing buildings, it may be acceptable to install pumps in basements as a resilience measure. However, for new development this is not considered an acceptable solution.

8.6.2 Surface water and sewer flooding

Developers should discuss public sewerage capacity with the water utility company at the earliest possible stage. It is important that a surface water drainage strategy shows that development will not make the risk worse, increase flood risk elsewhere, and that the drainage requirements regarding runoff rates and SuDS for new development are met.

If residual surface water flood risk remains, the likely flow routes and depths across the site should be modelled. The site should be designed so that these flow routes are preserved and building design should provide resilience against this residual risk.

When redeveloping existing buildings, the installation of some permanent or temporary flood-proofing and resilience measures could protect against both surface water and sewer flooding. Non-return valves prevent water entering the property from drains and sewers, providing they are maintained appropriately. Non-return valves can be installed within gravity sewers or drains within a property's private sewer upstream of the public sewerage system. These need to be carefully installed and must be regularly, and appropriately, maintained. Consideration must also be given to attenuation and flow ensuring that flows during the 100-year plus climate change storm event are retained within the site if any flap valves shut. This must be demonstrated with suitable modelling techniques.

8.6.3 Sustainable Drainage Systems

Sustainable Drainage Systems (SuDS) aim to mimic the natural processes of Greenfield surface water drainage by encouraging water to flow along natural flow routes and thereby reduce runoff rates and volumes during storm events while providing some water treatment benefits. SuDS also have the advantage of provided effective Blue and Green infrastructure and ecological and public amenity benefits when designed and maintained properly.

The inclusion of SuDS within developments should be seen as an opportunity to enhance ecological and amenity value, and promote Green Infrastructure, incorporating above ground facilities into the development landscape strategy. SuDS must be considered at the outset, during preparation of the initial site conceptual layout to ensure that enough land is given to design spaces that will be an asset to the development rather than an after-thought. Advice on best practice is available from the Environment Agency and the Construction Industry Research and Information Association (CIRIA).

More detailed guidance on the use of SuDS is providing in Section 9.

9 Surface water management and SuDS

9.1 What is meant by Surface Water Flooding?

Surface water flooding describes flooding from sewers, drains, and ditches that occurs during heavy rainfall.

Surface water flooding includes

- **pluvial flooding:** flooding as a result of high intensity rainfall when water is ponding or flowing over the ground surface (overland surface runoff) before it either enters the underground drainage network or watercourse or cannot enter it because the network is full to capacity;
- **sewer flooding:** flooding that occurs when the capacity of underground water conveyance systems is exceeded, resulting in flooding inside and outside of buildings. Normal discharge of sewers and drains through outfalls may be impeded by high water levels in receiving waters which may cause water to back up and flood on the urban surface. Sewer flooding can also arise from operational issues such as blockages or collapses of parts of the sewer network; and
- **overland flows entering the built up area from the rural/urban fringe:** includes overland flows originating from groundwater springs.

9.2 Role of the LLFA and Local Planning Authority in surface water management

From April 2015 local planning policies and decisions on planning applications relating to major development should ensure that SuDS for management of run-off are put in place. The approval of SuDS lies with the Local Planning Authority.

In April 2015 Cambridgeshire County Council was made a statutory consultee on the management of surface water and, as a result, will be required to provide technical advice on surface water drainage strategies and designs put forward for major development proposals.

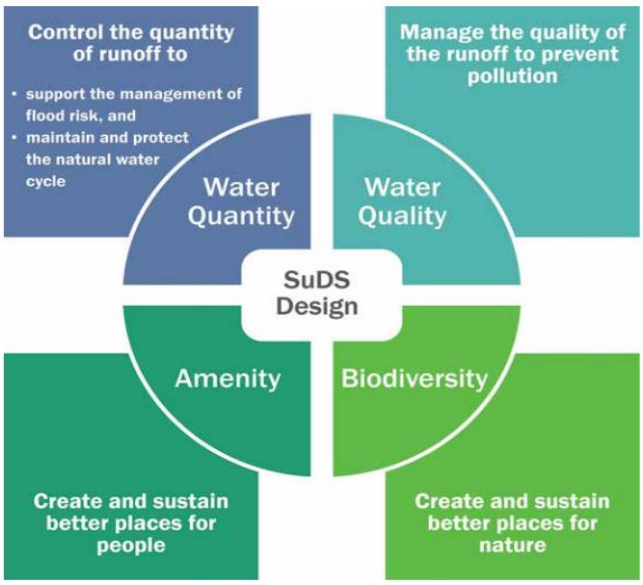
Major developments are defined as

- residential development: 10 dwellings or more, or residential development with a site area of 0.5 hectares or more where the number of dwellings is not yet known; and
- non-residential development: provision of a building or buildings where the total floor space to be created is 1,000 square metres or more or, where the floor area is not yet known, a site area of one hectare or more.

When considering planning applications, East Cambridgeshire District Council will seek advice from the relevant flood risk management bodies, principally Cambridgeshire County Council on the management of surface water, will satisfy themselves that the development's proposed minimum standards of operation are appropriate and ensure, through the use of planning conditions or planning obligations, that there are clear arrangements for on-going maintenance over the development's lifetime. Judgement on what SuDS system would be reasonably practicable will be through reference to Defra's Non-Statutory Technical Standards for SuDS and the Cambridgeshire Flood and Water SPD and will take into account design and construction costs.

It is essential that developers consider sustainable drainage at an early stage of the development process – ideally at the master-planning stage. This will assist with the delivery of well designed, appropriate and effective SuDS. Proposals should also comply with the key SuDS principles regarding solutions that deliver multiple long-term benefits. These four principles are shown in Figure 9-1.

Figure 9-1: Four principles of SuDS design



Source: The SuDS Manual (C753)

9.3 Sustainable Drainage Systems (SuDS)

Sustainable Drainage Systems (SuDS) are designed to maximise the opportunities and benefits that can be secured from surface water management practices.

SuDS provide a means of dealing with the quantity and quality of surface water whilst offering additional benefits over traditional systems of improving amenity and biodiversity. The correct use of SuDS can also allow developments to counteract the negative impact that urbanisation has on the water cycle by promoting infiltration and replenishing ground water supplies. SuDS if properly designed can improve the quality of life within a development offering addition benefits such as:

- Improving air quality
- Regulating building temperatures
- Reducing noise
- Providing education opportunities
- Cost benefits over underground piped systems

Given the flexible nature of SuDS they can be used in most situations within new developments as well as being retrofitted into existing developments. SuDS can also be designed to fit into the majority of spaces. For example, permeable paving could be used in parking spaces or rainwater gardens into traffic calming measures.

It is a requirement for all new major development proposals to ensure that sustainable drainage systems for management of runoff are put in place. Likewise, minor developments should also ensure sustainable systems for runoff management are provided. The developer is responsible for ensuring the design, construction and future/ongoing maintenance of such a scheme is carefully and clearly defined, and a clear and comprehensive understanding of the existing catchment hydrological processes and existing drainage arrangements is essential.

9.3.1 Types of SuDS Systems

There are many different SuDS components that can be implemented in attempts to mimic pre-development drainage (Table 9-1). The suitability of the techniques will be dictated in part by the development proposal and site conditions. Advice on best practice is available from the Environment Agency and the Construction Industry Research and Information Association (CIRIA) e.g. the CIRIA SuDS Manual C753 (2015).

Cambridgeshire County Council has produced SuDS guidance which includes information on different types of SuDS systems detailing practical issues, solutions and design considerations.

Table 9-1: Examples of SuDS components and potential benefits

SuDS Technique	Flood Reduction	Water Quality Treatment & Enhancement	Landscape and Wildlife Benefit
Living roofs	✓	✓	✓
Basins and ponds	✓	✓	✓
Constructed wetlands	✓	✓	✓
Balancing ponds	✓	✓	✓
Detention basins	✓	✓	✓
Retention ponds	✓	✓	✓
Filter strips and swales	✓	✓	✓
Infiltration devices	✓	✓	✓
Soakaways	✓	✓	✓
Infiltration trenches and basins	✓	✓	✓
Permeable surfaces and filter drains	✓	✓	
Gravelled areas	✓	✓	
Solid paving blocks	✓	✓	
Porous pavements	✓	✓	
Tanked systems	✓		
Over-sized pipes/tanks	✓		
Storm cells	✓		

9.3.2 Treatment

A key part of the four pillars of SuDS is to provide the maximum improvement to water quality through the use of the "SuDS management train". To maximise the treatment within SuDS, CIRIA recommends the following good practice is implemented in the treatment process:

1. **Manage surface water runoff close to source:** This makes treatment easier due to the slower velocities and also helps isolate incidents rather than transport pollutants over a large area.
2. **Treat surface water runoff on the surface:** This allows treatment performance to be more easily inspected and managed. Sources of pollution and potential flood risk is also more easily identified. It also helps with future maintenance work and identifying damaged or failed features.
3. **Treat a range of contaminants:** SuDS should be chosen and designed to deal with the likely contaminants from a development and be able to reduce them to acceptably low levels.
4. **Minimise the risk of sediment remobilisation:** SuDS should be designed to prevent sediments being washed into receiving water bodies or systems during events greater than what the feature may have been designed.
5. **Minimise the impact of spill:** Designing SuDS to be able to trap spills close to the source or provide robust treatment along several features in series.

The number of treatment stages required depends primarily on the source of the runoff. A drainage strategy will need to demonstrate that an appropriate number of treatment stages are delivered. Further information on treatment stages is provided in Section 6.3 the Cambridgeshire Flood and Water SPD.

9.3.3 SuDS Management

SuDS components should not be used individually but as a series of features in an interconnected system designed to capture water at the source and convey it to a discharge

location. SuDS components should be selected based on design criteria and how surface water management is to be integrated within the development and landscaping setting. By using a number of SuDS components in series it is possible to reduce the flow and volume of runoff as it passes through the system as well as minimising pollutants which may be generated by a development. Further information on SuDS management is provided in Section 6.3 the Cambridgeshire Flood and Water SPD.

9.3.4 Overcoming SuDS constraints

The design of a SuDS system will be influenced by a number of physical and policy constraints. These should be taken into account and reflected upon during the conceptual, outline and detailed stages of SuDS design. Table 9-2 details some possible constraints and how they may be overcome and includes information from both the SuDS Manual (C753) and the Cambridgeshire Flood and Water SPD. Guidance should also be sought from the Environment Agency.

Table 9-2: Example SuDS constraints and possible solutions

Constraint	Solution
Land availability	SuDS can be designed to fit into small areas by utilising different systems. For example, features such as permeable paving and green roofs can be used in urban areas where space may be limited.
Contaminated soil or groundwater below site	SuDS can be placed and designed to overcome issues with contaminated groundwater or soil. Shallow surface SuDS can be used to minimise disturbance to the underlying soil. The use of infiltration should also be investigated as it may be possible in some locations within the site. If infiltration is not possible linings can be used with features to prevent infiltration.
High groundwater levels	Non-infiltrating features can be used. Features can be lined with an impermeable liner or clay to prevent the egress of water into the feature. Additional, shallow features can be utilised which are above the groundwater table.
Steep slopes	Check dams can be used to slow flows. Additionally, features can form a terraced system with additional SuDS components such as ponds used to slow flows.
Shallow slopes	Use of shallow surface features to allow a sufficient gradient. If the gradient is still too shallow pumped systems can be considered as a last resort.
Ground instability	Geotechnical site investigation should be done to determine the extent of unstable soil and indicate whether infiltration would be suitable or not.
Sites with deep backfill	Infiltration should be avoided unless the soil can be demonstrated to be sufficiently compacted. Some features such as swales are more adaptable to potential surface settlement.
Open space in floodplain zones	Design decisions should take into account the likely high groundwater table and possible high flows and water levels. Features should also seek to not reduce the capacity of the floodplain and take into consideration the influence that a watercourse may have on a system. Factors such as siltation after a flood event should also be taken into account during the design phase.
Future adoption and maintenance	Local Planning Authority should ensure development proposals, through the use of planning conditions or planning obligations, have clear arrangements for on-going maintenance over the development's lifetime.

For SuDS components that are designed to encourage infiltration, it is imperative that groundwater levels are low enough and a site-specific infiltration test is conducted early on as part of the design of the development. Infiltration should be considered with caution within areas of possible subsidence or sinkholes. Where sites lie within or close to groundwater source protection zones (GSPZs) or aquifers, further restrictions may be applicable and guidance should be sought from the LLFA.

9.4 Other surface water considerations

9.4.1 Groundwater Source Protection Zones (GSPZ)

In addition to the AStGWF data the Environment Agency also defines Groundwater Source Protection Zones in the vicinity of groundwater abstraction points. These areas 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. The GSPZ requires attenuated storage of runoff to prevent infiltration and contamination. The definition of each zone is shown below:

- Zone 1 (Inner Protection Zone) – Most sensitive zone: defined as the 50-day travel time from any point below the water table to the source. This zone has a minimum radius of 50 metres
- Zone 2 (Outer Protection Zone) – Also sensitive to contamination: defined by a 400-day travel time from a point below the water table. This zone has a minimum radius around the source, depending on the size of the abstraction
- Zone 3 (Total Catchment) - Defined as the area around a source within which all groundwater recharge is presumed to be discharged at the source. In confined aquifers, the source catchment may be displaced some distance from the source. For heavily exploited aquifers, the final Source Catchment Protection Zone can be defined as the whole aquifer recharge area where the ratio of groundwater abstraction to aquifer recharge (average recharge multiplied by outcrop area) is >0.75. Individual source protection areas will still be assigned to assist operators in catchment management
- Zone 4 (Zone of special interest) – A fourth zone SPZ4 or 'Zone of Special Interest' usually represents a surface water catchment which drains into the aquifer feeding the groundwater supply (i.e. catchment draining to a disappearing stream). In the future this zone will be incorporated into one of the other zones, SPZ 1, 2 or 3, whichever is appropriate in the particular case, or become a safeguard zone.

Nine GSPZ have been identified in the East Cambridgeshire District. They are located in the following areas:

- North-east of Fordham,
- Six Mile Bottom,
- East of Stretchworth
- North of Stretchworth
- East of Newmarket
- South-east of Newmarket
- South East Cambridgeshire; Six Mile Bottom to Cheveley
- Chippenham
- South East Cambridgeshire; Bottisham, Snailwell and Kennet.

Only one GSPZ classed as Zone III is considered in the East Cambridgeshire area, although it appears as two separate ones in the map, it is shown to continue under Newmarket. The locations of the GPSZs are shown in Figure 9-2.

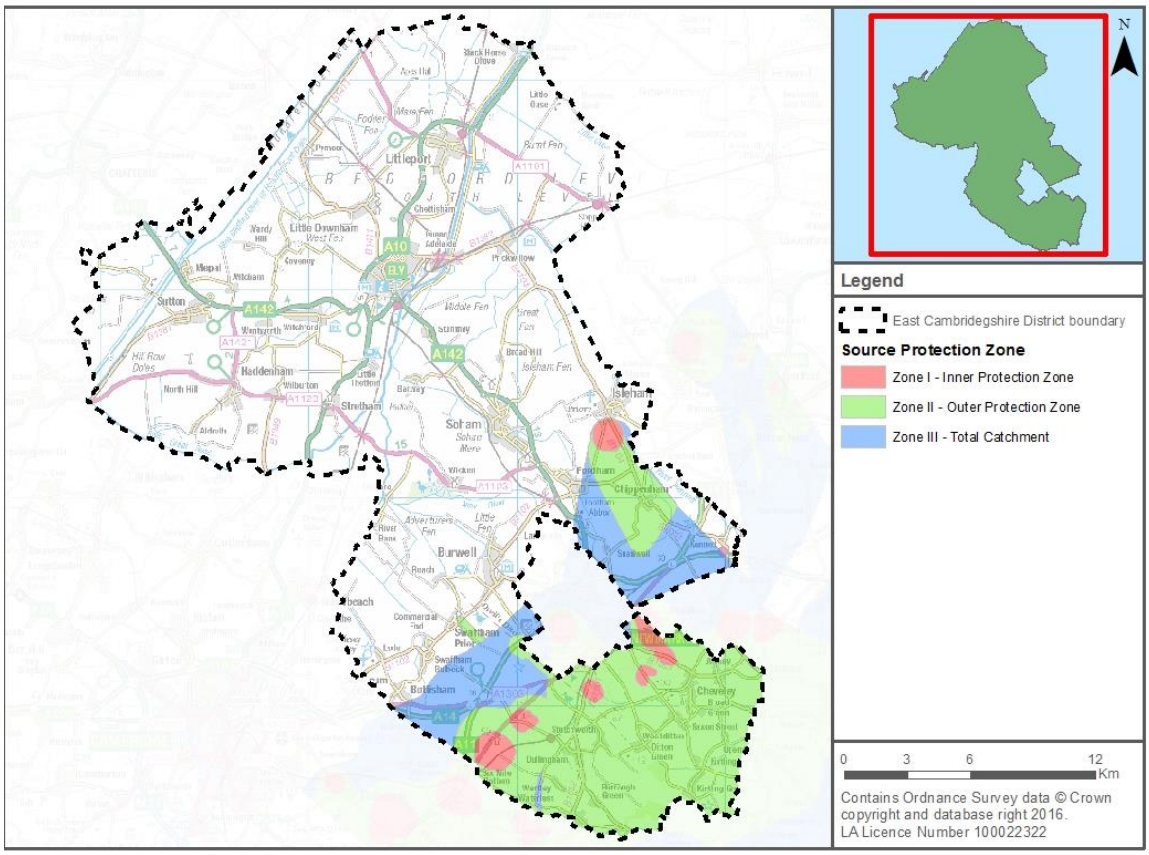
9.5 Nitrate Vulnerable Zones

Nitrate Vulnerable Zones (NVZs) are areas designated as being at risk from agricultural nitrate pollution. Nitrate levels in waterbodies are affected by surface water runoff from surrounding agricultural land entering receiving waterbodies.

The level of nitrate contamination will potentially influence the choice of SuDS and should be assessed as part of the design process.

The north and north-west part of the East Cambridgeshire District is classed as a surface water NVZ. Whereas, south-east of Soham, such as Isleham, Burwell and the rest of the District south-east of these towns, is classed as a groundwater NVZ. The area south of Haddenham, such as Aldreth and Stretham, is also classed as a groundwater NVZ.

Figure 9-2: Groundwater Source Protection Zones



9.6 Level 1 Assessment of Surface Water Flood Risk

In assessing the surface water flood risk across East Cambridgeshire, the Environment Agency's Risk of Flooding from Surface Water dataset has been used (Appendix D). These maps are intended to provide a consistent standard of assessment for surface water flood risk across England and Wales in order to help LLFAs, the Environment Agency and any potential developers to focus their management of surface water flood risk.

The Risk of Flooding from Surface Water dataset is derived primarily from identifying topographical flow paths of existing watercourses or dry valleys that contain some isolated ponding locations in low lying areas. They provide a map which displays different levels of surface water flood risk depending on the annual probability of the land in question being inundated by surface water (Table 9-3).

Table 9-3: Risk of Flooding from Surface Water dataset risk categories

Category	Definition
High	Flooding occurring as a result of rainfall with a greater than 1 in 30 chance in any given year (annual probability of flooding 3.3%)
Medium	Flooding occurring as a result of rainfall of between 1 in 100 (1%) and 1 in 30 (3.3%) chance in any given year.
Low	Flooding occurring as a result of rainfall of between 1 in 1,000 (0.1%) and 1 in 100 (1%) chance in any given year.
Very Low	Flooding occurring as a result of rainfall with less than 1 in 1,000 (0.1%) chance in any given year.

Although the Risk of Flooding from Surface Water dataset offers improvement on previously available datasets, the results should not be used to understand flood risk for individual properties. The results should be used for high level assessments such as SFRAs for local authorities. If a particular site is indicated in the Environment Agency mapping to be at risk from

surface water flooding, a more detailed assessment should be considered at a site-specific scale.

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10 Strategic flood risk solutions

10.1 Introduction

Strategic flood risk solutions may offer a potential opportunity to reduce flood risk in the District. As described in Section 2.8, East Cambridgeshire is covered by two Policy Units as part of the Great Ouse CFMP. In these Policy Units there are specific 'actions' associated to each Policy Unit to manage flood risk in the area. Those relevant to East Cambridgeshire, in relation to strategic flood risk mitigation, are:

- Continue with, and implement, the recommendations from the Great Ouse Tidal River Strategy.
- Ensure any policies within the Local Development Framework, or any revisions, are in line with the CFMP policy.
- Continue with, and implement, the recommendations of the Earith to Mepal Area action plan along with the Cranbrook / Counter Drain flood risk management strategy.
- Investigate opportunities to reduce current levels of flood risk management on the Main Rivers in the Bedford Ouse Rural and Eastern Rivers sub-area.
- Continue with, and implement, the recommendations from the Cambridgeshire County Council Surface Water Management Scoping Study.
- Ensure that opportunities are taken within minerals and waste development/ action plans to use mineral extraction sites to store flood water.
- Produce land management plans to explore opportunities to change land use and develop sustainable land use management practices.

The following sections outline different options which could be considered for strategic flood risk solutions, followed by detail on specific East Cambridgeshire schemes and partnerships.

Water Framework Directive considerations are also covered in Section 7 of the Cambridgeshire Flood and Water SPD.

10.2 Flood storage schemes

Flood storage schemes aim to reduce the flows passed downriver to mitigate downstream flooding. Development increases the impermeable area within a catchment, creating additional and faster runoff into watercourses. Flood storage schemes aim to detain this additional runoff, releasing it downstream at a slower rate, to avoid any increase in flood depths and/or frequency downstream. Methods to provide these schemes include[9]:

- enlarging the river channel;
- raising the riverbanks; and/or
- constructing flood banks set back from the river.

Flood storage schemes have the advantage that they generally benefit areas downstream, not just the local area.

The construction of new upstream storage schemes as part of upstream catchment-based approaches within East Cambridgeshire could provide one potential strategic solution to flood risk. Watercourses which are rural in their upper reaches but have high levels of flood risk to urban areas in the downstream reaches are potential candidates, as the open land in the upper reaches can potentially provide the space for an attenuation area, providing benefit to the urban area downstream.

10.2.1 Promotion of SuDS

Surface water flood risk is present in East Cambridgeshire. By considering SuDS at an early stage in the development of a site, the risk from surface water can be mitigated to a certain extent within the site as well as reduce the risk that the site poses to third party land. Regionally SuDS should be promoted on all new developments to ensure the quantity and quality of surface water is dealt with sustainably to reduce flood risk. Given the detailed policies and guidance produced by Cambridgeshire County Council (summarised in Chapter 9), this should actively

9 http://evidence.environment-agency.gov.uk/FCERM/en/FluvialDesignGuide/Chapter10.aspx?pagenum=2

promote developers to use this information to produce technically proficient and sustainable drainage solutions.

10.3 Catchment and Floodplain restoration

Compared to flood defences and flood storage, floodplain restoration represents the most sustainable form of strategic flood risk solution, by allowing watercourses to return to a more naturalised state, and by creating space for naturally functioning floodplains working with natural processes.

Although the restoration of floodplain is difficult in previously developed areas where development cannot be rolled back, the following measures should be adopted:

- Promoting existing and future brownfield sites that are adjacent to watercourses to naturalise banks as much as possible. Buffer areas around watercourses provide an opportunity to restore parts of the floodplain
- Removal of redundant structures to reconnect the river and the floodplain. There are a number of culverted sections of watercourse located throughout the district which if returned to a more natural state would potentially reduce flood risk to the local area
- Apply the Sequential Approach to avoid new development within currently undefended floodplain

For those sites considered within the Local Plan and / or put forward by developers, that also have watercourses flowing through or past them, the sequential approach should be used to locate development away from these watercourses. This will ensure the watercourses retain their connectivity to the floodplain. Loss of floodplain connectivity in rural upper reaches of tributaries which flow through urban areas in the District, could potentially increase flooding within the urban areas. This will also negate any need to build flood defences within the sites. It is acknowledged that sites located on the fringes of urban areas within the District are likely to have limited opportunity to restore floodplain in previously developed areas.

10.3.1 Upstream natural catchment management

Essentially, opportunities to work with natural processes to reduce flood and erosion risk, benefit the natural environment and reduce costs of schemes should be sought, requiring integrated catchment management and involving those who use and shape the land. It also requires partnership working with neighbouring authorities, organisations and water management bodies.

Conventional flood prevention schemes listed above will likely still be preferred, but consideration of ‘re-wilding’ rivers upstream could provide cost efficiencies as well as considering multiple sources of flood risk; for example, reducing peak flows upstream such as through felling trees into streams or building earth banks to capture runoff, could be cheaper and smaller-scale measures than implementing flood walls for example. With flood prevention schemes, consideration needs to be given to the impact that flood prevention has on the WFD status of watercourses. It is important that any potential schemes do not have a negative impact on the ecological and chemical status of waterbodies.

10.3.2 Structure Removal and / or modification (e.g. weirs)

Structures, both within watercourses and adjacent to them can have significant impacts upon rivers including, alterations to the geomorphology and hydraulics of the channel through water impoundment and altering sediment transfer regime, which over time can significantly impact the channel profile including bed and bank levels, alterations to flow regime and interruption of biological connectivity, including the passage of fish and invertebrates.

Many artificial in-channel structures (examples include weirs and culverts) are often redundant and / or serve little purpose and opportunities exist to remove them where feasible. The need to do this is heightened by climate change, for which restoring natural river processes, habitats and connectivity are vital adaptation measures. However, it also must be recognised that some artificial structures may have important functions or historical/cultural associations, which need to be considered carefully when planning and designing restoration work.

In the case of weirs, whilst weir removal should be investigated in the first instance, in some cases it may be necessary to modify a weir rather than remove it. For example, by lowering the weir crest level or adding a fish pass. This will allow more natural water level variations upstream of the weir and remove a barrier to fish migration.

Further information is provided in the 'Trash and Security Screen Guide 2009'[10], published by the Environment Agency/ Defra, which should be used as evidence for any culvert assessment, improvement or structure retention.

10.3.3 Bank Stabilisation

It is generally recommended that bank erosion is avoided where possible and encourage all landowners to avoid using machinery and vehicles close to or within the watercourse.

There are a number of techniques that can be employed to restrict the erosion of the banks of a watercourse. In an area where bankside erosion is particularly bad and/or vegetation is unable to properly establish, ecologically sensitive bank stabilisation techniques, such as willow spiling, can be particularly effective. Live willow stakes thrive in the moist environment and protect the soils from further erosion allowing other vegetation to establish and protect the soils.

10.3.4 Bank removal, set back and / or increased easement

The removal or realignment of flood embankments and walls can allow the natural interrelationship between the river channel and the floodplain to be reinstated. This can be achieved at a small scale within urban areas providing pockets of attractive green spaces along rivers, whilst also improving floodplain storage within confined urban environments at times of flooding.

A detailed assessment would need to be undertaken to gain a greater understanding of the response to the channel modification, including flood risk analysis to investigate flood risk impacts.

An assessment of formal flood defences has been undertaken as part of this SFRA. All formal defences have a role in reducing flood risk, and therefore opportunities for bank removal, set back and / or increased easement will be limited. However, there may be informal artificial structures (embankments, walls) or defences within the district which are now redundant.

10.3.5 Re-naturalisation

There is potential to re-naturalise a watercourse by re-profiling the channel, removing hard defences, re-connecting the channel with its floodplain and introducing a more natural morphology (particularly in instances where a watercourse has historically been modified through hard bed modification). Detailed assessments and planning would need to be undertaken to gain a greater understanding of the response to any proposed channel modification.

10.4 Flood defences

There are a number of formal flood defences within East Cambridgeshire (see Chapter 7 for further information).

Flood mitigation measures should only be considered if, after application of the Sequential Approach, development sites cannot be located away from higher risk areas. If defences are constructed to protect a development site, it will need be demonstrated that the defences will not have a resulting negative impact on flood risk elsewhere, and that there is no net loss in floodplain storage.

10 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/291172/scho1109brhf-e-e.pdf

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11 Level 1 assessment of potential development sites

11.1 Introduction

A number of potential development sites were provided by East Cambridgeshire District Council. These sites were screened against a suite of available flood risk information and spatial data to provide a summary of risk to each site. Indication is provided on the proportion of a given site affected by levels and types of flood risk, along with whether historic incidences of flooding have occurred.

The information provided is intended to enable a more informed consideration of the sites using the sequential approach.

11.2 Sequential testing

Table 11-1 summarises the flood risk to the supplied development sites. The majority of the sites are predominantly located within Flood Zone 1 or have a relatively small proportion of the site area within the Flood Zones. Surface water flooding is shown to be a risk to the majority of sites.

Inclusion of these sites in the SFRA does not mean that development can be permitted without further consideration of the Sequential Test. The required evidence should be prepared as part of a Local Plan Sustainability Appraisal or alternatively, it can be demonstrated through a free-standing document, or as part of strategic housing land or employment land availability assessments. NPPF Planning Practice Guidance for Flood Risk and Coastal Change describes how the Sequential Test should be applied in the preparation of a Local Plan. The assessments undertaken for this SFRA will assist the council when they undertake the Sequential Test.

Table 11-1: Summary of flood risk to potential development sites

Site Code	Site name	Area (ha)	Proportion of site shown to be at risk (%)								Located in an area benefitting from defences	Area of site outside of Flood Zones (ha)
			Flood Zones				Flood Risk from Surface Water dataset			Historic Flood Map		
			FZ3b	FZ3a	FZ2	FZ1	30yr	100yr	1,000yr			
Site/18/01	Old Station Goods Yard	1.07	0%	0%	0%	100%	0%	0%	0%	0%		1.07
Site/12/01	Hinton Hedges Road	1.58	0%	0%	0%	100%	6%	8%	8%	0%		1.58
Site/13/01	Beck Road	1.07	0%	0%	0%	100%	0%	1%	2%	0%		1.07
Site/17/01	Fish & Duck Marina	35.98	5%	47%	2%	46%	1%	1%	6%	0%	Yes	16.51
Site/12/02	De-Freville Farmyard	2.12	0%	0%	0%	100%	0%	0%	6%	0%		2.12
Site/12/03	Land south of Aldreth Road	0.28	0%	0%	0%	100%	0%	0%	8%	0%		0.28
Site/34/01	Land south of Sutton Road, Witchford	1.39	0%	0%	0%	100%	7%	6%	14%	0%		1.39
Site/31/01	Land south of Chapel Lane, Wicken	0.76	0%	0%	0%	100%	0%	1%	2%	0%		0.76
Site/08/01	Land east of Main Street, Coveney	1.91	0%	0%	0%	100%	0%	0%	0%	0%		1.91
Site/23/01	South west of the Shade, Soham	11.12	0%	0%	0%	100%	0%	0%	2%	0%		11.12
Site/16/01	Land west of Ely Road, Little Downham	1.20	0%	0%	0%	100%	3%	1%	3%	0%		1.20
Site/16/02	Land off Ely Road, (GA Hobbs & Sons Depot) Little Downham	1.87	0%	0%	0%	100%	3%	4%	15%	0%		1.87
Site/26/01	Land off Brick Lane, Mepal	2.80	0%	0%	0%	100%	2%	1%	5%	0%		2.80
Site/10/01	Lancaster Way Business Park	30.22	0%	0%	0%	100%	2%	2%	10%	0%		30.22
Site/10/02	Land south east of Lancaster Way Business Park	38.62	0%	0%	0%	100%	0%	0%	2%	0%		38.62
Site/10/03	Land south of Lancaster Way Business Park and ELY11 0 Phase IIIa Extension	23.43	0%	0%	0%	100%	1%	1%	5%	0%		23.43
Site/10/04	Land south of Lancaster Way Business Park - Phase IIIb Extension	10.85	0%	0%	0%	100%	0%	0%	2%	0%		10.85
Site/01/01	Land to the south and east of Elms Farm, Ashley	4.30	0%	0%	0%	100%	0%	1%	3%	0%		4.30
Site/01/02	Land to the north of Potters House, Ashley	1.68	0%	0%	0%	100%	1%	1%	2%	0%		1.68
Site/31/02	Back Lane, Wicken	0.91	0%	0%	0%	100%	0%	0%	6%	0%		0.91
Site/12/05	Metcalfe Way	1.82	0%	0%	0%	100%	0%	0%	2%	0%		1.82
Site/34/02	Land west of Mills Lane, Witchford	5.15	0%	0%	0%	100%	0%	0%	5%	0%		5.15
Site/11/02	Land at 5 Station Road, Fordham	1.56	0%	0%	0%	100%	0%	0%	1%	0%		1.56
Site/11/01	Land south of Fordham Road, Fordham	2.67	0%	0%	0%	100%	0%	0%	0%	0%		2.67
Site/11/03	Land off Soham Road	2.31	0%	0%	0%	100%	0%	0%	1%	0%		2.31
Site/12/04	Land adjacent to 4a High Street, Aldreth, Ely, Cambridgeshire, CB6 3PQ	0.55	0%	0%	0%	100%	0%	0%	1%	0%		0.55
Site/16/03	Land adjacent to School Lane, Pymoor	0.60	0%	0%	0%	100%	0%	0%	3%	0%		0.60
Site/23/02	Land north of Cherry Tree Lane, Soham	16.55	0%	0%	0%	100%	2%	2%	8%	0%		16.55
Site/23/03	Land south of Cherry Tree Lane, Soham	10.33	0%	0%	0%	100%	1%	0%	3%	0%		10.33
Site/23/04	LP15 allocation SOH1, Brook St, Soham	22.80	54%	14%	2%	30%	0%	3%	15%	0%	Yes	6.80
Site/11/04	Rules Garden	0.66	0%	0%	0%	100%	0%	0%	0%	0%		0.66
Site/10/05	Orwell Pit Farm	124.19	0%	0%	0%	100%	8%	3%	6%	0%		124.19
Site/18/02	Land off Mow Fen Drove	3.88	0%	98%	2%	0%	0%	0%	2%	0%	Yes	0.00
Site/28/01	Part of Dale Field	0.97	0%	0%	0%	100%	0%	0%	3%	0%		0.97
Site/12/06	Land to the east of Chewells Lane, Haddenham	1.59	0%	0%	0%	100%	0%	0%	2%	0%		1.59
Site/12/07	Residential development at land off Hod Hall Lane, Haddenham, Ely, Cambridgeshire, CB6 3UX	0.19	0%	0%	0%	100%	0%	0%	5%	0%		0.19
Site/10/06	Queen Adelaide South	1.96	0%	92%	1%	7%	7%	48%	24%	0%	Yes	0.14
Site/12/08	Land at Hinton Hall Farm	8.36	0%	0%	0%	100%	0%	0%	0%	0%		8.36
Site/18/03	Land to the south of Grange Lane, Littleport	26.09	0%	0%	0%	100%	1%	1%	5%	0%		26.09
Site/18/04	Land to the north of Oak Lane, Littleport	6.06	0%	0%	0%	100%	1%	1%	5%	0%		6.06
Site/18/05	Land to the east of A10 and north of Blackbank Drove, Littleport	6.26	0%	100%	0%	0%	0%	3%	29%	0%	Yes	0.00
Site/24/01	Stetchworth Park Stud	15.87	0%	0%	0%	100%	0%	0%	7%	0%		15.87
Site/34/03	Land at Witchford	39.61	0%	0%	0%	100%	1%	3%	11%	0%		39.61
Site/13/02	Land adjacent to Hall Barn Road Industrial Estate	0.77	0%	0%	0%	100%	0%	0%	0%	0%		0.77
Site/18/06	FP McCann Phase 2	10.01	0%	93%	3%	3%	1%	1%	3%	0%	Yes	0.35
Site/18/07	Land to the south of Croft Park Road, Littleport	0.59	0%	0%	0%	100%	6%	5%	9%	0%		0.59
Site/07/01	Land at Grange Farm, Red Lodge, Suffolk IP28 8LE	17.93	11%	4%	4%	81%	0%	1%	2%	0%		14.56
Site/17/02	The Wyches, Little Thetford	0.81	0%	0%	0%	100%	0%	0%	0%	0%		0.81
Site/31/03	Land off Hawes Lane, Wicken	2.35	0%	0%	0%	100%	0%	0%	3%	0%		2.35
Site/11/05	Land east of 67 Mildenhall Road	6.90	0%	0%	0%	100%	0%	0%	0%	0%		6.90
Site/08/02	Land off School Lane, Coveney	1.60	0%	71%	5%	24%	10%	14%	16%	0%	Yes	0.38
Site/10/07	Queen Adelaide North	2.51	0%	96%	1%	3%	43%	33%	18%	0%	Yes	0.07
Site/10/08	Queen Adelaide Farmland	20.55	0%	58%	2%	40%	28%	8%	9%	0%	Yes	8.15

Site Code	Site name	Area (ha)	Proportion of site shown to be at risk (%)								Located in an area benefitting from defences	Area of site outside of Flood Zones (ha)
			Flood Zones				Flood Risk from Surface Water dataset			Historic Flood Map		
			FZ3b	FZ3a	FZ2	FZ1	30yr	100yr	1,000yr			
Site/05/01	Low Road, Burwell	2.25	0%	0%	0%	100%	0%	0%	1%	0%		2.25
Site/05/02	Land lying to the North-East of Factory Road, Burwell, Cambridge	0.68	0%	16%	18%	66%	0%	3%	4%	0%	Yes	0.45
Site/10/09(i)	Greenacre Farm 1) West of Beald Drove; & East of Beald Drove	9.39	0%	0%	0%	100%	5%	4%	7%	0%		9.39
Site/10/09(ii)	Greenacre Farm 1) West of Beald Drove; & East of Beald Drove	6.33	0%	17%	10%	73%	11%	10%	9%	0%	Yes	4.61
Site/10/10	Greenacre Farm (North)	7.78	0%	0%	0%	100%	8%	7%	23%	0%		7.78
Site/18/08	Land west of Ely Road and south of Grange Lane, Littleport	32.38	0%	0%	0%	100%	0%	0%	6%	0%		32.38
Site/19/01	Sunny Ridge Farmyard	0.64	0%	0%	0%	100%	0%	0%	1%	0%		0.64
Site/19/02	Former Lode Station Yard	1.70	0%	0%	6%	94%	0%	0%	0%	0%		1.60
Site/11/06	Land south of Mildenhall Road / East of Chippenham Road, Fordham	2.08	0%	0%	0%	100%	0%	0%	1%	0%		2.08
Site/18/09	Land to west of A10, Littleport	4.19	0%	73%	3%	24%	0%	0%	2%	0%	Yes	1.02
Site/18/10	Housing/employment allocation, west of Woodfen Road	17.28	0%	4%	2%	94%	1%	6%	21%	0%	Yes	16.22
Site/04/01	Land off Brinkley Road, Burrough Green	0.36	0%	0%	0%	100%	0%	0%	0%	0%		0.36
Site/23/05	Parcels A and B	1.68	0%	0%	0%	100%	1%	1%	60%	0%		1.68
Site/05/03	Land at Reach Road	2.82	0%	17%	4%	79%	0%	1%	8%	0%	Yes	2.23
Site/09/01	Land south of Stetchworth Road, Dullingham	3.89	0%	28%	6%	66%	19%	4%	10%	0%		2.57
Site/26/02	Land off Station Road, Sutton	0.38	0%	0%	0%	100%	0%	0%	3%	0%		0.38
Site/34/04	Land adjacent to Mills Barn, Mills Lane, Witchford, Ely, Cambridgeshire, CB26 2FA	0.32	0%	0%	0%	100%	0%	0%	5%	0%		0.32
Site/27/01	Land off Heath Rad and Quarry Lane, Swaffham Bulbeck	4.96	0%	0%	0%	100%	0%	0%	2%	0%		4.96
Site/02/01	Land off High Street, Bottisham	8.35	0%	0%	0%	100%	0%	0%	2%	0%		8.35
Site/25/01	Land to the north of Berry Close, Stretham	2.76	0%	0%	0%	100%	0%	1%	4%	0%		2.76
Site/26/03	Land off The Row/The America	0.84	0%	0%	0%	100%	0%	0%	2%	0%		0.84
Site/10/11	The Grange	0.61	0%	0%	0%	100%	6%	1%	9%	0%		0.61
Site/10/12	Paradise Area	1.04	0%	0%	0%	100%	0%	0%	3%	0%		1.04
Site/13/03	Land off Fordham Road, Isleham	8.26	0%	0%	0%	100%	0%	0%	0%	0%		8.26
Site/23/06	Land north of Blackberry Lane, Soham	6.27	26%	17%	1%	57%	0%	0%	8%	0%	Yes	3.57
Site/23/07	Land at the Shade, Soham	25.19	0%	0%	0%	100%	3%	2%	16%	0%		25.19
Site/16/04	Rec Field	1.57	0%	0%	0%	100%	0%	0%	1%	0%		1.57
Site/34/05	Land south of Marroway Lane	2.24	0%	0%	0%	100%	1%	2%	14%	0%		2.24
Site/11/07	Land south of Mildenhall Lane	4.41	0%	0%	0%	100%	0%	0%	2%	0%		4.41
Site/34/06	Main Street, Witchford	3.06	0%	0%	0%	100%	3%	3%	9%	0%		3.06
Site/18/11	Eastfield Farm	23.18	0%	0%	0%	100%	1%	1%	5%	0%		23.18
Site/26/04	Land east of Garden Close, Sutton	1.83	0%	0%	0%	100%	0%	0%	5%	0%		1.83
Site/14/01	Wildtracks Offroad Activity Park	20.61	0%	0%	0%	100%	0%	0%	3%	0%		20.61
Site/34/07	Land south of Main Street, Witchford	2.07	0%	0%	0%	100%	0%	1%	5%	0%		2.07
Site/23/08	Land south of Blackberry Lane	6.98	0%	15%	0%	84%	0%	0%	10%	0%		5.89
Site/26/05	Land off Mepal Road, Sutton	18.26	0%	0%	0%	100%	1%	1%	5%	0%		18.26
Site/23/09	Land adjacent to The Shade, Soham	1.71	0%	0%	0%	100%	1%	1%	8%	0%		1.71
Site/23/10	Land adjacent to The Shade, Soham	2.06	0%	0%	0%	100%	0%	1%	5%	0%		2.06
Site/26/06	Land off A142, Sutton	11.38	0%	0%	0%	100%	1%	2%	4%	0%		11.38
Site/32/01	Land west of Clarke's Lane and south of Hinton Way, Wilburton	1.35	0%	0%	0%	100%	0%	0%	3%	0%		1.35
Site/14/02	Land to the east of Station Road	1.42	0%	0%	0%	100%	0%	0%	0%	0%		1.42
Site/14/03	Land to the south of Longstones Stud stable buildings	1.75	0%	0%	0%	100%	0%	0%	0%	0%		1.75
Site/18/12	Land west of Highfields, Littleport	28.85	0%	0%	0%	100%	0%	1%	6%	0%		28.85
Site/12/09	Anson Packaging Site	1.55	0%	0%	0%	100%	0%	0%	4%	0%		1.55
Site/26/07	Land north of Ely Road	8.35	0%	0%	0%	100%	2%	2%	11%	0%		8.35
Site/07/02	Land off Scotland End, Chippenham	0.52	0%	0%	0%	100%	0%	0%	0%	0%		0.52
Site/22/01	Land south of Chippenham Road, Snailwell	0.74	0%	0%	0%	100%	0%	0%	0%	0%		0.74
Site/22/02	Land north of Chippenham Road, Snailwell	0.99	0%	0%	0%	100%	0%	0%	0%	0%		0.99
Site/29/01	Main Street, Wentworth	0.59	0%	0%	0%	100%	0%	0%	2%	0%		0.59
Site/17/03	Land south of Popes Lane, Little Thetford	3.40	0%	26%	5%	69%	1%	2%	4%	0%	Yes	2.35
Site/12/10	Land off Bury Lane	1.68	0%	0%	0%	100%	0%	0%	0%	0%		1.68
Site/32/02	Land off Townsend Mews, Stretham Road, Wilburton	2.91	0%	0%	0%	100%	0%	0%	0%	0%		2.91
Site/11/08	Land adjoining 19 Station Road, Fordham,	0.16	0%	0%	0%	100%	0%	0%	0%	0%		0.16
Site/02/02	Bell Road, Bottisham	2.15	0%	0%	0%	100%	0%	1%	3%	0%		2.15
Site/02/03	West of Bell Road, Bottisham	3.78	0%	0%	0%	100%	0%	0%	1%	0%		3.78
Site/02/04	Land east of Bell Road, Bottisham	0.97	0%	0%	0%	100%	0%	0%	0%	0%		0.97

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			FZ3b	FZ3a	FZ2	FZ1	30yr	100yr	1,000yr			
Site/10/13	Land to the north of Ely	215.83	0%	0%	0%	100%	3%	1%	7%	0%		215.83
Site/26/08	East of Bury Lane, Sutton	6.57	0%	0%	0%	100%	3%	0%	5%	0%		6.57
Site/14/04	Land to the rear of 42 Station Road, Kennett	0.78	0%	0%	0%	100%	0%	0%	0%	0%		0.78
Site/23/11	Downfields, Soham	15.58	0%	0%	0%	100%	0%	0%	2%	0%		15.58
Site/20/01	North-east Mepal	3.92	0%	0%	0%	100%	3%	2%	9%	0%		3.92
Site/20/02	Land to the west of Mepal Church	3.04	6%	0%	0%	94%	1%	1%	12%	0%		2.87
Site/10/14	Land to the south of Ely golf club and to the east of Cambridge Road	9.54	0%	0%	0%	100%	0%	0%	2%	0%		9.54
Site/10/15	Land to the south of Witchford Road, Ely	17.14	0%	0%	0%	100%	8%	3%	6%	0%		17.14
Site/11/09	Land at and adjoining Scotsdale Garden Centre, Fordham	13.23	0%	0%	0%	100%	0%	0%	1%	0%		13.23
Site/05/05	Land at Ness Road, Burwell	7.74	0%	0%	0%	100%	0%	0%	1%	0%		7.74
Site/11/10	Land east of Collin's Hill	1.20	0%	0%	0%	100%	0%	1%	4%	0%		1.20
Site/34/08	Land to the east of Witchford	6.09	0%	0%	0%	100%	0%	0%	2%	0%		6.09
Site/26/09	West of Bury Lane, Sutton	6.43	0%	1%	0%	99%	0%	2%	10%	0%	Yes	6.39
Site/25/02	Reserve land, Manor Farm, Stretham	1.30	0%	0%	0%	100%	0%	0%	2%	0%		1.30
Site/23/12	Former Garden Centre site, Soham	3.83	0%	0%	0%	100%	0%	0%	15%	0%		3.83
Site/23/15	Land adjacent A142, Soham	10.84	0%	17%	2%	81%	0%	1%	7%	0%		8.79
Site/31/04	Land at Lower Road, Wicken	1.28	0%	0%	0%	100%	0%	0%	4%	0%		1.28
Site/23/13	Brook Street, Soham	17.12	54%	15%	1%	30%	0%	3%	20%	0%	Yes	5.22
Site/23/14	Northfield Road, Soham	7.81	0%	0%	0%	100%	1%	2%	18%	0%		7.81
Site/12/11	Land off Rowan Close, Haddenham	0.47	0%	0%	0%	100%	0%	0%	0%	0%		0.47
Site/25/03	Wilburton Road, Stretham	1.78	0%	0%	0%	100%	0%	0%	2%	4%		1.78
Site/11/11	Station Road, Fordham	2.41	0%	0%	0%	100%	0%	0%	6%	0%		2.41
Site/11/12	Station Road, Fordham	14.19	0%	0%	0%	100%	0%	0%	2%	0%		14.19
Site/27/02	Land off Heath Road, Swaffham Bulbeck	0.85	0%	0%	0%	100%	0%	0%	0%	0%		0.85
Site/27/03	Land off Commercial End, Swaffham Bulbeck	0.72	0%	0%	0%	100%	0%	0%	0%	0%		0.72
Site/14/05	Land to the west of Station Road, Kennett, Cambridgeshire	97.51	0%	0%	0%	100%	0%	1%	3%	0%		97.51
Site/18/13	Padnall, Littleport	1.00	0%	65%	7%	28%	0%	1%	4%	0%	Yes	0.28
Site/23/16	Land to the north of The Shade, Soham	1.44	0%	0%	0%	100%	4%	5%	25%	0%		1.44
Site/23/17	Land off Fordham Road, Soham	1.29	0%	0%	0%	100%	0%	0%	2%	0%		1.29
Site/11/13	Land fronting Soham Road and also accessed off Stewards Field	5.08	0%	0%	0%	100%	0%	0%	2%	0%		5.08
Site/13/04	Land fronting Beck Road, Isleham	1.57	0%	0%	0%	100%	0%	0%	4%	0%		1.57
Site/09/02	Former highways depot, Brinkley Road, Dullingham	0.22	0%	0%	0%	100%	0%	0%	1%	0%		0.22
Site/35/01	Land fronting Peterhouse Drive, Wooditton	0.46	0%	0%	0%	100%	0%	0%	0%	0%		0.46
Site/13/05	Land fronting Hall Barn Road, Isleham	5.10	0%	0%	0%	100%	0%	0%	1%	0%		5.10
Site/27/04	Land fronting Heath Road, Swaffham Bulbeck	0.59	0%	0%	0%	100%	0%	0%	0%	0%		0.59
Site/31/05	Land between 61 & 71 Church Road Wicken	0.32	0%	0%	0%	100%	0%	0%	3%	0%		0.32
Site/13/06	Land north of 55 Sun Street	1.88	0%	0%	0%	100%	0%	0%	1%	0%		1.88
Site/23/18	Soham Eastern Gateway (SOH3)	29.56	0%	11%	4%	85%	1%	1%	6%	0%	Yes	25.11
Site/05/04	Land at Newmarket Rd, Burwell	24.98	0%	0%	0%	100%	0%	0%	1%	0%		24.98
Site/28/02	Land at Goodwin Farm fronting Heath Road, Swaffham Prior	1.06	0%	0%	0%	100%	0%	29%	38%	0%		1.06
Site/28/03	Rogers Road	0.97	0%	0%	0%	100%	0%	0%	0%	0%		0.97
Site/16/05	Land south-west of Main Street, Pymoor	1.12	0%	100%	0%	0%	0%	1%	2%	0%	Yes	0.00
Site/16/06	Land south-east of cemetery, Little Downham	3.04	0%	0%	0%	100%	5%	1%	9%	0%		3.04
Site/32/03	Land to the south of School Lane, Wilburton	0.35	0%	0%	0%	100%	0%	0%	0%	0%		0.35
Site/32/04	Land to the north of the Bernstead off Station Road, Wilburton	2.16	0%	0%	0%	100%	3%	4%	8%	0%		2.16
Site/32/05	Land to the south of West End Road, Wilburton	0.62	0%	0%	0%	100%	0%	0%	0%	0%		0.62
Site/32/06	Land adjacent to Berristead, Wilburton	0.74	0%	0%	0%	100%	0%	2%	6%	0%		0.74
Site/32/07	Land adjacent to cemetery, Wilburton	0.16	0%	0%	0%	100%	0%	0%	6%	0%		0.16
Site/27/05	Land at Gutter Bridge	3.89	0%	34%	4%	62%	0%	0%	4%	0%		2.42
Site/16/07	Frithhead	2.22	0%	100%	0%	0%	0%	3%	6%	0%	Yes	0.00
Site/23/19	Land off Brook Street, Soham	2.91	57%	8%	0%	34%	0%	0%	2%	0%		1.00
Site/28/04	Land at Lower End, Swaffham Prior	0.33	0%	0%	0%	100%	0%	0%	0%	0%		0.33
Site/28/05	Land between High Street and B1102, Swaffham Prior	0.42	0%	0%	0%	100%	0%	0%	7%	0%		0.42
Site/13/07	Land off Hall Barn Road	0.99	0%	0%	0%	100%	0%	2%	15%	0%		0.99
Site/18/14	Hempfield	1.17	0%	0%	0%	100%	0%	2%	11%	0%		1.17
Site/23/20	Land north of Blackberry Lane	4.47	36%	23%	1%	40%	0%	0%	11%	0%		1.77

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			Flood Zones				Flood Risk from Surface Water dataset			Historic Flood Map		
			FZ3b	FZ3a	FZ2	FZ1	30yr	100yr	1,000yr			
Site/31/06	Land south of Church Road	0.25	0%	0%	0%	100%	0%	0%	4%	0%		0.25
Site/23/36	Existing housing allocation, land east of The Barn, Randalls Farm	0.32	0%	0%	0%	100%	1%	2%	4%	0%		0.32
Site/23/22	Existing housing allocation, land east of 5 Barway Road	0.32	0%	0%	0%	100%	1%	0%	10%	0%		0.32
Site/13/08	Existing housing allocation, land south and west of Lady Frances Court	0.57	0%	0%	0%	100%	0%	0%	0%	0%		0.57
Site/13/09	Existing housing allocation, land at 5a Fordham Road	0.57	0%	0%	0%	100%	0%	0%	0%	0%		0.57
Site/10/24	Existing housing allocation, land adjacent to Putney Hill Road	0.58	0%	100%	0%	0%	0%	0%	0%	0%	Yes	0.00
Site/31/07	Existing housing allocation, land north-west of The Crescent	0.27	0%	0%	0%	100%	0%	0%	6%	0%		0.27
Site/29/03	Existing housing allocation, land east of 1 Main Street	0.12	0%	0%	0%	100%	17%	7%	36%	0%		0.12
Site/29/02	Existing housing allocation, land opposite the Old Red Lion, Main Street	0.15	0%	0%	0%	100%	0%	0%	0%	0%		0.15
Site/06/01	Existing housing allocation, land rear of Star and Garter Lane	0.28	0%	0%	0%	100%	0%	0%	0%	0%		0.28
Site/06/02	Allocated site with planning permission at Land between 199 and 209 High Street	0.82	0%	0%	0%	100%	0%	0%	0%	0%		0.82
Site/16/08	Existing housing allocation, land north-east of 9 Straight Furlong	0.85	0%	100%	0%	0%	0%	0%	2%	0%	Yes	0.00
Site/12/12	Existing housing allocation, land at New Road	0.79	0%	0%	0%	100%	0%	0%	0%	0%		0.79
Site/11/15	Existing housing allocation, land between 37 and 55 Mildenhall Road	0.32	0%	0%	0%	100%	0%	0%	0%	0%		0.32
Site/11/21	Existing housing allocation, land east of 24 Mildenhall Road	0.61	0%	0%	0%	100%	0%	0%	0%	0%		0.61
Site/13/10	Existing housing allocation, land west of Pound Lane	0.32	0%	0%	0%	100%	0%	0%	1%	0%		0.32
Site/13/11	Existing housing allocation, land at Church Lane	0.40	0%	0%	0%	100%	0%	0%	1%	0%		0.40
Site/23/23	Existing housing allocation, land off Fordham Road	3.83	0%	0%	0%	100%	0%	0%	3%	0%		3.83
Site/23/24	Existing housing allocation, land adjacent to the cemetery	4.78	0%	0%	0%	100%	0%	0%	3%	0%		4.78
Site/02/05	Existing employment allocation, extension to Tunbridge Lane Business Park	0.95	0%	0%	0%	100%	0%	0%	0%	0%		0.95
Site/12/13	Existing employment allocation, land at Haddenham Business Park, Station Road	0.78	0%	0%	0%	100%	0%	0%	2%	0%		0.78
Site/18/16	Existing employment allocation, land north of Wisbech Road	4.69	0%	94%	4%	2%	2%	2%	8%	0%	Yes	0.09
Site/18/15	Existing employment allocation, land west of 150 Wisbech Road	1.52	0%	11%	8%	82%	1%	0%	2%	0%	Yes	1.24
Site/23/25	Existing employment allocation, land west of The Shade	2.79	0%	0%	0%	100%	1%	1%	46%	0%		2.79
Site/23/26	Existing employment allocation, land east of The Shade	5.24	0%	0%	0%	100%	1%	0%	4%	0%		5.24
Site/05/06	Existing allocation with planning permission at Former D S Smith Site Reach Road Burwell	3.06	0%	11%	0%	89%	0%	1%	4%	0%	Yes	2.72
Site/10/25	Existing employment allocation, Ely Road and Rail Distribution Centre	11.16	0%	0%	0%	100%	4%	2%	8%	0%		11.16
Site/11/16	Existing employment allocation, land north of Turners	8.21	0%	0%	0%	100%	0%	0%	1%	0%		8.21
Site/11/19	Existing employment allocation, land at Horse Racing Forensic Laboratories.	12.37	30%	10%	3%	58%	0%	0%	3%	0%		7.12
Site/11/18	Existing employment allocation, land north of Snailwell Road	5.54	1%	0%	0%	99%	0%	0%	2%	0%		5.51
Site/11/17	Existing employment allocation, land south of Snailwell Road	7.13	0%	0%	0%	100%	0%	0%	3%	0%		7.13
Site/11/20	Existing employment allocation, land south of Landwade Road	14.60	0%	1%	0%	99%	1%	1%	6%	0%		14.45
Site/10/18	Existing mixed-use allocation, Octagon Business Park	13.15	0%	71%	4%	25%	17%	11%	38%	0%	Yes	3.34
Site/10/19(i)	Existing mixed-use allocation, Station Gateway	11.41	0%	50%	0%	50%	9%	6%	14%	0%		5.72
Site/10/19(ii)	???	0.44	0%	50%	0%	50%	1%	5%	6%	0%		0.22
Site/23/27	Existing mixed-use allocation, land off Station Road	3.96	1%	0%	2%	97%	3%	8%	26%	0%		3.84
Site/23/28	Existing mixed-use allocation, Fountain Lane recreation ground and car park	3.17	0%	0%	0%	100%	1%	1%	6%	0%		3.17
Site/23/29	Existing mixed-use allocation, town centre, Church hall area	0.38	0%	0%	0%	100%	0%	0%	0%	0%		0.38
Site/23/30	Existing mixed-use allocation, Cooperative store area	0.28	0%	0%	0%	100%	0%	9%	12%	0%		0.28
Site/23/31	Existing mixed-use allocation, Budgens site	0.52	0%	0%	0%	100%	0%	0%	3%	0%		0.52
Site/10/21	Existing mixed-use allocation, Waitrose car park area	0.85	0%	0%	0%	100%	0%	0%	10%	0%		0.85
Site/10/22	Existing mixed-use allocation, land north of Nutholt Lane	0.34	0%	0%	0%	100%	9%	18%	11%	0%		0.34
Site/10/20	Existing leisure allocation, land at Downham Road, Ely	6.11	0%	0%	0%	100%	5%	6%	17%	0%		6.11
Site/10/23	The Gardens, Lynn Road Ely	0.45	0%	0%	0%	100%	2%	2%	7%	0%		0.45
Site/18/17	Residential development (under construction) at Highfield Farm	35.37	0%	0%	0%	100%	1%	2%	7%	0%		35.37
Site/23/32	Land rear of 48-64, Station Road, Soham	0.34	0%	0%	0%	100%	0%	0%	11%	0%		0.34
Site/23/33	Land to rear of 7 & 7A TOWNSEND, SOHAM	0.53	0%	0%	0%	100%	0%	0%	0%	0%		0.53
Site/23/34	Land Bound by Fordham Road, Staples Lane and Brook Street, Soham	2.84	0%	0%	0%	100%	0%	0%	0%	0%		2.84
Site/25/04	Land Parcel to East of Meadowcroft, Stretham	5.60	0%	0%	0%	100%	0%	0%	1%	0%		5.60
Site/33/01	Kings Of Witcham Ltd, The Slade, Witcham	0.43	0%	0%	0%	100%	9%	9%	16%	0%		0.43
Site/02/06	Crystal Park, Tunbridge Lane, Bottisham	0.79	0%	0%	0%	100%	0%	0%	0%	0%		0.79
Site/35/02	Land off Cricketfield Road	0.28	0%	0%	0%	100%	0%	0%	5%	0%		0.28
Site/23/35	90 Paddock Street, Soham	0.18	0%	0%	0%	100%	0%	0%	0%	0%		0.18
Site/34/09	Land North Of Field End, Witchford	5.18	0%	0%	0%	100%	1%	1%	13%	0%		5.18
Site/25/05	Land Formerly 21 Road, Newmarket	0.21	0%	0%	0%	100%	0%	0%	0%	0%		0.21

Site Code	Site name	Area (ha)	Proportion of site shown to be at risk (%)								Located in an area benefitting from defences	Area of site outside of Flood Zones (ha)
			Flood Zones				Flood Risk from Surface Water dataset			Historic Flood Map		
			FZ3b	FZ3a	FZ2	FZ1	30yr	100yr	1,000yr			
Site/18/18	Harvest Way, Littleport	1.36	0%	0%	0%	100%	5%	4%	30%	0%		1.36
Site/18/19	Field West Of 1B Upton Lane, Littleport	2.15	0%	0%	0%	100%	0%	0%	1%	0%		2.15
Site/18/20	Land To North East Of 5 Back Lane, Littleport	0.58	0%	36%	12%	52%	0%	0%	2%	0%	Yes	0.30
Site/25/06	Land Formerly 21 Newmarket Road Stretham	0.92	0%	0%	0%	100%	0%	0%	0%	0%		0.92
Site/12/14	Land North of Northumbria Close, Haddenham	0.72	0%	0%	0%	100%	9%	13%	62%	0%		0.72
Site/02/07	Land at Muckdungle Corner, Newmarket Road, Bottisham	0.69	0%	13%	0%	87%	0%	4%	19%	0%		0.60
Site/32/08	Land at Pony Lodge, Grunty Fen, Wilburton	0.18	0%	0%	0%	100%	3%	12%	50%	0%		0.18
Site/11/14	Land off Grove Park, Fordham	6.68	0%	6%	2%	91%	0%	0%	0%	0%	Yes	6.09
Site/10/16	Westmill Foods Site, Angel Drove	2.91	0%	0%	0%	100%	6%	5%	18%	0%		2.91
Site/10/17	Cathedral Marina	5.65	27%	0%	19%	54%	47%	9%	10%	0%		3.03
Site/23/21	Land off Station Road	1.15	1%	0%	0%	99%	6%	12%	52%	0%		1.14

12 Level 2 assessment of potential development sites

12.1 Introduction

The SFRA forms an integral part of East Cambridgeshire District Council's evidence base, in terms of identifying locations for development and preparation of flood risk policies in the Local Plan, with one of the objectives of an SFRA being to help inform site allocations so they are in accordance with the NPPF. Proposed site allocations have been provided by the Council for assessment. Following the Level 1 screening assessment, 15 sites were brought forward to undergo the Level 2 assessment.

This Level 2 SFRA assessment helps to determine variations in flood risk across the potential development sites, identifying site-specific FRA requirements and helping guide local policies to provide sustainable developments, as well as reducing flood risk to existing communities.

12.2 Site summary tables

As part of the Level 2 SFRA, detailed site summary tables have been produced for the potential development sites listed below. The summary tables can be found in Appendix G.

Table 12-1: List of Detailed Summary Tables

Site Ref	Nearest Settlement	Flood Zone Coverage (%)		OWC within 100m (Y / N)
		FZ3	FZ2	
ELY.M4	Ely	49.78%	49.78%	Yes
FRD.E1(D)	Fordham	39.44%	42.44%	Yes
FRD.E1(C)	Fordham	0.76%	1.03%	No
LIT.M1	Littleport	4.09%	6.11%	Yes
LIT.E2	Littleport	10.49%	18.09%	Yes
LIT.E1	Littleport	51.04%	58.69%	Yes
SOH.H1	Soham	69.08%	69.60%	Yes
SOH.H5	Soham	15.21%	15.68%	No
SOH.E1	Soham	17.38%	18.88%	Yes
SOH.M1	Soham	9.64%	13.33%	Yes
SOH.H6	Soham	59.35%	61.53%	Yes
SOH.M3	Soham	1.01%	2.70%	Yes
FRD.E1(G)	Fordham	3.49%	3.64%	Yes
WFD.M1	Witchford	11.26%	12.37%	Yes
LP7	Greengables	13.07%	13.07%	Yes

Where available, the results from existing detailed Environment Agency hydraulic models (Fenland and Eastern Rivers models) were used in the assessment to provide depth, velocity and hazard information.

Using the model information combined with the Flood Zones, climate change and Risk of Flooding from Surface Water (RoFfSW) extents produced for the Level 1 assessment, detailed site summary tables have been produced for the potential development sites (see Appendix G). Each table sets out the following information:

- Site area
- Current land use
- Existing drainage features
- Proportion of the site in each Flood Zone and description of fluvial flood risk
- Proportion of the site in the three RoFfSW events and description of surface water flood risk
- Whether the site would be at risk of inundation in the event of reservoir failure
- Whether the site is shown to have flooded in the past
- Description of the defence type, standard of protection and condition as well as any residual risk considerations

- Emergency planning information including whether the site is covered by a flood warning area and whether there any potential access and egress issues for the site
- What the 2080s climate change allowances are for the area and the climate change implications for the site, including the increase in the proportion of the site at risk compared to Flood Zone 3a
- A broadscale assessment of suitable SuDS techniques and considerations, including whether the site is in a source protection zone or a historic landfill site
- Information on whether the Exception Test will be required
- Requirements and guidance for site-specific flood risk assessments

12.2.1 Important note on datasets used for the summary table maps

It is important to recognise that for the SFRA, several different sets of data have been used to clarify the extent, depth, hazard and velocity for each site.

Flood zones

The extent of flooding, which determines the proportions of the site falling into the different Flood Zones, were determined from several sources:

- Flood Zone 2: based on Flood Zone 2 of the Environment Agency's Flood Map for Planning
- Flood Zone 3a: based on Flood Zone 3 of the Environment Agency's Flood Map for Planning
- Flood Zone 3b: derived from the 1 in 20-year results from Environment Agency detailed hydraulic models

Depth, velocity and hazard

Depth, velocity and hazard mapping for the 1 in 100-year event (Flood Zone 3a) have been taken from the Environment Agency's Fenland and Eastern Rivers detailed defended hydraulic models.

Climate change

Climate change extents are taken from the outlines produced for the Level 1 assessment. This involved the upscaling the 100-year event from existing defended hydraulic models for the relevant climate change allowance for the 2080s epoch.

12.2.2 Sites discounted from the Level 2 assessment

Several sites have been discounted from the Level 2 assessment on the following grounds:

- BUR.E1 - site is in the process of going through a planning application. Additionally, there is no detailed modelling available and 2D modelling techniques are not suitable in this area.
- ELY.M1 - site has been through previous planning applications with no issues relating to flooding. Additionally, there is no detailed modelling available and 2D modelling techniques are not suitable in this area.
- LTT.H1 - site is in the process of going through a planning application. Additionally, there is no detailed modelling available and 2D modelling techniques are not suitable in this area.
- WTM.H1 - site has planning permission. Additionally, there is no detailed modelling available and 2D modelling techniques are not suitable in this area.
- SUT.E1, WFD.E1 and WFD.H2: there are no detailed models covering these sites; however, 2D modelling techniques are not suitable in this area.

13 Summary

13.1 Overview

This Level 1 SFRA delivers a strategic assessment of risk from all sources of flooding in East Cambridgeshire. It also provides an overview of policy and provides guidance for planners and developers.

13.2 Sources of flood risk

- Flood history shows that East Cambridgeshire has been subject to flooding from several sources of flood risk, with the principal risk from fluvial sources.
- The key watercourses flowing through the study area are the Bedford River / Great Ouse system which comprises of the Old West, the River Ten Mile/ Ely Ouse, the two Bedford cut-off channels (Old Bedford River/ River Delph and the New Bedford River / Hundred Foot Drain) which form the Ouse Washes and were created as part of flood alleviation for the Fens, and tributaries, including the Little Ouse river. Another main watercourse in the District is the River Lark. The River Cam and its tributaries including the Cambridgeshire Lodes; Bottisham Lode, Swaffham Lode, Reach Lode, Burwell Lode, Soham Lode, Monks Lode, also flow through the study area. The majority of recorded fluvial flood events are associated with the River Great Ouse and its tributaries but there are numerous unnamed drains and Ordinary Watercourses also within East Cambridgeshire, many of which rely on pumping stations to drain the low-lying, flat expanses of the Fenlands.
- The main urban areas of Ely and Littleport are located along the Ely Ouse, with the towns of Burwell and Soham within close proximity to the Cambridgeshire Lodes. However, the main urban areas are located on higher ground, placing them mostly outside of the floodplains of the main watercourses.
- Other than these higher urban areas, the East Cambridgeshire District consists largely of low-lying fenland with multiple drainage networks. The District is largely pumped and reliant on flood defences, creating a significant residual risk if the defences were to fail. A high number of flood defences are present in the District, although their condition varies between very poor and very good.
- East Cambridgeshire is partially covered by the low-lying Middle Level. Watercourses in this area fall under the authority of the Middle Level Commissioners and associated IDBs. The watercourses in the Middle Level are managed for water level and flood risk management and the Commissioners and IDBs aim to provide a general standard of protection of 1% and 2-3% AEP respectively, although there may be areas where the standard of protection is lower due to local circumstances.
- East Cambridgeshire is also covered by the Ely Group of IDBs, which aim to provide a general standard of protection of 1% for developed areas and 5% for agricultural land, although there may be areas where the standard of protection is lower due to local circumstances, notably in the pumped drainage basins.
- East Cambridgeshire has experienced historic surface water / drainage related flood events caused by a number of mechanisms from insufficient storm and combined drainage capacity to poor surface water management. The Risk of Flooding from Surface Water dataset further shows a number of prominent overland flow routes; these predominantly follow topographical flow paths of existing watercourses or dry valleys with some isolated ponding located in low lying areas. In addition, a number of these follow local road infrastructure.
- The sewers are managed by Anglian Water. T The company's sewer flooding register was requested but not provided at the time of publication.
- There are no records of flooding from reservoirs impacting properties inside the study area. The level and standard of inspection and maintenance required under the Act means that the risk of flooding from reservoirs is relatively low.

13.3 Key policies

There are a number of relevant regional and local flood risk strategic documents and policies which have been considered within the SFRA, such as the Cambridgeshire Flood and Water Supplementary Planning Document (SPD), Catchment Flood Management Plan (CFMP), River

Basin Flood Risk Management Plan (FRMP), the Preliminary Flood Risk Assessment (PFRA) and Local Flood Risk Management Strategy (LFRMS). Other policy considerations have also been incorporated, such as sustainable development principles, climate change and flood risk management.

13.4 Development and flood risk

The Sequential and Exception Test procedures for both Local Plans and FRAs have been documented, along with guidance for planners and developers. Links have been provided for various guidance documents and policies published by other Risk Management Authorities such as the LLFA and the Environment Agency.

13.5 Defences

A review of existing flood defences was undertaken and found a number of formal defences in the study area. Defences consist of flood walls and embankments, with most along the Ten Mile / Ely Ouse and along the Bedford Rivers provide protection against a 1% AEP event. Defences are also located around the Cambridgeshire Lodes, although standard of protection varies with parts of the defences providing protection against 10%, 2%, and 1% events. Defences are located on the Main Rivers throughout the District.

13.6 Level 1 site screening

Potential development sites within the study area were screened against flood risk information to identify sites which would potentially need to be taken forward to a Level 2 SFRA.

Of the 231 potential development sites

- 183 sites are entirely within Flood Zone 1
- 45 sites are partially located within Flood Zone 3
- 2 sites are partially located within Flood Zone 2
- Of the 183 sites that are 100% in Flood Zone 1:
    - 52 sites are partially located within the 30-year surface water flood extents
    - 15 sites are partially located within the 100-year surface water flood extent
    - 71 sites are partially located within the 1000-year surface water flood extent
    - 45 sites are not at risk from surface water flooding

13.7 Level 2 assessment of proposed allocation sites

As part of the Level 2 SFRA, detailed site summary tables have been produced for each of the potential development sites taken forward from the Level 1 assessment.

The summary tables set out the flood risk to each site, including maps of extent, depth and velocity of flooding as well as hazard mapping. Each table also sets out the flood risk implications for the site, as well as guidance for site-specific FRAs. A broadscale assessment of possible SuDS constraints has also been provided, giving an indication where there may be constraints to certain sets of SuDS techniques.

13.7.1 Key Site Issues

- For all sites, with the exception of LIT.E1, SOH. H1 and SOH. H6, the majority of the sites are located within Flood Zone 1.
- All sites are at least partially located within Flood Zone 3a. Sites located at least partially within Flood Zone 3b include:
    - ELY.M4,
    - FRD.E1(D),
    - FRD. E1(C),
    - SOH. H1,
    - SOH.H5,
    - SOH.H6,
    - SOH.M3, and
    - FRD. E1(G)

- The following sites are at least partially located within IDBs:
    - LIT.M1
    - LIT.E2
    - LIT.E1
    - SOH.H1
    - SOH.E1
    - SOH.M1
    - SOH.H6
    - WFD.M1
- Development in the near vicinity of a watercourse within an IDB area will require the consent of the relevant IDB.
- It is recommended that detailed hydraulic modelling is undertaken by the developer on the ordinary watercourse that flows up to site LP7's southern boundary before entering into a culvert. This should also assess the risk posed by a blockage.
- All sites have been identified as having surface water flood risk issues. In the 30-year surface water event, all sites except SOH.H5, SOH.H6 and LP7 are affected to some degree by surface water flooding.
- Climate change mapping indicates that the depths, velocities and hazard of flooding may increase as a result of climate change. The significance of the increase tends to depend on the topography of site and the percentage allowance used.
- Four sites are located in Groundwater SPZs (FRD.E1(D), FRD.E1(C), FRD.E1(G) and LP7). This means that special consideration needs to be taken with SuDS. A suitable level of treatment should be ensured prior to discharging, along with establishing an understanding of constraints to sites and how SuDS can be designed to overcome these from relevant bodies (e.g. LLFA).
- A strategic assessment was conducted of SuDS options using regional datasets. Therefore, a detailed site-specific assessment of suitable SuDS techniques would need to be undertaken to understand which SuDS option would be best.
- Many of the proposed allocation sites benefit from the formal flood defences which are currently present within East Cambridgeshire. Flood mitigation measures should only be considered if, after a sequential approach, development sites cannot be located further away from high risk areas.
- For a number of sites, there is the potential for safe access and egress to be impacted by fluvial or surface water flooding. Consideration should be made to these sites to how safe access and egress can be provided during high rainfall events.

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14 Recommendations

A review of national and local policies has been conducted against the information collated on flood risk in this SFRA. Following this, several recommendations have been made for the Council to consider as part of Flood Risk Management in East Cambridgeshire.

14.1 Development control

14.1.1 Sequential approach to development

The NPPF supports a risk-based and sequential approach to development and flood risk in England, so that development is located in the lowest flood risk areas where possible; it is recommended that this approach is adopted for all future developments within the district.

New development and re-development of land should wherever possible seek opportunities to reduce overall level of flood risk at the site, for example by:

- Reducing volume and rate of runoff through the use of SuDS, as informed by national and local guidance
- Relocating development to zones with lower flood risk
- Creating space for flooding
- Green Infrastructure should be considered within the mitigation measures for surface water runoff from potential development and consider using Flood Zones 2 and 3 as public open space.

14.1.2 Cumulative impact of development and cross-boundary issues

The cumulative impact of development should be considered at the planning application and development design stages and the appropriate mitigation measures undertaken to ensure flood risk is not exacerbated, and in many cases the development should be used to improve the flood risk

Development control should ensure that the impact on receiving watercourses from development in Cambridgeshire has been sufficiently considered during the planning stages and appropriate mitigation measures put in place to ensure there is no adverse impact on flood risk or water quality, both within East Cambridgeshire and the wider area.

14.1.3 Sequential and Exception tests

Flood Zones show that areas of East Cambridgeshire are at high risk of flooding from fluvial sources; however, the area is also largely protected through a series of defences, therefore much of the risk is residual. If the defences along the main watercourses were to fail, there may be a high risk of flooding to developments within the floodplain. There is also risk of flooding from surface water sources. Therefore, a large number of proposed development sites will be required to pass the Sequential and, where necessary, Exception Tests in accordance with the NPPF. East Cambridgeshire District Council should use the information in this SFRA when deciding which development sites to take forward in their Local Plan.

Developers should consult with East Cambridgeshire District Council, Cambridgeshire County Council, the Environment Agency, Anglian Water and, where necessary, relevant IDBs at an early stage to discuss flood risk including requirements for site-specific FRAs, detailed hydraulic modelling, and drainage assessment and design.

14.1.4 Site-specific flood risk assessments

Developers should, where required, undertake more detailed hydrological and hydraulic assessments of the watercourses to verify flood extent (including latest climate change allowances), inform development zoning within the site and prove, if required, whether the Exception Test can be passed. Where a site-specific FRA has produced modelling outlines which differ from the Flood Map for Planning then a full evidence based review would be required; where this is acceptable to the EA then amendments to the Flood Map for Planning may take place. Where the watercourses are embanked, the effect of overtopping and breach must be considered an appropriately assessed.

All new development within the 1% AEP flood extent including an allowance for climate change (for the lifetime of the development) must not result in a net loss of flood storage capacity.

Where possible, opportunities should be sought to achieve an increase in the provision of floodplain storage. Where proposed development results in a change in building footprint, the developer should ensure that it does not impact upon the ability of the floodplain to store or convey water, and seek opportunities to provide floodplain betterment. Similarly, where ground levels are elevated to raise the development out of the floodplain, compensatory floodplain storage within areas that currently lie outside the floodplain should be provided to ensure that the total volume of the floodplain storage is not reduced.

Planning applicants should also consult with the Environment Agency, LLFA, relevant IDB (if in IDB district) and Anglian Water at an early stage to discuss FRA and/or consent requirements.

14.1.5 Residual risk

The risk to development from reservoirs is residual but developers should consider reservoir flooding during the planning stage. They should seek to contact the reservoir owner to obtain information and should apply the sequential approach to locating development within the site. Developers should also consult with relevant authorities regarding emergency plans in case of reservoir breach

Developers should include an assessment of the residual risk where developments are located in areas benefitting from defences. They should consider both the impact of breach, including the effect on safe access and egress, as well as potential for flood risk to increase in the future due to overtopping. Any improvements to defences should ensure they are in keeping with wider catchment policy.

14.1.6 Drainage strategies and SuDS

- Planners should be aware of the conditions for surface water management and ensure development proposals and applications are compliant with policy. SuDS are approved as part of the planning application for a development. It is the Local Planning Authority's (LPA) responsibility to ensure that the design submitted as part of either an outline or full planning application is robust and contains adequate detail to ensure that the SuDS are appropriate for the development and will be adequately maintained throughout their lifetime. The LPA may also seek expert advice from the LLFA as part of this process.
- A surface water drainage strategy is required to be submitted with a planning application which should contain details of the SuDS. Its scope should be commensurate with the size of development and can range from a paragraph describing the proposed drainage measures with a discharge location for residential extension, to extensive hydrological modelling accompanied by a full report with drawings for a larger site. Section 6.7 of the Cambridgeshire Flood and Water SPD provides further information on developing a surface water drainage strategy.
- The residual risk and maintenance of sustainable drainage and surface water systems must be clearly set out as part of a drainage strategy. Initial agreements should be in place to cover management funding for the lifetime of the development. Section 6.9 of the Cambridgeshire Flood and Water SPD provides further information on adoption and maintenance of SuDS.
- SuDS should be designed by a competent design team that works together from the outset to deliver a successful scheme. In many cases, overall costs savings can be realised where multiple benefits such as improved open spaces, recreational areas and surface water drainage function in one area. Principles governing SuDS design in East Cambridgeshire are discussed in Section 6.3 of the Cambridgeshire Flood and Water SPD.

14.1.7 Windfall sites

Windfall sites are sites that have not been specifically identified in the Local Plan, that do not have planning permission and have unexpectedly become available. Local authorities are expected to make a realistic allowance for windfall development based on past trends.

Should East Cambridgeshire District Council adopt a windfall policy, the acceptability of windfall applications in flood risk areas should be considered at the strategic level through a policy setting out broad locations and quantities of windfall development that would be acceptable or not in Sequential Test terms.

In the event of there being no windfall policy, it may be possible for the local authority to apply the Sequential Test taking into account reasonably available sites, historic windfall rates and their distribution across the District relative to Flood Zones[11].

14.1.8 Council review of planning applications

The Council should consult the Environment Agency's 'Flood Risk Standing Advice (FRSA) for Local Planning Authorities', last updated 15 April 2015, when reviewing planning applications for proposed developments at risk of flooding, as well as the Cambridgeshire Flood and Water SPD. The Council will consult the relevant statutory consultees as part of the planning application assessment and they may, in some cases, also contact non-statutory consultees (e.g. IDBs or Anglian Water) that have an interest in the planning application.

14.2 Infrastructure and Access

Safe access and egress will need to be demonstrated at all development sites; the development should be above the 1 in 100-year flood level, plus an allowance for climate change, and emergency vehicular access should be possible during times of flood. Finished Floor Levels should be above the 1 in 100-year (1% AEP) flood level, plus an allowance for climate change.

Where development is located behind, or in an area benefitting from, defences, consideration should be given to the potential for safe access and egress in the event of rapid inundation of water due to a defence breach with little warning.

14.3 Future flood management in East Cambridgeshire

14.3.1 Flood defences

Developers should include an assessment of the residual risk where developments are located in areas benefitting from defences. They should consider both the impact of breach, including the effect on safe access and egress, as well as potential for flood risk to increase in the future due to overtopping. Any improvements to defences should ensure they are in keeping with wider catchment policy.

14.3.2 Strategic catchment-wide solutions

Flood storage

The construction of new upstream storage schemes as part of upstream catchment-based approaches. Watercourses which are rural in their upper reaches but have high levels of flood risk to urban areas in the downstream reaches are potential candidates, as the open land in the upper reaches can potentially provide the space for an attenuation area, providing benefit to the urban area downstream. It should be noted that often such schemes are driven by requirements outlined by the LLFA and the Environment Agency.

Floodplain restoration

Floodplain restoration represents the most sustainable form of strategic flood risk solution, by allowing watercourses to return to a more naturalised state, for example by bank stabilisation, re-naturalisation, structure removal/ modification and enhancing outfalls in the riparian environment.

14.4 Use of SFRA data

It is important to recognise that the SFRA has been developed using the best available information at the time of preparation. This relates both to the current risk of flooding from rivers, and the potential impacts of future climate change.

The Environment Agency regularly reviews their flood risk mapping, and it is important that they are approached to determine whether updated (more accurate) information is available prior to commencing a site-specific FRA.

The SFRA should be **periodically updated** when new information on flood risk, flood warning or new planning guidance or legislation becomes available. New information on flood risk may be provided by East Cambridgeshire District Council, Cambridgeshire County Council (in its role as LLFA), the Highways Authority, the MLCs and IDBs, Anglian Water or the Environment Agency.

[11]http://webarchive.nationalarchives.gov.uk/20140328084622/http:/www.environment-agency.gov.uk/static/documents/Sequential_test_process_4.pdf

It is recommended that the SFRA is reviewed internally on an annual basis, allowing a cycle of review, followed by checking with the above bodies for any new information to allow a periodic update.

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Appendices

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A Watercourses in East Cambridgeshire

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B Flood Zone mapping

The flood zone maps show the extents of Flood Zones 1, 2 3a and 3b in East Cambridgeshire. The flood zones are defined as follows:

Zone 1: Comprised of land having a less than 1 in 1,000 annual probability of river or sea flooding in any year.

Zone 2: Comprised of land having between a 1 in 100 and a 1 in 1,000 annual probability of river flooding or 1 in 200 and 1 in 1,000 annual probability of sea flooding in any year.

Zone 3a: Comprised of land assessed as having a greater than 1 in 100 annual probability of river flooding or a greater than 1 in 200 annual probability of flooding from the sea in any year.

Zone 3b: Comprised of land where water has to flow or be stored in times of flood (the functional floodplain). The SFRA identified this Flood Zone as land which would flood with an annual probability of 1 in 20 years, where detailed hydraulic modelling exists.

In the absence of detailed hydraulic model information, a precautionary approach should be adopted for Flood Zone 3b with the assumption that the extent of Flood Zone 3b would be equal to Flood Zone 3a. If development is shown to be in Flood Zone 3a, further work should be undertaken as part of a detailed site-specific Flood Risk Assessment to define the extent of Flood Zone 3b.

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C Climate change mapping

The climate change maps show the potential impacts that climate change may have on river flows and, subsequently, on flood events. Where models exist in East Cambridgeshire, the following climate change allowances have been applied – 25%, 35% and 65%.

Where modelling output is not available, the Environment Agency's flood zones can provide some indication of areas where rare, more extreme flows might affect the floodplain extents, by comparing Flood Zone 3a with Flood Zone 2.

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D Surface water mapping

The Risk of Flooding from Surface Water dataset maps show the flooding that takes place from the 'surface runoff' generated by rainwater (including snow and other precipitation) which: (a) is on the surface of the ground (whether or not it is moving), and

(b) has not yet entered a watercourse, drainage system or public sewer.

The Risk of Flooding from Surface Water dataset will pick out natural drainage channels, rivers, low areas in the floodplain and flow paths between buildings but it will only indicate flooding caused by local rainfall.

The Risk of Flooding from Surface Water dataset shows predictions of flooded area but does not show whether individual properties will be affected by surface water flooding or have been affected in the past. The Risk of Flooding from Surface Water dataset should not be used to predict if individual properties will flood.

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E Groundwater mapping

The Areas Susceptible to Groundwater Flooding (AStGWF) maps are a set of strategic maps which show groundwater flood areas on a 1km square grid. The data was produced to annotate indicative Flood Risk Areas for Preliminary Flood Risk Assessment (PFRA) studies and allow the Lead Local Flood Authorities (LLFAs) to determine whether there may be a risk of flooding from groundwater.

This data shows the proportion of each 1km grid square where geological and hydrogeological condition show that groundwater might emerge. It does not show the likelihood of groundwater flooding occurring. It does not take account of the chance of flooding from groundwater rebound. This dataset covers a large area of land, and only isolated locations within the overall susceptible area are actually likely to suffer the consequences of ground water flooding.

The AStGWF data should only be used in combination with other information, for example local data or historical data. It should not be used as sole evidence for any specific flood risk management, land use planning or other decisions at any scale. However, the data can help to identify areas for assessment at a local scale where finer resolution datasets exist.

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F Level 2 Detailed Site Summary Tables

Detailed site summary tables have been created for the 15 sites that were taken forward to undergo a Level 2 assessment.

Where available, the results from existing detailed Environment Agency hydraulic models (Fenland and Eastern Rivers models) were used in the assessment to provide depth, velocity and hazard information.

Using the model information combined with the Flood Zones, climate change and Risk of Flooding from Surface Water (RoFfSW) extents produced for the Level 1 assessment, detailed site summary tables have been produced for the potential development sites (see Appendix G). Each table sets out the following information:

- Site area
- Current land use
- Existing drainage features
- Proportion of the site in each Flood Zone and description of fluvial flood risk
- Proportion of the site in the three RoFfSW events and description of surface water flood risk
- Whether the site would be at risk of inundation in the event of reservoir failure
- Whether the site is shown to have flooded in the past
- Description of the defence type, standard of protection and condition as well as any residual risk considerations
- Emergency planning information including whether the site is covered by a flood warning area and whether there any potential access and egress issues for the site
- What the 2080s climate change allowances are for the area and the climate change implications for the site, including the increase in the proportion of the site at risk compared to Flood Zone 3a
- A broad scale assessment of suitable SuDS techniques and considerations, including whether the site is in a source protection zone or a historic landfill site
- Information on whether the Exception Test will be required
- Requirements and guidance for site-specific flood risk assessments

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G Level 2 Flood Risk to Site GeoPDF Mapping

Each site taken forward to undergo a Level 2 assessment has had a GeoPDF map created to display available layers of flood risk data against the site boundary and background mapping.

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