URS

Epping Forest District Council

Level 1 Strategic Flood Risk Assessment Update

Final Report

August 2015

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Prepared for:

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REVISION SCHEDULE					
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EXECUTIVE SUMMARY

AECOM Infrastructure & Environment UK Limited ("AECOM", formerly URS) has been commissioned to assist Epping Forest District Council (EFDC) with the preparation of its Level 1 Strategic Flood Risk Assessment (SFRA) Update.

The original Level 1 SFRA, produced in March 2011, is to be updated to take account of amended and additional legislation, planning policy and strategies that have since emerged and which are relevant to the study area, such as the National Planning Policy Framework (NPPF) and Planning Practice Guidance (PGG). The SFRA Update also takes account of new and amended datasets such as the Environment Agency's updated Flood Map for Surface Water (uFMfSW) and the British Geological Survey (BGS) Infiltration Sustainable Drainage System (SuDS) Suitability Map.

The SFRA Update will be used by EFDC to gain an understanding of the flood risk within the district at a strategic-level and to carry out the Sequential Test to allocate future development within the district. Flood risk evidence within this SFRA Update will also underpin relevant planning policy. Finally, the SFRA Update provides guidance to potential developers looking to deliver a site-specific Flood Risk Assessment (FRA) to support a planning application, including the use of SuDS.

The district includes a number of large main rivers and associated tributaries such as the River Lee, River Roding, Nazeing Brook, Cobbins Brook and Cripsey Brook. Waltham Abbey, Nazeing and Lower Nazeing are identified as major fluvial flood risk areas within the district. The SFRA Update also identifies other areas within the district located within fluvial Flood Zones 2 and 3 and discusses the potential impact of climate change on future fluvial flood risk.

In addition to fluvial flood risk, the SFRA Update also presents relevant information relating to flooding from surface water, groundwater, sewers and artificial sources.

Flood risk management measures and policy considerations specific to EFDC are presented in the SFRA Update, with the aim of reducing, where possible, the probability and consequences of future flooding in the district. EFDC is a predominantly rural area, with approximately 92% of its area located within the Metropolitan Green Belt. Future development, particularly that located on greenfield land, has the potential to increase surface water flooding as a result of increasing impermeable surface area. The SFRA Update provides further guidance on EFDC's proactive approach towards surface water flood risk management, setting out when and where proposed development should be accompanied by a site-specific FRA and surface water management strategy.

The primary objective of the study is to enable EFDC to undertake sequential testing in line with the Government's principles of flood risk and planning set out in the NPPF. This will inform development of EFDC's emerging Local Plan.

The NPPF requires that all development is steered to areas of lowest flood risk where possible. Development is only permissible in areas at risk of flooding in exceptional circumstances where it can be demonstrated that there are no reasonable available sites in areas of lower risk and that the benefits of that development outweigh the risks from flooding. Such development is required to include mitigation and management measures to minimise risk to life and property should flooding occur.

The SFRA Update forms an essential reference tool providing the building blocks for future strategic planning. The core output of this study is a series of maps (included in Appendix A) which include a narrative of flood risk issues to assist EFDC to carry out the Sequential Test for potential development sites.

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ACRONYMS AND ABBREVIATIONS

ACRONYM	DEFINITION
ABD	Area benefitting from defences
AEP	Annual Exceedance Probability
ASTGWF	Areas Susceptible to Groundwater Flooding
ASTSWF	Areas Susceptible to Surface Water Flooding
AWS	Anglian Water Services
BGS	British Geological Survey
C&RT	The Canal and River Trust
CFMP	Catchment Flood Management Plan
CIL	Community Infrastructure Levy
CLG	(Department for) Communities and Local Government
Defra	Department for Environment, Flood and Rural Affairs
ECC	Essex County Council
ECPEM	Essex Civil Protection & Emergency Management
EFDC	Epping Forest District Council
ERF	Essex Resilience Forum
FCERM	Flood and Coastal Erosion Risk Management
FMfSW	Flood Map for Surface Water
FRA	Flood Risk Assessment
FRAZ	Flood Risk Assessment Zones
FRC	Flood Relief Channel
FRMP	Flood Risk Management Plan
FSA	Flood Storage Area
FWMA	Flood and Water Management Act
FRMPs	Flood Risk Management Plans
FWD	Floodline Warnings Direct
GIS	Geographical Information System
IDB	Internal Drainage Board

ACRONYM	DEFINITION
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
NPPF	National Planning Policy Framework
PPG	Planning Practice Guidance
PPS25	Planning and Policy Statement 25: Development and Flood Risk
RBD	River Basin District
RBMP	River Basin Management Plan
SA	Sustainability Appraisal
SAB	SuDS Approval Body
SFRA	Strategic Flood Risk Assessment
SuDS	Sustainable Drainage Systems
TWUL	Thames Water Utilities Limited
uFMfSW	Updated Flood Map for Surface Water

GLOSSARY

GLOSSARY	DEFINITION
Aquifer	A source of groundwater comprising water bearing rock, sand or gravel capable of yielding significant quantities of water.
Attenuation	In the context of this report - the storing of water to reduce peak discharge of water.
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.
Climate Change	Long term variations in global temperature and weather patterns caused by natural and human actions.
Culvert	A channel or pipe that carries water below the level of the ground.
DG5 Register	A water-company held register of properties which have experienced sewer flooding due to hydraulic overload, or properties which are 'at risk' of sewer flooding more frequently than once in 20 years.
Exception Test	The exception test should be applied following the application of the sequential test. Conditions need to be met before the exception test can be applied.
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 Resilience	Measures that minimise water ingress and promotes fast drying and easy cleaning, to prevent any permanent damage.
Flood Resistant	Measures to prevent flood water entering a building or damaging its fabric. This has the same meaning as flood proof.
Flood Risk	The level of flood risk is the product of the frequency or likelihood of the flood events and their consequences (such as loss, damage, harm, distress and disruption).
Flood Zone	Flood Zones show the probability of flooding, ignoring the presence of existing defences
Freeboard	Height of flood defence crest level (or building level) above designed water level
Functional Floodplain	Land where water has to flow or be stored in times of flood.
Local Development Framework (LDF)	The core of the updated planning system (introduced by the Planning and Compulsory Purchase Act 2004). The LDF comprises the Local Development Documents, including the development plan documents that expand on policies and provide greater detail. The development plan includes a core strategy, site allocations and a proposals map.
Local Planning Authority (LPA)	Body that is responsible for controlling planning and development through the planning system.
Main River	Watercourse defined on a 'Main River Map' designated by DEFRA. The Environment Agency has permissive powers to carry out flood defence works, maintenance and operational activities for Main Rivers only.
Mitigation measure	An element of development design which may be used to manage flood risk or avoid an increase in flood risk elsewhere.

GLOSSARY	DEFINITION
Residual Flood Risk	The remaining flood risk after risk reduction measures have been taken into account.
Return Period	The average time period between rainfall or flood events with the same intensity and effect.
Sequential Test	Aims to steer vulnerable development to areas of lowest flood risk.
Source Protection Zone	Defined areas in which certain types of development are restricted to ensure that groundwater sources remain free from contaminants.
Sustainable drainage systems (SuDS)	Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques.
Topographic survey	A survey of ground levels.
Watercourse	All rivers, streams, drainage ditches (i.e. ditches with outfalls and capacity to convey flow), drains, cuts, culverts and dykes that carry water.

1 INTRODUCTION AND USER GUIDE

1.1 Overview

1.1.1 AECOM Infrastructure & Environment UK Limited ("AECOM", formerly URS) has been commissioned to assist Epping Forest District Council (EFDC) with the preparation of their Strategic Flood Risk Assessment (SFRA) Update.

1.1.2 In April 2011 EFDC jointly produced a Level 1 SFRA in association with Harlow Council in accordance with Planning Policy Statement 25 (PPS25). Since the development of the original SFRA in 2011 there have been a number of changes to planning policy. New and updated flood risk datasets have also been made available since the initial SFRA in 2011.

1.1.3 The National Planning Policy Framework[1] (NPPF), which replaced PPS25, outlines that Local Plans should be supported by a Strategic Flood Risk Assessment (SFRA) and Local Planning Authorities (LPAs) should use the findings to inform strategic land use planning. Figure 1.1 overleaf, reproduced from the Planning Practice Guidance (PPG)[2], which replaced the Technical Guidance to PPS25, illustrates how flood risk should be taken into account in the preparation of the Local Plan for EFDC.

1.1.4 The purpose of the Level 1 SFRA Update is to collate and analyse the most up to date flood risk information for use by EFDC to inform the preparation of robust planning documents as part of the upcoming EFDC Local Plan. The Level 1 SFRA Update will also support prudent decision-making by Development Control officers on a day-to-day basis and support the Sustainability Appraisal.

1.1.5 In order to achieve this, the Level 1 SFRA Update will be delivered to provide a flood risk evidence base, thereby allowing EFDC to apply the Sequential Test in the allocation of future development sites within the district, as required by the NPPF, taking into account all sources of flooding. AECOM will prepare the Level 1 SFRA Update in such a way that it will provide relevant and easily accessible information for applicants preparing site-specific flood risk assessments (FRAs), as well as provide guidance on the suitability of different types of Sustainable Drainage Systems (SuDS) throughout the district.

1.1.6 It is important to note that the Level 1 SFRA Update is a high level strategic document aimed at informing local plans and policies. It covers the whole district and as such it is not possible, nor is it the purpose of the Level 1 SFRA Update, to go into detail on an individual site scale.

[1] Department for Communities and Local Government. 2012. National Planning Policy Framework. Available at: https://www.gov.uk/government/publications/national-planning-policy-framework--2

[2] Department for Communities and Local Government. 2014. Planning Practice Guidance: Flood Risk and Coastal Change. Available at: http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/

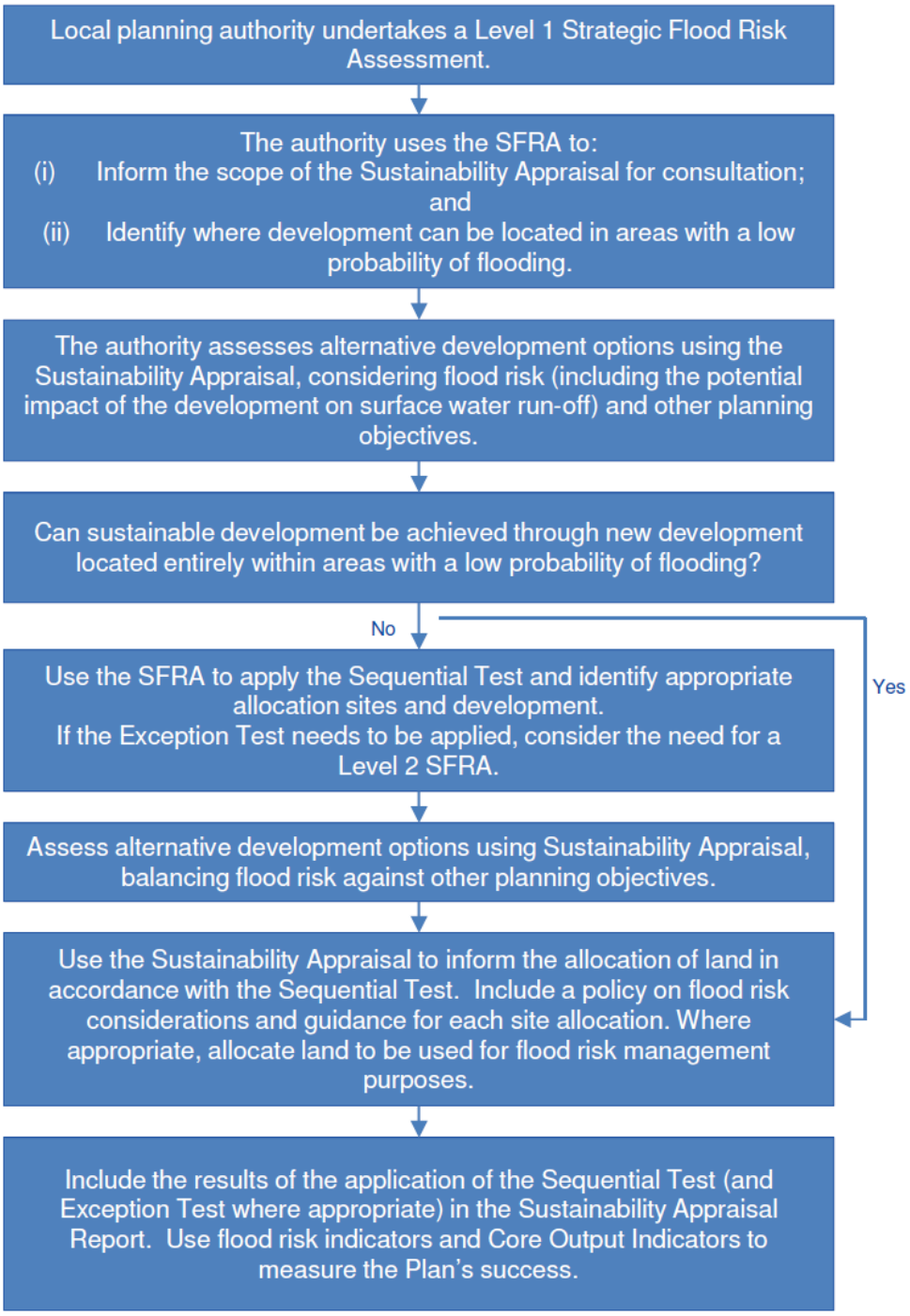

Figure 1.1 - Taking flood risk into account in the preparation of a Local Plan (Planning Practice Guidance for Flood Risk and Coastal Change, p6)

1.2 User Guide

1.2.1 It is anticipated that the Level 1 SFRA Update will have a number of end users, with slightly different requirements. This Section describes how to use the Level 1 SFRA Update and how to navigate the report and mapping deliverables.

1.2.2 The EFDC Level 1 SFRA Update report is set out as follows:

- Section 2: Study Area
- Section 3: SFRA Methodology
- Section 4: Strategic Assessment of Flood Risk
- Section 5: Policy and Local Context
- Section 6: Flood Risk Management Policy Considerations
- Section 7: Guidance on the application of the Sequential Test
- Section 8: Guidance for preparing Site Specific FRAs
- Section 9: Guidance on the application of Sustainable Drainage Systems
- Section 10: Summary and Recommendations

1.2.3 Appendix A: Flood Risk Mapping

Strategic Planning and Policy

1.2.4 The chief purpose of the Level 1 SFRA Update for EFDC, in accordance with the NPPF, is to provide a strategic overview of flood risk within the district to enable effective risk-based strategic planning for the future through the preparation of the Local Plan.

1.2.5 For those preparing site-specific FRAs for individual development sites, the strategic review provided by the SFRA provides a useful starting point for flood risk considerations. It should be noted that this document is strategic in nature and only provides an overview of flood risk within Epping Forest District (see Section 4).

1.2.6 The information presented in Section 4 should be used by EFDC to inform their knowledge of flooding and flood risk from all sources, throughout the district.

1.2.7 A number of policy options have been developed for the district and are presented in Section 6. Existing national and local policy relating to development and flood risk, as well as guidance for potential developers in the district is detailed, for example in relation to finished floor levels, emergency planning and storage of flood waters.

Applying the Sequential Test

1.2.8 The aim of the Sequential Test under the NPPF is to steer new development to areas with the lowest probability of flooding. The Sequential Test must be carried out by all LPAs as part of their site selection process. Section 7 provides detailed guidance on the application of the Sequential Test, including how it should be carried out by developers promoting development on Windfall sites. The strategic assessment of flood risk presented in Section 5 will inform the Sequential Test carried out by EFDC.

1.2.9 Section 7 provides guidance on the application of the Sequential Test for sites that have not been tested by the LPA, as well as details on when the Exception Test is required and how to apply it.

Preparing Site Specific FRAs

1.2.10 Section 8 provides specific guidance for preparing site-specific FRAs in accordance with the checklist presented in the PPG, which supports the NPPF. Recommendations are provided in Section 8 for potential mitigation and resilience measures that may need to be addressed.

Assessing Planning Applications

1.2.11 Section 8 can also be used by those assessing applications as a checklist for issues that need to be addressed as part of site-specific FRAs. Planning and development officers who are reviewing FRAs as part of the planning application process should consult Section 4 of the SFRA to provide the background for flood risk in the area relating to their planning application.

Sustainable Drainage Systems (SuDS)

1.2.12 As discussed in Section 5, EFDC will be required to oversee the use of SuDS for new development through enforcement of the planning process. Section 9 provides EFDC, as well as developers, with an overview of the potential use of infiltration SuDS within the district. Whilst this potential should be confirmed at the site-specific level through appropriate investigations, the SuDS mapping will give EFDC an indication of where infiltration SUDS are likely and where they may pose a challenge and require further assessment.

2 STUDY AREA

2.1 Overview

2.1.1 The district is located on the north eastern edge of London, in the south-western corner of the county of Essex. It is a mainly rural area with 92.4% being located within the Metropolitan Green Belt. The south-west of the district is more densely populated including Loughton, Buckhurst Hill and Chigwell. Much of the remaining population is located in the smaller towns of Epping, Waltham Abbey and Chipping Ongar. There are several villages and smaller rural settlements predominantly located towards the north of the district.

2.1.2 The district is crossed by the M11 travelling in a north - south direction and the M25 travelling in an east - west direction with an interchange located just to the south of the centre of the district. In addition, the Central Line of the London Underground network has stations at Buckhurst Hill, Loughton, Debden, Theydon Bois, Epping, Roding Valley, Chigwell and Grange Hill. The National Rail network crosses the district with a station at Roydon, located on the Cambridge to Liverpool Street main line.

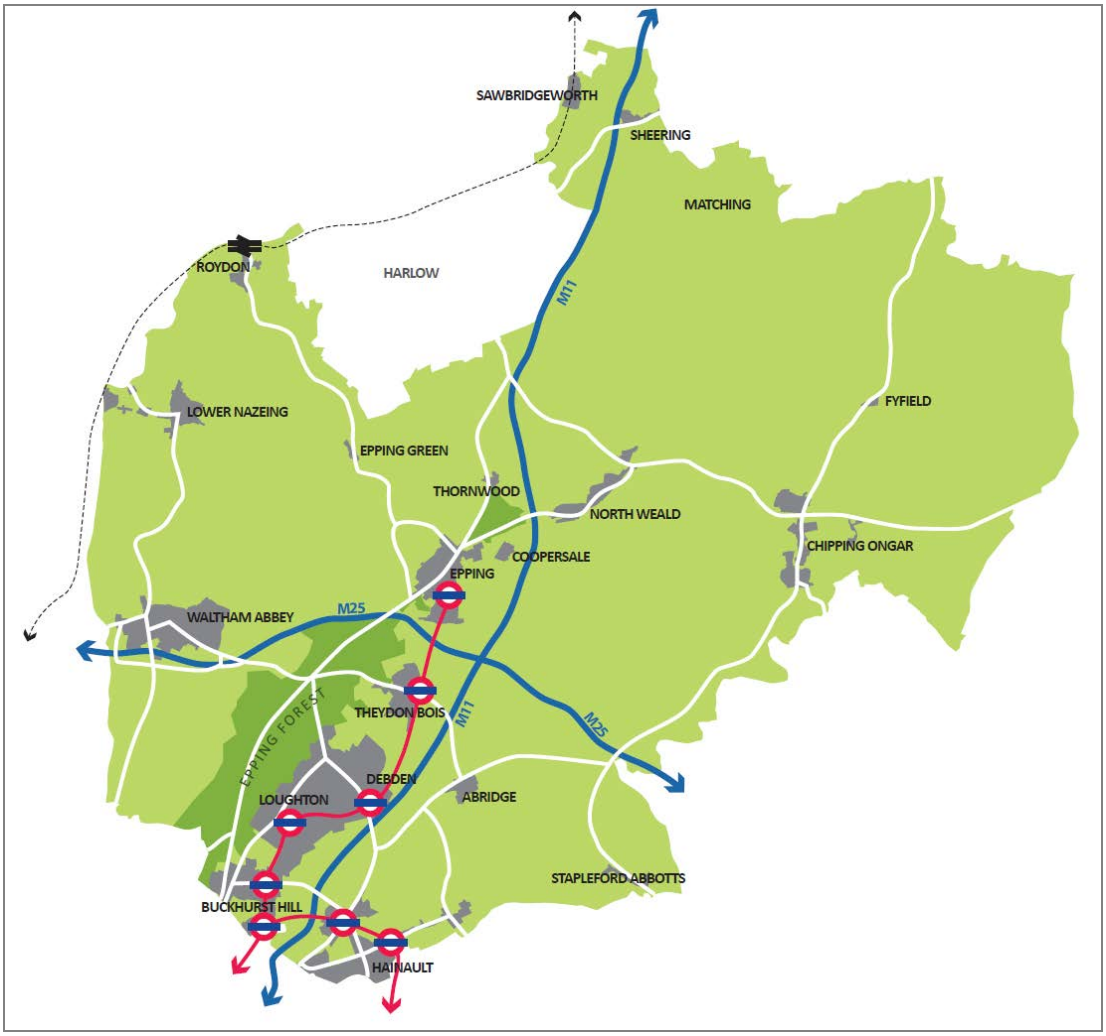

Figure 2.1: Study Area. Source: Epping Forest District Council

2.2 Topography

2.2.1 Appendix A Figure 1 shows the topography of the study area. A high point, broadly following the path of the B1393 through Epping Forest, divides the catchments of the River Lee and River Roding. Elevation along this ridge varies between approximately 100m and 120m AOD. The low points within the district lie within the River Lee and River Roding valleys, with a minimum elevation of approximately 15mAOD in the south and south-west of the district.

2.3 Principal Watercourses

2.3.1 Figure 2 in Appendix A illustrates surface water bodies in the district. The River Roding flows from the north to the south along parts of the eastern boundary of the district. Its catchment dominates the eastern two thirds of the district and has a rapid response to rainfall due to the predominance of a clay underlying geology. A major tributary to the River Roding is the Cripsey Brook.

2.3.2 The Lee Navigation, Old River Lee and Lee Flood Relief Channel (FRC) flow along the western boundary of the district and the River Lee's catchment occupies the western one third of the district. The upstream catchment is largely rural, while the Lower Lee catchment is heavily urbanised with the combination of man-made, impermeable surfaces and low permeability clayey soils. The two main tributaries of the Lower Lee are the Nazeing Brook and Cobbins Brook.

2.3.3 A small proportion of the north of the district falls into the catchment of the River Stort, and finally, the River Ingrebourne catchment is located on the south eastern boundary of the district.

2.3.4 Both the River Lee and Roding have proportions of their catchment defined by low permeability surfaces reducing the potential for infiltration to sub-soils. Therefore, a large proportion of the rainfall is conveyed directly to the river resulting in a 'flashy' hydrograph profile. This means that there is limited time for flood warning and evacuation processes unless they are well informed through weather forecasting techniques.

2.4 Geology / Hydrology

2.4.1 A number of surface water drainage channels across the district are spring fed at their head. This is caused by a perched water table at the boundary of impermeable and permeable strata. Groundwater fed watercourses and springs are affected by seasonal variability in rainfall and man-made interventions such as the construction of foundations and basements. Care should be taken in the use of infiltration drainage systems in areas where the permeable strata are of geographically limited extent as their use may contribute to groundwater flooding nearby. Almost the entire district is underlain by London Clay or Claygate Member bedrock (Appendix A Figure 4). Superficial Head deposits are located throughout the district, predominantly following the paths of the watercourses (Appendix A Figure 3). The British Geological Survey (BGS) indicates that such deposits were formed from down-slope movements. Alluvium is also present along corridors following the major watercourses within the district. The Lowestoft Formation is present throughout a large proportion of the district, formed through glacial processes. Small sections of other superficial deposits are present in EDC. Large sections of the south and west of the district are not underlain by any superficial deposits.

2.4.2 The south and south-west of the district is underlain by impermeable soils which are seasonally waterlogged. The majority of the remainder of the district is underlain by cracking clay soils.

3 SFRA METHODOLOGY

3.1.1 The Level 1 SFRA Update is a desk-based study, using readily available existing information and datasets to enable the application of the Sequential Test and to identify where the Exception Test may be required. The main tasks in preparing the Level 1 SFRA Update are described below.

3.2 Gathering data and analysing it for suitability

3.2.1 Under Section 10 of the NPPF, the risk of flooding from all sources must be considered as part of a Level 1 SFRA Update, including flooding from rivers (fluvial), land (overland flow and surface water), groundwater, sewers and artificial sources. Flooding from the sea is not relevant to the study area.

3.2.2 In order to provide this assessment of all sources of flooding in the district, an extensive set of datasets was obtained from relevant stakeholder organisations. This information was subject to a quality review and gap analysis by the project team to determine the best datasets for inclusion in the Level 1 SFRA update. It should be noted that records only appear where they have been reported to the relevant stakeholder organisations, and as such the records may not include all instances of flooding within the district. Further details of the datasets are included in Table 3.1.

3.3 Data Collected

3.3.1 The majority of the data utilised to develop district-level mapping was obtained from local stakeholders and is detailed in the following sections. The data obtained, the organisation that supplied it and the format of the data are detailed in Table 3.1.

Table 3.1: Data Supplied by Stakeholders

Data	Stakeholder	Format
Flood Zone 2 Outline	Environment Agency	GIS
Flood Zone 3 Outline	Environment Agency	GIS
Flood Zone 3b 5% AEP flood outline, based on a defended scenario, from the River Lee 2D Modelling and Mapping Report, CH2MHILL 2014 5% AEP flood outline, based on a defended scenario, from the Upper Roding Section 105 Modelling Report, Jacobs Gibb 2003 5% AEP flood outline, based on a defended scenario, from the Middle Roding Section 105 Modelling Report, Jacobs Gibb 2003 5% AEP flood outline, based on a defended scenario, from the Upper and Middle Stort Flood Mapping Model, Halcrow 2010 5% AEP flood outline, based on a defended scenario, from the Harlow Northern Extension SFRA – Hydrology and Hydraulic Modelling Report, Faber Maunsell 2006	Environment Agency	GIS
Flood Zone 3a with an allowance for climate change 1% AEP flood outline with a 20% allowance to account for the effects of climate change, based on a defended scenario, from the River Lee, Upper Roding, Middle Roding, Upper and Middle Stort and Harlow Northern Extension model studies described above.	Environment Agency	GIS
Main Rivers, Detailed River Network layers	Environment Agency	GIS
Epping Forest District Council records of flooding from fluvial, surface water, sewer, groundwater and other/unknown sources.	Epping Forest District Council	Spreadsheet
Essex County Council flooding records	Essex County Council	Spreadsheet
Groundwater Flood Incident Records	Environment Agency	Spreadsheet
Areas Susceptible to Groundwater Flooding	Environment Agency	GIS
Susceptibility to Groundwater Flooding	BGS	GIS
SuDS Infiltration Map	BGS	GIS
Canal and River Trust Overtopping Records	Canal and River Trust	GIS
DG5 sewer Incident records	Thames Water	Spreadsheet
Highways Flood Incident records	Highways Agency	Spreadsheet / Plans

3.4 Producing strategic flood risk maps, GIS deliverables and a technical report

3.4.1 A series of Geographical Information System (GIS) maps were produced using the data gathered during the initial part of the study. The mapping deliverables are identified in Table 3.2.

Table 3.2: Strategic Flood Risk Maps

Figure Number	Figure Title
A1	Topography
A2	Surface Waterbodies
A3	Superficial Geology
A4	Bedrock Geology
A5	Historic Flood Information
A6	Fluvial Flood Zones
A7	Updated Flood Map for Surface Water
A8	Sewer Flooding Records
A9	EA Areas Susceptible to Groundwater Flooding
A10	BGS Susceptibility to Groundwater Flooding
A11	BGS Infiltration SuDS Suitability Map
A12	Environment Agency Flood Warning Areas
A13	Epping Forest District Council Flood Risk Assessment Zones
A14	Flood Defence Information

Flood Incident Mapping

3.4.2 Flood incident records supplied by EFDC have been compiled from a number of sources; Fire Brigade records, Engineers Reports, members of the public and directly from EFDC officers. Records were grouped based on flood incident category where this information was included. EFDC flood incident records date between 1982 and 2012.

3.4.3 Of 2,224 records supplied, 459 records were identified as having a fluvial source, 426 surface water, 64 sewer and 23 groundwater. 956 flood incidents did not have a clear flood source in the EFDC records and have therefore been identified as having an ‘other’ or unknown source.

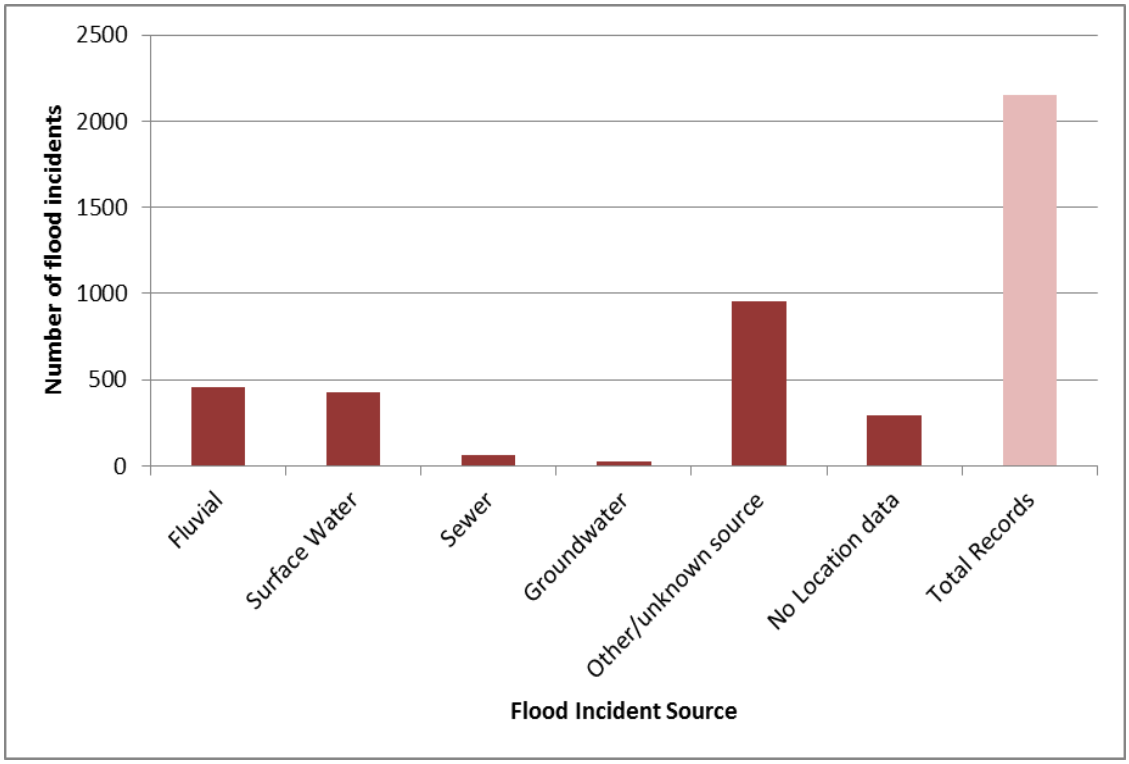

Figure 3.1: Summary of Epping Forest District Council Flood Incident Records

3.4.4 Location information was not provided for all 2,224 records supplied. Where x, y coordinates were provided the flood incident was directly converted from spreadsheet to GIS format. Such information allows the records to be geo-referenced and their location plotted on a map. Where x, y coordinates were not provided, though 6-digit post codes were, the postcodes were converted into x, y co-ordinates. Records could therefore be mapped, though with a lesser degree of accuracy. 296 flood incidents were recorded with no geographical/locational information and therefore could not be mapped. It should be noted that records only appear where they have been reported to EFDC, and as such the records may not include all instances of flooding within the district.

3.4.5 Highways Agency flood incident records have been obtained from two separate sources: one contractor operating on the M25 and M11 Junction 4-6, a second contractor operating on the M11 Junction 6-9. Highways Agency flood incident records were not supplied in GIS format, or with associated grid references. As the information could not be supplied in GIS format the location of the recorded flood incidents could not be defined within the scope of this Level 1 SFRA. These flood incidents could not be mapped.

3.4.6 At the time of writing this Level 1 SFRA Update no flooding incident records for the district have been supplied by London Underground or Network Rail.

Mapping of Flood Risk from Rivers

3.4.7 Fluvial flood incidents were identified from EFDC records. All overtopping records provided by the C&RT were classified as flooding from a fluvial source as they are located along the Lee Navigation, with the exclusion of one flood incident in the north of the district along the River Stort, where flooding was identified as occurring due to a water pipe discharging on to the towpath.

Mapping of Flood Risk from Surface Water

3.4.8 Surface water flood incidents were primarily identified from EFDC and ECC records. For the purposes of the flood incident mapping, incidents with a number of different sources were grouped together and classified purely as having a surface water source. Where flood incidents were identified as being 'Highways', 'Storm', 'Runoff from adjacent land' and 'Runoff from land/TWUL sewer' they were grouped together as being records of surface water flooding. One record provided by the Canal and River Trust (C&RT) was identified as surface water flooding.

3.4.9 Potential flood risk from surface water was mapped using the Environment Agency 'updated Flood Map for Surface Water' (uFMfSW) dataset, and is presented in Appendix A Figure 7. The uFMfSW mapping is discussed in Section 4.3.4 to Section 4.3.6. The mapping identifies those areas at risk of surface water flooding during rainfall events with a 1 in 30 chance of occurring in any given year (3.33% Annual Exceedance Probability (AEP), 1 in 100 chance of occurring in any given year (1% AEP) and a 1 in 1000 chance of occurring in any given year (0.1% AEP).

Mapping of Flood Risk from Sewers

3.4.10 DG5 sewer flooding records were provided by Thames Water Utilities Limited (TWUL). Flood incident records are not provided to street level detail, and are instead grouped into 4 digit post code areas. The records were supplied as a spreadsheet detailing the number of incidents in the period of the last 1 to 10 years and 1 to 20 years, grouped as internal and external property flooding. For the purposes of the flood mapping exercise, records of internal and external flooding incidents from the past 1 to 20 years were used. In order for the incidents to be mapped they were cross-referenced with GIS polygon layers of 4-digit post code areas (post code sectors).

3.4.11 It should be noted that records only appear on the DG5 register where they have been reported to TWUL, and as such the records may not include all instances of sewer flooding within the district. Furthermore, given that TWUL target these areas for maintenance and improvements, areas that have experienced flooding in the past may no longer be at the greatest risk of flooding in the future.

3.4.12 Correspondence with Anglian Water Services (AWS) confirmed that they are the sewage undertaker for a small area within the district; High Ongar and Roydon. AWS confirmed that they do not hold any records of flooding within their administrative area in the district.

3.4.13 EFDC provided a record of flood incidents of various sources which have occurred within the district. All those records identified as sewer flooding were included as such in the mapping.

Mapping of Flood Risk from Groundwater

3.4.14 The Environment Agency provided a limited number of groundwater flood incident records for the district. The data was provided as a spreadsheet with x and y coordinates included. The records could therefore be geo-referenced and mapped in GIS.

3.4.15 EFDC records identified as groundwater seepage were included as groundwater incidents.

Mapping of Flood Risk from Artificial Sources

3.4.16 All overtopping records provided by the C&RT were classified as flooding from a fluvial source, with the exclusion of one flood incident, where flooding was identified as occurring due to a

water pipe discharging on to the towpath. The overtopping records have been classified as originating from a fluvial source as the River Lee Navigation and Stort Navigation are both canalised rivers classified as Main Rivers by the Environment Agency. Therefore there are no records of flooding from artificial sources.

3.5 Providing suitable guidance

3.5.1 Sections of this report provide specific guidance for EFDC on policy considerations, the application of the Sequential Test, guidance on the preparation of site specific FRAs and guidance of the application of SuDS in the study area.

3.6 Need for a Level 2 SFRA

3.6.1 Following the application of the Sequential Test by EFDC, there may be an insufficient number of suitably available sites for development within areas identified to be at low risk of flooding and it may become necessary to consider the application of the Exception Test. Where this is necessary, the scope of the SFRA may need to be widened to a Level 2 assessment.

3.6.2 The increased scope Level 2 SFRA will need to consider the detailed nature of the characteristics within a Flood Zone including flood probability, flood depth, flood velocity, rate of onset of flooding and the duration of flooding. This may require interrogation of 2D modelling and breach / overtopping analysis for certain locations.

3.6.3 The scope of a Level 2 SFRA cannot fully be determined until the Sequential Test has been undertaken by EFDC on all possible site allocations.

4 FLOOD RISK IN EPPING FOREST DISTRICT

4.1 Introduction

4.1.1 This Section provides the strategic assessment of the flood risk across the district from each of the sources of flooding outlined in the NPPF. Where appropriate, the impact of climate change on the source of flooding is described. This Section should be read in conjunction with the mapping in Appendix A.

4.2 Flooding from Rivers

4.2.1 The Environment Agency 'Detailed River Network' dataset has been used to identify watercourses in the study area and their designation (i.e. Main River or ordinary watercourse). The main source of flood risk to Epping Forest is fluvial flooding associated with the River Roding and River Lee, as well as other smaller Main Rivers. Figure 2 in Appendix A illustrates Main River locations.

4.2.2 Both the River Lee and River Roding have proportions of their catchment defined by low permeability surfaces which reduce the potential for infiltration to sub-soils. Therefore, a large proportion of the rainfall is conveyed directly to the river, resulting in a 'flashy' hydrograph profile. This means that there is limited time for flood warning and evacuation processes unless they are well informed through weather forecasting techniques.

4.2.3 The Thames Catchment Flood Management Plan (CFMP) (2009) states that there are between 2,500 and 5,000 properties within the district at risk of flooding during a 1% AEP fluvial event.

4.2.4 An Environment Agency report on flood risk management in the Lower Lee catchment[3] recognised Waltham Abbey and Nazeing as major flood risk areas. The report identified Nazeing as an area with a standard of protection below 1 in 50 years (2% AEP), whilst a flood management scheme delivered in 2010 ensured that Waltham Abbey is protected to at least a 2% AEP standard of protection. The report estimated that 183 properties in Lower Nazeing are currently at risk of fluvial flooding during a 1% AEP event. 45 properties in Waltham Abbey are estimated to be at risk of flooding from Cobbins Brook during a 1% AEP event.

4.2.5 The Lee Flood Relief Channel (FRC) was completed in 1977 and is a predominantly artificial watercourse built to convey flood waters and relieve flood in the Lee catchment. When completed in 1977 the FRC provided protection to 13,000 to a design standard of 1 in 100 years. The Environment Agency report on management in the catchment states that in the current day the FRC predominantly provides protection to a design standard of 1 in 50 years. Approximately 6000 properties are protected to a 1 in 100 year standard.

Historic Flooding

4.2.6 Figure 5 in Appendix A presents the extents of historic fluvial flood events indicated by the Environment Agency's Historic Flood Map. Major fluvial flooding events are shown to have occurred in 1947, 1968, 1974, 1978, 1987, 1993, 2000 and 2001. The majority of flooding has occurred along sections of Main River which do not have raised defences, or did not at the time of the flood event.

4.2.7 The major flood event in the Lower Lee catchment occurred in 1947 and impacted Nazeing Mead, Nazeing Marsh and Waltham Abbey. The Environment Agency identified numerous

[3] Environment Agency (2013) Managing flood risk in the Lower Lee catchment, today and in the future

flood events along the River Roding and its tributaries, with major flood events in 1968 and 1974.

4.2.8 Historic records of fluvial flooding provided by EFDC, ECC and the C&RT indicate clusters of flood incidents in the major settlements within the district, as expected. Numerous incidents have been recorded in Lower Nazeing, Waltham Abbey, Loughton, Chipping Ongar, North Weald Basset and Thornwood.

4.2.9 The C&RT provided details of overtopping events along the sections of watercourse which they maintain. Recorded incidents of overtopping are limited, and have occurred along the River Lee Navigation and River Stort Navigation channel, which are classed as Main Rivers by the Environment Agency.

Flood Zone Maps

4.2.10 The risk of flooding is a function of the probability that a flood will occur and the consequence to the community or receptor as a direct result of flooding. The NPPF seeks to assess the probability of flooding from rivers by categorising areas within the fluvial floodplain into zones of low, medium and high probability, as defined in Table 4.1 and presented on the 'Flood Map for Planning (Rivers and Sea)' available on the Environment Agency website. These Flood Zones have also been presented in Figures 6A-6R in Appendix A.

Table 4.1: Fluvial Flood Zone Definitions

FLOOD ZONE	DEFINITION	PROBABILITY OF FLOODING
Flood Zone 1 - Low Probability	Land assessed as having a less than 1 in 1000 annual probability of river flooding (<0.1% AEP events).	Low Probability
Flood Zone 2 - Medium Probability	Land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% AEP and 0.1% AEP events).	Medium Probability
Flood Zone 3a - High Probability	Land assessed as having a 1 in 100 or greater annual probability of river flooding (>1% AEP event).	High Probability
Flood Zone 3b - High Probability	Land where water has to flow or be stored at times of flood, or land purposely designed to be flooded in an extreme flood event (0.1% AEP). The identification of the functional floodplain takes into account local circumstances but for the purposes of this SFRA, land which would flood during a 5% AEP event or greater in any year has been mapped.	Functional Floodplain

4.2.11 The 'Flood Map for Planning (Rivers and the Sea)' provides information on the areas that would flood if there were no flood defences or buildings in the 'natural' floodplain. The 'Flood Map for Planning (Rivers and Sea)' dataset is available on the Environment Agency website[4] and is the main reference for planning purposes as it contains Flood Zones 1, 2 and 3 which are referred to in the NPPF and presented in Table 4.1. There is no further subdivision of Flood Zone 3 in to Flood Zone 3a and 3b on the Environment Agency website.

4.2.12 The 'Flood Map for Planning (Rivers and Sea)' was first developed in 2004 using national generalised modelling (JFLOW) and is now routinely updated and revised using the results

[4] Environment Agency Flood Map for Planning (Rivers and Sea) http://apps.environment-agency.gov.uk/wiyby/37837.aspx

from the Environment Agency's programme of catchment studies, entailing topographic surveys and hydrological and/or hydraulic modelling as well as previous flood events.

4.2.13 It should be noted that a separate map is available on the Environment Agency website which is referred to as 'Risk of Flooding from Rivers and Sea'[5]. This map takes into account the presence of flood defences and so describes the actual chance of flooding, rather than the chance if there were no defences present. While flood defences reduce the level of risk they don't completely remove it as they can be overtopped or fail in extreme weather conditions, or if they are in poor condition. As a result the maps may show areas behind defences which still have some risk of flooding. This mapping has been made available by the Environment Agency as the primary method of communicating flood risk to members of the public, however for planning purposes the 'Flood Map for Planning (Rivers and the Sea)' and associated Flood Zones remains the primary source of information.

Hydraulic Modelling Studies

4.2.14 Details of hydraulic modelling studies that have been carried out within the district are provided below. Studies have been carried out on the River Lee (2010), Upper Roding (2003), Middle Roding (2003) and Upper and Middle Stort (2010).

Table 4.2: Hydraulic models for watercourses within Epping Forest District

Watercourse	Modelling Study
River Lee	The River Lee 2D Modelling and Mapping Study developed the work of previous modelling studies within the River Lee catchment, such as the Lee Model Maintenance Study, to build a 1D-2D hydraulic model extending from Hertford to the River Thames. The model covers the entire length of the River Lee through EFC as well as sections of the tributaries of Nazeing Brook, Cobbins Brook, Honey Lane Brook and Quinton Hill Brook.
Upper Roding	The Upper Roding model[6] covers the Upper Roding catchment to Passingford Bridge and the whole of the Cripsey Brook tributary. An out-of-bank hydraulic model was constructed along the watercourses, with a hydrological model producing the inflow hydrographs into the model. Flood levels were derived and subsequently mapped.
Middle Roding	The Middle Roding model[7] extends from Passingford Bridge Mill just downstream of the eastern boundary of the district where the B175 meets the A113 close to the M25, to its downstream extent at Redbridge south of the district. An out-of-bank model was developed, with model outputs consisting of flood levels, which were mapped in order to present flooding extents.
River Stort	The modelling study for the Stort[8] entailed the development of a linked 1D-2D model. The Stort passes along the boundary of the district at its north-western point near Sawbridgeworth. The Harlow Northern Extension SFRA – Hydrology and Hydraulic Modelling Report (2006)[9] was developed at the request of the Environment Agency to support a SFRA for the proposed development of a large area of land to the north of Harlow. An existing hydraulic model developed in the Lower Stort Modelling Report (PBA 2000)[10] was adapted for the purposes of the study. The model extends from Bishop's Stortford, north of the district, to the confluence with the River Lee.

[5] Environment Agency 'Risk of Flooding from Rivers and Sea' http://watermaps.environment-agency.gov.uk/wiyby/wiyby.aspx?topic=floodmap#x=237038&y=161974&scale=1
[6] PBA, Jacobs and Atkins (2003) Upper River Roding and Cripsey Brook Flood Study
[7] PBA, Jacobs and Atkins (2003) Middle River Roding Hydraulic Model (Passingford Mill to Redbridge)
[8] Halcrow Group Ltd. (2010) Stort Modelling and Mapping Flood Risk Study
[9] Faber Maunsell (2006) Harlow Northern Extension SFRA – Hydrology and Hydraulic Modelling Report
[10] Peter Brett Associates (2000) Lower Stort Modelling Report

4.2.15 It should be noted that the scope of these modelling studies typically covers flooding associated with Main Rivers, and therefore ordinary watercourses that form tributaries to the Main Rivers may not always be included in the model. Modelling of ordinary watercourses available on the 'Flood Map for Planning (Rivers and Sea)' may be the result of the national generalised JFLOW modelling carried out by the Environment Agency and may need to be refined when determining the probability of flooding for an individual site and preparing a site-specific FRA.

Flood Zones 2 and 3

4.2.16 Areas where there are properties within Flood Zones 2 or 3 include:

- Thornwood, where there are several properties located within Flood Zone 3 and the majority of properties in the north and east located within Flood Zone 2;
- North Weald Bassett, where a number of properties in areas adjacent to High Road are located within Flood Zone 2. A small number of properties in proximity to Wheelers Farm Gardens are located in Flood Zone 3;
- A limited number of properties in the north of Shelley are located within Flood Zone 2 and 3;
- Properties in central and southern Chipping Ongar are located within Flood Zone 2, including properties along the west end of Bowes Drive, Millbank Avenue, Rodney Road, Turners Close, The Borough Greenstead and Long Fields;
- High Ongar, where a small number of properties along Mill Lane are located within Flood Zone 2 and 3;
- A limited number of properties located adjacent to the B184 where it passes through Fyfield are located within Flood Zone 2 and 3;
- Properties located in the north of Abridge, primarily along Tree Close and Ongar Road are located within Flood Zone 2 associated with the River Roding;
- Loughton/Buckhurst Hill, where numerous properties in proximity to Avondale Drive, Malvern Gardens, Valley Close and Roding Road are located within Flood Zone 2 and 3. To the south-west, properties along Bradwell Road, Greensted Road and Boxted Close are located in Flood Zone 2, as are properties along Marlescroft Way and Highwood Lane. Further north, properties in proximity to the junction of High Road and Brooklyn Avenue are located within Flood Zone 2 and 3 associated with Loughton Brook;
- Waltham Abbey, where a relatively large number of properties are located within Flood Zone 2 and 3 associated with the River Lee, Quinton Hill Brook, Cobbins Brook, Honey Lane Brook and Highbridge Stream;
- Lower Nazeing, including an estate to the west along Old Nazeing Road, where a large number of properties are located within Flood Zone 2 and 3 associated with Nazeing Brook and Nazeing Drain Flood Relief Channel;
- Properties along Dobb's Weir Road to the north of Lower Nazeing are located within Flood Zone 3;
- Roydon, where properties at the north of the town are in Flood Zone 2 and 3, including the Roydon Mill Park Caravan Site.

4.2.17 It should be noted that the above presents an overview of areas located within Flood Zone 2 and 3 and does not identify all properties or areas located within a flood zone.

Functional Floodplain (Flood Zone 3b)

4.2.18 The Functional Floodplain is defined in the NPPF as 'land where water has to flow or be stored in times of flood'. The Functional Floodplain (also referred to as Flood Zone 3b), is not separately distinguished from Flood Zone 3a on the Environment Agency Flood Map for Planning. Rather the SFRA is the place where LPAs should identify areas of Functional Floodplain in discussion with the Environment Agency and LLFA.

4.2.19 The PPG states that the identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. However, land which would naturally flood during an event with a 1 in 20 chance of occurring in any given year (5% AEP) or greater, or is designed to flood (such as a flood attenuation scheme) in an extreme (0.1% AEP) flood, should provide a starting point for consideration and discussions to identify the functional floodplain.

4.2.20 The PPG states that 'areas which would naturally flood, but which are prevented from doing so by existing defences and infrastructure or solid buildings, will not normally be defined as functional floodplain'. There may be opportunities to reinstate areas which can operate as functional floodplain through the use of previously developed land adjacent to watercourses to provide space for flood water to reduce the risk to new and existing development.

4.2.21 EFDC has defined Flood Zone 3b for the district, predominantly based on the 5% AEP defended scenario and Flood Storage Areas (FSAs). EFDC's Flood Zone 3b outline was provided as a GIS layer to support this Level 1 SFRA Update. This is mapped in Appendix A Figures 6A-6R.

4.2.22 The PPG recognises the importance of pragmatic planning solutions that will not unnecessarily 'blight' areas of existing urban development. It may not be practical to refuse all future development within existing urban areas falling within land which would flood during a 5% AEP event, and therefore careful consideration in relation to EFDC flood specific policies such as U2A must be given to future development.

Climate Change

4.2.23 A considerable amount of research is being carried out worldwide in an endeavour to quantify the impacts that climate change is likely to have on flooding in future years. Climate change may increase peak rainfall intensity and river flow, which could result in more frequent and severe flood events. Climate change is perceived to represent an increasing risk to low lying areas of England, and it is anticipated that the frequency and severity of flooding will change measurably within our lifetime.

4.2.24 Recommended national precautionary sensitivity ranges for peak rainfall intensity and peak river flow for use in the planning system are derived from Department for Environment, Food and Rural Affairs FCDPAG3 Economic Appraisal Supplementary Note to Operating Authorities – Climate Change Impacts, October 2006[11] and presented in Table 4.3. (These values are subject to change in accordance with data from UKCP09).

[11] This document has now been superseded by Environment Agency Adapting to Climate Change: Advice for flood and coastal erosion risk management authorities, July 2011, but the allowances are considered suitable for use in the planning system. Further information can be found on the Environment Agency standing advice pages here: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/296964/LIT_8496_5306da.pdf

Table 4.3 Recommended national precautionary sensitivity ranges for peak rainfall intensity and peak river flow

PARAMETER	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
Peak rainfall intensity	+5%	+10%	+20%	+30%
Peak river flow	+10%	+20%		

4.2.25 As part of the hydraulic modelling studies for the fluvial watercourses in the district, simulations have been run for the 1% AEP event, including the implications of climate change based on these allowances. It should be noted that whilst the modelling of the annual probability events to generate the NPPF Flood Zones (and Flood Map for Planning) do not account for the presence of flood defences, the simulations including an allowance for climate change do tend to include the presence of existing flood defences. It is important to note that, as outlined in Section 4.2.15, detailed hydraulic modelling studies do not cover all watercourses within the district.

4.2.26 The flood outline for the 1% AEP event including climate change has been mapped for these watercourses on Figures 6A-6R in Appendix A. For the majority of modelled watercourses within the district, detailed modelling indicates a slight increase in the extent of the 1% AEP flood outline compared to the present day, despite taking into account existing flood defences. This is likely to be due to the absence of formal flood defences throughout a large area of the district. The most noticeable increase in the flood extent is along the Cripsey Brook flowing through Chipping Ongar and along the River Roding to the north and south of its confluence with the Cripsey Brook. The mapping indicates a number of properties located within areas of Chipping Ongar may be at increased risk as a result of the impacts of future climate change.

4.2.27 It is important to note that these areas, as well as those areas that are currently at risk of flooding may be susceptible to more frequent flooding in future years. For this reason, all of the policy recommendations set out in Section 6 require all floor levels, access routes, drainage systems and flood mitigation measures to be designed with an allowance for climate change; and the potential impact that climate change may have over the lifetime of a proposed development should be considered as part of a site-specific FRA. This provides a robust and sustainable approach to the potential impacts that climate change may have upon the district over the next 100 years, ensuring that future development is considered in light of the possible increases in flood risk over time.

4.3 Surface Water Flooding

Sources

4.3.1 Overland flow and surface water flooding typically arise following periods of intense rainfall, often of short duration, that is unable to soak into the ground or enter drainage systems. It can run quickly off land and result in localised flooding. The PPG states that an SFRA should identify areas at risk from surface water flooding and drainage issues, taking account of the surface water flood risk published by the Environment Agency as well other available information.

4.3.2 In the more rural northern parts of the district, surface water drainage tends to comprise isolated systems, which are linked to the ECC highway drainage network discharging to open ditches alongside roads. When these rural drainage networks become silted or blocked, surface water flooding can occur.

4.3.3 In more urban areas, surface water drainage is provided via a combination of gullies, carrier

pipes and adopted surface water sewers (often owned by water utilities, in the case of the district, TWUL and AWS and ECC highway drainage). A decrease in the permeability of urban areas over time (e.g. concreting of driveways, new development on greenfield land, or compaction of top soil due to frequent use thereby reducing initial infiltration capacity) has led to many surface water drainage systems being unable to cope adequately, leading to an increased frequency of surface water flooding.

National Level Pluvial Modelling

4.3.4 The Environment Agency has undertaken pluvial modelling at a national scale and produced mapping identifying those areas at risk of surface water flooding during the 3.33% AEP, 1% AEP and 0.1% AEP rainfall events. Broadly, the uFMfSW modelling exercise applies rainfall for the three events to a given area and simulates where water would be likely to drain and subsequently pond based on the ground surface. The uFMfSW takes account of structures such as buildings and bridges, and also applies varied drainage rates based on local information where available. However it does not explicitly account for the sewer network. The uFMfSW maps areas at increased risk of surface water flooding, and does not necessarily show areas that have previously flooded. The uFMfSW flood extents have been made available to EFDC as GIS layers, and are shown in Appendix A Figures 7A-7R. The uFMfSW provides all relevant stakeholders, such as the Environment Agency, ECC as the Lead Local Flood Authority (LLFA) and the public access to information on surface water flood risk which is consistent across England and Wales[12]. The modelling will help the Environment Agency take a strategic overview of flooding, and assist ECC as the LLFA in their duties relating to management of surface water flood risk. For the purposes of this Level 1 SFRA, the mapping also allows an improved understanding of areas within the district which may have surface water flood risk.

4.3.5 The modelling represents a significant improvement on previous mapping, namely the FMfSW (2010) and the Areas Susceptible to Surface Water Flooding (AStSWF) (2009).

4.3.6 The suitability of the mapping varies spatially depending on the confidence in the local modelling. The mapping available for the district is suitable for identifying areas that are at risk and approximate flood extents, and is not suitable for assessing risk at the individual property scale. The data has therefore been used in this Level 1 SFRA to highlight potential surface water risk which may justify further investigation through a site-specific FRA.

Historic Records

4.3.7 Recorded surface water flooding incidents were provided by EFDC and ECC and are presented in Figure 5 in Appendix A. The records only reflect events which were reported to EFDC's drainage team and ECC's Flood Management team. It is possible that surface water flooding has previously occurred but was not reported and therefore could not be included in their flood database, and as such the records may not include all instances of flooding within the district.

4.3.8 Comparison of historic flood records with the uFMfSW mapping shows a good correlation in terms of flood incidents being located in areas of potential flood risk. However, there are large areas identified by the uFMfSW as being at high risk of surface water flooding that do not have any associated recorded surface water flood incidents. This may be due to flood incidents not being reported. The uFMfSW shows risk of surface water flooding, and does not necessarily show areas where flooding has previously occurred. It is also important to note that due to the nature of the uFMfSW exercise, medium and high risk areas are often associated with the natural drainage networks such as Main Rivers and ordinary watercourses. It may therefore

[12] Environment Agency (2013) What is the updated Flood Map for Surface Water?

often be difficult to distinguish the source of a flood incident.

Climate Change

4.3.9 The uFMfSW does not include a specific scenario to determine the impact of climate change on the risk of surface water flooding. However a range of three annual probability events have been undertaken, 3.3%, 1% and 0.1% and therefore it is considered appropriate to use the 0.1% AEP event as a substitute dataset to provide a worst case scenario and an indication of the implications of climate change.

4.4 Groundwater Flooding

Sources

4.4.1 Groundwater flooding usually occurs in low lying areas underlain by permeable rock and aquifers that allow groundwater to rise to the surface through the permeable subsoil following long periods of wet weather. Low lying areas may be more susceptible to groundwater flooding because the water table is usually at a much shallower depth and groundwater paths tend to travel from high to low ground.

4.4.2 A number of surface water drainage channels across the district are spring fed at their head. This is caused by a perched water table at the boundary of impermeable and permeable strata. Groundwater fed watercourses and springs are affected by seasonal variability in rainfall and man-made interventions such as the construction of foundations and basements. Care should be taken in the use of infiltration drainage systems in areas where the permeable strata are of geographically limited extent as their use may contribute to groundwater flooding nearby. Almost the entire district is underlain by London Clay or Claygate Member bedrock (Figure 4 in Appendix A). The south and south-west of the district is underlain by impermeable soils which are seasonally waterlogged. The majority of the remainder of the district is underlain by cracking clay soils.

4.4.3 Figure 9 in Appendix A presents the Environment Agency's dataset: Areas Susceptible to Groundwater Flooding (AStGWF), which indicates where groundwater may emerge due to certain geological and hydrogeological conditions. This information is shown as a proportion of 1km grid squares where there is potential for groundwater emergence. The data does not show where flooding is likely to occur, but instead should be used at a strategic level to indicate areas for further investigation. This is due to the coarse nature of the dataset, being based largely on underlying geology, which in itself is a broad-scale dataset. The data is relatively broad and susceptibility varies greatly throughout the district. However the potential for groundwater emergence is shown to be above 75% in areas in proximity to the River Lee and River Roding. Areas where the potential for emergence is between 25% and 75% are predominantly associated with lesser Main Rivers and larger ordinary watercourses.

4.4.4 Appendix A Figure 10 presents a dataset produced by the BGS showing areas susceptible to groundwater flooding on the basis of geological and hydrogeological conditions. This layer is divided into three classes – High, Medium and Low risk. The highest risk areas are those with the potential for groundwater flooding to occur at the surface, medium risk are those which may experience groundwater flooding of property situated below the ground surface i.e. basements; and low risk are those with limited potential for groundwater flooding to occur. Some areas are not considered to be at risk of groundwater flooding.

4.4.5 Areas where the potential for groundwater flooding to occur at the surface largely correspond with areas of Alluvium and Head deposits associated with the Main Rivers located within the district. Areas with the potential for groundwater flooding of property situated below ground level are much less extensive but still associated with the Main Rivers within the district.

4.4.6 Areas where there is potential for groundwater flooding to occur, but this potential is limited, include areas around Epping Green, a band stretching across Epping Forest, Epping and Coopersale and around Stapleford Abbots and Abridge. These areas correspond with underlying Claygate Member bedrock geology.

4.4.7 Areas where no risk of groundwater flood is identified largely correspond with areas of Lowestoft Formation superficial deposits overlying London Clay bedrock, or where no superficial deposits are present overlying the London Clay.

Historic Records

4.4.8 Groundwater flooding is known to occur around Nazeing associated with outcrops of the highly permeable Lambeth Group sands and the Kesgrave Sands and Gravels.

4.4.9 Groundwater flooding incidents within the district are limited and where they have been recorded to occur, they are concentrated within urban areas of Epping Forest, specifically Chigwell, Loughton, Theydon Bois and Epping.

4.5 Sewer Flooding

Sources

4.5.1 During heavy rainfall, flooding from the sewer system may occur if:

1. **The rainfall event exceeds the capacity of the sewer system/drainage system:**

4.5.2 Sewer systems are typically designed and constructed to accommodate rainfall events with a 3.3% AEP or less. Therefore, rainfall events with a return period of frequency greater than 3.3% AEP would be expected to result in surcharging of some of the sewer system. While TWUL and AWS are concerned about the frequency of extreme rainfall events, it is not economically viable to build sewers that could cope with every extreme rainfall event.

2. **The system becomes blocked by debris or sediment:**

4.5.3 Over time there is potential that road gullies and drains become blocked from fallen leaves, build-up of sediment and debris (e.g. litter).

3. **The system surcharges due to high water levels in receiving watercourses:**

4.5.4 Within the study area there is potential for river outlets to become submerged due to high river levels. When this happens, water is unable to discharge. Once storage capacity within the sewer system itself is exceeded, the water will overflow into streets and potentially into houses. Where the local area is served by ‘combined’ sewers i.e. containing both foul and storm water, if rainfall entering the sewer exceeds the capacity of the combined sewer and storm overflows are blocked by high water levels in receiving watercourses, surcharging and surface flooding may again occur but in this instance floodwaters will contain untreated sewage.

Historic Records

4.5.5 DG5 sewer flooding records were provided by TWUL and are grouped into 4 digit post code areas (see Figure 8 in Appendix A). The records are not available at individual property level. EFDC provided records of sewer flooding, which are presented in Figure 3 and Figure 7 in Appendix A. AWS were consulted during the writing of this SFRA and confirmed that they hold no records of flooding within their service area in the district. It should be noted that records only appear on the DG5 register where they have been reported to TWUL, and as such they may not include all instances of sewer flooding. Furthermore given that TWUL target these

areas for maintenance and improvements, areas that experienced flooding in the past may no longer be at greatest risk of flooding in the future.

4.6 Artificial Sources

Reservoirs

Environment Agency Risk of Flooding from Reservoirs Mapping

4.6.1 The failure of a reservoir has the potential to cause catastrophic damage due to the sudden release of large volumes of water. The PPG encourages LPAs to identify any impounded reservoirs and evaluate how they might modify the existing flood risk in the event of a flood in the catchment it is located within, and / or whether emergency draw-down of the reservoir will add to the extent of flooding.

4.6.2 The Environment Agency dataset 'Risk of Flooding from Reservoirs' identifies areas that could be flooded if a large reservoir , as defined in the Reservoirs Act , were to fail and release the water it holds. The mapping shows that the following reservoirs could result in flooding in the district:

- Berners Hall Farm;
- Chigwell Raw Water;
- Chigwell Washwater Lagoon;
- Staples Road FSR;
- Balancing Pond C;
- Hatfield Forest Lake;
- Shrubbs Farm Reservoir;
- Kingstons Reservoir;
- Connaught Water;
- Sewardstone Green;
- King George V;
- William Girling;
- Rye Meads Lagoons 10, 12, 14 & 16;
- Rye Meads Lagoons 11, 13, 15 & 17;
- Rye Hill No. 2;
- Cobbins Brook FAS.

4.6.3 Berners Hall Farm is located in the north-east of the district. The area at risk should the reservoir fail follows the path of the River Roding as far south as the M25 at Passingford Bridge. The areas at risk are predominantly rural, though a limited number of properties within Fyfield may be at risk.

4.6.4 Chigwell Row Water and Chigwell Washwater Lagoon are located in the south of the district, just north of Chigwell Row. Areas at risk from failure of either or both reservoirs largely follow the little London Brook and subsequently the River Roding as far south as the junction of the M11 and A1168 (Chigwell Lane). Flood waters flowing western are indicated to be largely constrained by the M11. Few properties are at risk of flooding.

4.6.5 Staples Road Flood Storage Reservoir is located on the western boundary of Loughton, on the Loughton Brook. A number of properties within Loughton are at risk in the unlikely event of a failure of the reservoir, with areas at risk largely following Loughton Brook.

4.6.6 In the very north of the district, an area of predominantly greenfield land in proximity to Princey Brook is at risk of flooding should any of the following fail: Balancing Pond C, Hatfield Forest Lake, Shrubbs Farm Reservoir, Kingstons Reservoir. Within the district potentially only properties associated with Sheering Hall Farm are within areas of flood risk.

4.6.7 Rye Hill No. 2 reservoir is located in the north of the district, just south of Harlow. Areas at risk of flooding largely follow the path of Cobbins Brook, with very few properties at risk, with the exception of Waltham Abbey where a number of properties may be at risk of flooding in the event of a failure of Rye Hill No. 2. Cobbins Brook FSA is located approximately 1.5km north-east of Waltham Abbey and a number of properties within Waltham Abbey are at risk of flooding should the FSA fail at a time when flood waters are being stored.

4.6.8 Areas along the very western boundary of the district are at risk of flooding should the King George V or William Girling reservoirs fail, however the flood risk posed to properties within the district is limited.

4.6.9 Areas of the north-west of the district, including properties adjacent to Dobb's Weir Road, are at risk of flooding should Rye Meads Lagoons 10, 12, 14 & 16 or 11, 13, 15 & 17 fail.

4.6.10 Connaught Water and Sewardstone Green are located in the very south of the district, with properties within Sewardstonebury at risk from a failure of the latter.

4.6.11 Reservoirs in the UK have an extremely good safety record. The Environment Agency is the enforcement authority for the Reservoirs Act 1975 in England and Wales. All large reservoirs must be inspected and supervised by reservoir panel engineers. It is assumed that these reservoirs are regularly inspected and essential safety work is carried out. These reservoirs therefore present a managed risk.

4.6.12 EFDC and ECC are responsible for working with members of the Essex Resilience Forum (ERF) to develop emergency plans for reservoir flooding and ensuring communities are well prepared.

4.7 Effect of Development on Flood Risk Elsewhere

4.7.1 EFDC is beginning the preparation of its Local Plan, which will replace the existing Local Plan, and at the time of writing this Level 1 SFRA Update EFDC had not confirmed its potential site allocations for future development within the District. It is therefore not possible to provide a specific assessment of the potential impact of development on flood risk.

4.7.2 However, it is noted that the majority of potential site allocations are likely to be greenfield and therefore future development has the potential to increase surface water flood risk elsewhere through the reduction of permeable surfaces and potential for increased surface water run-off. A relatively large number of surface water flooding incidents have been recorded within the district. In the existing Local Plan and Alterations document, Policy U2B sets strict requirements for future development with regards to the need for FRAs which go beyond those detailed in the NPPF. It is recommended that a similar policy is included within the new Local Plan in order to reduce the potential impact on surface water flood risk as a result of new development.

4.8 Flood Risk Management Measures

4.8.1 Flood risk management seeks to reduce both the *probability* of flooding occurring – through

the management of land, river systems and flood defences); and the *consequences* of flooding – through influencing development in flood risk areas, flood warning and emergency response.

Flood Risk Management Plan

4.8.2 A FRMP is a high-level strategic plan through which the Environment Agency seeks to work with other key decision-makers within a river basin district to identify and agree long-term policies for sustainable flood risk management.

4.8.3 The Thames River Basin District (RBD) Flood Risk Management Plan (FRMP) covers the district and identifies different policies for different sub-catchments within the wider Thames catchments.

4.8.4 The administrative area of EFDC falls within two main RBD sub-areas. The policies and actions for each sub-area are summarised in Table 4.4.

Table 4.4: Thames RBD FRMP sub-catchments with flood risk management objectives

LONDON CATCHMENT
Social
Reduce the risk of flooding to communities where possible.
Raise community awareness and understanding of all sources of flooding.
Enhance recreation and general amenity across the river basin.
Reduce the risk of flooding from reservoirs to people, property, infrastructure and the environment.
Economic
Ensure development and redevelopment in areas at risk of flooding is appropriate, does not increase flood risk and reduces risk wherever possible.
Promote the use of sustainable drainage systems in development to help reduce pressure on existing drainage networks.
Environmental
Protect and enhance biodiversity through flood risk management schemes.
Restore naturally functioning river systems where possible.
Promote sustainable land use management to land owners across the catchment to achieve reductions in flood risk.
RIVER RODING, BEAM AND INGREBORNE CATCHMENT
Social
Reduce the risk of flooding to communities where possible
Raise awareness and understanding of all sources of flooding amongst communities.
Ensure communities are aware of resilience measures that can be taken to be prepared for flooding.
Improve the quality of flood risk data.
Economic
Ensure development and redevelopment in areas at risk of flooding is appropriate, does not increase flood risk and reduces risk wherever possible.
Promote the use of sustainable drainage systems to help reduce pressure on existing drainage networks.
Work in partnership to with developers to deliver capital schemes at redevelopment opportunities.
Environmental
Protect and enhance biodiversity through flood risk management schemes.
Restore naturally functioning river systems where possible.
Promote sustainable land use management to reduce flood risk.

4.8.5 In addition to the objectives set out in Table 4.4, the FRMP identified more specific objectives for the London and River Roding, Beam and Ingreborne sub-catchments. Those objectives which are relevant to EFDC are outlined below.

London sub-catchment

4.8.6 The FRMP sets catchment-wide objectives to work with LPAs and emergency planners to organise flood exercises and community works. In addition to this the Environment Agency will work to incorporate improvements to flood assets as part of future redevelopment within the catchment.

4.8.7 The FRMP states that work is currently being carried out to assess the economics of a flood alleviation scheme on the Nazeing Brook. Upstream storage of flood waters along the watercourse may mitigate flood risk downstream in the area of the confluence of the River Lee and Nazeing Brook.

4.8.8 The Lower Lee FRMS[3] provides further details of proposed management within the Lower Lee catchment in the future. The Strategy states that the Environment Agency will examine the feasibility of schemes to alleviate flooding in Lower Nazeing associated with the Nazeing Brook. It is indicated that any potential scheme would be likely to consist of storage of flood waters in upstream areas, with property-level protection measures for properties which would not benefit from such a scheme. It is also acknowledged that future climate change will reduce the standard of protection in the catchment.

4.8.9 Along the Cobbins Brook, an upstream floodwater storage area was developed in 2010 raising the standard of protection provided to all properties within Waltham Abbey to a minimum of the 2% AEP event. Continued maintenance of the new flood alleviation scheme, and the watercourse in general is recommended. Climate change is predicted to increase flood risk in Waltham Abbey and the Strategy identifies the potential to increase the height of the river wall running through the town to mitigate this.

4.8.10 The existing Lee FRC provides protection during a 1% AEP event to 13,000 properties within the catchment, including sections of the district; Nazeing Mead, Nazeing Marsh and Waltham Abbey. The Low Lee FRMS states that no expansion of the flood alleviation system is planned in the future, however maintenance, refurbishment and replacement of the FRC and associated assets is recommended to maintain the existing standard of protection.

River Roding

4.8.11 The FRMP and the River Roding Flood Risk Management Strategy[13], state that a flood storage area is proposed along the River Roding close to the south-eastern boundary of the district. The Shonks Mill FSA would be designed to alleviate flood risk posed to areas adjacent to the River Roding in Redbridge, downstream of the district. It would also be proposed to reduce maintenance of the River Roding channel upstream of the FSA.

4.8.12 The FRMP proposed withdrawal of maintenance of the River Roding in areas where the costs of maintenance have been identified to exceed the value of the protection provided by such activities.

Flood Risk Assessment Zones

4.8.13 As detailed in the original Level 1 SFRA, EFDC has taken a proactive approach to flood risk management within the district by introducing a number of policies in the EFDC Local Plan

[13] Environment Agency (May 2012) River Roding Flood Risk Management Strategy

(2008) and Alterations (2006). Policy U2B refers to Flood Risk Assessment Zones (FRAZs), and sets stringent requirements, beyond those outlined in the NPPF and accompanying PPG, for developers to produce FRAs to support planning applications.

4.8.14 FRAZs have been defined by EFDC as catchments of ordinary watercourse[24] identified as key areas where surface water runoff is contributing to Main Rivers or areas of known historic flooding. The FRAZs are shown in Appendix A Figure 13. Within FRAZs particular attention should be applied to surface water management, with the aim of reducing the cumulative impact of development throughout the district.

Flood Defences

4.8.15 Flood defences are structures which affect flow in times of flooding and therefore reduce the risk water from entering property. They generally fall into one of two categories; 'formal' or 'informal'.

4.8.16 A 'formal' flood defence is a structure which has been specifically built to control floodwater. It is maintained by its owner or statutory undertaker so that it remains in the necessary condition to function. In accordance with the Flood and Water Management Act, the Environment Agency has powers to construct and maintain defences to help against flooding. ECC has similar powers on ordinary watercourses outside areas management by Internal Drainage Boards (IDBs). Formal flood are mapped in Appendix A Figure 14. These should be referenced by those proposing development to identify the possibility of localised residual risks.

4.8.17 An 'informal' defence is a structure that has not necessarily been built to control floodwater and is not maintained for this purpose. This includes road and rail embankments and other linear infrastructure (buildings and boundary walls) which may act as water retaining structures or create enclosures to form flood storage areas in addition to their primary function.

4.8.18 A study of informal flood defences has not been made as part of this assessment. Should any changes be planned in the vicinity of road or railway crossings over rivers in the study area it would be necessary to assess the potential impact on flood risk to ensure that flooding is not made worse either upstream or downstream. Smaller scale informal flood defences should be identified as part of site specific FRAs and the residual risk of their failure assessed.

4.8.19 When completed in 1977 the Lee FRC provided protection to 13,000 to a design standard of 1 in 100 years. The Environment Agency report on management in the Lower Lee catchment[3] states that in the current day the FRC predominantly provides protection to a design standard of 1 in 50 years. Approximately 6000 properties are protected to a 1 in 100 year standard.

4.8.20 Other formal flood defences within the district include:

- An earth embankment, approximately 110m long located on the southern bank of Cripsey Brook immediately to the east of Ongar Bridge. The embankment is designed to provide a 1 in 50 year standard of protection.
- Approximately 1km to the north-east of Abridge, a small earth embankment with a section of brick wall is present on the northern bank of Hillmans Brook. The embankment provides a 1 in 5 year standard of protection.
- In 2014 the Hillmans Cottages Flood Alleviation Scheme was constructed providing protection to the Hillmans Cottages to the north of Hillmans Brook.
- Earth embankments approximately 150m long and providing a 1 in 5 year standard of protection are present on both banks of the River Roding immediately downstream of the junction of the M11 and A1168 south of Loughton.

- Two short raised earth embankments, both with a 1 in 5 year standard of protection, are present to the south of the junction of the River Roding and Lambourne End Brook to the west of Passingford Bridge. A concrete retaining wall with additional low brick wall with a 1 in 5 year standard of protection is located on the southern bank of the River Roding approximately 150m to the east. The defences provide a limited level of protection to properties located adjacent to the Main Rivers.
- In Bradwell Road, east Buckhurst Hill, a short 0.7m high brick wall is present providing protection to a limited number of properties to a design standard of 1 in 100 years.
- In the very south of the district, to the south of Buckhurst Hill, a long earth embankment is present to the east of the River Roding. The embankment provides protection to a 1 in 5 year standard.
- In Lower Nazeing, a number of short concrete walls and earth embankments are present close to the confluence of Nazeing Brook and Lichen Brook, providing protection to a 1 in 5 year standard.
- Earth embankments are present along the River Lee and Lee Navigation channel to the north of Waltham Abbey, providing protection to a 1 in 25 year standard. Earth embankments run adjacent to the north of Abbeyview Road with a design standard of 1 in 100 years. Defences along the Lee Navigation continue northwards towards Nazeing Marsh.
- An embankment, 1-1.8m in height and referred to as the Roydon Rail embankment, runs along the boundary of the district to the north-west of Roydon. The embankment runs parallel and to the south of a section of the River Stort and provides protection to a limited area to a 1 in 10 year design standard.

Flood Storage Areas

4.8.21 The Cobbins Brook FSA, constructed in 2010, is located approximately 1.5km north-east of Waltham Abbey. An earth embankment with steel sheet pile cut off wall is located downstream of the designated FSA, with a design standard of 1 in 100 years. The Environment Agency report on flood risk management within the Lower Lee catchment[3] states that the FSA improved the standard of protection within Waltham Abbey to a minimum of 1 in 50 years.

4.8.22 In the central area of the district, two small FSAs are located in proximity to Thornwood, along Thornwood Brook and Cripsey Brook Main Rivers. The FSAs, constructed in 1998, were designed as part of the Thornwood Flood Alleviation Scheme with earth embankments, both with a design standard of 1 in 100 years positioned downstream of the FSAs. Three further FSAs are located to the east, close to North Weald Bassett. Two FSAs, located along Thornhill Storage Pond Ditch and North Weald Basset Drain are designed to store water during events up to an including the 1 in 75 year (1.33% AEP) fluvial event, with associated raised earth embankments. Downstream, and to the north of North Weald Bassett, Church Lane FSA and an associated earth embankment provide storage of flood waters for events up to an including a 1 in 50 year return period, thus providing a level of protection to areas downstream for such events. The FSA was constructed in 1990 and is fed via a bypass channel upstream of Station Road.

4.8.23 A FSA is located to the north-west of Loughton, with an associated earth embankment with a standard of design of 1 in 75 year.

Residual Risk

4.8.24 In producing Flood Zone maps, the Environment Agency takes the presence of defences into

account by showing the areas that benefit from the defence (ABD). This area can also be deemed an area which is at risk of defence overtopping or failure. It can therefore also be described as a residual risk zone. Residual flood risks can arise due to:

- The failure of flood management infrastructure such as a breach of a raised flood defence, blockage of a surface water conveyance system or culvert, overtopping of an upstream storage area, or failure of a pumped drainage system; and/or
- A severe flood event that exceeds a flood management design standard and results in, for example, overtopping.

4.8.25 ABDs within the district are shown in Figure 14 in Appendix A. The main areas afforded a level of protection from flood defences are Thornwood, Waltham Abbey and areas along the River Lee along the western edge of the district. However, such areas are still at risk from flooding in the event of failure of the defences, or the occurrence of a flood event exceeding the design standard of the flood defences resulting in overtopping.

4.8.26 It is possible that future modelling or analysis work undertaken by the Environment Agency may lead to the identification of further ABDs for other areas, and therefore the flood maps should be updated if this information becomes available. Areas of residual risk are treated uniformly and are represented in the GIS as a simple outline of the expected affected area. Actual levels of residual risk will vary spatially depending on flow routes, velocities, flood depths and proximity to the breach or overtopping location. In the event that the Exception Test needs to be applied to specific site allocations in identified residual risk areas, the scope of the SFRA should be extended to a Level 2 assessment to refine information on the flood risk to include depth and hazard information in these locations.

Flood Warning Systems

4.8.27 The Environment Agency provides a free flood warning service for many areas at risk of flooding from rivers and the sea. In some parts of England the Environment Agency may be able to provide warnings when flooding from groundwater is possible. The Environment Agency free flood warning service can provide advance notice of flooding and can provide time to prepare for a potential flood event.

4.8.28 The Environment Agency issue flood *warnings* to homes and businesses when flooding is expected. Upon receipt of a flood warning, occupants should take immediate action.

4.8.29 The Environment Agency issues flood *alerts* when flooding is possible. Flood alerts cover larger areas than flood warnings and are issued more frequently. Upon receipt of an alert, occupants should be prepared for flooding and to take action.

4.8.30 If a flood alert from groundwater is available this does not mean that a particular property is definitely at risk. It is very difficult to predict the exact location of flooding from groundwater as it is often related to local geology. To help people, the Environment Agency provides flood alerts for large areas that could be affected if groundwater levels were high.

4.8.31 Flood alert and flood warning areas can be viewed on the Environment Agency website (http://apps.environment-agency.gov.uk/wiyby/37835.aspx) and were made available as GIS layers to support this Level 1 SFRA Update. There is one flood alert area and three flood warning areas within the Borough.

4.8.32 All stages of warning are disseminated via Floodline Warnings Direct (FWD), which is a free service that provides warnings to registered customers by telephone, mobile, email, SMS text message and fax.

4.8.33 Further information on Flood Warnings in force and Flood Warning Areas can be found from

the Environment Agency website, under Flood Warnings. Flood Warning Areas within the district are also presented in Appendix A Figure 12.

Flood Response Plan

4.8.34 Essex Civil Protection & Emergency Management (ECPEM) comprises Essex County Fire and Rescue Service in partnership with ECC[14]. ECPEM works on behalf of ECC and is a Category 1 Responder under the Civil Contingencies Act 2004[15]. The ECPEM is responsible for preparing contingency plans, including the Multi-Agency Flood Response Plan for Essex, which outlines the response to a major flooding incident within the county.

4.8.35 The Essex Resilience Forum (ERF) is a multi-agency partnership which is formed of Category 1 Responders within the county, namely emergency services, Environment Agency and Local Authorities, including EFDC. The ERF allows Category 1 responders to form a co-ordinated response to emergencies which might occur, including a major flood event.

4.8.36 ECC has a Multi-Agency Flood Response Plan which is the main guidance for all key officers in dealing with major flood emergencies. All departments should have emergency procedures in place to guide staff in their tasks where they differ from their normal work practices, such as providing care for evacuees at Emergency Rest Centres.

4.8.37 As LLFA ECC provides flood advice on its website: (http://www.essex.gov.uk/Environment%20Planning/Environmental-Issues/local-environment/flooding/Pages/Default.aspx). The website directs users to the Environment Agency website to view the flood warnings in place (as described in Section 4.8.27) and to view properties at risk of flooding from Main Rivers, surface water and reservoirs. ECC's website provides information on who to contact should flooding occur, as well as links to information on flood resilience and recovery.

4.8.38 EFDC also provides flood advice on its website: (http://www.eppingforestdc.gov.uk/index.php/residents/your-environment/drainage/flooding-and-land-drainage).

4.8.39 It is recommended that ECPEM's Flood Response Plan is reviewed and updated in light of the findings of the Level 1 SFRA Update to ensure that safe evacuation and access for emergency services is possible during times of flood both for existing developments and those being promoted as possible sites within the Local Plan process. It is further recommended that EFDC and ECC work with the Environment Agency to promote the awareness of flood risk to maximise the number of people signed up to the FWD service. Within the district particular attention should be given to vulnerable people including those with impaired hearing or sight and those with restricted mobility.

4.8.40 With respect to new developments, those proposing the development should take advice from the EFDC and ECC's emergency planning officers and for large-scale developments, the emergency services, when producing an evacuation plan as part of a FRA. As a minimum these plans should include information on:

- How flood warning is to be provided:
- Availability of existing warning systems;
- Rate of onset of flooding and available warning time; and

[14] Essex County Council (2015) http://www.essex.gov.uk/Environment%20Planning/Environmental-Issues/Pages/Emergency-Planning.aspx. Accessed 18/02/15
[15] HMSO 2004 *Civil Contingencies Act 2004*.

- Method of dissemination of flood warning.
- What will be done to protect the infrastructure and contents:
- How more easily damaged items could be relocated;
- The potential time taken to respond to a flood warning;
- Ensuring safe occupancy and access to and from the development;
- Occupant awareness of the potential frequency and duration of flood events;
- Provision of safe (i.e. dry) access to and from the development;
- Ability to maintain key services during an event;
- Vulnerability of occupants and whether rescue by emergency services may be necessary and feasible; and
- Expected time taken to re-establish normal practices following a flood event.

5 POLICY CONTEXT

5.1 National policy

National Planning Policy Framework (2012)

5.1.1 The NPPF was published on 27th March 2012 together with accompanying Technical Guidance[16]. The NPPF revoked most of the previous Planning Policy Statements (PPS) and Planning Policy Guidance. However, NPPF did not revoke the PPS25 Practice Guide[17]. This was revoked on the 6th March 2014 along with the NPPF Technical Guidance, when it was replaced by the PPG: Flood Risk and Coastal Change.

5.1.2 The NPPF consists of a framework within which councils and local people can produce local and neighbourhood plans that reflect the needs and priorities of their communities.

5.1.3 The overall approach to flood risk is broadly summarised in NPPF Paragraph 103:

5.1.4 *"When determining planning applications, local planning authorities should ensure flood risk is not increased elsewhere and only consider development appropriate in areas at risk of flooding where, informed by a site-specific FRA following the Sequential Test, and if required the Exception Test, it can be demonstrated that:*

- *within the site, the most vulnerable development is located in areas of lowest flood risk unless there are overriding reasons to prefer a different location, and*
- *development is appropriately flood resilient and resistant, including safe access and escape routes where required, and that any residual risk can be safely managed, including by emergency planning; and it gives priority to the use of sustainable drainage systems."*

National Planning Practice Guidance (2014)

5.1.5 The NPPF is supported by a series of Planning Practice Documents referred to as the National Planning Practice Guidance. The PPG: Flood Risk and Coastal change document outlines how LPAs should use the SFRA, as follows:

- SFRAs should assess the flood risk to an area from all sources, both in the present day, and in the future. The impacts of climate change should be considered when assessing future flood risk;
- The impact on flood risk of future development and changes to land use should also be considered;
- The SFRA should provide the foundation from which to apply the Sequential and Exception Tests in the development allocation and development management process (see Flood Zones 1-3b). Where decision-makers have been unable to allocate all proposed development and infrastructure in accordance with the Sequential Test, taking account of the flood vulnerability category of the intended use, it will be necessary to increase the scope of the SFRA (Level 2 SFRA) to provide the information necessary for application of the Exception Test;
- The SFRA should inform the sustainability appraisal of the Local Plan;

[16] Communities and Local Government. (March 2012) Technical Guidance to the National Planning Policy Framework.
[17] Department for Communities and Local Government. 2009. Planning Policy Statement 25: Development and Flood Risk Practice Guide

- The SFRA should outline requirements for site-specific FRAs, with specific requirements for particular locations;
- Define the flood risk in relation to emergency planning's capacity to manage flooding;
- Opportunities to decrease the existing flood risk within the study areas should be explored, such as surface water management, provision of flood storage and managing conveyance of flood flows.

5.1.6 SFRAs should be prepared in consultation with the Environment Agency, emergency response and drainage authority functions of the LPA, Lead Local Flood Authorities (LLFAs) and, where appropriate, Internal Drainage Boards (IDBs).

The Flood and Water Management Act (2010)

5.1.7 In response to the severe flooding across large parts of England and Wales in summer 2007, the Government commissioned Sir Michael Pitt to undertake a review of flood risk management. The Pitt Review - Learning Lessons from the 2007 Floods[18] and subsequent progress reviews outlined the need for changes in the way the UK is adapting to the increased risk of flooding and the role different organisations have to deliver this function.

5.1.8 The Flood and Water Management Act (the Act)[19] (2010) brings in new roles and responsibilities for local authorities. In particular, the Act defines the role of the LLFA, which includes Unitary Authorities or County Councils. Essex County Council (ECC) is the LLFA for Essex, which includes EFDC. LLFAs are encouraged to bring together relevant bodies and stakeholders to effectively manage local flood risk, which may include County, City and District/Borough Councils, IDBs, highways authorities, water companies and the Environment Agency. It should be noted that no IDBs operate within the district.

5.1.9 The new responsibilities the Act assigns to LLFAs include:

- Coordinated management of flooding from surface water, ground water and ordinary watercourses;
- Development, maintenance and implementation of a Flood Risk Management Strategy;
- Investigation and recording of local flood events;
- Establishment and maintenance of a Flood Risk Asset Register; and,
- Ordinary watercourse regulation.

Amendments to policy on Sustainable Drainage Systems

5.1.10 Following a consultation by Defra on the delivery of SuDS[20] in 2014, the Department for Communities and Local Government (DCLG) issued a Written Statement[21] outlining the Government's response regarding the future of SuDS. This was followed by a consultation exercise carried out in December 2014 by DCLG on the proposal to make LLFAs statutory consultees for planning applications with regards to surface water management and the Government published its formal response in March 2015. The PPG has subsequently been

[18] Cabinet Office (2008) Sir Michael Pitt Report 'Learning lessons learned from the 2007 floods' http://www.environment-agency.gov.uk/research/library/publications/33889.aspx
[19] HMSO (2010) The Flood and Water Management Act 2010 http://www.legislation.gov.uk/ukpga/2010/29/contents
[20] Defra (September 2014) Delivering Sustainable Drainage Systems Consultation Document
[21] Department for Communities and Local Government (Dec 2014) House of Commons Written Statement (HCWS161) Sustainable Drainage Systems.

amended to reflect the new approach to implementation of SuDS in development.

5.1.11 The proposed approach is to strengthen the planning system as a way of delivering SuDS, rather than implement Schedule 3 of the Act, as written, which would establish a new SuDS Approval Body (SAB) that would sit outside the existing planning system. This will be achieved principally by amending planning policy so that LPAs can give increased weight to the provision and maintenance of SuDS, alongside other material considerations, during the determination of a planning application.

5.1.12 From 6 April 2015 LPAs, including EFDC, will be expected to ensure that local planning policies and decisions on planning applications relating to major development[22] include SuDS for the management of run-off, unless demonstrated to be inappropriate. Minor developments with drainage implications will continue to be subject to existing planning policy (Section 103 of the NPPF) and smaller developments in flood risk areas should still give priority to the use of SuDS.

5.1.13 The PPG has been amended to state:

5.1.14 *"Sustainable drainage systems may not be practicable for some forms of development (for example, mineral extraction). New development should only be considered appropriate in areas at risk of flooding if priority has been given to the use of sustainable drainage systems. Additionally, and more widely, when considering major development, sustainable drainage systems should be provided unless demonstrated to be inappropriate."*

5.1.15 LPAs, including EFDC, should consult the relevant LLFA when considering major development. In considering planning applications EFDC will need to:

- Consult ECC, as the LLFA, on the management of surface water for major development,
- Satisfy themselves that the proposed minimum standards of operation are appropriate, and
- Ensure through the use of planning conditions or planning obligations that there are clear arrangements in place for ongoing maintenance over the lifetime of the development.

5.1.16 *"Local planning authorities are also advised to consult as appropriate:*

- *The relevant sewerage undertaker where a connection with a public sewer is proposed.*
- *The Environment Agency, if the drainage system directly or indirectly involves the discharge of water into a watercourse*
- *The relevant highway authority for an affected road*
- *The Canal and River Trust, if the drainage system may directly or indirectly involve the discharge of water into or under a waterway managed by them*
- *An internal drainage board, if the drainage system may directly or indirectly involve the discharge of water into an ordinary watercourse (within the meaning of section 72 of the Land Drainage Act 1991) within the board's district."*

5.1.17 *"The decision on whether a sustainable drainage system would be inappropriate in relation to a particular development proposal is a matter of judgement for the local planning authority. In*

[22] The definition for Major and Minor developments are set out in the Town and Country Planning Order 2010

making this judgement the local planning authority will seek advice from the relevant flood risk management bodies, principally the lead local flood authority."

5.1.18 ECC, as the LLFA, will become a statutory consultee for planning applications for major developments that have a drainage implication. As a statutory consultee, the LLFA will be under a duty to respond to the LPA and report on their performance on providing a substantive response within deadlines set out in legislation.

National Strategy for Flood and Coastal Erosion Risk Management

5.1.19 In accordance with the Act, the Environment Agency has developed a National Strategy for Flood and Coastal Erosion Risk Management (FCERM) in England. This Strategy provides a framework for the work of all flood and coastal erosion risk management authorities.

5.1.20 The National FCERM Strategy sets out the long-term objectives for managing flood and coastal erosion risks and the measures proposed to achieve them. It sets the context for, and informs the production of local flood risk management strategies by LLFAs, which will in turn provide the framework to deliver local improvements needed to help communities manage local flood risk. It also aims to encourage more effective risk management by enabling people, communities, business 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 risks;
- encourage innovative management of risks taking account of the needs of communities and the environment;
- ensure that emergency responses to flood incidents are effective and that communities are able to respond properly to flood warnings; and
- ensure informed decisions are made on land use planning.

5.1.21 The Environment Agency's 'Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities'[23] guidance is a supporting note for the National FCERM Strategy. It provides the UK Climate Projections (UKCP09) climate change factors for river flood flows and extreme rainfall for each river basin district, and provides advice on applying climate change projections in the FCERM. It is essential that land use planning decisions consider the impact of a changing climate where appropriate.

5.2 Local Policy

Epping Forest District Council Local Plan (2008) and Alterations (2006)

5.2.1 The Epping Forest District Local Plan (1998) and Alterations (2006) Document[24] in 2008, provide the overarching strategy for planning policies in Epping Forest. The Local Plan includes a number of policies relevant to flood risk and management:

[23] Environment Agency (2010) Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities
[24] Epping Forest District Council (2008) Combined policies of Epping Forest District Local Plan (1998) and Alterations (2006)

Policy U2A – Development in Flood Risk Areas

5.2.2 *"Development proposals within the Environment Agency's currently designed Flood Risk Zones will be determined in accordance with a sequential approach as set out in PPG25 [now replaced by the NPPF]. This will be, in order of priority:*

a. *areas with little or no flood risk*

b. *areas of low to medium risk*

c. *areas of high risk*

d. *areas of functional flood plain.*

5.2.3 *In accordance with this order of priority, the Council will only permit development in areas of functional flood plain if:*

a. *it involves use of land only, and would not increase flood risk or danger from flood risk; or*

b. *it is proven to be essential infrastructure which cannot be located elsewhere. No such development will be allowed if it would cause any negative impacts on any part of the flood regime of the watercourse involved.*

5.2.4 *Development in high risk areas will only be allowed if:*

a. *(iii) there will be no increased risk of flooding either on site or elsewhere in the floodplain or suitable mitigation measures will be incorporated as part of the scheme; and*

b. *(iv) the development would not reduce the effectiveness of existing flood defence measures; and*

c. *(v) there is no suitable alternative site available in the locality which is at a lower risk of flooding; and*

d. *(vi) there will be no significant adverse effects upon a watercourse, navigable waterway or sewer; or*

e. *(vii) adequate and appropriate flood-prevention measures to minimise the risk of flooding are incorporated as part of the development.*

5.2.5 *Development in all other flood risk areas will be allowed under this policy, provided that suitable flood minimisation and/or mitigation measures are included as part of the development. All applications or proposals for development in flood risk areas will be required to be accompanied by a Flood Risk Assessment covering matters (i) to (v) above, to be carried out to the satisfaction of the Council and/or the Environment Agency.*

POLICY U2B – Flood Risk Assessment Zones

5.2.6 *Within the Flood Risk Assessment Zones as shown on the Alterations Proposals Map, Flood Risk Assessments will be required for any development proposals (other than house extensions) which exceed 50m^2. Outside these zones, a Flood Risk Assessment will be required for any proposals which exceed 235m^2.*

POLICY U3A – Catchment Effects

5.2.7 *The Council will not permit development which would result in either:*

a. *(i) increased risk of flooding or a reduction in the effectiveness of existing flood defence measures, either on site or elsewhere within the catchment; or*

b. *(ii) significant adverse effects upon a watercourse, navigable waterway or sewerage infrastructure,*

5.2.8 *unless it is satisfied that adequate and appropriate attenuation measures, such that there is no increase in the risk of flooding, are incorporated as part of the development.*

POLICY U3B – SUSTAINABLE DRAINAGE SYSTEMS

5.2.9 *In consultation with the Environment Agency and, where appropriate, sewerage undertakers, the Council may require developments to include sustainable drainage systems to control the quality or attenuate the rate of surface water run-off. Contributions in the form of commuted sums may be sought in legal agreements to ensure that the drainage systems can be adequately maintained.*

5.2.10 EFDC is currently in the process of preparing a new Local Plan to replace the existing Local Plan and Alterations document. EFDC consulted on its Issues and Options for the Local Plan[25] in 2012, allowing members of the public and relevant stakeholders the opportunity to inform the council on whether all significant issues for future planning within the district were identified and to give their opinion on the options identified. The Local Plan is currently expected to be adopted in 2017.

5.2.11 Once adopted, the new Local Plan will replace all policies within the existing Local Plan and Alterations document. Local Plan policy relating to flood risk may be revised in response to the introduction of the NPPF and PPG.

5.3 Additional Guidance and Strategy Documents

National Strategy for Flood and Coastal Erosion Risk Management

5.3.1 In accordance with the Act, the Environment Agency has developed a National Strategy for Flood and Coastal Erosion Risk Management (FCERM) in England[26]. This Strategy provides a framework for the work of all flood and coastal erosion risk management authorities.

5.3.2 The National FCERM Strategy sets out the long-term objectives for managing flood and coastal erosion risks and the measures proposed to achieve them. It sets the context for, and informs the production of local flood risk management strategies by LLFAs, which will in turn provide the framework to deliver local improvements needed to help communities manage local flood risk. It also aims to encourage more effective risk management by enabling people, communities, business 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 risks;
- encourage innovative management of risks taking account of the needs of communities and the environment;

[25] Epping Forest District Council (2012) Community Choices: Issues and Options for the Local Plan. Consultation Document
[26] Defra, Environment Agency (2011) The National Flood and Coastal Erosion Risk Management Strategy for England.

- ensure that emergency responses to flood incidents are effective and that communities are able to respond properly to flood warnings; and,
- ensure informed decisions are made on land use planning.

5.3.3 The Environment Agency's 'Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities'27 guidance is a supporting note for the National FCERM Strategy. It provides the UK Climate Projections (UKCP09) climate change factors for river flood flows and extreme rainfall for each river basin district, and provides advice on applying climate change projections in the FCERM. It is essential that land use planning decisions consider the impact of a changing climate where appropriate.

Thames River Basin District Consultation on the draft Flood Risk Management Plan (FRMP)

5.3.4 The EU Floods Directive[28], transposed into UK Law through the Flood Risk Regulations[29], requires the Environment Agency to prepare FRMPs for all of England covering flooding from Main Rivers, the sea and reservoirs.

5.3.5 As such, the draft Thames River Basin District FRMP[30] has been published for consultation by the Environment Agency and sets out the proposed measures to manage flood risk in the Thames River Basin District (RBD) from 2015 to 2021 and beyond. As such, the FRMP will assist in the delivery of the requirements of the National Flood and Coastal Erosion Risk Management Strategy for England. This document draws on existing reports and plans which have been prepared in the past.

5.3.6 The River Lee and River Roding catchments drain the majority of the district, with the former included in what is referred to as the London sub-catchment in the FRMP and the latter included in the River Roding, Beam and Ingreborne sub-catchment. The objectives relevant to EFDC are outlined in further detail in Section 4.8.

5.3.7 The final FRMP is due to be published before 21 December 2015.

Thames Catchment Flood Management Plan

5.3.8 A Catchment Flood Management Plan (CFMP) is a high-level strategic planning document that provides an overview of the main sources of flood risk and how these can be managed in a sustainable framework for the next 50 to 100 years. The Environment Agency engages stakeholders within the catchment to produce policies in terms of sustainable flood management solutions whilst also considering local land use changes and effects of climate change. CFMPs are due to be replaced by Flood Risk Management Plans (FRMPs) in 2015.

5.3.9 The CFMPs are used to inform and support planning policies, statutory land use plans and implementation of the Water Framework Directive, so that future development in the catchment is sustainable in terms of flood risk. Awareness of the role of CFMPs among land-use planners is in its infancy at the time of this report.

5.3.10 The approach that the Environment Agency would like to see taken to flood risk management within the district is outlined in the Thames CFMP (2009).

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[27] Environment Agency (2010) Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities
[28] European Union (2007) EU Floods Directive http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32007L0060:EN:NOT
[29] HSMO (2009) The Flood Risk Regulations http://www.legislation.gov.uk/uksi/2009/3042/contents/made
[30] Environment Agency (October 2014) Humber River Basin District Consultation on the draft Flood Risk Management Plan https://consult.environment-agency.gov.uk/portal/ho/flood/draft_frmp/consult?pointId=s1407245182324#section-s1407245182324

5.3.11 The policies listed below are used to identify the appropriate approach to flood risk management across all CFMPs, and will continue to be used in the FRMPs:

- Policy 1 – No active intervention (including Flood Warning and Maintenance). Continue to monitor and advise.
- Policy 2 – Reduce existing flood risk management actions (accepting that flood risk will increase over time).
- Policy 3 – Continue with existing or alternative actions to manage flood risk at current levels.
- Policy 4 – Take further action to sustain the current level of flood risk into the future (responding to the potential increases in risk from urban development, land use change and climate change).
- Policy 5 – Take further action to reduce flood risk.
- Policy 6 – Take action with others to store water or manage runoff in locations that provide overall flood risk reduction or environmental benefits, locally or elsewhere in the catchment.

5.3.12 The preferred policy for the district in the CFMP is Policy 5, associated with the Lower Lee and Policy 6. The CFMP states that Policy 5 is typically applied to areas where there is a particularly strong case for taking further action to reduce the flood risk. Policy 6 typically applies where opportunities to reduce flood risk at a local scale exist in some locations, or at a catchment scale through more holistic management such as water storage.

Thames River Basin Management Plan

5.3.13 The Thames River Basin Management Plan (RBMP) details the pressures placed on the water environment within the Thames river basin, the existing state of water bodies and the proposed actions to be taken to manage the pressures. 2015 represents the end of the first of a continuous series of 6-year cycles introduced by the Water Framework Directive (WFD).

5.3.14 The WFD established a framework for the protection and improvement of inland surface waters (rivers and lakes), transitional waters (estuaries), coastal waters and groundwater. As set out in the WFD development must not result in the deterioration of the water quality status of a waterbody and must not prevent the future attainment of WFD Good Ecological Status (GES) or, in the case of artificial or heavily modified waterbodies, Good Ecological Potential. SuDS, in addition to their role in flood risk management, also have a key role in treatment of surface water runoff and therefore may contribute towards the attainment of GES.

5.3.15 The Thames RBMP defines a list of measures, relating to water quality, required for each WFD waterbody within the district. The Environment Agency requires all development proposing works to watercourses to request the relevant list of RBMP measures when formulating a FRA to ensure that proposed development is acceptable in relation to WFD requirements.

5.3.16 The Environment Agency website[31] provides details of the ecological and chemical status of the waterbodies within the district, as summarised in Table 5.1.

[31] Environment Agency (2015) Water Framework Directive - River Basin Management Plans - Rivers http://maps.environment-agency.gov.uk/wiyby/wiybyController?lang=_e&topic=wfd_rivers&layer=default&ep=map&layerGroups=default&scale=11&x=484653&y=155969#x=486885&y=154083&lg=1,7,8,9,&scale=6. Accessed 09/04/15

Table 5.1 WFD Status of Watercourses within the district

Water body	Hydromorphological Status	Current Ecological Quality	2015 Predicted Ecological Quality	Current Chemical Quality	2015 Predicted Chemical Quality
Lee (from Woolens Brook down to Tottenham Locks)	Heavily Modified	Moderate Potential	Moderate Potential	Fail	Fail
Lee Navigation (Small River Lee)	Not Designated/ Heavily Modified Water Body (HMWB)	Good Status	Good Status	Does Not Require Assessment (DNRA)	DNRA
Cobbins Brook	Not Designated/HMWB	Bad Status	Moderate Status	DNRA	DNRA
Nazeing Brook	Not Designated/HMWB	Moderate Status	Moderate Status	DNRA	DNRA
Canons Brook	Not Designated/HMWB	Moderate Status	Moderate Status	DNRA	DNRA
Stort Navigation (near Sawbridgeworth Lock)	Heavily Modified	Poor Potential	Moderate Potential	Fail	Fail
Princey Brook	Not Designated/HMWB	Poor Status	Moderate Status	DNRA	DNRA
Roding (Cripsey Brook to Loxford Water)	Heavily Modified	Poor Potential	Moderate Potential	Fail	Fail
Brookhouse Brook	Not Designated/HMWB	Poor Status	Moderate Status	DNRA	DNRA
Cripsey Brook (bottom section)	Not Designated/HMWB	Poor Status	Moderate Status	DNRA	DNRA
Cripsey Brook (top section)	Not Designated/HMWB	Poor Status	Moderate Status	DNRA	DNRA
Higher Laver Brook	Not Designated/HMWB	Moderate Status	Moderate Status	DNRA	DNRA
Roding (upper, Roding to Norton Ditch)	Heavily Modified	Moderate Potential	Moderate Potential	DNRA	DNRA

6 FLOOD RISK MANAGEMENT POLICY CONSIDERATIONS

6.1 Policy Considerations

6.1.1 In accordance with the NPPF, a specific policy on flood risk should be included in the EFDC Local Plan to ensure:

- Development is located in the lowest risk area where possible;
- New development is flood-proofed to a satisfactory degree and does not increase flood risk elsewhere;
- Surface water is managed effectively on site.

6.1.2 EFDC should work with ECC and the Environment Agency to improve the management of surface water drainage and ensure that those that own and maintain flood assets continue to do so.

6.1.3 EFDC should promote greater awareness of flood risk and to encourage more people to sign up to the Flood Warning Direct Services provided by the Environment Agency. Flood resilience at the individual property level should also be promoted.

6.1.4 It is recommended that the following flood risk objectives are taken into account during the policy making process. It should be noted that it is ultimately the responsibility of EFDC to formally formulate these policies and implement them.

6.2 Area Wide Recommendations

6.2.1 General flood mitigation policies should address the following issues:

NPPF Policy

- The NPPF requires a Flood Risk Assessment (FRA) to be carried out for all proposals in Flood Zone 2 and Flood Zone 3, for all developments greater than 1ha in Flood Zone 1, and where a development site is located in an area known to have experienced flooding problems from any flood source, including critical drainage problems;
- Where a development has not been subject to the Sequential Test, for example windfall sites, EFDC should ensure the Sequential Test, and where necessary the Exception Test, is undertaken in order to reduce the flood risk to the site and ensure that the vulnerability classification of the proposed development is appropriate to the Flood Zone classification. As stated in the NPPF, minor development and changes of use should not be subject to the Sequential or Exception Tests, with the exception of changes of use to a caravan, camping/chalet site or mobile/park home site;
- A sequential approach should be used to locate elements of development according to vulnerability and risk of flooding. The most vulnerable development should be located in the areas of the site at lowest risk of flooding and all development should be appropriate to the flood risk;
- The NPPF states that all development must avoid increasing flood risk elsewhere as a minimum. Runoff from the site post-development must not exceed pre-development rates for all storm events up to and including the 1% AEP storm event with an allowance for climate change. The appropriate climate change allowance

should be defined using Environment Agency guidance: 'Climate Change allowances for planners'[32];

- If necessary, attenuation of runoff should be provided on site for these storm events in order to meet runoff requirements;
- Where development within flood risk areas is absolutely necessary, flood resilient and resistant construction methods should be utilised to reduce the impact of flooding.

Core policies for inclusion within the EFDC Local Plan

Flood Risk Assessment

- Beyond the requirements of the NPPF, EFDC requires the following formal assessment of flood risk;
    1. For development of between 50 - 100m^2 impermeable area, within a FRAZ, a surface water drainage assessment and maintenance details will need to be submitted. Compliance with the principles of SuDS should be demonstrated;
    2. For development of between 100 - 235m^2 impermeable area, within a FRAZ, a FRA will need to be submitted, along with details of the proposed surface water management strategy and how this will be maintained. The assessment shall demonstrate that adjacent areas shall not be subject to increased flood risk and, dependent upon the capacity of the receiving drainage, shall include calculations of any increased storm run-off and the necessary on-site detention;
    3. For development over 235m^2 impermeable area, a full FRA will need to be submitted, along with details of the proposed surface water management strategy and how this will be maintained. The assessment will need to include calculations of the greenfield runoff rate, increased run-off rates and the associated volume of storm detention. The general principles of a FRA outlined in the NPPF, and in Section 9.6, below, should be used as a minimum requirement.
- FRAs are required for all developments identified as at high risk from sources of flooding other than fluvial;
- EFDC expects all development proposals to show a reduction in flood risk onsite and, where appropriate, elsewhere within the catchment. All development should aspire to achieve greenfield runoff rates from the site up to and including the 1% AEP (plus climate change) storm event;
- All new development greater than 1ha in size should be required to match greenfield runoff rates, with appropriate runoff attenuation up to and including the 1% AEP (plus climate change) storm event;
- Space should be specifically set aside for SuDS, which will be a requirement for all appropriate new development and used to inform the overall site layout. The drainage systems must be appropriate for local soil and geology conditions.

[32] Environment Agency (2013) Climate change allowances for planners: Guidance to support the National Planning Policy Framework

Finished Floor Levels/Lower Level Development

- It is recommended that, for development located in areas of potential surface water flood risk, potential flood depths are identified by the Environment Agency's website: http://watermaps.environment-agency.gov.uk/wiyby/wiyby.aspx?topic=ufmfsw#x=357683&y=355134&scale=2. Care should be taken when interpreting the uFMfSW as it is not intended for assessing flood risk at property level;
- It is recommended that, should any development be located in an area of medium to high surface water risk (1% AEP and 3.33% AEP storm events) it should be designed with appropriate building thresholds in order to reduce the risk of surface water inundation;
- In areas at risk of flooding, it is considered that undercroft or ground floor parking would be preferred to habitable rooms at ground floor level. Restrictions may apply to the provision of ground floor bedrooms;
- The construction of habitable basements, which are classified by the NPPF as highly vulnerable development, are not appropriate within Flood Zone 3 and would be discouraged in Flood Zone 2;
- If development is to be constructed with less vulnerable uses on the ground level, agreements need to be in place to prevent future alteration of these areas to more vulnerable uses without further study into flood risk;
- Single storey residential development should not normally be considered in high flood risk areas as they offer no opportunity for safe refuge areas on upper floors.

Emergency Planning

- In areas at risk of flooding, safe refuge should be provided within the building. An area of safe refuge should be located at least 300mm above the 1% AEP (with climate change) fluvial flood level;
- Safe access and egress routes should be provided for all residential development in areas of flood risk. Safe access and egress is defined as a route to and from any development, located entirely above the 1% AEP (plus climate change) flood level. Where safe access and egress is a potential issue, this should be discussed with EFDC as the LPA at the earliest stage;
- Critical infrastructure located in flood zones or other areas of known flooding should be assessed to ensure that there are adequate procedures for access and evacuation;
- In relation to areas identified as being at risk of flooding, the location of vulnerable development and critical infrastructure such as roads should be considered in detail;
- Emergency planning strategies should be put in place in order to direct people to safety during times of flood;
- Current emergency planning strategies should be reviewed to determine the suitability of refuge centres and evacuation routes based on the flood zone mapping produced in this study;
- Safety and resilience should be integral to the overall design of a site, for example dry access and egress routes for pedestrians, liaison with EFDC and ECC Emergency Planning teams, and finished floor levels a minimum of 300mm above the 1% AEP (plus climate change) flood level;

- Where new development is permitted in flood risk areas, this should include appropriate resilience and resistance features, and mitigation measures including evacuation plans to address residual risk.

Functional floodplain/flood alleviation and storage schemes

- It is recommended that the functional floodplain and sites identified for flood storage or alleviation should be protected from future development;
- Opportunities should be sought to reinstate as floodplain any areas which have been developed through removal, re-design or relocation of buildings and other structures;
- Opportunities should be sought to make space for water to accommodate climate change in order to assist in managing future flood risk;
- A 8m buffer zone must be maintained along fluvial river corridors, in accordance with Land Drainage Bylaws to ensure that maintenance of the channel can be undertaken;
- New development should avoid where possible the construction of new, or building over existing, culverts;
- Opportunities to enhance or restore a river corridor should be identified in appropriate applications e.g. de-culverting where possible, to return watercourses to a natural system, reducing back up of flows and under capacity where this does not exacerbate the flooding elsewhere. The design of flood storage areas should also take into account the potential for other land uses. Enhancement schemes and appropriate uses include informal recreation and wildlife habitat creation and conservation.

Delivery of EFDC policy

6.2.2 The NPPF states that planning obligations may be used by EFDC to "mitigate the impact of unacceptable development to make it acceptable in planning terms".

6.2.3 The Community Infrastructure Levy (CIL) came into force during April 2010[33] and allows Local Authorities in England and Wales to raise funds from developers undertaking new building projects within their area of governance. Such funds can be used to provide infrastructure that will be necessary to mitigate the effects of the development, including flood defences.

6.2.4 Any developments proposed in Environment Agency flood zones or in EFDC FRAZs that could affect drainage and flood patterns either in the FRAZ or downstream could provide an opportunity for CIL to be used.

6.2.5 Section 106 agreements (Town and Country Planning Act 1990)[34] are a mechanism designed to make a development proposal acceptable in planning terms, through the site specific mitigation of impacts from a development.

6.2.6 The use of Section 106 generated funds for the development of flood alleviation measures within the FRAZs would be dependent on the location of proposed developments in flood prone areas.

6.2.7 The following are examples of mitigation measures which could be funded by CIL or section

[33] HMSO (2010) The Community Infrastructure Levy Regulations
[34] HMSO (1990) Town and Country Planning Act

106 agreements:

- Where a development borders an area benefiting from flood defences (ABD), opportunities should be sought for the maintenance of these flood defences to be partly funded by the development for its lifetime.
- Permissions for riverside developments should, subject to consultation with appropriate agencies, include provision for developer contributions for refurbishment of assets such as bridges, culverts, walls etc. to ensure safety during the lifetime of the development.
- Opportunities should be pursued to retrofit SuDS in known problem areas, such as FRAZs, with developer contributions where appropriate.
- River channel restoration should be undertaken where possible to return the river to its natural state and restore floodplain to reduce the impact of flooding downstream;
- Opportunities should be sought to reduce the risk of flooding from the sewer network through consultation with TWUL/AWS to determine key areas for maintenance and flood alleviation schemes.

7 GUIDANCE ON THE APPLICATION OF THE SEQUENTIAL TEST

7.1 Sequential Approach

7.1.1 The sequential approach is a simple decision-making tool designed to ensure that sites at little or no risk of flooding are developed in preference to sites at higher risk. This will help avoid the development of sites that are inappropriate on flood risk grounds. The subsequent application of the Exception Test where required will ensure that new developments in flood risk areas will only occur where flood risk is clearly outweighed by other sustainability drivers.

7.1.2 The sequential approach can be applied at all levels and scales of the planning process, both between and within Flood Zones. All opportunities to locate new developments (except Water Compatible) in reasonably available areas of little or no flood risk should be explored, prior to any decision to locate them in areas of higher risk.

7.2 Applying the Sequential Test – Plan-Making

7.2.1 A LPA must demonstrate that it has considered a range of possible sites in conjunction with the Flood Zone and vulnerability information from the SFRA and applied the Sequential Test, and where necessary, the Exception Test, in the site allocation process. Figure 7.1 illustrates the approach for applying the Sequential Test that EFDC should adopt in the allocation of sites as part of the preparation of the Local Plan. The Sequential Test should be undertaken by EDFC and accurately documented to ensure decision processes are consistent and transparent.

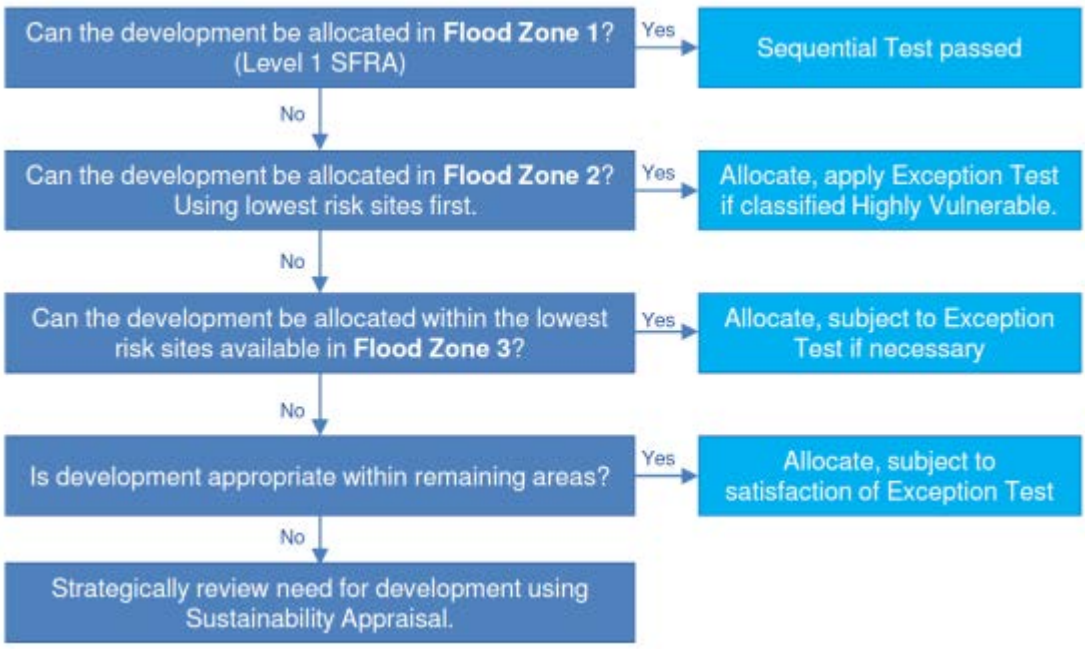

Figure 7.1 Application of Sequential Test for Local Plan preparation

7.2.2 The Sequential Test requires an understanding of the Flood Zones in the study area and the vulnerability classification of the proposed developments. Flood Zone definitions are provided in Table 4.1 and mapped in Figures 6A-6R in Appendix A (and the Flood Map for Planning (Rivers and Sea) on the Environment Agency website). Flood risk vulnerability classifications, as defined in the PPG are presented in Table 7-1.

Table 7.1 Flood Risk Vulnerability Classification (PPG, 2014)

Vulnerability Classification	Development Uses
Essential Infrastructure	Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk. Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood. Wind turbines.
Highly Vulnerable	Police stations, ambulance stations and fire stations and command centres and telecommunications installations required to be operational during flooding. Emergency dispersal points. Basement dwellings. Caravans, mobile homes and park homes intended for permanent residential use. Installations requiring hazardous substances consent. (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as 'Essential Infrastructure').
More Vulnerable	Hospitals. Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels. Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels. Non–residential uses for health services, nurseries and educational establishments. Landfill and sites used for waste management facilities for hazardous waste. Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.
Less Vulnerable	Police, ambulance and fire stations which are not required to be operational during flooding. Buildings used for shops, financial, professional and other services, restaurants and cafes, hot food takeaways, offices, general industry, storage and distribution, non–residential institutions not included in 'More Vulnerable', and assembly and leisure. Land and buildings used for agriculture and forestry. Waste treatment (except landfill and hazardous waste facilities). Minerals working and processing (except for sand and gravel working). Water treatment works which do not need to remain operational during times of flood. Sewage treatment works (if adequate measures to control pollution and manage sewage during flooding events are in place).

Vulnerability Classification	Development Uses
Water-Compatible Development	Flood control infrastructure. Water transmission infrastructure and pumping stations. Sewage transmission infrastructure and pumping stations. Sand and gravel working. Docks, marinas and wharves. Navigation facilities. MOD defence installations. Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. Water-based recreation (excluding sleeping accommodation). Lifeguard and coastguard stations. Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.

7.2.3 The NPPF acknowledges that some areas will (also) be at risk of flooding from sources other than fluvial. All sources must be considered when planning for new development including: Flooding from land or surface water runoff; Groundwater; Sewers; and Artificial Sources.

7.2.4 If a location is recorded as having experienced repeated flooding from the same source this should be acknowledged within the Sequential Test.

Table 7.2 Flood Risk Vulnerability and Flood Zone 'Compatibility' (PPG, 2014)

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

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

7.2.5 The recommended steps in undertaking the Sequential Test are detailed below. This is based on the Flood Zone and Flood Risk Vulnerability and is summarised in Table 7-2.

Recommended stages for LPA application of the Sequential Test in Plan-Making

7.2.6 The information required to address many of these steps is provided in the accompanying GIS layers and maps presented in Appendix A.

1. Assign potential developments with a vulnerability classification (Table 7-1). Where development is mixed, the development should be assigned the highest vulnerability class of the developments proposed.
2. The location and identification of potential development should be recorded.
3. The Flood Zone classification of potential development sites should be determined based on a review of the Flood Map for Planning (Rivers and Sea). Where these span more than one Flood Zone, all zones should be noted.
4. The design life of the development should be considered with respect to climate change:
   - 100 years – up to 2115 for residential developments; and
   - 75 years – up to 2090 for commercial / industrial developments, or other time horizon specific to the non-residential use proposed.
5. Identify existing flood defences serving the potential development sites. However, it should be noted that for the purposes of the Sequential Test, Flood Zones ignoring defences should be used.
6. Highly Vulnerable developments to be accommodated within the LPA area should be located in those sites identified as being within Flood Zone 1. If these cannot be located in Flood Zone 1, because the identified sites are unsuitable or there are insufficient sites in Flood Zone 1, sites in Flood Zone 2 can then be considered. Highly Vulnerable developments in Flood Zone 2 will require application of the Exception Test. If there are insufficient sites in Flood Zone 2 for Highly Vulnerable uses then the LPA may have to identify additional sites in Flood Zones 1 or 2 to accommodate this type of development. Within each flood zone Highly Vulnerable development should be directed, where possible, to the areas at lowest risk from all sources of flooding. It should be noted that Highly Vulnerable development is not appropriate in Flood Zones 3a and 3b.
7. Once all Highly Vulnerable developments have been allocated to a development site, the LPA can consider those development types defined as More Vulnerable. In the first instance More Vulnerable development should be located in any unallocated sites in Flood Zone 1. Where these sites are unsuitable or there are insufficient sites remaining, sites in Flood Zone 2 should be considered. If there are insufficient sites in Flood Zone 1 or 2 to accommodate More Vulnerable development, sites in Flood Zone 3a can then be considered. More Vulnerable developments in Flood Zone 3a will require application of the Exception Test. As with Highly Vulnerable development, within each flood zone More Vulnerable development should be directed to areas at lowest risk from all sources of flooding. It should be noted that More Vulnerable development is not appropriate in Flood Zone 3b.
8. Once all More Vulnerable developments have been allocated to a development site, the LPA can consider those development types defined as Less Vulnerable. In the first instance Less Vulnerable development should be located in any remaining unallocated sites in Flood Zone 1, continuing sequentially with Flood Zone 2, then 3a. Less Vulnerable development types are not appropriate in Flood Zone 3b – Functional Floodplain.
9. Essential Infrastructure should be preferentially located in the lowest flood risk zones, however this type of development may be located in Flood Zones 3a and 3b, provided the Exception Test is satisfied.
10. Water Compatible development has the least constraints with respect to flood risk and it is considered appropriate to allocate these sites last. The sequential approach should still be followed in the selection of sites; however it is appreciated that Water

Compatible development by nature often relies on access and proximity to water bodies.

11. On completion of the Sequential Test, EFDC may have identified sites that require the application of the Exception Test. By undertaking the Exception Test, more detail is needed on the flood risks such as flood hazard which would allow a sequential approach to site allocation within a Flood Zone. Consideration of flood hazard within a Flood Zone would include:
    - flood risk management measures,
    - the rate of flooding,
    - flood water depth,
    - flood water velocity.

7.2.7 Development in Flood Zone 3b (Functional Floodplain) should be avoided where possible, with the exception of Water Compatible development which is considered appropriate within this Flood Zone.

7.2.8 Where the development type is Highly Vulnerable, More Vulnerable, Less Vulnerable or Essential Infrastructure and a site is found to be impacted by a recurrent flood source (other than tidal or fluvial), it would be best practise to investigate the site and flood sources further regardless of any requirement for the Exception Test.

Windfall Sites

7.2.9 Windfall sites are those which have not been specifically identified as available in the Local Plan process. They comprise previously-developed sites that have unexpectedly become available. In cases where development cannot be fully met through the provision of site allocations, LPAs are expected to make a realistic allowance for windfall development, based on past trends. It is recommended that 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.

7.3 Applying the Sequential Test – Planning Applications

7.3.1 As illustrated in Figure 7.2, the flood risk Sequential Test can be considered adequately demonstrated if the Sequential Test has already been carried out for the site for the same development type at the Local Plan level.

7.3.2 If the answer to this is 'no', then it is necessary to undertake a Sequential Test for the site. The Environment Agency publication 'Demonstrating the flood risk Sequential Test for Planning Applications'[35] sets out the procedure as follows:

- Identify the geographical area of search over which the test is to be applied; this could be the District area, or a specific catchment if this is appropriate and justification is provided (e.g. school catchment area or the need for affordable housing within a specific area identified for regeneration in Local Plan policies).
- Identify the source of 'reasonably available' alternative sites; usually drawn from evidence base / background documents produced to inform the Local Plan.

[35] Environment Agency, April 2012, 'Demonstrating the flood risk Sequential Test for Planning Applications', Version 3.1

- State the method used for comparing flood risk between sites; for example the Environment Agency Flood Map for Planning, Level 1 SFRA mapping, site-specific FRAs if appropriate, other mapping of flood sources.
- Apply the Sequential Test; systematically consider each of the available sites, indicate whether the flood risk is higher or lower than the application site, state whether the alternative option being considered is allocated in the Local Plan, identify the capacity of each alternative site, and detail any constraints to the delivery of the alternative site(s).
- Conclude whether there are any reasonably available sites in areas with a lower probability of flooding that would be appropriate to the type of development or land use proposed.
- Where necessary, as indicated by Table 7-2, apply the Exception Test.
- Apply the Sequential approach to locating development within the site.

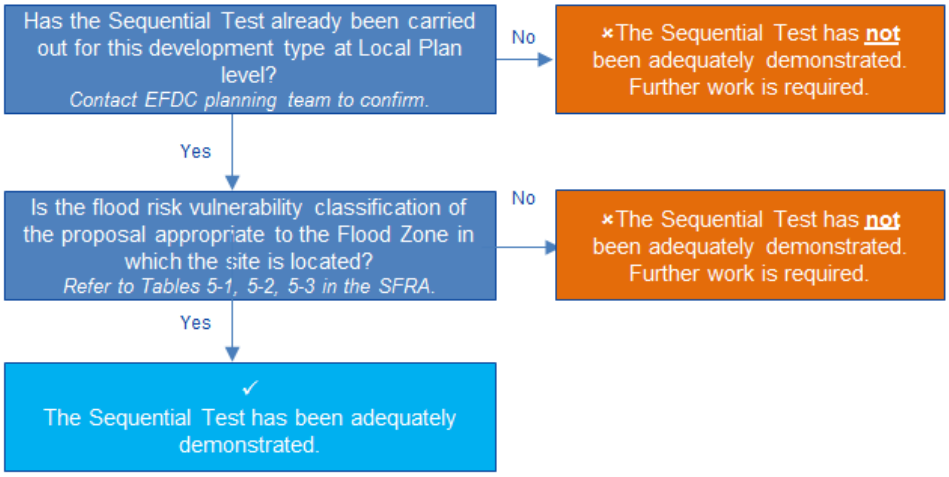

Figure 7.2 Determining when the Sequential Test is required for Planning Applications

7.3.3 It should be noted that it is for LPAs, taking advice from the Environment Agency as appropriate, to consider the extent to which Sequential Test considerations have been satisfied, taking into account the particular circumstances in any given case. The developer should justify with evidence to the LPA what area of search has been used when making the application. Ultimately EFDC needs to be satisfied in all cases that the proposed development would be safe and not lead to increased flood risk elsewhere.

Sequential Test Exemptions

7.3.4 It should be noted that the Sequential Test does not need to be applied in the following circumstances:

- Individual developments proposed on sites which have been allocated in development plans that have been through the Sequential Test.
- Minor development, which is defined in the NPPF as:
  - minor non-residential extensions: industrial / commercial / leisure etc. extensions with a footprint <250m^2;
  - alterations: development that does not increase the size of buildings e.g. alterations to external appearance;

  - householder development: for example; sheds, garages, games rooms etc. within the curtilage of the existing dwelling itself. This definition excludes any proposed development that would create a separate dwelling within the curtilage of the existing dwelling e.g. subdivision of houses into flats.

- Change of Use applications, unless it is for a change of use of land to a caravan, camping or chalet site, or to a mobile home site or park home site.
- Development proposals in Flood Zone 1 (land with a low probability of flooding from rivers or the sea) unless the SFRA, or other more recent information, indicates there may be flooding issues now or in the future (for example, through the impact of climate change).

7.4 Exception Test

7.4.1 The purpose of the Exception Test is to ensure that new development is only permitted in Flood Zone 2 and 3 where flood risk is clearly outweighed by other sustainability factors and where the development will be safe during its lifetime, considering climate change.

7.4.2 Paragraph 102 of the NPPF states that for the Exception Test to be passed:

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

7.4.3 Both elements of the Exception Test will have to be passed for development to be allocated or permitted.

7.4.4 When determining planning applications, EFDC should ensure flood risk is not increased elsewhere. The NPPF states that EFDC should only consider development appropriate in areas at risk of flooding *"where, informed by a site-specific FRA following the Sequential Test, and if required the Exception Test, it can be demonstrated that:*

- *within the site, the most vulnerable development is located in areas of lowest flood risk unless there are overriding reasons to prefer a different location; and*
- *development is appropriately flood resilient and resistant, including safe access and escape routes where required, and that any residual risk can be safely managed, including by emergency planning; and it gives priority to the use of sustainable drainage systems."*

7.4.5 There are a number of ways a new development can be made safe:

- Avoiding flood risk by not developing in areas at risk from floods,
- Substituting higher vulnerability land uses for lower vulnerability uses in higher flood risk locations and locating higher vulnerability uses in areas of lower risk on a strategic scale, or on a site basis,
- Providing adequate flood risk management infrastructure which will be maintained for the lifetime of the development, and
- Mitigating the potential impacts of flooding through design and resilient construction.

7.4.6 In order to determine part 1) of the Exception Test, applicants should assess their scheme

against the EFDC Sustainability Appraisal (SA). SA work for the new Epping Forest Local Plan has been underway since 2010. Further work, including a scoping update and site appraisal work, is being undertaken to support the emerging Local Plan. It is intended that SA plays a key role in the site allocation process, particularly in order to determine Part 1 of the Exception Test, where required, in line with the NPPF

Exception Test Exemptions

7.4.7 It is noted that applications for minor development and change of use are exempt from the Exception Test; however site-specific FRAs are still required, as detailed in Section 8.

8 GUIDANCE FOR PREPARING SITE-SPECIFIC FRAS

8.1 Overview

8.1.1 This Level 1 SFRA Update provides a strategic assessment of flood risk in Epping Forest District and should be consulted by prospective developers within the district. However it should be noted that this document has a strategic scope and therefore it is essential that site-specific FRAs are also developed for individual development proposals where required, and that where necessary and appropriate, suitable mitigation measures are incorporated.

8.1.2 A site-specific FRA is a report suitable for submission with a planning application which provides an assessment of flood risk to and from a proposed development, and demonstrates how the proposed development will be made safe, will not increase flood risk elsewhere and where possible will reduce flood risk overall in accordance with the NPPF and PPG.

8.2 When is a Flood Risk Assessment required?

8.2.1 The Environment Agency provides flood risk standing advice for applicants and agents on their website: https://www.gov.uk/planning-applications-assessing-flood-risk. This includes information on when a FRA is required and advice on the contents of FRAs for various development types in Flood Zone 1, Flood Zone 2 and Flood Zone 3.

8.2.2 The NPPF states that a site specific FRA is required in the following circumstances:

- 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).
- Proposals of 1 hectare or greater in Flood Zone 1.
- Where proposed development or a change of use to a more vulnerable class may be subject to other sources of flooding.

8.2.3 The Environment Agency Guidance Note for FRAs in Flood Zone 1: (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/311502/LIT_9193.pdf) should be consulted for advice on the approach and content of a FRA.

8.2.4 In addition to the requirements set by the NPPF, as outlined above, EFDC has set additional requirements for the assessment of flood risk for proposed developments, dependant on the developments' size and location within the district. The relevant policy is presented in Policy U2B of the Local Plan Alterations (2006).

Requirement for assessment of flood risk beyond NPPF policy

8.2.5 The Level 1 SFRA details requirements for assessment of flood risk for proposed developments beyond those set by the NPPF. As indicated by Figure 3 in Appendix A, there have been a large number of recorded flood incidents within the district. EFDC has therefore taken a proactive approach regarding flood policy, with strict policies outlined in the Local Plan aimed at reducing flood risk within the District.

8.2.6 EFDC has defined FRAZs (Figure 13 of Appendix A) where a FRA may still be required for development which does not match the NPPF criteria. FRAZs are defined as catchments of ordinary watercourses which have been identified by EFDC. These may contribute to Main

River watercourses or where there is a known risk or history of flooding.

8.2.7 Policy U2B of the Epping Forest Local Plan Alterations (July 2006) states that:

8.2.8 *'Within the Flood Risk Assessment Zones as shown on the Alterations Proposals Map, Flood Risk Assessments will be required for any development proposals (other than house extensions) which exceed 50m^2. Outside these zones, a flood risk assessment will be required for any proposals which exceed 235m^2."*

8.2.9 Policy U2B will be enforced, where appropriate, by attaching planning conditions requiring a FRA to planning permissions. The level of detail required in the FRA is dependent on the size of the developments as well as its location within the district and a guide is outlined as follows:

- For development less than 50m^2 impermeable area, a FRA is not required;
- For development of between 50 - 100m^2 impermeable area, within a FRAZ, a surface water drainage assessment and maintenance details will need to be submitted. Compliance with the principles of SuDS should be demonstrated;
- For development of between 100 - 235m^2 impermeable area, within a FRAZ, a FRA and Management and Maintenance plan will need to be submitted. The assessment shall demonstrate that adjacent properties shall not be subject to increased flood risk and, dependent upon the capacity of the receiving drainage, shall include calculations of any increased storm run-off and the necessary on-site detention;
- For development over 235m^2 impermeable area, a full FRA and Management and Maintenance plan will need to be submitted. The assessment will need to include calculations of the greenfield runoff rate, increased run-off rates and the associated volume of storm detention. The general principles of a FRA outlined in the NPPF, and in Section 9.6, below, should be used as a minimum requirement.

8.2.10 EFDC is currently working on delivering its new Local Plan and should flood risk policy change from that contained within the Local Plan Alterations Document, Flood Risk Assessment requirements should be updated as necessary.

8.3 Scope of a site-specific FRA

8.3.1 The PPG states that site-specific FRAs should always be proportionate to the degree of flood risk and make optimum use of readily available information, for example the mapping presented within this SFRA.

8.3.2 The PPG outlines how the objectives of a site-specific FRA are to establish the following:

- *"whether a proposed development is likely to be affected by current or future flooding from any source;*
- *whether it will increase flood risk elsewhere;*
- *whether the measures proposed to deal with these effects and risks are appropriate;*
- *the evidence for the local planning authority to apply (if necessary) the Sequential Test, and;*
- *whether the development will be safe and pass the Exception Test, if applicable."*

8.3.3 Table 8-1 is based on the checklist for site specific FRAs provided in the Planning Practice Guidance. Where appropriate, references have been added to determine where the information can be found to support each required item.

Table 8.1: Site-Specific Flood Risk Assessment Checklist (Planning Practice Guidance)

1. DEVELOPMENT DESCRIPTION AND LOCATION	
1a. What type of development is proposed (e.g., new development, an extension to existing development, a change of use etc.) and where will it be located?	☐
1b. What is its flood risk vulnerability classification? Refer to Section 7.2 Table 7.1.	☐
1c. Is the proposed development consistent with the Local Plan for the area? EFDC is in the process of delivering a new Local Plan. The existing Local Plan and Development Policies should be referred to on the EFDC website: http://www.eppingforestdc.gov.uk/index.php/contact-us/consultation/planning-our-future/existing-local-plan and advice sought from EFDC if necessary.	☐
1d. What evidence can be provided that the Sequential Test and where necessary the Exception Test has/have been applied in the selection of this site for this development type? Consult EFDC to determine if the site has been included in the Sequential Test. If not, refer to Section 7.3 for guidance on undertaking the Sequential Test for individual development sites and to determine whether the Exception Test is required.	☐
1e. Will your proposal increase overall the number of occupants and/or users of the building/land, or the nature or times of occupation or use, such that it may affect the degree of flood risk to these people? This is particularly relevant to minor developments (alterations & extensions) & changes of use.	☐
2. DEFINITION OF THE FLOOD HAZARD	
2a. What sources of flooding could affect the site? Refer to Section 4	☐
2b. For each identified source under 2a above, can you describe how flooding would occur, with reference to any historic records where these are available? Refer to Section 4	☐
2c. What are the existing surface water drainage arrangements for the site? Undertake a site survey to determine specific details. Where appropriate an asset location survey can be provided by Thames Water http://www.thameswater-propertysearches.co.uk/.	☐
3. PROBABILITY	
3a. Which flood zone is the site within? Refer to Appendix A Figure 6 or the Flood Map for Planning (Rivers and Sea) on the Environment Agency's website http://maps.environment-agency.gov.uk/wiyby	☐
3b. Does the SFRA show the same or a different flood zone compared with the Environment Agency's flood map? Refer to Appendix A Figure 6 or the Flood Map for Planning (Rivers and Sea) on the Environment Agency's website http://maps.environment-agency.gov.uk/wiyby. If different you should seek advice from the local planning authority and, if necessary, the Environment Agency enquiries@environment-agency.gov.uk.	☐

3c. What is the probability of the site flooding, taking account of the maps of flood risk from rivers and the sea and from surface water, on the Environment Agency's website, and the SFRA, and of any further flood risk information for the site? Refer to mapping in Appendix A, as well as the Flood Map for Planning (Rivers and Sea) and the Flood Risk from Surface Water mapping on the Environment Agency's website http://maps.environment-agency.gov.uk/wiyby.	☐
3d. If known, what (approximately) are the existing rates and volumes of surface water run-off generated by the site?	☐
4. CLIMATE CHANGE	
How is flood risk at the site likely to be affected by climate change? Refer to Section 4.2.23 and Section 4.3.9 of this Level 1 SFRA Update.	☐
5. DETAILED DEVELOPMENT PROPOSALS	
Where appropriate, are you able to demonstrate how land uses most sensitive to flood damage have been placed in areas within the site that are at least risk of flooding (including providing details of the development layout)? Refer to Section 8.4.1 regarding the use of the sequential approach within development sites.	☐
6. FLOOD RISK MANAGEMENT MEASURES	
How will the site/building be protected from flooding, including the potential impacts of climate change, over the development's lifetime? Refer to Section 8.4.2 for details regarding finished floor levels, basement dwellings, flood resilient design, car parking considerations, and provision of safe access / egress.	☐
7. OFF-SITE IMPACTS	
7a. How will you ensure that your proposed development and the measures to protect your site from flooding will not increase flood risk elsewhere? Refer to Section 8.4 regarding off-site impacts including flood routing and Section 9.	☐
7b. How will you prevent run-off from the completed development causing an impact elsewhere? Refer to Section 9 regarding surface water management. Refer to Section 9.3 regarding the use of specific types of SuDS throughout the district.	☐
7c. Are there any opportunities offered by the development to reduce flood risk elsewhere? Refer to Section 9 regarding surface water management. Refer to Section 9.3 regarding the use of specific types of SuDS throughout the district.	☐
8. RESIDUAL RISKS	
8a. What flood-related risks will remain after you have implemented the measures to protect the site from flooding?	☐
8b. How, and by whom, will these risks be managed over the lifetime of the development? (E.g., flood warning and evacuation procedures). Refer to Section 8.4.31 for details regarding flood warning and flood evacuation plans.	☐

Proposed Development in Low Probability Flood Zone 1

8.3.4 FRAs within Flood Zone 1 should primarily take consideration of how the ability of water to soak into the ground may change with development, along with how the proposed layout of

development may affect drainage systems. This is to ensure surface water generated by the site is managed in a sustainable manner and does not increase the burden on existing infrastructure and/or flood risk to neighbouring property. The assessment of surface water flood risk should take account of the impact of climate change over the lifetime of the development. As stated in paragraph 5.3.9, the 0.1% AEP is considered appropriate to use as a substitute dataset to indicate the potential implications of future climate change.

8.3.5 The uFMfSW dataset (Figures 7A-7R in Appendix A) should be used to indicate broad areas with a potential surface water flood risk. Figure 9 and 10 in Appendix A should be used to provide an indication of areas that may be susceptible to groundwater flooding and where infiltration SuDS may be viable; however more detailed site investigations will also be required to determine local conditions and suitability of drainage techniques. The Level 1 SFRA provides recommendations with respect to the provision of sustainable drainage opportunities that will address both the risk to life and the residual risk of flooding to development within particular 'zones' of the area. These recommendations should form the basis for the site-specific FRA.

Proposed Development within Medium Probability Zone 2

8.3.6 For all sites within Medium Probability Flood Zone 2, a scoping FRA should be prepared based upon readily available existing flooding information, sourced from the Environment Agency. If a significant flood risk from other sources (e.g. surface water, groundwater or sewer flooding) is identified then a more detailed FRA should be prepared. It will be necessary to demonstrate that the residual risk of flooding to the property is effectively managed throughout, for example through the provision of raised floor levels and the provision of planned evacuation routes or safe havens. SuDS techniques must be employed to ensure there is no increase in flooding elsewhere.

Proposed Development in Flood Zone 3a High Probability

8.3.7 All FRAs supporting proposed development within High Probability Flood Zone 3a should assess the proposed development against all elements of the Council's flood policy, and include an assessment of the following:

- The vulnerability of the development to flooding from other sources (e.g. surface water drainage, groundwater) as well as from river flooding. This will involve discussion with EFDC, the Environment Agency, ECC as LLFA, TWUL and AWS to confirm whether a localised risk of flooding exists at the proposed site.
- The vulnerability of the development to flooding over the lifetime of the development (including the potential impacts of climate change), i.e. maximum water levels, flow paths and flood extents within the property and surrounding area.
  - The design life of the proposed development should be considered with respect to climate change as 75 years (up to 2090) for commercial / industrial developments; and 100 years (up to 2115) for residential developments
  - Applicants should consult the Environment Agency to confirm the availability of modelled flood levels associated with nearby watercourses. Where this information is of suitable quality, modelled flood levels for the relevant annual probability events should be compared with site topographic information to more accurately determine the flood risk to the development site.
- Where the quality and/or quantity of information for any of the flood sources affecting a site are insufficient to enable a robust assessment of the flood risk,

further investigation may be required. For example, where hydraulic modelling is not available for ordinary watercourses, the scope of the FRA should be increased to include modelling to ensure details of flooding mechanisms are fully understood and that the proposed development incorporates appropriate mitigation measures;

- The potential of the development to increase flood risk elsewhere through the addition of hard surfaces, the effect of the new development on surface water runoff, and the effect of the new development on depth and speed of flooding to adjacent and surrounding property. This will require a detailed assessment to be carried out by a suitably qualified engineer;
- Opportunities for new developments to deliver reductions to wider flood risk issues where possible, e.g. larger developments may be able to make provisions for flow balancing within new attenuation SuDS features;
- The FRA should consider the vulnerability of those that could occupy and use the development including arrangements for safe access. The FRA should also take account of the vulnerability classification (Table 7.1) and the status of the site in relation to the Sequential and Exception Tests;
- The risk of localised flooding that may occur. This is typically associated with local catchment runoff following intense rainfall;
- A demonstration that residual risks of flooding (after existing and proposed flood management and mitigation measures are taken into account) are acceptable. Measures may include flood defences, flood resistant and resilient design, escape/evacuation, effective flood warning and emergency planning;
- Details of existing site levels, proposed site levels and proposed ground floor levels. All levels should be stated relevant to Ordnance Datum;
- It is essential that developers thoroughly review the existing and future structural integrity of informal defences, if present, upon which the development will rely (i.e. over the lifetime of the development), and ensure that emergency planning measures are in place to minimise risk to life in the unlikely event of a defence failure. This would be particularly important for development that could potentially be affected as a result of a breach of any reservoirs or canals in the study area. SuDS techniques must be employed to ensure no worsening of existing flooding problems elsewhere within the area;
- At all stages, the Local Planning Authority, and where necessary the Environment Agency, IDB and/or the Statutory Water Undertaker should be consulted to ensure the FRA provides the necessary information to fulfil the requirements for Planning Applications.

Proposed Development in Flood Zone 3b Functional Floodplain

8.3.8 In line with the NPPF, development will not normally be allowed in the Functional Floodplain unless it is classified as a Water Compatible or 'Essential Infrastructure' use. Table 2 from the PPG (refer to Section 7.2 of this report), details the type of developments classified as Water Compatible' or Essential Infrastructure.'

8.4 Guidance on Flood Risk Management Measures

Sequential approach within development sites

8.4.1 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. Most large development

proposals include a variety of land uses of varying vulnerability to flooding. The sequential approach should be applied within development sites to locate the most vulnerable elements of a development in the lowest risk areas e.g. residential developments should be restricted to areas at lower probability of flooding whereas parking, open space or proposed landscaped areas can be placed on lower ground with a higher probability of flooding. Whilst traditionally applied to the risk of river flooding, this approach should also be implemented when considering the risk of surface water flooding across a site.

Finished Floor Levels

8.4.2 Where developing in fluvial flood risk areas is unavoidable, the recommended method of mitigating flood risk to people, particularly with More Vulnerable (residential) land uses, is to ensure internal floor levels are raised a freeboard distance above peak flood water levels. Finished floor levels should be set a minimum of 300mm above the 1% AEP plus climate change peak flood level. The peak flood water level should be derived for the immediate vicinity of the site (i.e. relative to the extent of a site along a watercourse as flood levels are likely to vary with increasing distance downstream) as part of a site-specific FRA.

8.4.3 The Environment Agency's requirements for a freeboard above the peak flood level for finished internal floor levels within Less Vulnerable commercial and industrial units vary, depending upon the proposals. For such land uses, finished internal floor levels may not be required to be raised. However, it is strongly recommended that internal access is provided to upper floors (first floor or a mezzanine level) to provide safe refuge in a flood event. Such refuges will have to be permanent and accessible to all occupants and users of the site.

8.4.4 With respect to residential accommodation and in accordance with Tables 1, 2, and 3 of the PPG, basement accommodation, single storey accommodation, and multi-storey buildings with ground floor sleeping accommodation should not be permitted, or allocated, in Flood Zone 3. Sleeping accommodation should be restricted to the first floor or above to offer the required 'safe places'. Internal ground floors below this level could however be occupied by either Less Vulnerable commercial premises, garages or non-sleeping residential rooms (e.g. kitchen, study, lounge) (i.e. applying a sequential approach within a building).

8.4.5 Further consultation with the Environment Agency will therefore be required during the undertaking of any detailed FRA. For both Less and More Vulnerable developments where internal access to higher floors is provided, the associated plans showing this should be included within any site-specific FRA.

8.4.6 Hotels are classed as More Vulnerable land uses, however, where it is not be viable to raise finished floor levels, internal access to higher floors must be provided to give safe refuge to all occupants during times of flood. Sleeping accommodation should be set a minimum of 600mm above the 0.1% AEP plus climate change peak flood level.

8.4.7 In certain situations (e.g. for proposed extensions to buildings with a lower floor level or conversion of existing historical structures with limited existing ceiling levels), it could prove impractical to raise the internal ground floor levels to sufficiently meet the general requirements. In these cases, the Environment Agency should be approached to discuss options for a reduction in the minimum internal ground floor levels provided flood proofing (resistance) measures are implemented up to an agreed level. There are also circumstances where flood proofing (resilience) measures should be considered first. These are described further below.

Basement Dwellings

8.4.8 Basement dwellings are classified as Highly Vulnerable and as such they are not permitted within Flood Zone 3a and 3b. They must pass the Sequential and Exception Tests should they

be proposed for Flood Zone 2. Basements dwellings should therefore be discouraged within areas at risk of fluvial, surface water or groundwater flooding. Where they are constructed, access must be situated 300mm above the design flood level, and waterproof construction techniques should be employed to avoid seepage during flood events. An assessment of groundwater conditions will also be required to inform the structural integrity of the basement construction. Similar problems can also occur where excessive surface water ponding occurs close to the sides of buildings, leading to significant infiltration. Surface water flow paths should be assessed to ensure that this does not occur, and to inform the strategic location of SuDS and techniques to route flows around the edge of buildings.

Flood Resistant and Resilient Design

8.4.9 In order to mitigate any potential flood damage, there are a range of flood resilient construction techniques that can be implemented in new developments. The Department for Communities and Local Government (CLG) have published a document 'Improving the Flood Performance of New Buildings, Flood Resilient Construction'[36], the aim of which is to provide guidance to developers and designers on how to improve the resilience of new properties in low or residual flood risk areas, through the use of suitable materials and construction details.

8.4.10 Figure 8.1 provides a summary of different design strategies depending on the depth of floodwater that could be experienced.

8.4.11 A number of design strategies are detailed including the Water Exclusion Strategy and Water Entry Strategy. Resistance measures are aimed at preventing water ingress into a building (Water Exclusion Strategy); they are designed to minimise the impact of floodwaters directly affecting buildings and to give occupants more time to relocate ground floor contents. These measures will probably only be effective for short duration, low depth flooding, i.e. less than 0.3m.

[36] CLG (2007) Improving the Flood Performance of New Buildings, Flood Resilient Construction

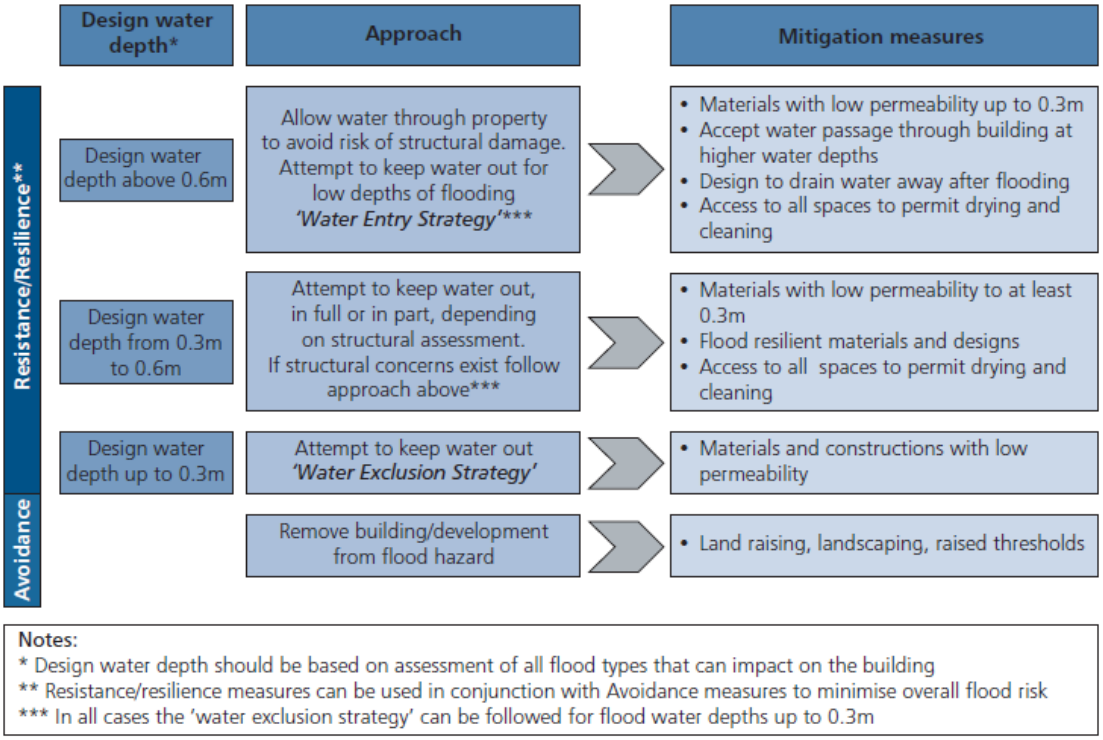

Figure 8.1: Flood Resilient Design Strategies, Improving Flood Performance, CLG 2007

8.4.12 For flood depths greater than 0.6m, it is likely that structural damage could occur in traditional masonry construction due to excessive water pressures. In these circumstances, the strategy should be to allow water into the building, i.e. the Water Entry Strategy.

8.4.13 The principle behind the Water Entry Strategy is not only to allow water through the property to avoid the risk of structural damage, but also to implement careful design in order to minimise damage and allow rapid re-occupancy of the building. The NPPF considers these measures to be appropriate for both changes of use and for Less Vulnerable uses where temporary disruption is acceptable and suitable flood warning is received.

8.4.14 Materials will be used which allow the passage of water whilst retaining their structural integrity and they should also have good drying and cleaning properties. Alternatively sacrificial materials can be included for internal and external finishes; for example the use of gypsum plasterboard which can be removed and replaced following a flood event. Flood resilient fittings should be used to at least 0.1m above the design flood level. Resilience measures are either an integral part of the building fabric or are features inside a building that will limit the damage caused by floodwaters.

8.4.15 Further specific advice regarding suitable materials and construction techniques for floors, walls, doors and windows and fittings can be found in 'Improving the Flood Performance of New Buildings, Flood Resilient Construction' (CLG, 2007).

Car Parks

8.4.16 Where car parks are specified as areas for the temporary storage of floodwaters, flood depths should not exceed 300mm given that vehicles may be moved by water of greater depths. Where greater depths are expected, car parks should be designed to prevent the vehicles from floating out of the car park. Signs should be in place to notify drivers of the susceptibility of flooding and flood warning should be available to provide sufficient time for car owners to

move their vehicles if necessary. The Defra / Environment Agency technical guidance document FD2320/TR2[37] should be consulted by potential developers for information on safety in relation to the depth of flood water. Further information is provided in Section 8.4.21.

Structures

8.4.17 Structures such as (bus, bike) shelters, park benches and refuse bins (and associated storage areas) located in areas with a high flood risk should be flood resilient and be firmly attached to the ground.

Safe Access and Egress

8.4.18 Safe access and egress is required to enable the evacuation of people from the development, provide the emergency services with access to the development during times of flood and enable flood defence authorities to carry out any necessary duties during periods of flood.

8.4.19 A safe access/egress route should allow occupants to safely enter and exit the buildings and be able to reach land outside the flooded area using public rights of way without the intervention of emergency services or others during design flood conditions, including climate change allowances.

8.4.20 For developments located in areas at flood risk the Environment Agency consider 'safe' access/egress to be in accordance with 'FRA Guidance for new Developments FD 2320'[38] (Defra and Environment Agency 2005). The requirements for safe access and egress from new developments are as follows in order of preference:

- Safe, dry route for people and vehicles.
- Safe, dry route for people.
- If a dry route for people is not possible, a route for people where the flood hazard, in terms of depth and velocity of flooding, is low and should not cause risk to people.
- If a dry route for vehicles is not possible, a route for vehicles where the flood hazard (in terms of depth and velocity of flooding) is low to permit access for emergency vehicles.

Flood Hazard

8.4.21 Guidance set out in the Defra / Environment Agency technical guidance document FD2320/TR2 categorises the danger to people for different combinations of flood water depth and velocity as shown in Table 8.2.

[37] Defra / Environment Agency (2005) Flood Risk Guidance for New Development Phase 2: Framework and Guidance for Assessing and Managing Flood Risk for New Development – Full Documentation and Tools. R&D Technical Report FD2320/TR2
[38] Defra and Environment Agency (2005) Flood Risk Assessment Guidance for New Development FD 2320.

Table 8.2 Danger to people relative to flood depth and velocity (Taken from Table 13.1 of the Defra/EA FD2320/TR2 report)

Velocity (m/s)	Depth of flooding (m)											
	0.05	0.10	0.20	0.30	0.40	0.50	0.60	0.80	1.00	1.50	2.00	2.50
0.00												
0.10												
0.25												
0.50												
1.00												
1.50												
2.00												
2.50												
3.00												
3.50												
4.00												
4.50												
5.00												

Key:
- Danger for some
- Danger for most
- Danger for all

8.4.22 The technical guidance document states that the velocity and depth scenarios shown in the white boxes in Table 8.2 are 'very low hazard' however it is important to note that a hazard is still present. FD2320/TR2 also states that safe access and egress routes should be within areas of very low hazard, however it is important to note that a hazard is still present.

Floodplain Compensation Storage

8.4.23 Where proposed development results in an increase in building footprint, the developer must ensure that it does not impact upon the ability of the floodplain to store water and that it does not impact upon floodwater flow conveyance.

8.4.24 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 must be provided to ensure that the total volume of the floodplain storage is not reduced.

8.4.25 Floodplain compensation 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 of the site and linked to the planning application. Floodplain compensation must be considered in the context of the 1 in 100 year flood level including an allowance for climate change.

8.4.26 The requirement for no loss of floodplain storage means that it is not possible to modify ground levels on sites which lie completely within the floodplain (when viewed in isolation), as there is no land available for lowering to bring it into the floodplain. It is possible to provide off-site compensation within the local area e.g. on a neighbouring or adjacent site, however, this would be subject to detailed investigations and agreement with the Environment Agency and EFDC to demonstrate that the proposals would improve and not worsen the existing flooding situation.

Flood routing

8.4.27 In order to demonstrate that 'flood risk is not increased elsewhere', development in the floodplain will need to prove that flood routing is not adversely affected by the development, for example giving rise to backwater affects or diverting floodwaters onto other properties.

8.4.28 Potential overland flow paths should be determined and appropriate solutions proposed to minimise the impact of the development, for example by configuring road and building layouts

to preserve existing flow paths and improve flood routing, whilst ensuring that flows are not diverted towards other properties elsewhere.

8.4.29 Careful consideration should be given to the use of fences and landscaping walls so as to prevent causing obstruction to flow routes and increasing the risk of flooding to the site or neighbouring areas.

Riverside development

8.4.30 Under Section 109 of the Water Resources Act 1991 and/or Environment Agency Byelaws, any works within 8 metres of any statutory Main River (both open channels and culverted sections) requires Environment Agency consent.

8.4.31 In addition, the Environment Agency seek a 8 metre wide undeveloped buffer strip alongside main fluvial rivers and behind flood defences, and would also ask developers to explore opportunities for river restoration as part of any development.

8.4.32 As of 6 April 2012 responsibility for the consenting of works by third parties on ordinary watercourses under Section 23 of the Land Drainage Act 1991 (as amended by the Flood and Water Management Act 2010) has transferred from the Environment Agency to ECC as the Lead Local Flood Authority. ECC now has responsibility for the consenting of works to ordinary watercourses and has powers to enforce un-consented and non-compliant works. This includes any works (including temporary) that affect flow within the channel of any ordinary watercourse (such as in channel structures or diversion of watercourses).

8.4.33 EFDC is currently working under a letter of agreement with ECC regarding consenting works to ordinary watercourses. This may be subject to change in future and EFDC should be contacted in the first instance should works to an ordinary watercourse be proposed within the district.

8.4.34 Consent is refused if the works would result in an increase in flood risk, a prevention of operational access to the watercourse and/ or they pose an unacceptable risk to nature conservation.

Flood Warning and Evacuation Plans

8.4.35 Evacuation is where flood alerts and warnings provided by the Environment Agency enable timely actions by residents or occupants to allow evacuation to take place unaided, i.e. without the deployment of trained personnel to help people from their homes, businesses and other premises. Rescue by the emergency services is likely to be required where flooding has occurred and prior evacuation has not been possible.

8.4.36 For all development proposed in Flood Zone 2 or 3a, a Flood Warning and Evacuation Plan should be prepared to demonstrate what actions site users will take before, during and after a flood event to ensure their safety, and to demonstrate their development will not impact on the ability of the local authority and the emergency services to safeguard the current population.

8.4.37 It may also be necessary to prepare a Flood Warning Evacuation Plan for development in Flood Zone 1 where the area surrounding the site and/or any potential egress routes away from the site may be at risk of flooding during the 1% annual probability flood event including an allowance for climate change.

8.4.38 Flood warning and evacuation plans should include:

- How flood warning is to be provided, such as:
  - availability of existing flood warning systems (Appendix A Figure 12);

  - where available, rate of onset of flooding and available flood warning time; and
  - how flood warning is given.
- What will be done to protect the development and contents, such as:
  - How easily damaged items (including parked cars) or valuable items (important documents) will be relocated;
  - How services can be switched off (gas, electricity, water supplies);
  - The use of flood protection products (e.g. flood boards, airbrick covers);
  - The availability of staff/occupants/users to respond to a flood warning, including preparing for evacuation, deploying flood barriers across doors etc.; and
  - The time taken to respond to a flood warning.
- Ensuring safe occupancy and access to and from the development, such as:
  - Occupant awareness of the likely frequency and duration of flood events, and the potential need to evacuate;
  - Safe access route to and from the development;
  - If necessary, the ability to maintain key services during an event;
  - Vulnerability of occupants, and whether rescue by emergency services will be necessary and feasible; and
  - Expected time taken to re-establish normal use following a flood event (clean-up times, time to re-establish services etc.).

8.4.39 The Environment Agency has a tool on their website to create a Personal Flood Plan[39]. The Plan comprises a checklist of things to do before, during and after a flood and a place to record important contact details.

8.4.40 There is no statutory requirement for the Environment Agency or the emergency services to approve evacuation plans. The LPA is accountable via planning condition or agreement to ensure that plans are suitable. This should be done in consultation with the local authority emergency planning staff.

[39] Environment Agency Tool 'Make a Flood Plan'. https://www.gov.uk/government/publications/personal-flood-plan

9 GUIDANCE ON THE APPLICATION OF SUSTAINABLE DRAINAGE SYSTEMS

9.1 Introduction

9.1.1 The PPG indicates that priority should be given to the use of SuDS in new developments. Appropriate deployment of SuDS within a development can offer benefits in terms of reductions in flood risk, improvements to water quality, quicker replenishment of groundwater and improved visual amenity.

9.1.2 SuDS are typically softer engineering solutions inspired by natural drainage processes, such as ponds and swales, which manage water as close to its source as possible. Wherever possible, a SuDS technique should seek to contribute to each of the three goals identified below with the preferred system contributing significantly to each objective. Where possible SuDS solutions for a site should seek to:

1. Reduce flood risk (to the site and neighbouring areas),
2. Reduce pollution, and
3. Provide landscape and wildlife benefits.

9.1.3 These goals can be achieved by utilising a management plan incorporating a chain of techniques, as outlined in Interim Code of Practice for Sustainable Drainage Systems[40], where each component adds to the performance of the whole system:

PREVENTION	Good site design and upkeep to prevent runoff and pollution (e.g. limited paved areas, regular pavement sweeping).
SOURCE CONTROL	Runoff control at / near to source (e.g. rainwater harvesting, green roofs, pervious pavements).
SITE CONTROL	Water management from a multitude of catchments (e.g. route water from roofs, impermeable paved areas to one infiltration/holding site).
REGIONAL CONTROL	Integrate runoff management systems from a number of sites (e.g. into a detention pond).

9.1.4 The application of SuDS is not limited to a single technique per site. Often a successful SuDS solution will utilise a combination of techniques, providing flood risk, pollution and landscape/wildlife benefits. In addition, SuDS can be employed on a strategic scale, for example with a number of sites contributing to large scale jointly funded and managed SuDS. It should be noted, each development site must offset its own increase in runoff and attenuation cannot be “traded” between developments.

9.1.5 SuDS techniques can be used to reduce the rate and volume and improve the water quality of surface water discharges from sites to the receiving environment (i.e. natural watercourse or public sewer etc.). The SuDS Manual[41] identified several processes that can be used to manage and control runoff from developed areas. Each option can provide opportunities for storm water control, flood risk management, water conservation and groundwater recharge.

- **Infiltration**: the soaking of water into the ground. This is the most desirable solution as it mimics the natural hydrological process. The rate of infiltration will vary with soil type and condition, the antecedent conditions and with time. The process can be used to recharge groundwater sources and feed baseflows of local watercourses,

[40] National SuDS Working Group (2004) Interim Code of Practice for Sustainable Drainage Systems
[41] CIRIA C697 SuDS Manual. http://www.ciria.org/Resources/Free_publications/the_suds_manual.aspx

but where groundwater sources are vulnerable or there is risk of contamination, infiltration techniques are not suitable.

- **Detention/Attenuation**: the slowing down of surface flows before their transfer downstream, usually achieved by creating a storage volume and a constrained outlet. In general, though the storage will enable a reduction in the peak rate of runoff, the total volume will remain the same, just occurring over a longer duration.
- **Conveyance**: the transfer of surface runoff from one place to another, e.g. through open channels, pipes and trenches.
- **Water Harvesting**: the direct capture and use of runoff on site, e.g. for domestic use (flushing toilets) or irrigation of urban landscapes. The ability of these systems to perform a flood risk management function will be dependent on their scale, and whether there will be a suitable amount of storage always available in the event of a flood.

9.1.6 As part of any SuDS scheme, consideration should be given to the long-term maintenance of the SuDS to ensure that it remains functional for the lifetime of the development. Table 9-1 has been reproduced from the SuDS Manual, CIRIA C697 and outlines typical SuDS techniques.

Table 9.1 Typical SuDS Components (Y = primary process. * = some opportunities, subject to design)

Technique	Description	Conveyance	Detention	Infiltration	Harvesting
Pervious Surfaces	Pervious surfaces allow rainwater to infiltrate through the surface into an underlying storage layer, where water is stored before infiltration to the ground, reuse, or release to surface water.		Y	Y	*
Filter Drains	Linear drains/trenches filled with a permeable material, often with perforated pipe in the base of the trench. Surface water from the edge of paved areas flows into the trenches, is filtered and conveyed to other parts of the site.	Y	Y		
Filter Strips	Vegetated strips of gently sloping ground designed to drain water evenly from impermeable areas and filter out silt and particulates.	*	*	*	
Swales	Shallow vegetated channels that conduct and/or retain water, and can permit infiltration when unlined.	Y	Y	*	
Ponds	Depressions used for storing and treating water.		Y	*	Y
Wetlands	As ponds, but the runoff flows slowly but continuously through aquatic vegetation that attenuates and filters the flow. Shallower than ponds. Based on geology these measures can also incorporate some degree of infiltration.	*	Y	*	Y
Detention Basin	Dry depressions designed to store water for a specified retention time.		Y		

Technique	Description	Conveyance	Detention	Infiltration	Harvesting
Soakaways	Sub-surface structures that store and dispose of water via infiltration.			Y	
Infiltration Trenches	As filter drains, but allowing infiltration through trench base and sides.	*	Y	Y	
Infiltration Basins	Depressions that store and dispose of water via infiltration.		Y	Y	
Green Roofs	Green roofs are systems which cover a building's roof with vegetation. They are laid over a drainage layer, with other layers providing protection, waterproofing and insulation. It is noted that the use of brown/green roofs should be for betterment purposes and not to be counted towards the provision of on-site storage for surface water. This is because the hydraulic performance during extreme events is similar to a standard roof (CIRIA C697).		Y		
Rainwater Harvesting	Storage and use of rainwater for non-potable uses within a building, e.g. toilet flushing. It is noted that storage in these types of systems is not usually considered to count towards the provision of on-site storage for surface water balancing because, given the sporadic nature of the use of harvested water, it cannot be guaranteed that the tanks are available to provide sufficient attenuation for the storm event.	*	*	*	Y

9.1.7 For further guidance on SuDS, the following documents and websites are recommended as a starting point:

- The NPPF and associated Planning Policy Guidance technical notes.
- The SuDS Manual – CIRIA C697 (2007) provides the best practice guidance on the planning, design, construction, operation and maintenance of Sustainable Drainage Systems and facilitates their effective implementation within developments.
- CIRIA C644 – Green Roofs (2007) provides guidance on the design, construction and operation of Green Roofs. The guidance also describes how 'quick wins' for biodiversity can be achieved in the built environment by incorporating nesting and roosting boxes for bird, bats and other animals.
- Interim Code of Practice for Sustainable Drainage Systems, National SuDS Working Group, 2004.
- www.ciria.org.uk/suds/
- Essex County Council – Sustainable Drainage Systems – Design Guide (2014) provides guidance to developers, designers and consultants on ECCs SuDS design requirements. Whilst responsibility for SuDS approval has been passed to EFDC as the LPA (see Section 5.1.10), ECC, as LLFA, will become a statutory consultee for planning applications for major developments that have a drainage implication and this guidance will remain a useful resource.

- Defra / Environment Agency Preliminary Rainfall Runoff Management Rev E42 provides guidance on surface water drainage strategy for the Environment Agency, LPAs and developers.

9.2 National SuDS Standards

9.2.1 A set of National Standards[43] (NS) (2015) have been published which set the requirements for the design, construction, maintenance and operation of sustainable drainage systems (SuDS). The NS are intended to be used alongside the NPPF and PPG.

9.2.2 The NS that are of chief concern in relation to the consideration of flood risk to and from development relating to runoff destinations, peak flow control and volume control are presented below:

Peak flow control

9.2.3 SuDS NS2 'For greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event must not exceed the peak greenfield runoff rate for the same event'.

9.2.4 SuDS NS3 'For developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event must be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event'.

Volume control

9.2.5 SuDS NS4 'Where reasonably practicable, for greenfield development, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event should never exceed the greenfield runoff volume for the same event'.

9.2.6 SuDS NS5 'Where reasonably practicable, for developments which have been previously developed, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event must be constrained to a value as close as is reasonably practicable to the greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for that event'.

9.2.7 SuDS NS6 'Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with SuDS NS4 or SuDS NS5 above, the runoff volume must be discharged at a rate that does not adversely affect flood risk'.

Flood risk within the development

9.2.8 SuDS S7 'The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 1 in 30 year rainfall event'.

9.2.9 SuDS S8 'The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur during a 1 in 100 year rainfall event in any part of: a building (including a basement); or in any utility plant susceptible

[42] Defra / Environment Agency (2013) Rainfall runoff management for developments
[43] DEFRA (Sustainable Drainage Systems (March 2015) Non-statutory technical standards for sustainable drainage systems

to water (e.g. pumping station or electricity substation) within the development'.

9.2.10 SuDS S9 'The design of the site must ensure that, so far as is reasonably practicable, flows resulting from rainfall in excess of a 1 in 100 year rainfall event are managed in exceedance routes that minimise the risks to people and property'.

9.3 Use of Infiltration SuDS in Epping Forest

9.3.1 As part of this SFRA, an assessment of the suitability of using infiltration SuDS techniques across the district has been undertaken. The BGS infiltration SuDS suitability map shown on Figure 11 in Appendix A is largely based on the BGS infiltration SuDS suitability dataset. It is understood from the BGS guidance notes that the dataset is derived from the following data:

- Infiltration constraints summary layer;
- Superficial deposits permeability;
- Superficial deposits thickness;
- Bedrock permeability;
- Depth to groundwater level; and
- Geological indicators of flooding

9.3.2 Four categories have been identified by the BGS for suitability for Infiltration SuDS:

1. Highly compatible for Infiltration SuDS: The subsurface is likely to be suitable for free-draining infiltration SuDS.
2. Probably compatible for Infiltration SuDS: The subsurface is probably suitable for infiltration SuDS although the design may be influenced by the ground conditions.
3. Opportunities for bespoke infiltration SuDS: The subsurface is potentially suitable for infiltration SuDS although the design will be influenced by the ground conditions.
4. Very significant constraints are indicated: There is a very significant potential for one or more geohazards associated with infiltration.

9.3.3 The infiltration SuDS suitability assessment shown on Figure 11 in Appendix A is based on the map produced by the BGS.

9.3.4 Areas indicated by the BGS to have very significant constraints on infiltration SuDS show a close correlation with the paths of the Main rivers and other major ordinary watercourses in the district. The largest areas of very significant constraints are associated with the River Lee, River Roding and Cripsey Brook. These areas also correlate with superficial deposits of Alluvium and Head associated with watercourses in the district.

9.3.5 It should be noted that this is a high level assessment and only forms an approximate guide to infiltration SuDS suitability; an enhanced site investigation is required in all cases to confirm local conditions. The maximum likely groundwater levels should be assessed, to confirm that soakaways will continue to function even during prolonged wet conditions.

9.3.6 In addition any proposed infiltration SuDS should be located away from areas of historic landfill, known contamination or areas which are at risk of contamination. This is to ensure that that the drainage does not re-mobilise latent contamination and exacerbate the risk to groundwater quality and down gradient receptors such as abstractors, springs and rivers. In such circumstances, a preliminary groundwater risk assessment may be required with the planning application.

9.3.7 It should be noted that whilst infiltration SuDS may not be appropriate in all locations, this does not rule out the potential for other SuDS techniques to be used, for example above-ground attenuation methods.

9.3.8 Design of soakaway systems should be undertaken in consultation with available technical guidance, for example BRE Digest 365: Soakaway Design[44] and the Building Regulations Approved Document H: Drainage and waste disposal[45].

[44] Building Research Establishment (1991) BRE Digest: Soakaway Design
[45] Royal Institute of British Architects (2006) Building Regulations Approved Document H: Drainage and Waste Disposal

10 SUMMARY AND RECOMMENDATIONS

10.1 Site Allocation Process

10.1.1 The outputs from this Level 1 SFRA Update should be used as an evidence base from which to direct new development to areas of low flood risk (Flood Zone 1). Where development cannot be located in Flood Zone 1, EFDC should use the flood maps to apply the Sequential Test to their remaining land use allocations.

10.1.2 Where the need to apply the Exception Test is identified, due to there being an insufficient number of suitable sites for development within zones of lower flood risk, the scope of the SFRA may need to be widened to a Level 2 assessment. The need for a Level 2 SFRA cannot be fully determined until EFDC has applied the Sequential Test. It is recommended that as soon as the need for the Exception Test is established, a Level 2 SFRA is undertaken by a suitably qualified technical expert or engineer so as to provide timely input to the overall plan making process.

10.2 Council Policy

10.2.1 The Local Plan for EFDC and supporting guidance documents should continue to include policies to:

- Protect the functional floodplain from development;
- Direct vulnerable development away from flood affected areas;
- Ensure all new development is 'safe', meaning that dry pedestrian access to and from the development is possible without passing through the 1 in 100 year plus climate change floodplain, and emergency vehicular access is possible; and
- Promote the use of strategic, integrated and maintainable SuDS in all flood zones for both Brownfield and greenfield sites. Space should be set-aside for SuDS.

10.3 Emergency Planning

10.3.1 It is recommended that the EFDC and ECC's Emergency Response Plans are reviewed and updated in light of the findings of the SFRA to ensure that safe evacuation and access for emergency services is possible during times of flood both for existing developments and those being promoted as possible sites within the plan making process. It is further recommended that EFDC works with the Environment Agency to promote the awareness of flood risk and encourage communities at risk to sign-up to the Environment Agency Flood Warning Service.

10.4 Future Updates to the SFRA

10.4.1 This SFRA has been updated building heavily upon existing knowledge with respect to flood risk within the district. The Environment Agency review and update the Flood Map for Planning (Rivers and Sea) on a quarterly basis and a rolling programme of detailed flood risk mapping is underway. Future new modelling of watercourses in the area will improve the current knowledge of flood risk within the district, and may marginally alter predicted flood extents within parts of the district in the future.

10.4.2 New information may influence future development control decisions within these areas. Therefore it is important that the SFRA is adopted as a 'living' document and is reviewed regularly in light of emerging policy directives, flood risk datasets and an improving understanding of flood risk within the district.

10.5 Level 2 SFRA

10.5.1 This Level 1 SFRA will allow EFDC to assess its proposed site allocations using the Sequential Test. This will act as a 'sieving' process, allocating as many sites as possible to Flood Zone 1. Where it is found that some sites can only be placed in Flood Zones 2 and 3, the Exception Test will need to be applied as described in Section 7, and EFDC may wish to consider the preparation of a Level 2 SFRA.

10.5.2 A Level 2 SFRA should be viewed as rather more site specific than a Level 1 SFRA, addressing flood risk to potential development sites which have gone through the Sequential Test and have been located in Flood Zones 2 or 3. The data required for a Level 2 SFRA will therefore depend upon which, if any, of the Council's final list of preferred sites remain in Flood Zones 2 and 3 following application of the Sequential Test and hence where the Exception Test needs to be applied.

10.5.3 It is important that a Level 2 SFRA considers the variation of flood risk within a Flood Zone due to flood risk management measures i.e. flood defences. This increased scope involves a more detailed review of flood hazard (flood probability, flood depth, flood velocity, rate of onset of flooding). If development is to be located behind defences, or downstream of flood storage reservoirs, it may be necessary to model constructional failure of the defence (breach) and water levels rising to exceed the level of the defence (overtopping). It is not necessary to carry out such scenarios behind all existing defences, if no new development is to be located behind these structures. In some instances improvements to existing flood defences may be required to manage residual flood risks. Here, the Level 2 SFRA should include an appraisal of the extent of works to provide or raise the flood defence to appropriate standard.

10.5.4 Environment Agency guidance on SFRAs[46] states that Level 2 SFRA outputs typically include:

- *"An appraisal of the current condition of flood defence infrastructure and of likely future flood management policy with regard to its maintenance and upgrade (see below).*
- *An appraisal of the probability and consequences of overtopping or failure of flood risk management infrastructure, including an appropriate allowance for climate change (see below).*
- *Definition and mapping of the functional floodplain in locations where this is required.*
- *Maps showing the distribution of flood risk across all flood zones from all sources of flooding taking climate change into account.*
- *Advice on appropriate policies for sites which could satisfy the first part of the Exception Test (sustainability benefits to the community that outweigh flood risk), and on the requirements that would be necessary for a site-specific flood risk assessment supporting a planning application for a particular application to pass the second part of the Exception Test.*
- *Advice on the preparation of site-specific flood risk assessments for sites of varying risk across the flood zones, including information about the use of sustainable drainage techniques.*
- *Meaningful recommendations to inform policy, development control and technical issues."*

[46] Environment Agency (July 2013) Strategic Flood Risk Assessments: Guidance to support the National Planning Policy Framework

APPENDIX A – FIGURES

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