Castle Point Borough Council Level 1 Strategic Flood Risk Assessment

Castle Point Borough Council

Project number: 60725540

March 2025

Delivering a better world

Quality information

Prepared by	Checked by	Verified by	Approved by
Sophie Brewer Consultant Becci Ward Consultant	Joanne Somerton Principal Consultant	Sarah Littlewood Associate	Richard Moore Project Manager

Revision History

Revision	Revision date	Details	Authorized	Name	Position
P01	11/09/2024	Draft for Stakeholder Review	RM	Richard Moore	Project Manager
P02	24/01/2025	Final	RM	Richard Moore	Project Manager
P03	04/03/2025	Final – amendments following additional EA comments	RM	Richard Moore	Project Manager

Prepared for:

Castle Point Borough Council

Prepared by:

AECOM Limited
Midpoint, Alencon Link
Basingstoke
Hampshire RG21 7PP
United Kingdom

T: +44 (0)1256 310200
aecom.com

Table of Contents

Figures

Tables

Abbreviations

Acronym	Definition
AEP	Annual Exceedance Probability
AIMS	Asset Information Management System
AOD	Above Ordnance Datum
AWSL	Anglian Water Services Limited
BGS	British Geological Survey
CDA	Critical Drainage Area
CFMP	Catchment Flood Management Plan
CIL	Community Infrastructure Levy
CPBC	Castle Point Borough Council
CSO	Combined Sewer Outfall
DTM	Digital Terrain Model
ECC	Essex County Council
FIR	Flood Investigation Report
FRA	Flood Risk Assessment
FRMP	Flood Risk Management Plan
FSA	Flood Storage Area
FWMA	Flood and Water Management Act
GI	Green Infrastructure
GIS	Geographical Information System
HMWB	Heavily Modified Water Bodies
HRA	Hydrogeological Risk Assessment
IUD	Integrated Urban Drainage
LFRMS	Local Flood Risk Management Strategy
LIDAR	Light Detection and Ranging
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
MAFP	Multi-Agency Flood Plan
MAP	Multi-Agency Partnership
NPPF	National Planning Policy Framework
NsiP	Nationally Significant Infrastructure Projects
PFRA	Preliminary Flood Risk Assessment
PPG	Planning Practice Guidance
RBMP	River Basin Management Plan
RoFSW	Risk of Flooding from Surface Water
RSPB	Royal Society for the Protection of Birds
SAB	SuDS Approval Body
SFRA	Strategic Flood Risk Assessment
SoP	Standard of Protection
SPD	Supplementary Planning Document
SPZ	Source Protection Zone

Acronym	Definition
SuDS	Sustainable Drainage Systems
SWMP	Surface Water Management Plan
TE2100	Thames Estuary 2100 Plan
WFD	Water Framework Directive
WRC	Water Recycling Centre

1. Introduction and User Guide

1.1 Introduction

1.1.1 In its role as the Local Planning Authority (LPA), Castle Point Borough Council (CPBC) is currently preparing documents that will form part of the new Local Plan for Castle Point and develop the vision for future development across the Borough.

1.1.2 CPBC faces the challenge of meeting the need for new development within a constrained land supply including areas already identified to be at risk of river (fluvial) flooding associated with the Prittle Brook and Benfleet Hall Brook, and tidal flooding associated with the River Thames. Furthermore, there is the potential risk arising from more localised flooding including surface water generated by heavy rainfall, elevated groundwater, existing drainage systems as well as artificial sources.

1.2 Approach to Flood Risk Management

1.2.1 The National Planning Policy Framework[1] (NPPF) and associated Planning Practice Guidance[2] (PPG) for Flood Risk and Coastal Change emphasise the active role LPAs such as CPBC should take to ensure that flood risk from all sources is assessed, avoided, controlled, mitigated and managed effectively and sustainably throughout all stages of the planning process taking into account the current and future impacts of climate change (NPPF paragraphs 170 and 172). The overall approach for the consideration of flood risk set out in paragraphs 003 and 004 of the PPG[2] is summarised as follows:

1.2.2 This has implications for LPAs and developers as described below.

Assess Flood Risk

1.2.3 The NPPF[1] outlines that Local Plans should be supported by a Strategic Flood Risk Assessment (SFRA) and LPAs should use the findings to inform strategic land use planning.

1.2.4 Figure 1-1, reproduced from the PPG[2], illustrates how flood risk should be taken into account in the preparation of the Local Plan by CPBC.

1.2.5 For sites in areas at risk of flooding, or with an area of 1 hectare or greater, developers must undertake a site-specific Flood Risk Assessment (FRA) to accompany planning applications (or prior approval for certain types of permitted development[3], or technical details consent[4]). Assessments of flood risk should identify sources of uncertainty and how these are accounted for in a mitigation strategy.

Avoid Flood Risk

1.2.6 CPBC should apply the sequential approach to site selection so that development is, as far as reasonably possible, located where the risk of flooding from all sources is lowest, taking account of climate change and the vulnerability of future users to flood risk. In plan-making this involves applying

[1] National Planning Policy Framework (2024) https://www.gov.uk/government/publications/national-planning-policy-framework--2
[2] Planning Practice Guidance (2022) https://www.gov.uk/guidance/flood-risk-and-coastal-change
[3] Planning Practice Guidance Paragraph 053 'Permitted development rights and flood risk' https://www.gov.uk/guidance/flood-risk-and-coastal-change#para53
[4] Permission in principle guidance, March 2019, https://www.gov.uk/guidance/permission-in-principle

the Sequential Test, and where necessary the Exception Test to Local Plans, as described in Figure 1-1.

1.2.7 In decision-taking this involves applying the Sequential Test and, if necessary, the Exception Test, for specific development proposals.

1.2.8 Within individual application sites, the most vulnerable aspects of development must be located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location. Measures to avoid flood risk can also be taken by locating the most vulnerable uses on upper storeys and raising finished floor levels and/or ground levels.

1.2.9 Where the Sequential and Exception Tests have been applied as necessary and not met, development should not be allowed.

Control Flood Risk

1.2.10 CPBC and developers can investigate measures to control the risk of flooding affecting the site. Early discussions with relevant flood risk management authorities, and reference to programmes of flood and coastal erosion risk management schemes will help to identify such opportunities.

1.2.11 CPBC and developers should seek flood risk management opportunities (e.g. safeguarding land required for future flood defence infrastructure improvements), and to reduce the causes and impacts of flooding (e.g. through the use of green infrastructure and natural flood management techniques and the use of sustainable drainage systems). This can help a development to deliver wider sustainability benefits to the community which can help the development to pass part (a) of the exception test (where relevant). As referenced in the NPPF paragraphs 172(b) and (c), 178, 181(c) and 182.

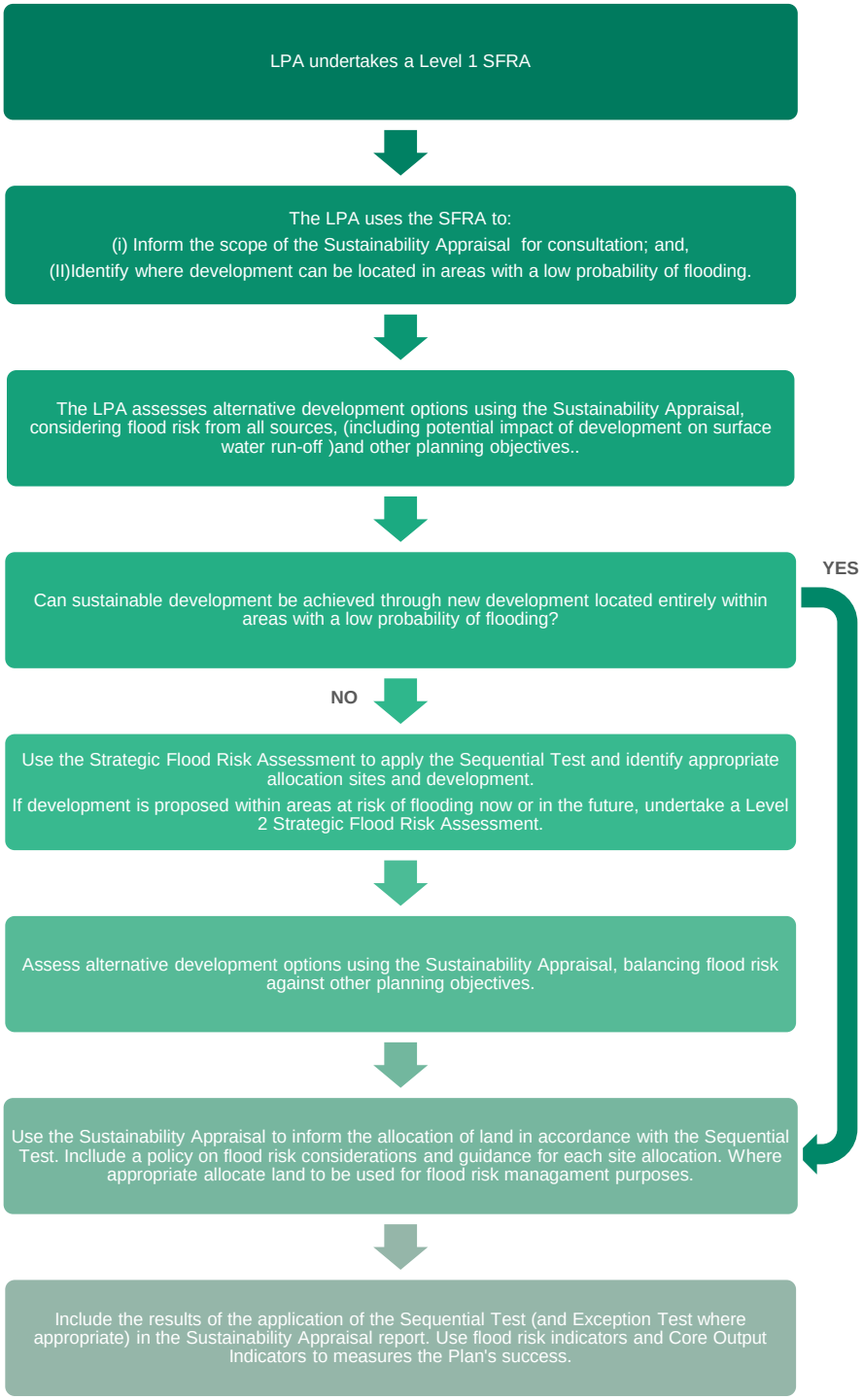
Mitigate Flood Risk

1.2.12 After applying measures to avoid and control the risk of flooding, the next step is to mitigate flooding. In accordance with paragraph 181(b) of the NPPF[1], development should only be allowed in areas at risk of flooding where it can be demonstrated that development is appropriately flood resistant and resilient, such that, in the event of a flood, it could be quickly brought back into use without significant refurbishment. Passive flood resilience and resistance measures should be prioritised over active measures as they are likely to be more effective and more reliable. In accordance with paragraph 170 “where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere”.

Manage Residual Flood Risk

1.2.13 CPBC and developers should consider further management measures to deal with any residual risk remaining after avoidance, control and mitigation have been utilised. Residual risks will need to be safely managed to ensure people are not exposed to hazardous flooding. LPAs and developers should provide safe access routes and consider whether adequate flood warning would be available to people using the development.

1.2.14 In accordance with the PPG[2], measures to manage residual risk need to be considered early in the design process to ensure that they can be complementary to other design requirements such as catering for the needs of the elderly or those with lesser mobility.



Source: PPG[2] for Flood Risk and Coastal Change, Diagram 1

Figure 1-1 Taking flood risk into account in the preparation of a Local Plan

1.3 Purpose of the SFRA

1.3.1 The purpose of this SFRA is to collate and present the most up to date flood risk information for use by CPBC to inform the preparation of the Castle Point Local Plan and prudent decision-making by Development Management officers on a day-to-day basis.

1.3.2 In order to achieve this, the SFRA will:

- Assess all potential sources of flooding, now and in the future, taking account of the impacts of climate change, based on readily available datasets.
- Inform the Sustainability Appraisal process, so that flood risk is fully taken into account when considering allocation options and in the preparation of plan policies.
- Identify existing flood risk management measures as well as areas that need to be adapted to climate change, and areas that need to be safeguarded for future flood risk management features and structures.
- Consider the potential cumulative impact of development and land use change on the risk of flooding in the study area.
- Inform the application of the Sequential and, if necessary, Exception Tests in the allocation of future development sites, as required by the NPPF[1], and planning application process.
- Identify the requirements for site-specific FRAs.
- Inform the preparation of flood risk policy and guidance and inform policies for land use change.
- Consider opportunities to reduce flood risk to existing communities and developments through better management of surface water, provision for conveyance and storage for flood water.

1.3.3 CPBC should take an integrated approach to flood risk management when preparing plans, as per NPPF[1] paragraph 167(c). This is a collaborative, catchment-based approach delivering coordinated management of water storage, supply, demand, wastewater, flood risk, quality of water and the wider environment.

1.3.4 This document forms a Level 1 SFRA which has been carried out to support the completion of the Sequential Test by CPBC and inform the allocation of sites within the Local Plan. Documents recording the application of the Sequential Test will be published as a separate document on the Council's website. Should the Sequential Test indicate that land outside flood risk areas cannot appropriately accommodate all necessary development; a further Level 2 SFRA will be undertaken to consider the detailed nature of flood risk within each Flood Zone and support the application of the Exception Test.

1.4 Flood Risk Policy and Guidance

1.4.1 There is an established body of policy and guidance documents which are of particular importance when considering development and flood risk. These are identified in Table 1-1.

Table 1-1 Flood Risk Policy and Guidance Documents

National Policy Documents	
National Planning Policy Framework	https://www.gov.uk/government/publications/national-planning-policy-framework--2
National Flood and Coastal Erosion Risk Management Strategy	https://www.gov.uk/government/publications/national-flood-and-coastal-erosion-risk-management-strategy-for-england--2
Flood and Water Management Act (2010)	http://www.legislation.gov.uk/ukpga/2010/29/pdfs/ukpga_20100029_en.pdf
Flood Risk Regulations (2009)	http://www.legislation.gov.uk/uksi/2009/3042/pdfs/uksi_20093042_en.pdf
National Guidance Documents	
Planning Policy Guidance – Flood Risk and Coastal Change	https://www.gov.uk/guidance/flood-risk-and-coastal-change
Environment Agency Standing Advice	https://www.gov.uk/guidance/flood-risk-assessment-standing-advice
Flood risk assessments: climate change allowances	https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances
Flood risk assessments: applying for planning permission	https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications
Government Guidance on preparing SFRAs	https://www.gov.uk/guidance/local-planning-authorities-strategic-flood-risk-assessment
ADEPT/Environment Agency Strategic flood risk assessments – A good practice guide	https://www.adeptnet.org.uk/system/files/documents/FRS18204%20SFRA%20Good%20Practice%20Guide_Final_Nov2021.pdf
Regional Policy and Guidance	
Anglian River Basin District Flood Risk Management Plan (FRMP)	https://www.gov.uk/government/publications/anglian-river-basin-district-flood-risk-management-plan
Thames River Basin District FRMP	https://www.gov.uk/government/publications/thames-river-basin-district-flood-risk-management-plan
South Essex Catchment Flood Management Plan	https://assets.publishing.service.gov.uk/media/5a7c4c79ed915d338141de14/South_Essex_Catchment_Flood_Management_Plan.pdf
Anglian Water Drainage and Wastewater Management Plan	https://www.anglianwater.co.uk/about-us/our-strategies-and-plans/drainage-wastewater-management-plan/final-plan/
Essex County Council Water Strategy	https://www.essex.gov.uk/sites/default/files/2024-03/Water%20Strategy%20for%20Essex%202024.pdf
Local Documents and Strategies	
Essex County Council South Essex Strategic Flood Risk Assessment	https://www.castlepoint.gov.uk/south-essex-strategic-flood-risk-assessment/
Essex County Council Surface Water Management Plan	https://flood.essex.gov.uk/our-strategies-and-responsibilities/surface-water-management-plans/
Preliminary Flood Risk Assessment	https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/698238/PFRA_Essex_County_Council_2017.pdf
Essex County Council Local Flood Risk Management Strategy	https://flood.essex.gov.uk/our-strategies-and-responsibilities/our-local-flood-risk-management-strategy/
Thames Estuary 2100 Plan	https://www.gov.uk/government/collections/thames-estuary-2100-te2100

1.5 User Guide

1.5.1 It is anticipated that the SFRA will have a number of end users, with slightly different requirements. For example, strategic planners who may be developing policies, undertaking the Sequential Test and allocating sites; development management officers, emergency planners, and those preparing site specific FRAs. This Section describes how the SFRA should be used and how to navigate the report and mapping deliverables. Table 1-2 provides a user guide to summarise the content of the SFRA.

Table 1-2 SFRA Structure

SFRA Section	
Section 2: Methodology	Identifies the datasets and methodologies applied within the SFRA for assessing flood risk.
Section 3: Assessing flood risk in Castle Point	Provides an overview of the different sources of flooding, cumulative impacts of development on flood risk and cross boundary considerations.
Section 4: Avoiding flood risk – Applying the Sequential Test	Provides details of how the Sequential Test should be applied at the Local Plan stage, and for individual planning applications, as well as information on the Exception Test.
Section 5: Measures to control and mitigate flood risk	Identifies existing measures in place to control flooding such as existing flood risk management infrastructure, flood storage areas, and flood alleviation schemes. Identifies opportunities that should be considered when developing strategic plans, and as part of site specific FRAs for future development, to control and mitigate the risk of flooding, such as safeguarding of land for future flood risk management, surface water management measures, property resilience measures.
Section 6: Assessing and managing residual risk	Provides an assessment of the risk of tidal flooding from overtopping or breach in the defences, as well as measures to manage residual risks such as flood warning, emergency planning, provision of safe access/escape and places of safety.
Section 7: Preparing a site-specific FRA	Provides details on when FRAs are required, what they should address and where to go for pre application advice.
Section 8: Next steps	Summary of next steps for CPBC
Appendix A Mapping	Castle Point Borough wide mapping of datasets identified in Section 2.
Appendix B Fluvial Modelling Mapping	Mapping of the results of the fluvial modelling.
Appendix C Tidal Overtopping Modelling Mapping	Mapping of the results of the overtopping tidal modelling.
Appendix D Tidal Breach Modelling Mapping	Mapping of the results of the tidal breach modelling.
Appendix E Surface Water Modelling Mapping	Mapping of the results of the surface water modelling.
Appendix F Summary of Recommendations	Recommendations for CPBC to take forward in their Local Plan preparation are provided throughout the SFRA. This Appendix provides a list of all the recommendations in one location.

Strategic Planning and Policy

1.5.2 The main purpose of the SFRA for CPBC, in accordance with the NPPF[1], is to provide a strategic overview of flood risk within the Borough to enable effective risk-based strategic planning for the future through the preparation of the Local Plan. As part of the SFRA, a number of policy recommendations and development management measures have been prepared to inform the development of the Castle Point Local Plan and in day-to-day decision making.

Applying the Sequential Test

1.5.3 The NPPF[1] sets strict tests to protect people and property from flooding which all LPAs are expected to follow. The aim of the Sequential Test under the NPPF[1] is to steer new development to areas with the lowest probability of flooding. Section 3 and the supporting mapping Appendices A, B, C, D and E

provides the data required to undertake the Sequential Test and Section 4 provides specific guidance on applying both the Sequential and, where appropriate, Exception Tests.

Emergency Planning

1.5.4 CPBC is a Category 1 Responder under the Civil Contingencies Act 2004[5] and therefore has a responsibility, along with other organisations, for developing emergency plans, contingency plans and business continuity plans to help reduce, control or ease the effects of an emergency.

1.5.5 CPBC maintains a Flood Response Plan[6] which reflects the known risks of flooding in Castle Point and details the response actions of the Council to incidents of flooding.

1.5.6 The SFRA deliverables, particularly Section 3, can be used by the CPBC Emergency Planning team as a useful resource providing up to date information about flood risk. The SFRA should be reviewed by the team to ensure that the findings are incorporated into their understanding of flood risk and future revisions of the Flood Response Plan.

Preparing Site-specific Flood Risk Assessments

1.5.7 Guidance on preparing a site-specific FRAs is given in "Flood Risk Assessments: applying for planning permission"[7], "Preparing a flood risk assessment: standing advice"[8] and that contained in the Site-specific flood risk assessment checklist[9] within the Flood Risk and Coastal Change PPG[2].

1.5.8 The SFRA can provide a useful starting point to the preparation of site-specific FRAs for individual development sites as follows:

- Section 3 provides an overview of the key issues within the Borough in relation to flood risk.
- Section 4 provides guidance on the application of the Sequential Test for sites that have not yet been tested by the LPA, as well as details on when the Exception Test is required, and how to apply it.
- Sections 5 and 6 provide details of measures that may need to be implemented to control, manage and mitigate flood risk.
- Section 7 provides specific guidance for preparing site specific FRAs in accordance with the checklist presented in the PPG[2] Flood Risk and Coastal Change.

Assessing Planning Applications

1.5.9 Planning and development officers who are reviewing FRAs as part of the planning application process should consult Section 3 of the SFRA to provide the background for flood risk in the area relating to the planning application. Section 7 builds on the guidance presented in the PPG[2] and Environment Agency Standing Advice and can be used by those assessing applications as a checklist for issues that need to be addressed as part of site-specific FRAs.

1.6 Monitoring and Update

1.6.1 SFRAs should be adopted as 'living documents' which are reviewed and updated regularly considering new or revised flood modelling studies, changes to the predicted impacts of climate change, local flood management schemes and/or flood risk management plans.

1.6.2 The Environment Agency National Flood Risk Management 2 (NaFRA2) project is ongoing which will lead to changes in flood products and is due to be published in 2025.

[5] His Majesty's Stationery Office (HMSO), 2004, *Civil Contingencies Act 2004*.
[6] CPBC, January 2021, *Flood Response Plan, version 1.4.*
[7] Environment Agency, August 2024, Flood risk assessments: applying for planning permission, https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications
[8] Environment Agency, August 2024, Preparing a flood risk assessment: standing advice, https://www.gov.uk/guidance/flood-risk-assessment-standing-advice
[9] Gov.uk, August 2022, Site-specific FRA Checklist https://www.gov.uk/guidance/flood-risk-and-coastal-change#para80

2. Methodology

2.1 Overview

2.1.1 Under Section 14 of NPPF[1], the risk of flooding from all sources must be considered as part of an SFRA, including flooding from the sea (tidal), rivers (fluvial), land (overland flow and surface water), groundwater, sewers and artificial sources.

2.1.2 The methodology for the appraisal of flood risk from these sources is outlined below. Section 2.2 describes the approach to consultation and identifies the stakeholder organisations that have been involved. Section 2.3 provides a description of the datasets and models received. Section 2.4 identifies the modelling tasks that have been completed as part of this SFRA.

2.2 Consultation

Duty to Cooperate

2.2.1 Under the Localism Act 2011[10], there is now a legal duty on LPAs to co-operate with one another, County Councils and other Prescribed Bodies to maximise the effectiveness within which certain activities are undertaken as far as they relate to a 'strategic matter'.

2.2.2 In complying with the duty to cooperate, Government Guidance recommends that LPAs 'scope' the strategic matters of Local Plan documents at the beginning of the preparation process taking account of each matters 'functional geography' and identify those LPAs and Prescribed Bodies that need to be constructively and actively engaged.

2.2.3 The Council prepared a Draft Sustainability Appraisal Environmental Report[11] as part of the background work required in preparing the Castle Point Local Plan. Flood risk is identified as a strategic matter and specific engagement activities are proposed with a number of adjoining LPAs and Prescribed Bodies both in relation to the preparation of the SFRA and the Local Plan.

2.2.4 Table 2-1 identifies the stakeholders that have been involved in the preparation of this SFRA, either directly through consultation or by providing publicly available data, and their roles and responsibilities with respect to flood risk management.

Table 2-1 SFRA Stakeholder Organisations and Roles

Stakeholder Organisation	Role/Responsibility
Castle Point Borough Council	As an LPA, CPBC has a responsibility to consider flood risk in their strategic land use planning and the development of their Local Plan. The NPPF requires LPAs to undertake a SFRA and to use their findings, and those of other studies, to inform strategic land use planning including the application of the Sequential Test which seeks to steer development towards areas of lowest flood risk prior to consideration of areas of greater risk. CPBC is also required to consider flood risk and, when necessary, apply the Sequential and Exception Tests when assessing applications for development. During the preparation of the SFRA, CPBC has provided access to available datasets held by the Council regarding flood risk across the Borough. The SFRA will be used by the CPBC's Emergency Planning team to ensure that the findings are incorporated into their understanding of flood risk and the preparation of their Multi-Agency Flood Plan (MAFP).
Environment Agency	The Environment Agency is responsible for managing the risk of flooding from Main Rivers and the sea and has a responsibility to provide a strategic overview for all flooding sources and coastal erosion. The Environment Agency has a role to provide technical advice to LPAs and developers on how best to avoid, manage and reduce the adverse impacts of flooding. Part of this role involves advising on the preparation of spatial plans, sustainability appraisals and evidence base documents, including SFRAs as well as providing advice on higher risk planning applications.

[10] HMSO, 2011, *Localism Act 2011.* http://www.legislation.gov.uk/ukpga/2011/20/contents/enacted
[11] Castle Point Borough Council, 2019, Local Plan – Regulation 19, Sustainability Appraisal (SA): Draft Environmental Report – October 2019.

	The Environment Agency is a statutory consultee for all major development within Flood Zones 2 and 3, and for any development that will carry out works within 20m of the banks of a main river. The Environment Agency undertakes systematic modelling and mapping of fluvial flood risk associated with Main Rivers in the study area, as well as supporting Lead Local Flood Authorities (LLFA) with the management of surface water flooding by mapping surface water flood risk across England. The Environment Agency has supplied available datasets for use within the SFRA and has undertaken reviews of the draft SFRA project deliverables.
Essex County Council	As the LLFA, under the Flood and Water Management Act (FWMA), Essex County Council (ECC) has a duty to take the lead in the coordination of local flood risk management, specifically defined as flooding from surface water, groundwater, and ordinary watercourses and to this end has prepared the Local Flood Risk Management Strategy (LFRMS) for Essex. ECC is responsible for regulation and enforcement on ordinary watercourses and is a statutory consultee for future sustainable drainage systems (SuDS) for major developments in the county, following changes to the Town and Country Planning (Development Management Procedures) (England) Order 2015. ECC is the Highways Authority and therefore has responsibilities for the effectual drainage of surface water from adopted roads insofar as ensuring that drains, including kerbs, road gullies and ditches and the pipe network which connect to the sewers, are maintained. As such, ECC is a key stakeholder in the preparation of the SFRA. ECC has provided current datasets in relation to the assessment of local sources of flooding (surface water, groundwater and ordinary watercourses), has been consulted on the draft project deliverables and will be involved in the implementation of any policy outcomes with respect to sustainable drainage or ordinary watercourse management.
Anglian Water Services Limited	Anglian Water (AWSL) is responsible for surface water drainage from development via adopted sewers and for maintaining public sewers into which much of the highway drainage connects. In relation to the SFRA, the main role that AWSL will play is providing data regarding past sewer flooding.
British Geological Survey	British Geological Survey (BGS) hold several datasets that have informed the SFRA, including superficial and bedrock geology and suitability of infiltration SuDS.
Neighbouring LPAs and other consultees	The following LPAs adjoin CPBC, Thurrock and Basildon to the west and north, and Rochford District and Southend-on-Sea to the north and east.

2.3 Data collection

2.3.1 The following information and datasets have been made available by the stakeholder organisations and used to inform the assessment of flood risk from each of the sources. The datasets are listed in Table 2-2 and hydraulic models received are listed in Table 2-3.

Table 2-2 Datasets obtained to inform the SFRA

Name	Description	Type	Source	SFRA Map (In Appendices)
LiDAR Topographic DTM	Light Detection and Ranging (LIDAR) is an airborne mapping technique, which uses a laser to measure the distance between the aircraft and the ground. The DTM is produced from the last return LiDAR signal and surface objects are removed (such as buildings, vegetation) to provide a ground surface model. The data covering Castle Point has a spatial resolution of 1m.	TIFF	Defra Data Services Platform	Appendix A Map 1
Detailed River Network	Spatial dataset showing Main Rivers and smaller watercourses.	GIS Shapefile	CPBC	Appendix A Map 2
Flood Map for Planning (Rivers and Sea) Flood Zone 2	The Environment Agency's best estimate of the areas of land at risk of flooding, from rivers or the sea with 0.1% chance of flooding each year, when the presence of flood defences is ignored.	GIS Shapefile	Defra Data Services Platform	Appendix A Map 3
Flood Map for Planning (Rivers and Sea) Flood Zone 3	The Environment Agency's best estimate of the areas of land at risk of flooding, when the presence of flood defences is ignored and covers land with a 1% or greater chance of flooding each year from Rivers; or with a 0.5% or greater chance of flooding each year from the Sea.	GIS Shapefile	Defra Data Services Platform	Appendix A Map 3
Risk of flooding from surface water flood extents (3.3% Annual Exceedance Probability (AEP), 1% AEP, 0.1% AEP)	GIS layers showing the extent of flooding from surface water that could result from a flood with a 3.3%, 1% and 0.1% chance of happening in any given year. This is not suitable for identifying whether an individual property will flood but is useful to identifying areas susceptible to surface water flooding and key flow paths.	GIS Shapefile	Defra Data Services Platform	Appendix A Map 6
Bedrock Geology and Superficial Deposits	Generalised digital geological map data based on British Geological Survey's (BGS) published poster maps of the UK.	GIS Shapefile	British Geological Society	Appendix A Map 7 and Map 8
Susceptibility to Groundwater Flooding	GIS layer identifying where there is potential for groundwater flooding to occur based on geological and hydrogeological information. The map shows the following information: limited potential for groundwater flooding to occur, potential for groundwater flooding of property situated below ground level, potential for groundwater flooding to occur at surface	GIS Shapefile	British Geological Society	Appendix A Map 9
Infiltration SuDS Suitability dataset	Dataset which gives a preliminary indication of the suitability of the ground for infiltration SuDS. These are drainage systems that allow surface water to infiltrate to the ground, such as soakaways, infiltration basins, infiltration trenches and permeable pavements. The mapping allows consideration of subsurface permeability, depth to groundwater, presence of geological floodplain deposits, presence of artificial ground, ground stability, potential for pollutant attenuation, and the Environment Agency's source protection zones.	GIS Shapefile	British Geological Society	Appendix A Map 13
Historic Flood Map / Recorded Flood Outlines	GIS layer showing areas of land that have previously been subject to flooding from sea, river or groundwater in line with criteria set by the Environment Agency. This excludes flooding from surface water, except in areas where it is impossible to determine whether the source is fluvial or surface water, but the dominant source is fluvial.	GIS Shapefile	Defra Data Services Platform	Appendix A Map 4
Flood Incidents	GIS layer of recorded Flood Incidents in CPBC.	GIS Shapefile	ECC	Appendix A Map 4
Critical Drainage Areas	GIS layers showing Critical Drainage Areas as defined in Section 3.3. These are discrete geographic areas within the Castle Point Surface Water Management Plan (SWMP) Study Area where multiple or interlinked sources of flood risk cause flooding during a severe rainfall event thereby affecting people, property, or local infrastructure.	GIS Shapefile	ECC	Appendix A Map 6

Name	Description	Type	Source	SFRA Map (In Appendices)
Sewer Flooding Records	Records of internal and external sewer flooding incidents within the last 5 years reported by AWSL within 4-digit postcode areas. It should be noted that records only appear on the register where they have been reported to AWSL, and as such they may not include all instances of sewer flooding.	Excel Spreadsheet	AWSL	Appendix A Map 10
Postcode Boundary	GIS layer of post code areas. Used to map the AWSL sewer flooding records which are reported by 4-digit post code area.	GIS Shapefile	CPBC	Appendix A Map 10
Reduction in Risk of Flooding from Rivers and Sea due to Defences	A spatial dataset that indicates where areas have reduced flood risk from rivers and sea due to the presence of flood defences. The dataset has been created to help initiate conversations about the impact flood defences have on the risk of flooding from the rivers and sea, and as a prompt to find out more about the flood defences in a particular area of interest. It does not replace any local, more detailed information.	GIS Shapefile	Defra Data Services Platform	Appendix A Map 3
Flood Map for Planning (rivers and sea) Flood Storage Areas	Areas that act as a balancing reservoir, storage basin or balancing pond.	GIS Shapefile	Defra Data Services Platform	Appendix A Map 5
Risk of Flooding from Reservoirs[12]	Flood extents for all large[13] raised reservoirs in the event that they were to fail and release the water held on a “dry day” when local rivers are at normal levels, and on a “wet day” when local rivers had already overflowed their banks.	GIS Shapefile	Defra Data Services Platform	Appendix A Map 11
Flood Warning Areas[14]	Geographical areas where flooding is expected to occur and where the Environment Agency provide a Flood Warning Service. They generally contain properties that are expected to flood from rivers or the sea and in some areas, from groundwater.	GIS Shapefile	Defra Data Services Platform	Appendix A Map 14
Working with Natural Processes datasets	A series of spatial datasets identifying best estimate of locations in the country where natural flood management methods can be applied, such as: floodplain woodland planting potential, riparian woodland planting potential, wider catchment woodland, floodplain reconnection potential, runoff attenuation features. Refer to Section 5.3.	GIS Shapefile	Defra Data Services Platform	Appendix A Map 12
Spatial Flood Defence Layer	Shows flood defences currently owned, managed or inspected by the Environment Agency. Typically, these are earth banks, stone and concrete walls, or sheet-piling that is used to prevent or control the extent of flooding.	GIS Shapefile	Defra Data Services Platform	Appendix A Map 5

[12] Environment Agency, Long term flood risk assessment https://flood-warning-information.service.gov.uk/long-term-flood-risk/
[13] A large reservoir is one that holds over 25,000 cubic metres of water, equivalent to approximately 10 Olympic sized swimming pools.
[14] Environment Agency, Flood Warning Service https://www.gov.uk/sign-up-for-flood-warnings

Table 2-3 Hydraulic Models received and used to inform the SFRA

Model	Details	Flood Zone 3b Functional Floodplain	Approach undertaken within this SFRA to map the risk in the future as a result of climate change	SFRA Map (In Appendices)
Prittle Brook Hydraulic Model, CH2M, June 2017	Updated 1D-2D model for the fluvial **Prittle Brook** using Flood Modeller Pro and TUFLOW software.	Model rerun by AECOM for 3.3% AEP extent to map Flood Zone 3b functional floodplain.	Hydrology checked and updated. Model re-run by AECOM for undefended present-day scenarios for the 3.3% AEP, 1% AEP and 0.1% AEP scenarios. The undefended future climate change scenarios for 1% AEP plus central (25%) and higher central (38%) allowances. 3.3% AEP + 25%CC, 3.3% AEP + 38%CC, 1% AEP + 25%CC, 1% AEP + 38%CC, 0.1% AEP + 25%CC and 0.1% AEP + 38%CC.	Appendix B Map 1 and Map 2B
Benfleet Hall Brook Model, JBA, May 2015	1D only model for the **Benfleet Hall Brook** using ISIS software.	Model rerun by AECOM for 3.3% AEP extent to map Flood Zone 3b functional floodplain.	Hydrology checked and updated. Model re-run by AECOM for undefended present-day scenarios for the 3.3% AEP, 1% AEP and 0.1% AEP scenarios.	Appendix B Map 1 and Map 2A
South Essex Surface Water Model, BMT, 2016	1D-2D direct rainfall model presenting South Essex using TUFLOW software. ESTRY is used to represent gullies in the 1D.	N/A	Model re-run by AECOM for the 3.3% AEP, 3.3% AEP + 40%CC, 1% AEP, 1 % AEP + 40%CC and 0.1% AEP, 0.1% AEP + 40%CC scenarios.	Appendix B Map 1 and Map 2
Integrated Urban Drainage Model for Canvey Island, Black & Veatch Ltd, 2015	1D-2D Integrated Urban Drainage model representing the drainage system on Canvey Island	N/A	Model re-run by AECOM for the 3.3% AEP, 3.3% AEP + 40%CC, 1% AEP, 1 % AEP + 40%CC and 0.1% AEP, 0.1% AEP + 40%CC scenarios.	Appendix B Map 1 and Map 2
Castle Point Tidal Overtopping and Breach Modelling, AECOM, 2024	2D model using TUFLOW software for 10 breach scenarios and one overtopping scenario. The boundary conditions used were the tidal curves derived from the nearest water level in the TE2100 extreme water level[15] dataset for each breach location. More information on the nearest node can be found in Table 3-2 of the Tidal and Breach Modelling Technical Note[16] [60725540-TF-001].	N/A	Model run by AECOM for the 0.5% AEP and 0.1% AEP for 2025, the 0.5% AEP and 0.1% AEP for 2125 using the higher central allowance (1.20m) and the 0.5% AEP and 0.1% AEP for 2125 using the upper end allowance (1.60m). Results for the above will be mapped for overtopping and breach depth and hazard. Time to inundation will be mapped for the 0.1% AEP 2125 Upper Event breach scenarios.	Appendix C Map 1 - 12 Appendix D Map 1 - 23

[15] Environment Agency (2022) Thames Estuary Modelling Extreme Water Levels – Final Report Issue P03. Document reference: TEA-00-00.00-RP-HY-00-000005.

2.4 Hydraulic Modelling Tasks

2.4.1 A number of hydraulic river models were provided by the Environment Agency at the start of the project. The models were checked for completeness, date of preparation and the hydrological methods used. Outputs from the models have been used to define Flood Zone 3b functional floodplain and to map the impacts of climate change on floodplain extents in the future, as described in the following subsections.

2.4.2 Where necessary and appropriate, models were re-run for the latest climate change allowances as part of this SFRA. In some cases, updates to the hydrological analysis informing the model have been updated. Table 2-3 summarises the models that have been received, how they have been used in the SFRA and any updates that have been undertaken. Full details of re-simulations are documented in separate standalone Technical Notes for the tidal and fluvial modelling [60725540-TF-001[16] and 60725540-FF-001[17]].

Fluvial Modelling

2.4.3 For the purposes of the SFRA it is proposed that for flooding from fluvial sources only the Prittle Brook and Benfleet Hall Brook model will be used. There are a number of other Main Rivers on Canvey Island which currently do not have any flood zones directly associated with them (as this area is subsumed by the tidal flood zones).

Functional Floodplain

2.4.4 The SFRA should identify areas of Flood Zone 3b functional floodplain, which is defined as land where water has to flow or be stored in times of flooding. As a starting point, this is typically identified by the normal form of the river channel and land that would flood with an annual probability of 3.3% or greater in any year, with existing flood risk management features and structures operating effectively. It is also identified by land that is designed to flood (such as a flood attenuation scheme), even if it would only flood in more extreme events (such as 0.1% annual probability of flooding).

2.4.5 A conservative approach has been taken to define areas of Flood Zone 3b functional floodplain using the 3.3% AEP undefended model results. This is due to the absence of defended models. The only AIMS flood defence within the Prittle Brook model has been removed as it is located outside of the Castle Point administrative area and has no impact on the model outputs in the area of interest. The formal AIMS defences for the Benfleet Hall Brook have been removed from the 1D model. This includes the raised flood embankments around the flood storage area and the wall around the downstream tidal outfall culvert.

2.4.6 The Environment Agency guidance ‘How to prepare a strategic flood risk assessment’[18] encourages the use of site specific FRAs to determine whether a site is affected by functional floodplain. If sites are proposed for development in such areas in any of the LPA’s Local Plans, it may be necessary to undertake additional assessment to map the location of the functional floodplain as part of a Level 2 SFRA.

Future Flood Risk

2.4.7 In line with the future risk of fluvial flooding, the area of functional floodplain is expected to increase as a result of climate change. Flood Zone 3a, and subsequently Flood Zone 3b, is expected to have a greater flood extent in the future.

Tidal Modelling

2.4.8 In order to determine the residual risk of flooding from the Thames Estuary, the scope of this SFRA included modelling of overtopping and breach in the tidal defences throughout the study area for the 0.5% and 0.1% AEP events for the epochs 2025 and 2125.

2.4.9 The breach locations cover two flood cells (Canvey Island and Hadleigh Marshes). All of the breach location are at walls, embankments or barriers. There are no breaches at structures (i.e. gates, sluices

[16] AECOM, 2024, Castle Point Strategic Flood Risk Assessment, Tidal and Breach Modelling Technical Note, 60725540-TF-001
[17] AECOM, 2024, Castle Point Strategic Flood Risk Assessment, Fluvial Modelling Technical Note, 60725540-FF-001.
[18] Environment Agency, March 2022, How to prepare a strategic flood risk assessment https://www.gov.uk/guidance/local-planning-authorities-strategic-flood-risk-assessment

etc.). In total, 9 breach locations are located around Canvey Island and 1 breach location at Hadleigh Marsh.

2.4.10 The methodology is included within the Tidal and Breach Modelling Technical Note[16] [60725540-TF-001] and the mapping of the results is presented in **Appendix C** (Overtopping Results) and **Appendix D** (Breach Results).

Surface Water Modelling

2.4.11 The scope of this SFRA included updated modelling of surface water throughout the study area. The modelling has been run for the 3.3%, 1% AEP and 0.1% AEP events and these events including climate change using the upper end peak rainfall allowance in the 2080s epoch. The upper end peak rainfall allowance in the 2080s epoch for both management catchments in the Borough is 40%. Further information on peak rainfall allowance is in Section 3.3.

2.4.12 The methodology is included within the Surface Water Modelling Technical Note[19] [60725540-SWF-001] and the mapping of the results in **Appendix E**. The outputs of this modelling are described in Section 3.3.

[19] AECOM, 2024, Castle Point Strategic Flood Risk Assessment, Surface Water Modelling Technical Note, 60725540-SWF-001.

3. Assessing Flood Risk

3.1 Overview

3.1.1 Using the datasets and modelling outputs identified in Section 2, this Section provides a strategic assessment of the flood risk across the Borough from each source.

Study Area

3.1.2 The study area is defined by the district boundary of CPBC and covers approximately 33km^2. Castle Point comprises two distinct areas, the Mainland to the north, on which the major settlements of Hadleigh, South Benfleet and Thundersley are located, and Canvey Island to the south in the Thames estuary. Castle Point borders Thurrock and Basildon to the west and north, and Rochford and Southend-on-Sea to the north and east.

3.1.3 The River Thames, which is tidally influenced, forms the southern Borough boundary. The Holehaven Creek is located to the east of the Borough which discharges into the River Thames. The East Haven Creek borders the east and part of the north of Canvey Island and discharges into the Holehaven Creek. The East Haven Creek continues as the Hadleigh Ray at the Benfleet flood barrier and flows east discharging into the River Thames. There are two other significant Main Rivers: Prittle Brook, which is located in the north-east of the Borough and flows out of the Borough to the east; and Benfleet Hall Brook, which flows north to south through the western area of the Borough and discharges into the Hadleigh Ray. **Appendix A Map 2** shows the study area and watercourses in the Borough.

3.1.4 The population of Castle Point was 89,600 in 2021[20]. The Borough forms part of the Thames Gateway regeneration area, which is a corridor of opportunity identified by the government as an area with the greatest development and commercial potential in the country.

Topography

3.1.5 **Appendix A Map 1** shows the topography of the Borough. The River Thames flows eastwards along the southern Borough boundary where the land is low lying with levels fluctuating around -2 metres Above Ordnance Datum (m AOD). Land is higher in the northern area of the Borough with levels reaching up to approximately 85m AOD in the north-east covering Hadleigh and Thundersley, and 40m AOD in the north-west covering Benfleet. Ground levels decrease towards the south of the Borough with levels fluctuating around 1m-2m AOD on Canvey Island.

Geology

3.1.6 The geology of the Borough comprises a covering of superficial deposits over approximately 60% of the area. This is mainly in the southern part of the Borough and a stretch running along the course of the Prittle Brook in the north. There are also two isolated areas of superficial deposits around the Hadleigh and Daws Heath areas.

3.1.7 The superficial geology of the southern area of the Borough comprises Quaternary age Tidal Flat deposits (clay and silt) and Beach and Tidal flat deposits (clay, silt and sand). Large parts of the northern area of the Borough are not overlain by superficial deposits. The superficial deposits present in the northern area include Head deposits (clay, silt, sand and gravel) and the two isolated areas of Glaciofluvial deposits (sand and gravel) and Superficial deposits (sand and gravel).

3.1.8 The bedrock geologies include Ypresian age Bagshot Formation, Claygate Member (upper part of London Clay Formation) and London Clay Formation.

3.1.9 The London Clay comprises clayey silt beds grading to silty fine-grained sand. This is found beneath the superficial deposits in the southern area of the Borough and at the surface in the central and north western part of the Borough. The upper sandier part of the London Clay Formation is known as the

[20] https://www.ons.gov.uk/visualisations/censusareachanges/E07000069/

Claygate Member to distinguish its coarser-grained nature. This is present in the central part of the northern area of the Borough. In the Hadleigh area and to the east of Thundersley, the Claygate Member is overlain by Bagshot Formation. This formation is characterised by fine grained yellow orange, brown quartz sand with frequent clay laminations, some silt layers, and flint pebble beds in the upper horizons.

Hydrogeology

3.1.10 Aquifers are defined as layers of permeable rock or unconsolidated material (sand, gravel, silt etc.) capable of storing and transporting large quantities of water. The understanding of the behaviour and location of aquifers is important as they can provide an indication of the potential for groundwater flooding.

3.1.11 The bedrock underlying the northeastern part of the Borough including Hadleigh and Daws Heath is designated a Secondary A aquifer. This is defined by the Environment Agency as a "*permeable layer capable of supporting water supplies at a local rather than strategic scale and in some cases forming an important source of base flow to rivers*". The remainder of the Borough to the east is designated unproductive strata which is defined as "*rock strata with low permeability that has negligible significance for water supply or river base flow*".

3.1.12 Small areas of superficial deposits designated a Secondary A aquifer are present in Hadleigh and Daws Heath.

3.1.13 The superficial deposits present around Canvey Island, along the corridor of the Prittle Brook and in the northwest of the Borough are classified as Secondary (undifferentiated) aquifer. According to Environment Agency definitions, a Secondary (undifferentiated) aquifer is defined as an "*aquifer where it is not possible to apply either a Secondary A or B definition because of the variable characteristics of the rock type. These have only a minor value".*

3.1.14 The Environment Agency defines Source Protection Zones (SPZ) around all major public and private water supply abstractions in order to safeguard groundwater resources from potentially polluting activities. There are no areas defined as a SPZ in the Borough.

3.2 Flooding from Rivers and Sea

3.2.1 As shown in **Appendix A Map 2**, the principal Main River-designated watercourses within the Borough include the River Thames, Holehaven Creek and the Hadleigh Ray which are tidally influenced; and the Prittle Brook and Benfleet Hall Brook, which are fluvial watercourses.

3.2.2 The Environment Agency have duties and powers in relation to Main Rivers[21] and ECC, in their role as the LLFA, have duties and powers in relation to Ordinary Watercourses including ditches, dykes, rivers, streams and drains (not public sewers).

Flood Zones

3.2.3 The NPPF[1] categorises areas within the tidal and fluvial floodplain into zones of low, medium and high probability (Table 3-1), as defined and presented on the Flood Map for Planning (Rivers and Sea)[22].

3.2.4 **Appendix A Map 3a** shows that the southern area of the Borough is defined as Flood Zone 3, i.e. high probability of flooding ignoring the presence of defences. The area at greatest risk of tidal flooding in Castle Point (assuming no defences are present) is Canvey Island and Hadleigh Marsh. The northern area of the Borough is defined as Flood Zone 1, i.e. low probability of flooding.

[21] All watercourses in England and Wales are classified as either 'Main Rivers' or 'Ordinary Watercourses'. The difference between the two classifications is based largely on the perceived 'importance' of the watercourse with particular reference to its potential to cause significant and widespread flooding. However, the watercourses classed as Ordinary Watercourses can still cause significant localised flooding.
[22] Flood Map for Planning https://flood-map-for-planning.service.gov.uk/ (Accessed February 2024)

Table 3-1 Flood Zones (PPG Flood Risk and Coastal Change Table 1)

Flood Zone	Flood Zone Definition for River Flooding	Probability of Flooding
Flood Zone 1	Land having a less than 0.1% AEP of river or sea flooding each year. Shown as clear on the Flood Map – all land outside Flood Zones 2 and 3.	Low
Flood Zone 2	Land having between a 1% and 0.1% AEP of river flooding each year; or land having between a 0.5% and 0.1% AEP of sea flooding each year.	Medium
Flood Zone 3a	Land having a 1% AEP or greater of river flooding each year or land having a 0.5% AEP or greater of sea flooding each year.	High
Flood Zone 3b	Land where water from rivers or the sea has to flow or be stored in times of flood. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. Functional floodplain will normally comprise: Land having an annual probability of greater than 3.3% AEP of flooding, with existing flood risk management features and structures operating effectively. Land that is designed to flood (such as a flood attenuation scheme), even if it would only flood in more extreme events (such as 0.1% annual probability of flooding). LPAs should define Flood Zone 3b within their SFRA in agreement with the Environment Agency. It is not separately distinguished from Flood Zone 3a on the Flood Map for Planning (Rivers and Sea).	Functional Floodplain

Tidal Flooding

3.2.5 The River Thames drainage basin covers an area of nearly 13,000km^2 of South East England[23] and drains the whole of Greater London before discharging into the North Sea via the Thames Estuary. It is tidally influenced for approximately 90km of its length up to Teddington in the London Borough of Richmond upon Thames. The southern boundary of the Castle Point study area is formed by the River Thames which has been heavily modified over time to include the construction of raised defences along its frontage. The defences are predominantly defined as 'hard defences' and largely provide a high standard of defence, offering protection up to 0.1% AEP level.

3.2.6 The Holehaven Creek is located to the east of the Borough and discharges into the River Thames. The East Haven Creek borders the east and part of the north of Canvey Island and discharges into the Holehaven Creek. The East Haven flood barrier is located just upstream of where the East Haven Creek discharges into the Holehaven Creek. The East Haven Creek continues as the Hadleigh Ray at the Benfleet flood barrier and flows east until discharging into the Thames. The East Haven and Benfleet flood barriers at either end of the East Haven Creek/Hadleigh Ray were constructed in the 1980s to limit the passage of flood water up the creek. The primary flood mechanisms associated with these tidally influenced watercourses are:

- Daily tidal fluctuation, occurring when the freshwater Thames is met by the incoming tide from the North Sea.
- Surge tides, which occur due to climatic conditions creating bands of low pressure in the Atlantic and North Sea. This causes a surge of water to move across the Atlantic, travelling southwards into the North Sea and becoming compressed as it travels towards and through the narrow English Channel, between Great Britain and mainland Europe. This causes a rapid rise in sea levels, which can be exacerbated by strong northerly winds.

3.2.7 The greatest overall flood risk from the Thames Estuary occurs when tidal surges coincide with particularly high tide levels and/or fluvial flooding in the upper reaches of the catchment. As the flood risk associated with fluvial mechanisms is relatively minor compared to the tidal influence, the risk from the River Thames is defined as tidal and addressed as such within this SFRA.

[23] Royal Geographical Society, The River Thames Factsheet https://www.rgs.org/media/ktkhhk0n/riverslesson4theriverthamesfactsheet.pdf

Historic records of tidal flooding

3.2.8 Historically South Essex and Castle Point has experienced tidal flooding on a large scale, due to its location on the Thames Estuary. The largest of these flood events were in 1731[24], 1791[24], 1881[24], 1928[25], 1938[26] and 1953[27].

Flood defences and further assessment of tidal flooding

3.2.9 Following the 1953 tidal surge, and subsequent local repairs and minor raising works, the 1972 Thames Barrier and Flood Protection Act was passed for wide-spread tidal defence raising within the Thames Estuary, associated with the construction of the current Thames barrier. It was these works that saw the concrete sea wall surrounding Canvey Island upgraded to its current form – nearly 7m above mean sea level.

3.2.10 Large parts of Canvey Island are currently protected against tidal flooding from the Thames. The sea wall provides the island with a significant Standard of Protection (SoP) against tidal flooding; up to the 0.1% AEP event. Further details about flood defence measures to control flood risk are included in Section 5.

3.2.11 The risk of flooding from the River Thames is therefore the residual risk should the flood defences overtop or fail (breach). As part of this SFRA, updated tidal modelling has been undertaken to assess the impact from overtopping or a breach in the flood defences along the River Thames frontage. This is further described in Section 2.4 and the Tidal and Breach Modelling Technical Note[16] [60725540-TF-001]**.** The modelling was undertaken in accordance with the latest Breach Modelling Guidance[28] and in consultation with the Environment Agency.

Impact of climate change on sea levels

3.2.12 LPAs are required to make allowances for climate change in Local Plans to help minimise vulnerability and provide resilience to flooding. Current guidance on the climate change allowances that should be applied are set out by the Environment Agency[29].

3.2.13 There are a range of allowances for each river basin district and epoch for sea level rise. The allowances for the South East river basin district are included in Table 3-2.

3.2.14 The guidance states that LPAs should assess both the Higher Central and the Upper End allowances for SFRAs.

Table 3-2 Sea level allowances in the South East river basin district

Allowance	2000 to 2035 (mm)	2036 to 2065 (mm)	2066 to 2095 (mm)	2096 to 2125 (mm)	Cumulative rise 2000 to 2125 (metres (m))
Higher Central	5.7 (200)	8.7 (261)	11.6 (348)	13.1 (393)	1.20
Upper End	6.9 (242)	11.3 (339)	15.8 (474)	18.2 (546)	1.60

Notes: Sea level allowances in the South East river basin district for each epoch in mm for each year (based on 1981 to 2000 baseline) – the total sea level rise for each epoch is in brackets.

Future Tidal Flood Zones

3.2.15 **Appendix A Map 3b** shows future tidal Flood Zones that have been created by extracting the maximum water levels from the tidal curves used within the boundary conditions as part of the tidal modelling. These curves have been derived from the most recent extreme water level data and climate change predictions. Please refer to the Tidal and Breach Modelling Technical Note[16] [60725540-TF-001] to understand how the tidal curves were developed.

[24] Canvey Island stories from the sea wall https://storymaps.arcgis.com/stories/3aae1e5b0833450597e0fee8c041ad5e
[25] BBC News Article about 1928 Flood of London https://www.bbc.co.uk/news/magazine-26153241
[26] Surge Watch Website, Coastal Flooding in 1938 https://www.surgewatch.org/the-sea-is-in-sir-coastal-flooding-on-the-east-coast-of-the-uk-on-12th-february-1938/
[27] Environment Agency Recorded Flood Outlines https://www.data.gov.uk/dataset/16e32c53-35a6-4d54-a111-ca09031eaaaf/recorded-flood-outlines (Accessed February 2024)
[28] Environment Agency, 29 June 2021 LIT 56413 Breach of defences guidance.
[29] Environment Agency, May 2022, Flood risk assessments: climate change allowances: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#sea-level-allowances [Accessed July 2024].

3.2.16 To provide a conservative approach, the maximum water level from the 0.5% AEP + Higher Central Climate Change scenario was applied to create Future Tidal Flood Zone 3 and the maximum water level from the 0.1% AEP + Higher Central Climate Change scenario was applied to create Future Tidal Flood Zone 2. These levels have been applied to the LiDAR to indicate land that will be at risk of tidal flooding in the future.

Fluvial Flooding

3.2.17 Flooding from rivers occurs when water levels rise higher than bank levels causing floodwater to spill across adjacent land (floodplain). The main reasons for water levels rising in rivers are:

- Intense or prolonged rainfall causing runoff rates and flows to increase in rivers, exceeding the capacity of the channel. This can be exacerbated by wet conditions and where there is significant groundwater base flow.
- Constrictions in the river channel causing flood water to back up.
- Constrictions preventing discharge at the outlet of the river, e.g. locked flood gates, or tide locking.

Main Rivers

3.2.18 The Environment Agency 'Detailed River Network' dataset has been used to identify watercourses in the study area, along with their designation (i.e., Main River or Ordinary Watercourse). This is shown in **Appendix A Map 2**.

3.2.19 The principal Main Rivers located within Castle Point Borough include:

- The **Prittle Brook** rises in Thundersley and flows easterly, discharging into the River Roach and then into the River Crouch estuary. The brook has an approximate length of 11.5km and a catchment area of ~20km^2. The watercourse is either canalised or culverted for the majority of its length.
- The **Benfleet Hall Brook** drains a small catchment area of ~5km^2 including most of the South Benfleet urban area. The catchment is relatively steep and less urbanised in the upper reaches; the lower catchment is dominated by a flood storage area (FSA) and the urban area which is generally flat. The watercourse consists of two tributaries which join within the FSA. The Benfleet Hall Brook discharges into the Hadleigh Ray via a flapped culvert.
- The **Kersey Marsh Sewer** and **Hadleigh Marsh Sewer** both rise in Hadleigh Marsh on the mainland and outfall to the Benfleet Creek. They are both rural catchments, which limits the potential flood consequence associated with them.

3.2.20 Additionally, there is an extensive network of arterial dykes designated as Main River that drain Canvey Island with important conveyance and storage functions.

Ordinary Watercourses

3.2.21 The South Essex SWMP[30] identifies the following Ordinary Watercourses[31] and unnamed drainage ditches in the Castle Point Borough:

- Prittle Brook (upper reaches)
- Tributary of Benfleet Brook
- Tributary of Rawreth Brook
- Janette Avenue
- East of Haven Road

[30] Essex County Council, The Sustainable Drainage Systems Design Guide For Essex Supporting Sustainable Development – Surface Water Management Plans. Available at: https://www.essexdesignguide.co.uk/suds/surface-water-management-plans/south-essex-inc-rochford-castle-point-and-basildon/

[31] This includes "all rivers and streams and all ditches, drains, cuts, culverts, dikes, sluices (other than public sewers within the meaning of the Water Industry Act 1991) and passages, through which water flows" according to the Land Drainage Act 1991.

3.2.22 Responsibility for the maintenance of these Ordinary Watercourses falls to riparian owners who own the land on either bank. CPBC is only responsible for Ordinary Watercourses where land on either bank is in Council ownership or where historical agreements have been made.

3.2.23 In addition to these, there are more than 16 watercourses and dykes that form the drainage system for Canvey Island, which is partly pumped. Different sections are operated and maintained by CPBC, AWSL and the Environment Agency. Fluvial flooding from this system is possible due to the flat and low lying topography of the Island and the restrictions on flow caused by sea defences and pump drains at the downstream end of these watercourses. If water were to overtop these dykes, the flat topography of the Borough could cause water to disperse over large areas.

Historical records of fluvial flooding

3.2.24 There has been one significant fluvial flood event associated with the Benfleet Hall Brook (September 1968)[27]. No fluvial flood events are indicated by the Environment Agency Recorded Flood Outlines[27] dataset associated with the Prittle Brook in the Castle Point Borough. The Historic Flood Map, presented in **Appendix A Map 4,** shows the greatest extent of past flooding but does not identify individual flood events. It should be emphasised that there could be unreported flooding incidents across the Borough.

Climate Change

3.2.25 The Environment Agency's online guidance 'Flood risk assessments: climate change allowances'[32] sets out the climate change allowances for peak river flows for specific 'management catchments' and provides advice on applying climate change projections when preparing FRAs. The allowances for the management catchments of relevance to Castle Point are set out in Table 3-3. SFRAs should consider the central and higher central allowances (shaded in grey). The northern area of the Borough is located within the Combined Essex management catchment and Canvey Island is located within the South Essex management catchment.

Table 3-3 Peak River Flow Allowances for management catchments in Castle Point

Management Catchment	Allowance Category	Total potential change anticipated for the '2020's (2015 to 2039)	Total potential change anticipated for the '2050's (2040 to 2069)	Total potential change anticipated for the '2080's (2070 to 2125)
South Essex	Upper end (95th)	22%	27%	48%
	Higher central (70th)	11%	11%	**26%**
	Central (50th)	6%	5%	**17%**
Combined Essex	Upper end (95th)	27%	37%	72%
	Higher central (70th)	13%	16%	**38%**
	Central (50th)	7%	8%	**25%**

3.2.26 Hydraulic modelling of the Prittle Brook and Benfleet Hall Brook (refer to Section 2 Table 2-3) includes increases in peak river flow due to the impacts of climate change. Scenarios have been undertaken to consider the change to the 3.3%, 1% and 0.1% AEP flood extents (excluding the presence of defences) when applying increases of 25 and 38% to peak river flow. These are mapped in **Appendix B Map 1, Map 2A and Map 2B**. These provide a suitable indication of the central and higher central allowances for the 2080s epoch.

Flood Defences

3.2.27 Flood defences are typically raised structures that alter natural flow patterns and prevent floodwater from entering property in times of flooding. They are generally categorised as either 'formal' or 'informal' defences. A 'formal' flood defence is a structure that is maintained by its respective owner, regardless of whether it is owned by the Environment Agency. An 'informal' flood defence is a structure that has often not been specifically built to retain floodwater and is not maintained for this specific

[32] Environment Agency (published 2016 and updated May 2022) Flood risk assessments: climate change allowances. Available at: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

purpose. Boundary walls and industrial buildings situated immediately adjacent to rivers often act as informal flood defences.

3.2.28 The Environment Agency Asset Information Management System (AIMS) contains details of flood defence assets associated with Main Rivers. This information is presented in **Appendix A Map 5**.

Flood Zone 3b Functional Floodplain

3.2.29 The following areas are defined as Flood Zone 3b in Castle Point, as shown in **Appendix B Map 1**:

- Flood extents from the Prittle Brook Hydraulic Model (CH2M, June 2017) have been rerun for the 3.3% AEP event to define Flood Zone 3b. The watercourse is mainly within bank as it flows east through residential areas. As the watercourse flows into rural land towards Belfairs Nature Reserve, the watercourse is out of bank, but the extent is mainly confined to the floodplain.
- Flood extents from the Benfleet Hall Brook Model (JBA, May 2015) have been rerun for the 3.3% AEP event to define Flood Zone 3b. Flood Zone 3b is mainly confined to the Flood Storage Area and within channel, with a small area of extent at Richmond Avenue.
- Due to the presence of formal flood defences on Canvey Island providing protection to 0.1% AEP, there is no Flood Zone 3b on the landward side of the defences.

3.2.30 In line with the future risk of fluvial flooding, the area of functional floodplain is expected to increase as a result of climate change. Flood extents from the Prittle Brook and Benfleet Hall Brook have been rerun for the 3.3% AEP + 25% climate change and 3.3% AEP + 38% climate change as shown in **Appendix B Map 1.** They show a small increase in flood extent, particularly in the upper reaches of both the Prittle Brook and Benfleet Hall Brook.

3.3 Flooding from Surface Water

3.3.1 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. This source of flooding can be compounded when combined with impermeable sub-soils, significant areas of development with associated hard standing areas or areas of open grassland.

Historic Records

3.3.2 In their role as the LLFA, ECC has duties to record and investigate flood incidents relating to local sources of flooding, namely flooding from surface water, groundwater and Ordinary Watercourses.

3.3.3 ECC has provided a GIS layer of Flood Incidents to inform the SFRA which is presented in **Appendix A Map 4**. Table 3-4 summaries past flood event in Castle Point. Two significant flood events are recorded in the dataset. 41 records were reported for the flood event on 24th August 2013, concentrated in Benfleet, Thundersley, Hadleigh and Canvey Island. 17 flood events were reported for the flood event on 20th July 2014 on Canvey Island.

3.3.4 ECC has undertaken a formal Section 19 Flood Investigation Report (FIR) in response to the flooding of properties on Canvey Island in July 2014. The magnitude of rainfall experienced was unprecedented and well beyond the national standards for design capacity of sewers and surface water drainage systems, causing the system to be overwhelmed in multiple locations. The evidence suggests that this occurred in the early stages of the drainage system, and the operation of the pumps did not contribute to the flooding. The pumps form the final stage of a long and incredibly complex system, and rainfall on the island may flow a substantial distance before reaching them. Additionally, whilst there were reports by residents that blockages in highway drains may have caused localised flooding, there was no evidence to suggest that any widespread failure of the drainage system occurred due to insufficient maintenance or poor condition of these or any other publicly or privately owned infrastructure.

3.3.5 A Section 19 FIR for surface water flooding in the south of Canvey Island at Roggel Road and Sprundel Avenue, in October and November 2013 indicated the incomplete installation of the private drainage system on Roggel Road combined with the underlying level of surface water flood risk and

drainage problems on Canvey Island as a whole, was exacerbated by intense rainfall during the flood events. This report also highlights highway flooding in Maurice Road, which lies parallel to Roggel Road to the east.

3.3.6 A Section 19 FIR[33] for The Avenue & The Crescent, Hadleigh, Essex for flooding in August and December 2013 indicates flooding was most likely due to water being prevented from entering a culvert, contributing to overland flow on Bilton Road and the subsequent flooding issues caused to properties in that location and further down the drainage system.

3.3.7 A S19 Flood Investigation Report[34] for Warren Chase, Thundersley for flooding in October 2021 caused by local surface water systems being overwhelmed. Water was reported to come from the highway where gullies were unable to cope with the volume of water on Warren Chase and at the junction between Warren Chase and the A13. Another FIR[35] for Canvey Island and Benfleet for flooding in October 2021 was produced by ECC and reports over 50 properties flooded. The underpass beneath Benfleet Station was understood to have flooded due to failure of the pumping station causing gridlock to the local area and buses were diverted for several hours. The report indicates the flooding was a result of the significant rainfall that fell over the Benfleet and Hadleigh area within a very short space of time which coincided with high tides. This may have caused an increase in flooding. There were also reports of blockages in drainage networks which led to an increase in overland flow.

Table 3-4 Summary of Past Flood Events in Castle Point

Flood Event	Source of flooding	Description (source in brackets where available)
January 1953	Tidal	A combination of high spring tides and a severe storm led to widespread flooding across the north-sea coast. The whole of Canvey Island was inundated with the loss of 58 lives and the evacuation of many more. Following this event, structural flood mitigation measures were put in place to increase the standard of protection offered by existing flood defences.
1968	Fluvial	Fluvial flooding from the Benfleet Sewer. Following this event, structural flood mitigation measures were undertaken along the watercourse to improve the standard of protection against flooding including the construction of the bunded washlands area.
October 1987	Surface Water	Flood record in Hadleigh (North Essex Catchment Flood Management Plan)
April 2007 to March 2009	Unknown	19 recorded flood incidents (Fire and Rescue Service).
28th November 2009	Unknown	Hadleigh flood record (Fire and Rescue Service)
28th February 2010	Unknown	Canvey Island 2 flood records (Fire and Rescue Service).
29th March 2010	Unknown	Hadleigh flood record (Fire and Rescue Service).
6th June 2010	Unknown	Hadleigh flood record (Fire and Rescue Service).
18th January 2011	Heavy Rainfall	3 records of flooding in Canvey Island (Echo Newspaper).
24th August 2013	Surface Water	Flooding on Canvey Island.
20th July 2014	Surface Water	Between 13:40 and 18:00, one million cubic metres of water fell on the island. The unprecedented amount of rainfall overwhelmed large parts of the drainage system on the island including infrastructure that predates the current standard of drainage infrastructure. The rainfall caused widespread flooding including internal flooding of over 330 properties and significant disruption to infrastructure.
17th and 23rd June 2016	Unknown	Flooding incidents which occurred in Great Bromley Tendring and Station Road Burnham Maldon. Approximately 15 residential properties internally in Great Bromley, Tendring alone (PRFA).
20th October 2021	Surface Water	Over 50 properties flooded in Benfleet and on Canvey Island[35] and flooding in Warren Chase, Thundersley[35]

[33] Essex County Council, July 2014, Flood Investigation Report, The Avenue & The Crescent, Hadleigh, Essex, Castle Point Borough.
[34] Essex County Council, April 2022, Flood Investigation Report, Warren Chase, Thundersley
[35] BMT Defence and Security UK Ltd, August 2022, Section 19 Flood Investigation Report for Castle Point

Climate Change

3.3.8 Climate change is predicted to result in wetter winters and increased summer storm intensity in the future. This will lead to an increased volume of water entering land and urban drainage systems, consequently resulting in surface water flooding.

3.3.9 LPAs are encouraged to make allowances for climate change in Local Plans to help minimise vulnerability and provide resilience to flooding. Table 3-5 shows the peak rainfall intensity allowance for all management catchments within CPBC. The specific allowance to be used depends on the development, as well as its development lifetime. Current guidance on the climate change allowances that should be applied are set out by the Environment Agency[36]. The Environment Agency advises that the peak rainfall allowances should only be used for surface water flood mapping in small catchments (under 5km^2), urbanised drainage catchments, and for site-scale applications.

Table 3-5 Peak Rainfall Intensity Allowances for management catchments in Castle Point

Management Catchment	AEP	Epoch 2050s (2022-2060) or 2070s (2061-2125)	Central Allowance	Upper End Allowance
South Essex	3.3%	'2050s'	20%	35%
	3.3%	'2070s'	20%	35%
	1%	'2050s'	20%	45%
	1%	'2070s'	25%	40%
Combined Essex	3.3%	'2050s'	20%	35%
	3.3%	'2070s'	20%	35%
	1%	'2050s'	20%	45%
	1%	'2070s'	25%	40%

3.3.10 The guidance advocates for the use of the Upper End allowances for both the 1% and 3.3% AEP events when assessing the impacts of climate change on surface water flood risk within SFRAs. For site-specific assessments, developers should use the 2050s epoch for development with a lifetime up to 2060 and the 2070s epoch for development with a lifetime between 2061 and 2125. In some locations, the allowance for the 2050s epoch is higher than that for the 2070s epoch. In these scenarios where the development has a lifetime beyond 2061, the guidance advocates using the higher of the two allowances.

Critical Drainage Areas

3.3.11 The South Essex SWMP[30] defined a Critical Drainage Area (CDA) as *'A discrete geographic area (usually a hydrological catchment), within the SWMP Study Area where multiple or interlinked sources of flood risk cause flooding during a severe rainfall event thereby affecting people, property, or local infrastructure'.*

3.3.12 Five CDAs have been identified in the Castle Point Borough SWMP. The locations covered by CDAs are shown in **Appendix A Map 6** and include:

- South Benfleet
- North Canvey Island
- Leighbeck
- Reeds Hill Farm
- New Thundersley

3.3.13 It should be noted that the NPPF also refers to areas with 'critical drainage problems' as notified by the Environment Agency. However, these are not the same as CDAs referred to within the SWMP and at the time of writing, the Environment Agency has confirmed that there are no *'areas with critical drainage problems for the purposes of the Development Management Procedure Order'* within Castle Point.

[36] Environment Agency Peak River Flow Allowances: https://environment.data.gov.uk/hydrology/climate-change-allowances/rainfall [Accessed August 2024].

3.3.14 The Castle Point SWMP should be referred to for further detail on specific surface water flood events and CDAs.

Canvey Island Integrated Urban Drainage Study

3.3.15 The Canvey Island Integrated Urban Drainage[37] (IUD) study is the result of a partnership project between AW, the Environment Agency, ECC, Essex Highways, CPBC and the Royal Society for the Protection of Birds (RSPB).

3.3.16 These partners have come together with the aim of managing non-tidal flood risk on Canvey Island where the causes of flooding are often related to drainage assets owned by more than one organisation. The Canvey Island IUD study has delivered an integrated catchment model of the drainage system on Canvey Island that includes all the components of the system and is capable of modelling the interaction between them.

Risk of Flooding from Surface Water Mapping

3.3.17 The Environment Agency has undertaken detailed modelling of surface water flood risk at a national scale and produced mapping identifying those areas at risk of surface water flooding during three probability events:

- 3.3% AEP
- 1% AEP
- 0.1% AEP

3.3.18 The latest version of the mapping is referred to as the 'Risk of Flooding from Surface Water' (RoFSW) and the extents are mapped in **Appendix A Map 6**. The RoFSW mapping illustrates the risk of surface water flooding to be widespread across the Borough. The surface water follows the natural topography of the land and accumulates in the natural depressions. Additionally, surface water flow pathways are present along the road networks.

3.3.19 It should be noted that these maps are based on topography, with assumptions about the underground drainage network, and their accuracy is not as robust as fluvial flood maps. However, where un-modelled watercourses are present, reference to the RoFSW mapping is a good starting point to identify potential areas of flood risk.

Surface Water Modelling

3.3.20 The scope of this SFRA included updated modelling of surface water throughout the study area. The modelling has been run for the 3.3% AEP, 1% AEP and 0.1% AEP events and these events including climate change using the upper end peak rainfall allowance in the 2080s epoch (40%).

3.3.21 **Present day flood risk: Appendix E Map 1** illustrates the risk of surface water flooding to be widespread across the Borough with the risk mostly associated with watercourses and surface water ponding in lower elevations. The mapping shows a flow path through a residential area in North Benfleet which is not associated with a watercourse where a number of properties are at risk of regular flooding. There is also surface water flood risk associated with the tributaries of the Prittle Brook in Thundersley, affecting residential areas and with the Benfleet Hall Brook in South Benfleet.

3.3.22 There are areas of high surface water flood risk associated with the drainage network of ordinary watercourses at Canvey Wick and Hadleigh Marshes, particularly to the north of the railway line. The risk of surface water flooding is widespread across Canvey Island primarily along, but not exclusively limited to, road networks.

3.3.23 **'Upper end' Climate Change Allowance:** Climate change is expected to increase the frequency, extent, and impact of flooding. **Appendix E Map 2** shows surface water flood risk in CPBC with a 40% Climate Change allowance. The mapping shows the flood extents increase slightly with climate change but are largely contained to the same areas.

[37] Black & Veatch, August 2015, Canvey Island Integrated Urban Drainage Study.

3.3.24 The areas that are shown to be at risk of flooding during the 3.3% AEP are at risk of regular flooding. Measures to control and mitigate flood risk, as outlined in Section 5 may need to be considered in these locations to reduce the risk of flooding.

3.4 Flooding from Groundwater

3.4.1 Groundwater flooding occurs when water levels in the ground rise above surface elevations. Groundwater flooding may take weeks or months to dissipate, as groundwater flow is much slower than surface water flow therefore water levels take much longer to recede.

3.4.2 Information regarding the Bedrock and Superficial geology within the Borough has been obtained from BGS datasets and mapped in **Appendix A Maps 7 and 8**. The bedrock and superficial geology and their aquifer designations are described in Section 3.1.

3.4.3 The BGS dataset 'Susceptibility to Groundwater Flooding' has been obtained by CPBC and mapped within this SFRA in **Appendix A Map 9**. This dataset shows where there is the potential for groundwater flooding but does not give any indication of the probability that it will occur. Susceptibility is classified into three categories: Potential for groundwater flooding to occur at surface; Potential for groundwater flooding of property situated below ground level; and Limited potential for groundwater flooding to occur. The mapping shows that throughout the north part of the Borough there is 'potential for groundwater flooding to occur at surface' and 'potential for groundwater flooding of property below ground level' associated with the Prittle Brook. In the wider catchment around Thundersley and Daws Heath there is 'limited potential for groundwater flooding to occur'. The area to the west of New Thundersley around the Manor Trading Estate is also susceptible to groundwater flooding. To the south of the Borough, there is a small area which has the 'potential for groundwater flooding below ground level' at Northwick Farm and Waterside Farm.

3.4.4 Groundwater investigations should be carried out as part of site-specific FRAs. This is particularly important for developments in which basement areas are proposed; it must be demonstrated that the site does not lie on a key groundwater flow route such that introducing a flow barrier within the system would increase the risk of groundwater flooding elsewhere.

3.5 Sewer flooding

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

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

3.5.2 Sewer systems are typically designed and constructed to accommodate rainfall events with an annual probability of 3.3% or greater. Therefore, rainfall events with an annual probability less than 3.3% would be expected to result in surcharging of some of the sewer system. While AW, as the sewerage undertaker recognises the impact that more extreme rainfall events may have, it is not cost beneficial to construct sewers that could accommodate every extreme rainfall event.

3.5.3 Furthermore, as urban areas expand to accommodate growth, the original sewer system is rarely upgraded proportionately and so becomes overloaded. This problem is compounded by climate change which is forecast to result in milder wetter winters and increased rainfall intensity in summer months.

2) The system becomes blocked by debris or sediment:

3.5.4 Over time there is potential that road gullies and drains become blocked from fallen leaves, build-up of sediment and debris (e.g. litter). The relatively flat topography of Canvey Island with levels fluctuating around 1m-2m AOD exacerbates this issue. The flat topography results in the deposition of debris during low flows which can cause sediment to build up more quickly. Higher flows are needed to keep systems clear.

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

3.5.5 Within the study area there is potential for surface water 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 may 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.

3.5.6 AWSL has provided an extract from their register of flooded properties for the study area. This shows properties that have been affected by sewer flooding (as reported to AW) since April 2013. Due to data protection requirements, this data has not been mapped at the individual property level; rather the register comprises the number of properties within 4-digit postcode areas that have experienced flooding, either internally or externally, since April 2013. It should be noted that it is likely that there have also been unreported sewer flooding incidents in this area over this time period.

3.5.7 AWSL Sewer records, presented in **Appendix A Map 10**, show that there is a high frequency of sewer flooding incidents in the CPBC study area. The majority of the sewer flooding events have taken place in the north west of Canvey Island (SS8 9) and North Thundersley (SS7 3).

3.6 Flooding from Reservoirs

3.6.1 The failure of a reservoir or artificial source has the potential to cause catastrophic damage due to the sudden release of large volumes of water. The PPG[2] encourages LPAs to identify any reservoirs and evaluate how they might modify the existing flood risk in the event of a flood in the catchment is located within, and/or whether emergency draw-down of the reservoir will add to the extent of flooding. In accordance with paragraph 046 of the PPG, LPAs should also consider any implications for reservoir safety and reservoir owners and operators caused by new development located downstream of a reservoir, such as the cost of measures to improve the design of the dam to reduce flood risk, the operation of the reservoir, and general maintenance costs.

3.6.2 The Environment Agency dataset 'Risk of Flooding from Reservoirs' identifies areas that could be flooded if a large[38] reservoir was to fail and release the water it holds. The guidance 'Reservoir flood maps: when and how to use them'[39] state what the reservoir flood maps show, how they were created and how to use them for assessments. The mapping shows the flood extent when local rivers are at normal levels (a 'dry day') or when local rivers are already in flood (a 'wet day'). This mapping reproduced in **Appendix A Map 11** identifies that areas around the South Benfleet FSA could be at risk of reservoir flooding if the South Benfleet FSA were to fail. The mapping also shows that areas south of the Hadleigh could be at risk from reservoir flooding associated with the Essex Leisure Fisheries waterbody. A small part of the urbanised area of Canvey Island could be at risk of reservoir flooding associated with Canvey Lake. Areas along the East Haven Creek could be at risk of reservoir flooding associated with marshes adjacent to East Haven Creek.

3.6.3 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 minimal risk.

3.6.4 CPBC is responsible for working with members of the Essex Local Resilience Forum to develop emergency plans for reservoir flooding and ensuring communities are well prepared.

3.6.5 Any proposals for development within the risk of flooding from reservoirs extent will need to confirm with the Environment Agency the source of this reservoir flood risk.

South Benfleet Flood Storage Area

3.6.6 The area south of the playing fields at Hope's Green along with Benfleet Marsh is classified as washlands and has been defined by the Environment Agency as a Flood Storage Area (FSA). It is also registered under the Reservoirs Act (1975) and will be maintained and operated as a Category C Reservoir and FSA with capacity to store surface water floodwaters during a 0.1% AEP event.

[38] A large reservoir is one that holds over 25,000 cubic metres of water, equivalent to approximately 10 Olympic sized swimming pools.
[39] Environment Agency (2021) Reservoir flood maps: when and how to use them. Available at: https://www.gov.uk/guidance/reservoir-flood-maps-when-and-how-to-use-them

3.6.7 For the purpose of planning, this area is designated as Flood Zone 3b Functional Floodplain and therefore nearly all types of development are inappropriate at this location. Only developments which are classified by Annex 3 of the NPPF as “Essential Infrastructure” or “Water Compatible” are appropriate for consideration within Flood Zone 3b and that these uses must (1) be designed and constructed to remain operational and safe for users in times of flood; (2) result in no net loss of floodplain storage; and (3) not impede water flows and not increase flood risk elsewhere. Essential Infrastructure must also pass the Exception Test if located in Flood Zone 3b. Housing and commercial or industrial development should not be permitted.

3.6.8 It is essential that the Environment Agency is consulted before development plans are planned for sites within this area.

3.7 Assessing the Cumulative Impact of Development

3.7.1 The NPPF[1] states that strategic policies should be informed by a SFRA, and should consider cumulative impacts in, or affecting, local areas susceptible to flooding (paragraph 166). The ‘How to prepare a Strategic Flood Risk Assessment’ guidance[18] also states that a SFRA should include an assessment of the cumulative impacts of development and land-use change which should include any impact expected from:

- Strategically planned development.
- Windfall development.
- Permitted development.
- Significant changes in land use, such as paving over domestic gardens or reforestation of uplands.

3.7.2 Development or the cumulative impacts of development may result in an increase in flood risk elsewhere as a result of impacts such as the loss of floodplain storage, the deflection or constriction of flood flow routes or through inadequate management of surface water. The loss of floodplain storage is less likely to be a concern in areas benefitting from appropriate flood risk management infrastructure, however assessment will still need to be made (refer to Section 5.6).

3.7.3 Where flood storage from any source of flooding is to be lost as a result of development, on-site level-for-level compensatory storage, accounting for the predicted impacts of climate change over the lifetime of the development, should be provided. Where it is not possible to provide compensatory storage on site, it may be acceptable to provide it off-site if it is hydraulically and hydrologically linked.

3.7.4 Identification of those areas where changes in land use could potentially increase surface water runoff rates and volumes can strategically aid spatial planning in avoiding areas where significant mitigation of surface water runoff following development may be required. The provision of multifunctional sustainable drainage systems, natural flood management and green infrastructure can also make a valuable contribution to mitigating the cumulative impacts of development on flood risk.

3.7.5 Whilst individual development with appropriate site mitigation measures should not result in measurable local effects with respect to hydrology and flood risk, the cumulative effect of multiple development may be more severe at downstream locations in the catchment. Locations where there are existing flood risk issues will be particularly sensitive to cumulative effects.

3.7.6 The cumulative impact should be considered throughout the planning process, from the allocation of sites within the Local Plan, to the planning application and development design stages.

3.7.7 From a review of all 162 potential future development sites provided by CPBC, there are multiple developments located in in Canvey Island that are potentially at risk from fluvial and/or surface water flooding. There is also one site in South Benfleet and three sites in Daws Heath. A detailed cumulative impact assessment may be required through hydraulic modelling which will be considered as part of the Level 2 SFRA. If these sites are taken forward to development and design stages, aspects relating to floodplain compensation and the management of surface water should be considered to ensure that flood risk is not increased elsewhere.

3.7.8 In Castle Point, there is a concern on the cumulative impact of flooding from a high intensity rainfall event occurring at the same time as high tide. To understand the potential impact of high tides on fluvial flood risk, the downstream boundary in the Canvey Island IUD model was edited to represent an increased water level of 0.5m. The South Essex Surface Water model was run for the tide locked scenario which assumes the drainage network is unable to discharge. Both models were run for the 1% AEP event.

3.7.9 The Canvey Island cumulative impact results show negligible differences with the tidal boundary increased by 0.5m. The results are not mapped as there are no noticeable differences. Therefore, based on the results Canvey Island is not at risk from the cumulative impact of flooding.

3.7.10 The South Essex Surface Water cumulative impact results show the largest depth difference is seen within the South Benfleet flood storage area. The increases in maximum flood depth are typically low in residential areas and the extent of flooding does not change significantly. It is therefore concluded that residential areas are at minimal risk from the cumulative impact of flooding.

3.7.11 The Surface Water Modelling Technical Note[19] [60725540-SWF-001] sets out the methodology applied and the results.

3.8 Assessing Cross Boundary Considerations

3.8.1 By its very nature, flooding is an issue that has significant cross boundary impacts. The causes and impacts of flooding do not respect administrative boundaries, and a wide range of organisations have responsibilities for managing flood risk either due to land ownership or statutory duties.

3.8.2 Watercourses, overland flow paths and groundwater flow routes pass from one LPA to a neighbouring one. Therefore, future development in one LPA has the potential to affect flood risk to existing development and surrounding areas in another LPA area.

3.8.3 Castle Point borders Thurrock and Basildon to the west and north, and Rochford and Southend-on-Sea to the north and east. The natural catchments within the Castle Point study area cross borders between LPA administrative areas. The Prittle Brook flows easterly from Castle Point into Southend. There are also surface water flowpaths associated with the Prittle Brook and Hadleigh Marshes which flow into Southend as well as surface water flow paths in the north of the Borough at Daws Heath which flow into Rochford. Surface Water flowpaths from Basildon in the north west of the catchment flow into the Borough near New Thundersley.

3.8.4 In these locations, LPAs that share river catchments should work together with other RMAs to assess and manage flood risk and consider the wider impacts of any proposed development. This may entail collaboration through flood risk management measures and consulting each other on applications for development on administrative boundaries. Applications for development that would increase the risk of flooding to neighbouring areas should not be permitted.

Recommendation 3-1 *CPBC should ensure communication between LPAs to make sure that action in one does not negatively impact upon another.*

4. Avoiding Flood Risk – Applying the Sequential Test

4.1 Overview

4.1.1 The sequential approach is a decision-making tool designed to select sites so that development is, as far as reasonably possible, located where the risk of flooding from all sources is lowest, taking account of climate change and the vulnerability of future users to flood 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 (as determined by Table 4-2), will ensure that new developments in flood risk areas will only occur where flood risk is clearly outweighed by other sustainability and safety drivers.

4.1.2 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.

4.2 Applying the Sequential Test for the Local Plan

4.2.1 Figure 4-1 illustrates the approach for applying the Sequential Test that CPBC should adopt in the allocation of sites as part of the preparation of the Castle Point Local Plan. The Sequential Test should be undertaken by CPBC and accurately documented to ensure decision processes are consistent and transparent. The Sequential Test requires an understanding of the risk of flooding in the study area from all sources (as provided within this SFRA) and the vulnerability classification of the proposed developments (as defined in the NPPF[1] are presented in Table 4-1).

4.2.2 All sources must be considered when planning for new development including flooding from land or surface water runoff; groundwater; sewers; and artificial sources. If a location is recorded as having experienced repeated flooding from the same source this should be acknowledged within the Sequential Test.

4.2.3 Sites should be identified as at low/medium/high risk considering all sources of flooding. It is noted that the definition is not synonymous with the Flood Zones on the Flood Map for Planning, as these are defined by the probability of flooding. It is also noted that a site may be defined as high risk due to one source of flooding, even though the risk from all other sources of flooding is low.

4.2.4 The Sequential Test needs to be applied to the whole LPA area to increase the possibilities of delivering development not exposed to flood risk, both now and in the future. When preparing a Local Plan, the LPA should demonstrate that a range of site allocations have been considered, using the SFRA to apply the Sequential and Exception Tests where necessary.

4.2.5 Where it is not possible to locate development in low-risk areas, the Sequential Test should go on to compare sites within medium risk areas and only where there are no sites in low and medium risk areas, should high-risk areas be considered.

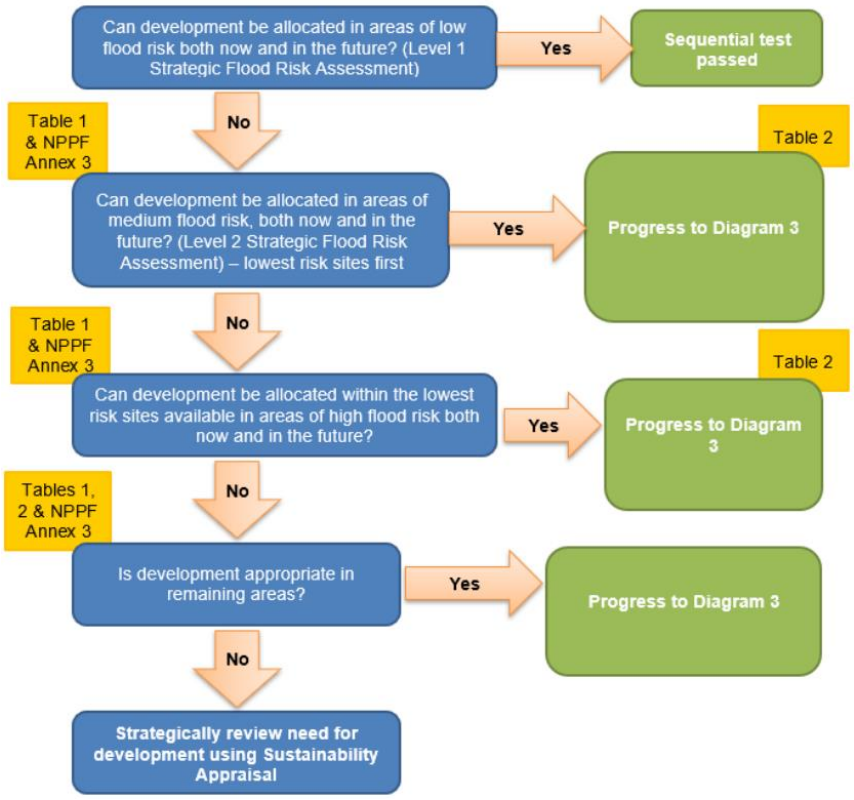


Figure 4-1 Applying the Sequential Test in the Preparation of a Local Plan (PPG Diagram 2)

Table 4-1 Flood Risk Vulnerability Classification (NPPF Annex 3)

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 infrastructure for electricity supply including generation, storage and distribution systems; including electricity generating power stations, grid and primary substations storage; and water treatment works that need to remain operational in times of flood. Wind turbines. Solar farms.
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.

Vulnerability Classification	Development Uses
	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).
	Car parks.
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.

4.2.6 The NPPF indicates suitability of a development based on its vulnerability and location within a fluvial or tidal Flood Zone as set out in Table 4-2. However, the vulnerability classification of types of development is still relevant in considering flood risk from other sources. For example, a basement dwelling will still be more vulnerable to surface water flooding than an office development.

Table 4-2 Flood Risk Vulnerability and Flood Zone 'Incompatibility' (PPG Table 2)

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 *	✓*	✗	✗	✗

✓ – Exception Test is not required ✗ – Development should not be permitted

† – In Flood Zone 3a essential infrastructure should be designed and constructed to remain operational and safe in times of flood.

* – In Flood Zone 3b (functional floodplain) essential infrastructure that has to be there and has passed the Exception Test, and water-compatible uses, should be designed and constructed to:

- remain operational and safe for users in times of flood
- result in no net loss of floodplain storage
- not impede water flows and not increase flood risk elsewhere

Recommendation 4-1 *CPBC should ensure the Sequential Test is undertaken for all strategic land allocations and check that the vulnerability classification of the proposed land use is appropriate to the Flood Zone classification.*

Recommendation 4-2 *CPBC should pursue opportunities to move existing development from within the floodplain to areas with a lower risk of flooding. This should include consideration of the vulnerability of existing developments and whether there is potential for land swap with lower vulnerability uses.*

Recommended Stages for LPA Application of the Sequential Test

4.2.7 The recommended steps in undertaking the Sequential Test are detailed below. To assist with the application of the Sequential Test, a site assessment database has been developed for CPBC, containing sites that may be proposed for allocation within the emerging New Local Plan. Each site is assessed based on the information and datasets within this SFRA. This provides a useful tool to enable CPBC to apply a sequential approach to the selection of sites, considering all sources of flooding now and in the future. This database can be used by CPBC when applying the steps below:

1. Identify the site location and boundary.
2. Assign potential developments with a vulnerability classification (Table 4-1). Where development is mixed, the development should be assigned the highest vulnerability class of the developments proposed.
3. The design life of the development should be considered with respect to climate change:
    - 100 years for residential developments; and
    - A minimum of 75 years for commercial / industrial developments, or other time horizon specific to the non-residential use proposed.
4. Identify the risk of flooding from all sources, both now and in the future, using this Level 1 SFRA.
5. Identify any existing flood defences serving the potential development sites. (However, it should be noted that for the purposes of the Sequential Test, the risk of flooding ignoring defences should be used).
6. Use this information to rank the sites from lowest to greatest risk of flooding from all sources. This is likely to be an iterative process, and the LPA will need to consider the relative risk posed by different sources of flood risk.
7. Steer development towards those sites at lowest risk, prior to the consideration of sites at greater risk.
8. Document the decision-making process to demonstrate how sites are considered to have ‘passed’ the Sequential Test.
9. For sites that are deemed to have passed the Sequential Test, determine whether the Exception Test also needs to be applied, by referring to Table 3 of the PPG[2] (reproduced in Table 4-2).

4.2.8 Where the development 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), the site and flood sources should be investigated further regardless of any requirement of the Exception Test.

Approach for Ranking Sites

4.2.9 As noted above, using the information within this SFRA, a site assessment database has been developed for CPBC, containing potential development sites that are under consideration within the Local Plan. Each site is assessed based on the information and datasets within this SFRA and an approach established to rank the sites to reflect the level of risk from all sources.

4.2.10 As noted in the Strategic Flood Risk Assessment Good Practice Guide[40], there is no specified approach in existing guidance of how to apply this ranking, and it is therefore for the LPA undertaking the process to decide. There are different approaches because there is variation between the different

[40] Environment Agency, ADEPT, CIWEM, Strategic flood risk assessments: A good practice guide. https://www.adeptnet.org.uk/strategic-flood-risk-assessment-good-practice-guide

sources of flooding which means that they cannot also be considered 'equivalent'. For example, in terms of:

- the **impact of the flooding** from each source (for example, the risks from reservoir flooding and surface water flooding are different in terms of likelihood and resulting flood depths and damage).
- the **reliability of the data** used to assess the risk (for example, hydraulic modelling undertaken to determine the risk of river and sea flooding is more detailed and reliable than national or regional scale mapping of groundwater flood risk based on a high level understanding of geology).
- the **perceived ease** with which each source can be managed (for example, there is a perception that in some situations, flooding from one particular source may be easier to manage and therefore does not need so much weight given to it during site selection and strategic planning).

4.2.11 For CPBC, the ranking displayed in Table 4-3 was applied based on the risk of flooding. All the sites are assessed within the database based on flooding from all sources, however in the overall scoring applied, scores 1-3 initially relate to the risk of flooding from rivers. These sites may also be at risk of surface water and/or groundwater flooding, and this is clearly visible when viewing the results in the database.

4.2.12 CPBC have used this approach as a tool for applying the sequential approach to the sites under consideration.

Table 4-3 Approach to ranking sites based on risk of flooding

Score	Criteria
1	More than 20% of the site is within the 3.3% AEP flood extent (Flood Zone 3b) associated with the Prittle Brook or Benfleet Hall Brook
2	Over 20% of the site is shown to be at risk of fluvial flooding from Prittle Brook or Benfleet Hall Brook for the design event including an allowance for climate change (1% AEP plus 38% climate change allowance).
3	Part of the site is shown to be at risk of fluvial flooding from Prittle Brook or Benfleet Hall Brook for the design event including an allowance for climate change (1% AEP plus 38% climate change allowance).
4	Part of the site is at risk of flooding from overtopping of the River Thames flood defences, for the design flood event for the year 2125 (0.5% AEP 2125).
5	More than 20% of the site is defined as high risk of flooding from surface water.
6	More than 20% of the site is defined as medium risk of flooding from surface water.
7	More than 20% of the site is defined as low risk of flooding from surface water.
8	Part of the site is at residual risk of flooding from a breach in the Canvey Island flood defences, for the design flood event for the year 2125 (0.5% AEP 2125 and has a Time to Inundation of under 1 hour.
9	Part of the site is at residual risk of flooding from a breach in the Canvey Island flood defences, for the design flood event for the year 2125 (0.5% AEP 2125 and has a Time to Inundation of 1 - 4 hours.
10	The site is defined as Flood Zone 1 and intersects an area at high risk of flooding from surface water and/or intersects an area that has the potential for groundwater flooding to occur at the surface.
11	The site is defined as Flood Zone 1 and intersects an area at medium risk of flooding from surface water and/or intersects an area that has the potential for groundwater flooding of property situated below ground level.
12	The site is defined as Flood Zone 1 and intersects an area at low risk of flooding from surface water and/or intersects an area that has limited potential for groundwater flooding to occur.
13	Remaining sites.

4.3 Applying Sequential Test for Planning Applications

4.3.1 The Sequential Test should be applied to 'Major'[41] and 'Non-major development'[42] proposed in areas at risk of flooding, including windfall sites. Paragraph 027 of the PPG[2] states the Sequential Test will not be required where:

- The site has been allocated for development and subject to the test at the plan making stage (provided the proposed development is consistent with the use for which the site was allocated and provided there have been no significant changes to the known level of flood risk to the site, now or in the future which would have affected the outcome of the test).
- The site is in an area at low risk from all sources of flooding, unless the SFRA, or other information, indicates there may be a risk of flooding in the future.
- The application is for a development type that is exempt from the test, as specified in footnote 60 of the NPPF[1]. This includes:
    - Householder development.
    - Small non-residential extensions (with a footprint of less than 250m^2).
    - Changes of use; except for changes of use to a caravan, camping or chalet site, or to a mobile home or park home site, where the Sequential and Exception tests should be applied as appropriate.

4.3.2 It is for CPBC, 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 what area of search has been used when making the application.

4.3.3 Ultimately, after applying the Sequential Test, CPBC needs to be satisfied in all cases that the proposed development would be safe and not lead to increased flood risk elsewhere. This needs to be demonstrated within an FRA and is necessary regardless of whether the Exception Test is required.

Recommendation 4-3 *CPBC should keep an up-to-date register of 'reasonably available' sites (for example as part of their housing and/or economic land availability assessments), clearly ranked in flood risk preference, and prepare guidance on the appropriate area of search for common development types.*

Applying the Sequential Approach *within* a Site

4.3.4 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 (considering all sources of flooding) e.g. residential elements 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. Reference should be made to tidal modelling included within this study (Section 2.4) to provide further detail on the varying level of tidal flooding within the Flood Zone.

Recommendation 4-4 *Apply a sequential approach to the layout and design of individual development sites.*

[41] 'Major' development defined by the Town and Country Planning Order 2015 as development involving any of the following: the winning and working of materials or the use of land for mineral-working deposits; waste development; provision of dwelling houses where the number of houses to be provided is 10 or more or development is to be carried out on a site having an area of 0.5 hectares or more; the provision of a building or buildings where the floor space is 1000 square metres or development carried out on a site having an area of 1 hectare or more.
[42] 'Non major development' is any development falling below the 'Major' thresholds but excluding minor development.

4.4 Exception Test

4.4.1 Following the application of the Sequential Test it may be concluded that there are no reasonable available alternative sites in areas of lower risk, and in some cases the Exception Test may be required. Figure 4-2 shows the decision-making process and Table 4-2 identifies when the Exception Test is required, based on the flood zone and the vulnerability classification of the proposed development. The Exception Test should only be applied as set out in Figure 4-2, i.e. only if the Sequential Test has shown that there are no reasonably available, lower-risk sites, suitable for the proposed development, to which the development could be steered.

4.4.2 For the Exception Test to be passed:

- Part 1 - 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.
- Part 2 - A site-specific FRA 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. If the risk of flooding is not reduced overall, the SFRA must also demonstrate why measures to reduce flood risk overall have not been secured, for example if such measures cannot be identified or are unfeasible.

4.4.3 Both elements of the test will have to be passed for development to be allocated or permitted.

4.4.4 In order to satisfy the **first part** of the Exception Test, the objectives of the Sustainability Appraisal can be used to assess each potential development site. Typical examples may include:

- The re-use of suitable brownfield land as part of a local regeneration scheme.
- An overall reduction in flood risk to the wider community through the provision of, or financial contribution to, flood risk management infrastructure.
- The provision of multifunctional SuDS that integrate with green infrastructure, significantly exceeding NPPF policy requirements for SuDS.

4.4.5 With respect to the **second part** of the Exception Test, there are a number of ways a new development can be made safe:

- Avoiding flood risk by not developing in areas at risk of flooding.
- 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.
- Mitigating the potential impacts of flooding through design and resilient construction.
- Managing the remaining residual risk through flood warning and emergency planning measures.

4.4.6 Consideration must also be made to ensure that the risk of flooding elsewhere is not increased and where possible is reduced. Further guidance on how development could satisfy the second part of the Exception Test is provided in Sections 5 and 6.

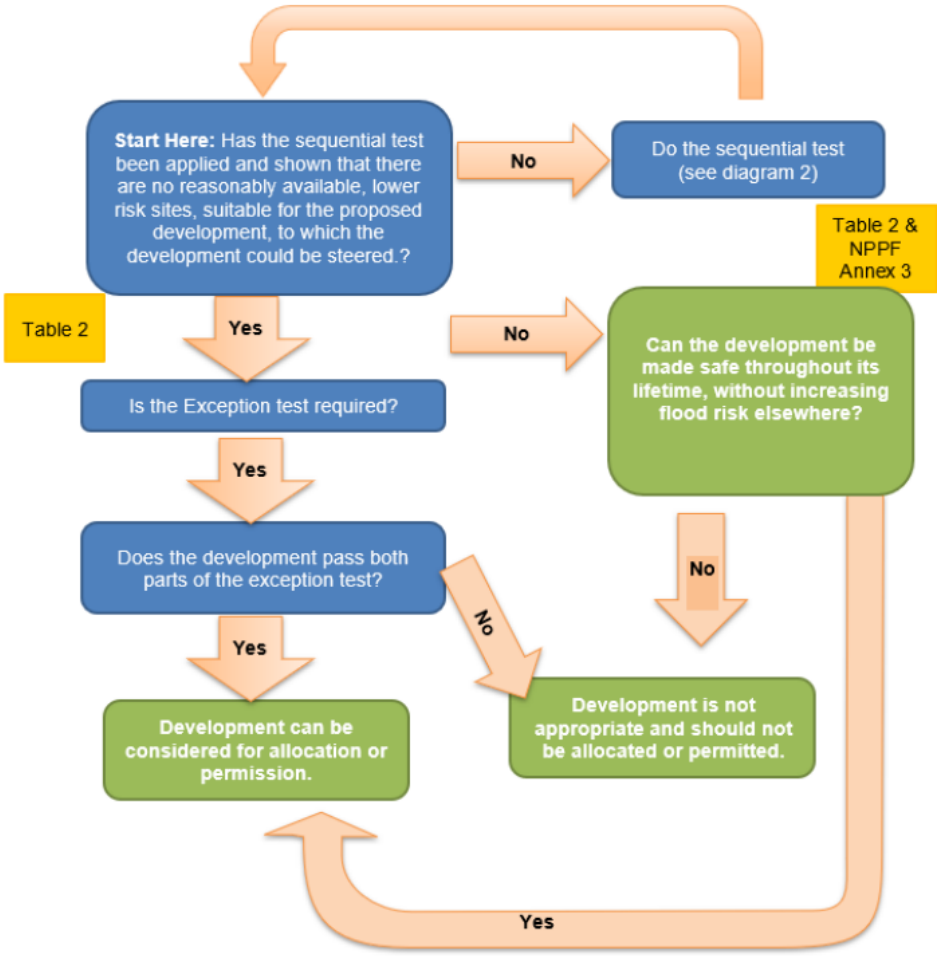


Figure 4-2 Application of the Exception Test in the preparation of a Local Plan (PPG Diagram 3)

5. Measures to Control and Mitigate Flood Risk

*The NPPF recognises that it is not always possible to **avoid** locating development in areas at risk of flooding, and the next steps are to **control** and **mitigate** the risks. This section identifies measures already in place, as well as measures that should be considered when developing strategic plans and as part of site specific FRAs for future development to control and mitigate the risk of flooding.*

5.1 Existing Flood Risk Management Infrastructure

Flood Defences

5.1.1 There are two main categories of flood defences, formal and informal (de facto). Formal defences are specifically constructed to control floodwater. Informal defences include structures that have not necessarily been constructed for this purpose but do have an impact on retaining flood water, such as railway and road embankments or other linear infrastructure such as boundary walls and buildings.

5.1.2 Information on flood defences has been gathered online from the Environment Agency's Asset Information Management System (AIMS). The AIMS provides details of the asset reference, location, type of defence, level of protection provided by the structure and the geographical extent of the defence or structure. Details of all AIMS flood defences in the study area are presented as a GIS layer. The defences are shown in **Appendix A Map 5**.

5.1.3 Almost all the flood defences in Castle Point are maintained by the Environment Agency aside from a few defences owned by the Local Authority, including: natural high ground surrounding Canvey Lake, natural high ground along Smallgrains Ditch; a few privately owned defences including: a section of earth embankment along East Haven Creek, natural high ground associated with the railway track south of Benfleet FSA, embankment along the railway track around Benfleet station, and a short section of retaining wall along Holehaven Creek. The majority of flood defences are Grade 3 (Grade 1 being the best classification and Grade 5 being the worst).

Thames Tidal Defences (River Walls)

5.1.4 Flood defences are present along the River Thames to the south of the Borough along the south of Canvey Island, which are mainly raised reinforced walls and recorded as providing protection up to a 0.1% AEP tidal flood event. The Environment Agency state that the defence height along the Thames Estuary in Castle Point varies between approximately 6.5m AOD and 7.2m AOD.

Canvey Island Flood Defences

5.1.5 Flood defences are present along the eastern, western and northern boundaries of Canvey Island, which are mainly raised reinforced walls or embankments and recorded as providing protection up to a 0.1% AEP tidal flood event. Embankments are also present along the south of Hadleigh Marsh providing protection up to a 0.1% AEP tidal flood event.

5.1.6 There are 13 pumping stations on Canvey Island, 8 main pumping stations and 5 low-flow (Figure 5-1). The purpose of the low-flow pumping stations is to keep levels down in dry weather to minimise silting and maximise the available storage for storm events. These are essential to the functioning of the system.

5.1.7 The pumping station at Leigh Beck has a built-in diesel emergency generator that automatically starts if there is a loss of mains power.

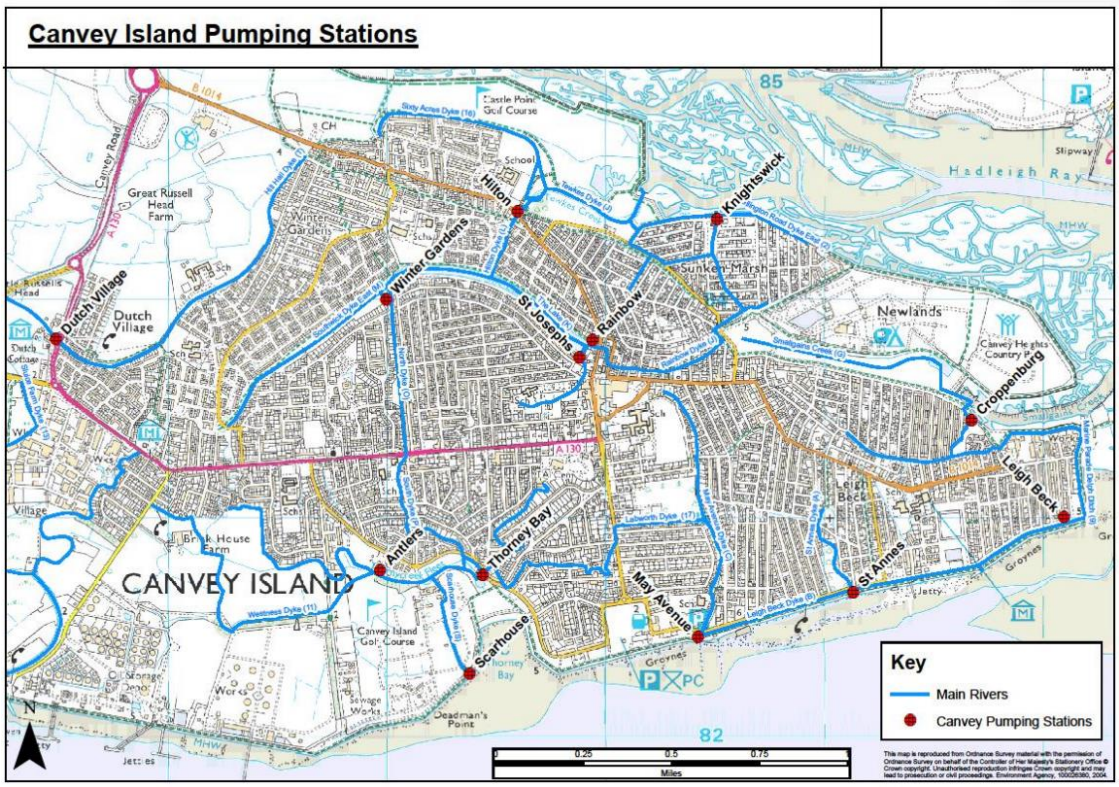


Figure 5-1 Pumping Stations on Canvey Island[43]

Flood Barriers

5.1.8 Flood barriers are further important flood infrastructure reducing the flood risk in Castle Point. The East Haven and Benfleet flood barriers located at either end of the East Haven Creek/Hadleigh Ray opened in the 1980s to limit the passage of flood water up the creek.

South Benfleet Flood Storage Area

5.1.9 To reduce fluvial flood risk, the South Benfleet FSA stores water from Benfleet Hall Brook at times when the Benfleet Barrier is closed and drainage outflow is restricted by a tidal flap valve which closes when water levels are high in Benfleet Creek

Recommendation 5-1 *Safeguard the South Benfleet Flood Storage Area and prevent loss of storage as a result of redevelopment.*

TEAM2100 Programme of Work

5.1.10 TEAM2100 will carry out the first part of the Environment Agency's Thames Estuary 2100 Plan, which sets out how to manage tidal flood risk in the Thames Estuary throughout the 21st century. TEAM2100 will improve tidal flood defences in London, Kent and Essex from 2015 to 2025.

Canvey Island southern shoreline revetment project

5.1.11 The Canvey Island southern shoreline revetment works project started in May 2021 and is planned to be completed in October 2025. This project will maintain the existing high level of tidal flood risk protection to thousands of homes, businesses and infrastructure on Canvey Island into the future. It will protect the tidal defences against erosion and extend their useful life to 2070 in light of increasing sea levels due to climate change. The renewing and improving of the revetment on the seaward face of the tidal defences will take place along a 3km stretch between Thorney Bay and the Island Yacht Club (Figure 5-2).

[43] Environment Agency, 2014, Canvey Island Drainage Network. Available at: https://essexrivers.wordpress.com/wp-content/uploads/2014/08/canvey-island-pumping-station-fact-sheet-final.pdf

Notes: Red line indicates the area of revetment between Thorney Bay and Island Yacht Club.

Figure 5-2 Canvey Island southern shoreline

Flood Alleviation Schemes

5.1.12 In addition to fluvial and tidal flood defences, a number of flood alleviation schemes have been completed or are in the appraisal process.

Prittle Brook

5.1.13 The introduction of 4-5 leaky dams. The two key goals are:

- To provide storage to capture and slow surface water flows in the upper Prittle Brook area and fluvial flows within the main Prittle Brook channel.
- The provision of treatment aspects to improve water quality through the use of mycelium embedded within leaky dam structures.

5.1.14 The site area crosses the boundary from Southend to Castle Point with benefits likely to be more pronounced downstream on the Southend side.

Two Tree Island

5.1.15 Two Tree Island is located partially in Castle Point and partially within Southend. A project was undertaken to renovate the sea wall on Two Tree Island, which is an area of low-lying wetlands north-east of Canvey Island across a saltmarsh. The designated nature reserve is looked after by the Essex Wildlife Trust and is susceptible to flooding, so needs to be expertly managed with appropriate coastal defences.

5.1.16 The project focuses on the saltmarsh east of the boat ramp (i.e. the area within Southend) and uses the following combined coastal defence measures directly on the coastline and in the intermediate tidal areas:

- Floating barrier islands to deflect wave energy in the intertidal area. These will be furthest out from the coastal frontage point.
- Potato matting (BESE) to encourage siltation and saltmarsh regeneration.
- Coir matting within the foreshore area between the coastal frontage and the floating barrier islands.

- Bio-blocks.
- Bio-tiles directly installed onto the existing coastal frontage structures, which will be brought up to standard using existing coastal defence funding within the relevant organisations where necessary.

5.1.17 The exact size, number and locations of all features will be determined following further computation modelling, optioneering and stakeholder engagement.

5.2 Safeguard Land for Flood Risk Management

Thames Estuary 2100 Plan

5.2.1 The Thames Estuary 2100 Plan (TE2100) sets out the aims and objectives for managing the estuary throughout the 21st century, and how these will be realised. The Plan includes 3 high-level aims, 9 strategic objectives, 2 strategic enablers, and 13 outcomes, as summarised in Table 5-1.

Table 5-1 TE2100 Aims and Objectives

Strategic Objectives	AIM A: Take an adaptive approach to manage tidal flooding and create climate resilient communities.	AIM B: Protect and enhance the value of the Thames, its tidal tributaries and floodplain. Deliver social, cultural and commercial benefits for communities and support resilient growth.	AIM C: Tackle the climate and nature crises by putting sustainability at the heart of this Plan. Restore ecosystems, reduce carbon emissions, and deliver environmental and biodiversity net gain.
1. Maintain flood defences in line with the flood risk management policies.	Outcome 1: Maintaining tidal flood defences. Outcome 4: Maintaining the Thames Barrier until 2070		
2. Adapt and improve all existing defences by the current deadlines set out in this Plan.	Outcome 2: Improving fixed flood defences		
3. Accelerate preparations to decide on an end-of-century option by 2040. The preferred option and timeline may change as this Plan adapts to future changes.	Outcome 5: Deciding on the future of the Thames Barrier		
4. Track indicators of change and review every 5 years. Update this Plan at least every 10 years using an adaptive FCERM economic approach based on monitoring evidence.	Outcome 11: Adapting our approach using the latest science and data		
5. Work together to develop community-led visions for future riversides. These will drive defence upgrades and identify where to deliver wider benefits.		Outcome 3: Creating a better riverside for local communities Outcome 8: Ensuring development is resilient to climate change	
6. Embed carbon reduction pathways within this Plan, striving to achieve carbon net zero status.			Outcome 10: Working towards net zero
7. Replace habitat lost to sea level rise over the course of this Plan. Support nature recovery and deliver environmental net gain.			Outcome 9: Improving biodiversity
8. Improve understanding of the link between sea level rise and other sources of flood risk. Use spatial and emergency planning to create resilient communities.	Outcome 6: Managing flood risk from all sources. Outcome 7: Increasing resilience to flood risk		
9. Share experience, innovation and learning of delivering and reviewing the Thames Estuary 2100 Plan with others planning to mitigate future climate risks.			
10. (Strategic enabler): develop and put in place a strategy to secure land to deliver this Plan - this will ensure future options remain viable and maximise opportunities for wider benefits	*Outcome 12: Securing land for Thames Estuary 2100*		
11. (Strategic enabler): develop and put in place a long-term investment strategy for this Plan - this will enable us to realise the financial benefits of an adaptation pathways approach	*Outcome 13: Funding multiple benefits through investment*		

5.2.2 Within the TE2100 Plan, Castle Point is covered by three specific Policy Units as follows:

Thames Estuary 2100 Plan

Policy Unit – Bowers Marshes (Policy Approach P4)

- The majority of this policy unit is in Basildon Council authority area, a small part is located in CPBC at South Benfleet.
- The areas at risk of flooding include properties near South Benfleet Flood Storage Area
- The types of flooding that could affect this policy unit include tidal flooding from Vange and East Haven Creeks – when the tide overtops flood defences, fluvial flooding from Pitseahall Fleet, Benfleet Hall Sewer and the marsh drainage systems on Bowers Marshes – when heavy rainfall causes rivers to overflow their banks or defences, a combination of these.
- To manage flood risks: Fobbing Horse Barrier controls tidal water levels on Vange Creek, East Haven and Benfleet Barriers control tidal water levels on East Haven Creek, Benfleet Hall Brook and Bowers Marshes have drainage systems, Vange and East Haven Creeks have secondary tidal flood defences. To reduce tidal flood risk, the South Benfleet Flood Storage Area stores water from Benfleet Hall Sewer during high water levels when the Benfleet Barrier is closed.

- The flood risk management policy is P4: take further action to keep up with climate and land use change so that flood risk does not increase.

- By 2040, tidal defence owners in this policy unit should: work with the council, developers and local infrastructure providers to adapt defences and achieve multiple benefits through proposed development; and work with the Environment Agency to raise defences where required.
- There is currently no riverside strategy for this area. By 2030, councils should work with communities to plan how their riverside will look in future.
- Network Rail will work with councils and the Environment Agency to ensure transport infrastructure in Essex is resilient to increasing flood risk.
- The Thames Estuary Partnership will work with communities, councils, the Environment Agency and other partners to scope the need and potential extension of the Thames Strategy East or creation of an alternative Joint Thames Strategy to cover this policy unit. Any agreed landscape vision for the river corridor will include a riverside strategy approach to tidal flood defence upgrades.

Policy Unit – Hadleigh Marshes (Policy Approach P3)

- The types of flooding that could affect this policy unit include tidal flooding – when the tide overtops flood defences, fluvial flooding from local watercourses including the drainage systems on Hadleigh Marshes – when heavy rainfall causes the ditches to flow onto the marsh, a combination of these.
- To manage these risks there are tidal flood defences to Hadleigh Marshes, drainage outfalls for the marsh drainage system.

- The flood risk management policy is P3: Flood defences will be maintained at their current level, accepting that the likelihood and/or consequences of a flood will increase because of climate change.

- Flood defence owners and infrastructure providers will plan to improve resilience into the future. This could include realigning flood defences.
- Where flood defences contain contaminated materials, flood defence owners should ensure defences are maintained to prevent their release to the estuary.
- These include Hadleigh Marsh landfill. The Environment Agency will continue to support research to develop and share long-term solutions for such sites.
- There is currently no riverside strategy for this area. By 2030, councils should work with communities to plan how their riverside will look in future.
- The Environment Agency will work with councils and the local community to implement resilience measures where a P3 policy applies.
- Network Rail will work with councils and the Environment Agency to ensure transport infrastructure in Essex is resilient to increasing flood risk.
- The Thames Estuary Partnership will work with communities, councils, the Environment Agency and other partners to scope the need and potential extension of the Thames Strategy East or creation of an alternative Joint Thames Strategy to cover this policy unit. Any agreed landscape vision for the river corridor will include a riverside strategy approach to tidal flood defence upgrades.

Policy Unit – Canvey Island (Policy Approach P4)

- The areas at risk of flooding are mostly residential.
- The types of flooding that could affect this policy unit include tidal flooding from the Thames including Hadleigh Ray, Holehaven and East Haven Creeks – when the tide overtops flood defences, surface water flooding – when heavy rainfall is unable to drain away, a combination of these.
- To manage these risks, there are: tidal defences on the Thames frontage, Hadleigh Ray and Holehaven Creeks, barriers at East Haven and Benfleet to control tidal water levels on East Haven Creek, secondary tidal defences, an extensive drainage system for the developed area with open channels integrated with the public surface water sewer network as well as pumped and gravity outfalls. The Environment Agency also uses flood alerts and flood warnings to inform people about potential flooding so they can take appropriate action.

- The flood risk management policy is P4: take further action to keep up with climate and land use change so that flood risk does not increase.

- By 2040, tidal defence owners in this policy unit should: work with the council, developers and local infrastructure providers to adapt defences and achieve multiple benefits through proposed development; and work with the Environment Agency to raise defences where required.
- There is currently no riverside strategy for this area. By 2030, councils should work with communities to plan how their riverside will look in future.
- The Thames Estuary Partnership will work with communities, councils, the Environment Agency and other partners to scope the need and potential extension of the Thames Strategy East or creation of an alternative Joint Thames

Thames Estuary 2100 Plan

Strategy to cover this policy unit. Any agreed landscape vision for the river corridor will include a riverside strategy approach to tidal flood defence upgrades.

Riverside Strategies

5.2.3 The Thames Estuary 2100 Plan introduces the riverside strategy approach which integrates upgrades to flood defences with riverside improvements and wider benefits. Riverside strategies need to be in place by 2030.

5.2.4 Throughout much of the estuary, flood walls and embankments will need to be a metre or more higher by 2100. Without careful design, higher defences could restrict access to and views of the river. But with early planning, there are opportunities to upgrade defences and create good public spaces. These spaces can be green, accessible, vibrant and attractive, while providing flood protection.

5.2.5 Councils or other organisations can create riverside strategies. Riverside strategies should be an integral part of statutory local planning. They can be standalone documents or form part of a Local Plan. They should include community ambitions for the riverside.

Recommendation 5-2 *CPBC must work with communities to plan how the riverside will look in future and prepare a riverside strategy.*

Future TE2100 Defence Improvements in Castle Point

5.2.6 Outcome 2 of the TE2100 Plan is ‘Improving fixed flood defences’: Flood walls and embankments protect against future sea level rise. They are adapted, raised, realigned or replaced in line with the flood risk management policies and riverside strategy visions.

5.2.7 By 2025, the Environment Agency will improve understanding of how defence heights could be raised across the estuary. This will include setting out the legal responsibilities of defence owners and how raising can be achieved.

5.2.8 By 2030, the Environment Agency, councils and defence owners will produce a plan for raising defences.

5.2.9 By 2040, defence owners downstream (east) of the Thames Barrier have adapted, raised, realigned or replaced defences in line with the flood risk management policies.

5.2.10 Any financial investment in CPBC’s flood defences will be subject to Defra’s Flood and coastal resilience partnership funding policy statement whereby financial contributions will be required from partners (including CPBC, Environment Agency, landowners and other key stakeholders) to attract the maximum amount of FCERM funding.

5.2.11 Ensuring protection from coastal flooding into the future will mean land must be safeguarded both for access and maintenance to current defences and to allow for expansion of defence footprints as a greater degree of protection is required.

5.2.12 Whilst hard defences could potentially be raised within existing footprints, the structures would be tall, unattractive and restrict public access. Additional space will be needed for construction works and vehicle access during defence-raising. Furthermore, land would be required for maintaining, replacing and improving flood defences along the Thames. Corridors of land along existing defence lines need to be safeguarded. Land requirements will vary by site and should be discussed and agreed with the Environment Agency.

5.2.13 Areas have also been identified within Castle Point where managed realignment of defences could achieve landscape, development, public amenity and environmental enhancements. Significant improvements can be made as part of integrated riverside design. Where defences require replacement, consideration should be given to flood defence adaptation rather than like-for-like replacement, utilising a combination of flood storage, river defences and floodplain attenuation. Any such designs must accommodate existing flood defence crest levels and allow for them to be raised in the future.

5.2.14 For further information, reference should be made to the TE2100 Plan: https://www.gov.uk/government/publications/thames-estuary-2100-te2100.

Recommendation 5-3 *The Local Plan and associated allocations should facilitate the recommendations of the TE2100 plan and South Essex CFMP in maintaining, enhancing and replacing flood defences, and safeguarding riverside land.*

Recommendation 5-4 *Where new development is proposed adjacent to the Thames Tidal Defence, consideration should be given to the specific recommendations of the TE2100 plan, in requiring reduction of current and future flood risk through the following measures:*

- *Secure land likely to be needed for all long term estuary wide options for flood risk management in the Thames Estuary.*
- *Raising existing flood defences to the required levels in preparation for future climate change impacts or otherwise demonstrate how tidal flood defences can be raised in the future, through submission of plans and cross-sections of the proposed raising.*
- *Demonstrating the provision of improved access to existing flood defences and safeguarding land for future flood defence raising and landscape, amenity and habitat improvements.*
- *Maintaining, enhancing or replacing flood defences to provide adequate protection for the lifetime of the development.*
- *Where opportunities exist, re-aligning or setting back flood defence walls and improving the river frontage to provide amenity space, habitat, access and environmental enhancements.*
- *Securing financial contributions towards the anticipated costs of flood risk management infrastructure required to protect the proposed development over its lifetime.*

Riverside Development

5.2.15 The Environment Agency is a statutory consultee for planning applications within 20m of Main Rivers. Permission from the Environment Agency is required for specific regulated flood risk activities[44] including activity within 8m of the bank of a Main River, (or 16m if it is a tidal Main River), and activity within 8m of any flood defence structure or culvert on a Main River, (or 16m on a tidal river). These 'corridors' of land should be protected from development for maintenance purposes and where possible opportunities should be sought for river restoration. Opportunities should be taken to de-culvert watercourses. Any projects such as landscape, development, public amenity and environmental enhancements of land around flood defences must accommodate existing flood defence crest levels and allow for them to be raised in the future.

5.2.16 In order for the sea defences to be improved on Canvey Island it is necessary for land adjacent to these defences to be left free from development, as far as possible, to provide the space for taller defences with a larger footprint. Accessibility is also essential in delivering such improvements. The Environment Agency has advised that approximately 19m should be left free from development for this purpose. This enables the delivery of well-designed and landscaped defences that not only ensure the future safety of residents but are also attractive and contribute to the quality of the environment.

5.2.17 The Environmental Permitting Regulations 2016 require a Flood Risk Activity Permit (FRAP) to be obtained for works on or near a Main River, on or near a flood defence structure, or in a floodplain. Applicants should review the Environment Agency flood risk activities: environmental permit information[45] to determine if a permit is required.

5.2.18 Consent will be refused if the works would result in an increase in flood risk, a prevention of operational access to the watercourse and/ or an unacceptable risk to nature conservation.

5.2.19 A pragmatic approach should be adopted for existing development in these areas and opportunities pursued for small scale set back of development from river walls to enable these structures to be modified, raised and maintained as needed.

[44] Flood risk activities: environmental permits, September 2022 https://www.gov.uk/guidance/flood-risk-activities-environmental-permits
[45] Environment Agency, Flood risk activities: environmental permits. Available at https://www.gov.uk/guidance/flood-risk-activities-environmental-permits

5.2.20 Developers are encouraged to seek pre-application engagement with the Environment Agency before finalising development layout designs close to watercourses and flood defence structures. For further information or advice, applicants and developers should contact the Environment Agency at enquiries@environment-agency.gov.uk.

5.2.21 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), lies with ECC (as LLFA). ECC is responsible 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 (such as in channel structures or diversion of watercourses). Enquiries and applications for Ordinary Watercourse consent should be directed through the ECC website[46].

Recommendation 5-5 *Safeguard land either side of the River Thames, Prittle Brook and Benfleet Hall Brook and their tributaries and promote the setting back of development to enable sustainable and cost effective flood risk management including upgrading of river walls and embankments. As a minimum, 8m and 16m should be maintained along fluvial and tidal watercourses respectively.*

Recommendation 5-6 *Safeguard land adjacent to the sea defences on Canvey Island to provide the space for taller defences with a larger footprint. As a minimum, 19m should be maintained along the sea defences. Only temporary development will be permitted on this land. Where land safeguarded for future flood defence works falls within a development site, opportunities should be taken to integrate future flood defence requirements into the landscaping and open space provision for the site.*

Previously developed sites

5.2.22 It is possible that some areas of previously developed land could come forward as part of the site allocation process which are now considered to be at risk from fluvial/tidal flooding.

Recommendation 5-7 *Where buildings have been demolished within the functional floodplain (Flood Zone 3b) for a significant length of time (i.e. over a year), the land should be reverted back to functional floodplain and consequently, development should be avoided within these areas. Where a building(s) is already located in the functional floodplain, any proposals to regenerate/replace such building(s) should not increase the footprint any greater than the existing footprint. For areas around the upper reaches of the Benfleet Hall Brook, further discussion will need to take place with CBPC, and further hydraulic modelling may be required to determine Flood Zone 3b.*

Green Infrastructure

5.2.23 Green Infrastructure (GI) is a strategically planned and managed network of natural and semi-natural green (land) and blue (water) spaces that intersperse and connect urban centres, suburbs and rural fringe, consisting of:

- Open spaces e.g. parks, woodland, nature reserves and lakes.
- Linkages e.g. river corridors, canals, pathways, cycle routes and greenways.
- Networks of ‘urban green’ e.g. private gardens, street trees, verges and green roofs.

5.2.24 The identification and planning of GI are critical to sustainable growth and flood risk management. GI can provide a wide range of ecosystem services, including climate mitigation and adaptation, and is central to climate change action. GI also provides additional green spaces for storm flows, freeing up water storage capacity in existing infrastructure and reducing the risk of damage to urban property, particularly in city centres and vulnerable urban regeneration areas. Additionally, GI can improve accessibility to waterways and water quality, supporting regeneration and improving opportunity for leisure, economic activity and biodiversity. For sites where the Exception Test is required, the inclusion of GI may assist in demonstrating that a development is delivering wider sustainability benefits, contributing to the site passing the first part of the Exception Test.

5.2.25 ***Recommendation 5-8*** *Safeguard land likely to be needed for green infrastructure.*

[46] Essex County Council, Apply for a watercourse consent. Available at: https://flood.essex.gov.uk/maintaining-or-changing-a-watercourse/apply-for-a-watercourse-consent/

Urban Greening Scenario Testing

5.2.26 In order to understand the potential impact of SuDS interventions, an urban greening scenario has been tested using the Canvey Island IUD model. The contributing flows from the urban drainage network were reduced by 10% to represent possible retrofit SuDS options such as raingardens, bioretention basins and swales. The urban greening scenario model was run for the 3.3% AEP event.

5.2.27 The Surface Water Modelling Technical Note[19] [60725540-SWF-001] sets out the methodology applied and the results.

5.2.28 The model results demonstrate that a 10% reduction in contributing flows does not have a significant impact on flood risk on Canvey Island. Further investigation, such as testing different percentage reductions to contributing flows, is required to gain a more detailed understanding of what would benefit the area.

Flood Storage

5.2.29 Flood Storage Areas (FSAs) are natural or man-made areas that temporarily fill with water during periods of high river level, retaining a volume of water which is released back into the watercourse after the peak river flows have passed. There are two main reasons for providing temporary detention of floodwater:

- To compensate for the effects of catchment urbanisation.
- To reduce flows passed downriver and mitigate downstream flooding.

5.2.30 Providing flood storage within a development area or further upstream of a development can manage and control the risk of flooding. In some cases, it can provide sufficient flood protection on its own; in other cases, it may be chosen in conjunction with other measures. The advantage of flood storage is that the flood alleviation benefit generally extends further downstream, whereas other methods tend to benefit only the local area and may increase the flood risk downstream.

5.2.31 Further guidance on Flood Storage is provided within Chapter 10 of the Environment Agency's Fluvial Design Guide[47].

Recommendation 5-9 *Safeguard land for new flood storage areas.*

Natural Flood Management

5.2.32 Natural flood management involves techniques that aim to work with natural hydrological and morphological processes, features, and characteristics to manage the sources and pathways of flood waters. Techniques include the restoration, enhancement and alteration of natural features and characteristics, but exclude traditional flood defence engineering that works against or disrupts these natural processes.

5.2.33 The contribution natural flood management techniques can make to reduce the causes and impacts of flooding will vary greatly from case to case. In some cases, they may be capable of comprehensively addressing flood risk to a site on their own, but in many cases, they will need to be used in a complementary way alongside more conventional flood risk management techniques such as engineered defences. Natural flood management techniques can also contribute to the delivery of biodiversity and environmental net gains and support the implementation of river basin management plans and the public body duty to have regard to them. For sites where the Exception Test is required, the inclusion of natural flood management techniques may assist in demonstrating that a development is delivering wider sustainability benefits, contributing to the site passing the first part of the Exception Test.

5.2.34 There are a number of opportunities available to reduce the causes and impacts of flooding through Working with Natural Processes (WWNP)[48]. This involves implementing measures that help to protect,

[47] Environment Agency (2010), Fluvial Design Guidance Chapter 10
https://assets.publishing.service.gov.uk/media/60549b7a8fa8f545cf209a29/FDG_chapter_10_-_Flood_storage_works.pdf
[48] Environment Agency and Flood and Coastal Risk Management R&D Programme (2021), Working with Natural Processes to Reduce Flood Risk. Available from: https://www.gov.uk/flood-and-coastal-erosion-risk-management-research-reports/working-with-natural-processes-to-reduce-flood-risk?web=1&wdLOR=c56AD7DAC-BB7B-471B-94B4-B5C5B91DEEE4

restore, and emulate the natural functions of catchments, floodplains, rivers, and the coast. WWNP takes many forms and can be applied in urban and rural areas, and on rivers, estuaries, and coasts.

5.2.35 As part of a research project undertaken by the Environment Agency and Flood and Coastal risk Management Research and Development Programme, a series of spatial datasets have been generated for these natural processes[49], identifying their best estimate of locations in the country where the methods can be applied. A description of the WWNP datasets is available in Table 5-2.

5.2.36 Defra have produced a Woodland Constraints dataset which refines potential locations for WWNP, taking into account roads, rail, urban areas, existing woodland, peat, and water bodies.

5.2.37 The WWNP data does not provide information on design, which may need to consider issues such as drain-down between flood events. It is important to note that land ownership and change to flood risk have not been considered. Locations identified may have more recent building or land use than available data indicates.

Table 5-2 Description of WWNP datasets

Natural Process	Benefits	Most Effective Conditions	Notes
Floodplain Woodland Planting Potential	Slows floodwaters and increases water depth on the floodplain. Reduces flood peaks, delays flood peak timing and desynchronises flood peaks. Enhances sediment deposition on the floodplain.	Middle and lower river reaches of middle to large catchments.	Based upon Flood Zone 2. Information is largely based on modelled data and open constraints data and is indicative rather than specific.
Riparian Woodland Planting Potential (woodlands on land immediately adjoining a watercourse)	Slows flood flows. Reduces sediment delivery to the watercourse. Reduces bankside erosion. Creates below ground storage.	At the reach scale in middle and upper catchments.	Based upon a 50m buffer of available OS Open Data river networks. Information is largely based on open data and is indicative rather than specific.
Wider Catchment Woodland	Intercepts, slows, stores and filters water. Reduces flood peaks, flood flows and frequency.	Small events on small catchments – extent of reduction decreases as flood magnitude increases.	Based upon the 1:50k BGS geology survey and relies upon identifying drift and bedrock geologies that are characteristic of slowly permeable soils. Information is largely based on the 100m gridded version of BGS data and open constraints data and is indicative rather than specific.
Floodplain Reconnection Potential (reconnecting watercourses and floodplains)	Encourages more regular floodplain inundation and flood water storage Decreases the magnitude of flood peaks and reduces downstream flood depths.	High frequency, low return period floods.	Designed to support signposting of areas where there is currently poor connectivity such that flood waters are constrained to the channel and flood waves may therefore propagate downstream rapidly Based upon the Risk of Flooding from Rivers and Seas probability maps and identifies areas of low and very low probability that are close to a watercourse, but do not contain residential property or key services (may contain non-residential property – important to consider).
Runoff Attenuation Features (3.3% and 1% AEP) (includes swales, ponds and sediments traps)	Delays and flattens the hydrograph and reduces peak flow locally for small flood events.	A cluster of features working as a network throughout the landscape.	Based upon the Risk of Flooding from Surface Water datasets and identifies areas of high flow accumulations for the 1% AEP and 3.3% AEP surface water maps. The areas of ponding or accumulation are between 100 and 5000 metres squared and have been tagged where they fall on an area of slope steeper than 6% as gully blocking opportunities

[49] Working with Natural Processes datasets (2017)
https://environment.data.gov.uk/searchresults?query=wwnp&searchtype=&orderby=default&pagesize=20&page=1

5.2.38 **Appendix A Map 12** provides information from the Environment Agency's 'Working with Natural Processes – Evidence Directory' about where these measures could be applied. This map shows that although there are a lot of existing woodland constraints within the Borough, there are also some opportunities to implement natural processes to alleviate flooding. There are potential opportunities for wider catchment woodland potential in the north of the Borough in New Thundersley, land to the east of Benfleet, Hadleigh Marshes, land to the north of Canvey Island at Benfleet Creek and to the west of Canvey Island. There are also areas with potential opportunities for riparian woodland planting which tend to centre around the watercourse corridors. This includes the Benfleet Creek in Hadleigh Marshes, and the East Haven Creek to the west of Canvey Island and other surrounding watercourses.

Recommendation 5-10 *Extend and enhance existing Green Infrastructure (GI) in the Borough including the implementation of floodplain and riparian woodland planting schemes. Land that is likely to be needed for natural flood management should be safeguarded (e.g. through the Prittle Brook and Benfleet Hall Brook catchments). Consideration should also be given to any necessary access to that land, and any additional land which may be needed temporarily during construction.*

5.2.39 The mapping in **Appendix A Map 12** should be used by CPBC to support future blue and green infrastructure planning.

Catchment to Coast Project

5.2.40 As part of the Catchment to Coast project[50] there are proposals for the enhancing of saltmarsh establishment and regeneration in the lower catchment including Canvey Island and Two Tree Island. The project is being delivered by an established partnership between Southend-on-Sea and Thurrock Borough Councils.

Identifying Flood Risk Management Interventions

5.2.41 As outlined in Section 3.3, the South Essex SWMP[30] identified CDA's located in Castle Point. During Phase 3 of the SWMP, an assessment matrix was prepared to identify and appraise a range of site-specific measures for alleviating surface water flooding. A short-listed set of preferred high-level options were then identified for each CDA. As part of this SFRA, AECOM have updated the options screening matrix and identified three potential high-level options in the South Benfleet CDA. These shortlisted options included the following:

- Option 1: Above ground flood storage area at Boyce Hill Golf Course.
- Option 2: Extension to existing above ground Flood Storage Area at Brook Road.
- Option 3: Extension to existing above ground Flood Storage Area near Saxon Way.

5.2.42 An outline of these options, including the opportunities and constraints is detailed in the Surface Water Modelling Technical Note[19] [60725540-SWF-001].

5.2.43 South Benfleet CDA was selected as the focus area for these flood risk management interventions as the Canvey Island Multi-Agency Partnership (MAP), established in 2014, already has a plan in place with the aim of raising awareness of flood risk and increasing the resilience of Canvey Island's communities and businesses to flooding. In March 2015, the group published the Canvey Island 6-Point Plan - Protecting our Canvey[51], which sets out the strategic aims and ambitions of AWSL, CPBC, the Environment Agency and ECC. The 6-Point Plan sets out the following proposed activities on Canvey Island:

1. Property level flood protection for circa 15,000 homes.
2. Dredge, re-profile and maintain Canvey Lake.
3. Increased drainage infrastructure capacity.
4. Canvey Resilient Communities Programme.

[50] Environment Agency Flood and Coastal Resilience Innovation Programme, Catchment to Coast Project https://engageenvironmentagency.uk.engagementhq.com/sou019-catchment-to-coast
[51] Canvey Island 6-Point Plan, November 2015. Available at: https://www.anglianwater.co.uk/contentassets/0cfa8326667e4147b6e3429fb18c2a3e/canvey-island-6-point-plan.pdf

5. Development of new innovative technologies, and

6. Investment in GI.

Developer Contribution

5.2.44 In some cases, and following the application of the Sequential Test, it may be necessary for the developer to contribute to the improvement of flood defence provision that would benefit both proposed new development and the existing local community. Developer contributions can also be made towards maintenance and provision of flood risk management assets, flood warning and the reduction of surface water flooding (i.e. SuDS). For new development in locations without existing defences, or where the development is the only beneficiary, the full costs of appropriate risk management measures for the life of the assets proposed must be funded by the developer. However, the provision of funding by a developer for the cost of the necessary standard of protection from flooding or coastal erosion does not mean the development is appropriate as other policy aims must also be met. Funding from developers should be explored prior to the granting of planning permission and in partnership with ECC, the LLFA and the Environment Agency.

5.2.45 CPBC has produced a Developers Contributions Guidance Supplementary Planning Document[52] (SPD) to provide advice to developers on when and how CPBC will expect to use Section 106 Agreements alongside the Community Infrastructure Levy (CIL) to secure an acceptable development that is sustainable, contributes towards a high-quality environment, and is supported by the services, facilities and infrastructure required to make Castle Point a good place to live, work and visit.

5.2.46 As part of this SFRA, a standalone document which provides advice for securing developer contributions towards flood management interventions has been created [60725540-DC-001][53].

5.3 Water Environment

5.3.1 A key objective of the Water Framework Directive (WFD) is the requirement to prevent deterioration in the current status of water bodies, whilst Heavily Modified Water Bodies (HMWBs) must achieve good ecological potential within a set deadline. If an activity has the potential to impact on the ecology or morphology of a water body, the risk of causing deterioration in the status must be assessed.

5.3.2 The southern area of the Borough (Canvey Island) is covered by the Thames River Basin Management Plan (RBMP), and the northern area is covered by the Anglian RBMP. These identify the current quality of water bodies in the Borough and set objectives for making further improvements to the ecological and chemical quality.

5.3.3 The Prittle Brook is a WFD watercourse in Castle Point; it is designated as a HMWB and has an overall ecological status of moderate under the WFD. The section of the River Thames south of Castle Point is classed as the ‘Thames Lower’ water body, and is a designated HMWB, with a current overall ecological status of moderate.

5.3.4 It is anticipated that growing population numbers and changing climate patterns will place increased pressure on water resources across the Thames Basin. New development can assist in alleviating this water scarcity by incorporating water efficiency measures such as grey water recycling, rainwater harvesting, and water use minimisation technologies. This will also have a substantial benefit on the sewer system which will receive less wastewater from properties, potentially freeing up capacity during flood events.

Recommendation 5-11 *Through measures to manage and mitigate flood risk, CPBC should also seek opportunities to achieve wider environmental benefits.*

Benfleet Creek

5.3.5 As part of the Catchment to Coast project, a series of innovative reedbeds will be installed at AWSL’s water recycling centre (WRC) at Benfleet. The key objective is to improve water quality from the Combined Sewer Outfalls (CSO) that outfall to Benfleet Creek from the AWSL WRC. It is likely that

[52] CPBC (2022) Developers Contributions Guidance Supplementary Planning Document (SPD) Cover Document. Available at: https://www.castlepoint.gov.uk/download/developers-contributions-guidance-cover-document-supplementary-planning-documentpdf.pdf?ver=11549&amp%3Bdoc=docm93jijm4n6841
[53] AECOM, 2025, Advice and model for securing developer contributions towards flood management interventions, 60725540-DC-001.

these CSO discharges are contributing to the reduced water quality and subsequent significant algae growth at Two-Tree Island which is inhibiting vegetation colonisation and growth and increasing coastal erosion risks.

5.3.6 The project will utilise land on the AWSL site at Benfleet Creek to test the capabilities of mycelium, reed beds, slow sand filters and/or hydrorock to filter water taken from a proportion of the CSO discharges (supported by detailed water quality and flow measurements to determine effectiveness).

5.4 Consultation with Water Companies

5.4.1 Large parts of Castle Point are at significant risk of flooding from surface water and inadequate local drainage infrastructure. For future development in the Borough to be sustainable, it must be delivered in parallel with improvements to the current infrastructure provision and strategic management of surface water, to ensure that development can be safe for its lifetime and where possible will reduce flood risk overall.

5.4.2 New development provides an opportunity to reduce the causes and impacts of flooding associated with surface water and sewer surcharge. As part of the Infrastructure Delivery Plan and to inform the sites allocation process, CPBC should work with AWSL to determine key areas for maintenance and locations that would benefit from infrastructure upgrades and/or flood alleviation schemes.

Recommendation 5-12 *Consult Anglian Water to determine constraints on drainage capacity and identify infrastructure requirements to support future growth.*

5.5 Sustainable Drainage Systems

5.5.1 SuDS are designed to control surface water run off close to where it falls, combining a mixture of built and nature-based techniques to mimic natural drainage as closely as possible, and accounting for the predicted impacts of climate change. Where possible SuDS solutions for a site should seek to provide benefits for:

- Water quantity (reduce flood risk to the site and neighbouring areas).
- Water quality (reduce pollution).
- Biodiversity (wildlife).
- Amenity (landscape).

5.5.2 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 four goals identified below.

5.5.3 The layout and function of drainage systems needs to be considered at the start of the design process for new development, as integration with road networks and other infrastructure can maximise the availability of developable land. This should ideally be achieved by incorporating SuDS.

5.5.4 Generally, the aim should be to discharge surface water run-off as high up the following hierarchy of drainage options as reasonably practicable in accordance with the Building Regulations 2010 Drainage and Waste Disposal Approved Document[54]:

- Into the ground (infiltration).
- To a surface water body.
- To a surface water sewer, highway drain, or another drainage system.
- To a combined sewer

5.5.5 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[55] identified several processes that can be used to manage and control runoff

[54] Drainage and waste disposal: Approved document H. Building Regulations in England for foul water drainage and disposal. Available from: Drainage and waste disposal: Approved Document H - GOV.UK (www.gov.uk)
[55] CIRIA C697 SuDS Manual. Available from: https://www.ciria.org/CIRIA/CIRIA/Item_Detail.aspx?iProductCode=C753F

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, 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.

5.5.6 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.

5.5.7 Table 5-3 has been reproduced from the SuDS Manual, CIRIA C697 and outlines typical SuDS techniques.

5.5.8 Adoption arrangements for SuDS scheme should be considered for the lifetime of the development. The LPA will need to consider whether the proposed standard of construction would facilitate adoption and maintenance by an appropriate body such as the water and sewerage company under the Ofwat-approved Sewerage Sector Guidance.

5.5.9 The role of a SuDS Approval Body (SAB) was initially given to LLFAs allowing them to be responsible for adopting and maintaining SuDS. As of January 2023, the government announced that Schedule 3 of the Flood and Water Management Act would be enacted in 2024, however; this is expected to be delayed, and its priority is unknown following the change in Government in July 2024. Schedule 3 provides a framework for the approval and adoption of drainage systems, an approving body, and national standards on the design, construction, operation, and maintenance of SuDS. It also makes the right to connect surface water runoff to public sewers conditional upon the drainage system being approved before any construction work can start.

5.5.10 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.

Recommendation 5-13 *All major developments and other development should not result in an increase in surface water runoff, and where possible, should demonstrate betterment in terms of rate and volumes of surface water runoff. Sustainable Drainage Systems (SuDS) should be used to reduce and manage surface water run-off to and from proposed developments as near to source as possible in accordance with the requirements of the Technical Standards and supporting guidance.*

Suitability for Infiltration SuDS

5.5.11 The use of infiltration techniques is highly dependent on the underlying ground conditions. As part of this SFRA, the detailed BGS Infiltration SuDS Map has been used to provide an indication of the suitability of using infiltration SuDS techniques across the Borough using the following categories:

- Highly compatible: The sub-surface is likely to be suitable for free-draining infiltration SuDS.
- Probably compatible for infiltration SuDS: The sub-surface is probably suitable for infiltration SuDS, although design may be influenced by the ground conditions.

- Opportunities for bespoke infiltration SuDS: The sub-surface is potentially suitable for infiltration SuDS although the design will be influenced by the ground conditions.
- Very significant constraints are indicated: There is a very significant potential for one or more geohazards associated with infiltration.

5.5.12 **Appendix A Map 13** shows that there are significant constraints indicated for infiltration SuDS due to the underlying soils and geology to the west of New Thundersley, the Benfleet Downs, land north of Hadleigh Marshes and West Wood. Flow attenuation of surface water released into a waterbody or a sewer could be considered for locations where infiltration is not suitable.

5.5.13 Canvey Island, South Benfleet and areas around New Thundersley and Hadleigh Marshes offer opportunities for bespoke infiltration SuDS. Detention measures are not constrained by geology, though in areas of permeable geology, there will also be a degree of infiltration of runoff taking place.

5.5.14 Areas which are highly compatible for infiltration SuDS include along Benfleet Road, Hadleigh and the area around Daws Heath. Large areas of Thundersley and east Hadleigh are likely to be compatible for infiltration SuDS.

Table 5-3 Typical SuDS Components

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		
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

Y: primary process, * some opportunities subject to design

Technical Standards and Supporting Guidance

5.5.15 Developers, designers and consultants looking for information on how to design SuDS within Castle Point should refer to the Essex SuDS Design Guide[56] for guidance on surface water drainage schemes.

5.5.16 The following documents will also provide advice on how best to design sustainable drainage schemes in Castle Point:

- Non-statutory technical standards for sustainable drainage schemes[57].
- The CIRIA SuDS Manual (C753)[55].
- BS8582 Code of practice for surface water management for development sites[58].

5.5.17 The Technical Standards[57] that are of chief concern in relation to the consideration of flood risk to and from development relating to peak flow control and volume control are presented below.

Peak flow control

5.5.18 **S2** For greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 100% AEP rainfall event and the 1% AEP rainfall event should never exceed the peak greenfield runoff rate for the same event.

5.5.19 **S3** For developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface water body for the 100% AEP rainfall event and the 1% AEP 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

5.5.20 **S4** Where reasonably practicable, for greenfield development, the runoff volume from the development to any highway drain, sewer or surface water body in the 1% AEP, 6-hour rainfall event should never exceed the greenfield runoff volume for the same event.

5.5.21 **S5** 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% AEP, 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.

5.5.22 **S6** Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with S4 or S5 above, the runoff volume must be discharged at a rate that does not adversely affect flood risk.

Flood risk within the development

5.5.23 **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 3.3% AEP rainfall event.

5.5.24 **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% AEP rainfall event in any part of: a building (including a basement); or in any utility plant susceptible to water (e.g. pumping station or electricity substation) within the development.

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

[56] Essex County Council, The Sustainable Drainage Systems Design Guide for Essex. Available from: https://www.essexdesignguide.co.uk/suds
[57] DEFRA (2015) Non-statutory technical standards for sustainable drainage schemes. Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/415773/sustainable-drainage-technical-standards.pdf
[58] BSI (2013) BS8582 Code of practice for surface water management for development sites. Available from: https://knowledge.bsigroup.com/products/code-of-practice-for-surface-water-management-for-development-sites?version=standard

5.5.26 All major development[59] should include provision for SuDS and, as the LLFA, CPBC is a statutory consultee on surface water management drainage issues for all such major developments.

5.5.27 For smaller schemes located within Flood Zones 2 and 3, SuDS will need to be addressed as part of an FRA and will be assessed by CPBC.

5.6 Floodplain Compensation Storage

5.6.1 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.

5.6.2 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 (Figure 5-3). Where land is not within the site boundary, it must be in the immediate vicinity, in the applicant's ownership and linked to the site. Floodplain compensation must be considered in the context of the 1% AEP flood level including an appropriate allowance for climate change. When designing a scheme flood water must be able to flow in and out and must not pond. An FRA must demonstrate that there is no loss of flood storage capacity and include details of an appropriate maintenance regime to ensure mitigation continues to function for the life of the development. Guidance on how to address floodplain compensation is provided in Appendix A3 of the CIRIA Publication C624[60].

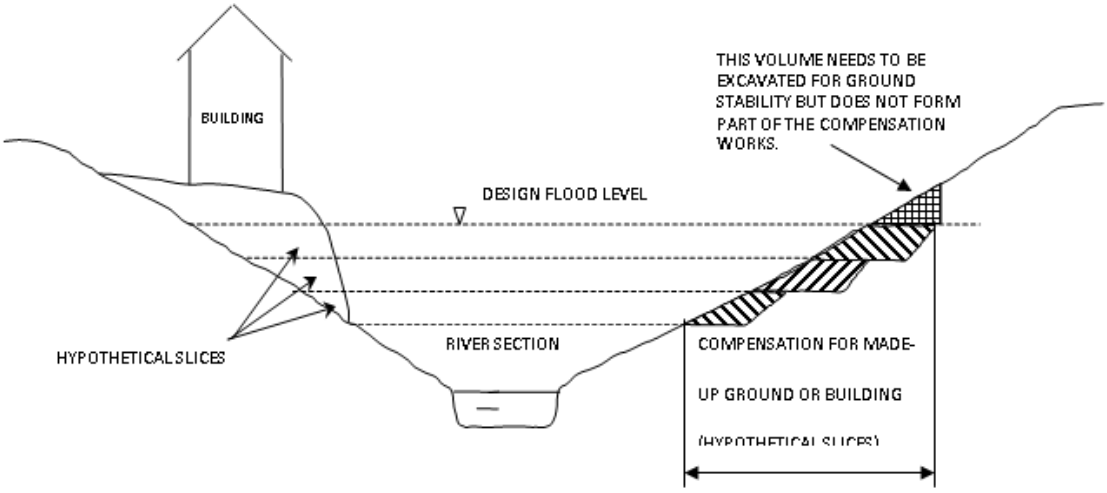


Figure 5-3 Example of Floodplain Compensation Storage (Environment Agency 2009)

5.6.3 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, or indirect compensation, by lowering land already within the floodplain, however, this would be subject to detailed investigations and agreement with the Environment Agency to demonstrate (using an appropriate flood model where necessary) that the proposals would improve and not worsen the existing flooding situation or could be used in combination with other measures to limit the impact on floodplain storage.

5.6.4 In defended areas, the need for compensation should be based on the results of a sensitivity test. The test can be assessed in three parts:

- What increase in flood levels may result from development in the defended area if the defences were breached or overtopped.
- What is the effect of this change, how much better or worse will flooding be to properties in particular.

[59] NPPF Annex 2 Glossary, Major development is defined as: "For housing, development where 10 or more homes will be provided, or the site has an area of 0.5 hectares or more. For non-residential development it means additional floorspace of 1,000m2 or more, or a site of 1 hectare or more, or as otherwise provided in the Town and Country Planning (Development Management Procedure) (England) Order 2015".
[60] CIRIA (2004) CIRIA Report 624: Development and Flood Risk - Guidance for the Construction Industry.

- Are the affects acceptable, and in reality, what mitigation measures can the developer implement to offset the impacts.
- Compensation will be an appropriate solution if the principle of development in the area is in accordance with the NPPF.

5.6.5 This evidence will need to be provided by the developer for review and the FRA for the development proposal must identify the resulting change.

5.6.6 Rather than stating what the impact on flood levels will be, it must also include what the impacts are as a result of the change (i.e. how many more properties will be at risk of flooding). If the increase in flood level means that water exceeds a building threshold then it is likely the proposals will be unacceptable.

5.6.7 If, however, the increase in flood level is very small, such that no additional properties will be at risk, then the proposals may be considered acceptable.

5.6.8 In principle, flood risk must be reduced up to the design flood (as defined in NPPF[1] and PPG[2]) including allowances for climate change and people must remain 'safe' from flooding during an extreme event.

Recommendation 5-14 *Where proposed development results in a change in building footprint, land raising or other structures such as bunds, the developer must ensure that it does not impact upon the ability of the floodplain to store water and should seek opportunities to provide betterment with respect to floodplain storage.*

5.7 Risk of Groundwater Flooding

5.7.1 The underlying geology creates pathways for groundwater to flow through the sub-surface and the potential for groundwater flooding to occur, which is exacerbated when water levels in the watercourses are elevated. Additional sub-surface development or additional infiltration has the potential to modify groundwater flows, leading to potential flooding elsewhere and/or impacting on groundwater abstractions downstream.

5.7.2 A preliminary Hydrogeological Risk Assessment (HRA) should be undertaken for all proposed developments. The preliminary HRA should identify:

- the depth and geometry of the penetration of works into the sub-surface from the construction of the proposed development (for example piled foundations, basements, excavation for services). These features can disrupt groundwater flow, alter groundwater levels and therefore increase the risk of groundwater flooding at or around the site.
- any changes in drainage, for example impermeable surfaces or infiltration/SuDS systems which could alter groundwater flow patterns and the elevation of the water table.

5.7.3 If the preliminary HRA identifies works below ground and/or changes in drainage a HRA (sometimes called a Basement Impact Assessment) will be required. The scope and detail required for the HRA will vary depending on the scale of sub-surface construction proposed and the local geological and hydrogeological conditions.

5.7.4 The HRA should therefore be used to determine the geological and hydrogeological setting and whether sub-surface development will reach the water table. The water table will move up and down depending on rainfall; the assessment should consider the highest level. If the development does extend down to the water table, it may disrupt groundwater flow in the aquifer by creating a barrier and increase the risk of flooding. The HRA should identify the impact and any required mitigation measures.

5.7.5 In some settings there may be an aquifer at depth and, depending on the proposed depth of the development, this may also have to be assessed. A site- specific ground investigation with trial pits and boreholes should be recommended if there is uncertainty over the geological or hydrogeological conditions at any proposed development site.

5.7.6 The HRA should also identify changes in drainage as these may create additional inflows to ground which can also exacerbate groundwater flood risk.

Recommendation 5-15 *Future development should assess the potential to impact on the risk of groundwater flooding as a result of sub-surface development or additional infiltration. Where required a Hydrogeological Risk Assessment should be undertaken to determine the potential for impact of groundwater flooding and appropriate mitigation measures.*

5.8 Property Flood Resilience

5.8.1 'Property Flood Resilience' is an approach to building design which aims to reduce flood damage and speed recovery and reoccupation following a flood. It uses a combination of flood resistance and recovery measures and is described in the industry-developed CIRIA Property Flood Resilience Code of Practice[61], which provides advice for both new-build and retrofit. It includes specific guidance for local authority planners. In accordance with paragraph 181(b) of the NPPF[1], "*development should only be allowed in areas at risk of flooding where it can be demonstrated that development is appropriately flood resistant and resilient, such that, in the event of a flood, it could be quickly brought back into use without significant refurbishment*".

5.8.2 Flood resilience measures should therefore now be the norm for designs of development that are proposed to take place in areas at risk of flooding.

5.8.3 Resistance and recovery measures are unlikely to be suitable as the only mitigation measure to manage flood risk, but they may be suitable in some circumstances, such as:

- Water Compatible and Less Vulnerable uses where temporary disruption is acceptable, and the development remains safe.
- Where the use of an existing building is to be changed and it can be demonstrated that the avoidance measures are not practicable, and the development remains safe.
- As a measure to manage residual flood risk from flood risk management infrastructure when avoidance measures have been exhausted.

5.8.4 Flood resistance and recovery measures cannot be used to justify development in inappropriate locations.

5.8.5 Where historic buildings are involved, early consultation with Historic England should be undertaken and their guide[62] on flood resilience for historic properties provides additional information.

Flood Resistance 'Water Exclusion Strategy'

5.8.6 Flood resistant construction can prevent entry of water or minimise the amount that may enter a building where there is short duration flooding with water depth up to approximately 0.6 metres, depending on the building's characteristics. Where measures to exclude water in this way are proposed above this level, advice should be sought from a suitably qualified building surveyor, architect or structural engineer.

5.8.7 There is a range of flood resistance and resilience construction techniques that can be implemented in new developments to mitigate potential flood damage. Flood resistance measures, or dry-proofing, stops water entering a building up to a safe structural limit. Resistance measures can be passive, such as flood doors which are normally closed; or active, such as air brick covers or removable flood barriers. Passive measures are to be prioritized above active measures.

5.8.8 This form of construction needs to be used with caution and accompanied by measures that will speed-up flood recovery, as effective flood resistance can be difficult to achieve. Hydrostatic pressures exerted by floodwater can cause long-term structural damage, undermine the foundations of a building or cause leakage through the walls, floor or sub-floor, unless the building is specifically designed to withstand such stresses. In addition, temporary and demountable defences are not appropriate for new-build developments.

[61] Kelly, D, Barker, M, Lamond, J, McKeown, S, Blundell, E and Suttie, E (2020) Guidance on the code of practice for property flood resilience, C790B, CIRIA, London (ISBN: 978-0-86017-895-8) https://www.ciria.org/CIRIA/Resources/Free_publications/CoP_for_PFR_resource.aspx
[62] Historic England, April 2015, Flooding and Historic Buildings. https://historicengland.org.uk/images-books/publications/flooding-and-historic-buildings-2ednrev/

5.8.9 There are a range of property flood protection devices available on the market, designed specifically to resist the passage of floodwater. These include removable flood barriers and gates designed to fit openings, vent covers and stoppers designed to fit WCs. These measures can be appropriate for preventing water entry associated with fluvial flooding as well as surface water and sewer flooding. The efficacy of such devices relies on their being deployed before a flood event occurs. It should also be borne in mind that devices such as air vent covers, if left in place by occupants as a precautionary measure, may compromise safe ventilation of the building in accordance with Building Regulations.

Flood Recovery 'Water Entry Strategy'

5.8.10 Flood recoverability measures (or wet-proofing), accept that water will enter the building, but through careful design and changes to the construction will minimise damage and allow faster cleaning, drying, repairing and re-occupancy of the building after a flood. Measures are preferably passive, such as the use of resilient building materials, or active such as moving sensitive equipment or belongings to upper floors when flooding is expected.

5.8.11 Materials should 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. Recovery measures are either an integral part of the building fabric or are features inside a building that will limit the damage caused by floodwaters.

5.8.12 A variety of flood recovery tools can be implemented, such as:

- Using materials with either, good drying and cleaning properties, or sacrificial materials that can easily be replaced post-flood.
- Design for water to drain away after flooding.
- Design access to all spaces to permit drying and cleaning.
- Raise the level of electrical wiring, appliances and utility metres.

5.8.13 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 and designed in such a way as to prevent entrainment of debris which in turn could increase flood risk and/or breakaway posing a danger to life during high flows.

Recommendation 5-16 *Where development or redevelopment is proposed in areas at risk of flooding, flood resilience measures must be implemented to mitigate the risk of flooding.*

5.9 Finished Floor Levels

5.9.1 In areas at risk of **river flooding**, the climate change allowance required depends on the vulnerability of the development, as set out in the climate change guidance[32]. For More Vulnerable development the central allowance should be used.

5.9.2 In areas at risk of **tidal flooding**, finished floor levels for More Vulnerable development should be a freeboard above the 0.5% AEP plus upper end climate change allowance. Finished floor levels for Less Vulnerable development should be a freeboard above the 0.5% AEP plus higher central climate change allowance.

5.9.3 These requirements are summarised in Table 5-4.

5.9.4 For more vulnerable single storey uses, ground floor levels should be provided 300mm above the 0.1% AEP flood level, inclusive of climate change.

5.9.5 For self-contained ground floor flats with access to refuge at a higher level for more extreme events, ground floor levels can be 300mm above the 1% AEP fluvial level inclusive of climate change, or 300mm above the 0.5% AEP tidal flood level, inclusive of climate change. If access to refuge from within the building is not available, then the floor levels for ground floor self-contained flats should be the same as that for single storey developments.

Table 5-4 Requirements for finished floor levels in Castle Point

Development Vulnerability	Finished floor level requirements in areas at risk of tidal flooding	Finished floor level requirements in areas at risk of fluvial flooding
Essential Infrastructure*	Finished floor levels should be raised a freeboard above the flood level for the 0.1% AEP plus upper end climate change allowance. *Refer to Overtopping maps in Appendix C to determine if a site is at risk during this 'design event'.*	Finished floor levels should be raised a freeboard above the flood level for the 1% AEP plus central climate change allowance.
More Vulnerable	Finished floor levels should be raised a freeboard above the flood level for the 0.5% AEP plus higher central climate change allowance with the upper end allowance being used as a sensitivity test for flood resilience/resistance measures. *Refer to Overtopping maps in Appendix C to determine if a site is at risk during this 'design event'.*	Finished floor levels should be raised a freeboard above the flood level for the 1% AEP plus central climate change allowance.
Less Vulnerable	Finished floor levels should be set a freeboard above the flood level for the 0.5% plus higher central climate change allowance where possible. Where this is not possible, it should be discussed with the Environment Agency and CPBC. *Refer to Overtopping maps in Appendix C to determine if a site is at risk during this 'design event'.*	Finished floor levels should be set a freeboard above the flood level for the 1% AEP plus central climate change allowance.

*For Essential Infrastructure proposals that fall within the category of Nationally Significant Infrastructure Projects (NSiPs), or for new settlements or significant urban extensions, the finished floor levels may need to be derived following the application of a sensitivity test to assess the flood risk from a credible maximum climate change scenario using:

- the H++ climate change allowances for sea level rise;
- the upper end allowance for peak river flow;
- the sensitivity test allowances for offshore wind speed and extreme wave height, and
- an additional 2mm for each year on top of sea level rise allowances from 2017 for storm surge

5.9.6 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 and/or CPBC should be approached to discuss options for a reduction in the minimum internal ground floor levels provided flood resistance measures are implemented up to an agreed level.

Recommendation 5-17 *Where developing in Flood Zone 2 and 3 is unavoidable, the recommended method of mitigating flood risk to people, particularly with More Vulnerable (residential) and Highly Vulnerable land uses, is to ensure internal floor levels are raised a freeboard level above the design flood level i.e. the known or modelled 1% AEP flood level for rivers or the 0.5% AEP flood level for tidal Thames, including an allowance for climate change.*

5.10 Basements

5.10.1 Annex 3 of the NPPF (Flood Risk Vulnerability Classification), classifies basement dwellings as Highly Vulnerable. Table 2 of the Flood Risk and Coastal Change PPG concludes that Highly Vulnerable uses should not be permitted in Flood Zones 3a and 3b. Basement dwellings are therefore incompatible in Flood Zone 3 and should not form part of developments planned in these areas.

5.10.2 Where basement dwellings are considered in Flood Zone 2, the Exception Test needs to be applied and a safe means to escape via internal access to higher floors is required (above the 0.1% AEP flood level including an allowance for climate change, in line with the requirements for places of safety, described further in Section 6.6).

Recommendation 5-18 *Basement dwellings should not be permitted in areas at risk of flooding.*

6. Assessing and Managing Residual Risk

6.1 Assessing Residual Risk

6.1.1 Section 3 identifies that a large area in the south of the Borough is identified as Flood Zone 3, high probability of flooding from the River Thames. Section 5 has identified that there are also flood defences along this frontage which are generally shown to be in fair condition, providing a significant level of protection.

6.1.2 Whilst these defences provide a significant standard of protection, there remains a residual risk of flooding. Residual risk describes the risks that remain after taking into account flood risk management infrastructure and/or any site specific mitigation measures that have been applied.

6.1.3 The residual risk can be:

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

6.1.4 The likelihood of such residual risk is very small; however, the scale of consequences from rapid inundation and deep water in heavily urbanised areas mean that these residual risks must be considered.

6.1.5 In order to better understand the residual risk of flooding from the tidal River Thames, the scope of this SFRA includes tidal modelling, to simulate overtopping of the defences, as well as breaches in the flood defences at 10 locations along the frontage (**Appendix D Map 1**). The breach results mapped are composite results, combining the maximum depth and hazard from each breach scenario.

6.1.6 As described in the Tidal and Breach Modelling Technical Note[16] [60725540-TF-001] **,** the modelling was undertaken in accordance with the latest Breach Modelling Guidance[28] and in consultation with the Environment Agency's Partnership and Strategic Overview team and Asset Management team.

6.1.7 The results of the modelling are presented in **Appendix C** and **Appendix D** for the following events:

- **Appendix C Overtopping Results**
  - Map 1: 0.5% AEP (2025) – Maximum Depth (m)
  - Map 2: 0.5% AEP (2025) – Maximum Hazard Rating
  - Map 3: 0.5% AEP (2125 Higher Central) – Maximum Depth (m)
  - Map 4: 0.5% AEP (2125 Higher Central) – Maximum Hazard Rating
  - Map 5: 0.5% AEP (2125 Upper End) – Maximum Depth (m)
  - Map 6: 0.5% AEP (2125 Upper End) – Maximum Hazard Rating
  - Map 7: 0.1% AEP (2025) – Maximum Depth (m)
  - Map 8: 0.1% AEP (2025) – Maximum Hazard Rating
  - Map 9: 0.1% AEP (2125 Higher Central) – Maximum Depth (m)
  - Map 10: 0.1% AEP (2125 Higher Central) – Maximum Hazard Rating
  - Map 11: 0.1% AEP (2125 Upper End) – Maximum Depth (m)
  - Map 12: 0.1% AEP (2125 Upper End) – Maximum Hazard Rating

- **Appendix D Breach Modelling Results**
  - Map 1: Breach Locations
  - Map 2: 0.5% AEP (2025) – Maximum Depth (m)
  - Map 3: 0.5% AEP (2125 Higher Central) – Maximum Depth (m)
  - Map 4: 0.5% AEP (2125 Upper End) – Maximum Depth (m)
  - Map 5: 0.1% AEP (2025) – Maximum Depth (m)
  - Map 6: 0.1% AEP (2125 Higher Central) – Maximum Depth (m)
  - Map 7: 0.1% AEP (2125 Upper End) – Maximum Depth (m)
  - Map 8: 0.5% AEP (2025) – Maximum Hazard Rating
  - Map 9: 0.5% AEP (2125 Higher Central) – Maximum Hazard Rating
  - Map 10: 0.5% AEP (2125 Upper End) – Maximum Hazard Rating
  - Map 11: 0.1% AEP (2025) – Maximum Hazard Rating
  - Map 12: 0.1% AEP (2125 Higher Central) – Maximum Hazard Rating
  - Map 13: 0.1% AEP (2125 Upper End) – Maximum Hazard Rating
  - Map 14: 0.1% AEP (2125 Upper End) – Time to Inundation Breach Location CAS01
  - Map 15: 0.1% AEP (2125 Upper End) – Time to Inundation Breach Location CAS02
  - Map 16: 0.1% AEP (2125 Upper End) – Time to Inundation Breach Location CAS03
  - Map 17: 0.1% AEP (2125 Upper End) – Time to Inundation Breach Location CAS04
  - Map 18: 0.1% AEP (2125 Upper End) – Time to Inundation Breach Location CAS05
  - Map 19: 0.1% AEP (2125 Upper End) – Time to Inundation Breach Location CAS06
  - Map 20: 0.1% AEP (2125 Upper End) – Time to Inundation Breach Location CAS07
  - Map 21: 0.1% AEP (2125 Upper End) – Time to Inundation Breach Location CAS08
  - Map 22: 0.1% AEP (2125 Upper End) – Time to Inundation Breach Location CAS09
  - Map 23: 0.1% AEP (2125 Upper End) – Time to Inundation Breach Location SOU01

6.1.8 Flood hazard is a function of the flood depth and flow velocity at a particular point in the floodplain along with a suitable debris factor to account for the hazard posed by any material entrained by the floodwater. The derivation of flood hazard is based on the methodology in Flood Risks to People FD2320[63] (Table 6-1).

Table 6-1 Hazard to People Rating (HR=d x (v +0.5)+DF) (Table 13.1 FD2320/TR2)

Flood Hazard (HR)	Description
Less than 0.75	Very low hazard – Caution
0.75 to 1.25	Dangerous for some – includes children, the elderly and the infirm
1.25 to 2.0	Dangerous for most – includes the general public
More than 2.0	Dangerous for all – includes the emergency services

Overtopping Results

6.1.9 During a 0.5% AEP 2025 overtopping scenario, flooding occurs across land to the north of Benfleet Creek where flood depths reach around 0.5m and a hazard rating of mostly low, with areas to the west significant to extreme. During a 0.5% AEP 2125 higher central scenario, flooding extends further north into the borough where flood depths reach around 5m with a hazard level of extreme. Flood extents continue to increase slightly during a 0.5% AEP 2125 upper end scenario, with flood depths reaching over 5m in the east of the borough. Areas indicating flooding have hazard ratings of extreme.

6.1.10 During a 0.1% AEP 2025 overtopping scenario, flooding occurs across land to the north of Benfleet Creek where flood depths reach around 1 to 1.5m in the east with hazard ratings of significant and 1.5 to 2m in the west with hazard ratings of extreme. During a 0.1% AEP 2125 higher central scenario, flooding extends further north into the borough where flood depths reach around 5m, with some areas to the east reaching over 5m, and hazard ratings of extreme. Flood extents continue to increase slightly during a 0.1% AEP 2125 upper end scenario, with flood depths reaching over 5m in the east of the borough, achieving a hazard rating of extreme.

[63] Environment Agency (2008) Supplementary note on Flood hazard ratings and thresholds for development planning and control purpose. Clarification of Table 13.1 FD2320/TR2 and Figure 3.2 FD2321/TR1. Available from: http://evidence.environment-agency.gov.uk/FCERM/Libraries/FCERM_Project_Documents/FD2321_7400_PR_pdf.sflb.ashx

Breach Results

6.1.11 During a 0.5% AEP 2025 breach event flooding occurs in the west of the borough, mostly within creeks where flood depths reach around 4m, achieving a hazard rating of significant to extreme. During a 0.5% AEP 2125 higher central breach event, flood depths extend across the entire of Canvey Island and around Benfleet Hall Brook reaching around 2m to 2.5m with hazard ratings of significant while areas surrounding watercourses reach extreme. Creeks to the west of the borough and land to the north of Benfleet Creek reach flood depths of 5m, achieving a hazard rating of extreme. Flood extents are similar during a 0.5% AEP 2125 upper end breach event, flood depths across the entire of Canvey Island and around Benfleet Hall Brook reach around 2m to 2.5m with hazard ratings of significant while areas surrounding watercourses and towards the east of the island reach extreme. Creeks to the west of the borough and land to the north of Benfleet Creek reach flood depths of 5.5m, achieving a hazard rating of extreme.

6.1.12 During a 0.1% AEP 2025 breach event flooding occurs in the west of the borough, mostly within creeks where flood depths reach around 4.5m, achieving a hazard rating of significant to extreme. Land around Benfleet Hall Brook, land to the north of Benfleet Creek and the south east of Canvey Island reaches flood depths of up to 1.5m, with hazard ratings ranging from low to extreme. During a 0.1% AEP 2125 higher central breach event, flood depths extend across the entire of Canvey Island and around Benfleet Hall Brook reaching around 2.5m to 3m with hazard ratings of significant to extreme. Creeks to the west of the borough and land to the north of Benfleet Creek reach flood depths of 5.5m, achieving a hazard rating of extreme. Flood extents are similar during a 0.5% AEP 2125 upper end breach event, flood depths extend across the entire of Canvey Island to around 2.5m and around Benfleet Hall Brook to around 4m with hazard ratings of significant to extreme. Creeks to the west of the borough and land to the north of Benfleet Creek reach flood depths of 6m, achieving a hazard rating of extreme

6.1.13 Time to inundation mapping illustrates the length of time from a breach before floodwaters reach a particular site for a 0.1% AEP 2125 upper end scenario. Table 6-2 provides a summary of the inundation from each breach location.

Table 6-2 Time to Inundation Summary 0.1% AEP 2125 Upper End

Breach Location	Time to Inundation Summary
CAS01	Land immediately upstream of the breach location is inundated within one hour. By hour four, floodwaters have extended further east, covering the west of Canvey Island. Floodwaters continue to move east, reaching Hilton Dyke and Canvey Lake by hour 16. The south of Canvey Island is inundated after over 20 hours.
CAS02	Land immediately upstream of the breach location is inundated within one hour. By hour four, floodwaters have extended north, east and west across Canvey Island covering Hilton Dyke, Canvey Lake and Thorneycreek Fleet. By hour 20, the majority of Canvey Island is inundated, with a small area to the south west remaining dry.
CAS03	Land immediately upstream of the breach location is inundated within one hour. By hour four, floodwaters have extended north, east and west across Canvey Island covering Hilton Dyke, Canvey Lake and Thorneycreek Fleet. By hour 20, the majority of Canvey Island is inundated, with a small area to the south west remaining dry.
CAS04	Land immediately upstream of the breach location is inundated within one hour. By hour four, floodwaters have extended north, east and west across Canvey Island. Inundation appears to drop off after hour four, with flood extents only increasing slightly, mainly to the north and west, until hour 20. After 20 hours, areas to the south of Canvey Island are inundated.
CAS05	Land immediately upstream of the breach location is inundated within one hour. By hour four, floodwaters have extended west across Canvey Island covering the east side of the island. Floodwaters continue to move west, with the majority of Canvey Island inundated by hour 20, with small areas to the north west and south west remaining dry. The north west of Canvey Island is inundated after over 20 hours.
CAS06	Land immediately upstream of the breach location is inundated within one hour. By hour four, floodwaters have extended south and west across Canvey Island. By hour eight, floodwaters have reached the south of the island and are continuing to extend west. By hour 20, almost the entire of Canvey Island is inundated, with a small area to the south west remaining dry.
CAS07	Land immediately upstream of the breach location is inundated within one hour. By hour four, floodwaters have extended east and west slightly. Hilton Dyke also indicates flooding around this time. Flood extents remain similar from this point, with small increases towards the south and west of the island until hour 20.
CAS08	Land immediately upstream of the breach location is inundated within one hour. Floodwaters extend to the north of Benfleet Creek across Benfleet Hall Brook and south of Benfleet Creek across the north of

Breach Location	Time to Inundation Summary
	Canvey Island by hour four. After this point, floodwaters don't extend much more. Small areas to the centre and west of Canvey Island are inundated by hours eight and 12.
CAS09	Land immediately upstream of the breach location is inundated within one hour. By four hours, floodwaters have inundated the eastern tip of Canvey Island and creeks in the west of the borough. Floodwaters don't extend much more, with only small areas to the west of Canvey Island inundated after eight hours.
SOU01	Land immediately upstream of the breach location is inundated within one hour, including land to the north of Benfleet Creek. Floodwaters do not extend much further, with no inundation indicated after 8 hours.

6.2 Development Safety

6.2.1 When assessing whether a development can be made safe, the following should be considered:

- Characteristics of a possible flood event including residual risks from flood risk management infrastructure e.g. type and source of flooding, frequency, depth, speed of onset, likelihood of warning.
- Ability of residents and users to safely access and exit a building during a design flood[64] and to evacuate before an extreme flood (0.1% AEP including climate change).
- Structural safety of buildings.
- Provision of an accessible place of safety in the event that a failure of flood risk management infrastructure would result in speeds of onset flooding that would not make escape from the development feasible.
- Impact of a flood on the essential services provided to or from a development.

6.2.2 In order to inform this assessment, the following sections describe the requirements for flood warning, emergency plans, access and escape and places of safety.

6.2.3 The recommendations made in this section are not to specifically enable development to take place in areas of flood risk. Sites outside of flood risk areas should still be favoured, with the Sequential and Exception Tests followed.

6.3 Flood Warning Areas

6.3.1 The Environment Agency operates a free Flood Warning Service[65] for many areas at risk of flooding from rivers and the sea. In some parts of England, the Environment Agency may also be able to tell when flooding from groundwater is possible.

6.3.2 The Environment Agency has provided a GIS layer of Flood Warning Areas in CPBC. There are 3 Flood Warning Areas within the Borough as shown in **Appendix A Map 14**. The Environment Agency issues flood warnings to residents and businesses that have registered for the service in these specific areas when flooding is expected.

- Canvey Island North.
- Canvey Island South.
- Leigh On Sea frontage from Chalkwell to Hadleigh Marshes including Two Tree Island.

6.3.3 CPBC has 8 emergency rest centres as detailed in Table 6-3. It should be noted that although these have been identified as emergency rest centres, whether each of the centres are operational during a flood event is dependent upon the locations and extent of flooding across the Borough at that particular time. The Multi Agency Flood Plan prepared by CPBC will provide more detail on the appropriate use of each rest centre.

[64] i.e. 0.5% AEP tidal event including appropriate allowance for climate change, or 1% AEP fluvial flood event or surface water event including an appropriate climate change allowance.
[65] Environment Agency Flood Warning Service https://check-for-flooding.service.gov.uk/

Table 6-3 Emergency Rest Centres in the Castle Point Borough

Rest Centre	Address	Post Code	Easting	Northing
The Appleton School	The Appleton School, Croft Road, Benfleet, Essex	SS7 5RN	577084	188071
SEEVIC College	SEEVIC College, Runnymede Chase, Benfleet, Essex	SS7 1TW	579167	188057
Runnymede Hall	Runnymede Hall, Kiln Road, Thundersley, Essex	SS7 1TF	579313	187995
The Deanes School	The Deanes School, Daws Heath Road, Thundersley, Benfleet, Essex	SS7 2TD	580256	188658
The King John School	The King John School, Shipwrights Drive, Thundersley, Benfleet, Essex	SS7 1RQ	579816	187319
Castle View School	Castle View School, Foksville Road, Canvey Island, Essex	SS8 7FH	580042	183427
The Paddocks	The Paddocks, Long Road, Canvey Island, Essex	SS8 0JA	579789	183238
Cornelius Vermuyden School	Cornelius Vermuyden School, Dinant Avenue Canvey Island Essex	SS8 9QS	578202	184140

Recommendation 6-1 *CPBC Emergency Planners should use the findings of the SFRA to inform the next planned review of the Multi-Agency Flood Plan.*

Catchment to Coast Project

6.3.4 As part of the Catchment to Coast project[66] there are opportunities to explore the installation of local monitoring and early warning systems in the Lower Catchment (including Canvey Island, Two Tree Island, the seawall at Hadleigh Station). This would provide an opportunity to pilot and evaluate a visual early warning system for high-risk surface water locations through improvements to local telemetry.

6.4 Emergency Plan

6.4.1 **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.

6.4.2 **Rescue** by the emergency services is likely to be required where flooding has occurred, and prior evacuation has not been possible. An emergency plan will be needed wherever emergency flood response is an important component of making a development safe.

6.4.3 In accordance with paragraph 043 of the Flood and Coastal Change PPG[2], "*an emergency plan will be needed wherever emergency flood response is an important component of making a development safe*". Emergency plans will be essential for sites on Canvey Island which are at residual risk of a breach, and those at risk of flooding used for holiday or short-let caravans and camping and for any site with transient occupancy (e.g. hostels and hotels).

Recommendation 6-2 *For all developments (excluding minor developments and change of use) proposed in Flood Zone 2 or 3, an Emergency 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.*

6.4.4 For sites in Flood Zone 1 that are located on 'dry islands', it may also be necessary to prepare an Emergency Plan to determine potential egress routes away from the site through areas that may be at risk of flooding during the 1% AEP flood event including an allowance for climate change.

6.4.5 The Environment Agency has a tool on their website to create a Personal Flood Plan[67]. The Plan comprises a checklist of things to do before, during and after a flood and a place to record important

[66] Environment Agency Flood and Coastal Resilience Innovation Programme, Catchment to Coast Project https://engageenvironmentagency.uk.engagementhq.com/sou019-catchment-to-coast
[67] Environment Agency Tool 'Make a Flood Plan'. Available from: https://www.gov.uk/government/publications/personal-flood-plan

contact details. Where proposed development comprises non-residential extension <250m^2 and householder development (minor development), it is recommended that the use of this tool to create a Personal Flood Plan will be appropriate. Reference should also be made to the ADEPT/EA guidance[68] on Flood Risk Emergency Plans for New Development.

6.4.6 Emergency Plans should include:

- How flood warning is to be provided, such as:
  - Availability of existing flood warning systems.
  - Where available, rate of onset of flooding and available flood warning time.
  - 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.
  - 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.
- Expected time taken to re-establish normal use following a flood event (clean-up times, time to re-establish services etc.).

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

Recommendation 6-3 *Where development is proposed or expected in flood risk areas with implications for emergency planning, local planning authorities should work with their emergency planning officers to produce local guidelines setting out requirements for flood warning, evacuation and places of safety, against which individual planning applications can then be judged. These should avoid additional burdens on emergency services, explore opportunities for development proposals to address any shortfall in emergency service and infrastructure capacity, and minimise the need for further consultation at planning application stage.*

6.5 Access and Escape

6.5.1 Where development may be proposed in areas at risk of flooding, safe access and egress are 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.

6.5.2 A safe access/escape route must be provided to allow occupants to safely enter and exit the buildings and be able to reach land outside the flooded area (e.g. within Flood Zone 1) using public rights of way without the intervention of emergency services or others during design flood conditions, including climate change allowances (i.e. 1% AEP fluvial flood event and surface water event including an appropriate climate change allowance). The potential for evacuation before a more extreme flood should also be considered when deciding a safe access/escape route.

[68] ADEPT, Environment Agency Flood Risk Emergency Plans for New Development. https://adeptnet.org.uk/floodriskemergencyplan

6.5.3 In accordance with paragraph 047 of the Flood and Coastal Change PPG[2], "*where access and escape are important to the overall safety of development in areas of flood risk, the local planning authority should consult with emergency planning staff and, where appropriate with the emergency services, unless local standards or guidelines have been put in place in lieu of consultation*".

6.5.4 For developments located in areas at risk of fluvial and tidal flooding safe access / escape must be provided for new development 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. However, the public should not drive vehicles in floodwater.

6.5.5 It is recognised that the residual risk to Canvey Island from a breach event is high and there would not be a safe dry route for people or vehicles to leave the island. Places of safety, as outlined in Section 6.6, are therefore critical to managing residual risk on Canvey Island. All new building applications on Canvey Island must be approved by the Environment Agency, who may require a first-floor level to enable vertical evacuation should the need arise.

Recommendation 6-4 *New development (excluding that on Canvey Island where safe access/escape is not possible) must have safe access/escape during design flood conditions including an allowance for climate change.*

'Dry Islands'

6.5.6 During times of flood, it is possible that all the land surrounding areas in higher elevation becomes flooded, resulting in this higher area becoming a 'dry island'. During prolonged periods of flooding, it may prove difficult to provide resources and emergency services to those living in these areas. In order to reduce the flood risk, these 'dry islands' should be treated the same as for the level of flood risk in the area surrounding them, regardless of their size. When contemplating development, it is important to study the wider area of the flood map to ensure that there is a dry route to a point outside the floodplain.

6.5.7 In exceptional circumstances, safe access above the design flood level including an allowance for climate change may not be achievable. In these circumstances the Environment Agency and CPBC should be consulted to determine whether the safety of the site occupants can be satisfactorily managed. This will be informed by the type of development, the number of occupants and their vulnerability and the flood hazard along the proposed egress route. For example, this may entail the designation of a safe place of refuge on an upper floor of a building, from which the occupants can be rescued by emergency services. It should be noted that sole reliance on a safe place of refuge is a last resort, and all other possible means to evacuate the site should be considered first. Provision of a safe place of refuge will not guarantee that an application will be granted.

6.6 Places of Safety

Recommendation 6-5 *Where a failure of flood risk management infrastructure would result in flooding with a speed-of-onset that would not allow sufficient time for safe access and escape, an internally accessible place of safety, capable of accommodating the likely number of occupants or users of the proposed development should also be provided.*

6.6.1 Places of safety should be located above the extreme flood level (0.1% AEP event) including an appropriate allowance for climate change. Consideration should also be made to the flood levels from the tidal breach modelling and safe refuge should be provided above the modelled breach flood level during the 0.1% AEP (1 in 1000 year) event including climate change.

6.6.2 In accordance with the section entitled 'How should residual risks be considered?' in the ADEPT/EA guidance on Flood Risk Emergency Plans for New Development[68], properties that include places of

safety have to be constructed to withstand the pressures of moving and standing water, so that if people are taking refuge within them during a flood they are structurally safe and can sustain a safe sheltering environment for residents should the building be surrounded by hazardous floodwaters. Places of safety should be internally accessible, suitably sized and a designed place of refuge above predicted flood levels. Places of safety should be designed to facilitate rescue in case emergency care is needed or, if it is unlikely to be safe, for occupants/users to wait until flood waters have receded sufficiently. They should be designed to provide adequate shelter in all conditions for the likely flood duration, accounting for loss of utilities. Reference should also be made to Section 7 of the ADEPT/EA Emergency Plan checklist[69] which provides guidance on how the Emergency Plan for a development should include information on temporary facilities/areas.

6.6.3 Local planning authorities should consider whether the development can be considered safe given the predicted duration of flooding and the vulnerability of occupants/users. In doing so, local planning authorities should account for the likely impacts of flooding on essential services such as electricity, gas, telecommunications, water supply and sewerage. Any place of safety needs to be designed to facilitate rescue in case emergency care is needed or if it is unlikely to be safe for occupants/users to wait until flood waters have receded sufficiently for safe access/escape to be possible.

6.7 Emergency Planning

6.7.1 CPBC Emergency Planning Team prepares contingency plans for incidents and risks across Castle Point to ensure adequate preparation and response during flood events. There are also several groups which support emergency planning across Essex. Where a new development or change of land use is proposed, flood evacuation plans should be developed through liaison with the emergency planners and the emergency services[68].

Recommendation 6-6 *Emergency planning strategies should be reviewed in the light of this updated SFRA to determine the suitability of refuge centres and evacuation routes based on the updated flood risk mapping produced.*

6.7.2 Emergency Planning can be broadly split into three phases, all of which should be considered in managing flood risk across the Borough:

1. Before a flood – raising flood awareness, ensuring no inappropriate use of the floodplain/flow paths, preparing suitable flood emergency plans and communicating them to the wider community.
2. During a flood – Flood alerts and communication, rescuing occupants, providing safe refuge and alternative accommodation.
3. After the flood – providing support to help people recover and return to their homes and businesses.

6.7.3 Consideration of emergency planning is even more critical when it relates to vulnerable sites and essential infrastructure, as further described below.

Vulnerable Sites

6.7.4 Emergency service authorities responsible for hospitals, ambulance, fire and police stations as well as prisons should ensure that emergency plans, in particular for facilities in flood risk areas, are in place and regularly reviewed so that they can cope in the event of a major flood. These plans should put in place cover arrangements through other suitable facilities, if deemed needed.

6.7.5 The NPPF classifies police stations, ambulance stations, fire stations and command centres as Highly Vulnerable buildings. It is essential that all establishments related to these services are located in the lowest flood risk zones to ensure that in the event of an emergency those services vital to the rescue operation are not impacted by flood water. Furthermore, development management policies should seek to locate more vulnerable uses such as schools and care homes in areas at the lowest risk of flooding to minimise the impact of a flood on their vulnerable users.

6.7.6 Allied to this, nominated rest and reception centres should also be identified within the study area and compared with the outputs of this SFRA to ensure that these centres are not at risk of flooding, so that

[69] ADEPT, Environment Agency Flood Risk Emergency Plans for New Development. Appendix 2: Emergency Plan Checklist https://adeptnet.org.uk/floodriskemergencyplan

evacuees will be safe during a flood event. Developments that would be suitable for such uses would include leisure centres, churches, schools and community centres.

6.7.7 On occasions where development of vulnerable sites within flood risk areas is unavoidable, necessary measures should be implemented to ensure the site is as safe as possible.

Essential Infrastructure

6.7.8 In the event of a flood incident, it is essential that the evacuation and rescue routes to and from any proposed development remain safe. Floodplain management and emergency response activities must have a focus on key infrastructure and any properties that are below sea level. Essential infrastructure located in Flood Zone 3a or 3b must be operational during a flood event to assist in the emergency evacuation process.

6.7.9 Relevant transport authorities and operators should examine and regularly review their infrastructure including their networks, stations, and depots, for potential flooding locations and to identify the need for any flood risk reduction measures. For large stations and depots, solutions should be sought to store or disperse rainwater from heavy storms in a sustainable manner.

Emergency Planning Teams

6.7.10 CPBC Emergency Planning Team prepares contingency plans for incidents and risks across Castle Point. There are also several groups which support emergency planning across Essex, these are listed below:

1. Essex Resilience Forum
2. Community Risk Register

7. Preparing a site-specific FRA

7.1 When is a Flood Risk Assessment required?

7.1.1 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 and resilient, will not increase flood risk elsewhere and where possible will reduce flood risk overall in accordance the NPPF/PPG. The assessment should demonstrate to the decision-maker how flood risk will be managed now and over the development's lifetime, taking climate change into account, and with regard to the vulnerability of its users. An FRA must be prepared by a suitably qualified and experienced person and must contain all the information needed to allow CPBC to satisfy itself that policy requirements have been met.

7.1.2 Guidance on preparing a site-specific FRAs is given in "Flood Risk Assessments: applying for planning permission"[7], Flood risk assessment: flood zones 1, 2, 3 and 3b[70], Preparing a flood risk assessment: standing advice"[8] and that contained in the site-specific flood risk assessment checklist[9] within the Flood Risk and Coastal Change PPG[2].

7.1.3 The NPPF[1] 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 in Flood Zone 1 with a site area of 1 hectare or more.
- 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). This would include the 5 areas in the SWMP as listed in Section 3.3.
- Proposals in an area within Flood Zone 1, which was identified in a SFRA as being at increased flood risk in future.
- Where proposed development or a change of use increases the vulnerability classification and where the SFRA shows it is at risk from other sources of flooding.

7.2 What needs to be addressed in a Flood Risk Assessment?

7.2.1 The PPG[2] states that the objectives of a site-specific flood risk assessment are to establish:

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

7.2.2 The PPG[2] states that site-specific FRAs need to be credible, fit for purpose, and proportionate to the anticipated degree of flood risk and the nature and scale of the development. Site-specific FRAs need to make optimum use of information already available, including information on the Environment Agency Flood Map for Planning[22] and surface water flood risk information, although in some cases additional modelling or detailed calculations will need to be undertaken. FRAs need to include the information set out in the flood risk assessment checklist in the PPG[9].

7.2.3 As a result, the scope of each site-specific FRA will vary considerably. Table 7-1 presents the different levels of site-specific FRA, as defined in the CIRIA publication C624[71], and identifies typical sources of

[70] Environment Agency (2024) Flood risk assessment: flood zones 1, 2, 3 and 3b. Available at: https://www.gov.uk/guidance/flood-risk-assessment-flood-zones-1-2-3-and-3b
[71] CIRIA, 2004, Development and flood risk – guidance for the construction industry C624.

information that can be used. Sufficient information must be included to enable the Council and where appropriate, consultees, to determine that the proposal will be safe for its lifetime, not increase flood risk elsewhere and where possible, reduce flood risk overall. Failure to provide sufficient information will result in applications being refused.

Table 7-1 Levels of Site-Specific FRAs

Description
Level 1 Screening study to identify whether there are any flooding or surface water management issues related to a development site that may warrant further consideration. This should be based on readily available existing information. The screening study will ascertain whether a FRA Level 2 or 3 is required. Typical **sources of information** include: • Castle Point Borough Council SFRA. • Flood Map for Planning (Rivers and Sea). • Environment Agency Standing Advice, and • NPPF Tables 1, 2 and 3
Level 2 Scoping study to be undertaken if the Level 1 FRA indicates that the site may lie within an area that is at risk of flooding, or the site may increase flood risk due to increased run-off. This study should confirm the sources of flooding which may affect the site. The study should include: • An appraisal of the availability and adequacy of existing information. • A qualitative appraisal of the flood risk posed to the site, and potential impact of the development on flood risk elsewhere, and • An appraisal of the scope of possible measures to reduce flood risk to acceptable levels. The scoping study may identify that sufficient quantitative information is already available to complete a FRA appropriate to the scale and nature of the development. Typical **sources of information** include those listed above, plus: • Local policy statements or guidance. • Thames Catchment Flood Management Plan. • Data request from the Environment Agency to obtain result of existing hydraulic modelling studies relevant to the site and outputs such as maximum flood level, depth and velocity. • Consultation with EA/Castle Point/sewerage undertakers and other flood risk consultees to gain information and to identify in broad terms, what issues related to flood risk need to be considered including other sources of flooding. • Historic maps. • Walkover survey to assess potential sources of flooding, likely routes for floodwaters, the key features on the site including flood defences, their condition, and • Site survey to determine general ground levels across the site, levels of any formal or informal flood defences etc.
Level 3 Detailed study to be undertaken if a Level 2 FRA concludes that further quantitative analysis is required to assess flood risk issues related to the development site. The study should include: • Quantitative appraisal of the potential flood risk to the development. • Quantitative appraisal of the potential impact of the development site on flood risk elsewhere, and • Quantitative demonstration of the effectiveness of any proposed mitigations measures. Typical **sources of information** include those listed above, plus: • Detailed topographical survey. • Detailed hydrographic survey. • Site-specific hydrological and hydraulic modelling studies, including overtopping and breach modelling where appropriate, which should include the effects of the proposed development. • Monitoring to assist with model calibration/verification, and • Continued consultation with the LPA, Environment Agency and other flood risk consultees.

7.3 Pre-application advice

Recommendation 7-1 *At all stages, CPBC, and where necessary the Environment Agency and/or the Statutory Water Undertaker may need to be consulted to ensure the FRA provides the necessary information to fulfil the requirements for planning applications.*

7.3.1 The Environment Agency and CPBC each offer pre-application advice services which should be used to discuss particular requirements for specific applications.

- CPBC: https://www.castlepoint.gov.uk/pre-application-meetings-and-advice/
- Environment Agency: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/297018/LIT_9015_c2822b.pdf

7.3.2 The following government guidance sets out when LPAs should consult with the Environment Agency on planning applications https://www.gov.uk/flood-risk-assessment-local-planning-authorities.

8. Next steps

8.1 Next steps

8.1.1 CPBC should use this SFRA, the associated mapping and resulting recommendations to:

- Develop their Local Plan and associated strategic policies.
- Safeguard land for flood risk management and green infrastructure.
- Carry out the Sequential Test for potential allocation sites.
- Carry out the Sequential Test for individual planning applications.
- Make decisions about individual planning applications.
- Decide whether a development can be made safe without increasing flood risk elsewhere.
- Aid discussions with emergency planning teams.
- Identify the need for local design guidance or codes.

8.1.2 Where development must be allocated in areas at risk of flooding further assessment of the risk of flooding may be required, for example through the preparation of a Level 2 SFRA.

8.2 Future monitoring and update

8.2.1 SFRAs are living documents that should be reviewed after a significant flood event or when there are changes to:

- The predicted impacts of climate change on flood risk.
- Flood products, for example surface water mapping, flood map for planning.
- Detailed flood modelling - such as from the Environment Agency or LLFA.
- Local Plans, spatial development strategies or relevant local development documents,
- Local flood management schemes.
- Flood Risk Management Plans.
- Shoreline Management Plans.
- Local Flood Risk Management Strategies.
- National planning policy or guidance.