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Southend-on-Sea Level 2 Strategic Flood Risk Assessment

Draft report

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This report describes work commissioned by Southend-on-Sea City Council by an instruction dated 2 January 2026. The Client's representative for the contract was Claire Victory of Southend-on-Sea City Council. Elsa Holm, Amy Ewens, Jolie Taberner and Sarah Hambling of JBA Consulting carried out this work.

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The methodology adopted and the sources of information used by JBA in providing its services are outlined in this Report. The work described in this Report was undertaken between 15 April 2026 and 27 July 2026 and is based on the conditions encountered and the information available during the said period. The scope of this Report and the services are accordingly factually limited by these circumstances.

Acknowledgements

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Abbreviations

AEP	Annual Exceedance Probability
AIMS	Asset Information Management System
BGS	British Geological Survey
CC	Climate Change
CCTV	Closed Circuit Television
EA	Environment Agency
FAA	Flood Alert Area
FMfP	Flood Map For Planning
FRA	Flood Risk Assessment
FWA	Flood Warning Area
GIS	Geographical Information System
JBA	Jeremy Benn Associates
LiDAR	Light Detection And Ranging
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
mAOD	metres Above Ordnance Datum
NaFRA2	National Flood Risk Assessment 2
NPPF	National Planning Policy Framework
OS	Ordnance Survey
PPG	Planning Practice Guidance
RBD	River Basin District
RMA	Risk Management Authority
RoFSW	Risk of Flooding from Surface Water
SFRA	Strategic Flood Risk Assessment
SuDS	Sustainable Drainage Systems

Definitions

1D model: One-dimensional hydraulic model, typically representing a watercourse and structures within the channel (for example bridges and culverts).

2D model: Two-dimensional hydraulic model, typically representing the floodplain flows.

Annual Exceedance Probability: The probability (expressed as a percentage) of a flood event occurring in any given year.

Brownfield: A previously developed parcel of land.

Climate change: Long term variations in global temperature and weather patterns caused by natural and human actions.

Design flood: A flood event of a given annual flood probability, which is generally taken as: fluvial (river) flooding likely to occur with a 1% annual probability (a 1 in 100 chance each year), or surface water flooding likely to occur with a 1% annual probability (a 1 in 100 change each year), plus an appropriate allowance for climate change, against which the suitability of a proposed development is assessed and mitigation measures, if any, are designed.

Dry island: Land which may not be at risk of flooding itself but is surrounded by flood risk and therefore may become cut off during a flood event.

Flood defence: Infrastructure used to protect an area against floods such as floodwalls and embankments; they are designed to a specific standard of protection (design standard).

Green infrastructure: A network of natural environmental components and green spaces that intersperse and connect the urban centres, suburbs, and urban fringe.

Greenfield: An undeveloped parcel of land.

Lead Local Flood Authority: The unitary authority for the area or if there is no unitary authority, the county council for the area.

Local Planning Authority (LPA): The local government body which is responsible by law to exercise planning functions for a particular area.

Main river: A watercourse shown as such on the statutory main river map held by the Environment Agency. They are usually the larger rivers and streams. The Environment Agency has permissive powers (not duties) to carry out maintenance and improvement works on main rivers.

Major development: Defined in the National Planning Policy Framework as a housing development where 10 or more homes will be provided, or the site has an area of 0.5 hectares or more, or as a non-residential development with additional floorspace of 1,000m² or more, or a site of 1 hectare or more, or as otherwise provide in the Town and Country Planning (Development Management Procedure) (England) Order 2015 (gov.uk).

Natural Flood Management: Techniques that work with nature to reduce the risk of flooding for communities.

Ordinary watercourse: Any river, stream, ditch, drain, cut, dyke, sluice, sewer (other than a public sewer) and passage through which water flows but which does not form part of a main river. The local authority or internal drainage board has permissive powers (not duties) on ordinary watercourses.

Permissive powers: Authorities have the power to undertake flood risk management activities, but not a duty to do so. This will depend on priorities in flood risk management.

Return period: An estimate of the interval of time between events of a certain intensity or size, in this instance it refers to flood events. It is a statistical measurement denoting the average recurrence interval over an extended period of time.

Riparian owner: A riparian landowner, in a water context, owns land or property, next to a river, stream or ditch.

Risk: In flood risk management, risk is defined as a product of the probability or likelihood of a flood occurring, and the consequence of the flood.

Risk Management Authority: The Environment Agency, Lead Local Flood Authorities, District and Borough Councils in an area where there is no unitary authority, Coast Protection Authorities in coastal areas, Water and sewerage companies, Internal Drainage Boards, and Highways authorities.

Standard of Protection (SoP): Defences are provided to reduce the risk of flooding (typically from a river, sea or surface water). A Standard of Protection is usually described in terms of an AEP flood event. For example, a flood embankment could be described as providing a 1% AEP Standard of Protection.

Stakeholder: A person or organisation affected by the problem or solution or interested in the problem or solution. They can be individuals or organisations, includes the public and communities.

Sustainable Drainage Systems: Sustainable Drainage Systems are methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques, such as grates, gullies, and channels.

Windfall site: A site which becomes available for development unexpectedly and therefore not included as allocated land in a planning authority's local plan.

Executive Summary

Introduction and context

This Level 2 Strategic Flood Risk Assessment (SFRA) document was prepared with the purpose of providing part of the evidence base for the Local Plan 2025 - 2045 for Southend -on-Sea City Council. It follows on from Southend-on-Sea Level 1 SFRA published at the same time as this report and should be read in conjunction.

The primary purpose of the Level 2 SFRA is to provide an appropriate understanding of the level of flood risk affecting development included in the updated Local Plan. The assessment takes into account all sources of flooding and considers other factors affecting flood risk such as residual risk. The information provided as part of the Level 2 SFRA enables Southend-on-Sea City Council to apply the Exception Test to sites in accordance with the National Planning Policy Framework (NPPF).

SFRA objectives

The Government's Planning Practice Guidance (PPG) on Flood Risk and Coastal Change advocates a tiered approach to risk assessment involving Level 1 and Level 2 SFRAs.

After completing the Level 1 SFRA and the 'Call for Sites' process, Southend-on-Sea City Council have undertaken the Sequential Test and have shortlisted sites which cannot be relocated outside of flood risk areas due to additional planning factors. The Level 2 assessment aims to build on identified risks from the Level 1 SFRA to provide a greater understanding of fluvial, surface water, groundwater, and sewer related flooding risks to these shortlisted sites. From this, Southend-on-Sea City Council and developers can make more informed decisions regarding future development. The Level 2 SFRA also identifies sites requiring further risk analysis at the site-specific Flood Risk Assessment (FRA) stage.

Summary of Level 2 SFRA

Southend-on-Sea City Council provided 33 sites to be assessed within this Level 2 SFRA. A GIS exercise was undertaken to screen these sites against all sources of flood risk (detailed in Section 5.1). Each site was then looked at individually to assess the nature of the risk on the site.

A Red-Amber-Green (RAG) assessment was then carried out based on the following criteria:

- 'Red sites' have been identified as being at risk from flooding within the EA FMfP or EA detailed fluvial and tidal hydraulic model outputs, tidal breach scenarios, significant surface water risk (based on EA data) or at risk from ordinary watercourses. For these sites an individual detailed site assessment with incorporated mapping has been undertaken, to inform the application of the Exception Test.
- 'Amber sites' have been identified with a reduced risk of flooding, including surface water risk impacting access and escape, and groundwater emergence risk. These have been identified within this report with more general flood risk

advice for developing the site. However, please note all the above risks of flooding identified are critical to ensuring no adverse impacts.

- 'Green sites' have been assessed as requiring no further assessment.

Following the initial RAG assessment, Southend-on-Sea City Council reviewed the sites and removed any sites with an existing full planning permission, as these will already have been subject to a more detailed site-specific assessment.

The final Level 2 assessment covers 16 'Red sites', four of which were combined into one new neighbourhood site, and 11 'Amber sites'. The 'Red sites' that have been assessed within the Level 2 SFRA through individual detailed site assessments and mapping, which are provided in Appendix A. Section 5.3 sets out what is contained within the detailed site assessments.

The following points summarise the Level 2 assessment:

- **Tidal** - Several of the sites assessed within this Level 2 SFRA are at risk of tidal flooding, which are CA012, HEA042, HEA054; EA037, HEA137; EA021, HEA271; EA014, HEA265; EA036, and two out of the four new neighbourhood sites (CA002uc and HEA143; EA020uc). HEA265; EA036, HEA137; EA021 and the two new neighbourhood sites are only at risk in the climate change scenarios. Several sites are also at risk in the tidal defence breach modelling scenarios.
- **Fluvial flooding** - A few of the sites assessed within this Level 2 SFRA are at risk of fluvial flooding. The sites at risk of fluvial flooding are CA004, EA033, HEA217 and the new neighbourhood site (CA001uc, CA002uc, CA003uc, and HEA143; EA020uc).
- **Flood Warning Areas (FWAs)** - Six sites (CA004, CA012, EA033, HEA042, HEA054; EA037, and HEA217) are located within existing EA FWAs. For proposed development within existing EA FWAs, developers should consult the EA to ensure that adequate flood warning procedures and evacuation processes are in place and that Risk Management Authorities (RMAs) are not put under any additional burden.
- **Surface water flooding** - Surface water tends to follow topographic flow routes, for example, along watercourses or isolated pockets of ponding where there are topographic depressions. The sites assessed at highest risk of surface water flooding are CA006, CA007, HEA217, HEA178, HEA271; EA014, EA033, HEA054; EA037, and CA012.
- **Access and escape routes** - CA004, CA007, CA012, HEA042, HEA054; EA037, HEA137; EA021, and HEA271; EA014 have potential access and escape route issues as a result of fluvial, tidal and/or surface water flooding of the surrounding roads. At these sites, consideration should be made as to how safe access and escape routes can be provided during flood events, both for people and emergency vehicles. Consideration should also be given to the nature of the risk, for example whether the flooding forms a flow path or bisects the site meaning access across the site from one side to another may be compromised.

- **Climate change** - Fluvial, tidal, and surface water climate change mapping indicates that flood extents are predicted to increase. As a result, the depths, velocities, and hazard of flooding may also increase. The significance of the increase will depend on the topography of the site and the climate change percentage allowance used. Site-specific FRAs should confirm the impact of climate change using latest guidance. The sites most at risk from increased risk due to climate change include HEA042, HEA054; EA037, HEA137; EA021, HEA265; EA036, and HEA271; EA014. It is recommended that Southend-on-Sea City Council work with other RMAs to review the long-term sustainability of existing and new development in these areas when developing climate change plans and strategies for the study area.
- **Historic flooding** - Four sites (CA012, HEA042, HEA054; EA037, and HEA271; EA014) are shown to be within the EA's historic flood map and recorded flood outlines. There are no records of flooding provided by Essex County Fire and Rescue Service within any of the sites.
- **Sewer flooding** - Anglian Water provided a redacted GDPR compliant version of their DG5 dataset for the study area, which identifies internal and external historic sewer flooding records between 2022 and 2026. CA006 is the only site with an incident recorded within the boundary. For several other sites, there are incidents in close proximity of the sites. The available data should always be supplemented by direct consultation with Anglian Water to ascertain if there is any site-specific risk from a public sewer. This is because sewer flood risk information is not publicly available and would need to be considered on a site-specific basis.
- **Groundwater flooding** - The risk of groundwater flooding is shown to vary across the study area. Several sites are shown to have a high risk of groundwater emergence. The sites most at risk of groundwater emergence are CA004, HEA271; EA014, HEA137; EA021, CA001uc and CA002uc. Seven of the sites are also shown to have a negligible risk of groundwater emergence due to the nature of the underlying local geological deposits (EA033, HEA178, CA006, HEA054; EA037, CA012, HEA143; EA020uc, and CA003uc. An appropriate assessment of the groundwater regime for a site should be carried out at the site-specific FRA stage.
- **SuDS** - A strategic assessment was conducted of SuDS options using regional datasets. A detailed site-specific assessment of suitable SuDS techniques would need to be undertaken at site-specific level to understand which SuDS option would be best.

Recommendations

Section 8 sets out the recommendations based on the findings of this Level 2 SFRA. This includes recommendations for applying the Exception Test, where required, requirements for developers in developing the Local Plan allocations, and guidance for windfall sites and development of sites not included within the Local Plan.

1 Introduction

1.1 Purpose of the Strategic Flood Risk Assessment

Paragraph 171 of the National Planning Policy Framework (NPPF) (2024) (gov.uk) states that *'Strategic policies should be informed by a strategic flood risk assessment and should manage flood risk from all sources. They should consider cumulative impacts in, or affecting, local areas susceptible to flooding, and take account of advice from the Environment Agency and other relevant flood risk management authorities, such as lead local flood authorities and internal drainage boards*.'

1.2 Levels of SFRA

The Planning Practice Guidance (PPG) Flood risk and coastal change (gov.uk) advocates a staged approach to risk assessment and identifies two levels of a Strategic Flood Risk Assessment (SFRA):

- A Level 1 assessment, which all Local Planning Authorities (LPAs) are required to undertake. Where potential site allocations are at low flood risk and where development pressures are low a Level 1 assessment is likely to be sufficient, without the LPA progressing to a more detailed Level 2 assessment. The Level 1 assessment should be of sufficient detail to enable application of the Sequential Test, to inform the allocation of development to areas of lower flood risk.
- A Level 2 assessment is required where land outside flood risk areas cannot appropriately accommodate all necessary development, creating the need to apply the NPPF's Exception Test, or if an LPA believe they may receive high numbers of applications in flood risk areas on sites not identified in the Local Plan. In these circumstances the assessment should consider the detailed nature of the flood characteristics within a Flood Zone and assessment of all sources of flooding.

This SFRA report fulfils the requirements for a Level 2 assessment of development sites identified for potential allocation within Southend-on-Sea and has been prepared in accordance with the NPPF (2024) and PPG (2022).

This report should be read alongside the Southend-on-Sea Level 1 SFRA and builds upon information presented within the Level 1 SFRA.

1.3 SFRA objectives

The objectives of this Level 2 SFRA are to:

1. Provide individual flood risk analysis for site options using the latest available flood risk data, thereby assisting the Council in applying the Exception Test, where required, to their proposed site options in preparation of their Local Plan.

2. Using the available data, provide information and comprehensive mapping presenting flood risk from all sources for the site.
3. Provide recommendations for making sites safe throughout their lifetime.
4. Take into account most recent policy and legislation in the NPPF, PPG, EA SFRA Guidance, and LLFA SuDS guidance.

1.4 Consultation

SFRAs should be prepared in consultation with other RMAs.

In addition to the Southend-on-Sea City Council as the LPA, the following parties were consulted during the preparation of the Level 2 SFRA through data requests and draft report reviews:

- Southend-on-Sea City Council LLFA
- Environment Agency
- Anglian Water

In addition, the following parties were consulted through data requests during the preparation of the Level 2 SFRA:

- Essex County Council
- Essex County Fire and Rescue Service

1.5 How to use this report

Table 1-1 below outlines the contents of this report and details how different users can apply this information.

Table 1-1: Outline of the contents of each section of this report.

Section	Contents	How to use
1. Introduction	Outlines the purpose and objectives of the Level 2 SFRA.	For general information and context.
2. Policy and strategy for flood risk management	Includes information on the implications of recent changes to planning and flood risk policies and legislation and signposts to relevant sections of the Level 1 SFRA.	Users should refer to this section and the relevant sections of the Level 1 SFRA for any relevant policy which may underpin strategic or site-specific assessments.
3. Sequential and Exception Tests	Signposts to relevant sections of the Level 1 SFRA for information on the Sequential and Exception Tests.	Users should refer to this section and the relevant sections of the Level 1 SFRA to understand and follow the steps required for applying the Sequential and Exception Tests.

Section	Contents	How to use
3. Information used in the Level 2 SFRA	Summarises the data used in the Level 2 detailed site assessments and mapping.	Users should refer to this section in conjunction with the detailed site assessments and mapping (Appendix A) to understand the data presented.
4. Level 2 Assessment Methodology	Summarises the sites taken forward to a Level 2 assessment and the outputs produced for each of these sites.	Users should refer to this section in conjunction with the detailed site assessments and mapping (Appendix A) to understand the data presented.
6. Flood risk management requirements for developers	Identifies the scope of the assessments that must be submitted in Flood Risk Assessments (FRAs) supporting applications for new development. Refers to relevant sections in the Level 1 SFRA for mitigation guidance.	Developers should use this section alongside the relevant sections of the Level 1 SFRA to understand requirements for FRAs, which conditions/guidance documents should be followed, and information on flood mitigation options.
7. Surface water management and SuDS	Signposts to relevant sections of the Level 1 SFRA for information on the management of surface water including types of SuDS, SuDS policy and guidance, and SuDS constraints.	Developers should use this section alongside the relevant sections of the Level 1 SFRA to understand what national, regional, and local SuDS standards are applicable.
8. Summary of Level 2 assessment and recommendations	Summarises the results and conclusions of the Level 2 assessment, and signposts to the Level 1 SFRA for planning policy recommendations.	Developers and planners should use this section to see a summary of the Level 2 assessment and understand the key messages from the detailed site assessments. Developers should refer to the Level 1 SFRA recommendations when considering requirements for site-specific assessments.
Appendix A: Detailed site assessments and mapping	Provides a detailed summary of flood risk for sites requiring a more detailed assessment, which considers flood risk, emergency planning, climate change, broadscale assessment of possible SuDS, Exception Test requirements, and requirements for site-specific FRAs.	Planners should use this appendix to inform the application of the Sequential and Exception Tests, as relevant. Developers should use these assessments to understand flood risk, access and escape route requirements, climate change, SuDS, and FRA requirements for site-specific assessments.

Section	Contents	How to use
	Provides mapping of the flood risk at each of the sites afforded a detailed site assessment. Includes depth, velocity and hazard information for fluvial and surface water flood risk where available, alongside climate change risk.	Planners should use this appendix to inform the application of the Sequential and Exception Tests, as relevant. Developers should use these assessments to understand flood risk, access and escape route requirements, climate change, SuDS, and FRA requirements for site-specific assessments.
Appendix B: Amber Site Surface Water Mapping	Provides mapping of each of the sites identified to be at amber risk due to minor surface water issues.	Planners should use this appendix to inform the application of the Sequential and Exception Tests, as relevant. Developers should use these assessments to understand flood risk, access and escape route requirements, climate change, SuDS, and FRA requirements for site-specific assessments.
Appendix C: Amber Site Groundwater Emergence Mapping	Provides mapping of each of the sites identified to be at amber risk due to risk of groundwater emergence.	Planners should use this appendix to inform the application of the Sequential and Exception Tests, as relevant. Developers should use these assessments to understand flood risk, access and escape route requirements, climate change, SuDS, and FRA requirements for site-specific assessments.
Appendix D: Tidal Modelling Methodology	This study makes use of two existing models to assess the coastal flood risk to the sites. The models were updated with a new tidal water level boundary, updated wave overtopping inflows, and new topographic data. The technical note describes the model updates, data and methodology used.	Developers and planners should use this appendix to understand the coastal modelling undertaken to determine the risk to the sites from extreme water levels and wave overtopping discharges.

1.6 SFRA study area

This SFRA covers the unitary authority area of Southend-on-Sea, hereafter referred to as the study area. Southend-on-Sea is a coastal city located in south-eastern Essex, north of the Thames Estuary. The study area is bordered by Castle Point Borough to the west and Rochford District to the north.

Southend-on-Sea is almost exclusively urban and has one of the highest urban densities in England, outside of London. The study area encompasses a number of distinct towns and suburbs, including Leigh-on-Sea, Shoeburyness, Eastwood, Prittlewell, Westcliff-on-Sea, Southchurch, Chalkwell, and Thorpe Bay. There are several parks and golf courses throughout the study area, and a few areas of greenbelt land, the largest situated in the northeast.

Sewerage and wastewater services are provided by Anglian Water, and Essex and Suffolk Water is the principal water supplier. Some developments within the study area may be supplied by New Appointment and Variations (NAV) suppliers. Locations where these companies supply can be found on the UK Parliament website (parliament.uk).

Southend-on-Sea City Council is the LLFA across the entire study area. Eastwood Brook, Prittle Brook, and Mucking Hall Brook are statutory main rivers within the study area that flow northwards and converge with the River Roach. Prittle Brook also has a culverted flood relief channel that diverts excess flows into the Thames Estuary during flood events. Willingdale Brook, a statutory main river, and C-X Ditch, an ordinary watercourse, flow southwards and discharge into the Thames Estuary.

Southend has an extensive coastline influenced by a large tidal range and is bordered by the Thames Estuary to the south and the North Sea to the east. The coastline is characterised by several popular sandy and shingle beaches, such as Shoebury Common, Bell Wharf Beach, and Chalkwell Beach. The southern seafront is urbanised with several tourist attractions and features Southend Pier, which is world's longest pleasure pier at 2.14km. There are also a number of flood walls and flood gates along the southern and eastern coastlines.

For further details and mapping of the study area, see Section 1.4 of the Southend-on-Sea Level 1 SFRA report.

2 Policy and strategy for flood risk management

The flood risk management roles and responsibilities for different organisations and relevant legislation, policy and strategy are detailed within Section 2 of the Southend-on-Sea Level 1 SFRA.

This contains details on:

- Key legislation for flood and water management.
- Key national, regional, and local policy documents and strategies.
- Roles and responsibilities for flood risk management in Southend-on-Sea.

As this Level 2 SFRA has been prepared alongside the Level 1 SFRA, there have been no changes in legislation, policy, and strategy, and users should refer to the Level 1 SFRA for latest available information.

3 Sequential and Exception Tests

Information on planning policy for flood risk management is detailed in Section 3 of the Southend-on-Sea Level 1 SFRA. Users should consider this section within the Level 1 SFRA to understand national planning policy guidance and how to evidence that a proposed development will pass the Sequential Test, and if necessary, the Exception Tests.

Section 3 contains detail on:

- the NPPF and PPG;
- the risk-based approach; and
- the Sequential and Exception Tests.

4 Information used in the Level 2 SFRA

This section outlines the datasets used in assessing the Local Plan proposed development sites in the Level 2 SFRA Appendix A.

It should be noted that datasets used to inform this SFRA may be updated following the publication of this SFRA and new information on flood risk may be produced by RMAs. This new information (such as updated mapping and modelling) may supersede the information included in this SFRA. Guidance should be sought from the LPA, LLFA, and the EA as appropriate to check the most up to date source of information is used for future flood risk assessment.

4.1 Historic flooding

The EA's Historic Flood Map and Recorded Flood Outlines datasets were used to understand whether historic flooding has been recorded at the sites.

Essex County Fire and Rescue Service also provided a record of 23 external flooding incidents within the Southend-on-Sea District between 2011 and 2024. One of these incidents occurred at the boundary to the Castle Point Local Area District but is likely to have happened within Southend-on-Sea.

It is important to note that the absence of historic flood records does not mean that an area has never flooded, only that records are not held. For previously undeveloped sites, it is likely that historic flooding incidents may have gone unreported due to a lack of site use or interest. In addition, it is also possible that flooding mechanisms have changed since the date of a recorded flooding incident, making it more or less likely for flooding to occur on site.

4.2 River networks

Main Rivers are represented by the EA's Statutory Main River layer. Ordinary Watercourses are represented by the OS Watercourse Link layer. Caution should be taken when using these layers to identify culverted watercourses which may appear as straight lines within these datasets but are unlikely to follow this path in reality.

4.3 Fluvial flooding

4.3.1 National modelling

The EA's Flood Map for Planning (FMfP) Flood Zones (accessed 21 April 2026) and Flood Zone 3b (functional floodplain) have been used for this study. These are defined in the Level 1 SFRA.

4.3.2 Detailed hydraulic modelling

Prittle Brook

For sites at risk from Prittle Brook, the EA's 2016 Prittle Brook detailed hydraulic model has been used within this assessment. This model has been incorporated into the EA's FMfP.

Depth, velocity, and hazard information is available for this modelling. However, hazard outputs are not currently available for the 1% AEP and 0.1% AEP undefended events.

It should be noted that the hydrology for this model was completed in 2016 and may not be appropriate for site-specific flood risk assessment, although in agreement with the EA this has informed the SFRA. For a site-specific FRA, the developer should undertake a review of the model hydrology compared with hydrological estimates based on latest data and methodologies. Should the hydrological inputs to the model be found to be under representative of current estimates, updates to the modelling with new hydrology may be required.

Eastwood and Noblesgreen

For sites at risk from Eastwood Brook, the EA's 2017 Eastwood and Noblesgreen detailed hydraulic model has been used within this assessment. This model has been incorporated into the EA's FMfP.

Depth, velocity, and hazard information is available for this modelling.

It should be noted that the hydrology for this model was completed in 2016 and may not be appropriate for site-specific flood risk assessment, although in agreement with the EA this has informed the SFRA. For a site-specific FRA, the developer should undertake a review of the model hydrology compared with hydrological estimates based on latest data and methodologies. Should the hydrological inputs to the model be found to be under representative of current estimates, updates to the modelling with new hydrology may be required

4.4 Tidal flooding

4.4.1 National modelling

The EA's Flood Map for Planning (FMfP) Flood Zones (accessed 21 April 2026) and Flood Zone 3b (functional floodplain) have been used for this study. These are defined in the Level 1 SFRA.

4.4.2 Tidal modelling

As part of this SFRA, the existing EA detailed hydraulic models of Southend and the Crouch and Roach estuary developed as part of the 2014 Essex, Suffolk and Norfolk Coastal modelling project were combined. The updated model has been used to assess the tidal risk to the site.

The model was simulated for the 3.3%, 0.5%, and 0.1% Annual Exceedance Probability (AEP) tidal events under present day (2026), and future climate change (2126) conditions. Both the defended and undefended configurations were used in this study. In addition, three defence breach scenarios were setup and simulated.

The tidal modelling methodology is provided in Appendix D.

4.5 Flood defences

Current flood defence information has been taken from the EA's Asset Information Management System (AIMS) Spatial Defences dataset. These datasets include all flood defences currently owned, managed or inspected by the EA and include information pertaining to their current condition and standard of protection.

4.6 Surface water flooding

The EA's Surface Water Spatial Planning Dataset, released in May 2026, has been used within this assessment to inform the extent and depth of surface water risk. Velocity and hazard data is not currently available within this dataset, therefore the Risk of Flooding from Surface Water (RoFSW) map has been used within this assessment to inform the velocity and hazard of surface water risk.

4.7 Climate change

Climate change mapping is shown in the detailed site assessments and mapping in Appendix A for fluvial, tidal and surface water flooding using modelled outputs with the latest climate change uplifts where available.

4.7.1 Climate change allowances for peak flows

Climate change is expected to increase the peak flows of rivers, meaning that flows which were previously thought to be extreme will now be considered far more possible. Areas benefiting from flood defences will find the standard of protection changes over time with overtopping of defences more likely unless they are upgraded.

Peak river flow climate change allowances developed by the EA are divided into a series of Management Catchments. Southend-on-Sea is covered by two Management Catchments, with the relevant allowances for each Management Catchment detailed in Table 4-1 and Table 4-2.

Table 4-1: Peak river flow allowances for the Essex Combined Management Catchment.

Allowance category	Total potential change (%) anticipated for '2020s' (2015 to 2039)	Total potential change (%) anticipated for '2050s' (2040 to 2069)	Total potential change (%) anticipated for '2080s' (2070 to 2125)
Upper end	27	37	72
Higher Central	13	16	38
Central	7	8	25

Table 4-2: Peak river flow allowances for the South Essex Combined Management Catchment.

Allowance category	Total potential change (%) anticipated for '2020s' (2015 to 2039)	Total potential change (%) anticipated for '2050s' (2040 to 2069)	Total potential change (%) anticipated for '2080s' (2070 to 2125)
Upper end	22	27	48
Higher Central	11	11	26
Central	6	5	17

The following methodology outlines the approach to assessing climate change for each Flood Zone:

- Flood Zone 3b plus climate change:
  - None of the hydraulic models had any available outputs. Therefore, the EA Rivers and Sea defended 3.3% AEP has been used to represent future Flood Zone 3b. There is currently no available depth, hazard, or velocity information available for this dataset.
- Flood Zone 3a plus climate change:
  - For sites at risk along Prittle Brook, the detailed hydraulic modelling outputs have been used for the 1% AEP plus 25% climate change, including available depth, velocity, and hazard information.
  - For sites at risk along Eastwood Brook or other watercourses, there is no suitable detailed modelled climate change data available. For these sites, the EA Rivers and Sea 1% AEP plus climate change layer has been used, which represents the 2080s Central allowance. There is currently no available depth, hazard, or velocity information available for this dataset.

- Flood Zone 2 plus climate change:
  - For sites at risk along Prittle Brook, the detailed hydraulic modelling outputs have been used for the 0.1% AEP plus 25% climate change, including available depth, velocity, and hazard information.
  - For sites at risk along Eastwood Brook or other watercourses, there is no detailed modelled climate change data available. For these sites, the EA Rivers and Sea 0.1% AEP plus climate change layer has been used, which represents the 2080s Central allowance. There is currently no available depth, hazard, or velocity information available for this dataset.

4.7.2 Climate change allowances for peak rainfall

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

Peak rainfall climate change allowances developed by the EA are divided into the same Management Catchments as peak river flows and are detailed in Table 4-3.

Table 4-3: Peak rainfall intensity allowances for small and urban catchments for the Essex Combined and the South Essex Management Catchments.

Allowance category	Total potential change (%) anticipated for '2050s' (2022 to 2060) for 3.3% AEP	Total potential change (%) anticipated for '2050s' (2022 to 2060) for 1% AEP	Total potential change (%) anticipated for '2070s' (2061 to 2125) for 3.3% AEP	Total potential change (%) anticipated for '2070s' (2061 to 2125) for 1% AEP
Upper end	35	45	35	40
Central	20	20	20	25

The EA's Surface Water Spatial Planning Dataset, released in May 2026, has been used within this assessment to inform the extent and depth of surface water risk with climate change. Climate change outputs are available for the 3.3%, 1%, and 0.1% AEP events with the Upper End climate change allowance for the 2070s epoch. There is currently no available velocity or hazard information to use within this assessment.

In addition, the 0.1% AEP surface water extent can be used as an indication of the impact of climate change on surface water flood risk from smaller watercourses, which are too small to be covered by the EA's Flood Zones.

4.7.3 Climate change allowances for sea level rise

Increasing global temperatures are leading to ocean warming. This is resulting in sea level rise from two different mechanisms: as the oceans warm seawater expands and the melting of ice over land is resulting in further water adding to the ocean.

The study area is located within the Anglian River Basin District (RBD). Table 4-4 shows the sea level rise allowances that apply.

Table 4-4: Sea level allowances for the Anglian RBD for each epoch in mm for each year (based on a 1981 to 2000 baseline). The total sea level rise for each epoch is in brackets.

Allowance category	2000 to 2035 (mm)	2036 to 2065 (mm)	2066 to 2095 (mm)	2096 to 2125 (mm)	Cumulative rise 2000 to 2125 (metres)
Upper end	7 (245)	11.3 (339)	15.8 (474)	18.1 (543)	1.60
Higher central	5.8 (203)	8.7 (261)	11.6 (348)	13 (390)	1.20

The detailed tidal hydraulic model, updated as part of this SFRA, was uplifted for the 2126 epoch for the higher central (70th percentile) and upper end (90th percentile) climate change scenarios.

4.8 Groundwater flooding

The JBA Groundwater Emergence map has been used to assess potential areas that are likely to be at higher risk of groundwater flooding. The JBA Groundwater Emergence map, shows the likelihood of groundwater emergence posing a risk to both surface and subsurface assets, based on predicted groundwater levels during a 1% AEP event. Surface water mapping and topographic data is used to gain an understanding of the overland flow routes which may be impacted by this emergence.

The JBA Groundwater Emergence mapping is categorised into five different classes; a detailed description of the classes is in Table 4-5 below.

Table 4-5: JBA Groundwater Emergence Map category descriptions.

Category	Potential risk
Groundwater levels are either at or very near (within 0.025m of) the ground surface.	Within this zone there is a risk of groundwater flooding to both surface and subsurface assets. Groundwater may emerge at significant rates and has the capacity to flow overland and/or pond within any topographic low spots.
Groundwater levels are between 0.025m and 0.5m below the ground surface.	Within this zone there is a risk of groundwater flooding to both surface and subsurface assets. There is the possibility of groundwater emerging at the surface locally.

Category	Potential risk
Groundwater levels are between 0.5m and 5m below the ground surface.	There is a risk of flooding to subsurface assets, but surface manifestation of groundwater is unlikely.
Groundwater levels are at least 5m below the ground surface.	Flooding from groundwater is not likely.
No risk.	This zone is deemed as having a negligible risk from groundwater flooding due to the nature of the local geological deposits.

4.8.1 Groundwater flooding and climate change

The impact of climate change is more uncertain for groundwater flooding associated with rivers and land catchments and those watercourses where groundwater has a large influence on winter flood flows. Changes in frequency and intensity of groundwater flooding due to climate change would depend on the flooding mechanism and geological characteristics.

Milder wetter winters may increase the frequency of groundwater flooding incidents in areas that are already susceptible, but warmer drier summers may counteract this effect by drawing down groundwater levels to a greater extent during the summer months.

4.9 Sewer flooding

Anglian Water is the water company responsible for the management of the sewerage networks across Southend-on-Sea.

Anglian Water provided a redacted GDPR compliant version of their DG5 dataset for the study area, which identifies internal and external historic sewer flooding records between 2022 and 2026.

Due to licencing and confidentiality restrictions, sewer data has not been represented on the mapping, but incidents within a site or within close proximity of a site were referred to within the detailed site assessments.

4.10 Residual risk

Three sites (CA004, EA033, and HEA217) assessed within the study area are near culverted sections of watercourses which flow beneath roads, railway lines, and footpaths, and present a residual flood risk should they become blocked or collapse. Potential culvert blockages that may affect a site were identified on OS Mapping and the OS Watercourse Link layer to determine where watercourses flow into culverts or through structures (i.e. bridges) in the vicinity of the sites. Any potential locations were flagged in the detailed site assessments.

Eight sites (CA012, HEA042, HEA054; EA037, HEA137; EA021, HEA265; EA036, HEA271; EA014, CA002uc, and HEA143; EA020uc) within the study area are located within close proximity of raised tidal flood defences which present a residual risk should

they breach or be overtopped. Raised flood defences were identified using the EA AIMS dataset. Three breach scenarios were setup to consider the impacts of a defence failure. More details on the breach modelling, including locations and trigger levels, are provided in Appendix D.

4.11 Depth, velocity, and hazard to people

The Level 2 assessment seeks to map the probable depth and velocity of flooding as well as the hazard to people and use this within the detailed site assessments. For this Level 2 assessment, depth, velocity, and hazard information has been made available for the following sources of flood risk:

- Fluvial:
  - Prittle Brook: in the present day, depth, velocity, and hazard information is available, except that hazard outputs are not currently available for the 1% AEP and 0.1% AEP undefended events. For the climate change events, depth, velocity, and hazard information is available for the 1% AEP and 0.1% AEP plus 25% climate change events (Central 2080s) allowance.
  - Eastwood and Noblesgreen: in the present day, depth, velocity, and hazard information is available. There is no suitable climate change data available.
  - National mapping: No depth, velocity, and hazard data has currently been made available.
- Tidal:
  - Modelling: Depth, velocity, and hazard information is available for all the present-day and climate change modelled tidal scenarios.
  - National mapping: No depth, velocity, and hazard data has currently been made available.
- Surface water - the EA's Surface Water Spatial Planning Dataset includes depth data for present day and climate change. Velocity and hazard information from the EA's RoFSW has been used to assess present day risk but is not available to assess future risk.

Hazard to people has been calculated using the below formula as suggested in Defra's Supplementary note on flood hazard ratings and thresholds for development planning and control purpose (gov.uk). The different hazard categories are shown in Table 4-6. Developers should also test the impact of climate change depths, velocities, and hazard on the site, as part of the site-specific FRA.

Table 4-6: Defra's 'Flood Risks to People' classifications

Description of Flood Hazard Rating	Flood Hazard Rating	Classification Explanation
Very Low Hazard/ Caution	<0.75	'Flood zone with shallow flowing water or deep standing water'
Danger For Some (i.e. children)	0.75 - 1.25	'Danger: flood zone with deep or fast flowing water'

Description of Flood Hazard Rating	Flood Hazard Rating	Classification Explanation
Danger For Most	1.25 - 2.00	'Danger: flood zone with deep fast flowing water'
Danger For All	>2.00	'Extreme danger: flood zone with deep fast flowing water'

4.12 SuDS suitability

The hydraulic and geological characteristics of each site have been assessed to determine the factors that potentially constrain schemes for surface water management. This assessment is designed to inform the early-stage site planning process and is not intended to replace site-specific detailed drainage assessments. A high-level assessment of suitability of SuDS is included in the detailed site assessments and mapping in Appendix A.

The assessment is based on catchment characteristics using the following data:

- EA 1m LiDAR
- The British Geological Survey website (bgs.ac.uk) geology and soils mapping
- JBA Groundwater Emergence Mapping (see Section 4.8 for further details)
- Historic landfill sites
- Groundwater Source Protection Zones
- Critical Drainage Areas
- OS Watercourse Link layer
- EA Surface Water mapping
- Flood Zones derived as part of this Level 2 SFRA (see Section 4.3 for further details)

This data was then collated to provide an indication of particular groups of SuDS systems which might be suitable at a site. SuDS techniques were categorised into five main groups, as shown in Table 4-7.

Table 4-7: Summary of SuDS categories

SuDS Type	Technique
Source Controls	Green Roof, Rainwater Harvesting, Rain Gardens
Infiltration	Infiltration Trench, Infiltration Basin, Soakaway, Pervious Pavements
Detention	Pond, Wetland, Subsurface Storage, Shallow Wetland, Extended Detention Wetland, Pocket Wetland, Submerged Gravel Wetland, Wetland Channel, Detention Basin
Filtration	Surface Sand Filter, Sub-Surface Sand Filter, Perimeter Sand Filter, Bioretention, Filter Strip, Filter Trench
Conveyance	Dry Swale, Under-drained Swale, Wet Swale

The suitability of each SuDS type for the development sites has been described in the detailed site assessments, where applicable. The assessment of suitability is broadscale and indicative only; more detailed assessments should be carried out during the site planning stage to confirm the feasibility of different types of SuDS.

4.13 Emergency Planning

Flood Warning Areas (FWAs) and Flood Alert Areas (FAAs) are detailed in the EA's GIS datasets and can be used to inform emergency planning. FAAs inform the EA when there is flooding first in the catchment, irrespective of properties, hence this coverage tends to apply to whole watercourses or stretch of coastline. FWAs are derived from the extreme flood outline (0.1% AEP event), focussed on communities, properties, and/or infrastructure. Modelled depth, velocity and hazard data can be used to understand safe access and escape routes for each site.

5 Level 2 Assessment Methodology

This section outlines how sites were screened against flood risk datasets to determine which sites required a Level 2 detailed site assessment. It also identifies other sites, referred to in this SFRA as 'amber sites', at lower risk with general recommendations for developers.

5.1 Site screening

Southend-on-Sea City Council provided 33 sites for assessment. These sites were screened using an 'overlap analysis' tool in GIS. This analysed various flood risk datasets against the site allocations layer and calculated the percentage cover for each flood risk dataset against each site. This was used to provide a summary of risk to each site, including:

- the proportion of the site in each Flood Zone derived from detailed hydraulic model outputs where available, and where detailed modelling was unavailable the information is taken from the EA's FMfP.
- the proportion of the site affected by climate change within the EA Rivers and Sea 3.3% AEP defended and 1% AEP and 0.1% AEP undefended extents plus climate change have been used to represent future Flood Zones using the Central 2080s allowance.
- whether the site is shown to be at risk from surface water flooding in the EA FMfP Surface Water Spatial Planning Dataset for the 3.3%, 1%, and 0.1% AEP events, and the 3.3%, 1%, and 0.1% AEP events with the Upper End climate change allowance (2070s epoch).
- whether the site is within, or partially within, the reservoir 'Dry Day' or 'Wet Day' flood extents.
- whether the site is within, or partially within, the EA Historic Flood Map dataset.
- whether the site is within 10m of watercourses shown within the EA's Statutory Main River layer dataset.
- whether the site is at risk from groundwater emergence using the JBA Groundwater Emergence Map.

The results of the screening provide a quick and efficient way of identifying sites that are likely to require a Level 2 assessment, assisting Southend-on-Sea City Council with Sequential Test decision-making so that flood risk is taken into account when considering allocation options.

5.2 Sites taken forward to a Level 2 assessment

Southend-on-Sea City Council provided 33 sites to be assessed within this Level 2 SFRA. A GIS exercise was undertaken to screen these sites against all sources of flood risk (detailed in Section 5.1). Each site was then looked at individually to assess the nature of the risk on the site.

A Red-Amber-Green (RAG) assessment was then carried out based on the following criteria:

- 'Red sites' have been identified as being at risk from flooding within the EA FMfP or EA detailed fluvial and tidal hydraulic model outputs, tidal breach scenarios, significant surface water risk (based on EA data) or at risk from ordinary watercourses. For these sites an individual detailed site assessment with incorporated mapping has been undertaken, to inform the application of the Exception Test.
- 'Amber sites' have been identified with a reduced risk of flooding, including surface water risk impacting access and escape, and groundwater emergence risk. These have been identified within this report with more general flood risk advice for developing the site. However, please note all the above risks of flooding identified are critical to ensuring no adverse impacts.
- 'Green sites' have been assessed as requiring no further assessment.

Following the initial RAG assessment, Southend-on-Sea City Council reviewed the sites and removed any sites with an existing full planning permission, as these will already have been subject to a more detailed site-specific assessment.

The final Level 2 assessment covers 16 'Red sites', four of which were combined into one new neighbourhood site, and 11 'Amber sites'. The 'Red sites' that have been assessed within the Level 2 SFRA through individual detailed site assessments are detailed in Table 5-1. Section 5.3 sets out what is contained within the detailed site assessments.

Table 5-1: Sites assessed through the Level 2 SFRA.

Site code	Location	Key source of flood risk	FZ3b	FZ3a	FZ2	SW 3.3% AEP (%)	SW 1% AEP (%)	SW 0.1% AEP (%)
CA004	West of Nestuda Way (B1013), Eastwood.	Fluvial and surface water	0	0	3	3	5	8
CA006	Southend Central, Cluster Area 6: Victoria Avenue West	Surface water	0	0	0	16	27	52
CA007	Southend Central, Cluster Area 7: Sutton Road	Surface water	0	0	0	11	19	35
CA012	Southend Central, Cluster Area 12: Kursaal	Tidal, breach, surface water	0	1	100	11	15	24
EA033	Flanking Progress Road, Eastwood	Fluvial, surface water	1	2	13	7	11	22
HEA042	Southend Central, Former Gas Works (Esplanade House)	Tidal, breach, surface water	0	40	60	5	10	25
HEA054; EA037	Southend Central, Marine Plaza	Tidal, breach, surface water	0	11	64	9	11	22
HEA137; EA021	Elm Road, Shoeburyness	Tidal (climate change only), breach, surface water	0	0	0	1	3	6

Site code	Location	Key source of flood risk	FZ3b	FZ3a	FZ2	SW 3.3% AEP (%)	SW 1% AEP (%)	SW 0.1% AEP (%)
HEA178	Leigh South, London Road	Surface water	0	0	0	2	11	32
HEA217	Prittlewell Chase, adjoining Priory House	Fluvial, surface water	2	2	2	2	10	47
HEA265; EA036	Terminal Close	Tidal (climate change only), breach, surface water	0	0	0	3	10	17
HEA271; EA014	Vanguard Way, Shoeburyness,	Tidal (climate change only), breach, surface water	0	0	0	3	7	29
New neighbourhood (CA001uc, CA002uc, CA003uc, and HEA143; EA020uc)	Greenbelt land, north of the A1159/A13/B1017 northeast of Southend	Fluvial, tidal (climate change only), breach, surface water	<1	<1	2	2	3	7

5.3 Detailed site assessments

As part of the Level 2 SFRA, detailed site assessments have been produced for the 16 sites identified in Section 5.2. Four of these were grouped as a new neighbourhood site and were analysed under one detailed site assessment. The detailed site assessments and mapping can be found in Appendix A. Table 5-2 sets out the information contained within each section of the site assessment.

Table 5-2: Summary of the information within each section of the detailed site assessments.

Section	Information
1. Background	• Location of the site • Area, current land use (greenfield/brownfield), proposed site use • Topography of the site • Geology and soil characteristics
2. Sources of flood risk	• Location of the site within the catchment • Existing drainage features • EA's FMfP fluvial and tidal - proportion of the site within the Flood Zones • Fluvial – proportion of site at risk including description from mapping/modelling, utilising depth, hazard, and velocity information from detailed hydraulic models where available • Fluvial climate change - summary of available climate change allowances and increase in flood extent compared to the present day • Tidal - proportion of site at risk including description from mapping/modelling, utilising depth, hazard, and velocity information from detailed hydraulic models where available • Tidal climate change - summary of available climate change allowances and increase in flood extent compared to the present day • Surface Water - proportion of site at risk, including description from FMfP Surface Water Spatial Planning Dataset mapping using available depth, hazard, and velocity information • Surface water climate change - summary of available climate change allowances and increase in flood extent and depth compared to the present day • Groundwater emergence risk • Sewer flood risk - reported incidences within and in the vicinity of the sites, identified by Anglian Water • Flood history - historic incidents on or surrounding the site from the EA Recorded Flood Outline and Historic Flood Map datasets, as well as external flooding incidents provided by Essex County Fire and Rescue Service
4. Flood risk	• Flood risk management infrastructure

Section	Information
management infrastructure	• Description of residual risk
• 5. Emergency planning	• Flood warnings and alerts • Access and escape routes • If the site is located on a dry island
6. Requirements for drainage control and impact mitigation	• Broadscale assessment of possible SuDS to provide indicative surface water drainage advice for each site assessed for the Level 2 SFRA. • Identification of potential SuDS constraints including Groundwater Source Protection Zones, Nitrate Vulnerable Zones and historic landfill sites
7. NPPF and planning implications	• Exception Test requirements • Requirements and guidance for site-specific Flood Risk Assessment • Guidance for site design and making development safe
8. Conclusions	• Summary of key risks to the site • Summary of considerations if development proceeds

5.4 Amber sites assessment

As set out in Section 5.2, 11 sites that are being taken forward by Southend-on-Sea City Council were identified as 'amber sites' based on the surface water risk on or surrounding the site and/or groundwater emergence potential at the site. The following sections provide an overview of the risk at each site and general recommendations. Appendix B and Appendix C provide static mapping for the sites identified to be at surface water risk and groundwater emergence risk respectively.

5.4.1 Surface water risk

Several sites have been identified as having minor surface water flood risk on the site and/or surrounding roads which could impede access and escape. Table 5-3 details the surface water risk at each site and static mapping is provided in Appendix B.

For these sites the developer should undertake a site-specific FRA at the planning stage and carefully consider the surface water flow routes/areas at risk and how these will impact the site itself as well as access and escape routes.

The following considerations should be made for development in areas with a risk from surface water flooding:

- Development should be steered away from existing flow paths and the areas of surface water risk on the site.
- Existing flow paths should be retained and integrated with blue-green infrastructure and public open space.

- The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to pre-development greenfield rates, with areas of surface water ponding used as open space and SuDS or water compatible/essential infrastructure uses only.
- Arrangements for safe access and escape routes will need to be provided for the 1% AEP surface event with an appropriate allowance for climate change, considering depth, velocity, and hazard. Design and access arrangements will need to incorporate measures, so development and occupants are safe.
- For any sites bisected by surface water flow paths, access and escape arrangements should be considered for each area of the site, should access between areas of the site not be possible.
- Provisions for safe access and escape routes should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk.

Table 5-3: Summary of surface water flood risk at 'amber sites'.

Site	Location	Summary of risk
CA005	Southend Central	The EA surface water mapping shows that there are several areas of isolated surface water ponding in all events, particularly in the north of the site. In all events, there is ponding surrounding Southend Victoria Railway Station in the south of the site. The risk extends, with several new areas of ponding in the 0.1% AEP event, including along Great Eastern Avenue and by Beecroft Car Park.
CA009	Southend Central	In the 3.3% and 1% AEP events, the EA surface water mapping shows that there is an area of flood risk centrally in the site, that stretches north, west, and south. This area of risk is associated with the existing building footprint of The Royals Shopping Centre. There is an area of ponding outside of the northeastern site boundary on Church Road in the 3.3% AEP event. The northern and western boundaries of the site are bordered by flood risk along Heygate Avenue and High Street in the 0.1% event. However, risk on surrounding roads does not exceed 0.3m so is unlikely to impede access and escape.
EA019	Southend Central	The EA surface water mapping shows that there is a small area by the western boundary that is at risk in the 3.3% AEP event. There is also an area of ponding that covers most of the southern portion of the site in the 0.1% AEP event. Depths onsite remain below 0.3m and access and escape are not shown to be impeded.

Site	Location	Summary of risk
HEA006	Southend Central	The EA surface water mapping shows that the entire northeast of the site is at risk of surface water ponding in all events. This area of pooling covers a raised car park and is not shown to be representative of the site topography (based on EA 1m LiDAR). Access and escape to the site are unimpeded.
HEA110	Leigh North	There is minimal risk shown to the site according to the EA surface water mapping. There is one small area in the northwest of the site that is within the 0.1% AEP extent. However, access and escape are potentially impeded. A significant flow path covers the majority of Hurt Way in the 3.3% AEP event, and this road represents the only access point into the site.
HEA115	Westcliff	The EA surface water mapping shows there is isolated ponding that covers an area in the centre and north of the site in all events.
HEA117	Prittlewell	The EA surface water mapping shows that there are several flow paths that encroach into the northwest and east of the site, particularly in the 0.1% AEP surface water event. There is also a flow path on Prince Avenue (A127) that crosses into the site by the northeastern boundary. However, depths within and surrounding the site mostly remain below 0.3m and are unlikely to impede access and escape.
HEA259	Prittlewell	There is a large area of ponding that surrounds and is associated with the football stadium building footprint in the west of the site in all modelled AEP events. There is also an area of surface water risk in the southeast, by Roots Hall Avenue. There is surface water risk along Roots Hall Drive to the south of the site however this remains below 0.3m and is unlikely to impede access and escape.
HEA266; EA006	Prittlewell	The EA surface water mapping shows that that there are two areas of ponding in the north of the site in the 3.3% AEP event, by Southend West substation. There is also an area of risk along the northern boundary. In the 1% and 0.1%, most of the northern half of the site is at risk of surface water flooding, from a large flow path that encroaches into the site. There is also some ponding in the south of the site, and there is a flow path travelling along the eastern boundary in the 0.1% AEP event. Depths along the road are not shown to exceed 0.3m and are therefore unlikely to impede access and escape.

Site	Location	Summary of risk
HEA269; EA016	Southend Central	An area in the northwest of the site is at risk of surface water flooding in all events, according to the EA surface water mapping. In the 0.1% AEP event, the area of risk extends to include most of the western half of the site as well as partially in the centre, along the west of Southend Central Station. Depths mostly remain below 0.3m and access and escape are unimpeded.

5.4.2 Groundwater emergence risk

Table 5-4 provides an overview of the site identified to be at high risk of groundwater emergence based on the JBA Groundwater Emergence Mapping. Static mapping showing the emergence risk is provided in Appendix C.

For sites identified as susceptible to groundwater flooding, additional investigation work may be required to support the detailed design of the site and drainage system. This may include groundwater monitoring to demonstrate that a sufficient unsaturated zone has been provided above the highest occurring groundwater level.

The following considerations should be made for development in areas with a higher risk from groundwater flooding:

- A sequential approach should be adopted to the site layout, steering more vulnerable development to the lowest areas of flood risk.
- High groundwater levels could be a potential constraint in the design of the surface water drainage system, and Southend-on-Sea City Council as LLFA should be consulted at an early stage.
- Attenuation features should be designed to prevent groundwater ingress from impacting hydraulic capacity and structural integrity.
- Below ground development such as basements are not appropriate in areas of higher groundwater flood risk.
- Infiltration testing may be required in accordance with BRE365 at the locations of and depths commensurate with proposed infiltration features. This is particularly important in areas where the underlying geology means that the site is more impermeable

Table 5-4: Summary of groundwater emergence risk at ‘amber sites'.

Site	Location	Summary of risk
HEA264; EA047	Fossetts	The JBA Groundwater Emergence Map (5m resolution) shows that groundwater levels are either at or very near (within 0.025m of) the ground surface in the northwest of the site, north of Sutton Road Crematorium by Fossetts Way. There is also a stretch at this groundwater level further south, within the Jones Memorial Recreation Ground. The remaining western area of the site predominantly has groundwater levels between 0.025m and 0.5m below the

Site	Location	Summary of risk
		ground surface. Based on the underlying site topography, any groundwater emerging is likely to flow in a north-westerly direction across and away from the site. Across the south of the site, and part of the east, groundwater levels are between 0.5m and 5m below the ground surface.

6 Flood risk management requirements for developers

The flood risk management requirements for developers are detailed within the Southend-on-Sea Level 1 SFRA (Section 7). Users should refer to this section for guidance on site-specific FRAs and other principles for managing flood risk in new development.

This contains details on:

- early consultation with statutory and non-statutory consultees;
- requirements for site-specific FRAs, including signposting to specific guidance; and
- emergency planning.

The sections below contain further information on emergency planning and the requirements for developer contributions.

6.1 Emergency planning

Safe access and escape routes from the site should be provided. The developer should seek to incorporate an emergency plan and a safe refuge point if the development site has been identified to be at risk of flooding. The local authority and Emergency Services should be consulted when designing an emergency plan.

This Level 2 assessment has identified six proposed sites (CA004, CA012, EA033, HEA042, HEA054; EA037, and HEA217) located within existing EA FWAs and/or FAAs. For proposed development within existing EA FWAs, developers should consult the EA to ensure that adequate flood warning procedures and evacuation processes are in place and that RMAs are not put under any additional burden.

Section 10 of the Level 1 SFRA report discusses NPPF requirements and what an emergency plan will need to consider and other relevant information on emergency planning. Further information is provided on the Southend-on-Sea City Council's emergency planning webpage (southend.gov.uk).

The duration and onset of flooding affecting a site depends on several factors:

- Location of the site within the catchment: flooding is likely to be rapid and flashy in the upper catchment (e.g. small tributaries) and slower responding and longer in duration in the lower catchment.
- Upstream storage: floodplains, reservoirs, and other storage areas upstream of a site may provide some online flood storage that reduces the flood risk downstream and delays the onset of flooding.
- Timing of peak flow: at the confluence of the larger watercourses and smaller tributaries, there may be different timings of peak flows, for example smaller tributaries would peak much earlier than the larger catchments.

- The principal source of flooding: where this is surface water, depending on the intensity and location of the rainfall, flooding could be experienced within 30 minutes of the heavy rainfall event e.g., a thunderstorm. Typically, the duration of flooding for areas at risk of surface water flooding, or from flash flooding from small watercourses, is short (hours rather than days).
- The preceding weather conditions prior to the flooding: wet weather lasting several weeks will lead to saturated ground. Rivers respond much quicker to rainfall in these conditions.
- Whether a site is defended, noting that if the defences were to fail, a site could be affected by very fast flowing and hazardous water within 15 minutes of a breach developing (depending on the size of the breach and the location of the site in relation to the breach), causing danger to life.
- Catchment geology: the permeability of a catchment affects its response time, for example chalk catchments take longer to respond than clay catchments.

6.2 Developer contributions

In some cases, and following the application of the Sequential Test, it may be appropriate 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 should include the following:

- Developers should check the online Flood Map for Planning (gov.uk) in the first instance to identify any major changes to the Flood Zones and the long-term flood risk mapping portal (gov.uk) for any changes to flood risk from surface water or inundation from reservoirs.
- Developer contributions can be made to maintenance and provision of flood risk management assets, flood warning and the reduction of surface water flooding (i.e. SuDS).
- Developers should also confirm that a development will not impact upon the ability of a floodplain to store or convey and seek opportunities to provide floodplain betterment, should the footprint of a development change.
- Where necessary, compensatory flood storage should be provided up to the 1% AEP plus climate change flood level and adjacent to the floodplain so that the flood storage can hydraulically fill and drain.
- Developers must be aware that that information within the Level 1 and Level 2 SFRAs will be a useful starting point for development considerations, however they must request the most recent data and update hydraulic modelling where required. The EA are due to publish a new national risk information for flooding and coastal erosion, this will include future scenarios accounting for climate change. Once this information is available, it should be used as the main source of flood risk information, unless site-specific modelling / information is available.

The council should only use planning obligations to secure contributions where it is satisfied that the contribution will fund works / measures which are:

- Necessary to make the development acceptable in planning terms;
- Directly related to the development; and
- Fairly and reasonably related in scale and kind to the development (Paragraph 57, NPPF).

7 Surface water management and SuDS

The Surface Water Management roles and responsibilities for different organisations and relevant legislation, policy and strategy are detailed within the Southend-on-Sea Level 1 SFRA (Section 9). Users should refer to this section when considering the different sources of flood risk to the site and how this can be mitigated in a sustainable way.

This contains detail on:

- role of the LLFA and LPA in surface water management;
- types of SuDS;
- sources of SuDS guidance; and,
- other surface water considerations including Groundwater Vulnerability Zones (GVZs), Groundwater Source Protection Zones (GSPZs), and Nitrate Vulnerability Zones (NVZs).

8 Recommendations

8.1 Considering the Exception Test for the proposed development sites

When required, to pass the Exception Test it must be shown that the development will provide wider sustainability benefits that outweigh the risk, and that the development will be safe throughout its lifetime without increasing risk elsewhere. The former is a planning-related consideration and the Level 2 SFRA helps to answer the latter part of the Test.

Some of the sites assessed in this Level 2 SFRA are at significant risk of tidal flooding and will require careful consideration and significant mitigation to pass the flood risk element of the Exception Test, including HEA042, CA012, and HEA054; EA037.

The other sites are likely to pass the flood risk element of the Exception Test by:

- Undertaking a sequential approach to site planning so development is steered away from areas within the site at the highest risk.
- Considering safe access/escape routes in the event of a flood (from all parts of the site, if say the site is severed by a flood flow path). If access and escape are affected, a Flood Response Plan may be required.
- Designing buildings with finished floor levels above the estimated flood level (fluvial 1% AEP event or tidal 0.5% AEP event with an allowance for climate change), including an allowance for freeboard.
- Using areas in Flood Zone 2 for the least vulnerable parts of the development in accordance with Table 2 in the PPG. No development should be permitted in Flood Zone 3b (aside from Essential Infrastructure).
- Testing flood mitigation measures if these are to be implemented, to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).
- Considering space for green infrastructure in the areas of highest flood risk.

Although not explicitly required within the PPG, consideration should be given to the surface water risk where this is high, with regards to the Exception Test.

If a site is split in future into smaller land parcels for development, and some of those parcels are in areas of flood risk, the Exception Test may need to be re-applied by the developer at the planning application stage.

8.2 Recommendations from the Level 1 SFRA

Recommendations from this report should be considered in addition to recommendations from the Level 1 SFRA, which still stand for the site allocations and any windfall development that comes forward. These recommendations are set out in Section 13 of the Level 1 SFRA.

8.3 Requirements for developers

The sections below set out requirements for developers to consider both for developing sites assessed within this Level 2 SFRA and for developing windfall sites.

8.3.1 Watercourses

Any sites located where there is a Main River (including culverted reaches of a Main River) will require an easement of 8m either side of the watercourse from the top of the bank. This may introduce constraints regarding what development will be possible and consideration will also need to be given for access and maintenance at locations where there are culverts. Developers will be required to apply for appropriate permits so the activity being carried out over easements does not increase flood risk. Further information relating to this can be viewed on the government website Flood risk activities: environmental permits (gov.uk).

Where no recent detailed hydraulic modelling is present, it is recommended that developers construct new, or update existing, detailed hydraulic models at these sites as part of a site-specific FRA using channel, structure, and topographic survey to confirm flood risk. Site-specific flood modelling will likely need to be developed in locations where it is necessary to understand the effects of proposed development schemes on the existing flood flow paths and flood volume storage, in the present day and in the future.

At the planning application stage, developers may need to undertake more detailed hydrological and hydraulic assessments of unmodelled watercourses and surface water interactions so that the potential effects of proposals can be evaluated at site level and ensure that there is no increase in risk off-site as a result of development. The modelling should evidence flood extents, depths, velocities and hazard (including latest climate change allowances), inform development zoning within the site and prove, if required, whether the Exception Test can be passed.

If an ordinary watercourse is within or immediately adjacent to the site area, consultation with the Southend-on-Sea City Council as the LLFA should be undertaken. If alterations or discharges are proposed to the watercourse, a land drainage consent will be required.

Developers should be aware of the need to identify the route of, and flood risk associated with, any culverts within a site. CCTV condition survey will be required to establish the current condition of the culvert and hydraulic assessments will be necessary to establish culvert capacity of both culverts on site and those immediately offsite that could pose a risk to the site. The risk of flooding should be established using site survey, including the residual risk of culvert blockage.

8.3.2 Flood risk management infrastructure and residual risk

For sites where existing flood defences provide a reduction in the flood risk to the site, it is important to understand the standard of protection these structures and measures provide. It is also necessary to understand how this level of protection changes over time, considering the implications of climate change.

If flood defences are required to protect a development site, evidence will be required to show that the new development does not adversely impact and increase flood risk to other areas, for example that there is no net loss in floodplain storage in circumstances where this is a material consideration. It will need to be established that these defences can be appropriately managed and maintained during the lifetime of the development. In some cases, it will be a requirement to demonstrate that there is an appropriate level of commitment to the maintenance of the standard of protection afforded by existing defences, where reliance is placed on the standard they provide.

8.3.3 Access and escape routes

Access and escape routes should be considered at the site, but also in the vicinity of the site, for example, a site may have low surface water risk, but in the immediate locality, access/escape routes to and from the site could be restricted for vehicles and/or people. For sites assessed within this Level 2 SFRA, an initial overview of potential access and escape options is provided within the detailed site assessments and potential constraints identified.

8.3.4 Surface water flood risk and SuDS

Surface water risk should be considered in terms of the proportion of the site at risk in the 3.3%, 1% and 0.1% AEP events (with an appropriate allowance for climate change), whether the risk is due to isolated minor ponding or deeper pooling of water, or whether the risk is due to a wider overland flow route.

A strategic assessment of SuDS options has been undertaken using regional datasets for sites assessed within this Level 2 SFRA. A detailed site-specific assessment of suitable SuDS techniques should be undertaken at site-specific level to understand which SuDS options are most appropriate. This may need to include infiltration testing to determine the suitability of infiltration methods.

Surface water risk and mitigation should be considered as part of a detailed site-specific FRA and surface water drainage strategy.

8.4 Use of SFRA data and future updates

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

The SFRA should be a 'living document', and as a result should be updated when new information on flood risk, flood warning, or new planning guidance or legislation becomes available. New information may be provided by Southend-on-Sea City Council as LPA and LLFA, the EA, and Anglian Water. Such information may be in the form of:

- New hydraulic modelling results.
- Flood event information following a future flood event.
- Policy or legislation updates.
- Updates to the EA flood mapping.
- New flood defence schemes or flood alleviation schemes.

The EA regularly reviews their flood risk mapping, and it is important that they are approached to determine whether updated information is available prior to commencing a detailed FRA.

It is recommended that the SFRA is reviewed in line with the EA's Flood Zone map updates to ensure latest data is still represented in the SFRA, allowing a cycle of review and a review of any updated data by checking with the above bodies for any new information.

Appendices

A Detailed site assessments and mapping

B Amber sites surface water mapping

C Amber sites groundwater emergence mapping

D Tidal modelling methodology

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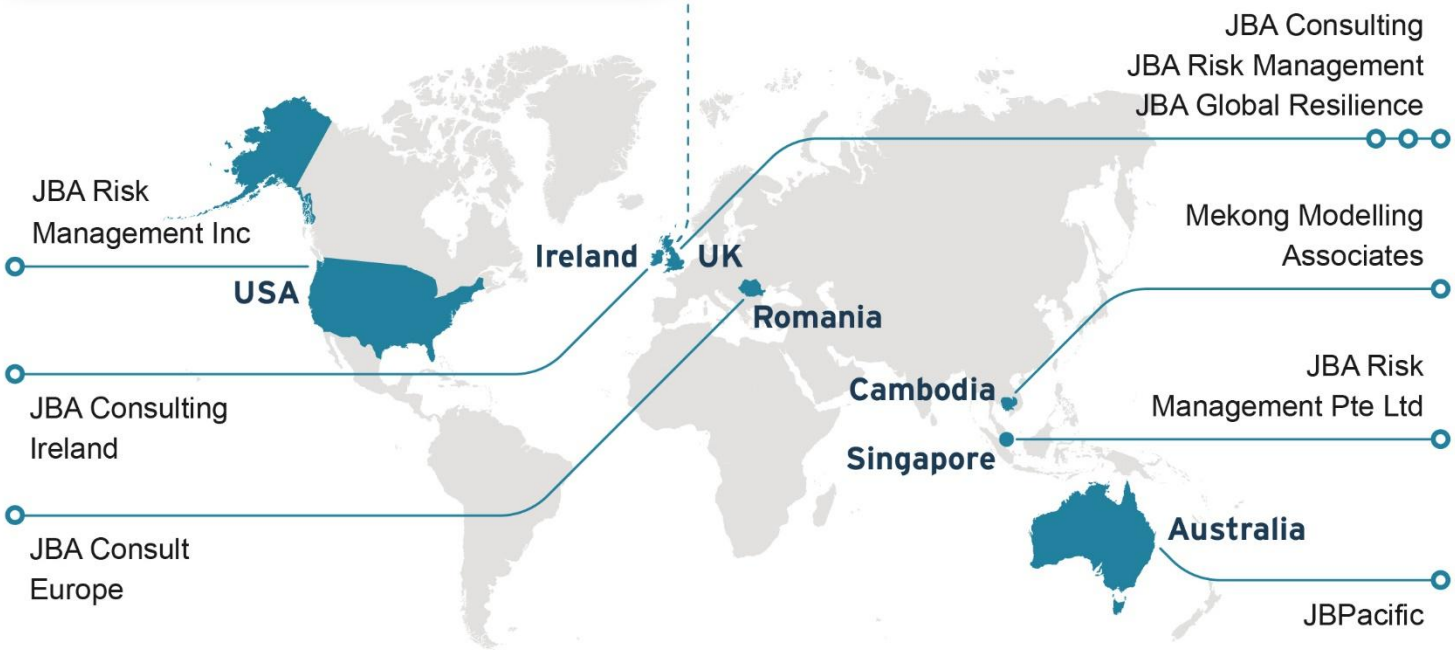

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