Ipswich Borough Council Final Draft Local Plan Review

Covering Paper for the Refresh of the Ipswich Strategic Flood Risk Assessment (September 2020)

30 September 2020

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SFRA Refresh Covering Paper

1. Introduction

1.1 In 2019, the Council commissioned a review and update of the Ipswich Strategic Flood Risk Assessment (SFRA) originally published in 2011. An up to date Ipswich SFRA was needed to inform the sequential approach to choosing sites to allocate for development through the Ipswich Local Plan Review. This refresh also allowed for consideration of the position post the Ipswich Tidal Barrier (which was not in place at the time of the original 2011 SFRA). A draft of the SFRA was submitted as evidence supporting the Final Draft Local Plan in June 2020.

1.2 However, an updated hydraulic model for the Lower Gipping has now been received from the Environment Agency (September 2020) which provides up to date flood risk information, taking account of climate change, to provide an up to date picture for the Ipswich Local Plan Examination.

1.3 In addition, the Council has taken the opportunity for the consultants to update eight site proformas from the Final Draft Ipswich Local plan to make clear the future risk to the proposed sites from the Lower Gipping – sites reference IP003, IP004, IP051, IP119, IP120b, IP279b, IP354 and IP355. The site assessments for a further eleven sites have also been updated to refer to the revised Lower Gipping modelling, and a new site proforma prepared for site IP105.

1.4 The newly updated Ipswich SFRA is attached. Ipswich Borough Council is consulting with Suffolk County Council as Lead Flood Authority and with the Environment Agency on the received report. The final version of the Ipswich SFRA incorporating any amendments as required through this focussed consultation will be submitted to the Inspectors next week (w/c 5 October).

2. Main Features of the Ipswich SFRA Refresh and Next Steps

2.1 The Ipswich SFRA refresh considers actual fluvial risk as well as residual tidal risk (in the light of the Ipswich Tidal Barrier). The identified risks can be mitigated through updating the existing Ipswich Flood Risk Safety Framework which forms part of the Development and Flood Risk Supplementary Planning Document (SPD). The Development and Flood Risk SPD aims to assist developers and their agents in submitting appropriate flood risk assessment and flood risk management information with planning applications to ensure the design of safe development in flood zones.[1]

[1] Ipswich Borough Council adopted a Development and Flood Risk Supplementary Planning Document (SPD) on 18th September 2013. This document was first updated in May 2014 and has subsequently been updated in January 2016 to reflect changes to national and local policy and guidance. It supports Core Strategy Policy DM4 Development and Flood Risk (adopted 2017 Ipswich Local Plan) and Core Strategy Policy DM4 Development and Flood Risk in the emerging Ipswich Local Plan.

2.2 Chapter 7 of the Ipswich SFRA refresh September 2020 suggests ways that this can be done. The detail is to be worked through as an SPD review. This is covered in the Executive Report on the update of the Council's Local Development Scheme which is going to Executive on 6th October 2020.

2.3 In addition, now that the refreshed SFRA has been received (28 September), a meeting has been arranged with the Environment Agency to update the Statement of Common Ground between the agency and Ipswich Borough Council, which will be submitted w/c 5th October 2020.

Strategic Flood Risk Assessment

Ipswich Borough Council

Project number: 60612179

September 2020

Quality information

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Revision History

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1. Executive Summary

Ipswich is located where the fluvial River Gipping becomes the tidal River Orwell. The town has historically been at risk of tidal flooding during tidal surge conditions and this risk has been increasing with rising sea levels attributed to a changing climate. The town was subject to flooding in 1953 when large parts of the east coast of England were inundated during a tidal surge. More recently, high tide conditions threatened the town in 2007 and 2013, both of which were close to spilling over the existing defences.

In response to the risk of tidal flooding affecting Ipswich, a new tidal flood defence barrier was officially opened in February 2019. The barrier, in combination with 1,100 metres of new and refurbished flood walls and a series of flood gates on the banks of the River Orwell, are designed to reduce the risk of flooding to 1,608 homes and 422 businesses as well as key infrastructure. The barrier provides protection to the town for the 1 in 300 year annual probability tidal flood event. The risk of tidal flooding to Ipswich is therefore a ‘residual’ risk i.e. it is only at risk of tidal flooding in the event of a breach in the flood defences or a failure of the operation of the barrier.

The River Gipping and its tributaries have posed a fluvial flood risk to the Borough in the past, with historical fluvial events recorded in 1939 and 1947. According to result of the recently completed hydraulic modelling of the River Gipping[1], the town is protected from flooding by flood defences in the present day for lower annual probability events, such as the 1 in 20 year and 1 in 100 year events during the present day. A small area is at risk of flooding during a 1 in 1000 year event flood in the present day. However, in the future, as a result of the impacts of climate change, the risk of flooding from the River Gipping could increase on the northern side of the watercourse, throughout Ipswich village, assuming no alterations are made to the flood defence levels in this area. Based on this information, there is therefore potential for an ‘actual’ risk of fluvial flooding from the River Gipping in the future.

The town is at risk of flooding from surface water runoff and exceedance of the local drainage network. In some localised areas (along spring lines and in some tributary valleys) this is exacerbated by the underlying ground conditions which are susceptible to groundwater emergence. In locations close to the tidal estuary, surface water may not be able to drain away during high tide conditions. Currently areas considered to be at greatest risk include Swinburne Rd, Norwich Rd, Monton Rise, Bridgewater Rd, Ellenbrook Rd, Bixley Rd, Holywells Rd, Duke Street and Maidenhall.

Ipswich Borough Council, in their role as Local Planning Authority, has the responsibility to ensure that the risk of flooding is understood and managed effectively through all stages of the planning process, in accordance with the Government’s approach for ‘meeting the challenge of climate change, flooding and coastal change’ set out in Section 14 of the National Planning Policy Framework.

Ipswich Borough Council (IBC) is required to undertake a Strategic Flood Risk Assessment (SFRA) to form part of the evidence base for the Local Plan. This SFRA supersedes the former SFRA which was published in May 2011.

Since the production of the last SFRA in May 2011 there have been a number of changes to legislation and guidance relating to planning and flood risk:

- Planning Policy Statements, covering all aspects of national planning policy have since been replaced by the NPPF. The accompanying technical guidance document relating to flood risk, originally derived from the PPS documents has been replaced by the Planning Practice Guidance 2016 (PPG). The Environment Agency have published new SFRA guidance.
- The Flood and Water Management Act gained Royal Ascent in 2010 resulting in Suffolk County Council becoming a Lead Local Flood Authority with duties 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 prepare a Local Flood Risk Management Strategy (LFRMS) for Suffolk.
- Flood Risk Management Plans and Surface Water Management Plans are also available for parts of the area.

The purpose of the SFRA is to collate relevant and up to date information on the risk of flooding to the Borough from all sources including the impact of climate change in the future, and thereby enable IBC to:

[1] Mott MacDonald, on behalf of the Environment Agency, September 2020, River Gipping Modelling Study.

- avoid inappropriate development in areas at risk of flooding;
- steer development towards areas at lowest risk of flooding from all sources, through the application of the Sequential Test;
- apply the Exception Test to differing land use allocations in areas identified as being at risk of flooding;
- where development is necessary, ensure that development is made safe for its lifetime without increasing flood risk elsewhere;
- safeguard land from development that is required, or likely to be required, for current or future flood management;
- use opportunities provided by new development to reduce the causes and impacts of flooding (where appropriate through the use of natural flood management techniques);
- where climate change is expected to increase flood risk so that some existing development may not be sustainable in the long-term, seek opportunities to relocate development, including housing, to more sustainable locations; and
- Inform the Local Plan's Sustainability Appraisal.

1.1 SFRA User Guide

It is anticipated that the SFRA may be used by:

- the Environment Agency
- developers and flood risk consultants,
- emergency planners and the emergency services,
- local resilience forums,
- lead local flood authorities,
- other departments within IBC
- other local planning authorities

This SFRA has been structured as follows:

- Section 2 describes the **approach to flood risk management**, and how this SFRA has been prepared.
- Section 3 describes the **sources of flooding** in Ipswich, and historic records of flooding.
- Section 4 provides an overview of the body of **policy and guidance** relevant to development and flood risk in Ipswich.
- Section 5 assesses the **risk of flooding** from all sources.
- Section 6 assesses the **residual risk of tidal flooding**, as a result of breach of the Ipswich Flood Defence Management Strategy.
- Section 7 sets out the **Safety Framework** for development in Ipswich.
- Section 8 contains **assessment of the site allocations** to inform the Exception Test.
- Section 9 describes **flood risk management** measures in Ipswich.
- Section 10 contains guidance for preparing site-specific **Flood Risk Assessments**.
- Section 11 sets out the **flood risk policy and development management approach** in Ipswich.

Ipswich Borough Council have prepared a separate report, documenting the application of the Sequential Test and Exception Test to their site allocations (AECOM, April 2020).

2. Introduction

2.1 Approach

The National Planning Policy Framework (NPPF)[2] and associated Planning Practice Guidance (PPG) for Flood Risk and Coastal Change[3] emphasise the active role LPAs such as Ipswich BC should take to ensure that flood risk is assessed, avoided, and managed effectively and sustainably throughout all stages of the planning process. Figure 2-1 overleaf, reproduced from the PPG, illustrates how flood risk should be considered in the preparation of the updated Local Plan by Ipswich BC. The overall approach for the consideration of flood risk set out in Section 1 of the PPG can be summarised as follows:

This has implications for LPAs and developers as described below:

2.1.1 Assess flood risk

Local planning authorities undertake a Strategic Flood Risk Assessment to fully understand the flood risk in the area to inform Local Plan preparation.

Section 3 provides a description of the flood sources in Ipswich. Section 4 provides an overview of the policies and guidance in place to manage flood risk. Sections 5 and 6 provide an assessment of the risk from each source.

In areas at risk of flooding or for sites of 1 hectare or more, developers undertake a site-specific flood risk assessment to accompany applications for planning permission (or prior approval for certain types of permitted development).

Section 9 describes what needs to be considered when preparing a site-specific FRA.

2.1.2 Avoid flood risk

In plan-making, Ipswich BC should apply a 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 uses to flood risk. In plan-making this involves applying the ‘Sequential Test’ to Local Plans and, if needed, the ‘Exception Test’ to Local Plans.

In decision-taking, where necessary, local planning authorities also apply the ‘sequential approach’. In decision-taking this involves applying the Sequential Test for specific development proposals and, if needed, the Exception Test for specific development proposals, to steer development to areas with the lowest probability of flooding.

Section 8 provides assessments of the site allocations within Ipswich to determine which sites could be delivered in line with the safety framework and meet the requirements of the Exception Test.

2.1.3 Manage and mitigate flood risk

Where development needs to be in locations where there is a risk of flooding as alternative sites are not available, Ipswich BC and developers must ensure development is appropriately flood resilient and resistant, safe for its users for the development’s lifetime, and will not increase flood risk overall.

In accordance with Environment Agency publication ‘Flood Risk Emergency Plans for New Developments’[4], new development should not increase the burden on Emergency Services or expose them to hazardous flooding when attempting to assist users of new developments.

[2] https://www.gov.uk/government/publications/national-planning-policy-framework--2
[3] https://www.gov.uk/guidance/flood-risk-and-coastal-change
[4] https://adeptnet.org.uk/floodriskemergencyplan

Section 7 provides details on what is considered safe development in Ipswich.

Local planning authorities and developers should seek flood risk management opportunities (e.g. safeguarding land), and to reduce the causes and impacts of flooding (e.g. through the use of sustainable drainage systems in developments).

Section 9 provides an overview of flood risk management measures.

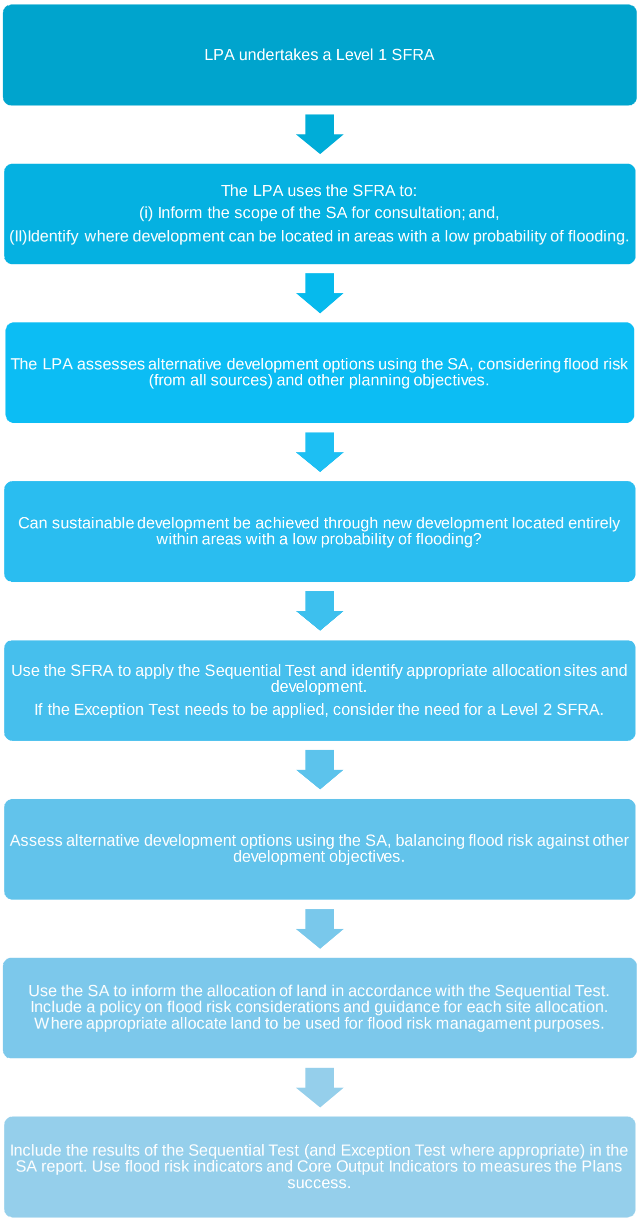


Figure 2-1 Taking flood risk into account in the preparation of a Local Plan[6]

2.2 Stakeholder Consultation

Under the Localism Act 2011[7], 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'. The Flood and Water Management Act 2010 also places duty on drainage authorities to co-operate. 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

[6] PPG Flood Risk and Coastal Change, page 6.
[7] HMSO, 2011, Localism Act 2011. http://www.legislation.gov.uk/ukpga/2011/20/contents/enacted

each matters 'functional geography' and identify those LPAs and Prescribed Bodies that need to be constructively and actively engaged.

The SFRA has been produced in collaboration with Ipswich BC, the Environment Agency, Suffolk County Council (SCC) Flood Team, the Joint Emergency Planning Unit (JEPU) and Suffolk Resilience Forum (SRF), Suffolk Fire and Rescue Service (SFRS) and Anglian Water.

Table 2-1 describes the roles of each organization in flood risk management and producing the SFRA.

Table 2-1 SFRA Stakeholder Organisations and Roles

Stakeholder Organisation	Role in flood risk management and production of the Ipswich BC SFRA
Ipswich Borough Council	As an LPA Ipswich BC 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. Ipswich BC 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, Ipswich BC has provided access to available datasets held by the Council regarding flood risk across Ipswich.
Suffolk Resilience Forum	Local Resilience Forums (LRFs) are multi-agency partnerships made up of representatives from local public services, including the emergency services, local authorities, the NHS, the Environment Agency and others. These agencies are known as Category 1 Responders, as defined by the Civil Contingencies Act. The LRFs aim to plan and prepare for localised incidents and catastrophic emergencies. They work to identify potential risks and produce emergency plans to either prevent or mitigate the impact of any incident on their local communities. The SRF has a Flood Plan[8] and a Strategic Evacuation and Shelter Plan, which incorporates an evacuation plan for Ipswich (it is noted that the evacuation plan is for all risk, not just flooding).
Joint Emergency Planning Unit	The Suffolk Joint Emergency Planning Unit (JEPU) is a shared service owned by all 6 local authorities in Suffolk. The purpose of the unit is to support each Suffolk local authority to discharge its statutory responsibilities relating to planning for emergencies and also to assist their internal business continuity. It also provides the routine local authority input to the Suffolk Resilience Forum. The SFRA will be used by the Joint Emergency Planning Unit to ensure that the findings are incorporated into their understanding of flood risk and the preparation of the SRF Flood Plan.
Environment Agency	The Environment Agency has a strategic overview role for all sources of flooding and coastal erosion (as defined in the Flood and Water Management Act 2010). It is also responsible for flood and coastal erosion risk management activities on main rivers and the coast, regulating reservoir safety, and working in partnership with the Met Office to provide flood forecasts and warnings to the community. 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. The Environment Agency undertakes systematic modelling and mapping of fluvial flood risk associated with all 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.
Suffolk County Council	As the LLFA, Suffolk County Council has a duty under the Flood and Water Management Act (FWMA) to take the lead in the coordination of local flood risk management, specifically defined as flooding from surface water, groundwater and ordinary watercourses. SCC is responsible for preparing a Local Flood Risk Management Strategy (LFRMS) for Suffolk; investigating flooding incidents that it becomes aware of, to the extent that it considers necessary or appropriate; the regulation and enforcement on ordinary watercourses; and SCC is 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. Suffolk County Council 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, Suffolk County Council is a key stakeholder in the preparation of the SFRA. Suffolk County Council has provided current datasets in relation to the assessment of local sources of flooding (surface water, groundwater and ordinary watercourses). The SFRA should align with the approach set out by the Suffolk Flood Risk Management Partnership in the Suffolk Flood Risk Management Strategy[9]. Suffolk County Council will be involved in the implementation of any policy outcomes with respect to sustainable drainage or ordinary watercourse management.

[8] Suffolk Resilience Forum, Suffolk Flood Plan. Available at: https://www.suffolkresilience.com/multi-agency-plans
[9] https://www.suffolk.gov.uk/roads-and-transport/flooding-and-drainage/guidance-on-development-and-flood-risk/

Anglian Water	Anglian Water 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 Anglian Water play is providing data regarding past sewer flooding for the study area.
British Geological Survey	BGS hold datasets that have informed the SFRA, including superficial and bedrock geology and suitability of infiltration SuDS.

Table 2-2Table 2-2 summarises the responsibilities of different organisations for managing flood risk from different sources in Ipswich. Often the responsibility of flood risk management falls to multiple stakeholders. e.g. surface water flooding – within a highway is the responsibility of the highway authority, however, where the flooding is caused by the surcharging of a combined sewer then the water utility may be involved. This highlights the importance of collaborative working in the approach to flood risk management.

Table 2-2 Responsibilities and duties for managing flood risk in Ipswich

	Environment Agency	Ipswich Borough Council	Suffolk County Council	Anglian Water	Highways England	Riparian Owners[10]
Main Rivers and the Sea	✓					✓
Ordinary Watercourses		✓[11]	✓			✓
Surface water		✓	✓[12]	✓[13]		✓
Groundwater		✓	✓			
Sewer				✓		
Reservoir	✓					✓
Highways drainage			✓		✓	

2.3 Data Collection

A large quantity of information and datasets have been made available by the stakeholder organisations and used to inform the assessment of flood risk in Ipswich. Descriptions of the datasets that have been used, along with details of their appropriate use or limitations, are included in a data register is included in Appendix B.

2.4 Living Document

This SFRA has been developed building heavily upon existing knowledge with respect to flood risk within the Borough. The Environment Agency review and update the Flood Map for Planning (Rivers and Sea)[14] on a quarterly basis and a rolling programme of detailed flood risk mapping is underway.

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

[10] If you own land or property next to a river, stream or ditch you are a riparian owner and have responsibilities to maintain the waterway but also rights to protect your property from flooding. Refer to https://www.gov.uk/guidance/owning-a-watercourse
[11] Under the amended Land Drainage Act 1991 section 14A, local authorities have some limited powers which include maintaining, repairing, operating and improving existing works; construct or repair new works; maintain or restore natural processes, monitor, investigate and survey a location or natural process, alter the water level, and alter or remove works. These works should be undertaken in agreement with Suffolk County Council as the LLFA.
[12] Suffolk County Council is responsible for highway drainage, including puddles and blocked highway gullies.
[13] Anglian Water is responsible for public sewerage and sewage treatment in Ipswich. Most sewers serving at least two properties are now the responsibility of Anglian Water. Most drains under the public highway serving at least one property are also Anglian Water's.
[14] https://flood-map-for-planning.service.gov.uk/

3. Sources of Flooding in Ipswich

3.1 Overview

The Ipswich Borough is in Suffolk County, and is bordered by Mid Suffolk District to the northwest, Babergh District to the west and south west, and the Suffolk Coastal area of East Suffolk Council to the east and south east. Figure 3-1 shows the area administered by IBC, as well as the watercourses and key flood risk management infrastructure in the Borough.

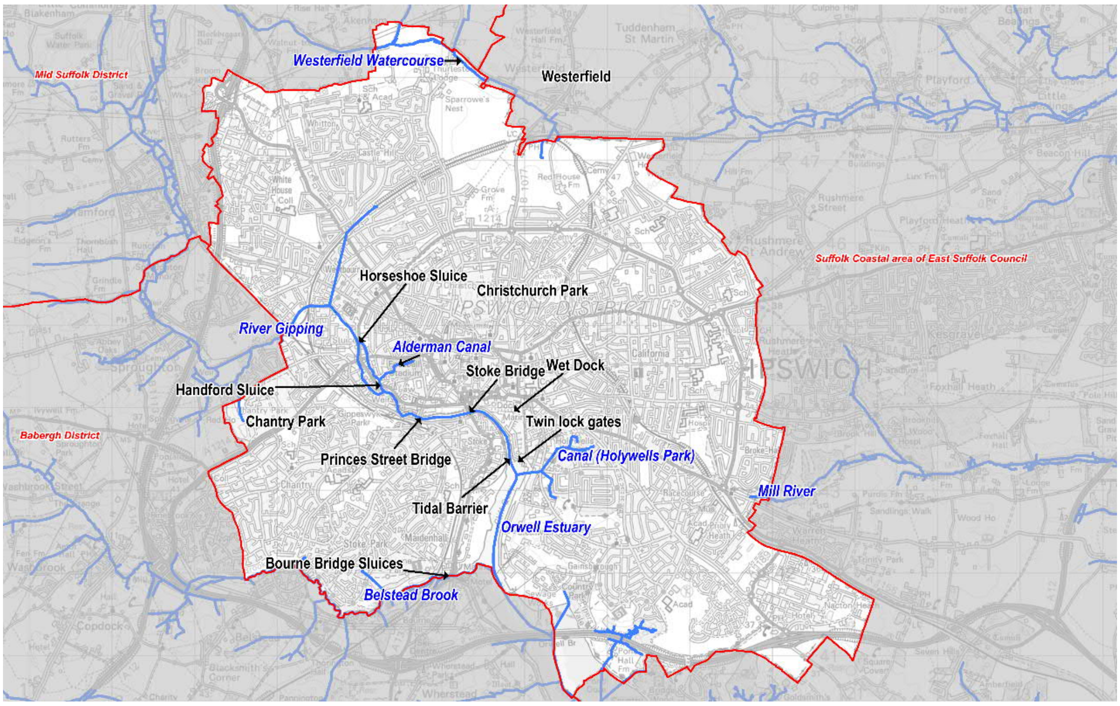


Figure 3-1 Watercourses and flood risk management infrastructure in Ipswich

This Section of the SFRA describes the following sources of flooding in Ipswich and any historic records of flooding:

- River Gipping
- River Orwell Estuary
- Belstead Brook
- Mill River
- Alderman Canal
- Wet Dock
- Westerfield Watercourse
- Other watercourses, springs and land drains
- Holywells Park canal
- Sewerage system
- Highway or railway drains
- SuDS and Soakaways
- Surface water runoff
- Groundwater
- Ponds and reservoirs

Section 4 provides an overview of the existing policy and guidance for managing development and flood risk in Ipswich. An assessment of the risk from each source of flooding is provided in the subsequent Sections 5 & 6.

3.2 River Gipping

3.2.1 Source

The River Gipping is a main river with a catchment that includes the towns and villages of Stowmarket, Needham Market, Bramford and Claydon, located in Mid Suffolk. The River Gipping flows south east from Stowmarket towards Ipswich town where the freshwater River Gipping becomes the tidal River Orwell at the Horseshoe and Handford Sluices (located in Figure 3-1). The Gipping through Ipswich is designated a County Wildlife Site.

3.2.2 Flood defences

Horseshoe Weir and Handford sluice at the normal tidal limits – these are adjustable and control upstream river levels, as well as the Alderman Canal water level if the penstock is open (refer to Section 3.6). In addition, a raised flood embankment on the left bank upstream of Horseshoe Sluice provides protection against fluvial and severe tidal flooding upstream of Yarmouth Road. Floodwalls are also present on both banks immediately upstream of Horseshoe Sluice.

3.2.3 Historic flooding

The most recent severe fluvial events were in 1947 and 1939, the extents of which are shown in Appendix A Figure 2. These were partly caused by flood debris that obstructed the old "Seven Arches Bridge" at London Road. The current replacement bridge is single span and no longer obstructs the flow.

It appears that during these events, floodwater followed the original path of the River Gipping before it was filled in 1882, through the "Ipswich Village" area, and spilled across Bridge Street into the Wet Dock at Albion Wharf. Floodwater was reported to be five feet deep in Princes Street and cars were swept away. Figure 3-2 is an extract from the John Speeds map of 1610 which shows the former course of the River Gipping through 'Ipswich Village'.

Refer to Section 5.2 for an assessment of the risk of flooding from the River Gipping.

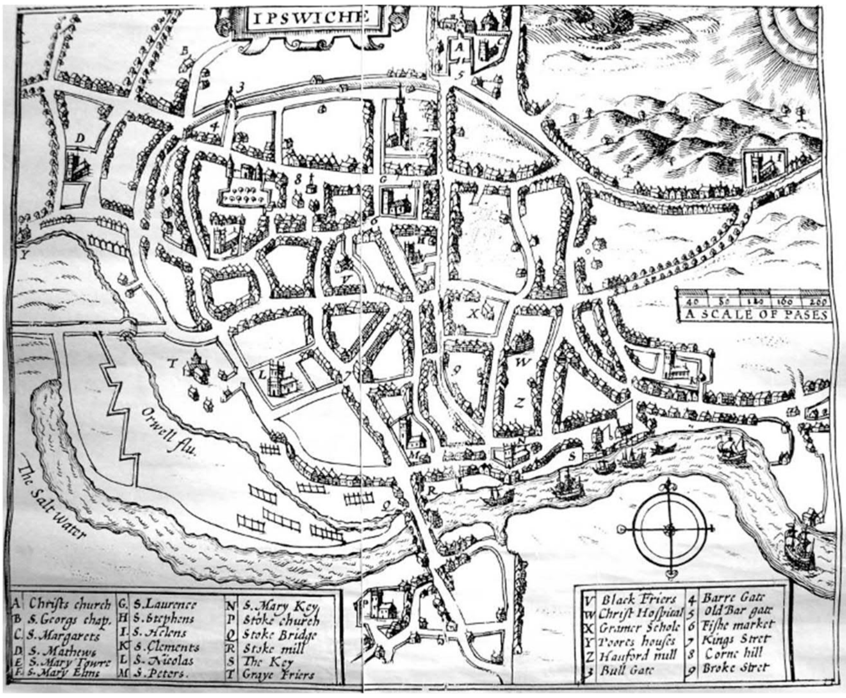


Figure 3-2 John Speed Map of 1610[15]

[15] Source: Historic maps of Ipswich, available at: http://www.ipswich-lettering.co.uk/historicmaps.html

Figure 3-3 1939 Floodwater from River Gipping spilling into wet dock at Albion Wharf

Figure 3-4 1939 Floodwater in Princes Street

3.3 River Orwell

3.3.1 Source

The River Gipping becomes the River Orwell at the Horseshoe Sluice, adjacent to Yarmouth Road. The western channel continues as the River Orwell, and the eastern channel between the Horseshoe Sluice and the Handford Sluice is the most downstream reach of the River Gipping. The two sluices form the tidal limits of the watercourse, and from this point downstream the River Orwell is tidally influenced.

The River Orwell channel is largely defended on either side by raised defences (mainly steel or concrete flood walls). In some sections including the west bank terminal and parts of the east bank, there are no flood defences present. The Ipswich Barrier, which began operation in February 2019 is located on the River Orwell, in line with the southern end of the Marina (Wet Dock). This barrier and its lateral floodwalls now form the primary tidal flood defence for areas of the town to the west of the Wet Dock.

3.3.2 Historic flooding

Tidal flooding (or storm surge) is caused by weather patterns and is worst when combined with a high spring tide. Water levels in the North Sea are raised when atmospheric pressure is low over the North Sea and high over the Atlantic. Previous severe tidal flooding has been accompanied by and exacerbated by hurricane force winds.

Storm surges have caused tidal flooding in East Anglia on many occasions. Major surge tides occurred in 1236, 1287, 1613, 1619, 1762, 1894,1904,1905, 1927/8, and 1938. These would not have caused great damage because at the time the marshes surrounding the town had not been built on.

The most recent serious flood was in 1953, the extent of which in Ipswich is shown in Appendix A Figure 2. 2,500 people died and thousands were made homeless in Northern Europe and the East coast of England. 40 people died at Felixstowe where homes were destroyed. No deaths occurred in Ipswich, but the flood affected residential properties in the Bath Street area (these were subsequently demolished) and power and gas supplies failed.

Flood defences built between 1971 and 1983 saved the town from serious surge tide flooding on 2/3 January 1976, 11/12 January 1978 and 1 February 1983.

More recently on 9th November 2007, a surge tide peaked at 2.2 m above normal. Luckily this coincided with low water and the tide level reached 3.2m AOD. Only minor flooding at The Strand, Wherstead (to the south of Ipswich Borough) occurred. If the peak surge had coincided with high water, the level would have reached about 3.8 m AOD. Advance warnings were provided, and emergency plans were activated along the East coast. The progress of the surge along the coast was closely monitored. At Great Yarmouth the surge peaked at high water and some minor overtopping of defence occurred. It was some 4 hours before it reached Ipswich. A slightly higher tide level (3.48 m AOD) was recorded on 24 November 2007, again this cause no serious problems.

On the 5th/6th December 2013 there was an East Coast tidal surge which was higher than the 2007 and 1983 events. The surge affected areas of the town close to The Waterfront and the tidal river. All of these appear to be linked to tidal water entering surface water drainage systems causing drains to overflow when tide levels in the river exceeded land levels. This occurred at West End Road where the road level drops below 3.5m AOD, Burrell Road – leading to the evacuation of four homes and an emergency road closure and Ancaster Road where a basement carpark flooded. Large flows of water from a manhole lead to the closure of Stoke Bridge and resulted in shallow inundation to the Dance East studios at The Mill on Ipswich Waterfront. The Strand at Wherstead was impassable for a number of days and commercial buildings at Foxes Marina were flooded".

3.3.3 Defences and Barrier

The River Gipping and Orwell flood defences were upgraded in a comprehensive scheme between 1970 and 1983. The river channel was improved, and 15 km of flood defence walls and 5 control structures were constructed including:

- A "guillotine" gate at the Norwich Railway Bridge, which could be dropped to prevent fluvial flows in the Gipping from entering Ipswich (this has subsequently been decommissioned)
- At the normal tidal limit of the Orwell the Horseshoe Weir was replaced by a pair of vertical lifting sluice gates which remain closed in low flow conditions regulating flows towards Handford Sluice. The vertical Handford Sluice gates were replaced by a bottom hinged tilting gate on a fixed weir and maintains an upstream water level of 3.2m AOD in the Gipping and Alderman canal (when its Penstock is open) during normal flow conditions.
- Velocity control structure across the Orwell New Cut at Bath Street (no longer operational following recent construction of the Ipswich Tidal Barrier)
- A flapped tidal sluice and embankment at the outlet of Belstead Brook to Oyster Creek and the Orwell estuary to prevent tidal waters flowing westwards up the valley of the Belstead Brook.
- A floodgate at the Wet Dock lock gates

These improvements were designed to withstand a surge tide of up to 4.20m AOD (similar to the 1953 tide level) combined with a fluvial flow of up to $3m^3$/sec. The channel through Ipswich was designed to take a fluvial flow of 110m3/sec against a tidal level of 2.8m AOD (at least equal to the 1939 and 1947 floods).

Subsequently, the Ipswich Flood Defence Management Strategy has been implemented. The first stages were constructed between 2008 and 2010 – these replaced and raised the level of the defences on the east and west banks of the Orwell downstream of the Wet Dock, and the Wet Dock flood gate was also replaced; all with a crest level of 5.71 m AOD.

In August of 2019 the final elements of the Ipswich Flood Defence Management Strategy were completed. These included a 22m wide rising sector flood gate spanning the New Cut channel, a 9m wide rail gate across the rail line at Griffin Wharf and the connection of the earlier east and west bank works with raised flood walls and manually operated flood gates. These works continue the 5.71m AOD defence level. The Strategy is designed to provide a standard of protection against tidal and fluvial flooding, including combinations of 0.33 % annual exceedance probability (1 in 300 years) allowing for increased sea levels to the year 2109.

Refer to Appendix A Figure 6 for the locations and crest levels of the flood defences.

The Wherstead Road area is protected, mainly by the high ground of the West Bank Terminal and some local raising of the main road. A future scheme may be needed to reduce the risk of overflow from the Wherstead Rd flood compartment B to the Bath Street Compartment C at the point where the road dips under the railway bridge.

Ipswich is included in the Essex and South Suffolk Shoreline Management Plan (SMP). The consultation draft dated 12 February 2010 confirms the policy of "Hold the Line" upstream of the Orwell bridge (West bank) and the Cliff Quay Sewage treatment works (East Bank).

Refer to Section 5.3 for an assessment of the risk of tidal flooding to Ipswich, and Section 6 for an assessment of the residual risk in the event of a breach of the flood defences.

3.4 Belstead Brook

3.4.1 Source

The Belstead Brook is a main river located to the southwest of Ipswich town. It flows southeast from its source near Naughton village to its confluence with the Orwell Estuary at Bourne Bridge. The catchment is mainly a rural undeveloped floodplain and includes Copdock and the extreme southwest of Ipswich. The discharge of fluvial flows to the estuary is regulated by a flapped tidal sluice structure sited within a tidal flood embankment. The flood plain behind the sluice and embankment frequently functions for the purpose of fluvial flood storage at times when the flaps are closed by high tides on the estuary side of the sluice.

3.4.2 Historic flooding

There are three properties known to have been flooded from the Belstead Brook, these are located along the upstream part of the watercourse.

3.4.3 Defences

A flapped tidal sluice and a flood embankment at the downstream end of the Brook prevent tidal waters from back flowing westwards into the valley of the Belstead Brook. Refer to Section 5.4 for an assessment of the risk of flooding from the Belstead Brook.

3.5 Mill River

3.5.1 Source

The Mill River flows east from the east of Ipswich before discharging to the estuary of the River Deben at Kirton Creek. The upstream catchment in the urban area has been replaced with a surface water sewer, which outfalls into the Bixley Heath SSSI wetland area. Upstream of the wetland area large sections of the original valley have been filled, however the original valley remains in two areas – upstream of Bixley Rd and just off Bucklesham Rd. Drainage of these areas is reliant on the surface water sewer.

Water leaves the wetland area just upstream of the entrance to Bixley Heath and flows through several ponds at Purdis Heath. The part of Mill River classified as a main river starts downstream of the ponds and flows through a rural area.

3.5.2 Historic flooding

Ipswich BC hold a number of records of flooding to the south of railway line at the top of the Mill River catchment as well as records on Bucklesham Road, shown on Appendix A Figure 2.

Refer to Section 5.5 for an assessment of the flood risk from the Mill River.

3.6 Alderman Canal

3.6.1 Source

The Alderman Canal, which is an ordinary watercourse and designated Local Nature Reserve, originally fed water mills at Alderman Road and Stoke Bridge with flows from the River Gipping.

The line of the Alderman canal was formerly the route of the River Gipping through Ipswich with a former channel continuing past Little Gipping Street, under Friars Street and discharging to the Orwell near to Cardinals Park (just upstream of Stoke Bridge).

Circa 1880 the channel downstream of Alderman Road was filled in and replaced with part of the “Low Level trunk sewer”. Apart from a 762 mm rectangular penstock, river flows are now prevented from entering the canal by an embankment across the old channel. There is no known formal outlet.

A survey was carried out in February 2010 as follows:

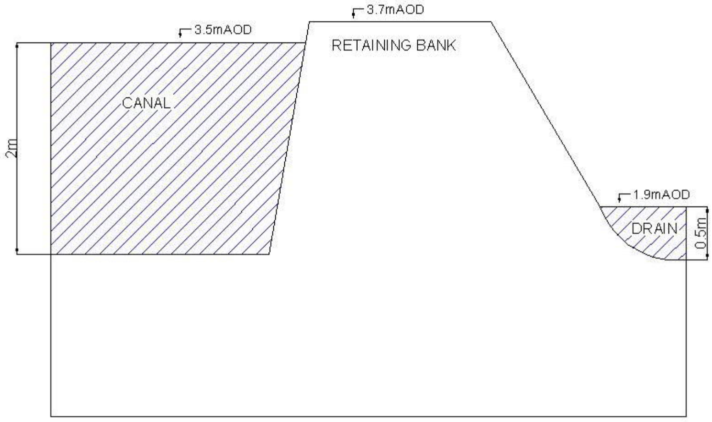


Figure 3-5 Cross section of the Alderman Canal

Water is retained at a high level by another earth embankment crest level 3.7m AOD along the south side of the canal. Any leakage is intercepted by a counter ditch, which drains the low-lying meadows and playing fields back into the Tidal Orwell via a culvert and surface water sewer at Constantine Road. The water level in the canal is normally the same as the River Gipping, however during periods of flood risk the Environment Agency close the penstock to prevent overtopping of the embankment, which has only 200 mm freeboard in normal conditions.

There are a number of trees along the embankment of the canal, which could increase the likelihood of a breach if they were to fall due to high winds.

3.6.2 Historic flooding

No records of flooding associated with the Alderman Canal have been made available to inform the SFRA.

Refer to Section 5.7 for an assessment of the residual risk of flooding from the Alderman Canal in the event of a failure of the embankment.

3.7 Wet Dock

3.7.1 Source

The Wet Dock, completed in 1842, is connected to the River Orwell by twin locks. Water levels are normally maintained at approximately 1.5 m AOD. The Orwell Navigation Service closes a movable floodgate sited between the lock gates, when the tide level reaches 2.6 m AOD.

The Wet Dock Lock gates normally retain water in the Wet Dock; however, each leaf gate includes 2 sluices, each 1.1m X 0.4m located close to the base of the gate. These might be opened to assist drain down should flooding occur when the lock gates are closed. The level of the top of the lock gates is 3.1m AOD. The Wet Dock Flood Gate (within the lock) was replaced and raised as part of the recent flood defence improvement works (along with the Ipswich Flood Barrier, 2019). The gate needs to be closed at a relatively low level (2.5m AOD). The flood gate maintains a flood defence level of 5.71m AOD (significantly higher than the top of the lock gates).

The Dock sewer, owned by the Port Authority and skirting the North and East of the Wet Dock, originally intercepted the polluted water from old culverts and streets thus keeping the enclosed dock clear of pollution. The Dock sewer has two outfalls into the Orwell. The Port authority has resisted the connection of piped drainage systems into the dock and as a consequence the enclosed saltwater in the Dock is of good quality.

However approximately every year or two, surface water flooding (resulting from overloading of piped drainage systems) affects Duke Street, Fore Street, College Street and Key Street - the lowest roads surrounding the Dock. The floodwater overflows into the dock, this helps reduce flood levels and consequences.

3.8 Westerfield Watercourse

3.8.1 Source

The Westerfield Watercourse flows west from Westerfield village towards the River Gipping at Claydon. Areas of undeveloped land including the Council's Millennium Cemetery in the north of Ipswich fall within its catchment.

3.8.2 Historic flooding

Ipswich BC and Suffolk County Council hold records of highway and garden flooding along the Westerfield Watercourse (Appendix A Figure 2), however many of these refer to surface water flooding rather than specifically from the watercourse.

Refer to Section 5.6 for an assessment of the risk of flooding from Westerfield Watercourse.

3.9 Other watercourses, springs, land drains

3.9.1 Source

Underlying geological conditions in the Borough, including the horizon of the Red Crag with London Clay create spring lines giving rise to many other smaller watercourses. As the town has been urbanised some have become fragmented, piped or only flow in exceptional conditions. During heavy rainfall, runoff and overflow from overloaded or blocked drainage systems inevitably makes its way towards the minor watercourses and then the low areas adjacent to the Orwell and Gipping, including the Wet Dock.

As Ipswich developed many of these watercourses were used for water supplies, or culverted where they flowed through streets – towards the Orwell. Examples are Northgate Street, Lower Brook Street, Spring Road and Upper Orwell Street.

Some watercourses were used to create the ponds in Christchurch Park, Holywells Park and Chantry Park. Along the western boundary of Holywells Park, a canal, with water retained by an earth embankment up to 3m high, originally fed the Cliff Brewery. This is now drained via an old Anglian Water storm overflow Sewer to the Orwell. Problems have recently arisen with high water levels or falling trees threatening to breach the embankment, with leaks flooding across parking areas in adjacent premises. The canal embankment presents a residual flood risk to adjacent areas.

Land drainage systems (intended to drain ground water using porous pipes) have been installed in valley bottoms in several areas to help drain gardens. Examples can be found at Tuddenham Avenue, Cavendish Street, Ancaster Road, Gippeswyck Park and Cliff Lane.

Land drains were also incorporated in the main river flood defences – these drain ground on the land ward side and at intervals outfall through the sheet piled walls with flaps intended to prevent reverse flow.

3.10 Sewerage System

3.10.1 Source

In the late 1800s the Low-Level Trunk Sewer was installed, and tributary sewers were added as the town grew rapidly. The original system is still in use and carries foul and surface water runoff from north west and central Ipswich around the Wet Dock and to the Cliff Quay Wastewater Treatment Works. **Appendix A Figure 3** shows the trunk sewer locations.

In the lowest parts of the town, the Low-level sewer is extremely shallow and pumping stations were installed to lift foul/combined flows into the sewer, often with separate surface water systems draining to the estuary by gravity. Flap valves were intended to prevent reverse flow when tide levels exceed ground level. In some areas, such as Bath Street and Wherstead Road, oversized pipes or storage tanks are included to store runoff when rainfall coincides with high tidal conditions.

By 1939 the system had to be reinforced by the addition of the High-Level trunk sewer constructed on a roughly parallel route to the North of the Low-Level Sewer. This permitted development of the Crofts residential area to the NW of Ipswich.

Later flows from villages outside Ipswich at Blakenham, Bramford & Claydon were pumped into the system. Storm-water overflow sewers, from the trunk sewers to the rivers, were added to relieve flooding. Even so both trunk sewers flood during severe weather, especially where they cross the tributary valleys. Flows then route overland along the valleys and watercourses towards the lowest parts of the town.

Many other sewerage improvements and additions were made as the town expanded, the most recent being “Project Orwell” a £33M 2.4m diameter tunnel and a series of pumped tanks which provided further relief and reduced emissions from the overflow sewers to the river/estuary. This was completed in 2000.

Foul and combined flows from North West and central Ipswich are pumped into the Cliff Quay wastewater treatment works.

Much of the East of Ipswich drains via combined sewers to either the “Eastern Area trunk sewer”, built in 1960, or the “South East Area Sewer” built in 1983. As they enter the Cliff Quay treatment works, large storm overflow structures allow surplus flows to spill via screens to the Orwell.

There are now some 40 major outfalls through the flood defence walls into the Orwell or Gipping. Most have flap valves intended to prevent reverse flow and tidal flooding. Some of these are very large: - twin 2.7 m square flap valves at Stoke Bridge and two pairs of 2.4m diameter flaps at Toller Rd.

The Anglian Water system in Ipswich now includes 15 pumping stations, a further 4 pumped tanks, at least 6 attenuation tanks and an open attenuation pond at Ransomes Europark. The sewerage system serving NW and central Ipswich is therefore complex.

Anglian Water (AW) has “Infoworks” computer models to enable them to understand the operation of the sewer network and model possible improvement schemes in detail.

Much of the Chantry area, south of the river, is served by separate foul and surface water sewerage systems. Surface water systems drain to Belstead Brook. Foul sewage is drained by gravity to Chantry wastewater treatment works. AW is currently developing a model for parts of this area.

3.11 Highway or Railway Drains

3.11.1 Source

In a few areas of Ipswich, highway or railway drains discharge to watercourses; in other areas private systems serve large areas. In the Dales Road area, the railway, in cutting, is thought to drain rural runoff from fields East of Henley Road towards Norwich Road.

Highway or railway drains are unlikely to be shown on Anglian Water’s sewer maps. Some have been mapped by Ipswich BC in **Appendix A Figure 4**.

3.12 SuDS and Soakaways

As a result of policy changes during the last few years, SuDS, soakaways or attenuation systems have been increasingly used to reduce adverse impacts on watercourses and the sewerage network. Examples of this are at the Park and Ride and Anglia Parkway sites North of Bury Rd and St Mary’s Convent. Areas of the town served by such systems are recorded by IBC and included in **Appendix A Figure 4**.

In parts of Ipswich, soakaways are used for surface water drainage; these are normally the property owners’ responsibility. However, some 82 soakaways, adopted by the Highway Authority, are known to exist and have been mapped, (see plan in appendices) others probably exist. During the past few years many of the older ones, installed circa 1950-1970, have been found to be totally inadequate and several have been replaced/enlarged.

Ravenswood, a 1,200 home development in south-east Ipswich, uses landscaped infiltration basins and soakaways for surface water drainage - all designed to protect homes from a 1 in 100 year rainfall event. These features do not affect the springs and watercourses in Braziers Wood.

Some recent developments, located in low areas, where attenuation storage has been installed, have suffered from flooding because surcharging of the sewerage system prevents discharge at the designed rates. AW typically specifies an allowable discharge and designers erroneously assume the sewer has capacity, for that discharge rate, without surcharging.

Other recent developments have included low-level basement car parking or buildings below water levels (surcharge levels) that commonly occur in adjacent sewers. Some of these are situated in flood risk zones. Private pumping systems are increasingly being used in an effort to avoid flooding of such low areas.

3.13 Surface water

An overview of surface water flood risk is provided below. IBC have prepared a Surface Water Management Plan (SWMP) which is a plan which outlines the preferred surface water management strategy for Ipswich. When considering surface water flood risk in Ipswich, reference should be made to the Ipswich Surface Water Management Plan available on the Suffolk County Council website. Reference should also be made to Suffolk County Council guidance documents, who as Lead Local Flood Authority are a statutory consultee for surface water drainage proposals for major developments in Ipswich.

3.13.1 Source

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, either because they are at capacity or are unable to outfall due to high tidal conditions. Surface water can run quickly off land and result in localised flooding.

This currently occurs much more frequently than tidal or fluvial flooding in Ipswich, generally with relatively low consequences. However, repeated flooding can cause much distress and expense, especially where floodwater (often with sewage) enters or comes close to entering homes

3.13.2 Historic flooding

Ipswich is unusual in having about 30 years of detailed records of local flooding resulting from heavy rainfall, not attributed to overtopping of river or tidal defences. Such flooding results from surface runoff, overloading of soakaways, SuDS, piped systems, ordinary watercourses (ditches, streams or valley bottoms) or ground water.

As the town grew and more surfaces were paved, the rate and volume of runoff has increased. Flooding has resulted, often subsequently alleviated by drainage improvements. As a result, the oldest records are unlikely to be of much significance. However, stubborn problems remain as shown on a map included in **Appendix A Figure 2**.

Currently the most serious problems are at: Swinburne Rd, Norwich Rd, Monton Rise, Bridgewater Rd, Ellenbrook Rd, Bixley Rd, Holywells Rd, Duke Street, Maidenhall and Cobham Road. Historic flood incidents at Lovetofts Drive, Daimler Close, Coltsfoot Road and Hadleigh Road have led to the implementation of flood mitigation measures by Anglian Water.

IBC have many photos of such flooding, for example, Figure 3-6 shows Holywells Road which is reported to flood several times each year. Figure 3-7 shows flooding on Duke Street; the water level is just below the floor level of the commercial properties, and water is overflowing into Wet Dock which restricts flood depths.

Figure 3-6 Holywells Road

Figure 3-7 Duke Street

Major newsworthy flooding events occurred on 22 occasions between 1976 and 2007.

Approximately every year or two, surface water flooding (resulting from overloading of piped drainage systems) affects Duke Street, Fore Street, College Street and Key Street - the lowest roads surrounding the Dock. The floodwater overflows into the dock, this helps reduce flood levels and consequences.

Refer to Sections 5.8 and 5.9 for an assessment of the risk of flooding from small watercourses, drains and surface water runoff.

3.14 Groundwater

3.14.1 Source

As described in Section 3.9, due to the geology in the area, parts of Ipswich are at risk of groundwater flooding. These are mostly at the interface between the crag and the clay geology types which area also associated with the presence of springs and the start of minor watercourses.

3.14.2 Historic

Groundwater flooding has affected gardens in many areas including: Tuddenham Avenue, Spring Road, Springfield Close, Cavendish Street / Back Hamlet Allotments, Birkfield Drive, Heatherhayes, Pembroke Close, Lavender Hill, Coltsfoot Road, Lavenham Road, Worsely Close, Manchester Rd and Ritabrook Rd. Basement and subway flooding has also occurred. Locations of groundwater flooding have been mapped by Ipswich BC and are shown in Appendix A Figure 5.

Refer to Section 5.10 for an assessment of groundwater flooding.

3.15 Reservoirs

3.15.1 Source

There are several small ponds located within the Borough of Ipswich and neighbouring Babergh, however there are no large reservoirs within the study area.

Refer to Section 5.11 for an assessment of the risk of flooding from the ponds within Babergh.

3.16 Summary

This Section has provided an overview of the sources of flooding in Ipswich. Section 4 identifies the existing policy and guidance for managing development and flood risk in Ipswich. An assessment of the risk from each source of flooding is provided in the subsequent Sections 5-6.

4. Policy and Local Context

4.1 Overview

There is an established body of policy and guidance which are of particular importance when considering development and flood risk in Ipswich. These are identified in Table 4-1 along with links for where these documents can be found for further detail.

Table 4-1 Flood Risk Policy and Guidance Documents

National Legislative and Policy Documents Policy Documents		
Flood and Water Management Act (2010)	Provides for a more comprehensive management of flood risk, designating roles and responsibilities for different Risk Management Authorities. Designates Suffolk County Council as the Lead Local Flood Authority, with duties and responsibilities for managing local flood risk (defined as flooding from surface water, groundwater and ordinary watercourses).	https://www.legislation.gov.uk/ukpga/2010/29/contents
Flood Risk Regulations (2009)	The Flood Risk Regulations transpose the EU Floods Directive into law in England. It aims to provide a consistent approach to flood risk across Europe.	http://www.legislation.gov.uk/uksi/2009/3042/contents/made
Revised National Planning Policy Framework	The NPPF was first published by the UK's DCLG in March 2012 and most recently updated in February 2019, consolidating over two dozen previously issued documents called Planning Policy Statements (PPS) and Planning Policy Guidance Notes (PPG) for use in England.	https://www.gov.uk/government/publications/national-planning-policy-framework--2
National Flood and Coastal Erosion Risk Management Strategy for England (2020)	The National FCERM Strategy sets out the long-term objectives for managing flood and coastal erosion risks and the measures proposed to achieve them. It provides a framework for the work of all flood and coastal erosion risk management authorities.	https://www.gov.uk/government/publications/national-flood-and-coastal-erosion-risk-management-strategy-for-england--2
The Environmental Permitting (England and Wales) Regulations (2016)	In order to complete works on or near a main river, on or near a flood defence structure, in a floodplain or on or near a sea defence. Guidance on obtaining an environmental permit is available from the Environment Agency.	https://www.gov.uk/guidance/flood-risk-activities-environmental-permits http://www.legislation.gov.uk/uksi/2016/1154/contents/made
Draft National Flood and Coastal Erosion Risk Management Strategy 2019	In accordance with Section 7 of the Flood and Water Management Act 2010, the Environment Agency has a statutory duty to develop, maintain, apply and monitor a national flood and coastal erosion risk management strategy. The last strategy was published in 2011, this draft update, 201, 9 is now under consultation with the aim of publishing the final strategy in 2020.	https://www.gov.uk/government/consultations/draft-national-flood-and-coastal-erosion-risk-management-strategy-for-england

Regional Flood Risk Policy		
North Essex and East Suffolk Catchment Flood Management Plans	Role of the CFMP is to establish flood risk management policies which will deliver sustainable flood risk management for the long term (an Environment Agency Document).	https://www.gov.uk/government/collections/catchment-flood-management-plans
Anglian Water River Basin Management Plan (2016)	A framework for protecting and enhancing the benefits provided by the water environment and provide guidance in decision making on land-use planning.	https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/718327/Anglian_RBD_Part_1_river_basin_management_plan.pdf
River Basin Flood Risk Management Plans (FRMPs)	The Anglian FRMP sets out how risk management authorities will manage flood and coastal erosion risk over the next 6 years.	https://www.gov.uk/government/publications/anglian-river-basin-district-flood-risk-management-plan
South Suffolk and Essex Shoreline Management Plan (2010)	The SMP is divided into three summary documents. The one of relevance in this instance covers the Stour, Orwell and Tendring frontage. The aim of the SMP is to justify policies' and identify their implications	http://eacg.org.uk/smp8.asp
Guidance Documents		
Planning Practice Guidance – Flood Risk and Coastal Change	Describes the planning approach to development within areas at risk of flooding from all sources	http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/
Environment Agency Standing Advice	Guidance on information to be included within robust site-specific Flood Risk Assessments (FRAs)	https://www.gov.uk/guidance/flood-risk-assessment-standing-advice
Flood Risk Assessments: Climate Change Allowances (2016) – Last revised July 2020	Environment Agency guidance which sets out when and how local planning authorities, developers and their agents should use climate change allowances in flood risk assessments. It provides the climate change factors for river flood flows, extreme rainfall, storm surge and wave climate for each river basin district. The guidance provides climate change allowance to consider in flood risk assessments in order to demonstrate how flood risks will managed over the design life of the development.	https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances
Improving the Flood Performance of New Buildings: Flood Resilient Construction (DCLG 2007)	Guidance to developers and designers on how to improve the resilience of new properties in low or residual flood areas.	https://www.gov.uk/government/publications/flood-resilient-construction-of-new-buildings
Flood Risks to People: Phase 2 – FD2321/TR2 (DEFRA/EA 2006)	Guidance on a methodology for assessing and mapping the risk of serious harm caused by flooding.	http://www.google.co.uk/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&cad=rja&uact=8&ved=2ahUKEwip3r2g0ufmAhUIWsAKHcUGCtYQFjABegQIAxAC&url=http%3A%2F

		%2Frandd.defra.gov.uk%2FDocument.aspx%3FDocument%3DFD2321_3438_PR.pdf&usg=AOvVaw1D-isSRD4loi-PdtAtrJK1
BS 8533 Assessing and Managing Flood Risk in Development – Code of Practice (BSI 2017)	The standard gives recommendations and guidance on the appropriate assessment and management of flood risk in developments.	https://shop.bsigroup.com/ProductDetail?pid=000000000030350005
ADEPT/EA Flood Risk Emergency Plans for New Development (2019)	A guide for planners: How to consider emergency plans for flooding as part of the planning process. Created by the Association of Directors of Environment, Economy, Planning and Transport (ADEPT)	https://www.adeptnet.org.uk/system/files/documents/ADEPT%20%26%20EA%20Flood%20risk%20emergency%20plans%20for%20new%20development%20September%202019....pdf
Local Documents and Strategies		
IBC Local Plan: Core Strategy and Policies Development Plan Document (DPD) and Site Allocations and Policies (incorporating IP-One Area Action Plan) Development Plan Document (DPD) (2017)	The Core Strategy and Policies DPD sets out the vision, objectives and spatial planning strategy for the Borough until 2031 and contains policies to facilitate sustainable development including policy and guidance on flood risk. The Site Allocations and Policies DPD allocates sites for development and identifies sites or areas for protection across the whole Borough up to 2031.	https://www.ipswich.gov.uk/content/adopted-ipswich-local-plan-2011-2031
IBC Surface Water Management Plan (2012)	The SWMP assessed the mechanisms of surface water flooding in detail within 4 of the 30 drainage areas and provided recommendations for managing flooding. One of the outcomes of the SWMP was the Lovetofts Flood Alleviation Project.	http://www.greensuffolk.org/assets/Greenest-County/Water--Coast/Surface-Water-Management-Plans/Ipswich-Flood-Risk-Management-Strategy-v12.pdf
Ipswich Development and Flood Risk Supplementary Planning Document (2014, updated 2016)	Provides detailed guidance on how policies or proposals in development plan documents will be implemented.	https://www.ipswich.gov.uk/sites/default/files/development_and_flood_risk_spd.pdf
Suffolk Local Flood Risk Management Strategy (2012)	Provides guidance to local bodies responsible for managing surface water flood risk in the County. Appendices include SuDS guidance for developers and a Protocol which includes responsibilities, policies and advice for planners regarding space for SuDS guidance on local authorities responsible for managing flood risk in the County.	https://www.ipswich.gov.uk/sites/www.ipswich.gov.uk/files/Suffolk_LFRMS_April_2012.pdf
Ipswich Emergency Plan	Ipswich BC has, for many years, had a Flood Response Plan, which forms part of the Council's Major Emergency Response Plan. These plans are closely aligned with the strategic Suffolk Flood Plan produced by the Suffolk Resilience Forum and the Town Centre and Waterfront Evacuation Plan.	Emergency plans are viewable on the Suffolk Resilience Forum's website – http://www.suffolkresilience.com / Or Ipswich BC's website.

Sewers for Adoption Version 7 (8th edition is published but has "pre-implementation status currently)	A guide for use by developers when planning, designing and constructing foul and surface water drainage systems intended for adoption under an agreement made in accordance with Section 104 of the Water Industry Act 1991.	https://www.water.org.uk/wp-content/uploads/2018/10/SfA-8-Master-2.pdf
Sustainable Drainage Systems (SuDS) Adoption Manual – Anglian Water Services	A design guide created by Anglian Water to outline their expectations from Sustainable Drainage Systems which are to be adopted.	https://www.anglianwater.co.uk/siteassets/developers/aw_suds_manual_aw_fp_web.pdf
Non-statutory National Standards for Sustainable Drainage Systems (DEFRA 2011)	Document to outline the national standards for SuDS.	https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/82421/suds-consult-annexa-national-standards-111221.pdf
Non-Statutory Technical Standards for Sustainable Drainage: Practice Guidance (Local Authority SuDS Officer Organisation 2016)	The document aims to support the technical standards for SuDS	https://www.susdrain.org/files/resources/other-guidance/lasoo_non_statutory_suds_technical_standards_guidance_2016_.pdf

5. Assessment of Flood Risk

5.1 Approach

Flood risk is a product of the 'probability' that a flood will occur AND the 'consequences' of that event. Consequences may include death, injury, damage to property or businesses.

5.1.1 Probability of flooding

Probability, frequency or return period are ways of describing how often flooding will occur. Throughout this report probability is expressed as the annual exceedance probability (AEP) i.e. the probability of the event occurring in any year, expressed as a percentage. For example, a large flood which may be calculated to have a 1% chance to occur in any one year, is described as 1% AEP.

5.1.2 Climate Change

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

The predicted impacts of climate change on flood risks must be considered over the anticipated lifetime of planned developments. For residential development, this is typically a minimum of 100 years, unless there is specific justification for considering a shorter period. For example, the time in which flood risk or coastal change is anticipated to impact on it, where a development is controlled by a time-limited planning condition. The lifetime of a non-residential development depends on the specific development. Planners should use their experience within their locality to assess how long they anticipate the development being present for. For strategic planning purposes, when specific development types are unknown, a figure of 75 years is typically used for non-residential development.

5.1.3 Consequences

The consequences of flooding depend on a number of factors, including the depth and speed of floodwater (defined as the flood hazard), vulnerability of people or building uses, emergency planning and public awareness.

The rest of this Section provides an assessment of the risk of flooding for each of the sources of flooding identified in Ipswich. For each source, the probability of flooding is identified and the impact of climate change on the probability of flooding is described. Where available, relevant modelling is referred to, supported by maps in Appendix A.

5.2 River Gipping

5.2.1 Flood Zones

The NPPF assesses the probability of flooding from rivers and the sea by categorising areas into zones of low, medium and high probability, as defined in Table 5-1 and presented on the Flood Map for Planning (Rivers and Sea) available online[16]. These Flood Zones have been presented in **Appendix A Figure 6**.

[16] https://flood-map-for-planning.service.gov.uk/

Table 5-1 Flood Zones (extracted from the PPG 2014)

Flood Zone	Definition
Zone 1 Low Probability	Land having a less than 1 in 1,000 annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map – all land outside Zones 2 and 3)
Zone 2 Medium Probability	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding. (Land shown in light blue on the Flood Map)
Zone 3a High Probability	Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding. (Land shown in dark blue on the Flood Map)
Zone 3b The Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. (Not separately distinguished from Zone 3a on the Flood Map)

5.2.2 Modelling

The Environment Agency engaged Mott McDonald to develop a new fluvial flood model for the River Gipping[17] with updated hydrology and inclusion of up to date climate change guidance. At the time of writing (September 2020), this is going through final completion and sign of by the Environment Agency and outputs have been made available for inclusion within this SFRA.

The modelling shows that during the present day defended scenarios, floodwater remains in bank within the Ipswich study area during the 5% AEP event and 1% AEP event. During the 0.1% AEP (1 in 1000 year) event, there is some flooding on the west bank of the River Gipping on the edge of Sainsbury's off Hadleigh Road.

Appendix A Figure 8A shows the extent of these modelled flood extents.

5.2.3 Functional floodplain

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

The PPG states that the identification of Functional Floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. However, land which would naturally flood with an annual probability AEP of 1 in 20 (5% AEP) or greater in any year or is designed to flood (such as a flood attenuation scheme) in an extreme (0.1% annual probability) flood, should provide a starting point for consideration. The guidance goes on to say that 'areas which would naturally flood with an annual probability of 1 in 20 (5% AEP) or greater but are prevented from doing so by existing infrastructure or solid buildings will not normally be defined as functional floodplain'.

The modelling of the River Gipping shows that water remains in bank during the 5% AEP event due to the presence of flood walls along the edge of the river in Ipswich. There is no additional functional floodplain along the River Gipping than the channel of the watercourse**. Appendix A Figure 6** shows the Flood Zones in Ipswich.

5.2.4 Peak River Flow Climate Change Allowances

Ipswich is in the Anglian River Basin District. Table 5-2 shows the peak river flow allowances which should be used to determine design flood levels. There is no longer a standard 20% allowance added as the climate change allowance, rather, in order to select the correct climate change allowance to apply, consideration of the flood zone, type of development and lifetime of development should be made. Reference must be made to the PPG for full details https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#vulnerability.

For example, for a development located within Flood Zone 3 where residential development (more vulnerable, 100-year lifetime) is planned, the design flood level should be the higher central allowance (1% AEP plus 35%). A sensitivity test then needs to be completed for the upper end allowance (1% AEP plus 65%) to understand the potential impact of the higher potential change in flood levels.

[17] Mott MacDonald, September 2020, River Gipping Modelling Study.

Table 5-2 Peak river flow allowances by river basin district[19]

River basin district	Allowance category (as defined by NPPF)	Total potential change in peak river flow anticipated for the '2020s' (2015 to 2039)	Total potential change in peak river flow anticipated for the '2050s' (2040 to 2069)	Total potential change in peak river flow anticipated for the '2080s' (2070 to 2115)
Anglian	Upper end	25%	35%	65%
	Higher central	15%	20%	35%
	Central	10%	15%	25%

The outputs from the River Gipping modelling study including allowances for climate change are shown in **Appendix A Figure 8A**. This includes:

- 1% AEP event plus central allowance (25%);
- 1% AEP event plus central allowance (35%);
- 1% AEP event plus central allowance (65%);
- 0.1% AEP event plus central allowance (25%).

Maximum flood depth and hazard maps are provided for the 1% AEP event plus central allowance (65%); and 0.1% AEP event plus central allowance (25%) in **Appendix A Figures 8B – 8E**.

In the future, as a result of climate change, and assuming no alterations to the existing flood defences, the modelling results show that the 1% AEP event including 25% and 35% allowances for climate change remain in bank. But consideration of the upper end allowance of 65%, shows that areas along West End Road and Sir Alf Ramsey Way could become at risk of flooding. During the 0.1% AEP event including 25% allowance for climate change, areas throughout Ipswich Village are shown to be at risk of flooding, with water levels of 4.97m AOD in the north along West End Road, and 3.97m AOD throughout Ipswich village (**Appendix A Figure 8D and 8E**).

5.2.5 Cross Boundary Interactions

There are two reservoirs upstream in the Stowmarket area that are designed to reduce the amount of water in the River Gipping. Management of these reservoirs will impact the risk of flooding downstream in this part of Ipswich, however, due to the location of the reservoirs in the upper catchment, the potential to reduce peak flows is relatively small. The Environment Agency has a strategic overview role for all sources of flooding and is also responsible for flood risk management activities on the River Gipping as it is a main river.

5.3 River Orwell

Tidal flooding occurs as a result of sea level or estuary level rise due to astronomical tides and meteorological surges. **Appendix A Figure 1** shows the extent of the Tidal River Orwell in Ipswich Borough. The mapping shows this part of Ipswich to be low lying with the settlements along the floodplain of the of the Tidal River Orwell to be less than 10m AOD. This part of Ipswich will become more susceptible to flooding from high tide levels resulting from sea level rise.

5.3.1 Flood Zones

The NPPF assesses the probability of flooding from rivers and the sea by categorising areas into zones of low, medium and high probability, as defined in Table 5-1 and presented on the Flood Map for Planning (Rivers and Sea) available online. These Flood Zones have been presented in **Appendix A Figure 6** and do not account for the presence or function of any existing flood defence infrastructure.

[19] https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#table-1

5.3.2 Modelling

Modelling of the Orwell Estuary has been undertaken by the Environment Agency as part modelling of the wider area, described in the East Anglian Coastal Modelling Report[20]. The modelling study includes ten existing and eight new 2D hydrodynamic models which were developed to map the flood risk. The Stour and Orwell model covering the estuaries and the coast from Harwich to Felixstowe fall within the list of the eighteen models used in the study.

The models were used to assess the flood risk for a range of design events for present day and climate change modelling scenarios. The water levels were based on the Extreme Still Water Sea Levels (ESWSL)[21] plus an allowance for the interaction of wind and waves, for the 10%, 5%, 3.33%, 1.33%, 1%, 0.5%, 0.2% and 0.1% AEP events. A selection of the flood extents is shown in **Appendix A Figure 7A.**

The modelled water level from the Stour and Orwell model for the 0.5% AEP event for 2018 is 4.12m AOD tide level.

5.3.3 Climate Change

Climate change is leading to increase in sea levels, which then increases the risk of flooding and coastal erosion to coastal areas.

The impact of climate change has been included within the modelled scenarios for the Stour and Orwell for the 5%, 0.5% and 0.1% AEP events. The modelling applied sea level rise estimates using two approaches: the UKCP09 sea-level change guidance[22] using the medium emission 95th percentile scenario; and the NPPF sea level rise guidance[23]. These are both shown in **Appendix A Figure 7B**.

The modelled water level from the Stour and Orwell model for the 0.5% AEP event for 2118 is 5.27m AOD tide level.

5.4 Belstead Brook

5.4.1 Modelling

Modelling of the Belstead Brook has been undertaken in 2015[24] and made available for this SFRA. The modelled reach of the watercourse is approximately 18km and the drainage area is 50km^2 located in the south of the borough. The Belstead Brook was modelled for the following present-day AEP events: 50%, 20%, 10%, 5%, 3.3%, 2%, 1.33%, 1%, 0.5% and 0.1% AEP.

Mapping of the 0.1% AEP, 1% AEP and 5% AEP modelled flood extents are shown in **Appendix A Figure 9A**.

The downstream boundary applied for the Belstead Brook model was taken from the 2010 Stour and Orwell Model at IPS Dock and represents the 20% AEP and 20% AEP plus climate change tidal results respectively. The peak of the water level of the tide is timed to coincide with the peak fluvial flow from upstream.

5.4.2 Climate Change

As part of this SFRA, AECOM have obtained and re-run the model for the Belstead Brook to assess the climate change allowances set out in the PPG and described in Table 5-2. Allowances of 25%, 35% and 65% have been applied to the 1% AEP flood event.

The maximum flood extents are included in **Appendix A Figure 9B**.

[20] JBA Consulting, 2019, East Anglian Coastal Modelling Report.
[21] ESWSL is the level the sea is expected to reach during a storm event for a flood event.
[22] UK Climate Projections. Available at: https://webarchive.nationalarchives.gov.uk/20181204111018/http://ukclimateprojections-ukcp09.metoffice.gov.uk/
[23] https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#table-3
[24] JBA Consulting, 2015, Essex Norfolk and Suffolk Survey and Model Build: Belstead Brook.

5.5 Mill River

5.5.1 Modelling

The Mill River has not been modelled for inclusion on the Flood Map for Planning, due to the catchment area which falls under the 3km^2 threshold for JFLOW modelling. Outputs from JFLOW modelling first appear on the Ipswich Golf Course to the east of the urban fringe.

The Environment Agency Long Term Flood Risk Map[25] shows the risk of flooding from surface water mapping (ROFSW) in this area and the overland flow paths at the upstream end of the Mill River. The areas of high risk to the south of the railway line are supported by the historic records of flooding held by Ipswich BC shown on **Appendix A Figure 10B.**

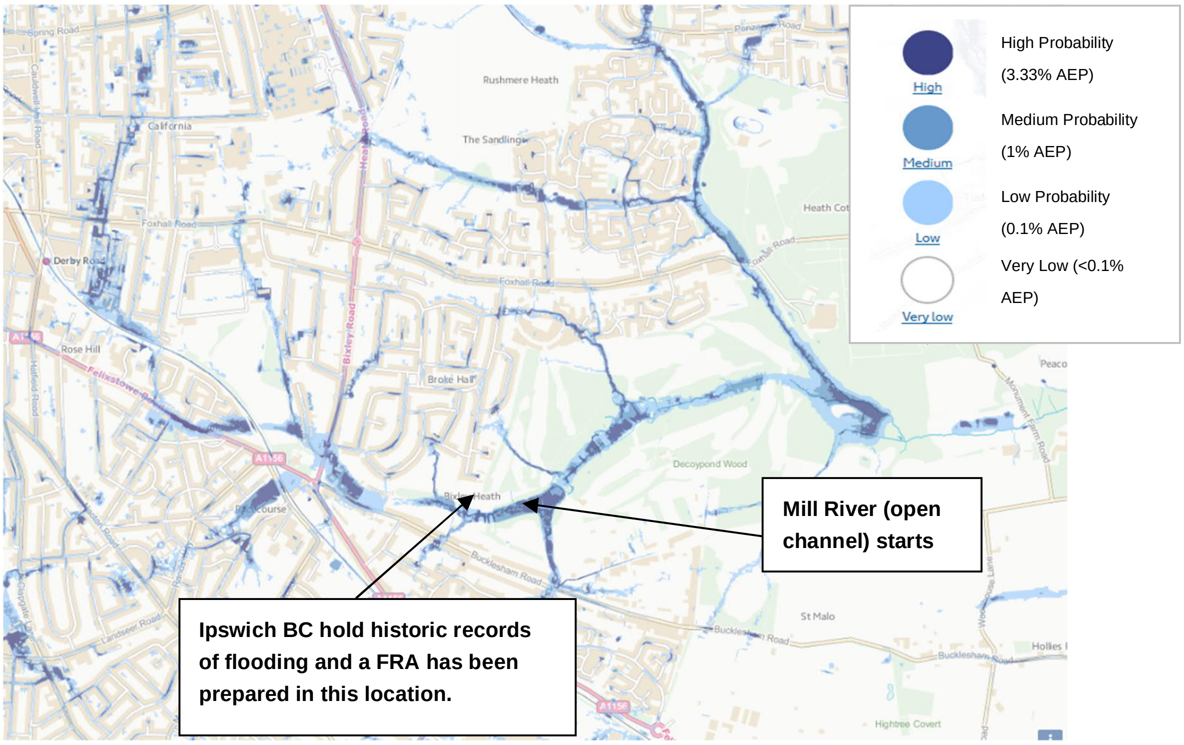


Figure 5-1 Mill River, Risk of Flooding from Surface Water Mapping

The SFRA prepared in 2011 referenced a planning application relating to a site in the original valley bottom off Bucklesham Road which was supported by an FRA undertaken by Anglian Water. At this location normal flows are conveyed through Anglian Water's surface water sewer. The FRA showed that this area floods to a level of 26.25 m AOD in a 1% AEP event. Floor levels for new developments within the site need to be at least 300 mm higher. If this area were filled increased flooding would be expected in adjacent areas.

[25] https://flood-warning-information.service.gov.uk/long-term-flood-risk/

5.6 Westerfield Watercourse

5.6.1 Flood Zones

The Westerfield Watercourse is shown on the Flood Map for Planning. It is assumed due to the catchment size and coarseness of the data available that the modelling for this watercourse is mapped using JFLOW modelling. The floodplain of the watercourse is largely rural, however there are a number of properties and highways located in the floodplain, including the junction between Henley Road and Lower Road and properties at Waterworks Cottage, Thurleston Lane. Flood Zone 3b Functional Floodplain has not been mapped in this location. In the absence of modelled Flood Zone 3b, and for the purposes of planning, Flood Zone 3a should be referred to as an indication of the Flood Zone 3b Functional Floodplain.

5.6.2 Modelling

The SFRA prepared in 2011 referenced that an ISIS model of the watercourse was built by a developer in 2009. No further details about this model have been made available for this version of the SFRA and Environment Agency Flood Zone mapping remains the point of reference to establish flood zone extents to inform planning.

The Environment Agency Long Term Flood Risk Map[26] shows the risk of flooding from surface water mapping (ROFSW) in this area and the overland flow paths at the upstream end of the Westerfield Watercourse.

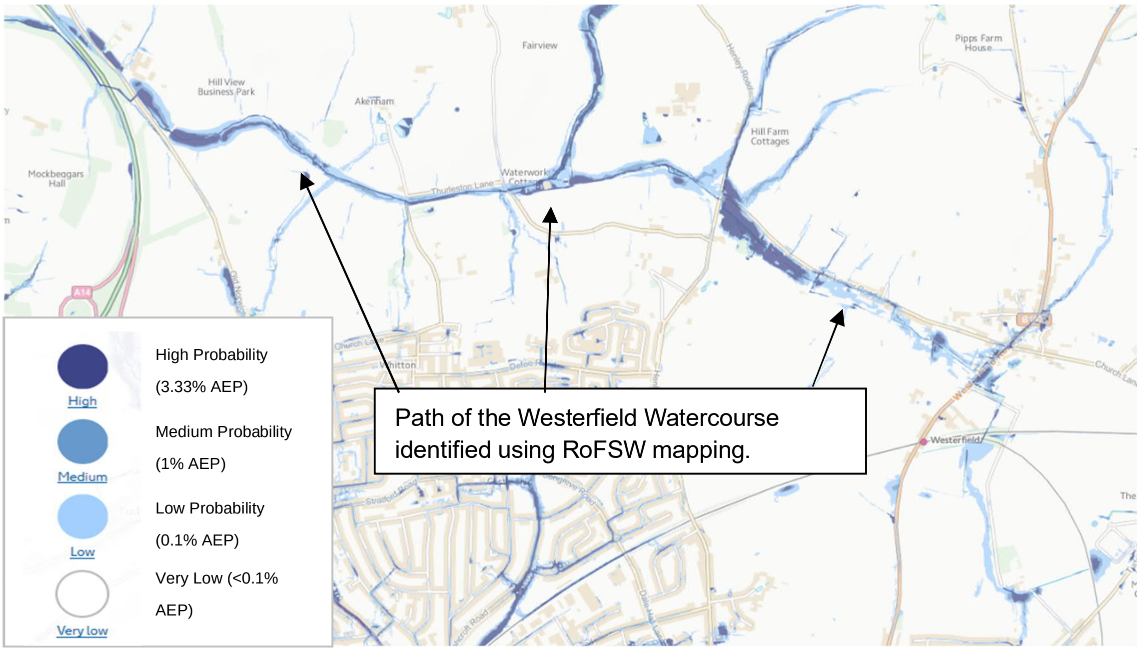


Figure 5-2 Westerfield Watercourse, Risk of Flooding from Surface Water Mapping

5.7 Alderman Canal

The risk of flooding posed by the Alderman Canal is a residual risk, in the event of a failure of the embankment.

A simple assessment of the residual risk as a result of a failure of the embankment has been carried out assuming the whole contents of the canal spill into counter drain and flood the recreation area.

A cross section of the Alderman Canal is shown in Section 3 Figure 3-5. The volume of water in the canal is approximately 8,500 cubic metres. This would flood across the recreation area as shown in Figure 3-5, flooding this area to a level of approximately 2.7 m AOD.

The alderman canal east is a 1.6ha Local Nature Reserve owned by IBC and managed by the Greenways Project.

[26] https://flood-warning-information.service.gov.uk/long-term-flood-risk/

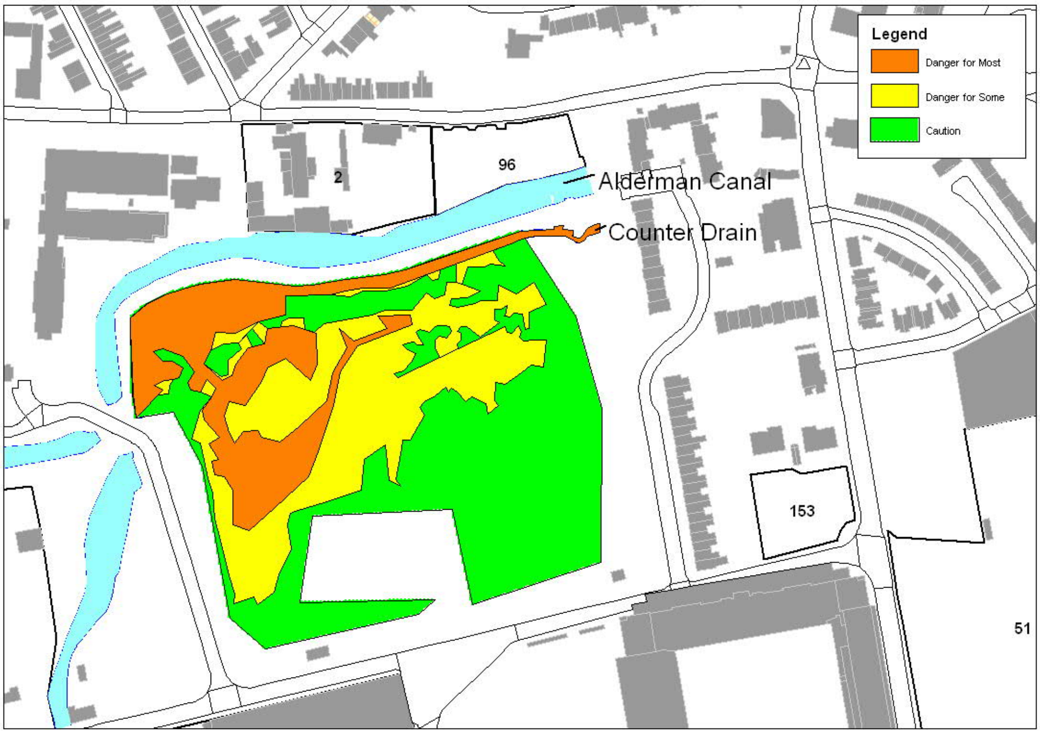


Figure 5-3 Food risk from Alderman Canal due to embankment failure

Suggested management measures include:

- Ensuring the embankment is not damaged by trees blown over by strong winds - when roots are liable to be lifted with embankment material.
- Ensuring the coloured area is not developed for any vulnerable land uses and that no approvals are given for any localised land raising which could impact flood hazard characteristics or flood flowpaths.

5.8 Sewers and local drainage network

5.8.1 Risk of flooding

During heavy rainfall, flooding from the local drainage network may occur if:

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

New sewer systems are typically designed and constructed to accommodate rainfall events with an annual probability of 1 in 30 (3.3% AEP) or greater. Therefore, rainfall events with an annual probability more than 1 in 30 (3.3% AEP) would not be expected to result in surcharging of the sewer system. However, in Ipswich, much of the sewer system is older and may not have been designed to a 1 in 30 year standard. While Anglian Water, as the sewerage undertaker within IBC, recognise the impact that more extreme rainfall events may have, it is not cost beneficial to construct sewers that could accommodate every extreme rainfall event.

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

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

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

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

Water companies are required to maintain a register of properties which are at risk of flooding due to hydraulic overloading of the sewers (the sewer pipe is too small, or at too shallow a gradient). This is called the DG5 risk register. An extract from the DG5 register for Ipswich has been provided by Anglian water and is included in **Appendix A Figure 10**.

Many factors can influence flooding from this source, such as whether manhole covers are stuck, blocking of grilles or gullies etc. The extent of surface water flooding is mapped and included in **Appendix A Figure 11A and 11B**, and historic records of flooding are mapped in **Appendix A Figure 2 and Figure 5**.

Within **Appendix A Figure 5**, flooding is only shown where repeated complaints are received by Suffolk County Council (as LLFA) that do not appear to be due to blocked road gullies. The map shows 88 locations, the extent of flooded areas is based on contours, photographs and reports (not generally LIDAR). 2001 and 2009 annual numbers ranged from 68 to 200 with no apparent trend. No indication of frequency is provided on the map, however since the flooding has occurred and by inspection of the records and newspaper cuttings it is regarded as “likely” - typically occurring with return periods between less than 1 year to 25 years.

During heavy rainfall, manhole covers are blown off, sometimes along with road surfacing, and foul debris is deposited on streets in several areas. The open manholes represent a serious hazard to people. Councillors and MPs are involved, and petitions have been received. Repeated flooding (even if it only comes close to entering buildings) causes a great deal of stress and anxiety and recent changes in property conveyance practices are believed to have led to under reporting of flooding. Some roads become impassable.

Flooding particularly affects buildings lower than adjacent roads, especially basements and subways, these are not shown on the map. Some have been fitted with flood boards, non-return valves or pumps in an effort to alleviate the problem but these techniques are not reliable.

Non-main rivers, streams and ditches along with some roads and valley bottoms where floodwater is known to flow are also shown on the map. There are also smaller un-mapped valleys/roads, which occasionally carry floodwater towards the Orwell or Gipping.

The most frequently flooded areas are the roads around the Wet Dock - Bridge Street, Key Street, College Street and Duke Street. However, the depth of floodwater is currently limited since it can easily overflow overland into the wet dock. Paving levels around the Wet dock should therefore not be raised

Recently constructed developments at the wet dock include a building with shallow undercroft parking that has suffered repeated flooding that damages car-stacking equipment. This flooding is due to surcharging of the sewerage system back through a pumped sump.

Deeper basements will be at risk of rapid, deep and potentially dangerous flooding from sewers or overland flows.

The Low Level sewer is routed through these areas and so the overland “escape route” also benefits low areas upstream.

Such flooding is certain to increase due to climate change and increasing paving of gardens and may decrease where/when/if major sewerage improvements are made. In the future, increasing sea levels will particularly increase flooding from sewerage systems that drain surface water from the lowest parts of the town into the Tidal Orwell. When tide levels are above the soffit of outfall pipes the hydraulic gradient and hence capacity of drainage systems serving the lowest areas is reduced. If the tide exceeds upstream ground levels, then discharge to the Orwell is not possible.

Raising of the proposed tidal barrier at the New Cut at Low tide in advance of expected surface water flooding events predicted by the Environment Agency / Met office flood warning service should help mitigate this effect.

However, the performance of sewers draining into the estuary downstream of the Barrier will reduce unless future improvements such as the addition of storage capacity are implemented.

Saltwater will be able to enter the foul sewerage system via road gullies when tides exceed the defence levels.

Where floodwater fills adjacent flood compartments at different rates, sewage may overflow from manholes and road gullies. This appears most likely in the Alderman Rd, Portman Rd area and parts of Princes Street and Cardinal Park where ground levels are as low as 2.7m AOD before this area suffers tidal inundation. A similar effect is likely in the Riverside Industrial estate at Rapier Street.

The new East bank tidal defences cross over Anglian Water 's 1.5m x 1.5m Low Level trunk sewer, which feeds into the Cliff Quay Treatment works. If the tide level exceeds about 5.7m AOD then saltwater may enter the main lift pumping station at Cliff Quay STW. This would "back up" the Low Level trunk sewer and overflow into the Project Orwell Tunnel, which has a storage capacity of 25,000 cu m.

Simple calculations indicate that the 0.1% tidal event would not fill the tunnel, however tidal floodwater may be able to enter via drains connecting into the Low Level and High Level sewers at Cliff Quay. Once the tunnel is filled it would overflow along Shiplaunch Street into the Wet Dock.

Reference should be made to Section 8 for specific flood risk information on site allocations.

5.8.2 Anglian Water Underground Storage Tanks

Anglian Water maintains underground surface water storage tanks at Alderman Recreation Ground, east of Yarmouth Road, adjacent to Stoke Bridge, Warwick Road, the Albany and the tunnel. There is also a tank to store water at Wherstead Road during tide locked conditions. These tanks were designed to increase storage capacity within the network to reduce the instances of pollution from some of the outfalls.

Anglian Water (AW) has completed sewerage flood relief schemes in Hadleigh Road and Larchcroft Road (2007) as well as Lovetofts Drive and Coltsfoot Road. Such projects are normally triggered by internal flooding, inside buildings, which occurs more often than twice in 10 years.

5.9 Surface water flooding

5.9.1 Topography

Light Detection and Ranging (LiDAR) topographic survey data[27] is presented in **Appendix A Figure 1**. Away from the main valley of the Orwell and Gipping the ground rises steeply to a flattish, predominantly residential, area at about 30-40m AOD. Boulder clay (diamicton) caps the very highest areas to the north of Ipswich (approximately 60-70m AOD). Below this sands and gravels overlay London Clay. Many of the minor watercourses are fed by springs issuing from the base of the sands and gravels. Over time some watercourses have eroded steep sided tributary valleys cutting into the higher areas

5.9.2 Risk of Flooding from Surface Water (RoFSW) mapping

The Environment Agency has undertaken modelling of surface water flood risk at a national scale and produced mapping identifying and classifying those areas at risk of surface water flooding:

- 3.33% annual probability (1 in 30 year), 'high'
- 1% annual probability (1 in 100 year), 'medium'
- 0.1% annual probability (1 in 1,000 year) 'low'

Appendix A Figures 11A and 11B present the Risk of Flooding from Surface Water (ROFSW) mapping for the IBC study area in combination with historical surface water flooding data recorded by IBC and SCC.

The RoFSW mapping for Ipswich 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. In Ravenswood, it is noted that the SuDS basins are shown as areas at risk of flooding on the mapping.

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.

[27] Light Detection and Ranging (LiDAR) is an airborne mapping technique, which uses a laser to measure the distance between the aircraft and the ground. Up to 100,000 measurements per second are made of the ground, allowing highly detailed terrain models to be generated at spatial resolutions of between 25 cm and 2 m. Environment Agency's LiDAR data archive contains digital elevation data derived from surveys carried out since 1998.

5.9.3 Surface Water Management Plan

The Surface Water Management Plan[28] for Ipswich estimated 1,525 properties are at risk of surface water flooding in Ipswich. The SWMP identified 34 sub catchments across the Borough. Each was assessed against a set of criteria to create a list of 10 priority areas to include:

- London Road to Lavenham Road and Hadleigh Road
- Ancaster Road/Burrell Road
- Lovetofts Drive to Lagonda Drive
- Worsley Close/ Ellenbrook Green
- Swinburne Road to Bramford Lane:
- Coltsfoot / London Road / Campion Road
- Portman Road area:
- Maidenhall Approach / Rapier Street / Belstead Avenue / Wherstead Road:
- Chesterton Close / St Catherine's Court:
- Belstead Road / Lanercost Way:

The first four areas were studied in detail and an action plan has been prepared which sets out measures for alleviating flooding in these areas and suggests ways to reduce the effects of urban creep (paving of gardens, small extensions, etc) which should also have Suffolk wide benefits. Following the SWMP, Anglian Water have implemented a flood relief project to alleviate surface water flood risk at Lovetofts Drive.

Extracts from the SWMP are included in **Appendix C**.

5.9.4 Cross Boundary Surface Water Flooding

A review of the local topography (**Appendix A Figure 1**) shows that there will be surface water runoff interactions between Ipswich BC and the neighbouring LPAs of Babergh District, Mid Suffolk and the Suffolk Coastal area of East Suffolk Council.

- Surface water runoff from Babergh District flows into the western edges of Ipswich; the catchments of the Belstead Brook and River Gipping.
- Surface water runoff associated with the catchment of the Westerfield Watercourse flows along the boundary between Ipswich and Mid Suffolk.
- The headwaters of the Mill River catchment are within Ipswich town, these surface water flows and surface water sewer networks drain east into the Mill River which flows east into the Suffolk Coastal area of East Suffolk Council.

5.9.5 Peak Rainfall Intensity Climate Change Allowance

For the purposes of both site level and strategic flood risk assessments, both the central and upper end allowance should be applied to rainfall allowances to understand the potential range of impacts on development that changes in the climate could have.

Table 5-3 Peak rainfall intensity allowances in small and urban catchments (1961-1990 baseline)[29]

Applies across all of England Allowance category	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Upper end	10%	20%	40%
Central	5%	10%	20%

[28] Suffolk Flood Risk Management Partnership, June 2012, Ipswich Surface Water Management Plan, Phase 3 Report
[29] https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#types-of-allowances

The ROFSW mapping does not include a specific scenario to determine the impact of climate change on the risk of surface water flooding. However, a range of three annual probability events have been modelled, 3.3%, 1% and 0.1%, and therefore it is possible to use with caution the 0.1% outline as a substitute dataset for the 1% AEP + climate change, to provide an indication of the implications of climate change.

5.9.6 Residual risk of surface water flooding

It is important to recognise that the risk of flooding from the surface water in Ipswich can never be fully mitigated, and there will always be a residual risk of flooding that will remain after measures have been implemented to protect an area or a particular site from flooding. This residual risk is associated with a number of potential risk factors including (but not limited to):

- a flooding event that exceeds that for which the surface water drainage network has been designed e.g. flooding of the sewer network resulting in overflows (refer to Section 5.8);
- flooding of the surface water network due to lack of maintenance or blocked assets; and / or,
- general uncertainties inherent in the prediction of flooding.

Measures to mitigate this residual risk are included in Section 9.

5.10 Groundwater flooding

5.10.1 Geology

Datasets have been obtained from the British Geological Survey (BGS) website to provide a high-level identification of the bedrock geology and superficial deposits across the Borough. These are displayed in **Appendix A Figure 12A and Figure 12B** respectively.

Bedrock Geology is the consolidated rock underlying the ground surface. Superficial deposits refer to the more geologically recent deposits (typically of Quaternary age) that may be present above the bedrock such as floodplain deposits, beach sands and glacial drift. Underlying geology can influence the presence and nature of groundwater in an area, and therefore potential groundwater flood risk. The geology can also impact on the potential for infiltration-based drainage systems.

The Bedrock Geology mapping show the primary solid deposits are the White Chalk Subgroup, the Lambeth Group, the Neogene to Quaternary Rock and the Thames Group. The soil classification in each group is summarised below:

- The **Lambeth Group** classification is typically composed of Clay, Silt, Sand and Gravel;
- The **Neogene to Quaternary Rock** classification is typically composed of Gravel, Sand, Silt and Clay;
- The **Thames Group** classification is typically composed of Clay, Silt, Sand and Gravel; and,
- The **White Chalk Subgroup** is composed of Chalk.

The mapping in **Appendix A Figure 12** shows the Neogene to Quaternary Rock and the Thames Group to be predominantly found to the north, the east and the south west of the Borough. The White Chalk Group and the Lambeth Group are located beneath the channel of the Main Rivers.

The Superficial Deposits mapping (**Appendix A Figure 12B**) shows Alluvium, Crag Group, Glacial Sand and Gravel, River Terrace Deposits and Till to be present within Ipswich. The Glacial Sand and Gravel and the Till superficial deposits cover the majority of the Borough to the north, west, south and south west of the Borough.

5.10.2 Hydrogeology

The primary source of groundwater flooding in Ipswich is the intersection of London Clay with the overlying Red Crag. It is also useful to consider the presence of aquifers as a potential groundwater flood source.

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.

The White Chalk Subgroup found within the study area is described by the Environment Agency as being 'Secondary A Aquifer'. The Environment Agency describes 'Secondary A Aquifer' as:

- 'permeable layers 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'.

5.10.2.1 Groundwater flood risk

Groundwater poses a significant risk of flooding to some parts of the Borough. The risk is predominantly associated with the White Chalk Subgroup and the Lambeth Group (and other permeable rock) bedrock geology underlying the immediate areas surrounding the main rivers in the study area.

The bedrock and superficial deposits which influence the nature of Groundwater flooding in Ipswich are shown in **Appendix A Figure 12A and Figure 12B**.

Groundwater flooding can be associated with rising water levels within permeable superficial deposits (such as river terrace gravels), typically found in river valleys. This can cause groundwater to emerge in low lying areas (otherwise isolated from the impacts of fluvial flooding) causing groundwater flooding. This type of flooding may occur along the bottom of valleys where main rivers flow, preceding the onset of fluvial flooding, and last longer than fluvial flooding. Groundwater flooding can also exacerbate the effects of fluvial flooding.

Groundwater flooding can also occur as a result of the water table in a bedrock or superficial aquifer rising as a result of extreme rainfall. Chalk aquifers can take several months to become saturated and do not react quickly to intense rainfall, however once the groundwater level has reached the surface, flooding can last several months.

Elevated groundwater levels in the aquifers can often result in groundwater emergence at the surface at topographical low points, such as 'dry valleys'.

5.10.2.2 AStGWF Mapping

The area susceptible to groundwater flooding mapping (**Appendix A Figure 13**) illustrates a strategic scale map showing where groundwater flooding could occur on a 1km square grid. The mapping illustrates the majority of the grids mapped for Ipswich to be classified as having less than 25% susceptibility of groundwater flooding. The mapping also shows the east and the south-east parts of Ipswich not to be susceptible to groundwater flooding.

In particular, the grid between the Horseshoe Sluice at Yarmouth Road (where the River Gipping meets the River Orwell) up to the Civic Drive and Norwich Road roundabout to have the highest susceptibility percentage for groundwater flooding (i.e. 50% to 75%). Figure 13 also show most of the areas along embankment of the main rivers (i.e. the River Gipping and the Tidal River Orwell) to be classed as 25% to 50% susceptibility to groundwater flooding. Refer to the Appendix A Figure 13 for the percentage bands.

Retro fitting of infiltration type drainage for existing development may increase the risk of groundwater flooding and increasing sea levels will increase the risk in lower areas. Some isolated low areas have been identified that close to the Gipping at Yarmouth Road and Gatacre Road and where ground levels are below between 3.8m and 3.4m AOD.

From local knowledge of historic groundwater flooding incidents, the most at risk areas are considered to be those identified in Section 3.14.2.

5.11 Reservoir Flooding

The Environment Agency dataset 'Risk of Flooding from Reservoirs' available on the long term flood risk map[30] identifies areas that could be flooded if reservoirs were to fail and release the water they hold. The mapping shows the pond near to Mustar House and the Freston Brook found within the administrative boundary of Babergh District near to the southern border of Ipswich have the potential to lead to inundation that would drain to the Orwell estuary. However, no properties within Ipswich are shown to be at risk (**Appendix A Figure 14**).

[30] https://flood-warning-information.service.gov.uk/long-term-flood-risk/map

6. Assessment of Residual Tidal Flood Risk

6.1 Residual Risk

Since 1977 defences have protected Ipswich from many surge tides and very few people can remember when flooding last occurred. Since the completion of the new Barrier in 2019 and the associated flood defence improvements along the channels of the River Orwell and River Gipping, Ipswich now benefits from an even greater standard of protection against tidal flooding.

However, there remains a risk that these defences can be overtopped or fail to perform as intended. This remaining risk is referred to as a ‘residual risk’.

The probability of tidal flooding due to overtopping or failure of these defences and gates is relatively low, but the consequences, if flooding were to occur, are very high. The residual risk will be highest where fast moving or deep floodwater could rapidly inundate and damage areas posing a high risk of death / injury.

At present tidal flooding will most likely occur during the winter, coincident with strong winds – probably from a Northerly direction. It should be noted that it is not possible to provide advance warning of a breach.

Before severe flooding occurs, it is likely that advanced warnings would be received, however emergency responders may be attending incidents involving power outages, flying debris, damaged buildings, traffic disruption or even snow fall etc. The Orwell Bridge may be closed with traffic diverted through Ipswich. Effects of the storm would be regional or national.

Increased storminess is likely to increase the frequency or severity of storm surges and wind damage potential.

In general consequences of severe tidal flooding are likely to be:

- Death and injury of public, especially children, the infirm or elderly,
- Death or injury of emergency service staff,
- Destruction and damage to vehicles, buildings, possessions, essential infrastructure –such as power supplies, or fire stations,
- Destruction of vegetation including trees and the ITFC football pitch by saltwater – long lasting or permanent once salt enters the ground.
- Sewage would escape and mix and spread with the floodwater – health hazards.
- Uninsurable buildings and contents
- Reduced Property values
- Long term damage to regeneration plans
- Damage to Economy
- Long term damage to health caused by anxiety and stress

The chance of people being exposed to floodwater depends on whether they are outdoors, on foot or in vehicles. People in multi-storied buildings may stay above flood level. If they are in the open or in single storey buildings, they will be exposed. If they are in basements they will be at greater risk.

The degree to which people are exposed depends on whether flood warnings are received and acted on and whether there are focussed emergency response plans drawn up by developers for the occupants of new developments in accordance with the Local Resilience Forum. Such documents may inform occupants of the advised response to take in a forewarned flood, or in the circumstances of an un-warned breach inundation.

Whilst a flood-warning scheme is available, not everyone will receive it or act on it. Many people passing through flood risk areas in cars may not to receive a warning, (especially those diverted into Ipswich if the Orwell Bridge is closed).

Even those who receive warnings and live in multi storey buildings will not all react in an appropriate way, children or others may be attracted to floods and car owners may attempt to move their cars from basements.

The speed of onset will have a major impact on whether people are exposed to floodwater. Where onset is slow, they will have time to leave the area. If a defence suddenly overtops or collapses people will be at high risk.

Vulnerable people are less able to cope than others in a flood situation and will be more prone to death or injury.

The assessment of tidal risk considers frequency, hazard rating and speed and duration of inundation.

6.2 Modelling

6.2.1 Suitability of breach modelling

As part of the 2011 version of the SFRA, Ipswich BC commissioned the Halcrow Group to slightly modify the Environment Agency ISIS TUFLOW model and use this to simulate overtopping and breaching for existing and future defence scenarios.

As part of this SFRA update, the Environment Agency have undertaken a sensitivity analysis on the previous breach modelling which has confirmed that it is still considered robust and fit for purpose for the breach locations, widths and invert levels specified.

This conclusion has been drawn because the governing tidal levels in the estuary that were used in the 2011 modelling when compared to the subsequent 2018 modelling for the Stour and Orwell are similar for the 0.5% AEP climate change event and are slightly lower for the current day 0.5% AEP tidal event, as shown in the box below.

This means that the tidal volumes entering areas of Ipswich inland of the defences would be similar and flood propagation levels, flood hazard and flood flow characteristics would only change if, since the time of the last SFRA, there has been significant changes in local ground levels with the potential to modify a flow path from the breach location or to reduce flood storage capacity within the flood zone. At the time of writing, there are no known areas where ground levels have been altered significantly.

Comparison of tidal levels

The 2009 modelling (Halcrow) used the following tide levels for the breach assessments:

Breaching of the future defences (post 2015 Barrier construction)

- 0.5% AEP (1 in 200 year) in 2010 – 4.25m AODN tide level.

- 0.5% AEP (1 in 200 year) in 2100 – 5.28m AODN tide level.

The 2018 Stour and Orwell Coastal Model (“with defences” model runs, which include the new flood defences associated with the Barrier) give the following levels:

- 0.5% AEP (1 in 200 year) 2018 - 4.12m AODN tide level.

- 0.5% AEP (1 in 200 year) 2118 - 5.27m AODN tide level.

6.2.2 Breach modelling parameters

As noted above, for the purposes of informing this update to the SFRA, reference has been made to the Halcrow ISIS TUFLOW modelling (2009) included in the 2011 SFRA.

The 2D TUFLOW model developed to simulate the breach of flood defences generally has a 10 m minimum grid size and was built using 2008 LIDAR data supplemented where necessary e.g. under the railway bridge at Wherstead Rd or where ground raising has recently taken place at Bath Street and Ranelagh Road by data produced by Ipswich BC.

Breach and open gate locations were chosen based on the proximity of potential development sites at the time (2009) and where the head of water retained by the sheet piled defences is highest relative to the ground level on the landward side. These were agreed with Environment Agency along with the following assumptions:

- A width of 20 m for the breaches in hard defences.

- Breaches are assumed to develop (i.e. defence collapses to ground level) either when overtopping commences or when the maximum tide/fluvial water level is reached
- Breaches are repaired after 36 hrs.
- Where gates have been represented in the open position they are assumed to be open throughout the simulation.
- Large buildings close to breach locations identified from OS Master Map are included where these are likely to influence flood flows. These are represented as 300mm raised platforms. This represents both the obstruction to fast flows and storage within the buildings.
- Manning's "n" for buildings is set at 0.1.
- The initial water level in the Wet Dock is assumed to be 2.6m AOD.
- The tidal profiles applied in the breach modelling are shown in Figure 6-1.

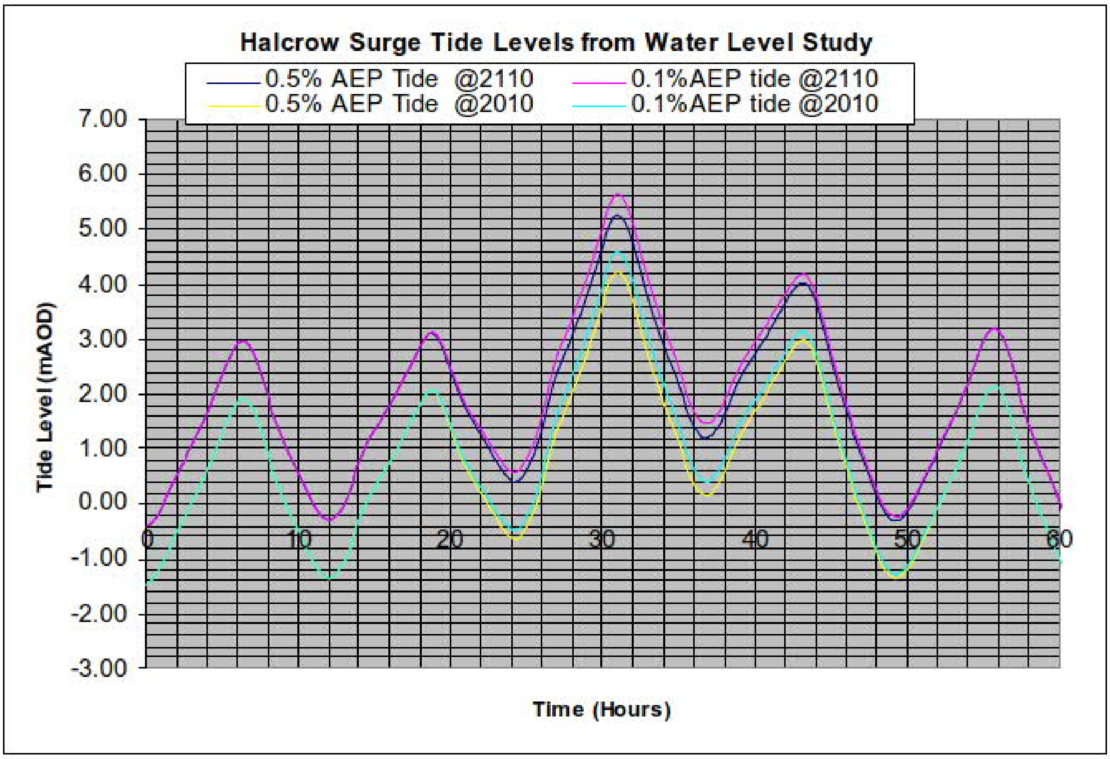


Figure 6-1 Tidal profiles applied in breach modelling (Halcrow 2009)

6.2.3 Breach scenarios

Four base models were developed in 2009, IP01 – IP04, which are described as follows:

IP01 represents the existing situation at the time of modelling in 2009. It includes the East and West bank defences, large buildings in close proximity to breach sites, and raised ground levels. This model was used to simulate fully operational, overtopping and breach scenarios for sea levels and fluvial flows at 2010 and 2110. Multiple breaches were not considered. The subsided section of floodwall at New Cut East is assumed to be at 3.8m. ***Given the subsequent implementation of the FDMS, this base model is no longer relevant to the SFRA.***

IP02 includes the full implementation of the Flood Defence Management Strategy (FDMS), this time including the constriction in the New Cut East at the barrier site, a fluvial pumping station, raised and repaired defences at New Cut East, a flood gate at Wherstead Rd railway bridge and a major development planned on the north bank, upstream of Stoke Bridge which raises the existing defence to 6m AOD (at the time of model development this was at SHLAA Site IP047). This model was used to simulate scenarios at 2015 and 2110 all assuming the barrier is left open. (The probability of the barrier being left open is low as several back-up systems are planned). It should be noted that the major development (on the north bank upstream of Stoke Bridge) has not been progressed, therefore, the flood defence relative to former SHLAA site 47 was not raised to 6m AOD.

IP03 represents the full implementation of the FDMS as described for IP02, but this time the New Cut Barrier is raised (i.e. in operation).

IP04 represents full implementation of the FDMS with the New Cut Barrier raised, but assuming the fluvial pumping station was not operating.

Note: The three base models, IP02, IP03 and IP04 are all based on the same model grid which includes a major development on the north bank, upstream of Stoke Bridge which is planned to raise the existing defence to 6m AOD. It should be noted that this development has not yet progressed to construction phase. Therefore, there is potential for the flow paths and flood storage capacity shown by these breach scenarios to be slightly modified from the current situation. However, this data remains the best available data at the time of writing and is considered suitable to inform the sequential allocation of development sites at the strategic scale. As site level plans are progressed, flood risk assessments should include consideration of breach assessments to inform development layout and site access/egress.

For each of the base models IP01 – IP03, a range of breaches or gate failures were modelled. These are shown and described in Figure 6-2 and Table 6-1. Now that the IFDS has been implemented, only the base models IP02 – IP04 remain relevant to the study area.

As noted previously, a sensitivity check has been made on the 0.5% AEP to the year 2110 (completed in 2009) against 2018 modelling. This has confirmed that water levels used and results from the 2009 modelling are comparative to the 2018 modelling and for the purposes of mapping in this SFRA, climate change will be referred to as the 0.5% AEP event accounting for climate change impacts to the year 2118 (as opposed to 2110).

6.2.4 Scenarios to consider in relation to land use planning and development control

The resulting flood hazard relating to a failure of the New Cut Barrier(i.e. Model IP03 and associated breaches BR02, BR03 and BR04), the Wet Dock Lock Gates (BR01) or the West Bank Railway Gates (BR06) would be managed largely by evacuation in advance and are not considered appropriate to include when planning for land use allocations and development control.

Combined Flood Depth and Flood Hazard Maps have therefore been created, combining the results for the remaining modelled scenarios, which are:

- IP03 BR05 Barrier Closed, Breach in new East Bank defence or Red 7 gate left open.
- IP03 BR07 Barrier Closed, Gate in Wherstead Rd defences left open.
- IP04 BR00 Barrier closed and pumping station not operational, fully operational (just overtopping).

The following combined maps are included in Appendix A:

- **Appendix A Figure 19** Combined Flood Depth 0.5% AEP 2118
- **Appendix A Figure 20** Combined Flood Hazard 0.5% AEP 2118
- **Appendix A Figure 21** Combined Flood Depth 0.1% AEP 2118
- **Appendix A Figure 22** Combined Flood Hazard 0.1% AEP 2118

(Thumbnail figures of the flood hazard for all the breach events are included further down this section for completeness).

Table 6-1 Modelled breach scenarios

	Note: Present Day Scenarios relate to 2015 Climate Change Scenarios account for changes to 2118	Fully operational	Wet Dock Lock Gates left open	Breach into West End Rd (left bank)	Breach d/s Princes St bridge (left bank)	Breach into Bath Street area (right bank)	Breach in new East Bank defence or Red 7 gate left open	Railway gate in West Bank defence left open	Gate in Wherstead Rd defences left open
		BR00	BR01	BR02	BR03	BR04	BR05	BR06	BR07
Model	Base Scenario	Modelled Annual Exceedance Probability (AEP) events							
IP01[31]	Defences in place in 2009, including the upgraded East and West bank defences.	2015 0.5% 2015 0.1% 2118 0.5% 2118 0.1%	2015 0.5% 2015 0.1% 2118 0.5% 2118 0.1%	2015 0.5% 2015 0.1% 2118 0.5% 2118 0.1%	2015 0.5% 2015 0.1% 2118 0.5% 2118 0.1%	2015 0.5% 2015 0.1% 2118 0.5% 2118 0.1%	2015 0.5% 2015 0.1% 2118 0.5% 2118 0.1%	2015 0.5% 2015 0.1% 2118 0.5% 2118 0.1%	2015 0.5% 2015 0.1% 2118 0.5% 2118 0.1%
IP02	Ipswich FDMS including barrier, pumping station for fluvial flow, repairs to New Cut u/s defences, Wherstead Rd floodgate, Site IP047 with enhanced defences. Barrier open.			2015 0.5% 2015 0.1% 2118 0.5% 2118 0.1%	2015 0.5% 2015 0.1% 2118 0.5% 2118 0.1%	2015 0.5% 2015 0.1% 2118 0.5% 2118 0.1%			
IP03	Ipswich FDMS including barrier, pumping station for fluvial flow, repairs to New Cut u/s defences, Wherstead Rd floodgate, Site IP047 with enhanced defences. Barrier closed.	2015 0.5% 2118 0.1%	2015 0.5% 2015 0.1% 2118 0.5% 2118 0.1%				2015 0.5% 2015 0.1% 2118 0.5% 2118 0.1%	2015 0.5% 2015 0.1% 2118 0.5% 2118 0.1%	2015 0.5% 2015 0.1% 2118 0.5% 2118 0.1%
IP04	Ipswich FDMS including barrier, repairs to New Cut u/s defences, Wherstead Rd floodgate, Site IP047 with enhanced defences (not yet constructed) Barrier closed and pumping station not built.	2118 0.5% 2118 0.1%							

[31] The Ipswich Flood Defence Management Strategy was completed in 2019 with the opening of the new Barrier at the New Cut. This scenario is no longer relevant to the study area.

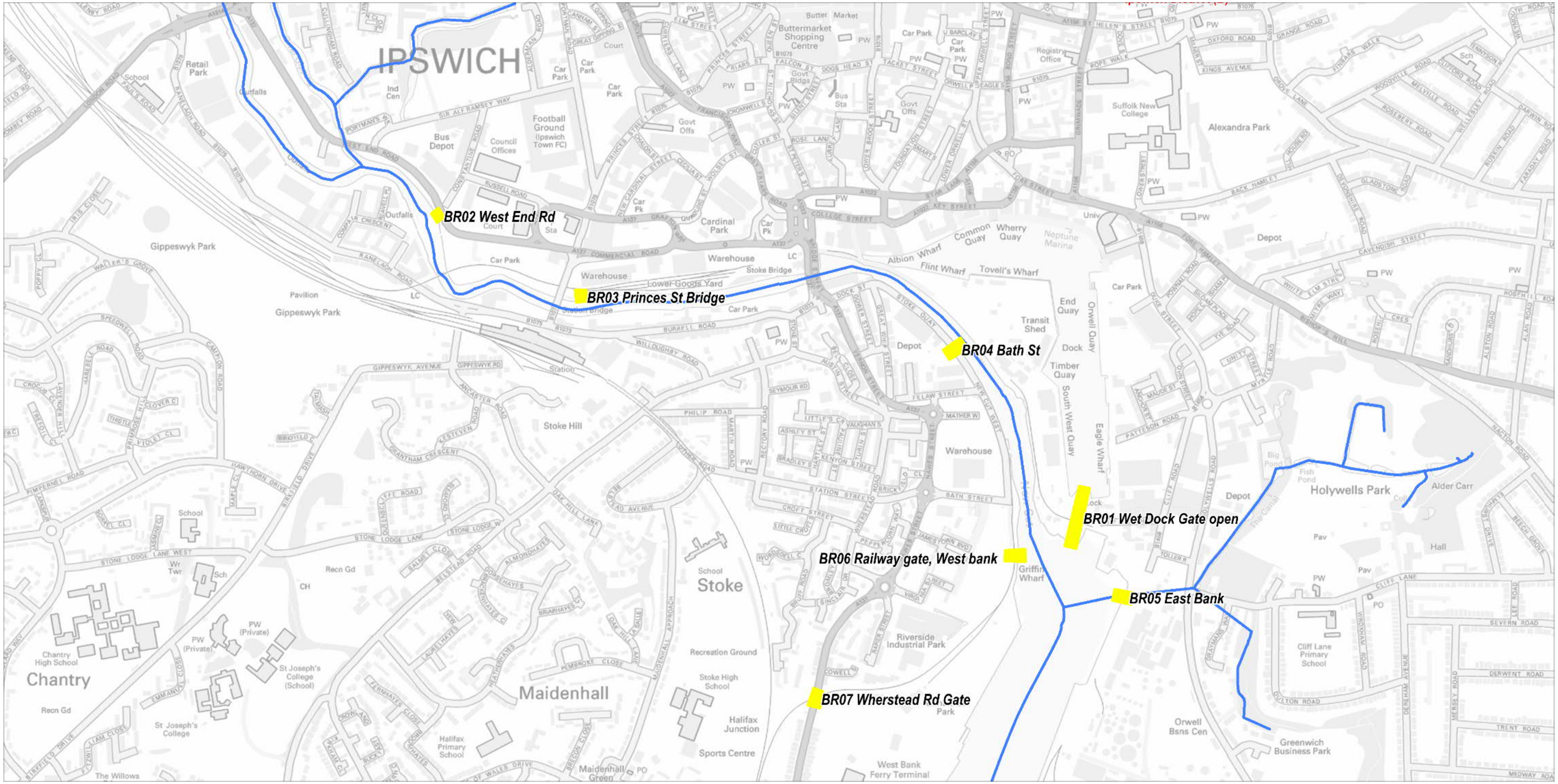


Figure 6-2 Breach locations along the Orwell, Ipswich

6.2.5 Hazard Maps

"Flood hazard" describes the conditions in which people are likely to be swept over or drown based on depth and velocity of floodwater – (not the rate of rise of floodwater) in a particular event.

DEFRA ‘s Flood Risk to People Guidance provides ways of assessing risks to people in flood risk areas. The formula below is used in the assessment to calculate hazard ratings across flooded areas. The variation in hazard rating is mapped and used later in considering the safety of developments. It is standard practice to assess risk using the above hazard ratings from 0.5% and 0.1% AEP events

Hazard Rating (from DEFRA FRA guidance for new development Fd2320/TR2 table 13.1)

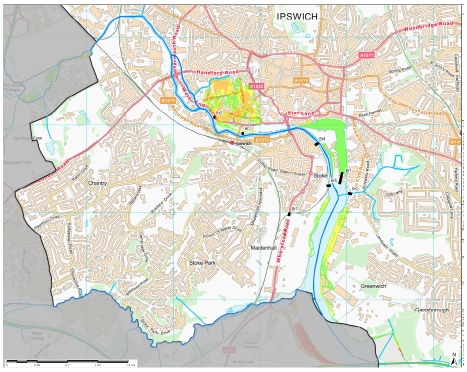
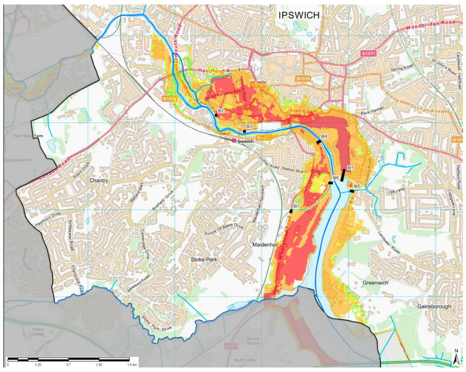
HR=d(v+0.5)+debris factor

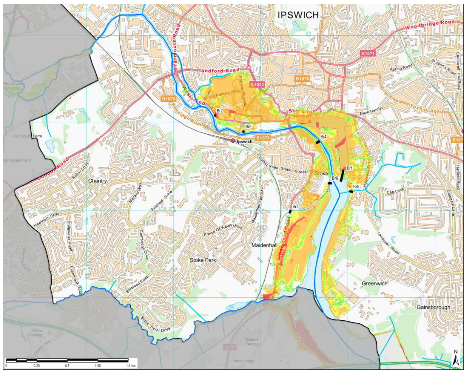
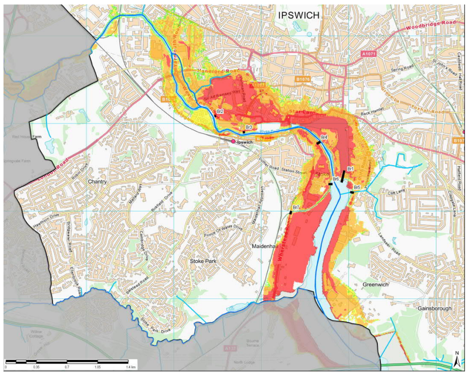
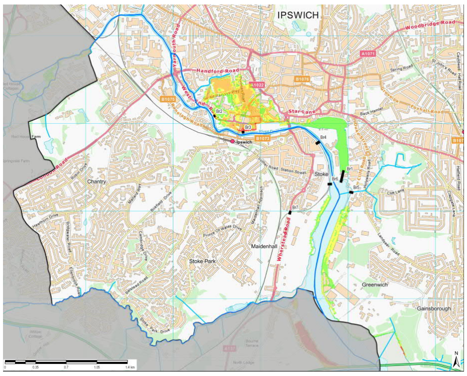
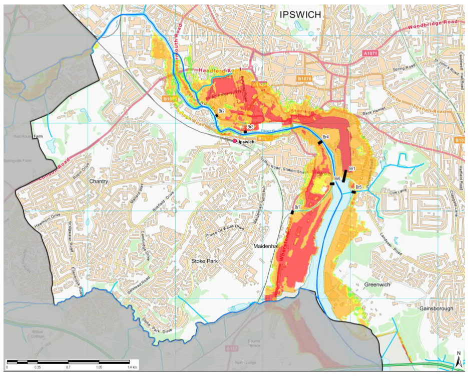
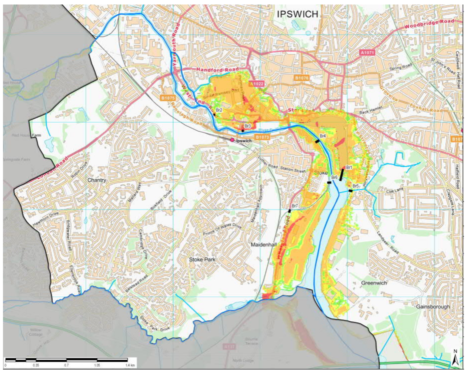
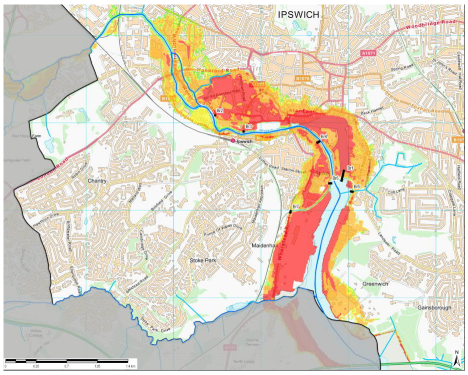
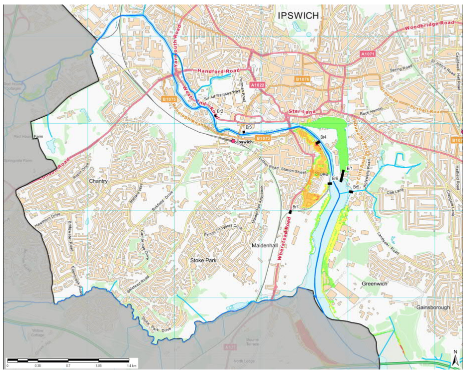
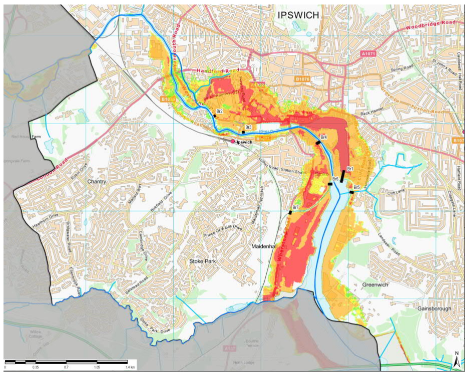
HR	Degree of Hazard		Description
HR<0.75	LOW	Caution	Caution - Flood zone with shallow flowing water or or deep standing water"
0.75-1.25	MODERATE	Danger for some (eg: Children)	Danger - Flood zone with deep or fast flowing water
1.25-2	SIGNIFICANT	Danger for most people	Danger - flood zone with deep fast flowing water
>2	EXTREME	Danger for all people	Extreme danger - flood zone with deep fast flowing water

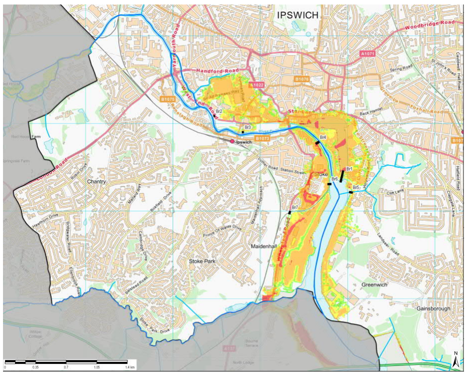
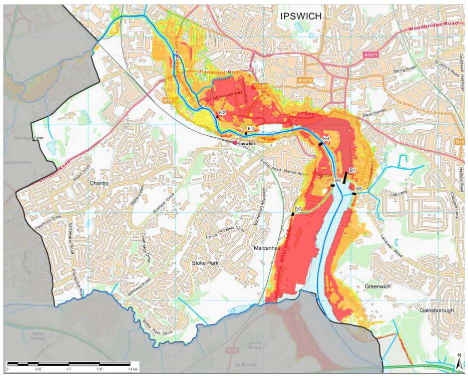
Depth (m)	Debris Factor	Velocity (m/s) 0	0.1	0.2	0.25	0.5	1	1.5	2	4	4.5	5
0.05	0.5	0.53	0.53	0.54	0.54	0.55	0.58	0.60	0.63	0.73	0.75	0.78
0.1	0.5	0.55	0.56	0.57	0.58	0.60	0.65	0.70	0.75	0.95	1.00	1.05
0.2	0.5	0.60	0.62	0.64	0.65	0.70	0.80	0.90	1.00	1.40	1.50	1.60
0.25	0.5	0.63	0.65	0.68	0.69	0.75	0.88	1.00	1.13	1.63	1.75	1.88
0.3	1	1.15	1.18	1.21	1.23	1.30	1.45	1.60	1.75	2.35	2.50	2.65
0.4	1	1.20	1.24	1.28	1.30	1.40	1.60	1.80	2.00	2.80	3.00	3.20
0.5	1	1.25	1.30	1.35	1.38	1.50	1.75	2.00	2.25	3.25	3.50	3.75
0.6	1	1.30	1.36	1.42	1.45	1.60	1.90	2.20	2.50	3.70	4.00	4.30
0.8	1	1.40	1.48	1.56	1.60	1.80	2.20	2.60	3.00	4.60	5.00	5.40
1	1	1.50	1.60	1.70	1.75	2.00	2.50	3.00	3.50	5.50	6.00	6.50
1.9	1	1.95	2.14	2.33	2.43	2.90	3.85	4.80	5.75	9.55	10.50	11.45
2	1	2.00	2.20	2.40	2.50	3.00	4.00	5.00	6.00	10.00	11.00	12.00
2.5	1	2.25	2.50	2.75	2.88	3.50	4.75	6.00	7.25	12.25	13.50	14.75
3	1	2.50	2.80	3.10	3.25	4.00	5.50	7.00	8.50	14.50	16.00	17.50

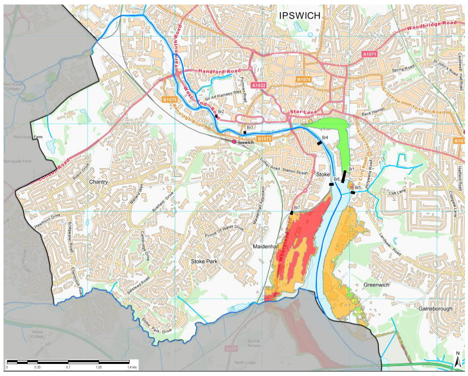
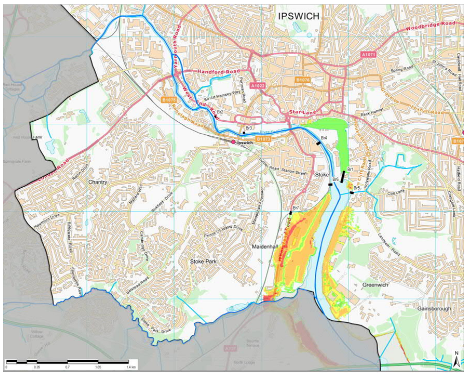
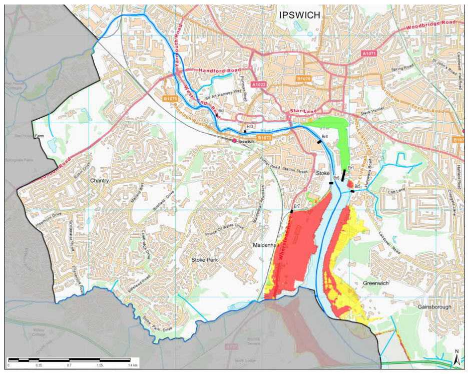
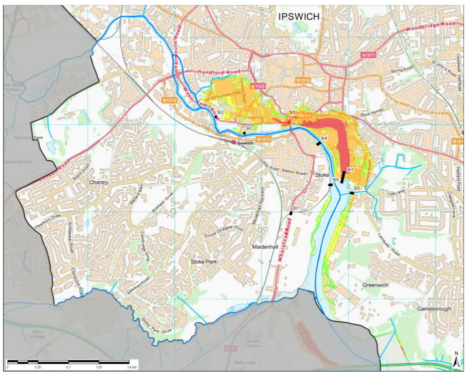
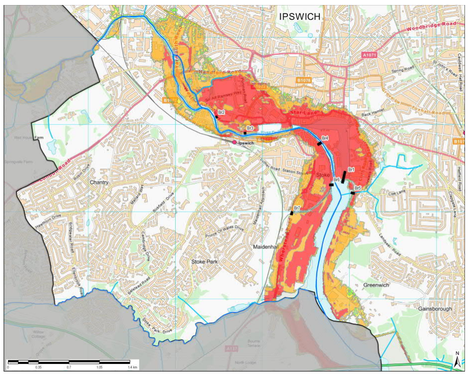
Hazard maps at a small scale are included below to enable comparisons to be made.

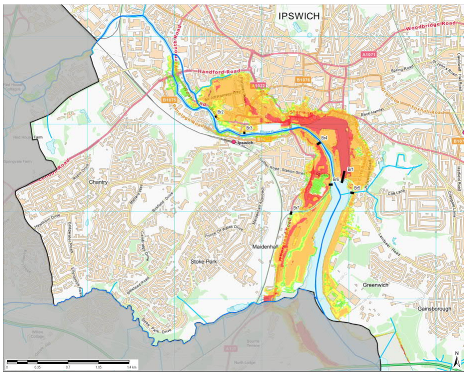
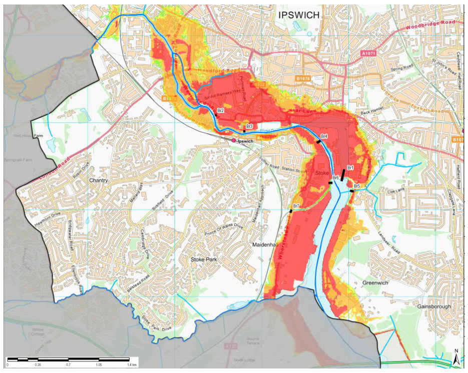
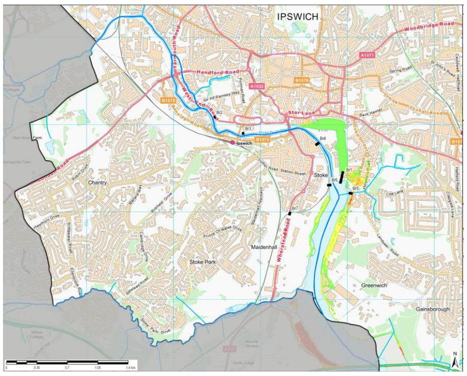
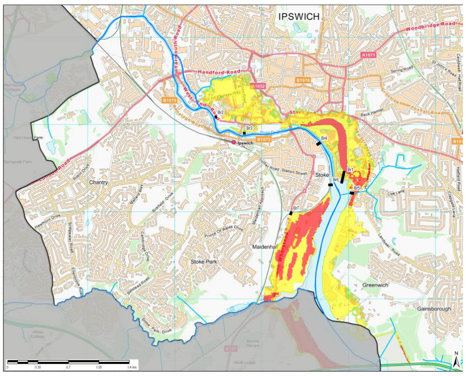
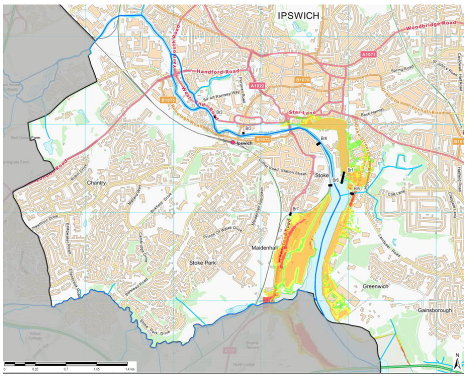
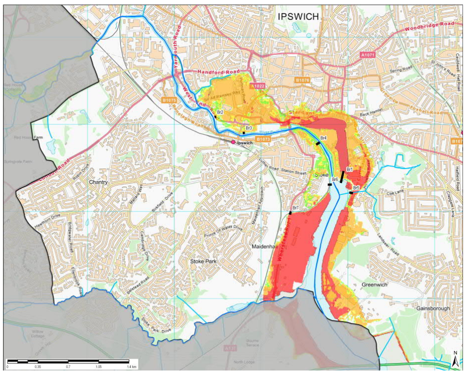
IP02 Ipswich FDMS with Barrier Open

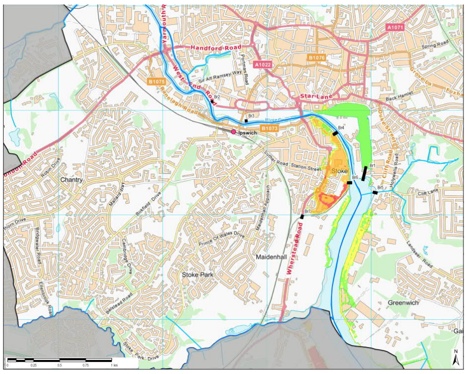
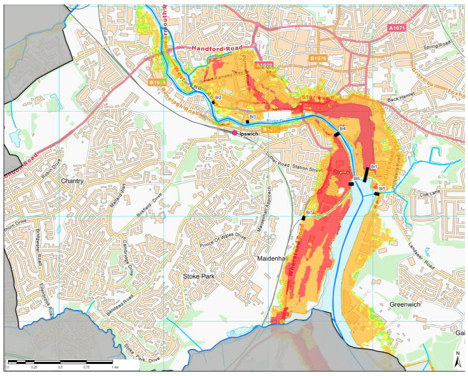
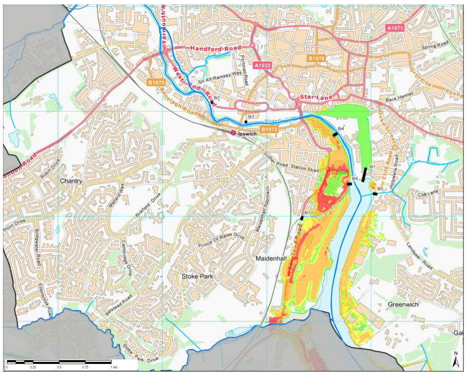
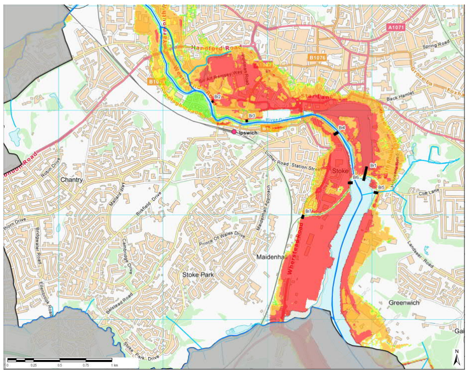
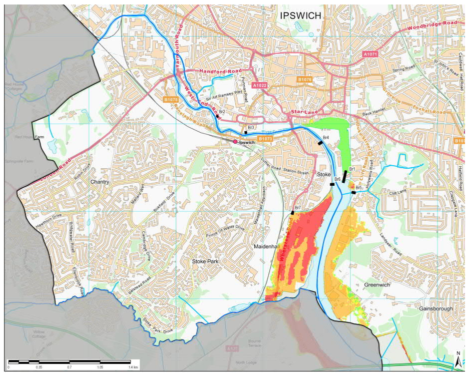
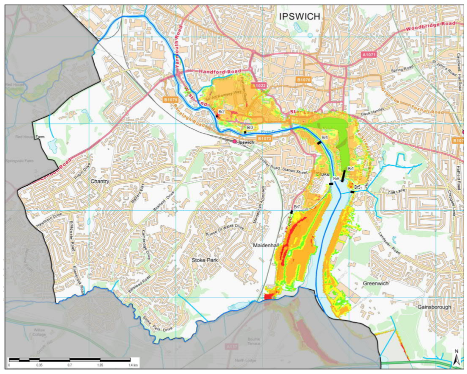
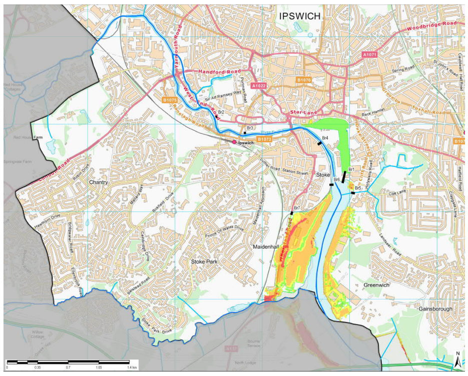
Scenario	AEP	At 2015 (present day)	At 2118 (climate change)
BR02 breach into West End Rd	0.5%		

	0.1%		
BR03 Breach adj. Princes Street bridge into Compartment J	0.5%		
	0.1%		
BR04 Breach into Bath Street Compartment	0.5%		 **Overtopping Occurs in CC scenario**

	0.1%		 **Overtopping Occurs in CC scenario**

IP03 Ipswich FDMS with Barrier Closed			
Scenario	**AEP**	**At 2015 (present day)**	**At 2118 (climate change)**
BR00 No breaches or open gates – fully operational	0.5%	No flooding upstream of barrier. For downstream of barrier see BR01 below:	
	0.1%		
BR01 Wet Dock Flood gates left open	0.5%		

	0.1%		
BR02 Breach into West End Road	0.5%	Considered below in barrier open scenario. Unlikely to occur with barrier closed since water levels in the river channel upstream of the barrier are limited - due to the low level (4.25mAOD of the New Cut East Defence.	
	0.1%		
BR03 Breach adj. Princes Street bridge	0.5%	Considered below with barrier open	Considered below with barrier open
	0.1%		
BR04 Breach into Bath Street area	0.5%	Considered below with barrier open	Considered below with barrier open
	0.1%		
BR05 Breach at new East Bank defence	0.5%		
	0.1%		

BR06 Railway gate in West bank defence left open.	0.5%		
	0.1%		
BR07 Gate @ Wherstead Rd Bridge left open	0.5%	Tide level too low to breach.	
	0.1%		

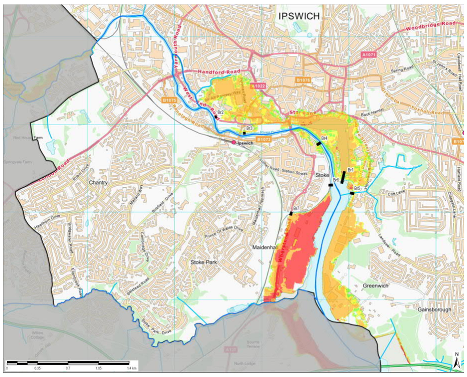
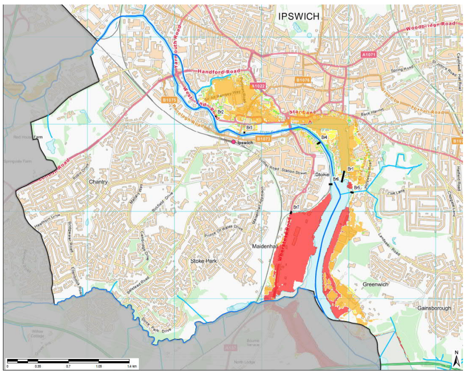
IP04 Ipswich FDMW with Barrier Closed, Pumping Station not operating			
Scenario	**AEP**	**At 2015 (present day)**	**At 2118 (climate change)**
BR00 Future fluvial pumping station inoperative	0.5%	Pumping station probably not required until 2035 to 2053.	
	0.1%	Pumping station probably not required until 2035 to 2053.	

Table 6-2 provides the resulting flood levels in the Village and Wet Dock areas for each scenario. These provide an indicative comparison of risks associated with each scenario.

Table 6-2 Flood levels predicted in Compartments J and H (0.5% AEP) for years 2015 and 2118

		Breach Location	Fully operational	Wet Dock Lock Gates left open	Breach into West End Road (left bank)	Breach into Princes Street bridge (left area)	Breach into Bath Street area (right bank)	Breach in new East Bank defence	Railway Gate in West Bank defence left open	Gate in Wherstead Road defences left open	Fluvial pumping station inoperative
		Breach Ref	00	01	02	03	04	05	06	07	00
			Barrier Raised		Barrier open			Barrier Raised			
			Maximum Flood Level Reached (m AOD)								
Year / tide level	Present day (2015) Tide level 4.25mAOD	H Wet Dock	0	4.2	0	0	0	0	0	0	0
		J Village	0	3.5	3.1	3.3	0	0	0	0	0
	Climate change scenario (2118) Tide level 5.28m AOD	H Wet Dock	0	5.2	4.9	4.8	4.9	4.1	4.5	3.9	3.9
		J village	0	5.2	4.9	4.9	4.7	3.6	4.0	0	3.6

The table shows that in the present day scenario (2015) the highest flood levels result if the Wet Dock floodgates were left open.

If the Barrier is open AND breaches develop at West End Road or, adjacent to Princes Street Bridge there will be localised flooding in compartment J but none in the Wet Dock - compartment H.

If sea levels rise as predicted, by 2118 compartments J & H appear to be affected by more scenarios, some involving breaches into other compartments – i.e. BR04 (Bath Street) and BR06 (Railway Gate West Bank defence).

For BR04 this is because the New Cut barrier is also assumed to be open and floodwater overtops the New Cut East defences and floods into the Wet Dock.

For BR06 the New Cut barrier is closed but floodwater rapidly fills the Bath Street compartment and then overflows over the defences into the river channel upstream of the Barrier. Floodwater in the channel eventually overtops the New Cut East defences and floods into the Wet Dock.

Table 6-3 considers the relative risk associated with each of the breach scenarios or gate failures and outlines suggestions for controlling the residual risks. Some scenarios are unlikely and control measures appear to be practical. Therefore, there are existing or possible measures that reduce residual risk.

A framework of further measures to manage residual risks (for safe development) is described in Section 7. This includes safe access requirements based on hazard maps for breach and overtopping scenarios.

Table 6-3 Assessment of residual risks and controls

Existing or planned controls	Consequence (High/Med/Low)	Chance	Suggested additional controls for consideration by Ipswich BC or EA
Wet Dock Lock Gates left open (BR01)			
Gate is operated by the Orwell Navigation Service; adjacent control building is manned 24 Hrs. 7 days per week Mechanism and gate recently replaced by the EA. In event of failure, flood gate could be pulled into position by hawser/ vehicle. Emergency planning. Gate will be operated frequently so failure in a major rare event is less likely.	H	M	Operate at lower tide levels giving more warning/time to force gates shut. Further improvements to emergency plan. Flood sirens. All subject to discussion with the EA and ONS.
New Cut Barrier Open			
EA's Flood Defence Management Strategy includes for future maintenance/ replacement and includes backup systems for power and hydraulic rams and allows for possible risk in flood warning predictions.	H	L	Flood sirens
Breach into West End Road (BR02) – localised area where sheet piles are about 1.2m above landward ground level			
New Cut Barrier as above. EA's Flood Defence Management Strategy includes for future maintenance/ replacement. Structural design.	L	L	Raise landward ground levels to further reduce unlikely failure of piles. (Possibly funded by Planning tariff/Section 106 agreement.)
Breach downstream of Prince St Bridge (BR03) where sheet piles protrude about 1.5m above landward ground level			
New Cut Barrier, EA's Flood Defence Management Strategy includes for future maintenance/ replacement	L	L	Proposals for SHELAA Site IP047 were approved by the planning committee March 2010. It included raising and replacing much of the defence in this location. **The development did not take place and the site remains undeveloped.** Short lengths of exposed sheet piling would remain adjacent to Stoke Bridge and Princes Street bridge. Raise land ward ground level to further reduce unlikely failure of piles. (Possibly funded by Planning contributions).
Breach through defence wall into Bath Street compartment (BR04)			
New Cut Barrier, EA's Flood Defence Management Strategy includes for future maintenance/ replacement	M	L	Construction of high-level Riverside walkway or safe access. Consider similar on Island site.
Breach through new East Bank Defence wall (or Red 7 Shiplaunch gate left open) (BR05)			
EA's Flood Defence Management Strategy includes for future maintenance/ replacement. Modern structural design, safety factors, and earth bank on landward side	M	L	Red 7 gate – warning system/ emergency plan. Ensure ships are secure, including any on slipway.

Railway gate left open – new west bank defence (BR06)			
EA's Flood Defence Management Strategy includes for future maintenance/ replacement. Modern structural design, safety factors, and earth bank on landward side	M	L	Warning system /Emergency plan
Gate in Wherstead Road defences left open (BR07)			
EA's Flood Defence Management Strategy includes for future maintenance/ replacement. Modern structural design, safety factors,	M	L	Warning system /Emergency plan
Fluvial Pumping Station Inoperative			
EA's Flood Defence Management Strategy includes for future maintenance/ replacement. Modern design, safety factors,	M	L	Warning system/ Emergency plan

6.3 Speed of Onset and Duration

Figures showing the speed of onset and duration of flooding for each compartment are included in **Appendix D**.

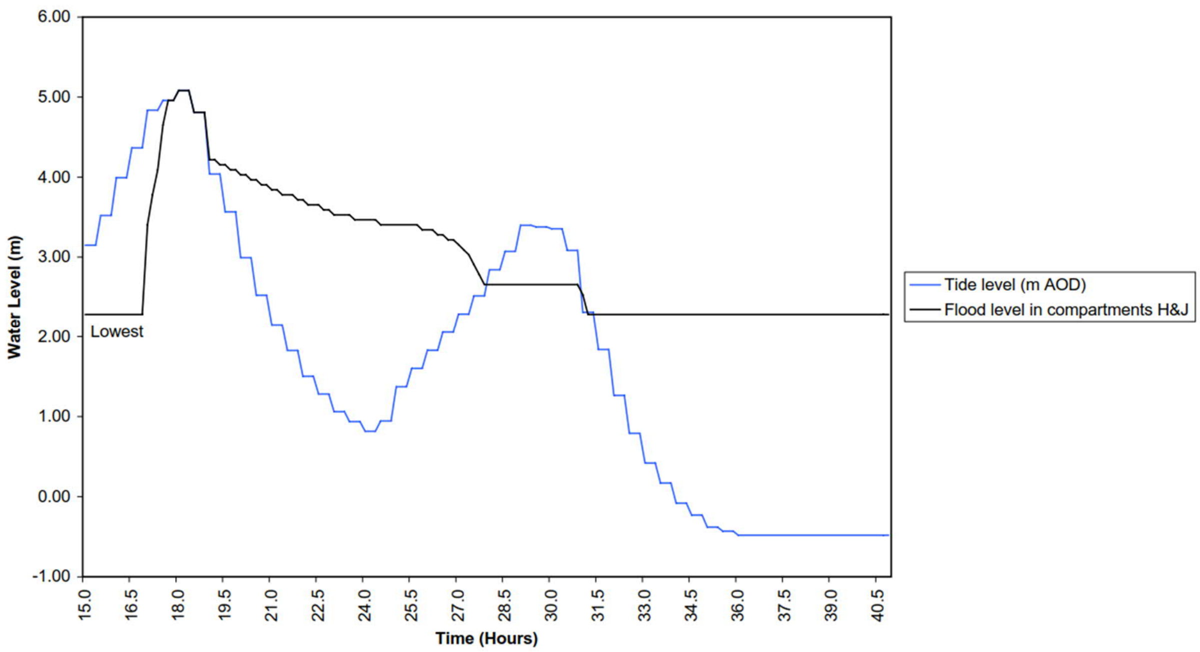


Figure 6-3 Speed of onset and duration, compartment H and J

Figure 6-3 is an example for compartments J and H. If the level of a site is known the speed of onset and duration can be deduced from the graph. In general, the speed of onset from the commencement of overtopping to peak flood level is an hour or so. The duration of flooding varies up to 26 Hours.

Floodwater levels will rapidly reduce as floodwater flows back to the estuary over defences. When the flood level reaches the defence level, the trapped water behind the defences will fall at a reduced rate which is likely to depend largely on whether gulley grates, and highway drains block with flood debris.

7. Safety of development in Flood Zones 2 and 3 to inform the Exception Test

7.1 Introduction

The second part of the Exception Test sets out that proposals for development in areas of flood risk must demonstrate that the development will be **safe** for its lifetime taking account of the vulnerability of its users.

Guidance on what is safe is provided in the PPG and the Defra and Environment Agency R&D *'Flood Risk Assessment Guidance for New Development' FD2320.* The Environment Agency '*Flood Risk Emergency Plans for New Developments'*[32] also sets out how to consider emergency plans for flooding as part of the planning process.

Ultimately, it is the responsibility of local planning authorities to decide what level of risk is acceptable.

The PPG states that after applying a sequential approach so that, as far as possible, development is located to where there is the lowest risk of flooding, new development can be made safe by:

- designing buildings to avoid flooding by, for example, raising floor levels;
- providing adequate flood risk management infrastructure which will be maintained for the lifetime of the development, for example, using Community Infrastructure Levy or planning obligations, or Partnership Funding where appropriate;
- leaving space in developments for flood risk management infrastructure to be maintained and enhanced, and;
- mitigating the potential impacts of flooding through design and flood resilient and resistant construction.

The PPG emphasises that, when considering safety, specific local circumstances need to be taken into account, including:

- the characteristics of a possible flood event, e.g. the type and source of flooding and frequency, depth, velocity and speed of onset;
- the safety of people within a building if it floods and also the safety of people around a building and in adjacent areas, including people who are less mobile or who have a physical impairment. This includes the ability of residents and users to safely access and exit a building during a **design flood** and to evacuate before an **extreme flood**;
- the structural safety of buildings, and;
- the impact of a flood on the essential services provided to a development.

While safety considerations are always very important, local planning authorities should seek to ensure that communities are sustainable, including ensuring that certain sections of society, such as the elderly and those with less mobility, are not unnecessarily excluded from areas where there is a risk of flooding.

'Design flood' and 'extreme flood'

When considering safety of proposed developments and design of mitigation measures two terms are used:

The **design flood** is a flood event of a given annual probability, against which the suitability of a proposed development is assessed, and mitigation measures, if any, are designed.

- For fluvial flooding, the design flood is the 1% AEP event, taking account of the presence of defences and including an appropriate allowance for climate change.

[32] Adept, Environment Agency, September 2019, Flood risk emergency plans for new development. A guide for planners. https://www.adeptnet.org.uk/system/files/documents/ADEPT%20%26%20EA%20Flood%20risk%20emergency%20plans%20for%20new%20development%20September%202019....pdf

- For tidal flooding, the design flood is the 0.5% AEP event, taking into account the presence of defences and including an appropriate allowance for climate change.

It is the design flood for which mitigation measures such as finished floor levels and safe access/egress arrangements need to be considered.

The **extreme flood** event is the 0.1% AEP event, against which flood response procedures are considered.

7.2 Specific local circumstances

The local circumstances specific to Ipswich are summarised below.

7.2.1 Actual flood risk from the fluvial River Gipping

The River Gipping modelling study confirms that during the present day conditions, the study area is not at risk of flooding from the River Gipping for the **design** event (1% AEP). However, based on current predictions of climate change and the assumption that no upgrades to the defences will be made, there is potential for areas of Ipswich to be at actual risk of fluvial flooding from the River Gipping during the design event in the future. This is shown in Figure 8A and 8B, where the 1% AEP event including 65% allowance for climate change leads to flooding in parts of Ipswich village with flood levels between 3 and 4.8m AOD.

With respect to the **extreme** flood, the modelling shows that a small area on the west bank of the River Gipping off Hadleigh Road is at risk of flooding during the **extreme** flood in the present day (0.1% AEP). In the future, the risk of flooding during the extreme flood event (0.1% AEP including 25% climate change) extends throughout Ipswich town with flood levels between 3.97m and 4.97m AOD. Appendix A Figures 8D and 8E show the depth and hazard rating during this extreme flood event.

Mitigation and Management at Site Level

Appropriate measures to protect against the actual flood risk from the fluvial River Gipping on individual development sites include:

- Finished floor levels should be set above the **design flood** level including an appropriate allowance for climate change.
- Safe access should be available in relation to the **design flood** level including an appropriate allowance for climate change.
- Due to the nature of fluvial flooding, and the location of Ipswich at the lower end of the catchment, it is likely that there will be advanced warning prior to fluvial flooding from the River Gipping in Ipswich. This will provide time for occupants of premises at risk of fluvial flooding to take steps to protect themselves in the event of an **extreme** flood in the future (0.1% AEP), for example by evacuating, moving vulnerable items, installing flood barriers to properties. Flood warning and emergency response planning procedures should be in place.
- Safe refuge should be provided, above the **extreme** flood level including an appropriate allowance for climate change.

Further details are provided in the following subsections.

Management at Borough Level

As part of their emergency planning response, it is recommended that Ipswich BC consider the most appropriate approach for managing the future fluvial flood risk from the River Gipping. For example, Ipswich BC may wish to set out a preferred approach for occupants regarding containment and refuge, or tailored evacuation across the affected areas. This will need consideration of the capacity within other parts of the Borough for evacuations, including any new additions made from new development.

It should be noted that the risk in the future from the River Gipping may change, for example, should there be upgrades to the standard of protection provided by the defences. However, given the time horizons, planning and funding for such improvements cannot be guaranteed and therefore it is prudent to put alternative arrangements in place to manage the future risk in the event that the defences are not upgraded.

7.2.2 Residual risk of tidal flooding

The Ipswich Flood Defence Management Strategy is designed to provide a standard of protection against tidal and fluvial flooding, including combinations of 0.33 % annual exceedance probability (1 in 300 years) allowing for increased sea levels to the year 2109.

Ipswich is therefore protected against tidal flooding for the 'design event' (0.5% AEP including climate change) and said to be at 'residual' risk of tidal flooding. The residual risk is the risk that remains after the flood risk defence and management measures are taken into account.

This remaining residual risk is different in its probability of occurring, likely warning time and anticipated flooding impacts. For example, a failure to close the Barrier may have some warning time associated with it, and it is assumed the Environment Agency have an operational strategy in place to mitigate the impacts. A breach in the local flood defences, whilst of low probability, may occur with little warning, and may lead to rapid onset of flooding with greater flood depths and velocities than experienced during a fluvial flooding event. Such events are not considered the 'design event', rather an 'extreme flood' event.

It is therefore crucial that measures to manage the residual risk of tidal flooding take into account the potential nature of the flood events.

Management at Site Level

The primary measure to keep people safe during a potential breach event (extreme flood), will be either for people to evacuate prior to the event, or for people to remain where they are. Given the sudden nature of breach events, and the rapid onset of flooding, all buildings should be designed with safe refuge above the maximum extreme breach flood level (0.1% AEP including climate change).

Residents should be aware of the safe refuge protocol in the unlikely event of rapid inundation behind the flood defences. Safe access/egress routes, where these are available for specific sites, should also be familiar to occupants.

Management at Borough Level

It is recommended that Ipswich BC formalise their strategy for managing the residual risk of tidal flooding in Ipswich and engage with residents in areas at residual risk of flooding to ensure they are aware of safe refuge procedures in the unlikely event of rapid inundation behind the flood defences.

7.3 Recommendations for Safety Framework

Guidance for what is considered 'safe' in Ipswich has been developed over the years in collaboration with Suffolk Resilience Forum, Ipswich BC's Emergency Plans officer and the Environment Agency and specific requirements are set out in Ipswich BC's Development and Flood Risk Supplementary Planning Document (SPD).

With the specific local circumstances for Ipswich in mind, this Section provides recommendations for the Safety Framework based on the updated SFRA, the PPG and other relevant guidance documents.

The safety framework covers the following:

- Finished floor levels;
- Safe access/egress;
- Safe refuge;
- Structural safety of buildings;
- Special measures and information to assist emergency services;
- Flood warning and response plans.

7.3.1 Finished Floor Levels

Where developing in Flood Zone 2 and 3 is unavoidable, the recommended method of mitigating flood risk to people is to ensure internal floor levels are raised a freeboard level above the design flood level.

In areas of fluvial flood risk:

All development (Less Vulnerable, More Vulnerable, Highly Vulnerable) should set finished floor levels 300mm above the fluvial design flood level (1% AEP) including an appropriate allowance for climate change.

In areas of residual tidal flood risk:

All development is protected from tidal flooding by the IFDMS for the design event (0.5% AEP including climate change).

In order to mitigate the residual risk of flooding in the event of a failure of the tidal flood defence infrastructure, sleeping accommodation should be set above the maximum tidal breach level (0.5% AEP) including climate change.

The maximum breach flood level varies considerably depending on the flood compartment and will be highest closest to the breach location. The flood compartments are shown in **Appendix A Figure 15** and reproduced in Figure 7-1. The maximum breach flood levels for each compartment are presented in Table 7-1 and Figures 7-2 and 7-3.

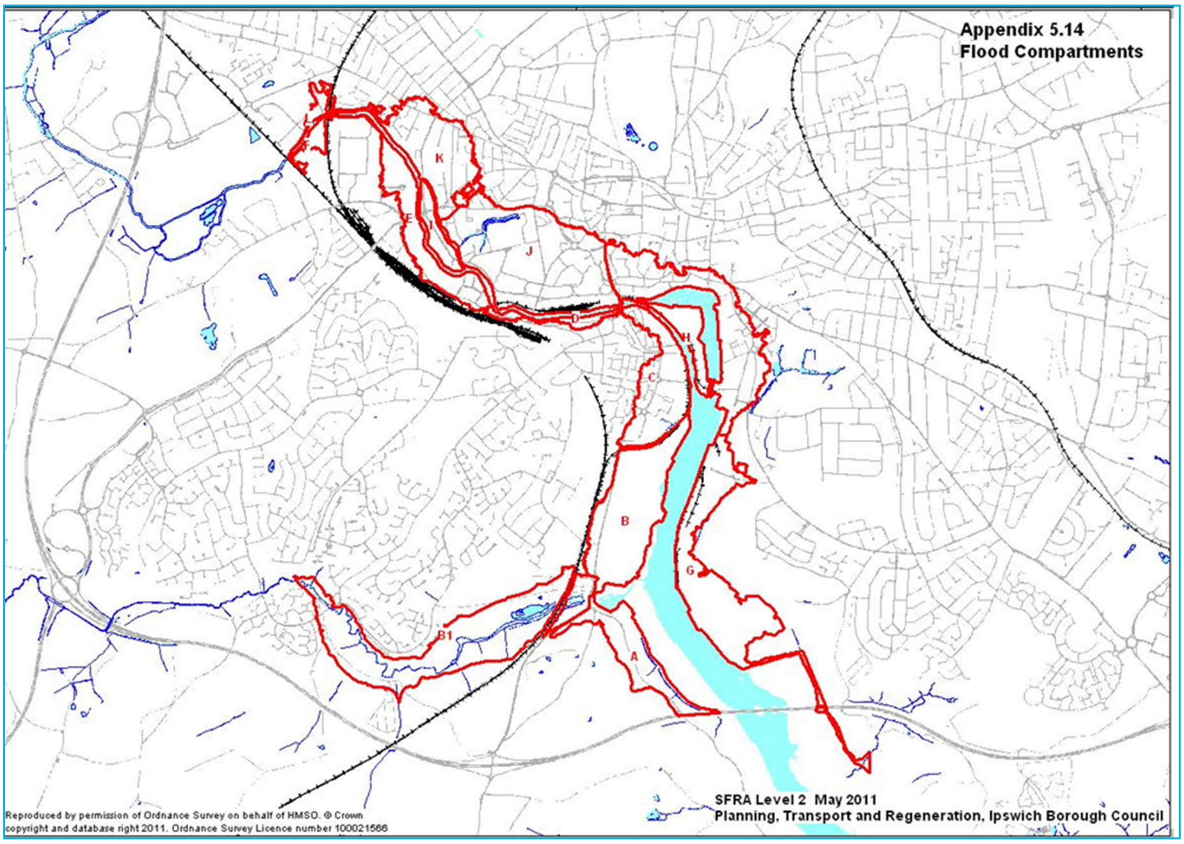


Figure 7-1 Flood compartments

Table 7-1 Maximum flood levels

Flood compartment	Maximum flood level reached in 0.5% AEP event with breach 05 or 07 with Barrier.
A	5.3 m AOD
B	5.3 m AOD
C	Mostly 3.5m AOD but locally up to 5.3 close to Breach 07 (gate across Wherstead Rd, Figure 6-2).
D	4 m AOD - No relevant breach modelled - this is the maximum water level in the Orwell upstream of the Barrier before flooding into compartment H occurs. The IFDMS is designed to prevent this in a 300 year RP event.
E	No relevant breach modelled. Either undertake a site-specific model or use 4m AOD as suggested above.
F	Not currently in Flood Zones 2 or 3, refer to flood levels from River Gipping model.
G	5.3 m AOD
H Wet Dock area	Mostly 4m AOD but locally up to 5.3 close to Breach 05 (Figure 6-2).
I Island @West End Rd	Most of the island at West End Road has ground levels between 5.5m AOD and 4 m AOD. The 1% AEP fluvial level including 65% climate change allowance is 4.8m AOD. Finished floor levels to be 300mm above i.e. 5.2m AOD.
J "Village" / Portman Rd	3.6 m AOD ignoring backflow through sewers from compartment H – safe to assume 4 m AOD but 3.6 m AOD is consistent with Hazard map.
K	Land here is not in Flood Zone 3. GL is >4m AOD and <5.3m AOD

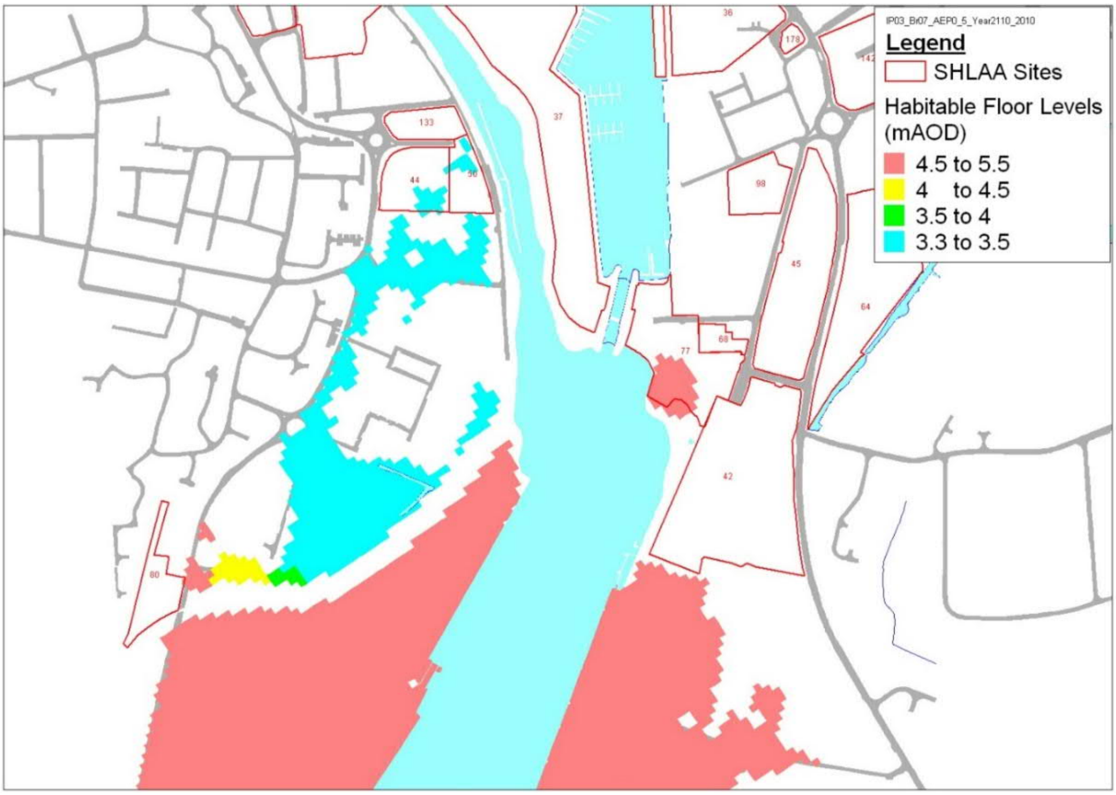


Figure 7-2 Design Flood levels for sleeping accomodation, Compartment C (Breach 7, Barrier in place)

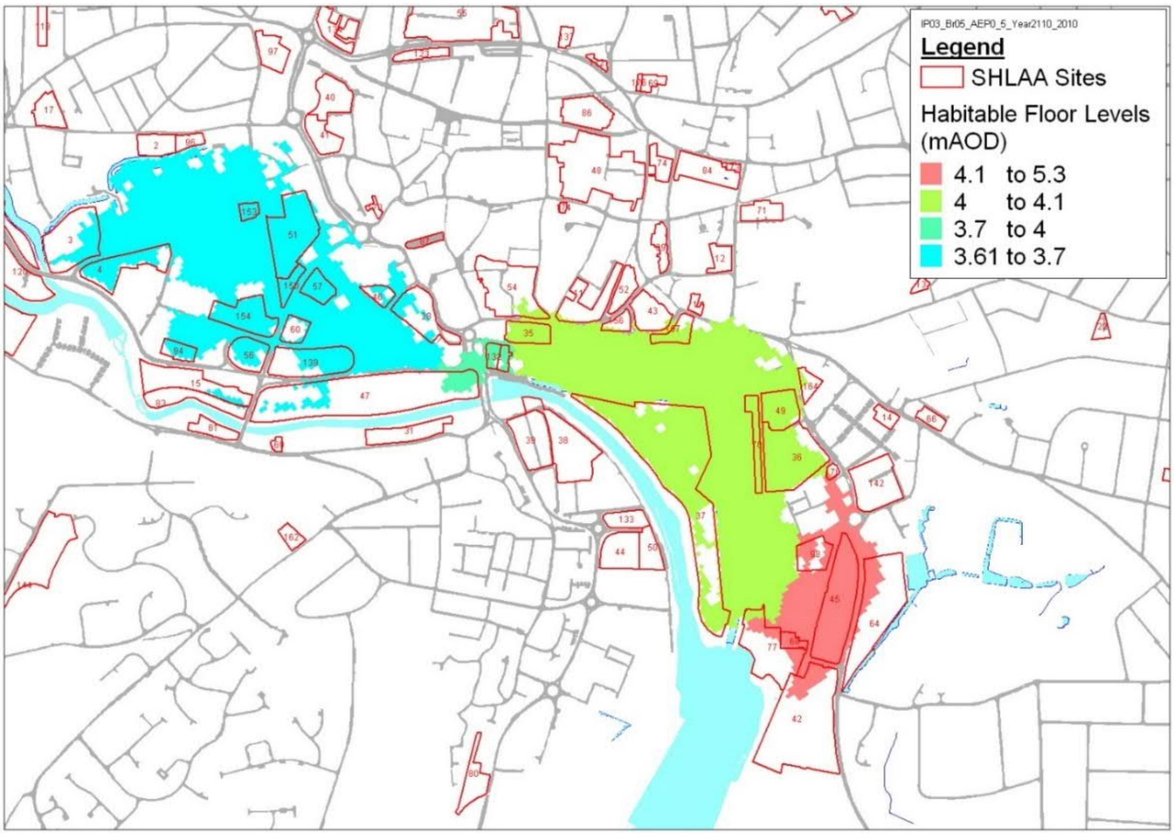


Figure 7-3 Design Flood Levels for sleeping accommodation, Compartments H +J (Breach 5, Barrier in place)

7.3.2 Safe Access/Egress

As set out in the PPG, access considerations for new development should include the voluntary and free movement of people during a '**design flood**', as well as the potential for evacuation before a more '**extreme'** flood. Access and egress must be designed to be functional for changing circumstances over the lifetime of the development. Specifically:

- Access routes should allow occupants to safely access and exit their dwellings in design flood conditions. Vehicular access to allow the emergency services to safely reach the development during design flood conditions will also normally be required. The design flood for fluvial flooding (i.e. from the River Gipping) is the 1% AEP event assuming defences are in place and including climate change, and for tidal flooding is the 0.5% AEP event with defences in operation and including an allowance for climate change.
- Wherever possible, safe access routes should be provided that are located above design flood levels and avoiding flow paths. Where this is not possible, limited depths of flooding may be acceptable, provided that the proposed access is designed with appropriate signage etc to make it safe. The acceptable flood depth for safe access will vary depending on flood velocities and the risk of debris within the flood water. Even low levels of flooding can pose a risk to people in situ (because of, for example, the presence of unseen hazards and contaminants in floodwater, or the risk that people remaining may require medical attention).

Guidance prepared by the Environment Agency[33] uses a calculation of flood hazard to determine safety in relation to flood risk. 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, the use of which for the purpose of planning and development control is clarified in the abovementioned publication. Flood hazard mapping is presented within Appendix A for the River Gipping and the tidal breach modelling.

Table 7-2 Hazard to People Rating (HR=d x (v +0.5) + DF) (Table 13.1 FD2320/TR2)

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

As a result of the IFDMS, development proposed in Ipswich is protected from tidal flooding during the design flood (0.5% AEP event taking account of defences and including climate change). Safe access and egress are therefore available during this design event. However, the flood hazard mapping provided for the breach events (i.e. the extreme flood) can usefully be used to determine the availability of safe routes during an *extreme* event and this information used to inform flood response plans for managing the residual risk.

For developments located in areas at risk of fluvial flooding, safe access and egress must be provided for new development in design flood conditions (1% AEP including climate change) 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.

[33] Environment Agency, HR Wallingford, May 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. http://evidence.environment-agency.gov.uk/FCERM/Libraries/FCERM_Project_Documents/FD2321_7400_PR_pdf.sflb.ashx

For fluvial flooding, a ‘dry’ access/egress is a route located above the 1% annual probability flood level (1 in 100 year) including an allowance for climate change.

7.3.3 Safe Refuge

A place of safe refuge is an internally accessible and suitably sized and designed place above predicted flood levels, where occupants can seek temporary refuge for the duration of the flooding[4].

In areas at risk of fluvial flooding, safe refuge should be provided above the extreme flood level (0.1% AEP) including climate change. This will provide a safe place in the event that occupants fail to evacuate prior to the onset of flooding, or a flood warning not be received.

The risk of tidal flooding in Ipswich is a residual risk, in the unlikely event of a failure of flood defence infrastructure. In such an event the resultant speed-of-onset of flooding may prevent safe evacuation away from the area of risk, and the depth and duration of flooding may prevent vehicular access by the emergency services. As a result, in order to manage this residual risk, safe refuge should be provided above the extreme flood level (0.1% AEP breach flood level including climate change to 2118, which is 5.7m AOD).

The quality of refuge (provision of facilities, communications, warm clothes etc.) required must be suitable and sufficient for the likely duration of flooding assuming there is no mains power or telephone services. Landings and stairwells are not suitable for planned temporary refuges.

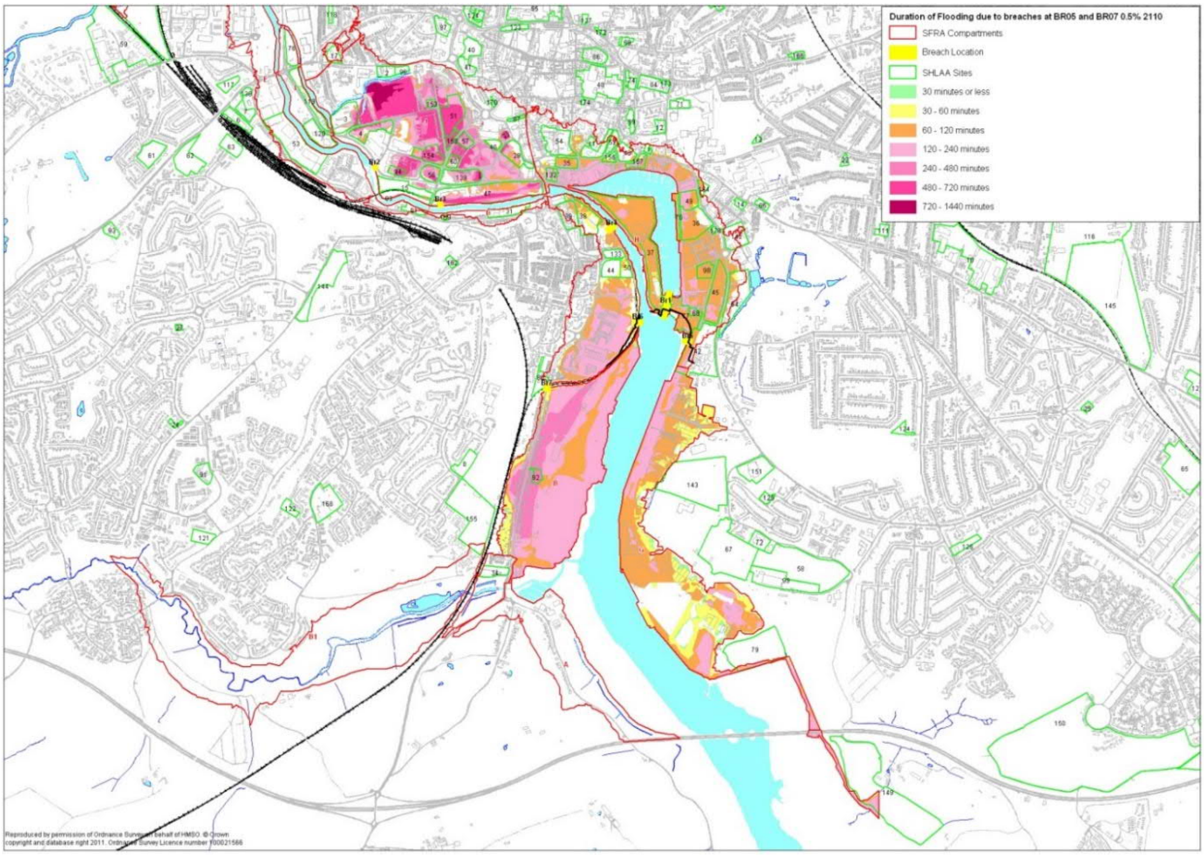


Figure 7-4 Tidal and fluvial flood duration

Figure 7-4 shows how the duration of flooding varies across Flood Zone 3 in the event of a sudden collapse of 20m of defence to ground level at high tide during a 0.5% AEP event. It assumes the Barrier is operational and combines the effects of Breach 5 (flooding compartments J and H) and Breach 7 (flooding compartment C).

For flood levels above breaches, water level/time data is from 2D modelling which provided data for point locations in each compartment. For flood levels below breaches, water level/time data is from IBC’s spreadsheets which simulate final drain down through a simplified drainage system without blockages and assumes dry weather. For each compartment the two sets of data were spliced together and a graph of flood level vs. time was created and used to estimate contours corresponding to the range of durations shown.

7.3.4 Structural safety of buildings

All buildings should be designed to remain standing and resist moving floodwater. In some cases, structural damage to buildings might best be avoided by allowing water to enter and pass through buildings, rather than by resisting the ingress of floodwater.

The Government has published a document 'Improving the Flood Performance of New Buildings, Flood Resilient Construction[35]', the aim of which is to provide guidance to developers and designers on how to improve the resistance and resilience of new properties to flooding through the use of suitable materials and construction details. Reference should also be made to the Planning Practice Guidance (PPG). Figure 7-5 provides a summary of the Water Exclusion Strategy (flood resistance measures) and Water Entry Strategy (flood resilience measures) which can be adopted depending on the depth of floodwater that could be experienced.

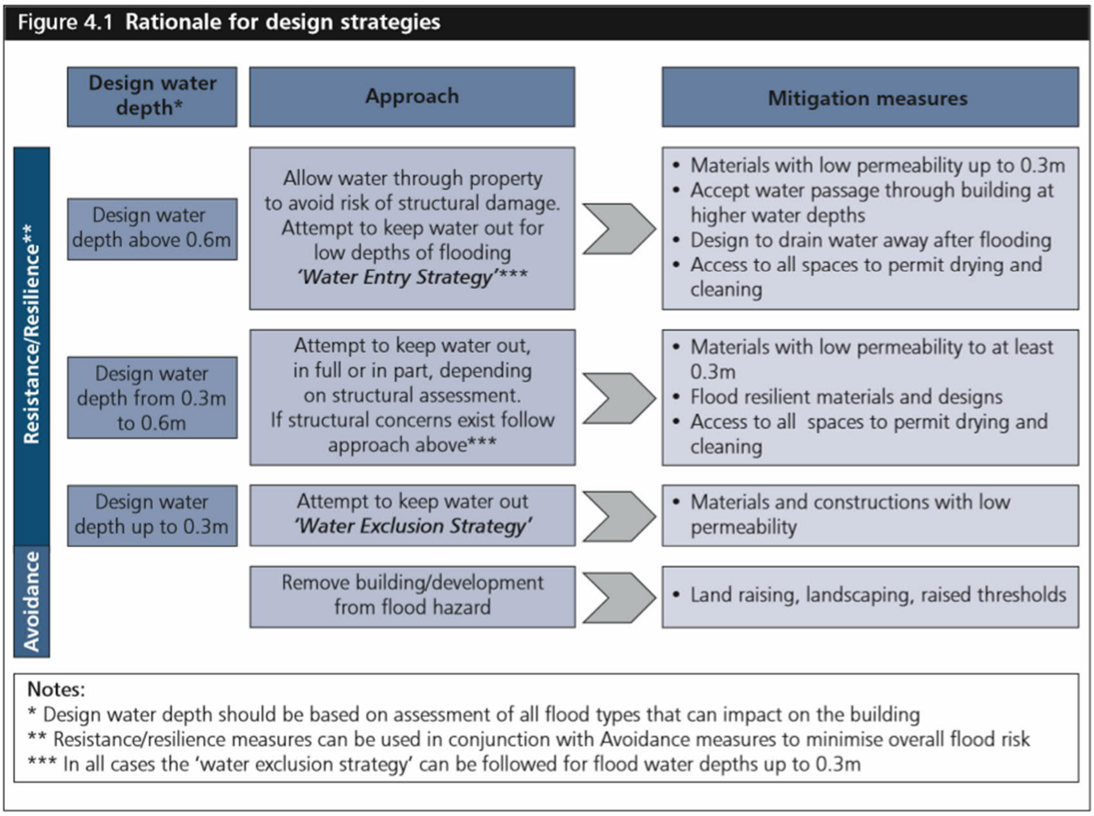


Figure 7-5 Flood Resistant / Resilient Design Strategies, Improving Flood Performance, CLG 2007

7.3.4.1 Flood Resistance 'Water Exclusion Strategy'

Resistance measures are aimed at preventing water ingress into a building (Water Exclusion Strategy); they are designed to minimise the impact of floodwaters directly affecting buildings and to give occupants more time to relocate ground floor contents. These measures will probably only be effective for short duration, low depth flooding, i.e. less than 0.3m, although these measures should be adopted where depths are between 0.3m and 0.6m and there are no structural concerns

In areas at risk of flooding of low depths (<0.3m), implement flood resistance measures such as:

- Using materials and construction with low permeability.

[35]DCLG, Defra, Environment Agency, May 2007, Improving the Flood Performance of New Buildings – Flood Resilient Construction
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/7730/flood_performance.pdf

- Land raising.
- Landscaping e.g. creation of low earth bunds (subject to this not increasing flood risk to neighbouring properties).
- Raising thresholds and finished floor levels e.g. porches with higher thresholds than main entrance.
- Flood gates with waterproof seals.
- Sump and pump for floodwater to remove waste faster than it enters.

There are a range of property flood protection devices available on the market which are 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.

7.3.4.2 Flood Resilience 'Water Entry Strategy'

For flood depths greater than 0.6m, it is likely that structural damage could occur in traditional masonry construction due to excessive water pressures. In these circumstances, the strategy should be to allow water into the building, but to implement careful design in order to minimise damage and allow rapid re-occupancy. This is referred to as the Water Entry Strategy. These measures are appropriate for uses where temporary disruption is acceptable and suitable flood warning is received.

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

In areas at risk of frequent or prolonged flooding, implement flood resilience measures such as:

- Use 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.
- Coat walls with internal cement-based renders; apply tanking on the inside of all internal walls.
- Ground supported floors with concrete slabs coated with impermeable membrane.
- Tank basements, cellars or ground floors with water resistant membranes.
- Use plastic water resistant internal doors.

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

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.

7.3.4.3 Water compatible infrastructure

Table 2 of the NPPF classifies water compatible infrastructure as docks, marinas and wharves. These types of infrastructure should be designed to withstand to maximum flood velocities and flood depths, to not impede water flows, remain operationally safe for users during flood events, and not increase the flood risk to the surrounding areas. All water compatible infrastructure should incorporate flood resilience measures.

7.3.5 Special measures and information to assist emergency services

Emergency services are concerned that development in flood risk areas does not impose additional risks on their staff, or additional demands on their services. They are required to plan for "reasonably foreseeable" emergencies, but the term "reasonably foreseeable" is not clearly defined in terms of probability.

No matter what standards are adopted for flood defences, safe access, or safe working environments there is a chance that some residential or commercial developments may not always be safely accessible by emergency services. Even developments outside Flood zones 2/3 could become inaccessible for short periods during a very extreme and rare flood.

The new Barrier provides an extremely high standard of defence. The design incorporates factors of safety and back up mechanical systems. Failure is considered to be very unlikely. The Ipswich FDMS as a whole has reduced the risk and demand for emergency services considerably, even with the anticipated rise in sea levels and anticipated increased population due to development. The probability of evacuation plans needing to be activated is initially 0.1% AEP; by 2109 this would be 0.33% AEP. It should be noted that the Wherstead Road area has a lower standard of flood defence, and emergency plans in this area will need to be activated more frequently,

The requirements for safe access to new developments are based on limiting flood hazards to people. The requirement for safe access will also reduce the risks to emergency services' personnel but will not make it "safe" for them in all imaginable extreme events.

Power supplies are likely to fail during a flood and not everybody will evacuate in advance, so there will be an increased risk of fire in residential properties.

Special measures should be taken to reduce fire risk in Flood Zones. These should be identified in FRAs and shown on planning application details.

Whilst every effort will always be made by SFRS to respond to fires and rescues, due to the nature and scale of tidal flood events a dynamic risk assessment may determine that FRS resources are unable to respond normally along flooded routes where the depth of flood water at any point is greater than 20cm. This may prevent or delay emergency response. Strategic and tactical risk assessments and resource limitations may also cause response times to vary significantly from normal operating procedures. These issues may also arise for any other type of significant / wide scale flooding event.

The Building Regulations Approved Document B5 'Access and Facilities for The Fire & Rescue Service' includes guidance for provision of areas of suitable hard standing for the fire appliances, as well as specific requirements for access around buildings and building designs to assist with rescue and firefighting.

Such hard standings and access routes need to be as high as reasonably practicable to reduce the possibility of emergency services being unable to gain access or becoming trapped by flood water but will need to be compatible with floor levels and surrounding street levels (as set out in this framework).

The Fire and Rescue Service is unable to use floodwater or fire hydrants that are submerged for firefighting. Large building designs should therefore include at least one fire hydrant in the hard standing. This will normally be a raised pillar style fire hydrant with the outlets above ground level.

A clearly marked secure premises information box should be provided in a safe and accessible location (Agreed with SFRS) containing any special equipment which may be required for operating a pillar fire hydrant.

In addition, life safety fire sprinkler systems, designed to be resilient and operate in flood conditions should be considered. Fire extinguishers and alarms should be installed (in compliance with relevant standards) for all developments in Flood Zones 2 and 3.

Developers are advised to contact the Suffolk Fire and Rescue Service regarding these requirements before finalizing building designs and FRAs. They are consultees and may require further measures for specific developments.

7.3.6 Emergency and flood warning plans

An FRA must include an appropriate Emergency Flood Management Plan (FMP) and application drawings are required showing signage and evacuation routes. Advice should be sought from emergency services when producing an FMP.

The aim will be to self-evacuate on receipt of appropriate advance warnings received via the Environment Agency's national system. Severe flood warnings are normally issued at least 2 hours before flooding. Details of the Flood Warning Service are included in Section 9.6.

However, no warnings would be received for a sudden breach (collapse of defences) when tide levels are significantly below defence levels. In such an unlikely event, evacuation is unlikely to be achievable; in fact, it might be more hazardous.

The FMP should advise occupants to use the safe refuge if flooding is imminent or occurring and monitor the situation via local TV or radio, the internet, or mobile phone.

The FMP needs to detail the provision of flood emergency kit(s) for building users, to include information, warning of the dangers of using portable heaters, (carbon monoxide and fire), fuel storage and candles etc. during potential utility failures, dangers of walking in floodwater, flood warning codes and actions, information about the EA's flood warning system, the nearest Ipswich BC Rest Centre location and information on flood insurance. DEFRA's "Obtaining flood insurance in high risk areas", July 2012 provides guidance. The SRF can provide fact sheets on candle safety and carbon monoxide poisoning.

Particular attention should be given to the communication of warnings to vulnerable people including those with impaired hearing or sight and those with restricted mobility. The police are responsible for evacuations; they may be able to assist but cannot normally force people to evacuate.

Consideration should be given to informing appropriate response organisations, such as the council's Ipswich HEARS service and Social Services, about any elderly or vulnerable people who may require assistance.

The FMP should deal with potential difficulties involved in immediate evacuation which may need to be carried out in inclement weather and require the provision of transport to reach local authority designated rest centres.

Developers are strongly encouraged to liaise with the developers of any nearby sites in the drafting of their FMP to co-ordinate procedures and so minimise confusion during an incident

Ipswich BC emergency advice web site contains further information and links to the EA's website https://www.ipswich.gov.uk/content/emergencies-latest-information. Reference should also be made to the newly published ADEPT/EA guidance, Flood Risk Emergency Plans for New Development[36].

Suggested structure for Emergency Flood Management Plans
1. Introduction • Describe the location of the site fully and accurately • Attach a site plan to help identify the location and size of the site • State the size of the development including the number and type of properties within the development. • Define the access and egress arrangements for the site, the height of proposed buildings and the rescue or re-supply points for those instructed not to evacuate. • State the likelihood of flooding. How big is the risk? • State who will be responsible for reviewing and implementing the FMP.

[36] https://www.adeptnet.org.uk/floodriskemergencyplan

2. Warning arrangements
- How will occupants be informed if a flood is likely to occur?
- Do you intend to register the site with the Environment Agency's flood warning service 'Floodline'?
- What procedure will you follow in responding to any flood warnings received from the Environment Agency?

3.0 Instructions to occupants in the event of a flood warning
- How will occupants be instructed on the procedures to follow in the event of a flood or flood warnings?
- What will these instructions cover?
- What is the procedure for passing on information to new occupants?

4.0 Instructions to commercial tenants in the event of a flood warning
- How will commercial tenants be instructed on the procedures to follow in the event of a flood or flood warnings?
- What will these instructions cover?
- When commercial tenants leave, how will new commercial tenants be informed of the flood evacuation procedures?

5.0 Advice and information from developers
- List useful telephone numbers and websites
- Provide residents/tenants with information on the Environment Agency's Floodline Warnings Direct service.

There is no statutory requirement for the Environment Agency or the emergency services to approve evacuation plans. IBC is accountable via planning condition or agreement to ensure that plans are suitable. This should be done in consultation with emergency planning staff. The FEP evacuation should be structured in accordance with the Suffolk Resilience Forum Guide to Evacuation and Shelter in Suffolk plan. A list of identified Rest Centres in Ipswich can be found in **Appendix Figure 6.**

7.3.7 Water Compatible Development

Ideally the above approach should be followed, however it is recognised that providing safe access, raised floor levels and temporary refuges is likely to be impracticable. The operators of docks, marinas and wharves will be familiar with flood risk and so flood warnings are very likely to be followed. Therefore, the only requirements are:

- Structural Safety of buildings.
- Emergency plans for evacuation and flood warning arrangements for users of buildings
- Emergency plans for actions by Emergency responders
- Flood resilience measures

8. Applying the Exception Test - Assessment of site allocations

8.1 Overview

Using the information presented within this SFRA, the Sequential Test has been applied by IBC to steer potential development towards areas of lowest flood risk. The Council has identified sites at low risk of flooding for development through the Sequential Test.

However, there is not enough land at low risk of flooding to meet the housing land requirement.

Furthermore, the Local Plan is an urban regeneration led plan which focuses development in the centre of Ipswich. Therefore, whilst there are sites outside Flood Zone 3 which the SHELAA identifies as suitable, available and achievable for development, some sites located within Flood Zone 3 are required in addition to meet the housing requirement and to meet the objectives of urban regeneration and sustainable development.

Where residential development (defined as More Vulnerable development) is proposed in Flood Zone 3, the Exception Test is required.

Table 8-1 identifies the potential development sites identified through the SHELAA which are located in Flood Zones 2 and 3. Each site has been reviewed against the flood risk information within the SFRA and the Safety Framework to determine whether development could be delivered on the site that would be considered safe.

The following details have been recorded in Table 8-1:

- Proportion in each Flood Zone and Areas Benefitting from Flood Zones, as shown on the Flood Map for Planning (Rivers and Sea);
- Within 300m of a Main River (Yes/No);
- Within 300m of an Ordinary Watercourse (Yes/No);
- At High, Medium or Low risk of surface water flooding, based on the Risk of Flooding from Surface Water Mapping (Yes/No);
- Probability of groundwater emergence based on the Areas Susceptible to Groundwater Flooding mapping (proportion of the 1km grid square in which the site is located susceptible to groundwater emergence);
- Site is located within an area shown to have experienced flooding on the Environment Agency Historic Flood Map (Yes/No). These records may relate to tidal, fluvial or groundwater flooding;
- Number of historic records of flooding recorded by Ipswich BC within 500m of the site;
- The ‘actual’ risk from the River Gipping in the future as a result of climate change; flood levels for the 1% AEP event including 65% climate change and the 0.1% AEP event including 25% climate change;
- The residual risk of tidal flooding to the site, in the event of breach in the flood defences, as detailed in Section 6.2.3. The maximum hazard rating on the site is recorded.

More detailed site assessment sheets including site specific figures of the flood risk datasets are included in Appendix F.

Table 8-1 Flood risk information for site allocations

Site Reference	Address	FZ 2 Proportion	FZ 3 Proportion	Area Benefitting from Defences	Within 300m of a Main River	Within 300m of an Ordinary Watercourse	ROFSW Low	ROFSW Medium	ROFSW High	ASTGWF	Historic Flood Map	IBC Historic Flood	Actual risk of FLUVIAL flooding from R. Gipping during design flood: Max water level 1% AEP plus 65% CC	Actual risk of FLUVIAL flooding from Ri. Gipping during extreme flood: Max water level 0.1% AEP plus 25% CC	Residual risk of TIDAL flooding: Maximum Hazard Rating on Site	
IP001	Land between 81-97 Fore Street	15%	31%	6%	No	No	YES	YES		>= 25% <50%		14	None	3.97m AOD	No hazard in modelled scenario	Actual risk of fluvial flooding from the River Gipping during an extreme flood in the future (extreme flood level including 25% climate change is 3.97m). Residual risk of tidal flooding, in event of a failure of flood defence infrastructure. Maximum breach flood level in compartment H 4 – 4.1m AOD. Sleeping accommodation above maximum breach flood level. Safe refuge above the extreme maximum breach flood level (0.1% AEP 2118) 5.7m AOD. This is also adequate for the fluvial extreme fluvial flood as the level for the 0.1% AEP event including 25% climate change is 3.97m AOD.
IP003	Waste tip north of Sir Alf Ramsey Way	16%	78%	87%	Yes	Yes	YES			>= 50% <75%	Yes	23	Varies: Western edge 3.45 - 4.80m AOD Eastern edge 3.17 – 3.68m AOD	3.97m AOD	Danger to Most	Actual risk of fluvial flooding from River Gipping in the future during the design flood (design flood level including 65% climate change is 3.5 – 4.8m AOD across site). Residual risk of tidal flooding, in event of failure of flood defence infrastructure. Maximum breach level compartment J 3.61 – 3.7m AOD. Finished floor levels 300mm above fluvial design flood level including climate change (3.5 – 4.8m AOD). Sleeping accommodation above maximum breach flood level. Dry access/egress achievable during the fluvial design flood including 65% climate change south along West End Road. Safe refuge above the extreme maximum breach flood level (0.1% AEP 2118) 5.7m AOD. This is also adequate for the fluvial extreme fluvial flood as the level for the 0.1% AEP event including 25% climate change is 3.97m AOD.
IP004	Bus Depot, Sir Alf Ramsey Way	1%	99%	100%	Yes	Yes	YES			>= 50% <75%	Yes	26	3.17m AOD	3.97m AOD	Danger to Most	Actual risk of fluvial flooding from River Gipping in future during the design flood (design flood level including 65% climate change is 3.17m AOD on the site). Residual risk of tidal flooding, in event of failure of flood defence infrastructure. Maximum breach level compartment J 3.61 – 3.7m AOD. Finished floor levels 300mm above fluvial design flood level including climate change (3.17m AOD). Sleeping accommodation above maximum breach flood level. Dry access/egress achievable during the fluvial design flood including 65% climate change south along West End Road. Safe refuge above the extreme maximum breach flood level (0.1% AEP 2118) 5.7m AOD. This is also adequate for the fluvial extreme fluvial flood as the level for the 0.1% AEP event including 25% climate change is 3.97m AOD. Investigate potential to raise site and part of the existing highway linking to site IP003 to aid site safety. Likely SuDS is attenuation.
IP011 b	Smart Street/Foundation Street	31%	47%	52%	Yes	Yes	YES	YES	YES	>= 25% <50%		32	None	3.97m AOD	Danger for Some	Actual risk of fluvial flooding from the River Gipping during an extreme flood in future (extreme flood level including 25% climate change is 3.97m). Residual risk of tidal flooding, in event of a failure of flood defence infrastructure. Maximum breach flood level in compartment H 4 – 4.1m AOD. Sleeping accommodation above maximum breach flood level. Safe refuge above the extreme maximum breach flood level (0.1% AEP 2118) 5.7m AOD. This is also adequate for the fluvial extreme fluvial flood as the level for the 0.1% AEP event including 25% climate change is 3.97m AOD. Development here has potential to influence flooding at Key Street.
IP011c	Smart Street/Foundation Street	1%	0%	0%	Yes	Yes	YES	YES		>= 25% <50%		14	None	None	No hazard in modelled scenario	The site is largely in Flood Zone 1 and not at risk of fluvial or tidal flooding. No further mitigation measures are required.
IP015	West End Road Surface Car Park	40%	51%	84%	Yes	Yes	YES	YES	YES	< 25%	Yes	22	None	3.97m AOD	Danger to Most	Actual risk of fluvial flooding from the River Gipping during an extreme flood in future (extreme flood level including 25% climate change is 3.97m). Residual risk of tidal flooding, in event of failure of flood defence infrastructure. Maximum breach level compartment J 3.61 – 3.7m AOD. Sleeping accommodation above maximum breach flood level. Safe refuge above the extreme maximum breach flood level (0.1% AEP 2118) 5.7m AOD. This is also adequate for the fluvial extreme fluvial flood as the level for the 0.1% AEP event including 25% climate change is 3.97m AOD.
IP028 b	Land west of Greyfriars Road (Jewsons)	13%	86%	91%	Yes	Yes	YES	YES	YES	>= 25% <50%	Yes	21	None	3.97m AOD	Danger to Most	Actual risk of fluvial flooding from the River Gipping during an extreme flood in future (extreme flood level including 25% climate change is 3.97m). Residual risk of tidal flooding, in event of failure of flood defence infrastructure. Maximum breach level compartment J 3.61 – 3.7m AOD. Sleeping accommodation above maximum breach flood level. Safe refuge above the extreme maximum breach flood level (0.1% AEP 2118) 5.7m AOD. This is also adequate for the fluvial extreme fluvial flood as the level for the 0.1% AEP event including 25% climate change is 3.97m AOD. Site also at risk of flooding from overland flow and the local sewer network

Site Reference	Address	FZ 2 Proportion	FZ 3 Proportion	Area Benefitting from Defences	Within 300m of a Main River	Within 300m of an Ordinary Watercourse	ROFSW Low	ROFSW Medium	ROFSW High	ASTGWF	Historic Flood Map	IBC Historic Flood	Actual risk of FLUVIAL flooding from R. Gipping during design flood: Max water level 1% AEP plus 65% CC	Actual risk of FLUVIAL flooding from Ri. Gipping during extreme flood: Max water level 0.1% AEP plus 25% CC	Residual risk of TIDAL flooding: Maximum Hazard Rating on Site	
IP031a	103-115 Burrell Road	7%	81%	83%	Yes	Yes	YES	YES	YES	>= 25% <50%		24	None	None	No hazard in modelled scenario	The site is not at actual risk of fluvial flooding from the River Gipping during the design flood or the extreme flood. The site may be at residual risk of tidal flooding in the event of a failure of tidal flood defence infrastructure. Maximum breach level for compartment D is 4m AOD. Sleeping accommodation above maximum breach flood level. Safe refuge above the extreme maximum breach flood level (0.1% AEP 2118) 5.7m AOD. This is also adequate for the fluvial extreme fluvial flood as the level for the 0.1% AEP event including 25% climate change is 3.97m AOD. Potential to raise the site to provide safe access from the east.
IP031b	22 Stoke Street IP2 8BX	26%	40%	40%	Yes	Yes	YES			>= 25% <50%		22	None	None	No hazard in modelled scenario	The site is not at actual risk of fluvial flooding from the River Gipping during the design flood or the extreme flood. The site may be at residual risk of tidal flooding in the event of a failure of tidal flood defence infrastructure. Maximum breach level for compartment D is 4m AOD. Sleeping accommodation above maximum breach flood level. Safe refuge above the extreme maximum breach flood level (0.1% AEP 2118) 5.7m AOD. This is also adequate for the fluvial extreme fluvial flood as the level for the 0.1% AEP event including 25% climate change is 3.97m AOD. Potential to raise the site to provide safe access from the east.
IP035	Key Street/Star Lane/Burtons Site	1%	99%	100%	Yes	Yes	YES	YES		>= 25% <50%		23	None	3.97m AOD	Danger to Most	Actual risk of fluvial flooding from the River Gipping during an extreme flood in future (extreme flood level including 25% climate change is 3.97m). Residual risk of tidal flooding, in event of a failure of flood defence infrastructure. Maximum breach flood level in compartment H 4 – 4.1m AOD. Sleeping accommodation above maximum breach flood level. Safe refuge above the extreme maximum breach flood level (0.1% AEP 2118) 5.7m AOD. This is also adequate for the fluvial extreme fluvial flood as the level for the 0.1% AEP event including 25% climate change is 3.97m AOD.
IP037	Island Site	5%	95%	57%	Yes	Yes	YES	YES		>= 25% <50%		35	None	3.97m AOD	Danger to Most	Actual risk of fluvial flooding from the River Gipping during an extreme flood in future (extreme flood level including 25% climate change is 3.97m). Residual risk of tidal flooding, in event of a failure of flood defence infrastructure. Maximum breach flood level in compartment H 4 – 4.1m AOD. Sleeping accommodation above maximum breach flood level. Safe refuge above the extreme maximum breach flood level (0.1% AEP 2118) 5.7m AOD. This is also adequate for the fluvial extreme fluvial flood as the level for the 0.1% AEP event including 25% climate change is 3.97m AOD. Potential to provide a new bridge to Mather Way and raise parts of the site. Develop the site with IP133 and IP050. At risk from tidal surface water and combined sewers. Existing defences here have failed in the past. As part of a site-specific FRA, a site-specific breach assessment close to the site will be required. Off-site foul water sewer under the river will be required.
IP039a	Land between Gower Street and Great Whip Street	9%	76%	72%	Yes	Yes	YES	YES	YES	>= 25% <50%		22	None	None	Danger to Most	The site is not at actual risk of fluvial flooding from the River Gipping during the design flood or the extreme flood. Residual risk of tidal flooding, in event of a failure of flood defence infrastructure. Maximum breach flood level in compartment C 3.5m AOD. Sleeping accommodation above maximum breach flood level. Safe refuge above the extreme maximum breach flood level (0.1% AEP 2118) 5.7m AOD. Risk from tidal surface water and combined sewers. A high-level trunk sewer crosses the site. Likely SuDS is attenuation.
IP043	Commercial Buildings, Star Lane	16%	21%	18%	Yes	Yes	YES			>= 25% <50%		18	None	3.97m AOD	Danger to Most	Actual risk of fluvial flooding from the River Gipping during an extreme flood in future (extreme flood level including 25% climate change is 3.97m). Residual risk of tidal flooding, in event of a failure of flood defence infrastructure. Maximum breach flood level in compartment H 4 – 4.1m AOD. Sleeping accommodation above maximum breach flood level. Safe refuge above the extreme maximum breach flood level (0.1% AEP 2118) 5.7m AOD. This is also adequate for the fluvial extreme fluvial flood as the level for the 0.1% AEP event including 25% climate change is 3.97m AOD. The site is sloping; more vulnerable uses can be located at higher level. Risk of flooding from surface water and combined sewers. Discharge of surface water may be an issue as Star Lane surface water sewer is pumped via Stoke Bridge Tank back into the combined sewer.

Site Reference	Address	FZ 2 Proportion	FZ 3 Proportion	Area Benefitting from Defences	Within 300m of a Main River	Within 300m of an Ordinary Watercourse	ROFSW Low	ROFSW Medium	ROFSW High	ASTGWF	Historic Flood Map	IBC Historic Flood	Actual risk of FLUVIAL flooding from R. Gipping during design flood: Max water level 1% AEP plus 65% CC	Actual risk of FLUVIAL flooding from Ri. Gipping during extreme flood: Max water level 0.1% AEP plus 25% CC	Residual risk of TIDAL flooding: Maximum Hazard Rating on Site	
IP045	Holywells Road west/Toller Road	17%	83%	100%	Yes	Yes	YES	YES	YES	< 25%		3	None	3.97m AOD	Danger to All	<u>Actual risk</u> of fluvial flooding from the River Gipping during an extreme flood in future (extreme flood level including 25% climate change is 3.97m). <u>Residual risk</u> of tidal flooding, in event of a failure of flood defence infrastructure. Maximum breach flood level in compartment H close to Breach 05 is 4.1 – 5.3m AOD. Sleeping accommodation above maximum breach flood level. Access/egress routes along Holywells Road may have a potential hazard rating of up to Significant ("Danger for most") and Extreme ("Danger for all") during breach scenario. Safe refuge above the extreme maximum breach flood level (0.1% AEP 2118) 5.7m AOD. This is also adequate for the fluvial extreme fluvial flood as the level for the 0.1% AEP event including 25% climate change is 3.97m AOD. There have been suggestions to raise the site and provide safe access through the site to junction of Toller and Holywells Road. The site is at risk of flooding from surface water and combined sewers. There is frequent deep flooding on Holywells Road – the cause needs to be established and resolved. There may be a risk of collapsing embankments to the canal in Holywells park.
IP047	Land at Commercial Road	0%	100%	100%	Yes	Yes	YES			>= 25% <50%	Yes	43	None	3.97m AOD	Danger to Most	<u>Actual risk</u> of fluvial flooding from the River Gipping during an extreme flood in future (extreme flood level including 25% climate change is 3.97m). <u>Residual risk</u> of tidal flooding, in event of failure of flood defence infrastructure. Maximum breach level compartment J 3.61 – 3.7m AOD. Sleeping accommodation above maximum breach flood level. Access/egress route along Commercial Road / Grafton Way may have a potential hazard rating of up to Significant ("Danger for most") and Extreme ("Danger for all") during breach scenario. Safe refuge above the extreme maximum breach flood level (0.1% AEP 2118) 5.7m AOD. This is also adequate for the fluvial extreme fluvial flood as the level for the 0.1% AEP event including 25% climate change is 3.97m AOD. **Note – breach modelling outputs at this location assume that land raising has been completed which is not the case currently. This will have to be considered as part of site design.**
IP052	Land between Lower Orwell Street and Star Lane	5%	1%	0%	Yes	Yes	YES	YES	YES	>= 25% <50%		17	None	None	No hazard in modelled scenario	Majority of site in Flood Zone 1 and not at risk of fluvial or tidal flooding. The site is safe for development. Risk of flooding from surface water and combined sewers should be assessed as part of a FRA. Attenuation is likely SuDS at this location.
IP054 b	Land between Old Cattle Market and Star Lane	29%	23%	27%	Yes	Yes	YES	YES	YES	>= 25% <50%		24	None	3.97m AOD	Danger to some	The majority of the site is in Flood Zone 1; south eastern part in Flood Zone 3. <u>Actual risk</u> of fluvial flooding from the River Gipping during an extreme flood in future (extreme flood level including 25% climate change is 3.97m). <u>Residual risk</u> of tidal flooding, in event of a failure of flood defence infrastructure. Maximum breach flood level in compartment H 4 – 4.1m AOD. Sleeping accommodation above maximum breach flood level. Dry access/egress for the site may be achievable from the northern side of the site along Turret Lane or Rose Lane / St Peter's Street. The route along Star Lane is shown to be flooded, at Significant hazard (Danger for Most), and would therefore not offer a dry route. Safe refuge above the extreme maximum breach flood level (0.1% AEP 2118) 5.7m AOD. This is also adequate for the fluvial extreme fluvial flood as the level for the 0.1% AEP event including 25% climate change is 3.97m AOD.
IP064 a	Holywells Road (east)	19%	29%	30%		Yes	YES	YES	YES	< 25%		3	None	3.97m AOD	Danger to Most	<u>Actual risk</u> of fluvial flooding from the River Gipping during an extreme flood in future (extreme flood level including 25% climate change is 3.97m). <u>Residual risk</u> of tidal flooding, in event of a failure of flood defence infrastructure. Maximum breach flood level in compartment H close to Breach 05 is 4.1 – 5.3m AOD. Sleeping accommodation above maximum breach flood level. Access/egress routes along Holywells Road may have a potential hazard rating of up to Significant ("Danger for most") and Extreme ("Danger for all") during breach scenario. Safe refuge above the extreme maximum breach flood level (0.1% AEP 2118) 5.7m AOD. This is also adequate for the fluvial extreme fluvial flood as the level for the 0.1% AEP event including 25% climate change is 3.97m AOD. The site is at risk of flooding from surface water and combined sewers. There is frequent deep flooding on Holywells Road – the cause needs to be established and resolved. There may be a risk of collapsing embankments to the canal in Holywells park.
IP096	Car Park, Handford Road (east)	6%	3%	6%		Yes	YES			>= 50% <75%		11	None	None	No hazard in modelled scenario	Majority of the site is in Flood Zone 1, and safe for development. Development should be set back from the Alderman Canal.

Site Reference	Address	FZ 2 Proportion	FZ 3 Proportion	Area Benefitting from Defences	Within 300m of a Main River	Within 300m of an Ordinary Watercourse	ROFSW Low	ROFSW Medium	ROFSW High	ASTGWF	Historic Flood Map	IBC Historic Flood	Actual risk of FLUVIAL flooding from R. Gipping during design flood: Max water level 1% AEP plus 65% CC	Actual risk of FLUVIAL flooding from Ri. Gipping during extreme flood: Max water level 0.1% AEP plus 25% CC	Residual risk of TIDAL flooding: Maximum Hazard Rating on Site	
IP098	Transco, south of Patteson Road	47%	53%	80%	Yes	Yes	YES			< 25%		3	None	3.97m AOD	Danger to Most	Actual risk of fluvial flooding from the River Gipping during an extreme flood in future (extreme flood level including 25% climate change is 3.97m). Residual risk of tidal flooding, in event of a failure of flood defence infrastructure. Maximum breach flood level in compartment H close to Breach 05 is 4.1 – 5.3m AOD. Sleeping accommodation above maximum breach flood level. Access/egress routes along Cliff Road towards Myrtle Road roundabout may have a potential hazard rating of up to Significant ("Danger for most") during a breach scenario. Safe refuge above the extreme maximum breach flood level (0.1% AEP 2118) 5.7m AOD. This is also adequate for the fluvial extreme fluvial flood as the level for the 0.1% AEP event including 25% climate change is 3.97m AOD.
IP105	Depot, Beaconsfield Road	100%	0%	57%	Yes	Yes	YES	YES	YES	>= 25% <50%	Yes	10	None	4.85m AOD	No hazard in modelled scenario	Site located in Flood Zone 2. Actual risk of fluvial flooding from the River Gipping during an extreme flood in future (extreme flood level including 25% climate change is 3.97m). The site is not shown to flood during the design flood, and therefore requirements for finished floor levels and access/egress are met. Safe refuge must be provided above the extreme flood level for the River Gipping, which is 4.85m AOD. All development should be set back 16m from the edge of the River Gipping. The Environment Agency need to be consulted and an Environmental Permit obtained for any works within 16m a Main River.
IP119	Land east of West End Road	42%	4%	3%	Yes	Yes	YES			>= 50% <75%	Yes	40	4.82m AOD	4.97m AOD	No hazard in modelled scenario	Approximately half of the site is in Flood Zone 1 and half in Flood Zone 2/3. Most of the island at West End Road has ground levels between 4 and 5.5m AOD. Actual risk of fluvial flooding from River Gipping in future during the design flood (design flood level including 65% climate change is 4.82m AOD on the site). Residual risk of tidal flooding in the event of a failure of flood defence infrastructure. Finished floor levels 300mm above fluvial design flood level including climate change (4.82m AOD). The section of West End Road immediately adjacent to the site is shown to be at Significant hazard during the design flood including an allowance for climate change (1% AEP plus 65% climate change) and therefore does not provide a suitable access/egress route. However, dry access/egress for the site is achievable to the south along West End Road. There may also be potential to design a route into the site layout to the north of the site towards the A1071. The use of a raised riverside pathway in the site design would enable a dry access route for people to be maintained without resulting in significant land take. With respect to the residual risk of tidal flooding, safe refuge must be provided above the 0.1% AEP flood level including an allowance for climate change over the lifetime of the development (5.7m AOD to 2118). This will also be adequate as a safe place of refuge for the extreme fluvial flood, as the flood level for the 0.1% AEP event including 25% allowance for climate change is 4.97m AOD. Development should be set back 16m from the edge of the River Gipping.
IP120b	Land west of West End Road	39%	8%	11%	Yes	Yes	YES			>= 50% <75%	Yes	24	4.75m AOD	4.80m AOD	No hazard in modelled scenario	Approximately half of the site is in Flood Zone 1 and half in Flood Zone 2/3. Most of the island at West End Road has ground levels between 4 and 5.5m AOD. Actual risk of fluvial flooding from River Gipping in future during the design flood (design flood level including 65% climate change is 4.75m AOD on the site). Residual risk of tidal flooding in the event of a failure of flood defence infrastructure. Finished floor levels 300mm above fluvial design flood level including climate change (4.75m AOD). The section of West End Road to the north of the site is shown to be at Significant hazard during the design flood including an allowance for climate change (1% AEP plus 65% climate change) and therefore does not provide a suitable access/egress route. However, dry access/egress for the site is achievable to the south along West End Road. There may also be potential to design a route into the site layout to the north of the site towards the A1071. The use of a raised riverside pathway in the site design would enable a dry access route for people to be maintained without resulting in significant land take. With respect to the residual risk of tidal flooding, safe refuge must be provided above the 0.1% AEP flood level including an allowance for climate change over the lifetime of the development (5.7m AOD to 2118). This will also be adequate as a safe place of refuge for the extreme fluvial flood, as the flood level for the 0.1% AEP event including 25% allowance for climate change is 4.80m AOD. Development should be set back 16m from the edge of the River Gipping.

Site Reference	Address	FZ 2 Proportion	FZ 3 Proportion	Area Benefitting from Defences	Within 300m of a Main River	Within 300m of an Ordinary Watercourse	ROFSW Low	ROFSW Medium	ROFSW High	ASTGWF	Historic Flood Map	IBC Historic Flood	Actual risk of FLUVIAL flooding from R. Gipping during design flood: Max water level 1% AEP plus 65% CC	Actual risk of FLUVIAL flooding from Ri. Gipping during extreme flood: Max water level 0.1% AEP plus 25% CC	Residual risk of TIDAL flooding: Maximum Hazard Rating on Site	
IP132	Bridge Street, Northern Quays (west)	0%	100%	100%	Yes	Yes	YES	YES		>= 25% <50%		22	None	3.97m AOD	Danger to Most	Actual risk of fluvial flooding from the River Gipping during an extreme flood in future (extreme flood level including 25% climate change is 3.97m). Residual risk of tidal flooding, in event of a failure of flood defence infrastructure. Maximum breach flood level in compartment H 4 – 4.1m AOD. Sleeping accommodation above maximum breach flood level. In the event of a failure of the tidal flood defences, the access / egress route along College Street and Star Lane are shown to have a hazard rating of Significant (Danger for Most) and would therefore not offer a safe route. Safe refuge above the extreme maximum breach flood level (0.1% AEP 2118) 5.7m AOD. This is also adequate for the fluvial extreme fluvial flood as the level for the 0.1% AEP event including 25% climate change is 3.97m AOD.
IP133	South of Felaw Street	39%	51%	61%	Yes	Yes	YES	YES		>= 25% <50%		4	None	None	Caution	The site is not at actual risk of fluvial flooding from the River Gipping during the design flood or the extreme flood. Residual risk of tidal flooding, in event of a failure of flood defence infrastructure. Maximum breach flood level in compartment C 3.5m AOD. Sleeping accommodation above maximum breach flood level. Safe refuge above the extreme maximum breach flood level (0.1% AEP 2118) 5.7m AOD. Development should be set back 16m from the River Orwell.
IP136	Silo, College Street	0%	100%	100%	Yes	Yes	YES	YES		>= 25% <50%		23	None	3.97m AOD	Danger to Most	Actual risk of fluvial flooding from the River Gipping during an extreme flood in future (extreme flood level including 25% climate change is 3.97m). Residual risk of tidal flooding, in event of a failure of flood defence infrastructure. Maximum breach flood level in compartment H 4 – 4.1m AOD. Sleeping accommodation above maximum breach flood level. The hazard mapping shows that in the event of a breach in the flood defences during the 0.5% AEP event (2118), parts of the access/egress routes away from the site along College Street and Star Lane may have a potential hazard rating of up to Significant ("Danger for most"). Safe refuge above the extreme maximum breach flood level (0.1% AEP 2118) 5.7m AOD. This is also adequate for the fluvial extreme fluvial flood as the level for the 0.1% AEP event including 25% climate change is 3.97m AOD.
IP178	Island House, Duke Street	44%	51%	50%			YES	YES		< 25%		6	None	3.97m AOD	Danger to Most	Actual risk of fluvial flooding from the River Gipping during an extreme flood in future (extreme flood level including 25% climate change is 3.97m). Residual risk of tidal flooding, in event of a failure of flood defence infrastructure. Maximum breach flood level in compartment H 4.1 – 5.3m AOD. Sleeping accommodation above maximum breach flood level. Dry access/egress routes along Duke Street and to the east. Safe refuge above the extreme maximum breach flood level (0.1% AEP 2118) 5.7m AOD. This is also adequate for the fluvial extreme fluvial flood as the level for the 0.1% AEP event including 25% climate change is 3.97m AOD.
IP188	Websters saleyard site, Dock Street	17%	83%	94%	Yes	Yes	YES	YES	YES	>= 25% <50%		22	None	None	Caution	The site is not at actual risk of fluvial flooding from the River Gipping during the design flood or the extreme flood. Residual risk of tidal flooding, in event of a failure of flood defence infrastructure. Maximum breach flood level in compartment C 3.5m AOD. Sleeping accommodation above maximum breach flood level. The hazard mapping shows that in the event of a breach in the flood defences during the 0.5% AEP event (2118), part of the access/egress routes away from the site along Stoke Quay may have a potential hazard rating of up Low to Moderate ("Danger for some"). Safe refuge above the extreme maximum breach flood level (0.1% AEP 2118) 5.7m AOD. Development should be set back 16m from the River Orwell.
IP226	Helena Road	2%	98%	100%	Yes	Yes	YES	YES		< 25%		3	None	3.97m AOD	Danger for All	Actual risk of fluvial flooding from the River Gipping during an extreme flood in future (extreme flood level including 25% climate change is 3.97m). Residual risk of tidal flooding, in event of a failure of flood defence infrastructure. Maximum breach flood level in compartment H 4.1 – 5.3m AOD. Sleeping accommodation above maximum breach flood level. In the event of a failure of the tidal flood defences, access/egress routes along Cliff Road towards the Myrtle Road roundabout and along Patteson Road may have a potential hazard rating of up to Significant ("Danger for most") and Extreme ("Danger for all"). Safe refuge above the extreme maximum breach flood level (0.1% AEP 2118) 5.7m AOD. This is also adequate for the fluvial extreme fluvial flood as the level for the 0.1% AEP event including 25% climate change is 3.97m AOD.

Site Reference	Address	FZ 2 Proportion	FZ 3 Proportion	Area Benefitting from Defences	Within 300m of a Main River	Within 300m of an Ordinary Watercourse	ROFSW Low	ROFSW Medium	ROFSW High	ASTGWF	Historic Flood Map	IBC Historic Flood	Actual risk of FLUVIAL flooding from R. Gipping during design flood: Max water level 1% AEP plus 65% CC	Actual risk of FLUVIAL flooding from Ri. Gipping during extreme flood: Max water level 0.1% AEP plus 25% CC	Residual risk of TIDAL flooding: Maximum Hazard Rating on Site	
IP279 b(2)	South of former BT office, Bibb Way	18%	2%	1%	Yes	Yes	YES	YES		>= 50% <75%		39	3.9m AOD	4.6m AOD	No hazard in modelled scenario	Majority of the site is in Flood Zone 1, and safe for development. The southern edge of the site is within Flood Zone 3. Actual risk of fluvial flooding from River Gipping in future during the design flood (design flood level including 65% climate change is 3.9m AOD on the site). Residual risk of tidal flooding, in event of failure of flood defence infrastructure. Maximum breach level compartment J 3.61 – 3.7m AOD. Finished floor levels 300mm above fluvial design flood level including climate change (3.9m AOD). Sleeping accommodation above maximum breach flood level. Dry access/egress achievable during the fluvial design flood including 65% climate change north towards Handford Road. Safe refuge above the extreme maximum breach flood level (0.1% AEP 2118) 5.7m AOD. This is also adequate for the fluvial extreme fluvial flood as the level for the 0.1% AEP event including 25% climate change is 4.6m AOD.
IP354	72 (Old Boatyard) Cullingham Road IP1 2EG	74%	26%	45%	Yes	Yes	YES			>= 50% <75%	Yes	39	4.47m AOD	4.7 – 4.95m AOD	No hazard in modelled scenario	Majority of the site is in Flood Zone 2, with the western edge within Flood Zone 3. Actual risk of fluvial flooding from River Gipping in future during the design flood (design flood level including 65% climate change is 4.47m AOD on the site). Residual risk of tidal flooding, in event of failure of flood defence infrastructure. Maximum breach level compartment J 3.61 – 3.7m AOD. Finished floor levels 300mm above fluvial design flood level including climate change (4.47m AOD). Sleeping accommodation above maximum breach flood level. Safe access/egress achievable during the fluvial design flood including 65% climate change along Cullingham Road, at low hazard rating. Safe refuge above the extreme maximum breach flood level (0.1% AEP 2118) 5.7m AOD. This is also adequate for the fluvial extreme fluvial flood as the level for the 0.1% AEP event including 25% climate change is 4.7 – 4.95m AOD. Development must be set back 16m from the edge of the River Gipping.
IP355	77-79 Cullingham Road	90%	4%	62%	Yes	Yes	YES	YES		>= 50% <75%		24	4.16m AOD	4.49m AOD	No hazard in modelled scenario	Majority of the site is in Flood Zone 2, with a small section of Flood Zone 3 and Flood Zone 1. Actual risk of fluvial flooding from River Gipping in future during the design flood (design flood level including 65% climate change is 4.16m AOD on the site). Residual risk of tidal flooding, in event of failure of flood defence infrastructure. Maximum breach level compartment J 3.61 – 3.7m AOD. Finished floor levels 300mm above fluvial design flood level including climate change (4.16m AOD). Sleeping accommodation above maximum breach flood level. Safe access/egress achievable during the fluvial design flood including 65% climate change along Cullingham Road, at low hazard rating. Safe refuge above the extreme maximum breach flood level (0.1% AEP 2118) 5.7m AOD. This is also adequate for the fluvial extreme fluvial flood as the level for the 0.1% AEP event including 25% climate change is 4.7 – 4.95m AOD. Development must be set back from the watercourse along the from the edge of the Alderman Canal.

9. Flood risk management

9.1 Overview

Further to the Safety Framework for development in Flood Zones 2 or 3 set out in Section 7, this section provides information and guidance on flood risk management measures that should be applied when considering development in Ipswich.

9.2 Basements

Basements can be defined as self-contained, with no free internal access upstairs in an event of flood water coming down outside access routes.

Basement dwellings are defined as 'highly vulnerable' because they are particularly vulnerable to all forms of flooding. Surface water flooding can pose a serious risk to users of basements, but other forms of flooding, such as groundwater flooding, can be equally dangerous. Basements are at high risk because they are likely to flood first, inundate rapidly, and escape may be difficult, particularly for people with mobility impairments. If basements flood there is not only the risk of damage to the property but also a risk to life. Resilient design may also be difficult to implement, for example, locating a useable electricity supply above predicted flood levels.

The NPPF does not permit habitable basements in Flood Zone 3 and the suggested Safety Framework for development in Flood Zones 2 and 3 (described in Section 7) would prevent basement dwellings from being built in both Flood Zones 2 and 3. However, in some locations basements outside Flood Zone 2 could be flooded by tidal or fluvial flooding via the sewerage system.

Basement dwellings should therefore not be permitted where the floor level is below the 0.1% AEP tide level in 100 years' time.

Basements dwellings should not be permitted in areas susceptible to surface water flooding.

Basements in Flood Zone 1 should only be permitted subject to adequate FRAs, which must address ground water, sewer and overland flood sources.

The above recommendations should also apply to changes of use of existing basements.

9.2.1 Basement car parking

Long-term and residential car parking is unlikely to be acceptable in areas which regularly flood to a significant depth, due to the risk of car owners being away from the area and being unable to move their cars when a flood occurs. Like other forms of development, flood risk should be avoided if possible. If this is not feasible, the FRA should detail how the design makes the car park safe.

9.3 Car Parks

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

Where car parks are proposed in basements or under croft areas, developers should ensure that there are safe, dry access routes to land outside of the floodplain whilst ensuring that water cannot enter the car park during a 1 in 100 year (1% AEP) plus climate change flood event.

9.4 Riverside Development

Development should be set back from the edge of watercourses, and opportunities for riverside restoration should be considered.

Where development is located adjacent to a Main River, the Environment Agency should be consulted on works, operations in the bed or within 20m of the top of a bank, or development within 9m of a main river or formal defence. Further guidance is available on the Environment Agency website[37].

As the LLFA, SCC require a 3.5m access strip adjacent to any Ordinary Watercourses. Appendix B of the LFRMS for SCC sets out the requirements for consenting. Further guidance is on the Suffolk CC website[38].

9.5 Development Layout and Sequential Approach

A sequential approach to site planning should be applied within new development sites.

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.

Consideration of the presence of 'older' defences should be included especially where they are located upstream of the new Barrier and its associated raised defences. These defences may still perform a useful function for the management of fluvial flow volumes at times when the barrier is closed.

9.6 Flood Warning and Alert

Flood Warning Areas are geographical areas where the Environment Agency expect flooding to occur and where they 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. Specifically, Flood Warning Areas define locations within the Flood Warning Service Limit that represent a discrete community at risk of flooding.

Flood Alert Areas are geographical areas where it is possible for flooding to occur from rivers, sea and in some locations, groundwater. A single Flood Alert Area may cover the floodplain within the Flood Warning Service Limit of multiple catchments of similar characteristics containing a number of Flood Warning Areas.

The flood alert areas in Ipswich are illustrated in **Appendix A Figure 16** and summarised in Table 9-1. These may be subject to change since the completion of the IFDMS, The Environment Agency issue flood warnings to homes and businesses when flooding is expected. Upon receipt of a warning, occupants should take immediate action.

Ipswich BC has designated emergency rest centres across the Borough. The locations of these centres are illustrated in **Appendix A Figure 6**.

Table 9-1 Environment Agency Flood Warning and Flood Alert Areas in Ipswich

Flood Warning Area Name	Description
River Gipping	The River Gipping from Needham Market to London Road Bridge, Ipswich
Tidal River Orwell	The Tidal River Orwell at Cliff Quay industrial area, Ipswich
	The Tidal River Orwell at Ipswich Wet Dock and waterfront, to upstream of Stoke Bridge
	The Tidal River Orwell estuary from Felixstowe to Bourne Bridge in Ipswich
	The Tidal River Orwell from Bourne Park to Hadleigh Road Industrial Estate
Flood Alert Area Name	Description
River Gipping	The River Gipping downstream of Needham Market, to upstream of London Road Bridge, Ipswich
River Orwell and River Stour (District of Babergh)	The Suffolk and Essex coast from Felixstowe to Clacton including Orwell and Stour estuaries.

[37] Flood risk activities: environmental permits, https://www.gov.uk/guidance/flood-risk-activities-environmental-permits
[38] https://www.suffolk.gov.uk/roads-and-transport/flooding-and-drainage/guidance-on-development-and-flood-risk/

9.7 Surface Water Management

9.7.1 Overview

The NPPF Planning Practice Guide states "developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage systems".

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 published by DCLG and Department for the Environment, Food and Rural Affairs (DEFRA)[39] as well as SCC's SuDS Guidance[40] and the CIRIA SuDS Manual. In line with the IBC Local Plan, SuDS must be implemented for all development sites unless it is demonstrated that SuDS are not suitable.

Suitable surface water management measures should be incorporated into new development designs in order to reduce and manage surface water flood risk to and posed by the proposed development. This should ideally be achieved by incorporating SuDS.

The Construction Industry Research and Information Association (CIRIA) SuDS Manual 2015 defines sustainable drainage or SuDS as *'a way of managing rainfall that minimises the negative impacts on the quantity and the quality of runoff whilst maximising the benefits of amenity and biodiversity for people and the environment'.*

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

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

Generally, the aim should be to discharge surface water run-off as high up the following hierarchy of drainage options as reasonably practicable:

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

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

- **Infiltration**: the soaking of water into the ground. This is the most desirable solution as it mimics the natural hydrological process. The rate of infiltration will vary with soil type and condition, the antecedent conditions and with time. The process can be used to recharge groundwater sources and feed baseflows of local watercourses, but where groundwater sources are vulnerable or there is risk of contamination, infiltration techniques are not suitable. Infiltration testing to confirm the infiltration rate should be undertaken in accordance with BRE 365. If the site lies within groundwater Source Protection Zones 1 or 2[42] the risk of contaminating groundwater and control measures required to mitigate this should be considered, in accordance with IBC Supplementary Planning Document (SPD).

[39] Sustainable drainage systems: non-statutory technical standards - https://www.gov.uk/government/publications/sustainable-drainage-systems-non-statutory-technical-standards; PPG Flood Risk and Coastal Change – 23rd March 2015 http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/reducing-the-causes-and-impacts-of-flooding/why-are-sustainable-drainage-systems-important/
[40] https://www.suffolk.gov.uk/roads-and-transport/flooding-and-drainage/guidance-on-development-and-flood-risk/
[41] CIRIA C697 SuDS Manual. Available from: http://www.ciria.org/Resources/Free_publications/the_suds_manual.aspx
[42] Groundwater Source Protection Zones, http://apps.environment-agency.gov.uk/wiyby/37833.aspx

- **Detention/Attenuation**: the slowing down of surface flows before their transfer downstream, usually achieved by creating a storage volume and a constrained outlet.
- **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.

Ground conditions primarily dictate the use of infiltration and attenuation SuDS, as summarised in Table 9-2.

Table 9-2 Conditions for different type of SuDS

	Infiltration SuDS	Attenuation SuDS
Soil permeability >10mm/Hr	OK	Use infiltration in preference
Soil permeability <10mm/Hr	No	OK
High water table	Not below water table	May be OK, permanent water possible
Filled land	No	
Contaminated land	Probably not	OK
Groundwater Source Protection Outer Zone	Subject to pollution control measures, not directly to aquifer strata	OK
Groundwater Source Protection Inner Zone	OK for roof water	OK

As part of any SuDS scheme, consideration should be given to the whole life management and maintenance of the SuDS to ensure that it remains functional for the lifetime of the development. For brownfield sites with existing direct, uncontrolled discharges to the sewerage system, SuDS incorporated in new development, should reduce peak flows discharged to the sewerage system and thus provide a more strategic benefit to local flooding. **Reference should be made to the Suffolk Flood Risk Management Strategy Appendix A for further detail on the design standards for SuDS.**

It is important to note that SuDS require adequate space, and this will have implications for the consideration of site capacities during the preparation of the Strategic Housing and Employment Land Availability Assessment by Ipswich BC.

9.7.2 Guidance on SuDS

General guidance to consider when designing SuDS is as follows:

- SuDS would not be required to limit flows discharged from developments alongside the Tidal River Orwell, however the Environment Agency does require SuDS to limit flows discharged to the Gipping. Developers should consult the Environment Agency to agree an acceptable discharge rate to the River Gipping;
- Infiltration SuDS should not be used where there is potential for ground instability such as infilled ground, contaminated ground or close to steep slopes. An assessment of suitability for infiltration should be undertaken to demonstrate the impact of infiltration SuDS on ground conditions. Soakaways need to be above the groundwater table;
- Maintenance / Adoption - maintenance is vital to the long-term performance of the SuDS and it is important that drainage proposals consider the appropriate level of ongoing maintenance required for throughout the design life of the SuDS. The design of the SuDS should also consider safe access for maintenance. Confirmation of the ownership / adoption arrangement for the SuDS should be established at the conceptual design stage;
- Attenuation SuDS should be designed to attenuate to a controlled discharge rate. Discharge to existing land drains, highway drains or piped watercourses will only be permitted by SCC where they are constructed to an acceptable standard, have proven adequate capacity and clearly defined maintenance responsibilities. Water quality requirements will also need to be met;

- No minimum threshold is set for the control of flows. However, design should ensure that the flow control is protected from blockage. Attenuation systems are normally inappropriate for draining small areas where small throttles (<100mm) would be prone to blockage;
- Infiltration devices should not be designed within 5m of a building or road, or areas of unstable land in accord with Clause 3.25a of The Building Regulations 2010 Drainage and Waste Disposal[43];
- Best practice guidance in the Suffolk Flood Risk Management Partnership (SFRMP)[44] SuDS guidance and Anglian Water's Surface Water Drainage Policy[45]requires discharge rates from new developments should be restricted to Greenfield runoff rates;
- Where a Brownfield site is redeveloped, Anglian Water set out in their Surface Water Drainage Policy[46] that no historic right of connection will exist, and any new sewer connections will be treated as new, and therefore discharge rate limited to the equivalent 1 in 1 year Greenfield rate. Where this is not practical, the developer will be asked to calculate the Brownfield rate, based on existing roof areas, and the discharge rate from the development will be limited to the equivalent 1 in 1 year rate, or a rate agreed by Anglian Water;
- Layout and form of buildings and roads must be designed around SuDS bearing in mind SuDS should be sited in lower areas, but preferably close to source, making use of topography;
- Infiltration systems must be sited at least 5m from buildings, 4 m from adopted highway kerb lines and 10m from railway boundary fences.

The preference is to use infiltration drainage wherever appropriate. Reference should be made to geology **Appendix A Figure 17** to determine where infiltration systems are most likely to be possible (subject to soakage tests).

These are areas expected to have sands and gravels that are outside the flood plain, above spring lines and outside known filled areas (which may possibly be contaminated). Inner groundwater protection zones are also shown. Soils outside the area might be found to be suitable for infiltration systems and in such cases infiltration systems should be used.

Experience shows that even in the Kesgrave sands and gravels, soakage rates may not be high enough for infiltration systems. Soakage rates measured in accordance with BRE365 can vary from less than 1mm/Hr to about 100 mm/Hr depending on the depth and location of the test pit. Soakage tests carried out in bore holes or small pits are often inappropriate, very inaccurate and not normally acceptable for planning purposes.

9.7.3 Opportunities for Strategic SuDS or Flood risk reduction

Highway drainage/flood relief schemes have in the last few years used infiltration type SuDS to avoid increased downstream flood risk often associated with traditional piped schemes. Such schemes would be particularly beneficial where surface water could be separated from the existing combined sewerage system.

For Brownfield sites, no historic right to connect will exist and SuDS incorporated in new development, must reduce peak flows discharged to the sewerage system to Greenfield rates, and thus provide a more strategic benefit to local flooding.

Retrofitting SuDS as development becomes denser and "Space for water" is lost is a growing problem. Where space could be identified it should be possible to connect Highway drainage into SuDS in adjacent open spaces.

Ipswich BC are encouraged to identify sites such as wide verges or other open land that could be used for SuDS to provide strategic relief.

The Heath Road and Bixley Road scheme installed in 2009/10 comprises open land used for SuDS to provide strategic relief. This was a retrofit SuDS scheme to mitigate flooding that was occurring due to the paving of verges to provide a cycleway.

[43] The Building Regulations 2010 – Drainage and waste disposal. Approved Document H. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/442889/BR_PDF_AD_H_2015.pdf
[44] Sustainable Drainage Systems (SuDS) a Local Design Guide, https://www.suffolk.gov.uk/roads-and-transport/flooding-and-drainage/guidance-on-development-and-flood-risk/
[45] Anglian Water Surface Water Drainage Policy, February 2019 https://www.anglianwater.co.uk/developers/development-services/surface-water-policy/
[46] Anglian Water Surface Water Drainage Policy, February 2019 https://www.anglianwater.co.uk/developers/development-services/surface-water-policy/

In appropriate locations, to reduce flood risk generally and locally developers should be required to drain highways adjacent to their sites into SuDS within their sites.

The Council is considering how to reduce the impact of paving of gardens and loss of grass verges, and some measures relating to new footway crossings are in place. For driveways, if the surface to be covered is more than five square metres, planning permission is needed for laying traditional, impermeable driveways that do not provide for the water to run to a permeable area. The maps with this report should assist in development of policies.

9.8 Strategic Flood Risk Management

9.8.1 Flood Storage

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.

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 the other methods benefit only the local area, and may increase the flood risk downstream.

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

The capacity of drainage systems serving the low-lying areas of Ipswich is reduced when tide levels are above the soffit of outfall pipes. Discharge to the Orwell will not be possible whilst the tide is above upstream ground levels.

Rising sea levels, paving of gardens and increased development will increase the risk of flooding whilst the above mitigation measures will offset the effect to a certain extent.

Anglian Water's existing underground storage tanks at Alderman Recreation Ground, east of Yarmouth Rd, and adjacent to Stoke Bridge were designed primarily to reduce pollution from some of the outfalls and can be expected to fill several times per year and so do not provide sufficient flood storage at present.

Flooding of the lowest areas should be expected at present, and indeed the local flooding maps do show such flooding in several areas. It is thought that flooding in other low open space areas is simply not reported.

Detailed sewerage modelling by Anglian Water could determine how much additional storage is needed to provide adequate future standards of protection but would need to make assumptions regarding future paving and development.

Spaces for additional storage need to be identified and reserved before they are developed.

Such storage (attenuation type SuDS) would most likely be a combination of facilities provided at ground level (landscaped basins, ponds etc) and underground, sited in the lowest parts of the tidal flood compartments and/or adjacent to AW's existing tanks.

Flood storage areas could drain by gravity until low water neap tide levels come close to the level of bottom of the flood storage area. LWNT by 2107 is predicted at 0.15 m AOD.

Appendix A Figure 18 identifies locations of current storage facilities in Ipswich and low lying areas likely to be needed for flood storage and local flooding in the future.

[47] Environment Agency, Fluvial Design Guidance Chapter 10 http://evidence.environment-agency.gov.uk/FCERM/en/FluvialDesignGuide/Chapter10.aspx?pagenum=2

10. Guidance for FRAs

10.1 What is a Flood Risk Assessment?

A site-specific FRA is a report suitable for submission with a planning application which provides an assessment of flood risk to and from a proposed development and demonstrates how the proposed development will be made safe, will not increase flood risk elsewhere and where possible will reduce flood risk overall in accordance with paragraph 160 of the NPPF and PPG. A FRA must be prepared by a suitably qualified and experienced person and must contain all the information needed to allow IBC to satisfy itself that policy requirements have been met.

10.2 When is a Flood Risk Assessment required?

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

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

In addition, SCC Local Flood Risk Management Strategy (Appendix C) requires FRAs for:

- Development in areas shown on 'flood risk from surface water' maps online (https://flood-warning-information.service.gov.uk/long-term-flood-risk/map).
- Development in basements and on lowered ground levels;
- Land raising where this impacts on surface water flood risk;
- Sites adjacent to roads with no drainage – drainage and flooding of highway issues should be resolved as part of the planning application;

10.3 How detailed should a FRA be?

The PPG states that site-specific FRAs should be proportionate to the degree of flood risk, the scale and nature of the development, its vulnerability classification and the status of the site in relation to the Sequential and Exception Tests. Site-specific FRAs should also make optimum use of readily available information, for example the mapping presented within this SFRA and available on the Environment Agency website, although in some cases additional modelling or detailed calculations will need to be undertaken.

Throughout all stages of preparation, reference should be made to the Ipswich BC Development and Flood Risk SPD and the SCC SuDS Guidance.

Table 10-1 presents the different levels of site-specific FRA as defined in the Construction Industry Research and Information Association CIRIA publication C624[48] and identifies typical sources of information that can be used.

[48] CIRIA, 2004, Development and flood risk – guidance for the construction industry C624.

Table 10-1 Levels of Site-Specific Flood Risk Assessment

Description
Level 1 Screening Study 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: • IBC SFRA • IBC SWMP • IBC Flood Risk Supplementary Planning Document (SPD) • Flood Map for Planning (Rivers and Sea) • Environment Agency Standing Advice • PPG 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. • East Suffolk Catchment Flood Management Plan. • Data request from the EA 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/IBC/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. • Site survey to determine general ground levels across the site, levels of any formal or informal flood defences
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 which should include the effects of the proposed development. • Monitoring to assist with model calibration/verification. • Continued consultation with the LPA, Environment Agency and other flood risk consultees.

10.4 Environment Agency Data Requests

The Environment Agency offers a series of 'products' for obtaining flood risk information suitable for informing the preparation of site-specific FRAs as described on their website https://www.gov.uk/planning-applications-assessing-flood-risk.

- Products 1 – 4 relate to mapped deliverables including flood level and flood depth information and the presence of flood defences local to the proposed development site;
- Product 5 contains the reports for hydraulic modelling of the Main Rivers, or Breach Modelling;
- Product 6 contains the model output data so the applicant can interrogate the data to inform the FRA.
- Product 7 comprises the hydraulic model itself.

- Product 8 contains flood defence breach hazard mapping.

Products 1 – 6 and 8 can be used to inform a Level 2 FRA. In some cases, it may be appropriate to obtain Product 7 and to use as the basis for developing a site-specific model for a proposed development as part of a Level 3 FRA. This can be requested via their National Customer Contact Centre via enquiries@environment-agency.gov.uk.

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

The PPG 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 it will increase flood risk elsewhere;
- Whether the measures proposed to deal with these effects and risks are appropriate;
- The evidence for the local planning authority to apply (if necessary) the Sequential Test, and;
- Whether the development will be safe and pass the Exception Test, if applicable.

Ipswich BC has set out particular requirements for FRAs in specific areas, in Table 10-2.

Table 10-2 Guidance for FRAs in specific areas

Area	Special requirements for FRA	Purpose
Areas susceptible to surface water flooding	FRAs required considering overland flows through and from off site. Will affect site layout, floor levels and need for resilient design. SWMP being prepared	To ensure development does not worsen flooding, or is flooded by the overland flows
Adjoining flood defence walls.	Breach of defences… SFRA provides hazard maps for certain breach locations… For other locations it may be possible to infer hazard ratings from the SFRA.	
Holywells Road area	Holywells canal embankment stability & risk of overtopping. Canal outlet/highway drainage. - flood-paths. Severe local flooding -. Highway drainage investigation. Surface runoff from frontage development. Combined sewer flooding from Cliff Lane. Tidal flooding. Sewerage system surcharging. AW tunnel overflow via Ship Launch Rd if overloaded or if outfall penstock malfunctions.	Highway drainage system not recorded
Wet Dock frontages - Sites S of Key St, Fore St	There should be no increase in ground level (paving). Ground floor levels to be set above likely 1% AEP local surface water flood levels.	To avoid worsening flooding of low-lying properties by overland flows.
Lowest parts of Zone 3	SW Flood storage, Ground water. Foul & SW drainage.	
Green field sites with permeable soils	Foul drainage availability / capacity. BRE365 Soakaway tests, ground water levels, ground water protection. Layout and levels of proposed dev to have space to retain 100 year event runoff on site allowing for adequate clearance from infiltration systems to buildings. Maintenance arrangements.	To ensure layouts allow sufficient space for adequate SuDS and ensure SuDS are maintained in the future
Greenfield sites with impermeable soils	Foul drainage, Soakage tests or ground investigations required to prove ground unsuitable for infiltration type SuDS. If not suitable - Green field runoff rates, outfall capacity, suitability or route. Layout and levels of proposed dev to	To ensure combined sewer flooding and pollution of watercourses is not worsened.

	have space to retain 100-year event runoff on site in lower parts of site. Land drainage – pipes and or ditches	
Brownfield Sites	SuDS to reduce off site discharges. Soakage tests in permeable areas, Contamination /remediation may affect drainage.	
Sites adjacent to roads with no drainage e.g. Humber Doucy Lane site 30, Whitton Church lane, Norwich Rd North of Ipswich	Drainage or flooding of highway to be resolved as part of the development.	
Isolated sites North of Ipswich with no readily available FW or SW drainage.	FW – consider draining wider area – some existing properties served by unsatisfactory septic tanks etc. SW drainage, greenfield runoff, land drainage,	No readily available foul sewer probable capacity issues.
Sites SE boundary of Ipswich	FW, SW	No readily available foul sewer.

10.6 Flood Risk Assessment Checklist

Table 10-3 provides a checklist for site-specific FRAs listing the information that will likely need to be provided along with references to sources of relevant information. The exact level of detail required under each heading will vary according to the scale of development and the nature of the flood risk.

Table 10-3 Site-Specific Flood Risk Assessment Checklist (building on guidance in PPG)

What to Include in the FRA		Source(s) of Information
1. Site Description		
Site address	-	-
Site description	-	-
Location plan	Including geographical features, street names, catchment areas, watercourses and other bodies of water	-
Site plan	Plan of site showing development proposals and any structures which may influence local hydraulics e.g. bridges, pipes/ducts crossing watercourses, culverts, screens, embankments, walls, outfalls and condition of channel	OS Mapping Site Survey
Topography	Include general description of the topography local to the site. Where necessary, site survey may be required to confirm site levels (in relation to Ordnance datum). Plans showing existing and proposed levels.	SFRA Appendix A, Figure 1
Geology	General description of geology local to the site.	SFRA Appendix A, Figures 12A and 12B
Watercourses	Identify Main Rivers and Ordinary Watercourses local to the site.	SFRA Appendix A, Figure 1
Status	Is the development in accordance with the Council's Spatial Development Plan?	Seek advice from IBC if necessary
2. Assessing Flood Risk		
The level of assessment will depend on the degree of flood risk and the scale, nature and location of the proposed development. Refer to Table 10-1Table 10-1 regarding the levels of assessment. Not all of the prompts listed below will be relevant for every application.		
Flooding from Rivers	Provide a plan of the site and Flood Zones. Identify any historic flooding that has affected the site, including dates and depths where possible. How is the site likely to be affected by climate change? Determine flood levels on the site for the 1% annual probability (1 in 100 chance each year) flood event including an allowance for climate change.	SFRA Appendix A, Figure 6 Environment Agency Flood Map for Planning (Rivers and Sea). Environment Agency Products 1-7.

	Determine flood hazard on the site (in terms of flood depth and velocity). Determine the flood level, depth, velocity, hazard, rate of onset of flooding on the site.	New hydraulic model (where EA data not available)
Flooding from Land	Identify any historic flooding that has affected the site. Review the local topography and conduce a site walkover to determine low points at risk of surface water flooding. Review the Risk of Flooding from Surface Water mapping & SWMP report.	SFRA Appendix A, Figure 2, 11A, and 11B. Topographic survey. Site walkover. Risk of Flooding from Surface Water mapping (EA website).
Flooding from Groundwater	Desk based assessment based on high level BGS mapping in the SFRA. Ground survey investigations. Identify any historic flooding that has affected the site.	SFRA Appendix A, Figure 13 Ground Investigation Report
Flooding from Sewers	Identify any historic flooding that has affected the site. For sites in the Hollywells Road area consideration of sewerage system surcharging is required including understanding of the potential impact of outfall restrictions at Ship Launch Road.	SFRA Appendix A, Figures 10A and Figure 10B Where appropriate an asset location survey can be provided by Anglian Water https://www.anglianwater.co.uk/developers/development-services/locating-our-assets/
Reservoirs, Docks, canals and other artificial sources	Identify any historic flooding that has affected the site. Review the Risk of Flooding from Reservoirs mapping & EA breach modelling for the Flood Defences. For sites in the Holywells Road area, consideration of the Holywells canal is required, including embankment stability, risk of overtopping and canal outlets.	SFRA Appendix A, Figure 14 Risk of Flooding from Reservoirs mapping (EA website).
3. Proposed Development		
Current use	Identify the current use of the site.	-
Proposed use	Will the proposals increase the number of occupants / site users on the site such that it may affect the degree of flood risk to these people?	-
Vulnerability Classification	Determine the vulnerability classification of the development. Is the vulnerability classification appropriate within the Flood Zone?	SFRA
4. Avoiding Flood Risk		
Sequential Test	Determine whether the Sequential Test is required. Consult IBC to determine if the site has been included in the Sequential Test. If required, present the relevant information to IBC to enable their determination of the Sequential Test for the site on an individual basis.	Consult with IBC.
Exception Test	Determine whether the Exception Test is necessary. Where the Exception Test is necessary, present details of: Part 1) how the proposed development contributes to the achievement of wider sustainability objectives as set out in the IBC Core Strategy's Report. (Details of how part 2) can be satisfied are addressed in the following part 5 'Managing and Mitigating Flood Risk'.)	Refer to IBC Development and Flood Risk Supplementary Planning Document
5. Managing and Mitigating Flood Risk		
Section 7 of the SFRA presents measures to manage and mitigate flood risk and when they should be implemented. Where appropriate, the following should be demonstrated within the FRA to address the following questions: How will the site/building be protected from flooding, including the potential impacts of climate change, over the development's lifetime? How will you ensure that the proposed development and the measures to protect your site from flooding will not increase flood risk elsewhere? Are there any opportunities offered by the development to reduce flood risk elsewhere?		

What flood-related risks will remain after you have implemented the measures to protect the site from flooding (i.e. residual risk) and how and by whom will these be managed over the lifetime of the development (e.g. flood warning and evacuation procedures)?		
Development Layout and Sequential Approach	Plan showing how sensitive land uses have been placed in areas within the site that are at least risk of flooding.	SFRA Section 9.5
Finished Floor Levels	Plans showing finished floor levels in the proposed development in relation to Ordnance Datum taking account of indicated flood depths and relate to surrounding ground levels Refer to Ipswich BC SPD[49] Section 8.16 and 8.17 for design flood levels supported by text within Section 7.3	SFRA 7.2 Ipswich SPD Chapter 7
Flood Resistance	Details of flood resistance measures that have been incorporated into the design. Include design drawings where appropriate.	SFRA Section 7.2
Flood Resilience	Details of flood resilience measures that have been incorporated into the design. Include design drawings where appropriate.	SFRA Section 7.2
Safe Access / Egress	Provide a figure showing proposed safe route of escape away from the site and/or details of safe refuge. Include details of signage that will be included on site. Where necessary this will involve mapping of flood hazard associated with river and/or tidal flooding (Flood Hazard maps are included in Appendix A). This may be available from Environment Agency modelling or may need to be prepared as part of hydraulic modelling specific for the proposed development site. Reference should be made to the Ipswich BC SPD Section 7.3 where the framework for minimum requirements for 'safe' development is proposed. As part of all assessments, consideration should be made of the likely demand on emergency services as outlined in Section 7.3.7 of the SPD.	SFRA 7.2 SFRA Appendix A Ipswich SPD Chapter 7
Flow Routing	Provide evidence that proposed development will not impact flood flows to the extent that the risk to surrounding areas is increased. Where necessary this may require modelling.	SFRA Section 9.7
Riverside Development Buffer Zone	Provide plans showing how a buffer zone of relevant width will be retained adjacent to any Main River or Ordinary Watercourse in accordance with requirements of the Environment Agency and IBC.	SFRA Section 9.4
Surface Water Management Greenfield Sites with permeable soils Greenfield Sites impermeable soils	Pre application advice from IBC and Suffolk County Councils Floods Team should be sought to gain advice on suitable SuDS and drainage for individual development sites. Details of the following should be included within the FRA: Calculations (and plans) showing areas of the site that are permeable and impermeable pre and post-development. Calculations of pre and post-development runoff rates and volumes including consideration of climate change over the lifetime of the development. Details of the methods that will be used to manage surface water (e.g. permeable paving, swales, wetlands, rainwater harvesting). Information on proposed management arrangements For Greenfield sites with permeable soils, BRE365 Soakaway tests will be required along with information on groundwater levels and groundwater protection. The development layout and ground levels of proposed development must have space to retain the 100 year rainfall runoff on site allowing for adequate clearance from infiltration systems to buildings. Details of maintenance arrangements must be provided. Where soils are impermeable, development proposals must include soakage tests or ground investigations to prove that the ground is unsuitable for infiltration. If infiltration is not suitable greenfield runoff rates, outfall capacity and suitability of discharge route/receiving watercourse must be confirmed. The site layout and ground levels must outline how the 1 in 100 year storm will be retained on site – i.e. space required. Where appropriate, reference the supporting Outline or Detailed Drainage Strategy for the site. .	SFRA Section 10.7
Flood Warning and Evacuation Plan	Where appropriate reference the Flood Warning and Evacuation Plan or Personal Flood Plan that has been prepared for the proposed development (or will be prepared by site owners).	SFRA Section 7.2 and 9.6

[49] Ipswich Borough Council Development and Flood Risk Supplementary Planning Document, January 2016

Safe Refuge	Temporary refuges (any place where individuals trapped by floodwater can remain for a short period in relative safety while awaiting rescue) are needed for most developments within the floodplain. They should be above the 0.1% AEP tide level at the end of the development's lifetime.	SFRA Section 7.2 SPD Chapter 7

10.7 Pre-application Advice

At all stages, IBC, and where necessary the Environment Agency and/or the Statutory Water Undertaker along with Suffolk County Council as LLFA and Highway Authority may need to be consulted to ensure the FRA provides the necessary information to fulfil the requirements for planning applications.

Where a development is subject to the Exception Test, the Suffolk Resilience Forum will look collectively with the emergency services and LPA to give advice on the preparation of a FRA and evacuation plan. While useful guidance for both decision makers and developers can be found on the Suffolk Resilience Forum website, it may be sensible to seek pre application advice for these sites from the SRF.

The Environment Agency and IBC each offer pre-application advice services which should be used to discuss particular requirements for specific applications. Both are charged services.

- Environment Agency: https://www.gov.uk/government/publications/pre-planning-application-enquiry-form-preliminary-opinion
- IBC: https://www.ipswich.gov.uk/services/planning-applications

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 .

11. Flood Risk Policy and Development Management Approach

11.1 Overview

In order to encourage a holistic approach to flood risk management and ensure that flooding is taken into account at all stages of the planning process, this Section builds on the findings of the SFRA to set out the approach that IBC are adopting in relation to flood risk planning policy and with respect to development management decisions on a day-to-day basis.

11.2 Policy Approach

The overall approach for development in each NPPF Flood Zone is set out below:

11.2.1 Flood Zone 3b (Functional Floodplain)

The Functional Floodplain as defined in this SFRA comprises undeveloped land within the 1 in 20 year (5% AEP) flood outline. This zone comprises land where water has to flow or be stored in times of flood. These areas should be safeguarded from any development.

However, in accordance with NPPF Table 3: Flood risk vulnerability and flood zone 'compatibility', where Water Compatible or Essential Infrastructure cannot be located elsewhere, it must pass the exception test and:

- Remain operational and safe for users in times of flood;
- Result in no net loss of flood storage;
- Not impede water flows; and
- Not increase flood risk elsewhere.

11.2.2 Flood Zone 3a High Probability

Flood Zone 3a High Probability comprises land having a 1 in 100 year or greater probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year. Where development is proposed, opportunities should be sought to:

- Relocate existing development to land in zones with a lower probability of flooding;
- Reduce the overall level of flood risk in the area through the layout and form of the development, and the appropriate application of sustainable drainage techniques;
- Remain safe for users in times of flood; and
- Create space for flooding to occur by restoring natural floodplain and flood flow paths and by identifying, allocating and safeguarding open space for flood storage.

11.2.3 Flood Zone 2 Medium Probability

Flood Zone 2 Medium Probability comprises land having between a 1 in 100 year (1% AEP) and 1 in 1000 year (0.1% AEP) probability of flooding from fluvial watercourses or between a 1 in 200 and 1 in 1000 annual probability of flooding from the sea (0.5% - 0.1%) in any year. Where development is proposed in areas of Flood Zone 2, the planning policy approach is similar to Flood Zone 3a. Opportunities should be sought to:

- Relocate existing development to land in zones with a lower probability of flooding;
- Reduce the overall level of flood risk in the area through the layout and form of the development, and the appropriate application of sustainable drainage techniques;
- Remain safe for users in times of flood; and
- Create space for flooding to occur by restoring natural floodplain and flood flow paths and by identifying, allocating and safeguarding open space for flood storage.

11.2.4 Flood Zone 1 Low Probability

Flood Zone 1 Low Probability comprises land having a less than 1 in 1000-year (<0.1%) AEP probability of flooding from rivers or the sea. Where development over 1ha is proposed or there is evidence of flooding from another localised source in areas of Flood Zone 1, opportunities should be sought to:

- Ensure that the management of surface water runoff from the site is considered early in the site planning and design process;
- Ensure safe access and egress to and from both buildings and the site and create space for flooding to occur;
- Ensure that proposals achieve an overall reduction in the level of flood risk to the surrounding area, through the appropriate application of sustainable drainage techniques.

11.2.5 Cumulative Impact of Minor and Permitted Development

The PPG advises that minor developments (as defined in Section 5.1.3) are unlikely to result in significant flood risk issues unless:

- they would have an adverse effect on a watercourse, floodplain or its flood defences;
- they would impede access to flood defence and management facilities; or
- where the cumulative impact of such developments would have a significant impact on local flood storage capacity or flood flows.

In parts of Ipswich there is potential for both minor development as well as permitted development to be considered to be having a cumulative impact on flood risk in the local area as a result of impacts on local flood storage capacity and flood flows. Given the small scale of the development in the context of the wider fluvial catchments it is not possible to undertake modelling to confirm the impact of such development.

FRAs for all minor development within Flood Zone 3 should demonstrate that the proposal is safe and will not increase flood risk elsewhere by not impeding the flow of flood water, reducing storage capacity of the floodplain. Details of flood mitigation measures to reduce the impact of flooding on the proposed development and ensure that the proposed development does not result in an increase in maximum flood levels within adjoining properties should be provided. This may be achieved by ensuring (for example) that the existing building footprint is not increased, that overland flow routes are not truncated by buildings and/or infrastructure, hydraulically linked compensatory flood storage is provided within the site (or upstream), and/or the incorporation of floodable voids. It is acknowledged that full compensation may not be possible on all minor developments, however, an applicant must be able to demonstrate that every effort has been made to achieve this and provide full justification where this is not the case.

11.2.6 Changes of Use

Where a development undergoes a change of use and the vulnerability classification of the development changes, there may be an increase in flood risk. For example, changing from industrial use to residential use will increase the vulnerability classification from Less to More Vulnerable.

For change of use applications in Flood Zones 2 and 3, applicants must submit an FRA with their application. This should demonstrate how the flood risks to the development will be managed so that it remains safe through its lifetime including provision of safe access and egress and preparation of Flood Warning and Evacuation Plans where necessary.

As changes of use are not subject to the Sequential or Exception tests, IBC should consider when formulating policy what changes of use will be acceptable, having regard to paragraph 157 of the NPPF and taking into account the findings of this SFRA. This is likely to depend on whether developments can be designed to be safe and that there is safe access and egress.

11.2.7 Basement dwellings

As detailed in Section 9.2, the NPPF does not permit habitable basements in Flood Zone 3 and the suggested Safety Framework for development in Flood Zones 2 and 3 (described in Section 7) would prevent basement dwellings from being built in both Flood Zones 2 and 3. However, in some locations basements outside Flood Zone 2 could be flooded by tidal or fluvial flooding via the sewerage system.

Basement dwellings should therefore not be permitted where the floor level is below the 0.1% AEP tide level in 100 years' time.

Basements dwellings should not be permitted in areas susceptible to surface water flooding.

Basements in Flood Zone 1 should only be permitted subject to adequate FRAs, which must address ground water, sewer and overland flood sources.

The above recommendations should also apply to changes of use of existing basements.

11.2.8 Basement for other uses and basement extensions

Basements extensions may involve either the extension of an existing habitable basement under a house, or the construction of a completely new basement. It is becoming increasingly popular in some areas to construct basements which extend beyond the footprint of the host property and under the amenity area.

Basements for other uses in Flood Zone 3a and 2 may be granted provided there is a safe means to escape via internal access to higher floors 300mm above the 1 in 200 year (0.5% AEP) tidal flood level or 1 in 100 year (1% AEP) fluvial flood level, including an allowance for climate change.

IBC should consider introducing a requirement that all basement development in Flood Zone 3 seeks planning permission. Applications should be supported by a FRA as well as other reports and evidence formulating a Basement Impact Assessment (BIA). Table 8-1 identifies which management and mitigation measures will need to be addressed as part of a FRA for a basement development and these are briefly described below.

An FRA must provide details of an appropriate sustainable urban drainage system for the site and investigation to determine whether a perimeter drainage system or other suitable measure is necessary to ensure any existing sub-surface water flow regimes are not interrupted.

Basement development may affect groundwater flows, and even though the displaced water will find a new course around the area of obstruction this may have other consequences for nearby receptors e.g. buildings, trees. Emerging evidence shows that even where there are a number of consecutively constructed basement developments, the groundwater flows will find a new path. IBC may therefore require a Hydrology Report to be submitted with proposals. This report should be prepared by a structural engineering or hydrology firm that is fully accredited by the main professional institute(s) and therefore whose advice we would accept as independent.

The FRA must also address the impact of the proposed extension on the ability of the floodplain to store floodwater during the 1 in 100 year (1% AEP) event including allowance for climate change and where necessary provide compensatory floodplain storage on a level for level, volume for volume basis.

11.3 Development Management Measures

Table 11-1 sets out the measures that should be considered for different types of proposed development within each NPPF Flood Zone. Before consulting Table 11-1, refer to development vulnerability classification (PPG Table 2) to determine the vulnerability classification of the proposed development.

Table 11-1 Development Management Measures Summary Table

	All Development	Minor development				Other development			
	Flood Zone 3b (Undeveloped – Functional Floodplain)	Flood Zone 3b (Developed)	Flood Zone 3a	Flood Zone 2	Flood Zone 1	Flood Zone 3b (Developed)	Flood Zone 3a	Flood Zone 2	Flood Zone 1
Proposed Development Types	Flood Zone 3b (Undeveloped Functional Floodplain) should be protected from any new development. Only Essential Infrastructure or Water Compatible development may be permitted.	'Developed land' within Flood Zone 3b relates solely to existing buildings that are impermeable to flood water. Some minor development proposals may be considered. Change of use to a higher vulnerability classification is not permitted.	Land use should be restricted to Water Compatible or Less Vulnerable development. More Vulnerable development can be considered. Highly Vulnerable development is not appropriate.	Land use should be restricted to Water Compatible, Less Vulnerable or More Vulnerable development. Highly Vulnerable development can be considered.	No restrictions.	'Developed land' within Flood Zone 3b relates solely to existing buildings that are impermeable to flood water. Some re-development proposals may be considered. Change of use to a higher vulnerability classification is not permitted.	Land use should be restricted to Water Compatible or Less Vulnerable development. More Vulnerable development can be considered.	Land use should be restricted to Water Compatible, Less Vulnerable or More Vulnerable development. Highly Vulnerable development can be considered.	No restrictions.
Basements	Not permitted.	Basements, basement extensions, conversions of basements to a higher vulnerability classification or self-contained units are not permitted.	Self-contained residential basements and bedrooms at basement level are not permitted. All basements, basement extensions and basement conversions may be considered. Regard will be had to whether the site is also affected by groundwater flooding.		No restrictions.	Basements, basement extensions, conversions of basements to a higher vulnerability classification or self-contained units are not permitted.	Self-contained residential basements and bedrooms at basement level are not permitted. All basements, basement extensions and basement conversions may be considered. Regard will be had to whether the site is also affected by groundwater flooding.		No restrictions.
Flood Risk Assessment	Yes – for Essential Infrastructure	Yes – key outcomes must be: • How the development is likely to be affected by current or future flooding from any source • That measures proposed to deal with these effects and risks are appropriate • Development does not increase the risk of flooding elsewhere by not impeding the flow of water or reducing storage capacity. It is acknowledged that full compensation may not be possible in all cases, but justification must be given. • Whether the development is safe for its lifetime.			Required if site > 1 hectare, or there is evidence of a localised flood source.	Yes – key outcomes must be • How the development is likely to be affected by current or future flooding from any source. • That measures proposed to deal with these effects and risks are appropriate. • Development results in an improvement to flood risk by not impeding the flow of water, reducing storage capacity or increasing the number of properties at risk of flooding. • Evidence to support the application of the Sequential Test, where appropriate. • Whether the development is safe for its lifetime and passes the Exception Test, if applicable.			Required if site > 1 hectare, or there is evidence of a localised flood source.
Sequential Test	Not required.	Not required	Not required	Not required	N/A	Yes – if not addressed at the Local Plan level and development type is not included in the list of exemptions			N/A

Exception Test	Yes – required for Essential Infrastructure.	Not required	Not required	Not required	N/A	Yes – required for More Vulnerable development and Essential Infrastructure		Yes – required for Highly Vulnerable development	N/A
Sequential approach to site planning	N/A	Yes	Yes	Yes	Yes – with respect to flooding from other sources.	Yes	Yes	Yes	Yes – with respect to flooding from other sources.
Finished Floor Levels	N/A	Areas of fluvial flood risk: For Less Vulnerable, More Vulnerable and Highly Vulnerable development, floor levels should be set 300mm above modelled 1 in 100-year (1% AEP) flood level including an allowance for climate change. Areas of residual tidal flood risk: Sleeping accommodation should be set above the 0.5% AEP plus climate change maximum breach level (Table 7-1).			No minimum level specified. Floor levels should take account of any localised flood risk from surface water ponding.	Areas of fluvial flood risk: For Less Vulnerable, More Vulnerable and Highly Vulnerable development, floor levels should be set 300mm above modelled 1 in 100-year (1% AEP) flood level including an allowance for climate change. Areas of residual tidal flood risk: Sleeping accommodation should be set above the 0.5% AEP plus climate change maximum breach level (Table 7-1).			No minimum level specified. Floor levels should take account of any localised flood risk from surface water ponding.
Flood Resistance	N/A	Yes – typically applied in areas of flood depths <0.3m and between 0.3m and 0.6m where no structure concerns	Yes – typically applied in areas of flood depths <0.3m and between 0.3m and 0.6m where no structure concerns	Yes – typically applied in areas of flood depths <0.3m and between 0.3m and 0.6m where no structure concerns	Yes – with respect to surface water flood risk.	Yes - typically applied in areas of flood depths <0.3m and between 0.3m and 0.6m where no structure concerns	Yes - typically applied in areas of flood depths <0.3m and between 0.3m and 0.6m where no structure concerns	Yes - typically applied in areas of flood depths <0.3m and between 0.3m and 0.6m where no structure concerns	Yes – with respect to surface water flood risk.
Flood Resilience	N/A	Yes – typically applied in areas of flood depths >0.6m.	Yes - typically applied in areas of flood depths >0.6m.	Yes - typically applied in areas of flood depths >0.6m.	Yes – with respect to surface water flood risk.	Yes - typically applied in areas of flood depths >0.6m.	Yes - typically applied in areas of flood depths >0.6m.	Yes - typically applied in areas of flood depths >0.6m.	Yes – with respect to surface water flood risk.
Safe Access/ Egress and Safe Refuge	N/A	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 is low • If a dry route is not possible, a route for vehicles where the flood hazard is low 'Dry' access/egress is a route located above the fluvial 1 in 100-year (1% AEP) flood event including an allowance for climate change, or the tidal 1 in 200-year (0.5% AEP) flood event including the presence of IFDMS and an allowance for climate change. In all cases safe refuge must be provided above the extreme flood (0.1% AEP fluvial flood including an allowance for climate change; or 0.1% AEP tidal breach level including an allowance for climate change).			Safe means of escape must be provided in relation to risk of flooding from other sources.	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 is low • If a dry route is not possible, a route for vehicles where the flood hazard is low 'Dry' access/egress is a route located above the fluvial 1 in 100-year (1% AEP) flood event including an allowance for climate change, or the tidal 1 in 200-year (0.5% AEP) flood event including the presence of IFDMS and an allowance for climate change. In all cases safe refuge must be provided above the extreme flood (0.1% AEP fluvial flood including an allowance for climate change; or 0.1% AEP tidal breach level including an allowance for climate change).			Safe means of escape must be provided in relation to risk of flooding from other sources.

<table>
<tr>
<td>Floodplain compensation storage</td>
<td>N/A</td>
<td>Yes - Development must not result in a net loss of flood storage capacity in relation to the 1% annual probability) fluvial flood event including allowance for climate change. Where possible, opportunities should be sought to achieve an increase in the provision of floodplain storage.

It is recognised that full compensation storage may not always be viable for minor development. In these cases, justification must be provided, and measures taken to mitigate loss of floodplain storage i.e. through measures to allow the passage of floodwater or provide storage (refer to ‘flood voids’, and ‘flow routing’ below).</td>
<td>Not required.</td>
<td>Yes - Development must not result in a net loss of flood storage capacity in relation to the 1 in 100-year (1% AEP) flood event including allowance for climate change. Where possible, opportunities should be sought to achieve an increase in the provision of floodplain storage.

Where possible floodplain compensation should be provided on a level for level, volume for volume basis.

It is recognised that full compensation storage will not be viable for sites wholly within Flood Zone 3. In these cases, justification must be provided, and measures taken to mitigate loss of floodplain storage i.e. through measures to allow the passage of floodwater or provide storage (refer to ‘flood voids’, and ‘flow routing’ below).</td>
<td>Not required.</td>
</tr>
<tr>
<td>Flood voids</td>
<td>N/A</td>
<td>Yes – where it is not possible to provide floodplain compensation storage or full compensation cannot be achieved, flood voids can be used to provide mitigation.

Flood voids should be appropriately designed and kept clear to enable them to function effectively.</td>
<td>Not required.</td>
<td>Yes – where it is not possible to provide floodplain compensation storage or full compensation cannot be achieved, flood voids can be used to provide mitigation. Void openings should be a minimum of 1m long and open from existing ground levels to at least the 1 in 100 year (1% AEP) plus climate change level. Minimum of 1m void length per 5m wall. Require maintenance plan and apply condition to ensure voids remain open for the lifetime of the development.</td>
<td>Not required.</td>
</tr>
<tr>
<td>Flow routing</td>
<td>N/A</td>
<td colspan="4">Yes - Minor development and new development should not adversely affect flood routing and thereby increase flood risk elsewhere. Opportunities should be sought within the site design to make space for water, such as:

Removing boundary walls or replacing with other boundary treatments such as hedges, fences (with gaps).

Considering alternatives to solid wooden gates or ensuring that there is a gap beneath the gates to allow the passage of floodwater.

On uneven or sloping sites, consider lowering ground levels to extend the floodplain without creating ponds. The area of lowered ground must remain connected to the floodplain to allow water to flow back to river when levels recede.

Create under-croft car parks or consider reducing ground floor footprint and creating an open area under the building to allow flood water storage.

Where proposals entail floodable garages or outbuildings, consider designing a proportion of the external walls to be committed to free flow of floodwater.</td>
</tr>
<tr>
<td>Riverside development</td>
<td></td>
<td colspan="4">Yes – Retain an 16m wide buffer strip alongside Main Rivers and seek opportunities for riverside restoration. Retain a 3.5m wide buffer strip alongside Ordinary Watercourses. All new development within 16m of a Main River or 3.5m of an Ordinary Watercourse will require consent from the Environment Agency or Suffolk County Council (as LLFA) respectively.</td>
</tr>
<tr>
<td>Surface water management</td>
<td>N/A</td>
<td colspan="4">Proposed 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. Proposed development should implement Sustainable Drainage Systems (SuDS) in accordance with the requirements of the ’Non-statutory technical standards for sustainable drainage systems’[50], to reduce and manage surface water runoff to and from proposed developments. Requirements within the non-statutory technical standards for Greenfield and previously developed sites are as follows:
<table>
<tr><th></th><th>Previously developed site</th><th>Greenfield site</th></tr>
<tr><td>Peak Flow Control Volume</td><td>the peak runoff rate from the development to any drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year (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.</td><td>The peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year (1% AEP) rainfall event should never exceed the peak greenfield runoff rate for the same event.</td></tr>
<tr><td>Volume Control</td><td>Where reasonably practicable, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year (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.</td><td>Where reasonably practicable, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year (1% AEP), 6 hour rainfall event should never exceed the greenfield runoff volume for the same event.

Where this is not reasonably practicable, the runoff volume must be discharged at a rate that does not adversely affect flood risk.</td></tr>
</table>
</td>
</tr>
</table>

[50] Defra, March 2015, Non-statutory technical standards for sustainable drainage systems. https://www.gov.uk/government/publications/sustainable-drainage-systems-non-statutory-technical-standards

		Where this is not reasonably practicable, the runoff volume must be discharged at a rate that does not adversely affect flood risk.			
Flood Warning and Evacuation Plan	N/A	Yes - The Environment Agency has a tool on their website to create a Personal Flood Plan[51]. The Plan comprises a checklist of things to do before, during and after a flood and a place to record important contact details. For minor development, it is recommended that the use of this tool to create a Personal Flood Plan will be appropriate.	Yes - In areas of known surface water flood risk, it may be appropriate to prepare a Personal Flood Plan using the Environment Agency tool on their website.	Yes – Flood Warning and Evacuation Plan (FWEP) required to include details of how flood warnings will be provided, what will be done to protect the development and its contents, and how safe occupancy and access to and from the development will be achieved.	Yes - It may be necessary in the following cases: -Sites of particularly significant surface water flood risk. -Where the site is located within a dry island (i.e. the area surrounding the site and/or any potential egress routes away from the site may be at risk of flooding during the 1 in 100 year (1% AEP)) flood event including an allowance for climate change even if the site itself is not).
Planning conditions	N/A	Conditions to secure the implementation of measures set out in the FRA. Condition to prevent conversion of a non-habitable basement to a habitable space at a later date. Condition to keep voids clear.	Conditions to secure the implementation of measures set out in the FRA.	Conditions to secure the implementation of measures set out in the FRA. Condition to prevent conversion of a non-habitable basement to a habitable space at a later date. Condition to keep voids clear.	Conditions to secure the implementation of measures set out in the FRA.

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

Consult the Environment Agency[52] and/or Lead Local Flood Authority	N/A	Consult the Environment Agency: - If development (including boundary walls) is within 20m of the top of bank of a Main River, consult Environment Agency on flood defence requirements. Consult the Lead Local Flood Authority: -If development is within 8 m of an Ordinary Watercourse	Consult Environment Agency: - If application site >1 hectare - If development (including boundary walls) is within 20m of the top of bank of a Main River, consult Environment Agency on flood defence requirements. Consult the Lead Local Flood Authority: -If development is within 8 m of an Ordinary Watercourse	Consult Environment Agency; - If application site > 1 hectare. - If development (including boundary walls) is within 20m of the top of bank of a Main River, on flood defence requirements. Consult the Lead Local Flood Authority: -If development is within 8m of an Ordinary Watercourse	Consult the Environment Agency: -On all applications -If development (including boundary walls is within 20m of a Main River, consult Environment Agency on flood defence requirements. -Change of use where flood risk vulnerability classification has changed to more vulnerable or highly vulnerable or from water compatible to less vulnerable Consult Lead Local Flood Authority: -If development is 'major', consult on 'Surface Water Drainage Statement' -If development is within 8m of an Ordinary Watercourse	Consult the Environment Agency: - If application site >1 hectare. -Essential infrastructure. -Highly vulnerable. -More Vulnerable and it's a landfill or waste facility or is a caravan site. -Less Vulnerable and it's one of the following: land or building used for agriculture or forestry; a waste treatment site; a mineral processing site, as wastewater treatment plant or a sewage treatment plant. - If development (including boundary walls) is within 20m of the top of bank of a Main River, consult Environment Agency on flood defence requirements. Consult the Lead Local Flood Authority: -If development is 'major' consult on 'Surface Water Drainage Statement'. -If development is within 8m of an Ordinary Watercourse.	Consult Environment Agency; -Application site > 1 hectare. -If development (including boundary walls) is within 20m of the top of bank of a Main River. Consult the Lead Local Flood Authority: -If development is 'major' consult on 'Surface Water Drainage Statement'. -If development is within 8m of an Ordinary Watercourse

[52] Government guidance for LPAs regarding when to consult the Environment Agency https://www.gov.uk/flood-risk-assessment-local-planning-authorities.

12. Abbreviations and Glossary

ACRONYM	DEFINITION
AEP	Annual Exceedance Probability
AOD	Above Ordnance Datum
AIMS	Asset Information Management System
BC	Borough Council
BGS	British Geological Survey
CFMP	Catchment Flood Management Plan
Defra	Department for Environment, Flood and Rural Affairs
DCLG	Department for Communities and Local Government
EA	Environment Agency
ESWSL	Extreme Still Water Sea Levels
IBC	Ipswich Borough Council
FRA	Flood Risk Assessment
FWMA	Flood and Water Management Act 2010
GIS	Geographical Information System
LiDAR	Light Detection and Ranging
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
PPG	Planning Practice Guidance
NFM	Natural Flood Management
NPPF	National Planning Policy Framework
RoFSW	Risk of Flooding from Surface Water
SA	Sustainability Appraisal
SCC	Suffolk County Council
SFRS	Suffolk Fire and Rescue Service
SFRA	Strategic Flood Risk Assessment
SPD	Supplementary Planning Document
SPZ	Source Protection Zone
SuDS	Sustainable Drainage Systems
SFRS	Suffolk Fire and Rescue Service

GLOSSARY	DEFINITION
1D Hydraulic Model	Hydraulic model which computes flow in a single dimension, suitable for representing systems with a defined flow direction such as river channels, pipes and culverts
2D Hydraulic Model	Hydraulic model which computes flow in multiple dimensions, suitable for representing systems without a defined flow direction including topographic surfaces such as floodplains
Asset Information Management System (AIMS)	Environment Agency database of assets associated with Main Rivers including defences, structures and channel types. Information regarding location, standard of service, dimensions and condition.
Aquifer	A source of groundwater comprising water bearing rock, sand or gravel capable of yielding significant quantities of water.
Attenuation	In the context of this report - the storing of water to reduce peak discharge of water.
Catchment Flood Management Plan	A high-level plan through which the Environment Agency works with their key decision makers within a river catchment to identify and agree policies to secure the long-term sustainable management of flood risk.
Climate Change	Long term variations in global temperature and weather patterns caused by natural and human actions. For fluvial events a 70% increase in river flow is applied and for rainfall events, a 30% increase. These climate change values are based upon information within the NPPF and Planning Practice Guidance as at 3rd February 2017.
Critical Drainage Area	Within the SWMP – A discrete geographic area (usually hydrological catchment) where multiple and interlinked sources of flood risk (surface water, groundwater, sewer, main river and/or tidal) cause flooding in one or more Local Flood Risk Zone during severe weather thereby affecting people, property or local infrastructure. By the Environment Agency - discrete geographical area where multiple and interlinked sources of flood risk cause flooding during severe weather.
Culvert	A structure, often a channel or pipe that carries water below the level of the ground.
Design flood	This is a flood event of a given annual flood probability, which is adopted as the basis for engineering design of project components. For example, the design flood event for setting finished floor levels in areas at risk of fluvial flooding is the 1% AEP including an allowance for climate change. In areas at risk of tidal flooding, the design flood is the 0.5% AEP event including an allowance for climate change.
DG5 Register	A water-company held register of properties which have experienced sewer flooding due to hydraulic overload, or properties which are 'at risk' of sewer flooding more frequently than once in 20 years. Refer to Map 9 included in Appendix A.
Evapotranspiration	The sum of evaporation and plant transpiration from the land and ocean surface to the atmosphere. Evaporation accounts for the movement of water to the air from sources such as the soil, canopy interception, and waterbodies.
Exception Test	The approach set out in the NPPF to help ensure that where new development is proposed in areas of flood risk, risk to people and property will be managed satisfactorily, while allowing necessary development to go ahead in situations where suitable sites at lower risk of flooding are not available. For the Exception Test to be satisfied it must be demonstrated that the development will be safe for its lifetime, will not increase flood risk overall and will deliver wider sustainability benefits that outweigh the risk of flooding. Refer to Section 8.
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 flood) which is the largest flood that a given project is designed to safely accommodate.
Flood Resilience	Measures that minimise water damage (e.g. to buildings) and promote fast drying and easy cleaning.
Flood Resistant	Measures that prevent flood water entering a building or damaging its fabric. This has the same meaning as flood proof.
Flood Risk	The level of flood risk is the product of the frequency or likelihood of the flood events and their consequences (such as loss, damage, harm, distress and disruption).
Flood Zone	Flood Zones refer to the probability of river and sea flooding ignoring the presence of existing flood defences (i.e. the natural floodplain). It should be noted that Flood Zones on the Environment Agency Flood Map for Planning do not take account of the potential impact of climate change. See Section 6 for further information on Flood Zones https://flood-map-for-planning.service.gov.uk/
Fluvial	Relating to the actions, processes and behaviour of a watercourse (river or stream).

Freeboard	A freeboard is used to account for residual uncertainty within design, often an extra 300mm or 600mm added to finished floor level above the design flood level to account for any uncertainty in flood levels as a safety factor. Refer to Section 7.3 for further guidance.
Functional Floodplain	Land where water has to flow or be stored in times of flood.
Groundwater	Water that is in the ground, this is usually referring to water in the saturated zone below the water table.
ISIS	A commonly-used 1D hydraulic modelling software package.
Lead Local Flood Authority (LLFA)	As defined by the Flood and Water Management Act, Suffolk County Council (SCC) as LLFA are responsible for developing, maintaining and applying a strategy for local flood risk management (flooding from surface water, groundwater and ordinary watercourses) in their areas and for maintaining a register of flood risk assets.
Light Detection and Ranging (LiDAR)	Airborne ground survey mapping technique, which uses a laser to measure the distance between the aircraft and the ground. Within this report, LiDAR has been used to map topography across Ipswich Borough Council as illustrated in Figure 1.
Local Flood Risk Zone	Discrete areas of flooding that do not exceed the national criteria for a ‘Flood Risk Area’ but still affect houses, businesses or infrastructure. A LFRZ is defined as the actual spatial extent of predicted flooding in a single location.
Local Planning Authority (LPA)	The public authority that is responsible for controlling planning and development through the planning system.
Main River	Watercourse defined on a ‘Main River Map’ designated by Defra. The Environment Agency has permissive powers to carry out flood defence works, maintenance and operational activities for Main Rivers only.
Mitigation measure	An element of development design which may be used to manage flood risk or avoid an increase in flood risk elsewhere.
Ordnance Datum	In the British Isles, an ordnance datum is a vertical datum used by an ordnance survey as the basis for deriving altitudes on maps. A spot height may be expressed as AOD (Above Ordnance Datum), in this instance meaning above mean sea level at Newlyn in Cornwall.
Ordinary Watercourse	A watercourse that does not form part of a Main River. 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.
Residual Flood Risk	The remaining flood risk after risk reduction measures have been taken into account. An example of residual flood risk includes the failure of flood management infrastructure, or a severe flood event that exceeds a flood management design standard, such as a flood that overtops a raised flood defences, or an intense rainfall event which the drainage system cannot cope with.
Return Period	Also known as a recurrence interval is an estimate of the likelihood of an event, such as a flood to occur.
Risk	Risk is a factor of the probability or likelihood of an event occurring multiplied by consequence: Risk = Probability x Consequence. It is also referred to in this report in a more general sense.
Sequential Test	Aims to steer vulnerable development to areas of lowest flood risk.
Sewer Flooding	Flooding caused by a blockage or overflowing from a sewer.
Source Protection Zone (SPZ)	Defined areas in which certain types of development are restricted to ensure that groundwater sources remain free from contaminants.
Surface Water Flooding	Flooding caused when intense rainfall exceeds the capacity of the drainage systems or when, during prolonged periods of wet weather, the soil is so saturated such that it cannot accept any more water.
Sustainable drainage systems (SuDS)	Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques.
Tidal flooding	Inundation from a tidal water body such as the sea or an estuary.
Topographic survey	A survey of ground levels.
TUFLOW	A modelling package for simulating depth averaged 2D free-surface flows that is in widespread use in the UK and elsewhere for 2D inundation modelling.

Appendix A Maps

Figure 1 – Topography, Main Rivers and Ordinary Watercourses

Figure 2 – Historic Flooding Records

Figure 3 – Trunk Sewers

Figure 4 – Highways and Railway Drains

Figure 5 – Local Flooding, Watercourses, ASTSWF and Groundwater Flooding

Figure 6 – Flood Zones

Figure 7A – River Orwell Modelled Flood Extents

Figure 7B – River Orwell Modelled Flood Extents, including the impact of Climate Change

Figure 8A – River Gipping Modelled Flood Extents

Figure 8B – River Gipping Maximum Flood Depth: 1% AEP plus 65% climate change

Figure 8C – River Gipping Maximum Hazard: 1% AEP plus 65% climate change

Figure 8D – River Gipping Maximum Flood Depth: 0.1% AEP plus 25% climate change

Figure 8E – River Gipping Maximum Hazard: 0.1% AEP plus 25% climate change

Figure 9A – Belstead Brook Modelled Flood Extents, present day

Figure 9B – Belstead Brook Modelled Flood Extents, including the impact of Climate Change

Figure 10 – Anglian Water Sewer Flooding Records

Figure 11A- Risk of Flooding from Surface water

Figure 11B- Risk of Flooding from Surface water

Figure 12A – Bedrock Geology

Figure 12B – Superficial Deposits

Figure 13 – Areas Susceptible to Groundwater Flooding

Figure 14 – Risk of flooding from Reservoirs

Figure 15 – Flood Compartments

Figure 16 – Flood Warning areas and Flood Alert Areas

Figure 17 – Areas where Infiltration type SuDS are likely to be possible

Figure 18 – Flood Storage Facilities Existing & Future Needs

Figure 19 – Combined Flood Depth 0.5% AEP 2118

Figure 20 – Combined Flood Hazard 0.5% AEP 2118

Figure 21 Combined Flood Depth 0.1% AEP 2118

Figure 22 Combined Flood Hazard 0.1% AEP 2118

(Refer to SFRA Section 6.2.3 for details of how the combined maps (Figures 19-22) have been created).

Appendix B Data Register

	Dataset Description	Source	Format	Benefits / Limitations
Fluvial	Flood Map for Planning (Rivers and Sea) Flood Zones 2 and 3	Environment Agency Geostore* (*available to the public on the Environment Agency website)	GIS Layer	A quick and easy reference that can be used as an indication of the probability of flooding from Main Rivers. The original Flood Map was broad scale national mapping typically using JFLOW modelling software that is generally thought to have inaccuracies. This is regularly updated with the result of new modelling studies. For those rivers where there is no updated modelling, the Flood Zones from JFLOW modelling may not provide an accurate representation of probability of flooding. Typically, watercourses with a catchment area less than 3km^2 are omitted from Environment Agency mapping unless there is a history of flooding affecting a population. Consequently, there will be some locations adjacent to watercourses that on first inspection, suggest there is no flood risk.
Fluvial	Main Rivers	Environment Agency Geostore	GIS Layer	Identification of the Main River network for which the Environment Agency have responsibility to maintain.
Fluvial	Detailed River Network (DRN)	Environment Agency Geostore	GIS Layer	Identification of the river network including Main Rivers and Ordinary Watercourses for which the Environment Agency and Ipswich County Council have discretionary and regulatory powers.
Fluvial	Modelled flood outlines for River Gipping	Environment Agency	GIS Layer	The flood extents for the hydraulic model studies that have been completed for Rivers within the Ipswich Borough have been mapped. These provide indication of flooding from these rivers. The Environment Agency applies the outcomes from these detailed modelling studies to update the Flood Map for Planning (Rivers and Sea) on a quarterly basis. Some watercourses have not been modelled (e.g. some of the tributaries of other the Main Rivers). The flood risk from these is based on broad scale JFLOW modelling and therefore the flood risk from these cannot be as accurately assessed.
Fluvial	Modelled flood outlines for the Tidal River Wey Orwell	Environment Agency	GIS Layer	
Fluvial	Asset Information Management System (AIMS) for Ipswich Borough	Environment Agency	GIS Layer	Shows where there are existing defences, structures, heights, type and design standard. However, many fields contain default values.
Surface Water	‘Risk of Flooding from Surface Water’ dataset	Environment Agency Partners Catalogue	GIS Layer	Provides an indication of the broad areas likely to be at risk of surface water flooding, i.e. areas where surface water would be expected to flow or pond. This dataset does not show the susceptibility of individual properties to surface water flooding.
Groundwater	GIS layers of the geology across the Ipswich Borough	IBC	GIS Layer	Illustrates bedrock and superficial geology across the Borough.
Groundwater	Aquifer Designation Maps for Bedrock and Superficial	Environment Agency Geostore	GIS Layer	A polygon shapefile that shows aquifer designations for bedrock aquifers. The designations identify the potential of the geological strata to provide water that can be abstracted and have been defined through the assessment of the underlying geology.

	Dataset Description	Source	Format	Benefits / Limitations
	GIS layer 'Susceptibility to Groundwater Flooding'	British Geological Survey	GIS Layer	Dataset produced by BGS showing areas susceptible to groundwater flooding on the basis of geological and hydrogeological conditions. Suitable for broad scale assessment such as the SFRA.
Other	LiDAR data (DTM, ASCII)	Environment Agency Geomatics Group	GIS ASCII	Provides a useful basis for understanding local topography and the surface water flood risk in the area. Spatial resolution of 1m. Accuracy of +/- 0.25m. The Environment Agency's LiDAR data archive contains digital elevation data derived from surveys carried out since 1998.
Historic Flooding	Recorded Flood Outlines	Environment Agency Geostore	GIS Layer	A single GIS layer showing the extent of historic flood events from fluvial, surface water, groundwater sources created using best available information at time of publication. However, some of the data is based on circumstantial and subjective evidence. There is not always available metadata, e.g. date of flood event.
	Environment Agency – Anglian Region	Environment Agency	GIS Layer	Dataset comprising of the 1939 historic flood event outlines for the River Gipping, the 1947 historic flood event outlines for the River Gipping, the 1974 historic flood event outlines for the River Gipping; and the 2013 Tidal surge outlines. The dataset also contains the 1953 flood outlines for IBC.
	Historic Flood Incidents	IBC	GIS Layer	Dataset comprising of reported flood incidents (various types of flooding) between 2012 – 2019.
Emergency Planning	Flood Warning Areas	Environment Agency Geostore	GIS Layer	Indicates which areas are covered by the flood warning system.
Planning	OS Mapping of Ipswich administrative area	OS via IBC	GIS Layer	Provides background mapping to other GIS layers. Designed for use at 1:50K and 1:10K scales.
	GIS layer of administrative boundary	IBC	GIS Layer	Defines the administrative area of IBC for mapping purposes.

Appendix C Extracts from the SWMP

Appendix D Speed of onset and duration of flooding

Appendix E Guidance on producing flood plans for new buildings

Appendix F Level 2 SFRA Site Proformas