Strategic Flood Risk Assessment

Ipswich Borough Council

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Quality information

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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 River Gipping and its tributaries pose a fluvial flood risk to the Borough with historical fluvial events recorded in 1939 and 1947. While fluvial flood risk is well managed and largely considered to be a residual risk, the risk still remains, and on-going hydraulic modelling will be used to update the impact of climate change on fluvial flood risk extents.

The town is also 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, Coltsfoot Road, Monton Rise, Bridgewater Rd, Ellenbrook Rd, Bixley Rd, Hadleigh 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:

- 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 1 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 describes the application of the **Sequential Test.**
- Section 8 sets out the **Safety Framework** for development in Ipswich.
- Section 9 contains **assessment of the site allocations** to inform the Exception Test.
- Section 10 describes **flood risk management** measures in Ipswich.
- Section 11 contains guidance for preparing site-specific **Flood Risk Assessments**.
- Section 12 sets out the **flood risk policy and development management approach** in Ipswich.

2. Introduction

2.1 Approach

The National Planning Policy Framework (NPPF)[1] and associated Planning Practice Guidance (PPG) for Flood Risk and Coastal Change[2] emphasise the active role LPAs such 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.

Section 7 provides details of how Ipswich BC have applied the Sequential Test to their site allocations.

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 9 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.

[1] https://www.gov.uk/government/publications/national-planning-policy-framework--2
[2] https://www.gov.uk/guidance/flood-risk-and-coastal-change

In accordance with Environment Agency publication 'Flood Risk Emergency Plans for New Developments'[3], new development should not increase the burden on Emergency Services or expose them to hazardous flooding when attempting to assist users of new developments[4].

Section 8 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 10 provides an overview of flood risk management measures.

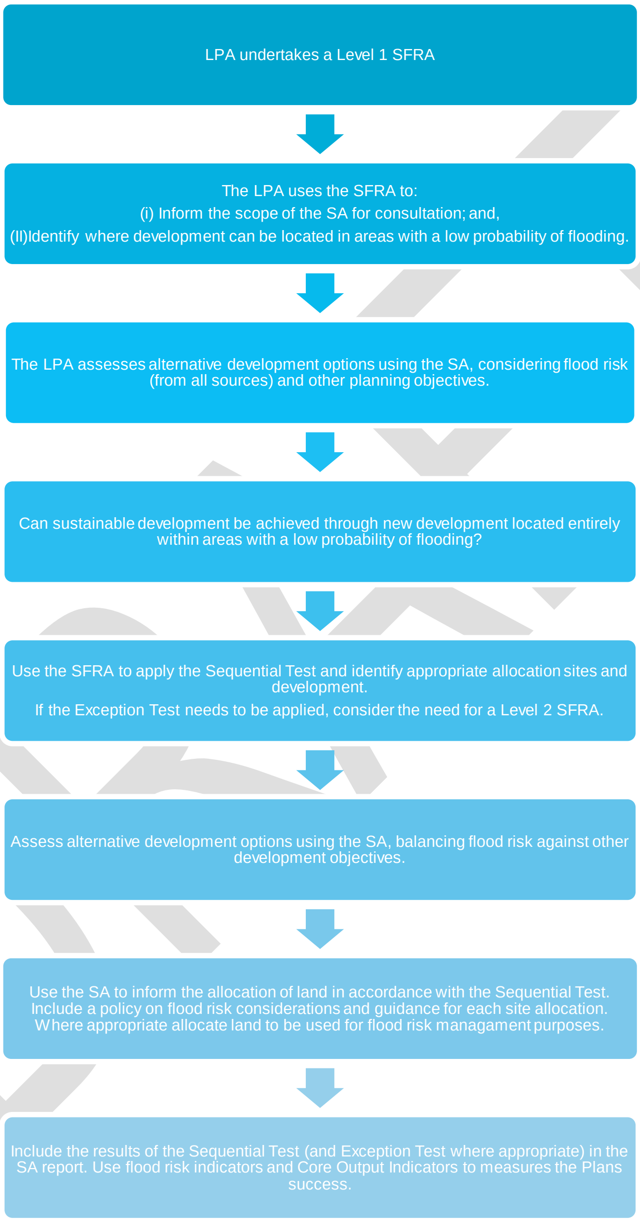

Figure 2-1 Taking flood risk into account in the preparation of a Local Plan[5]

2.2 Stakeholder Consultation

Under the Localism Act 2011[6], 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

[3] https://adeptnet.org.uk/floodriskemergencyplan
[4]

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

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 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[7] 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

[7] Suffolk Resilience Forum, Suffolk Flood Plan. Available at: https://www.suffolkresilience.com/multi-agency-plans

	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[8]. Suffolk County Council will be involved in the implementation of any policy outcomes with respect to sustainable drainage or ordinary watercourse management.
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 2-2 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[9]
Main Rivers and the Sea	✓					✓

[8] https://www.suffolk.gov.uk/roads-and-transport/flooding-and-drainage/guidance-on-development-and-flood-risk/
[9] 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

Ordinary Watercourses		✓[10]	✓			✓
Surface water		✓	✓[11]	✓[12]		✓
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)[13] 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] 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.
[11] Suffolk County Council is responsible for highway drainage, including puddles and blocked highway gullies.
[12] 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.
[13] 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.

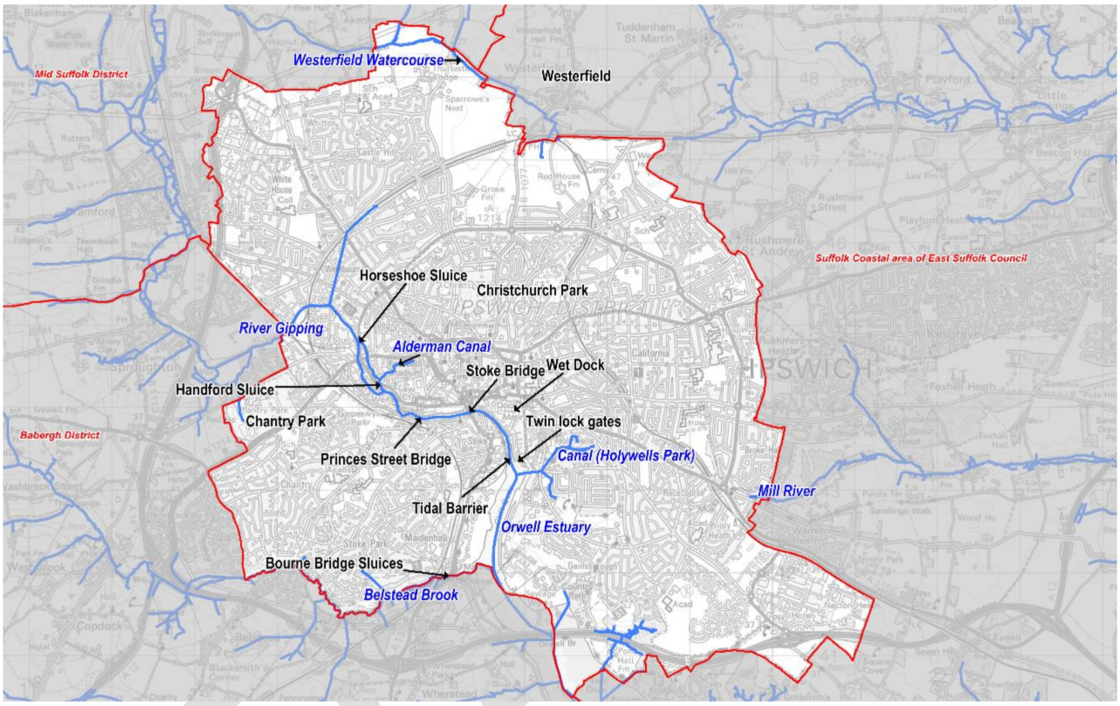

Figure 3-1 Watercourses and flood risk management infrastructure in Ipswich

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 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 below is an extract from the John Speeds map of 1610 which shows the former course of the River Gipping through 'Ipswich Village'.

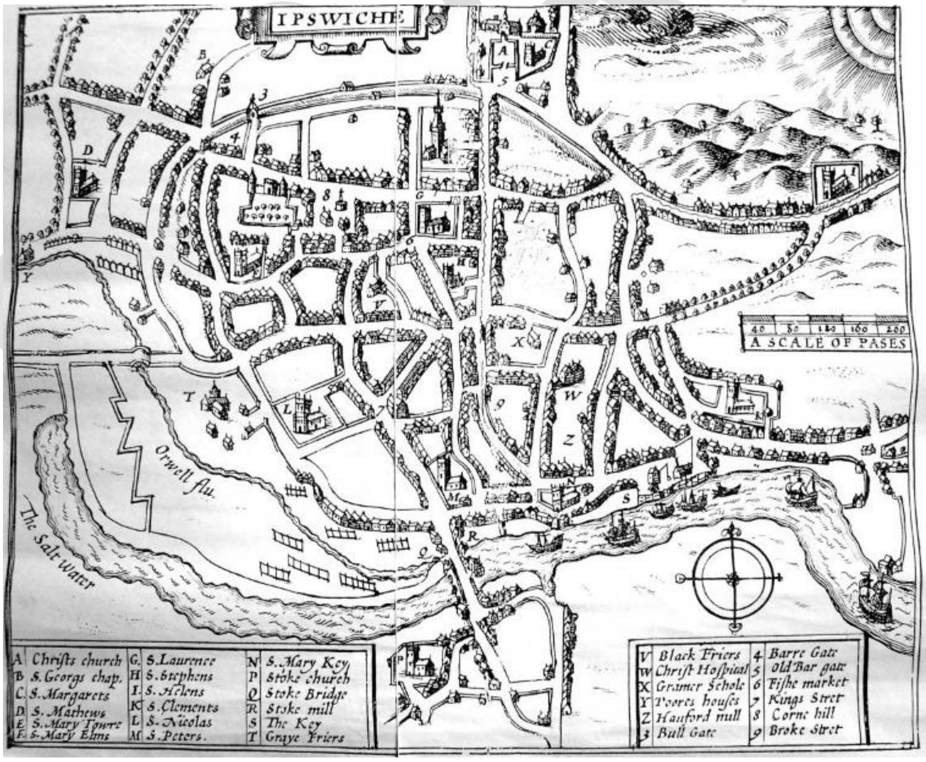

Figure 3-2 John Speed Map of 1610[14]

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

Figure 3-2 1939 Floodwater from river Gipping spilling into wet dock at Albion Wharf

Figure 3-3 1939 Floodwater in Princes Street

Refer to Section 5.1 for an assessment of the risk of flooding from the River Gipping.

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 embankments and 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 2/3January 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 3.5mAOD, 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 3.2mAODN 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 AODN (similar to the 1953 tide level) combined with a fluvial flow of up to 3m3/sec. The channel through Ipswich was designed to take a fluvial flow of 110m3/sec against a tidal level of 2.8mAODN (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 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 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 5.3 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 5.4 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:

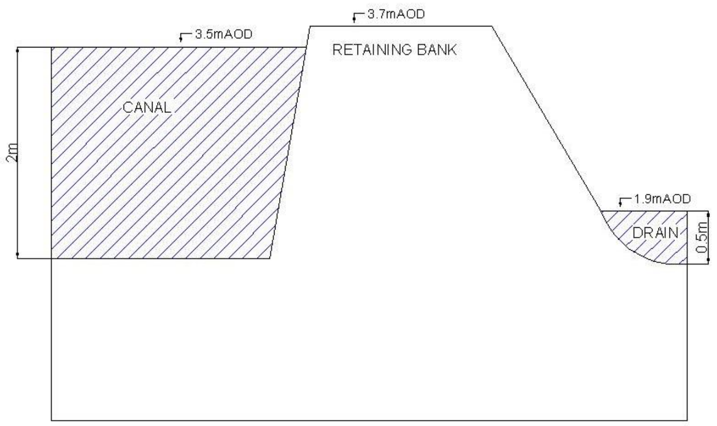

Figure 3-4 Cross section of the Alderman Canal

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 5.6 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 3.1mAOD. The Wet Dock Gate formed part of the recent flood defence improvement works (along with the Ipswich Flood Barrier, 2019). The flood gate maintains a flood defence level of 5.71mAOD (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 salt water 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 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 5.5 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 eastern 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 Waste Water 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 3.

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 1200 home development currently under construction, 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 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, Hadleigh Rd, Holywells Rd, Duke Street, Maidenhall and Cobham Road. Historic flood incidents at Lovetofts Drive, Daimler close and Coltsfoot Road have led to the implementation of flood mitigation measures by Anglian Water.

IBC have many photos of such flooding, such as the following, included to illustrate some relevant problems.

Figure 3-5 Holywells Road – floods several times per year.

Figure 3-6 Duke Street – water level just below floor level of shop, water is overflowing into Wet Dock – this restricts flood depth.

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 5.7 and 5.8 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 5.9 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 5.10 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 (2011)	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
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
Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities	A supporting note for the National FCERM Strategy. It provides the UK Climate Projections (UKCP09) climate change factors for river flood flows, extreme rainfall, storm surge and wave climate for each river basin district, and provides advice on applying climate change projections in the FCERM.	https://www.gov.uk/government/publications/adapting-to-climate-change-for-risk-management-authorities
Flood Risk Assessments: Climate Change Allowances (2016) – Revised February 2019	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=2ahUKEwip3r2g0ufmAhUlWsAKHcUGCtYQFjABegQIAxAC

		&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 and Site Allocations (incorporating IP-One Area Action Plan) Development Plan Document (2017)	Core strategy sets out the IBC plans for development within the Borough over the next 15 years including policy guidance on flood risk.	https://www.ipswich.gov.uk/content/adopted-ipswich-local-plan-2011-2031
IBC Surface Water Management Plan (2012)	The Strategic Assessment and Background Information provides information on all types of flooding across the Borough.	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	Emergency plans are viewable on the Suffolk Resilience Forum's website – http://www.suffolkresilience.

	Forum and the Town Centre and Waterfront Evacuation Plan.	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 change measurably within our lifetime.

The predicted impacts of climate change on flood risks must be considered over the anticipated lifetime of planned developments.

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 on the Environment Agency website. These Flood Zones have been presented in Appendix A Figure 6.

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 are currently undertaking an update to the model for the River Gipping. However, final outputs are not available for this version of the SFRA.

As a result, the modelling from the previous study for the River Gipping[15] has been used within this version of the SFRA. The modelling was completed in 2012 and was an update to the 1D-2D ISIS-TUFLOW model for River Gipping Flood Risk Study completed in April 2011. The update involved adding 2D domains at Cardinall Park and to the floodplain along a section of the River Gipping downstream of the A14 flood storage reservoir. Flood outlines have been produced for defended and undefended scenarios for the 5%, 2%, 1.33%, 1%, and 0.1% AEP events. An increase in flow of 20% was applied to the 5% AEP event and 1% AEP event model scenarios to model the anticipated impact of climate change (the 20% increase was in accordance with planning policy current in 2012 and is one of the drivers for the model update currently being finalised).

The 5% AEP event outline has been used to delineate Flood Zone 3b Functional Floodplain in Appendix A Figure 6. Figure 7 in Appendix A shows the 1% AEP including 20% climate change event. These outputs are further described below.

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.

[15] JBA Consulting, 2012, River Gipping Flood Risk Study: Bramford and Claydon 2D Modelling Report.

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.

Table 5-2 Peak river flow allowances by river basin district[16]

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 Environment Agency are currently updating the model for the River Gipping to include outputs for the 1% AEP including 25%, 35% and 65% climate change allowances.

The extent of Flood Zone 2 (0.1% AEP excluding the presence of defences) should be used as a proxy indication of the potential impacts of climate change on the risk of flooding from the River Gipping. This is shown in Appendix A Figure 9.

AECOM Position Statement – Jan 2020
Hydraulic model re-runs to include updated climate change allowances will be included in SFRA addendums to be prepared in early 2020.

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.

5.2.6 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.

5.2.7 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 on the Environment Agency website. 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.

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

5.2.8 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[17]. 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)[18] 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.

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

5.2.9 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[19] using the medium emission 95th percentile scenario; and the NPPF sea level rise guidance[20]. These are both shown in Appendix A Figure 9.

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

5.3 Belstead Brook

5.3.1 Modelling

Modelling of the Belstead Brook has been undertaken in 2015[21] 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 modelled results is shown in Appendix A Figure 8 and Figure 9. The 1% AEP is used to represent Flood Zone 3a, 5% AEP Flood Zone 3b and 0.1% AEP Flood Zone 2.

5.3.2 Climate Change

The risk of flooding including an allowance for climate change was also modelled for the 1% AEP, 0.5% AEP and 0.1% AEP events plus a 20% increase in flow.

This does not include the new allowances set out in the PPG and described in Table 5-2. As a result, it is recommended that the extent of Flood Zone 2 (0.1% AEP excluding the presence of defences) should be used as a proxy indication of the potential impacts of climate change on the risk of flooding from the Belstead Brook until any further modelling becomes available. This is shown in Appendix A Figure 9.

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

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Hydraulic model re-runs to include updated climate change allowances will be included in SFRA addendums to be prepared in early 2020.

5.4 Mill River

5.4.1 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 3km2 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[22] 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.

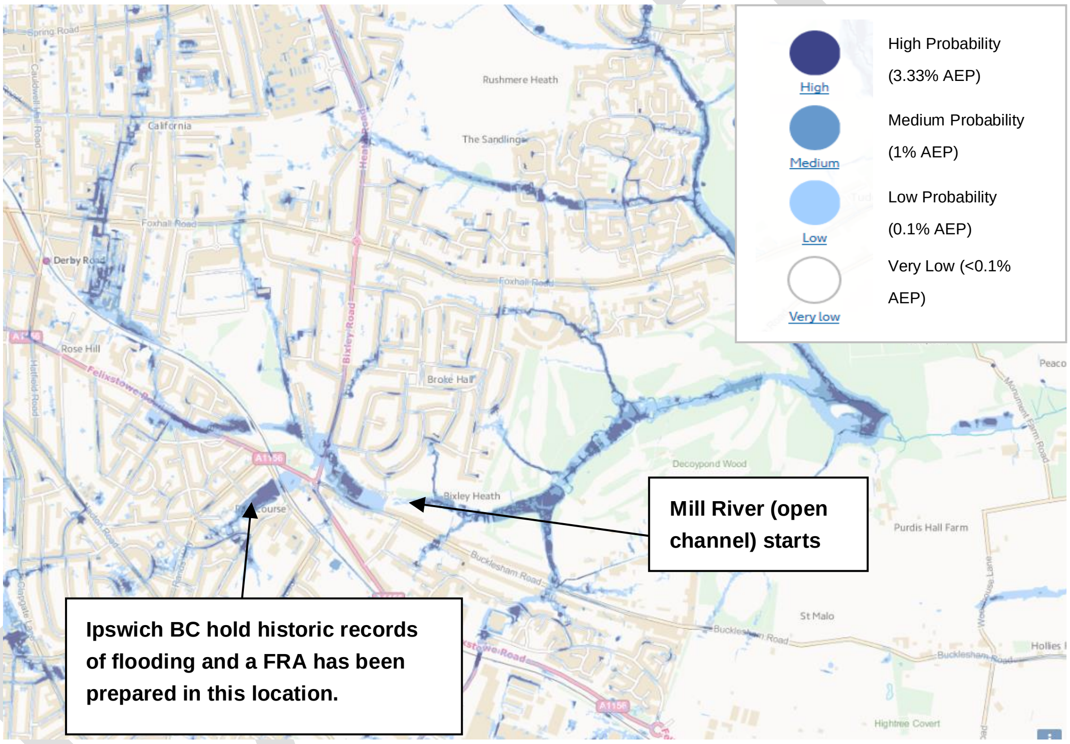


Figure 5-1 Mill River, Risk of Flooding from Surface Water Mapping

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.

5.5 Westerfield Watercourse

5.5.1 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

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

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.

5.5.2 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[23] 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.

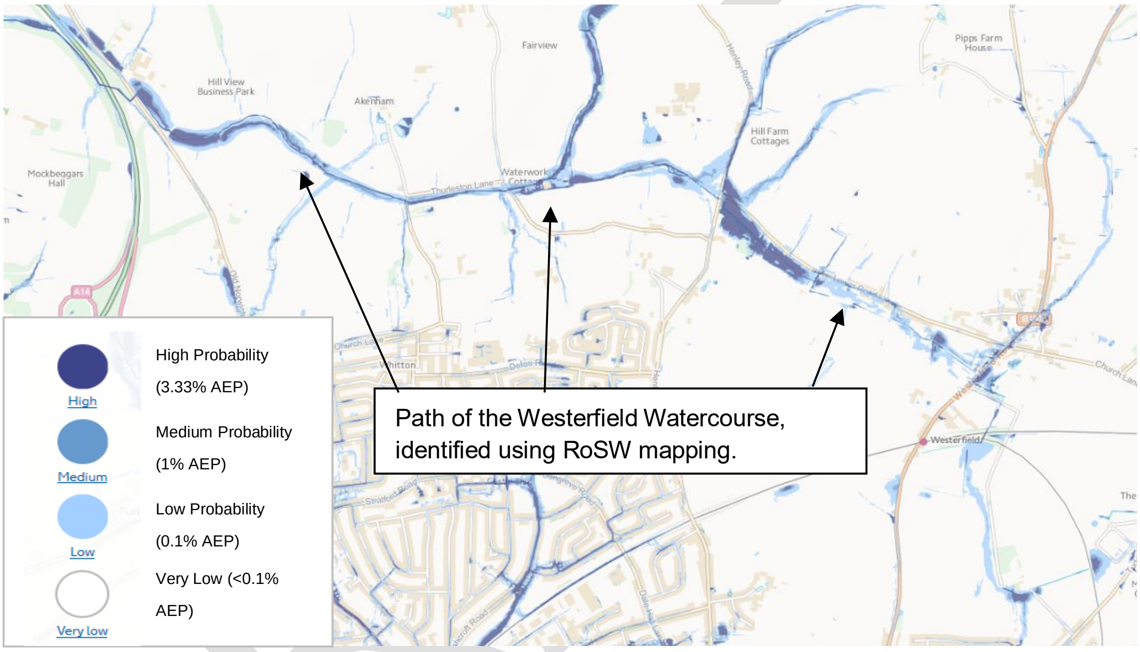


Figure 5-2 Westerfield Watercourse, Risk of Flooding from Surface Water Mapping

5.6 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 3-4. The volume of water in the canal is approximately 8,500 cubic metres. This would flood across the recreation area as shown in Figure 5-3, 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.

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

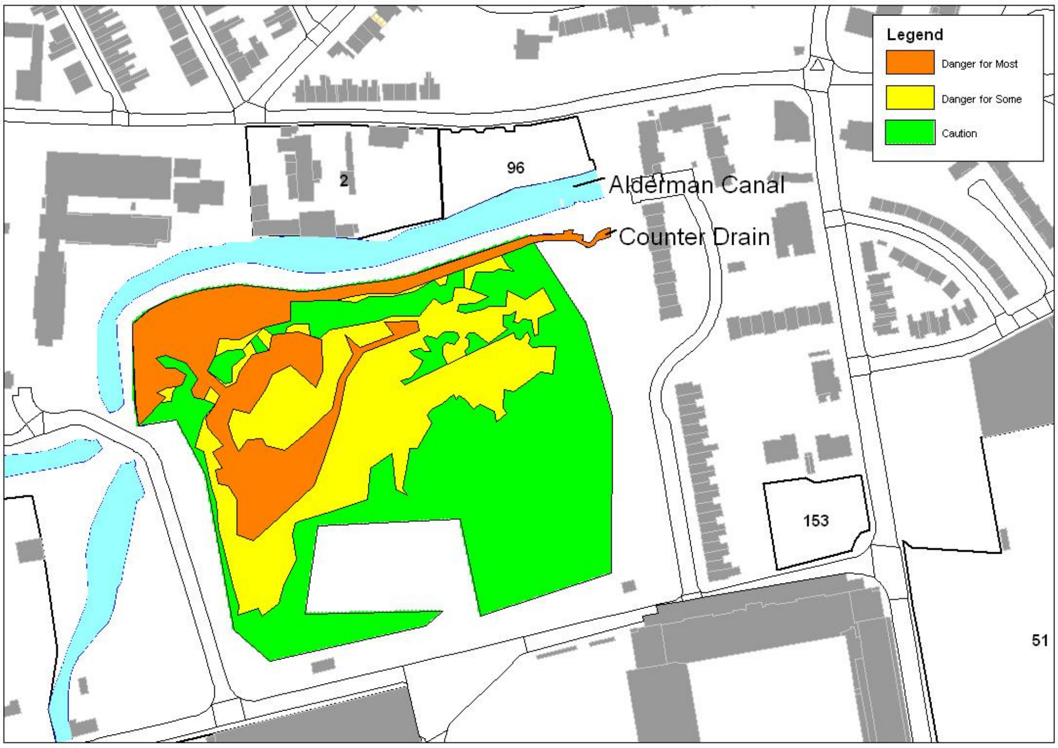


Figure 5-3 Food risk from Alderman Canal due to embankment failure

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.

5.7 Sewers and local drainage network

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 less 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.

AECOM Position Statement – Jan 2020
The DG5 register from Anglian Water was not available to inform this update to the SFRA. When data is available it will be included within SFRA updates.

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 10a and 10b and historic records of flooding are mapped in Figure 2).

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 affect.

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 salt water 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 9 for specific flood risk information on site allocations.

5.7.1 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.

5.8 Surface water flooding

5.8.1 Topography

Light Detection and Ranging (LiDAR) topographic survey data[24] 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

5.8.2 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 10a & 10b 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/SCC.

[24] 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.

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 created by ditches. Additionally, surface water flow pathways are present along the road networks.

It should be noted that these maps are based on topography 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.

5.8.3 Surface Water Management Plan

The Surface Water Management Plan[25] 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:

These areas have been 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.

5.8.4 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.

5.8.5 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.

[25] Suffolk Flood Risk Management Partnership, June 2012, Ipswich Surface Water Management Plan, Phase 3 Report

Table 5-3 Peak rainfall intensity allowances in small and urban catchments (1961-1990 baseline)[26]

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%

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.

5.8.6 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 5.7).
- 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 10.

5.9 Groundwater flooding

5.9.1 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 11 and Figure 12 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,

[26] https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#types-of-allowances

- The **White Chalk Subgroup** is composed of Chalk.

The mapping in Figure 11, Appendix A 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 (Figure 12, Appendix A) 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.

5.9.2 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'.

5.9.2.1 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 11 and Figure 12.

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'.

5.9.2.2 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.

5.10 Reservoir Flooding

The Environment Agency dataset 'Risk of Flooding from Reservoirs' available on the long term flood risk map[27] 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).

[27] 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 will 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.

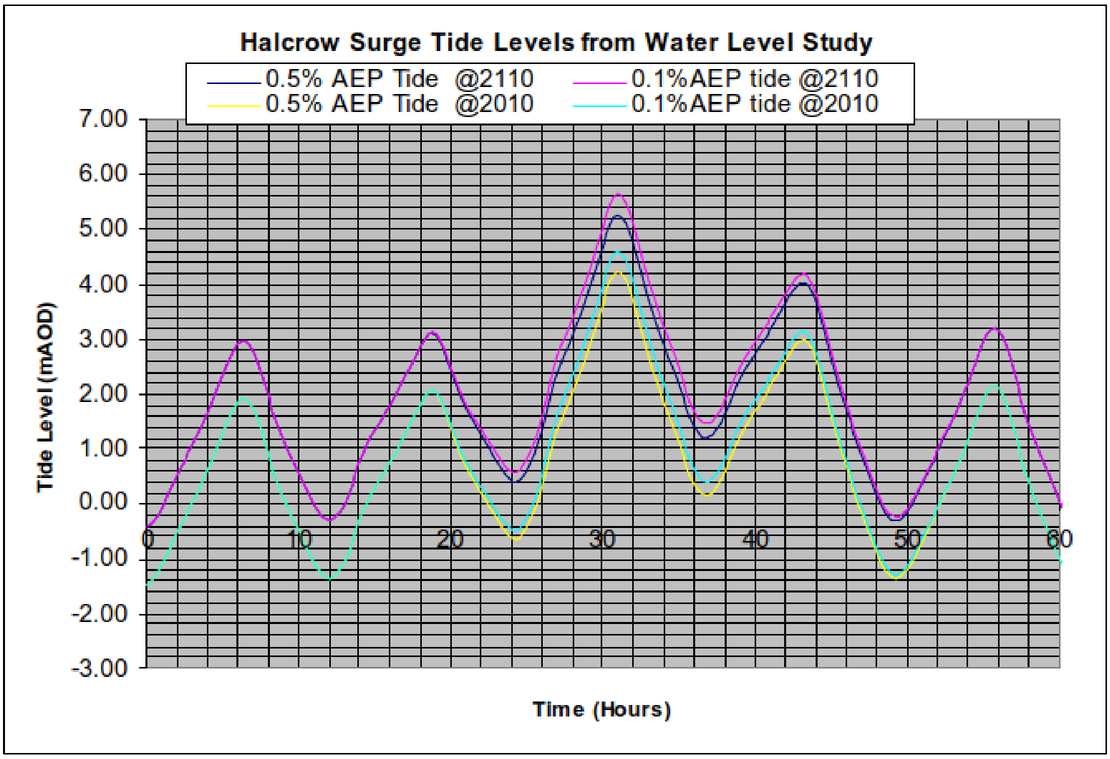


Figure 6-1 Tidal profiles applied in breach modelling (Halcrow 2009)

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 47). 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 6mAOD.

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 6mAOD. 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.

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[28]	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, Tesco development 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, Tesco development 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, pumping station for fluvial flow, repairs to New Cut u/s defences, Wherstead Rd floodgate, Tesco development with enhanced defences (not yet constructed) Barrier closed and pumping station not built.	2118 0.5% 2118 0.1%							

[28] 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.

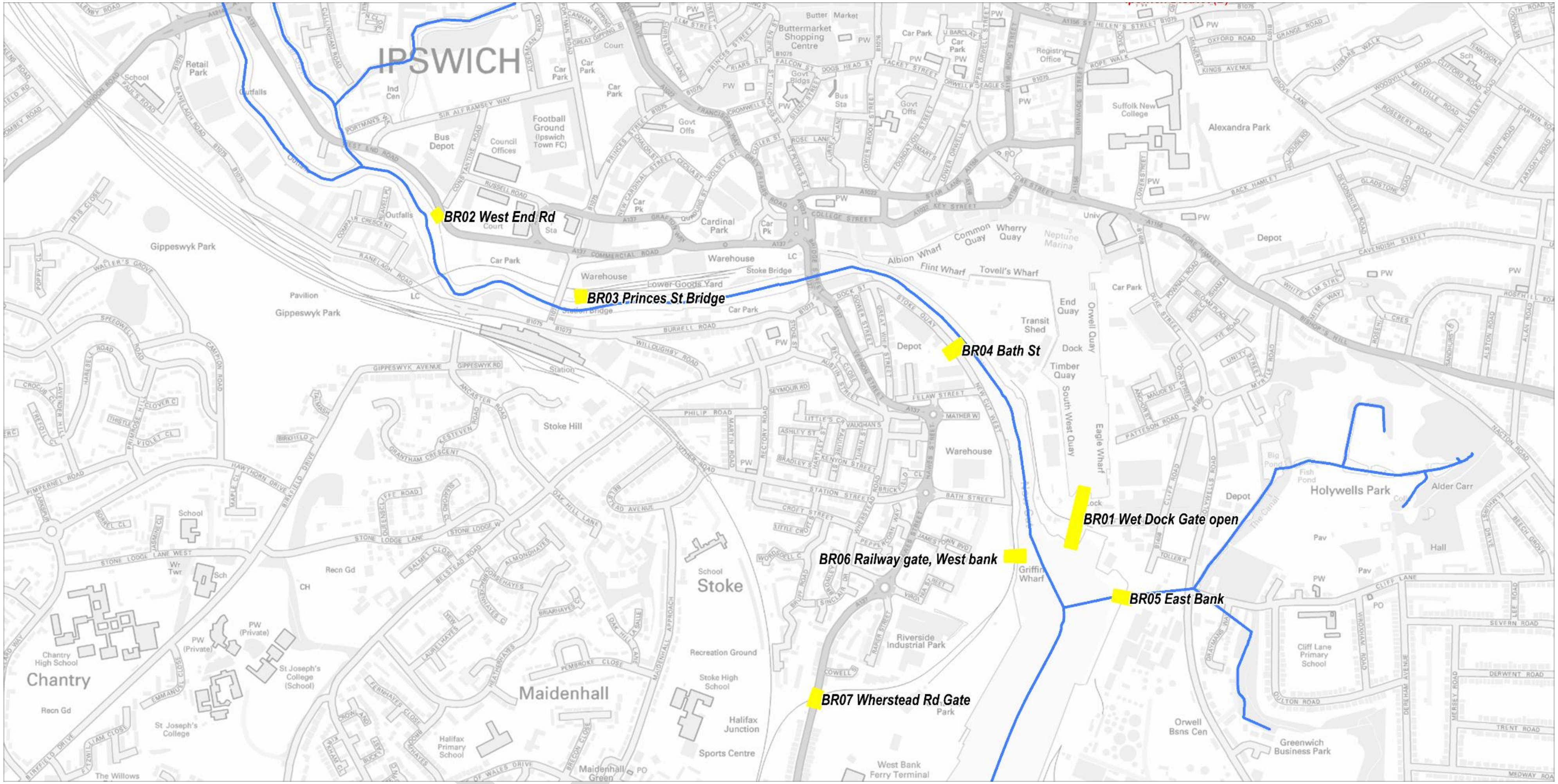


Figure 6-2 Breach locations along the Orwell, Ipswich

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 influences to the year 2118 (as opposed to 2110).

Hazard maps for the following scenarios are included in Appendix A Figure 19. The results for the 0.5% AEP including climate change to the year 2118 have been mapped.

- IP02 Barrier Open: BR02 Breach at West End Road
- IP02 Barrier Open: BR03 Breach at Princes St bridge (left bank)
- IP02 Barrier Open: BR04 Breach at Bath Street (right bank)
- IP03 Barrier Closed: No Breach
- IP03 Barrier Closed: BR01 Wet Dock Gate open
- IP03 Barrier Closed: BR05 Breach at East bank defence
- IP03 Barrier Closed: BR06 Railway gate in West bank open
- IP03 Barrier Closed: BR07 Wherstead Rd Gate open.
- IP04 Barrier Closed, PS not operating. No Breach.

6.2.4 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)

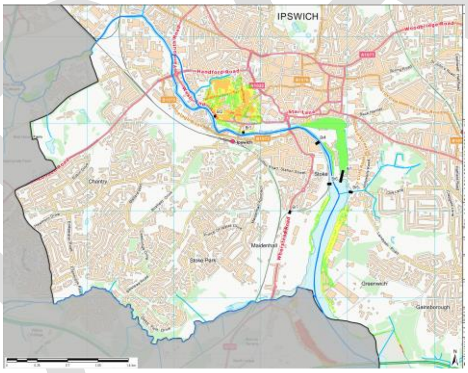
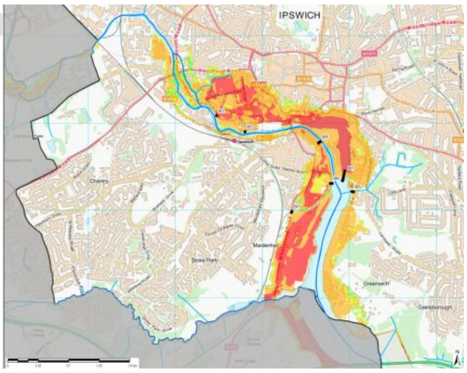
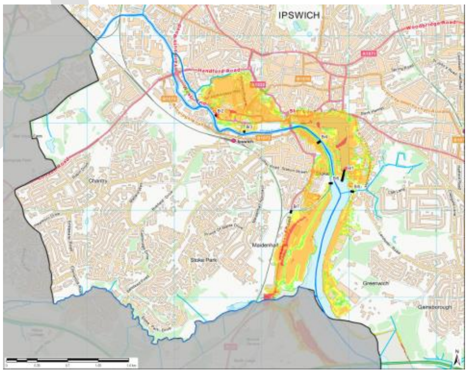
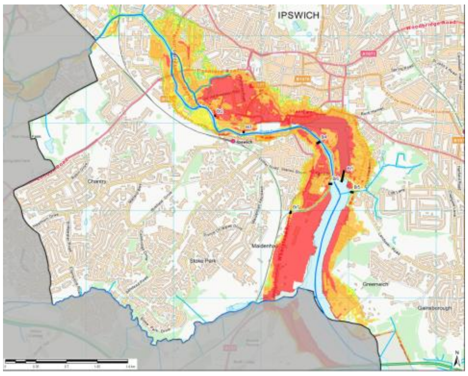
HR=d(v+0.5)+debris factor

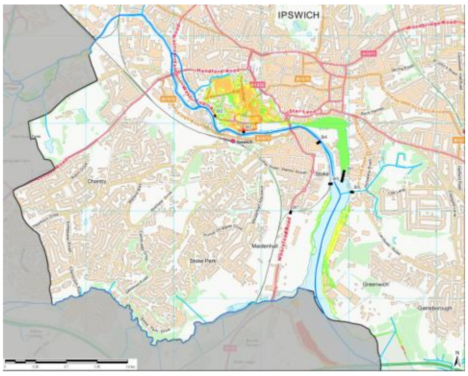
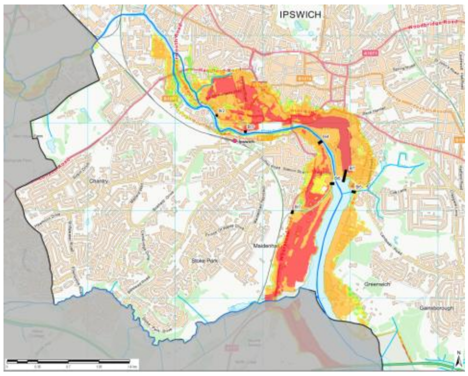
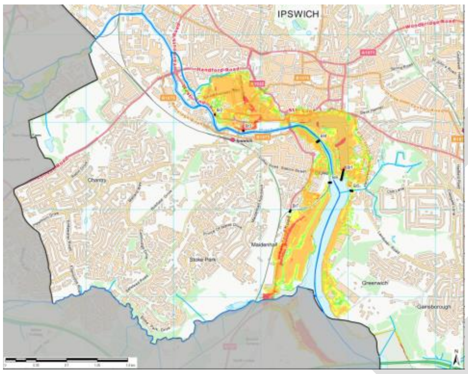
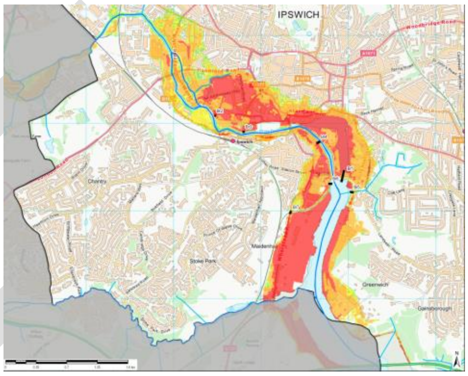
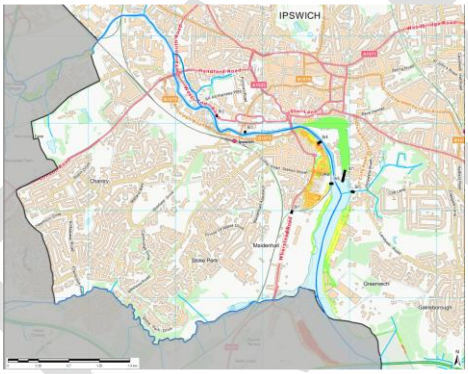
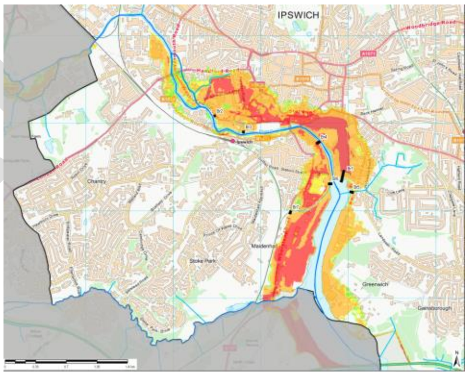
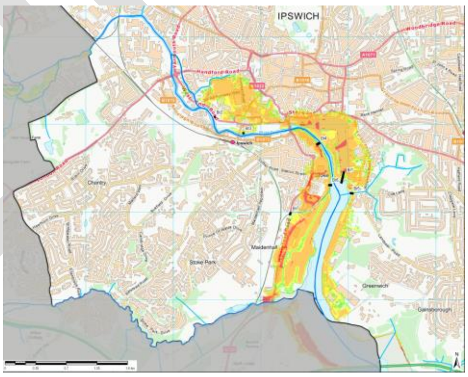
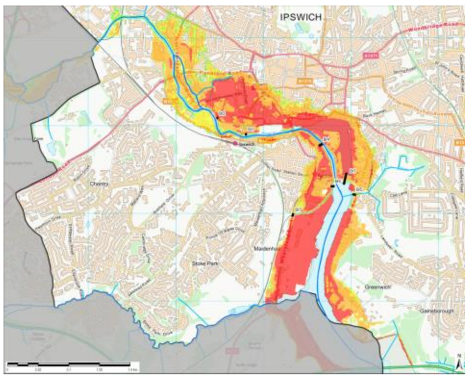
HR	Degree of Hazard		Description
HR<0.75	LOW	Caution	Caution - Flood zone with shallow flowing water or or deep standing water"
0.75-1.25	MODERATE	Danger for some (eg: Children)	Danger - Flood zone with deep or fast flowing water
1.25-2	SIGNIFICANT	Danger for most people	Danger - flood zone with deep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

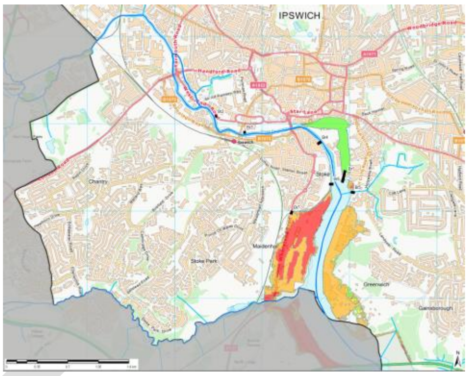
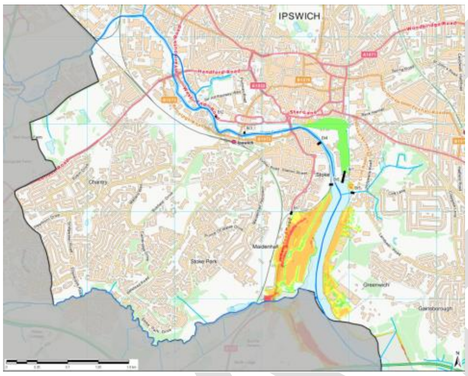
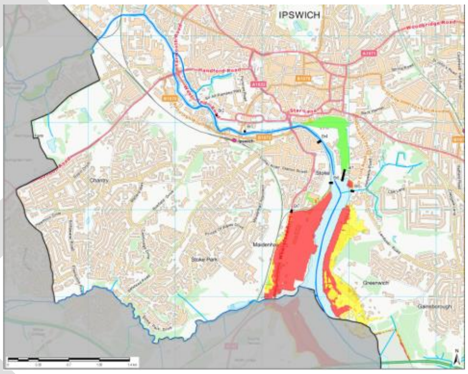
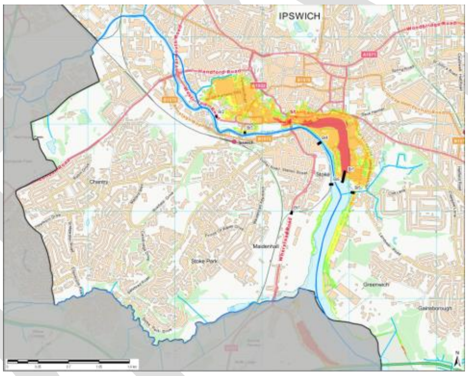
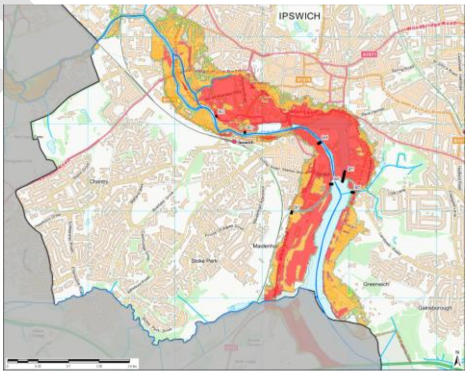
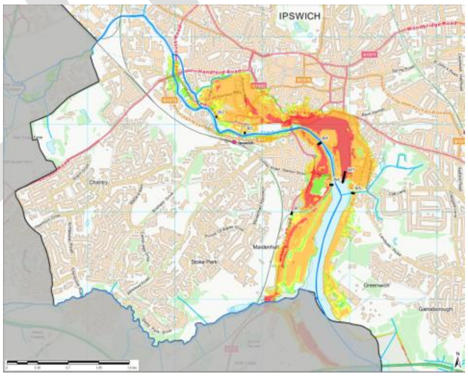
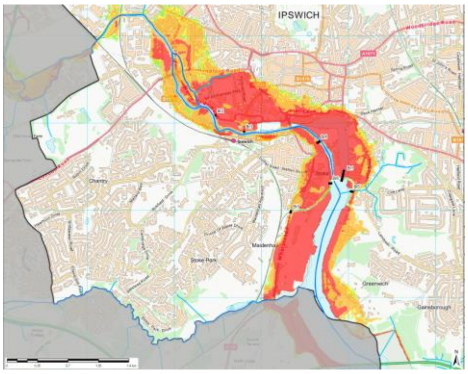
		Velocity (m/s)										
Depth (m)	Debris Factor	0	0.1	0.2	0.25	0.5	1	1.5	2	4	4.5	5
0.05	0.5	0.53	0.53	0.54	0.54	0.55	0.58	0.60	0.63	0.73	0.75	0.78
0.1	0.5	0.55	0.56	0.57	0.58	0.60	0.65	0.70	0.75	0.95	1.00	1.05
0.2	0.5	0.60	0.62	0.64	0.65	0.70	0.80	0.90	1.00	1.40	1.50	1.60
0.25	0.5	0.63	0.65	0.68	0.69	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

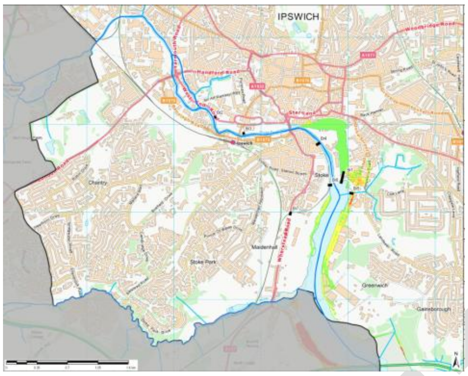
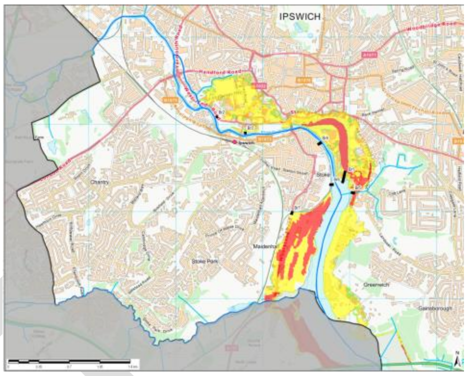
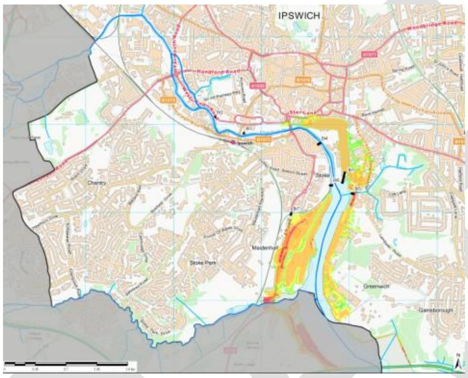
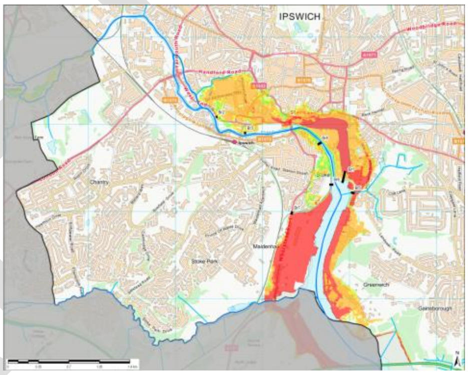
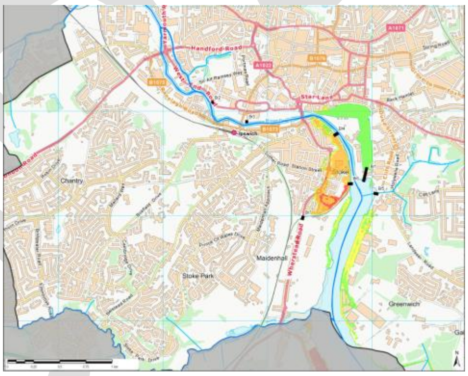
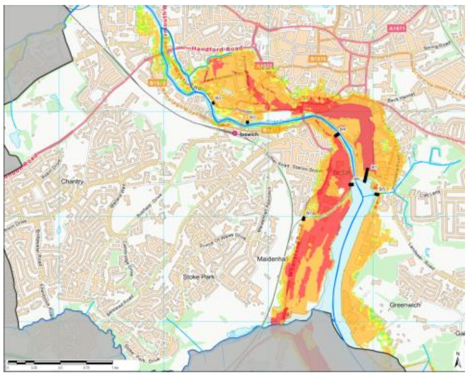
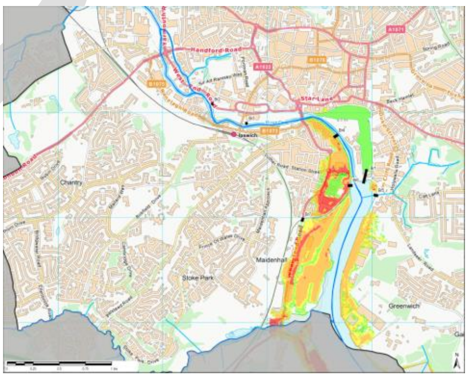
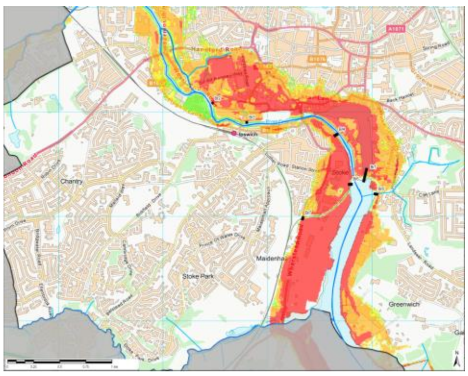
Hazard maps at a small scale are included below to enable comparisons to be made. Full sized hazard maps for fully operational defences are included in Appendix A figures 19A to 19AF.

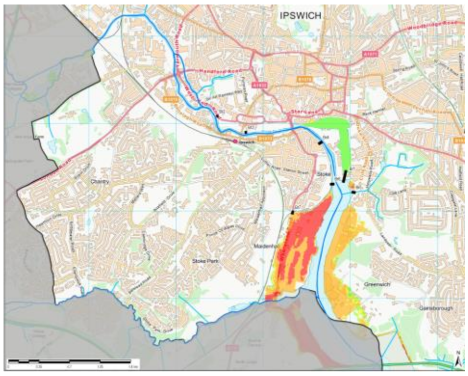
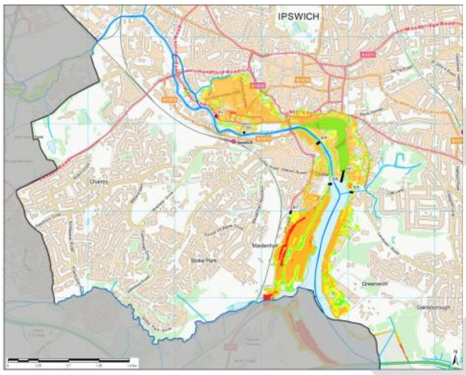
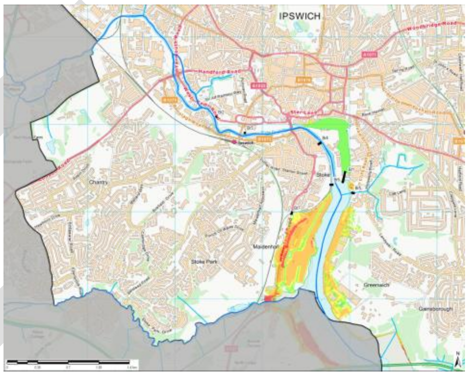
IP02 Ipswich FDMS with Barrier Open

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	0.5%	Considered below with barrier open	Considered below with barrier open
	0.1%		

Breach adj. Princes Street bridge			
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%		

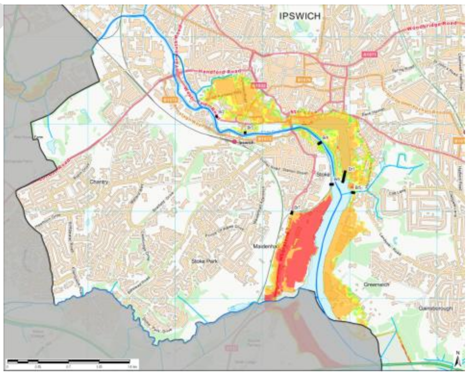
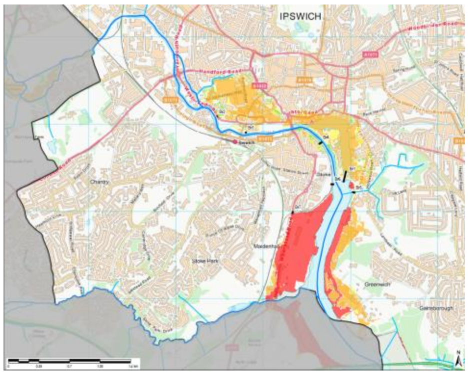
IP04 Ipswich FDMW with Barrier Closed, Pumping Station not operating			
Scenario	**AEP**	**At 2015 (present day)**	**At 2118 (climate change)**
BR00 Future fluvial pumping station inoperative	0.5%	Pumping station probably not required until 2035 to 2053.	
	0.1%	Pumping station probably not required until 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% exceedance probability for present day (2015) and future scenario (cc to 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 Wgerstead 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 5.28mAOD	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 8. 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
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.
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
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.)
New Cut Barrier, EA's Flood Defence Management Strategy includes for future maintenance/ replacement	L	L	Proposed new development on SHELAA site IP047 was approved by the planning committee March 2010. It includes raising and replacing much of the defence in this location. Short lengths of exposed sheet piling will 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.)
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.
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.
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

EA's Flood Defence Management Strategy includes for future maintenance/ replacement. Modern structural design, safety factors,	M	L	Warning system /Emergency plan
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.

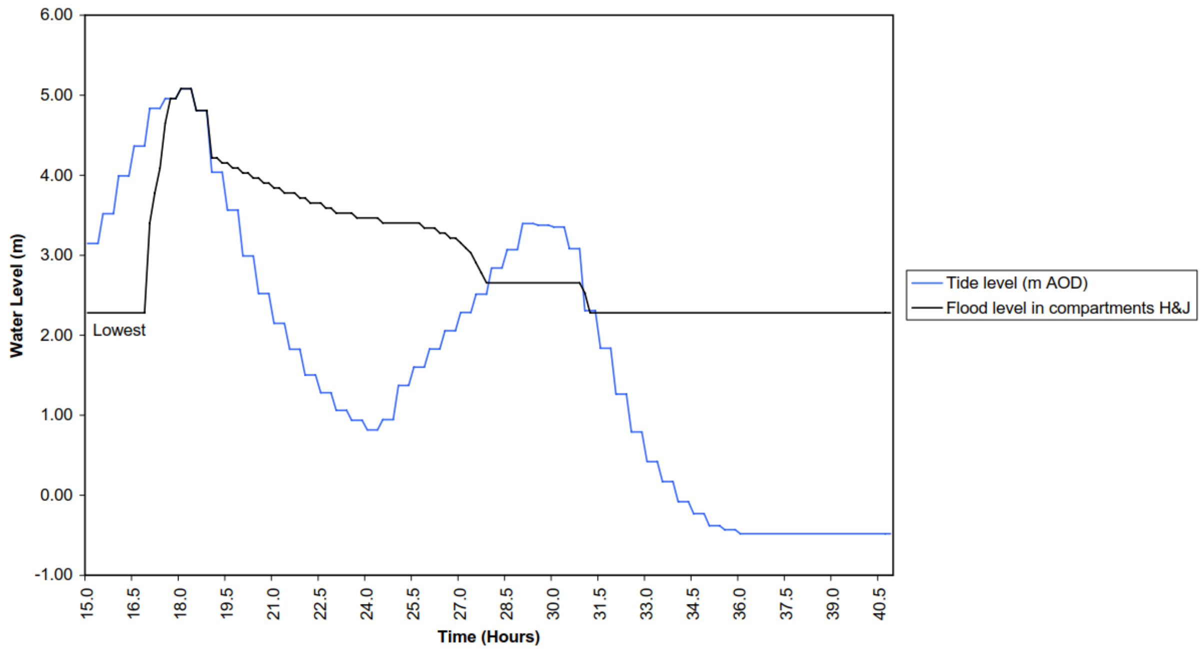


Figure 6-3 Speed of onset and duration, compartment H and J

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. Sequential and Exception Tests

7.1 Sequential Test Overview

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

The Sequential Test requires an understanding of the risk of flooding from all sources in the study area as well as the vulnerability classification of the proposed developments. This SFRA provides an assessment of flood risk from all sources in Ipswich. Flood risk vulnerability classifications, as defined in the PPG are presented in Table 7-1.

The flow diagram presented in Figure 7-1 illustrates how the Sequential Test process should be applied to identify the suitability of a site for allocation, in relation to the flood risk classification.

Where it has been determined that the Sequential Test has been satisfied, and there are no reasonable available alternative sites in an area of lower flood risk where the development could be located, Table 7-2 should be used to determine whether the Exception Test will need to be applied.

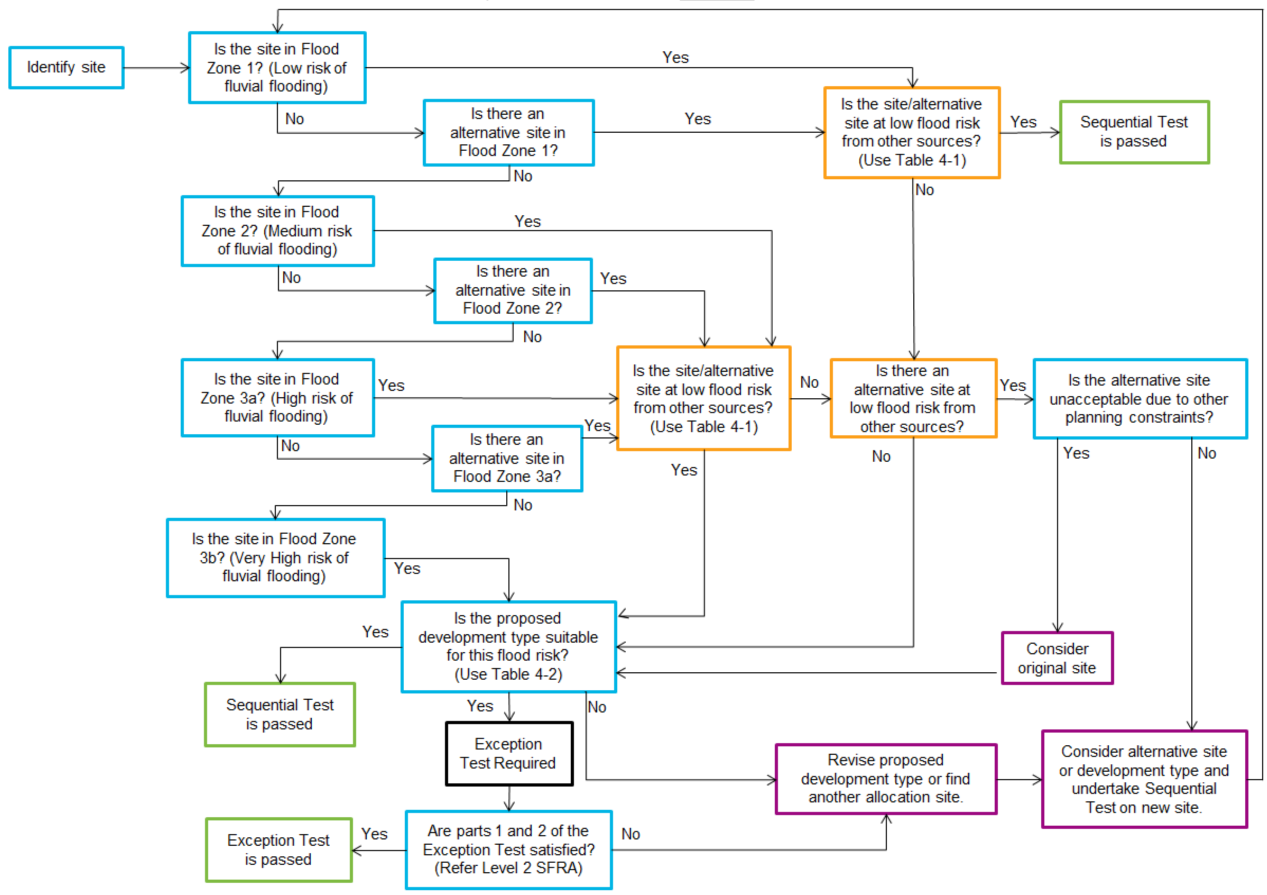


Figure 7-1 Application of Sequential Test for Plan-Making

Table 7-1 Flood Risk Vulnerability Classification (PPG)

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

	Water treatment works which do not need to remain operational during times of flood. Sewage treatment works (if adequate measures to control pollution and manage sewage during flooding events are in place).
Water-Compatible Development	Flood control infrastructure. Water transmission infrastructure and pumping stations. Sewage transmission infrastructure and pumping stations. Sand and gravel working. Docks, marinas and wharves. Navigation facilities. MOD defence installations. Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. Water-based recreation (excluding sleeping accommodation). Lifeguard and coastguard stations. Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.

Table 7-2 Flood Risk Vulnerability and Flood Zone 'Compatibility' (PPG)

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

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

* In Flood Zone 3b (functional floodplain) essential infrastructure that has to be there and has passed the Exception Test, and water-compatible uses, should be designed and constructed to:
- remain operational and safe for users in times of flood;
- result in no net loss of floodplain storage;
- not impede water flows and not increase flood risk elsewhere.

7.2 The Exception Test

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

- Part 1 - It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by the SFRA where one has been prepared; and
- Part 2 - A site-specific Flood Risk Assessment must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

Both elements of the test have to be passed for development to be allocated or permitted. In order to determine part 1) of the exception test, applicants should assess their scheme against the objectives within the safety framework detailed in Section 7 and the Council's Development and Flood Risk Supplementary Planning Document (SPD)[29].

In order to demonstrate Part 2) of the Exception Test, the measures presented as part of the Safety Framework (Section 8) should be applied and demonstrated within a site-specific FRA as detailed in Section 11.

7.3 Sequential Test Statement 2019

Ipswich BC is currently producing a review of its Core Strategy and Policies Development Plan Document (DPD) and Site Allocations and Policies (incorporating IP-One Area action Plan) DPD. These two documents will form the Council's Local Plan once adopted.

Site allocations are informed by the Strategic Housing and Employment Land Availability Assessment (SHELAA). The SHELAA looks at known potential development sites and assesses their suitability, availability and achievability. Where all the criteria are met, this assessment of potential capacity provides the evidence for making Local Plan allocations.

In order to allocate sites, the Council has undertaken a Sequential Test of SHELAA sites to assess the level of flood risk present on each site and to steer development to sites at a lower risk of flooding where appropriate, while considering the necessity to develop on previously developed land in areas of central Ipswich. There are limited brownfield sites available for development in Flood Zone 1 and it is therefore necessary to locate some development in Flood Zones 2 and 3a when considering the need to regenerate brownfield sites, and to locate development in central locations to minimise carbon emissions and the need to travel.

The following tables identify the sites under 4 categories:

- Brownfield sites in Flood Zone 1 (Table 7-3);
- Greenfield sites in Flood Zone 1 (Table 7-4);
- Ipswich Garden Suburb sites (Table 7-5);
- Brownfield sites in Flood Zone 2 or 3 (Table 7-6);

Within each table, the sites have been clustered to reflect the varying risk of flooding from all sources. I.e. those sites highest up in the table are considered to be generally at lower risk than those lower down the table and are therefore preferential for development. The order is based on a high level sieving exercise referring to the following criteria:

- proportion in each flood zone,
- 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 ROFSW mapping (yes, no),

[29] Ipswich Borough Council, Development and Flood Risk Supplementary Planning Document, January 2016. Available at: https://www.ipswich.gov.uk/sites/default/files/development_and_flood_risk_spd_jan_16_0.pdf

- the probability of groundwater emergence based on the AStGWF mapping (proportion within a 1km grid square).

Ipswich BC is not able to meet its total housing requirements from sites within Flood Zone 1, and therefore sites within Flood Zone 2 and 3 are required for development. This is also required to ensure the regeneration of central Ipswich, and to ensure brownfield land is recycled to take account of the benefits of sustainable development.

Ipswich BC have identified 1,024 dwellings on brownfield sites in Flood Zone 1, shown in Table 7-3.

Table 7-3 Brownfield sites in Flood Zone 1

Site Reference	Address	Site Area	IP One	Dwellings	FZ 2 Proportion (%)	FZ 3 Proportion (%)	Area Benefitting Defences (ABD)	Within 300m of a Main River	Within 300m of an Ordinary	ROFSW Low	ROFSW Medium	ROFSW High	ASTGWF	Historic Flood Map	IBC Historic Flood Occurrences
IP382	42 Bond Street/ rear of 65-71 Upper Orwell Street	0.07	Y	6	0	0	0						>= 25% <50%		9
IP376	9-13 St Matthew's Street	0.04	Y	13	0	0	0						>= 50% <75%		15
IP336	Wellington Court garages, Beaufort Street	0.06	No	9	0	0	0						>= 25% <50%		21
IP089	Waterworks Street	0.3	Y	23	0	0	0						>= 25% <50%		15
IP024	Mallard Way garages	0.14	No	5	0	0	0						< 25%		5
IP172	15-19 St Margaret's Street	0.08	Y	9	0	0	0						>= 25% <50%		12
IP067a	Former British Energy Site (north), Cliff Quay	0.38	No	17	0	0	0			Y			< 25%		0
IP221	Waterford Road	0.35	No	12	0	0	0			Y			< 25%		1
IP366	6 Lower Brook Street	0.04	Y	8	0	0	0			Y	Y		>= 25% <50%		12

Site Reference	Address	Site Area	IP One	Dwellings	FZ 2 Proportion (%)	FZ 3 Proportion (%)	Area Benefitting Defences (ABD)	Within 300m of a Main River	Within 300m of an Ordinary	ROFSW Low	ROFSW Medium	ROFSW High	ASTGWF	Historic Flood Map	IBC Historic Flood Occurrences
IP084a	County Hall, St Helen's Street	0.32	Y	42	0	0	0			Y	Y		>= 25% <50%		12
IP150d	Ravenswood	1.79	No	34	0	0	0			Y	Y				6
IP249	131 Bramford Road	0.04	No	8	0	0	0			Y	Y		>= 25% <50%	Yes	27
IP307	Prince of Wales Drive	0.27	No	12	0	0	0			Y	Y		< 25%		2
IP266	Western House, Dunlop Road - JTS	0.17	No	9	0	0	0			Y	Y		>= 25% <50%		4
IP048b	Mint Quarter/Cox Lane west	1.34	Y	36	0	0	0			Y	Y		>= 25% <50%		14
IP010a	Co-op Depot, Felixstowe Road	2.22	No	75	0	0	0			Y	Y		< 25%		6
IP010b	Felixstowe Road	2.79	No	62	0	0	0			Y	Y		< 25%		7
IP014	Orwell Church, Fore Hamlet	0.21	Y	23	0	0	0			Y	Y		< 25%		3
IP135	112-116 Bramford Road	0.17	No	19	0	0	0			Y	Y		>= 25% <50%	Yes	27
IP012	Peter's Ice Cream etc, Grimwade Street	0.32	Y	35	0	0	0			Y	Y		>= 25% <50%		17
IP373	59 - 61 Westgate Street	0.06	Y	5	0	0	0			Y	Y	Y	>= 25% <50%		14

Site Reference	Address	Site Area	IP One	Dwellings	FZ 2 Proportion (%)	FZ 3 Proportion (%)	Area Benefitting Defences (ABD)	Within 300m of a Main River	Within 300m of an Ordinary	ROFSW Low	ROFSW Medium	ROFSW High	ASTGWF	Historic Flood Map	IBC Historic Flood Occurrences
IP125	Corner of Hawke Road and Holbrook Road	0.25	No	15	0	0	0			Y	Y	Y	< 25%		1
IP277	Barrack Corner	0.03	No	6	0	0	0			Y	Y	Y	>= 50% <75%		10
IP048a	Mint Quarter	1.33	Y	53	0	0	0			Y	Y	Y	>= 25% <50%		18
IP150e	Ravenswood	3.61	No	126	0	0	0			Y	Y	Y			4
IP101	R/o Stratford Road and Cedarcroft Road	0.2	No	9	0	0	0			Y	Y	Y	< 25%		2
IP080	240 Wherstead Road	0.49	Y	27	0	0	0			Y	Y	Y	>= 25% <50%		6
IP009	Victoria Nurseries, Westerfield Road	0.39	No	12	0	0	0			Y	Y	Y	< 25%		11
IP041	Former Police Station site, Elm Street	0.56	Y	58	0	0	0		Y	Y	Y	Y	>= 50% <75%		23
IP040	Civic Centre area, Civic Drive	0.76	Y	59	0	0	0		Y	Y	Y	Y	>= 25% <50%		21
IP066	J J Wilson, White Elm St and 46-70 Cavendish St	0.88	No	55	0	0	0		Y	Y	Y	Y	< 25%		4
IP177	Lock-up garages rear of 16-30 Richmond Road	0.13	No	6	0	0	0		Y	Y			>= 25% <50%		2
IP279b(1)	North of former BT office, fronting Handford Road	0.4	Y	18	0	0	0	Y	Y	Y			>= 50% <75%		24

Site Reference	Address	Site Area	IP One	Dwellings	FZ 2 Proportion (%)	FZ 3 Proportion (%)	Area Benefitting Defences (ABD)	Within 300m of a Main River	Within 300m of an Ordinary	ROFSW Low	ROFSW Medium	ROFSW High	ASTGWF	Historic Flood Map	IBC Historic Flood Occurrences
IP309	Bridgeward Social Club, 68A Austin Street	0.29	Y	15	0	0	0	Y	Y	Y			>= 25% <50%		9
IP143	Former Norsk Hydro ('Topsite'), Sandy Hill Lane	4.51	No	85	0	0	0	Y		Y	Y	Y	>= 25% <50%		2
IP011a	Smart Street/Foundation Street	0.15	Y	18	0	0	0	Y	Y	Y	Y	Y	>= 25% <50%		14

7.1 Ipswich BC have identified 698 dwellings on greenfield sites in Flood Zone 1, (not including the Ipswich Garden Suburb) shown in Table 7-4.

Table 7-4 Greenfield sites in Flood Zone 1

Site Reference	Address	Site Area	IP One	Dwellings	FZ 2 Proportion (%)	FZ 3 Proportion (%)	Area Benefitting Defences (ABD)	Within 300m of a Main River	Within 300m of an Ordinary	ROFSW Low	ROFSW Medium	ROFSW High	ASTGWF	Historic Flood Map	IBC Historic Flood
IP372	62 Warrington Road	0.13	No	1		0	0						>= 25% <50%		3
IP296	57 Henley Road and land to rear	0.1	No	3		0	0						< 25%		9
IP380	113 Sidegate Lane	0.12	No	1		0	0			Y			< 25%		1
IP356	79 Hutland Road	0.09	No	5		0	0			Y					6
IP061	Lavenham Road School site	0.9	No	23		0	0			Y			>= 25% <50%		3

Site Reference	Address	Site Area	IP One	Dwellings	FZ 2 Proportion (%)	FZ 3 Proportion (%)	Area Benefitting Defences (ABD)	Within 300m of a Main River	Within 300m of an Ordinary	ROFSW Low	ROFSW Medium	ROFSW High	ASTGWF	Historic Flood Map	IBC Historic Flood
IP286	Adj 742 Old Norwich Road	0.97	No	14		0	0			Y	Y		< 25%		0
IP032	King George V Field, Old Norwich Road	3.7	No	99		0	0			Y	Y	Y	< 25%		4
IP033	Land at Bramford Road (Stock's site)	2.04	No	55		0	0			Y	Y	Y	< 25%		3
ISPA4.1	Land at Humber Doucy Lane - Urban Edge of Ipswich	23.6	No	496		0	0		Yes	Y	Y	Y	< 25%		7
IP374	Land adjacent Kingscroft, Thurleston Lane	0.18	No	1		0	0		Yes				< 25%		2

7.2 A further 3,268 dwellings are identified at the Ipswich Garden Suburb between 2018 and 2036, shown in Table 7-5.

Table 7-5 Garden Suburb sites in Flood Zone 1

Site Reference	Address	Site Area	IP One	Dwellings	FZ 2 Proportion (%)	FZ 3 Proportion (%)	Area Benefitting Defences (ABD)	Within 300m of a Main River	Within 300m of an Ordinary	ROFSW Low	ROFSW Medium	ROFSW High	ASTGWF	Historic Flood Map	IBC Historic Flood
-	Ipswich Garden Suburb Phase N3a	59.14	No	912	0	1%	0		Y	Y	Y	Y	< 25%		7
-	Ipswich Garden Suburb Phase N2	50.01	No	1100	0	1%	0		Y	Y	Y	Y	< 25%		3
-	Ipswich Garden Suburb Phase N1a	43.29	No	800	0	1%	0		Y	Y	Y	Y	< 25%		17

-	Ipswich Garden Suburb Phase N1b	12.46	No	456	0	1%	0			Y	Y	Y	< 25%		17

7.3 Tables 7.3 to 7.5 show potential housing capacity of 4,990 dwelling in Flood Zone 1. The Local Plan housing requirement is 8,010 dwellings 2018-2036 and therefore additional land will need to be identified to meet housing need.

7.4 Sites identified in Flood Zones 2 and 3 are shown in Table 7-6. This exercise has demonstrated that there are not enough sites available and developable within the plan period located within Flood Zone 1 to meet the housing requirement to 2036. Therefore, sites identified as being located within Flood Zone 2 and 3 have been taken forward to a ‘pro-forma’ stage where additional information on flood depth, rate of onset and propagation of floodwater across compartments is provided. This will be used to further inform the site allocation process.

Table 7-6 Sites in Flood Zone 2 and 3

Site Reference	Address	Site Area	IP One	Dwellings	FZ 2 Proportion	FZ 3 Proportion	ABD	Within 300m of a Main River	Within 300m of an Ordinary	ROFSW Low	ROFSW Medium	ROFSW High	ASTGWF	Historic Flood Map	IBC Historic Flood
IP064a	Holywells Road (east)	1.2	Yes	66	19%	29%	30%		Y	Y	Y	Y	< 25%		3
IP354	72 (Old Boatyard) Cullingham Road IP1 2EG	0.34	Yes	24	74%	26%	45%	Y	Y	Y			>= 50% <75%	Yes	39
IP120b	Land west of West End Road	1.02	Yes	103	39%	8%	11%	Y	Y	Y			>= 50% <75%	Yes	24
IP119	Land east of West End Road	0.61	Yes	28	42%	4%	3%	Y	Y	Y			>= 50% <75%	Yes	40
IP098	Transco, south of Patteson Road	0.57	Yes	62	47%	53%	80%	Y	Y	Y			< 25%		3
IP047	Land at Commercial Road	3.11	Yes	173	0%	100%	100%	Y	Y	Y			>= 25% <50%	Yes	43
IP043	Commercial Bldgs & Jewish Burial Ground, Star Lane	0.7	Yes	50	16%	21%	18%	Y	Y	Y			>= 25% <50%		18
IP031b	22 Stoke Street IP2 8BX	0.18	Yes	18	26%	40%	40%	Y	Y	Y			>= 25% <50%		22
IP004	Bus Depot, Sir Alf Ramsey Way	1.07	Yes	48	1%	99%	100%	Y	Y	Y			>= 50% <75%	Yes	26
IP003	Waste tip north of Sir Alf Ramsey Way	1.46	Yes	114	16%	78%	87%	Y	Y	Y			>= 50% <75%	Yes	23
IP355	77-79 Cullingham Road	0.06	Yes	6	90%	4%	62%	Y	Y	Y	Y		>= 50% <75%		24

Site Reference	Address	Site Area	IP One	Dwellings	FZ 2 Proportion	FZ 3 Proportion	ABD	Within 300m of a Main River	Within 300m of an Ordinary	ROFSW Low	ROFSW Medium	ROFSW High	ASTGWF	Historic Flood Map	IBC Historic Flood
IP279b(2)	South of former BT office, Bibb Way	0.62	Yes	29	18%	2%	1%	Y	Y	Y	Y		>= 50% <75%		39
IP226	Helena Road	1.85	Yes	337	2%	98%	100%	Y	Y	Y	Y		< 25%		3
IP136	Silo, College Street	0.16	Yes	48	0%	100%	100%	Y	Y	Y	Y		>= 25% <50%		23
IP133	South of Felaw Street	0.37	Yes	45	39%	51%	61%	Y	Y	Y	Y		>= 25% <50%		4
IP132	Bridge Street, Northern Quays (west)	0.18	Yes	73	0%	100%	100%	Y	Y	Y	Y		>= 25% <50%		22
IP037	Island Site	6.02	Yes	421	5%	95%	57%	Y	Y	Y	Y		>= 25% <50%		35
IP035	Key Street/Star Lane/Burtons Site	0.54	Yes	86	1%	99%	100%	Y	Y	Y	Y		>= 25% <50%		23
IP011c	Smart Street/Foundation Street	0.08	Yes	7	1%	0%	0%	Y	Y	Y	Y		>= 25% <50%		14
IP188	Websters saleyard site, Dock Street	0.1	Yes	9	17%	83%	94%	Y	Y	Y	Y	Y	>= 25% <50%		22
IP105	Depot, Beaconsfield Road	0.33	No	15	100%	0%	57%	Y	Y	Y	Y	Y	>= 25% <50%	Yes	10
IP054b	Land between Old Cattle Market and Star Lane	1.09	Yes	40	29%	23%	27%	Y	Y	Y	Y	Y	>= 25% <50%		24

Site Reference	Address	Site Area	IP One	Dwellings	FZ 2 Proportion	FZ 3 Proportion	ABD	Within 300m of a Main River	Within 300m of an Ordinary	ROFSW Low	ROFSW Medium	ROFSW High	ASTGWF	Historic Flood Map	IBC Historic Flood
IP052	Land between Lower Orwell Street and Star Lane	0.39	Yes	29	5%	1%	0%	Y	Y	Y	Y	Y	>= 25% <50%		17
IP045	Holywells Road west/Toller Road	2.06	Yes	148	17%	83%	100%	Y	Y	Y	Y	Y	< 25%		3
IP039a	Land between Vernon Street and Stoke Quay (west)	0.48	Yes	45	9%	76%	72%	Y	Y	Y	Y	Y	>= 25% <50%		22
IP031a	103-115 Burrell Road	0.43	Yes	20	7%	81%	83%	Y	Y	Y	Y	Y	>= 25% <50%		24
IP028b	Land west of Greyfriars Road (Jewsons)	0.9	No	40	13%	86%	91%	Y	Y	Y	Y	Y	>= 25% <50%	Yes	21
IP015	West End Road Surface Car Park	1.21	Yes	67	40%	51%	84%	Y	Y	Y	Y	Y	< 25%	Yes	22
IP011b	Smart Street/Foundation Street	0.62	Yes	56	31%	47%	52%	Y	Y	Y	Y	Y	>= 25% <50%		32

As described in Section 7.1, where residential development is proposed in Flood Zone 3, the Exception Test needs to be applied. Further information to support the application of the Exception Test for these proposed development sites is provided in Section 9.

7.3.2 Windfall Sites

Windfall sites are those which have not been specifically identified within in the Local Plan process or they are below the site size threshold to be considered. They comprise sites that have unexpectedly become available. In cases where development needs cannot be fully met through the provision of site allocations, a realistic allowance for windfall development should be assumed, based on past trends. It is recommended that the acceptability of windfall applications in flood risk areas should be considered at the strategic level through a policy setting out broad locations of windfall development that would be acceptable or not in Sequential Test terms. Where this is not possible, windfall applications will need to apply the sequential test as part of the planning application process in consultation with IBC.

7.4 Applying Sequential Test to Planning Applications

It is necessary to undertake a sequential test for a planning application if both of the following apply:

- The proposed development is in Flood Zone 2 or 3.
- A sequential test hasn't already been done for a development of the type you plan to carry out on your proposed site (check with IBC).

The Environment Agency publication 'Demonstrating the flood risk Sequential Test for Planning Applications[30]' sets out the procedure for applying the sequential test to individual applications as follows:

- Identify the geographical area of search over which the test is to be applied; this could be the Borough area, or a specific catchment if this is appropriate and justification is provided (e.g. school catchment area or the need for affordable housing within a specific area).
- Identify the source of 'reasonably available' alternative sites; usually drawn from evidence base / background documents produced to inform the Local Plan.
- State the method used for comparing flood risk between sites; for example, the Environment Agency Flood Map for Planning, the SFRA mapping, site-specific FRAs if appropriate, other mapping of flood sources.
- Apply the Sequential Test; systematically consider each of the available sites, indicate whether the flood risk is higher or lower than the application site, state whether the alternative option being considered is allocated in the Local Plan, identify the capacity of each alternative site, and detail any constraints to the delivery of the alternative site(s).
- Conclude whether there are any reasonably available sites in areas with a lower probability of flooding that would be appropriate to the type of development or land use proposed.
- Where necessary, as indicated by Table 7-2 apply the Exception Test.
- Apply the Sequential approach to locating development within the site.

It should be noted that it is for IBC, taking advice from the Environment Agency as appropriate, to consider the extent to which Sequential Test considerations have been satisfied, taking into account the particular circumstances in any given case. The developer should justify with evidence what area of search has been used when making the application.

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

7.4.1 Sequential Test Exemptions

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

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

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

dwelling itself. This definition excludes any proposed development that would create a separate dwelling within the curtilage of the existing dwelling resulting in a net addition e.g. subdivision of houses into flats.

- Change of Use applications, unless it is for a change of use of land to a caravan, camping or chalet site, or to a mobile home site or park home site.
- Development proposals in Flood Zone 1 (land with a low probability of flooding from rivers or the sea) unless the SFRA, or other more recent information, indicates there may be flooding issues now or in the future (for example, through the impact of climate change).
- Redevelopment of existing properties (e.g. replacement dwellings), provided they do not increase the number of dwellings in an area of flood risk (i.e. replacing a single dwelling within an apartment block).

8. Safety of development in Flood Zones 2 and 3 – informing the Exception Test

8.1 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.

The Environment Agency Flood Risk Emergency Plans for New Developments[31] also sets out that new development should not increase the burden on the Emergency Services or expose them to hazardous flooding when attempting to assist users of new developments.

Guidance on what is safe is provided in the Defra and Environment Agency R&D *'Flood Risk Assessment Guidance for New Development' FD2320 provides guidance on this topic area.* **Ultimately, it is the responsibility of the planning authorities to decide what level of risk is acceptable.**

Important considerations include:

- The characteristics of a possible flood event e.g. flood depths and velocities (hazard ratings), frequency, speed of onset and duration of flooding;
- The safety of people connected with the development - people within the building and those around or in adjacent areas. This includes the ability to safely access and exit the building during a design flood (0.5% AEP) and ability of residents and users to evacuate before an extreme flood (0.1% AEP);
- Consideration of the potential of fluvial flooding becoming an actual risk over a developments lifetime. While a site may be considered to be 'defended' in the present day scenario i.e. at residual risk, as rainfall intensities increase, the risk of the flood defences being overtopped also increases. This should be investigated in any site level FRA.
- The structural safety of the building;
- The impact of floods on water, electricity or fuel supplies for example;
- Flood warning and evacuation and likelihood of buildings being occupied at the time of a flood.

In Ipswich the newly completed Flood Defence Management Strategy has reduced the risk to people and the demand for emergency services, even with the anticipated sea level rise in the future. Much of the proposed development in Ipswich town will benefit from the protection of these defences and this can be taken into account when considering development within the Flood Compartments upstream of the Barrier.

However, even with the IFDMS in place, there remains a residual risk of flooding due to overtopping or failure of the defences. Measures should be implemented to reduce these residual risks, for example building design, safe access and escape, flood warning and evacuation plans.

8.2 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

31 https://www.adeptnet.org.uk/system/files/documents/ADEPT%20%26%20EA%20Flood%20risk%20emergency%20plans%20for%20new%20development%20September%202019....pdf

and specific requirements are set out in Ipswich BC's Development and Flood Risk Supplementary Planning Document (SPD). This Section provides an overview of the safety framework for development in Ipswich.

The safety framework requires:

- Buildings to structurally resist loads due to moving floodwater.
- Raised habitable floor levels.
- Emergency plans for flood warning, response and evacuation arrangements for users of buildings.
- Temporary Refuges for people who may have to remain in buildings (following an un-warned or rapid inundation such as might occur if flood defence infrastructure were to breach).
- "Safe" access/escape routes for building users which will also assist emergency services.
- Special measures to further assist emergency services.
- Flood resilience measures.

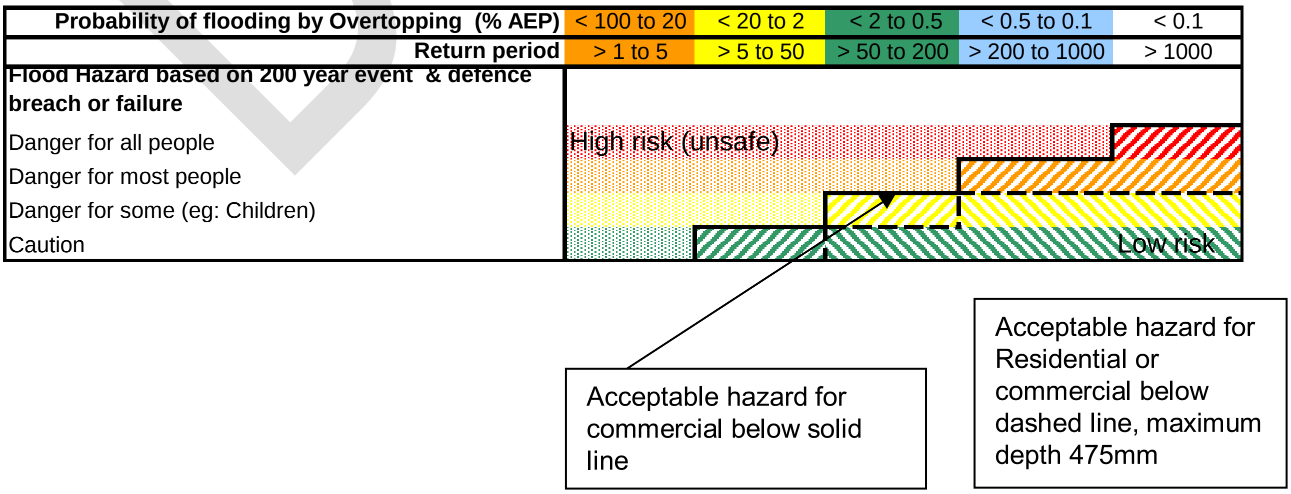
Even if a development complies with the framework there remains a small probability that a flood will occur, putting people at risk. Developers are therefore encouraged to improve on the following minimum requirements.

8.2.1 Safe access

To help reduce risks to people who do not evacuate or who may have to stay in safe refuges due to rapid inundation following a breach, hazard ratings on access and escape routes to higher ground (where buildings likely to be used as places of assembly during flooding are likely to be located) should be limited. High risk relates to high flood hazard rating combined with a high probability of flooding. Low risk relates to low hazard and probability.

Section 7.3.1 of the Ipswich Development and Flood Risk SPD refers to safe access and includes a table to illustrate the acceptability of flood hazard on access or escape routes. This is broadly based on Table 12.3 of the DEFRA / Environment Agency's "Flood Risk Assessment Guidance for New Development Phase 2 R&D Technical Report FD2320/TR2"[32] which suggests low risk cells in the table would be acceptable for safe access to residential developments, and medium risk for commercial developments.

Figure 8-1 Acceptability of Hazard of Access or Escape Routes – In areas protected by defences



32 http://evidence.environment-agency.gov.uk/FCERM/Libraries/FCERM_Project_Documents/FD2320_3364_TRP_pdf.sflb.ashx

The hazard maps for the different modelled scenarios considered are presented in Appendix A. These are hazards due to overtopping, breaches or open gates allowing for present day (2015) and sea level rise to 2118. It should be noted:

- The hazard map relates to breaches at the locations shown on the map. If development is proposed close to defences where breaches have not been considered in this SFRA then a site-specific FRA will need to infer hazard ratings or undertake new 2D Modelling.
- The hazard maps relate to the 0.5% AEP event for the year 2118 and during the course of the Local Plan period, allowable access levels will gradually increase.

8.2.2 Floor levels for habitable rooms

Habitable rooms include kitchens, living rooms, dining rooms and bedrooms but not garages or utility rooms. Floor levels must normally be above the 0.5 % AEP flood level including climate change over the lifetime of the development, typically 100 years, plus a 300mm allowance for freeboard (this is referred to as the design flood level). Where it is available, this should be the breach inundation level on site (rather than the level in the estuary).

The 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 8-1.

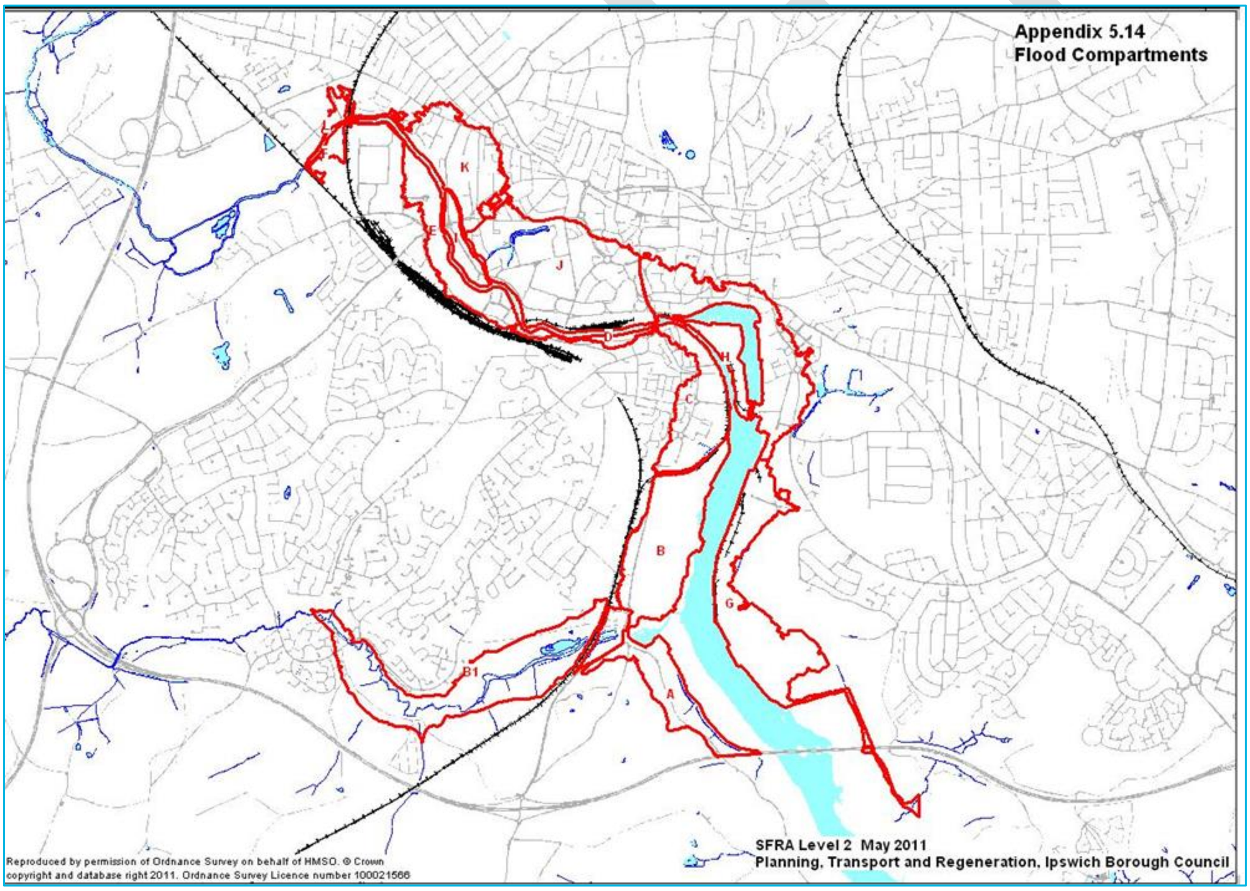


Figure 8-1 Flood compartments

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, Contact EA regarding fluvial levels for the River Gipping.
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 0.1% AEP fluvial level is 3.95m AOD. Habitable floors to be above ground and >4mAOD.
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 >4mAOD and <5.3 m AOD

Table 8-1 Maximum flood levels

Note: to establish the 'design flood level' the flood level below (including allowance for climate change for the development lifetime) must also include an additional 300mm for freeboard.

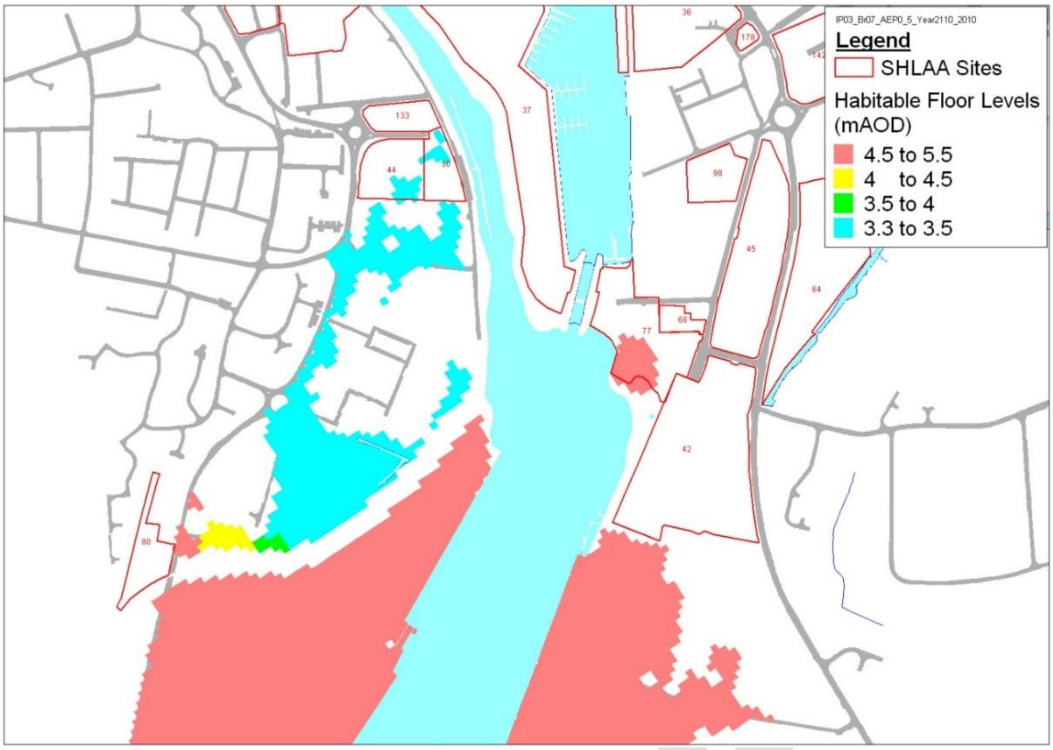


Figure 8-2 Design Flood levels for Habitable floors in Compartment C (Breach 7, Barrier in place)

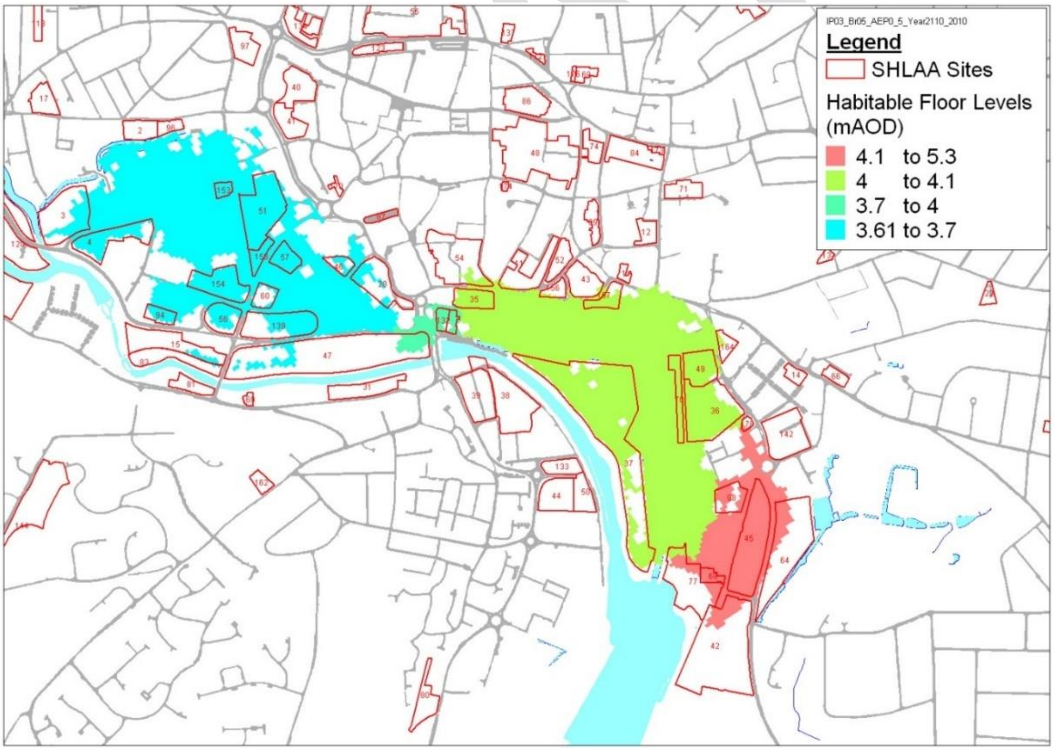


Figure 8-3 Design Flood Levels for Habitable Floors in Compartments H +J (Breach 5 with Barrier in place, 0.5% AEP)

8.2.3 Commercial floor levels

Commercial floor levels should be at least high enough to avoid surface water flooding during a 1% AEP rainfall event.

8.2.4 Temporary refuges

A temporary “safe refuge” - is any place where individuals trapped by floodwater can remain for a short period in relative safety whilst awaiting rescue. Safe refuges play a role in reducing the overall risk of flooding; they do not in themselves make a development safe.

Temporary refuges are needed for most developments within the floodplain. They should be above the 0.1% AEP event tide level over the lifetime of the development (5.7m AOD by 2111). They would most likely to be needed if there was no time to evacuate, i.e. for a sudden breach in the defences.

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.

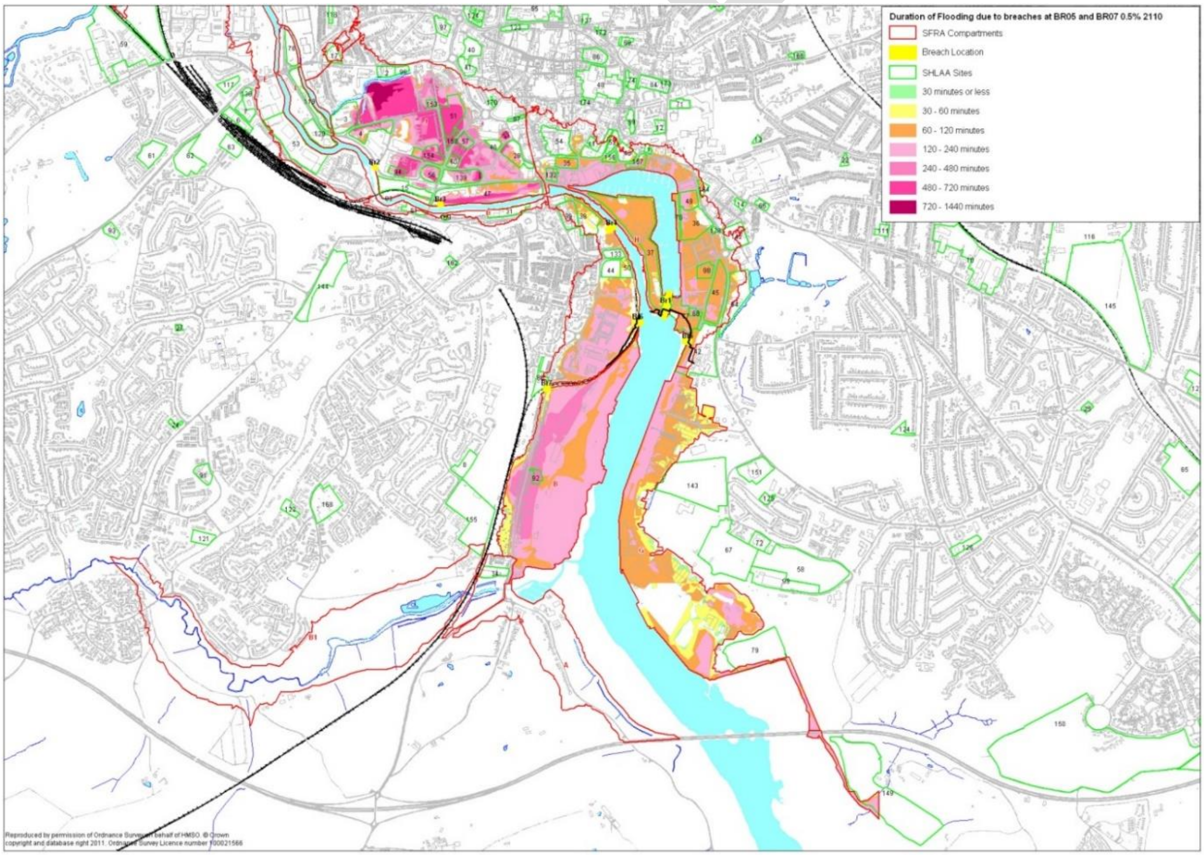


Figure 8-4 Tidal and fluvial flood duration

Figure Figure 8-4 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 v time was created and used to estimate contours corresponding to the range of durations shown.

8.2.5 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[33]', 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 NPPF practice guide. Figure 8-5 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.

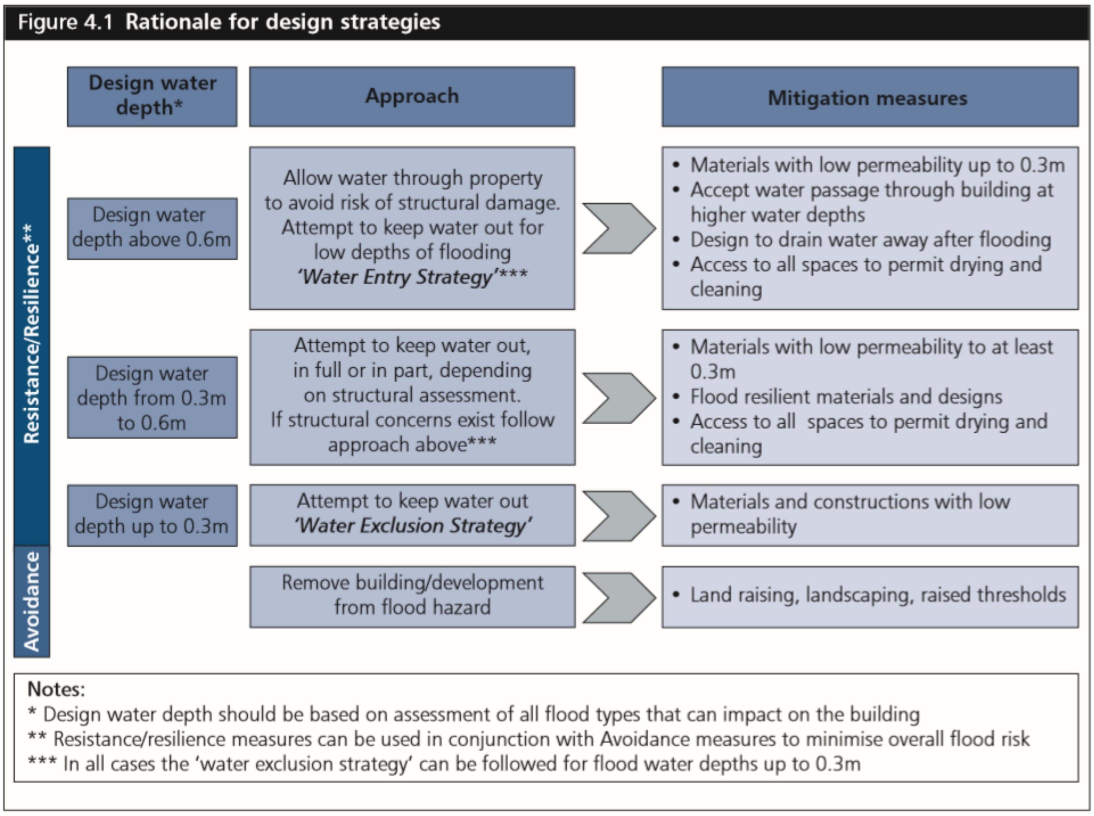


Figure 8-5 Flood Resistant / Resilient Design Strategies, Improving Flood Performance, CLG 2007

8.2.5.1 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

[33] 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

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.
- 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.

8.2.5.2 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.

8.2.5.3 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.

8.2.6 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.

8.2.7 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 10.6.

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 https://www.adeptnet.org.uk/system/files/documents/ADEPT%20%26%20EA%20Flood%20risk%20emergency%20plans%20for%20new%20development%20September%202019....pdf.

Suggested structure for Emergency Flood Management Plans
1.0 Introduction
1.1 Describe the location of the site fully and accurately
1.1.1 Attach a site plan to help identify the location and size of the site
1.1.2 State the size of the development including the number and type of properties within the development.
1.1.3 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.
1.2 State the likelihood of flooding. How big is the risk?
1.3 State who will be responsible for reviewing and implementing the FMP.
2.0 Warning arrangements
2.1 How will occupants be informed if a flood is likely to occur?
2.2 Do you intend to register the site with the Environment Agency's flood warning service 'Floodline'?
2.3 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
3.1 How will occupants be instructed on the procedures to follow in the event of a flood or flood warnings?
3.2 What will these instructions cover?
3.3 Procedure for passing on information to new occupants?
4.0 Instructions to commercial tenants in the event of a flood warning
4.1 How will commercial tenants be instructed on the procedures to follow in the event of a flood or flood warnings?
4.2 What will these instructions cover?
4.3 When commercial tenants leave, how will new commercial tenants be informed of the flood evacuation procedures?
5.0 Advice and information from developers
5.1 List useful telephone numbers and websites
5.2 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 Figure 6.

8.2.8 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

9. Applying the Exception Test - Assessment of site allocations

9.1 Overview

Using the information presented within this SFRA, the Sequential Test has been applied to steer potential development towards areas of lowest flood risk, as detailed in Section 7.

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, some sites located in Flood Zone 3 are required 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, as set out in Section 7.1.

Table 9-1 identifies the potential development sites 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.

Table 9-1 Flood risk information for site allocations

Table ite Reference	Address	Site Area	IP One	Dwellings	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	Maximum Hazard Rating on Site	Safety Framework
IP001	Land between 81-97 Fore Street	0.08	Yes	7	15%	31%	6%			YES	YES		>= 25% <50%		14	Caution	Protected by the IFDMS. At residual risk of flooding. Site is located on the edge of Flood Zone 3. Safe access achievable along Fore St and north. FFL should be set above maximum water level 4m AOD in Compartment H (Table 7-1).
IP003	Waste tip north of Sir Alf Ramsey Way	1.46	Yes	114	16%	78%	87%	Yes	Yes	YES			>= 50% <75%	Yes	23	Danger to Most	Protected by the IFDMS. At residual risk of flooding. Site is located on the edge of Flood Zone 3. Due to proximity to

Table ite Reference	Address	Site Area	IP One	Dwellings	FZ 2 Proportion	FZ 3 Proportion	Area Benefitting from Defences	Within 300m of a Main River	Within 300m of an Ordinary	ROFSW Low	ROFSW Medium	ROFSW High	ASTGWF	Historic Flood Map	IBC Historic Flood	Maximum Hazard Rating on Site	Safety Framework
																	River Orwell, safe access may not be achievable, depending on the location of the breach. Safe refuge should be provided set above maximum water level 4m AOD in Compartment J (Table 7-1).
IP004	Bus Depot, Sir Alf Ramsey Way	1.07	Yes	48	1%	99%	100%	Yes	Yes	YES			>= 50% <75%	Yes	26	Danger to Most	Protected by the IFDMS. At residual risk of flooding. Due to proximity to River Orwell, safe access may not be achievable, depending on the location of the breach. Safe refuge

Table ite Reference	Address	Site Area	IP One	Dwellings	FZ 2 Proportion	FZ 3 Proportion	Area Benefitting from Defences	Within 300m of a Main River	Within 300m of an Ordinary	ROFSW Low	ROFSW Medium	ROFSW High	ASTGWF	Historic Flood Map	IBC Historic Flood	Maximum Hazard Rating on Site	Safety Framework
																	should be provided set above maximum water level 4m AOD in Compartment J (Table 7-1).
IP011b	Smart Street/Foundation Street	0.62	Yes	56	31%	47%	52%	Yes	Yes	YES	YES	YES	>= 25% <50%		32	Danger for Some	Protected by the IFDMS. At residual risk of flooding. Site is located on the edge of Flood Zone 3. Safe access achievable along Foundation Street and north. FFL should be set above maximum water level 4m AOD in Compartment H (Table 7-1).

Table ite Reference	Address	Site Area	IP One	Dwellings	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	Maximum Hazard Rating on Site	Safety Framework
IP011c	Smart Street/Foundation Street	0.08	Yes	7	1%	0%	0%	Yes	Yes	YES	YES		>= 25% <50%		14	Danger for Some	Protected by the IFDMS. At residual risk of flooding. Site is located on the edge of Flood Zone 3. Safe access achievable along Foundation Street and north. FFL set above maximum water level 4m AOD in Compartment H (Table 7-1).
IP015	West End Road Surface Car Park	1.21	Yes	67	40%	51%	84%	Yes	Yes	YES	YES	YES	< 25%	Yes	22	Danger to Most	Protected by the IFDMS. At residual risk of flooding. The site is entirely within the defended floodplain with limited opportunities

Table ite Reference	Address	Site Area	IP One	Dwellings	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	Maximum Hazard Rating on Site	Safety Framework
																	for safe access in the event of a breach. Safe refuge should be provided above 4m AOD in Compartment J. FFL for habitable rooms should be set above 4m AOD (Table 7-1).
IP028b	Land west of Greyfriars Road (Jewsons)	0.9	No	40	13%	86%	91%	Yes	Yes	YES	YES	YES	>= 25% <50%	Yes	21	Danger to Most	Protected by the IFDMS. At residual risk of flooding. Site is located on the edge of Flood Zone 3. Safe access achievable along Greyfriars Road. FFL set above maximum

Table ite Reference	Address	Site Area	IP One	Dwellings	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	Maximum Hazard Rating on Site	Safety Framework
																	water level 4m AOD Compartment J (Table 7-1).
IP031a	103-115 Burrell Road	0.43	Yes	20	7%	81%	83%	Yes	Yes	YES	YES	YES	>= 25% <50%		24	-	Protected by the IFDMS. At residual risk of flooding. Safe access likely to be achievable along Burrell Road to south which is in Flood Zone 1. FFL should be set above maximum water level 4m AOD in Compartment D (Table 7-1).
IP031b	22 Stoke Street IP2 8BX	0.18	Yes	18	26%	40%	40%	Yes	Yes	YES			>= 25% <50%		22	-	Protected by the IFDMS. At residual risk of flooding. Safe access likely to be

Table ite Reference	Address	Site Area	IP One	Dwellings	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	Maximum Hazard Rating on Site	Safety Framework
																	achievable along Burrell Road to south which is in Flood Zone 1. FFL should be set above maximum water level 4m AOD in Compartment D (Table 7-1).
IP035	Key Street/Star Lane/Burtons Site	0.54	Yes	86	1%	99%	100%	Yes	Yes	YES	YES		>= 25% <50%		23	Danger to Most	Protected by the IFDMS. At residual risk of flooding. Safe access likely to be achievable to the north along Lower Brook Street. Onset of flooding in the event of a breach could be within 1 hour (Appendix D). FFL should be

Table ite Reference	Address	Site Area	IP One	Dwellings	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	Maximum Hazard Rating on Site	Safety Framework
																	set above maximum water level 4m AOD in Compartment H (Table 7-1).
IP037	Island Site	6.02	Yes	421	5%	95%	57%	Yes	Yes	YES	YES		>= 25% <50%		35	Danger to Most	Protected by the IFDMS. At residual risk of flooding. The site is entirely within the defended floodplain with limited opportunities for safe access in the event of a breach. Safe refuge should be provided above 5.3m AOD. FFL for habitable rooms should be set above

Table ite Reference	Address	Site Area	IP One	Dwellings	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	Maximum Hazard Rating on Site	Safety Framework
																	5.3m AOD (Table 7-1).
IP039a	Land between Vernon Street and Stoke Quay (west)	0.48	Yes	45	9%	76%	72%	Yes	Yes	YES	YES	YES	>= 25% <50%		22	Danger to Most	Protected by the IFDMS. At residual risk of flooding. Safe access likely to be achievable to the south along Vernon Street. FFL should be set above maximum water level 3.5m AOD in Compartment C (Table 7-1).
IP043	Commercial Bldgs & Jewish Burial Ground, Star Lane	0.7	Yes	50	16%	21%	18%	Yes	Yes	YES			>= 25% <50%		18	Danger to some	Protected by the IFDMS. At residual risk of flooding. Site is located on the edge of Flood Zone 3. Safe access achievable

Table ite Reference	Address	Site Area	IP One	Dwellings	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	Maximum Hazard Rating on Site	Safety Framework
																	along Star Lane. FFL set above maximum flood level 4m AOD in Compartment H (Table 7-1).
IP045	Holywells Road west/Toller Road	2.06	Yes	148	17%	83%	100%	Yes	Yes	YES	YES	YES	< 25%		3	Danger to All	Protected by the IFDMS. At residual risk of flooding. The site is entirely within the defended floodplain with limited opportunities for safe access in the event of a breach. Safe refuge should be provided above 5.3m AOD. FFL for habitable rooms should be set above

Table ite Reference	Address	Site Area	IP One	Dwellings	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	Maximum Hazard Rating on Site	Safety Framework
																	5.3m AOD (Table 7-1).
IP047	Land at Commercial Road	3.11	Yes	173	0%	100%	100%	Yes	Yes	YES			>= 25% <50%	Yes	43	Danger to Most	Protected by the IFDMS. At residual risk of flooding. The site is entirely within the defended floodplain with limited opportunities for safe access in the event of a breach. Safe refuge should be provided above 4m AOD in Compartment J. FFL for habitable rooms should be set above 4m AOD (Table 7-1).

Table ite Reference	Address	Site Area	IP One	Dwellings	FZ 2 Proportion	FZ 3 Proportion	Area Benefitting from Defences	Within 300m of a Main River	Within 300m of an Ordinary	ROFSW Low	ROFSW Medium	ROFSW High	ASTGWF	Historic Flood Map	IBC Historic Flood	Maximum Hazard Rating on Site	Safety Framework
IP052	Land between Lower Orwell Street and Star Lane	0.39	Yes	29	5%	1%	0%	Yes	Yes	YES	YES	YES	>= 25% <50%		17	-	Majority of site in Flood Zone 1, safe for development.
IP054b	Land between Old Cattle Market and Star Lane	1.09	Yes	40	29%	23%	27%	Yes	Yes	YES	YES	YES	>= 25% <50%		24	Danger to some	Majority of site in Flood Zone 1. South eastern part of site at residual risk of flooding. FFL should be set above maximum water level 4m AOD in Compartment H (Table 7-1).
IP064a	Holywells Road (east)	1.2	Yes	66	19%	29%	30%		Yes	YES	YES	YES	< 25%		3	Danger to Most	Protected by the IFDMS. At residual risk of flooding. The site is entirely within the defended floodplain; safe access may be

Table ite Reference	Address	Site Area	IP One	Dwellings	FZ 2 Proportion	FZ 3 Proportion	Area Benefitting from Defences	Within 300m of a Main River	Within 300m of an Ordinary	ROFSW Low	ROFSW Medium	ROFSW High	ASTGWF	Historic Flood Map	IBC Historic Flood	Maximum Hazard Rating on Site	Safety Framework
																	achievable along Holywells Road in the event of a breach, depending on the time of the breach and the warning period. Safe refuge should be provided above 5.3m AOD. FFL for habitable rooms should be set above 5.3m AOD (Table 7-1).
IP096	Car Park, Handford Road (east)	0.22	Yes	22	6%	3%	6%		Yes	YES			>= 50% <75%		11	Caution	Majority of the site is in Flood Zone 1, and safe for development. The southern edge of the site is at residual risk.

Table ite Reference	Address	Site Area	IP One	Dwellings	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	Maximum Hazard Rating on Site	Safety Framework
																	FFL should be set above maximum water level 4m AOD in Compartment J (Table 7-1).
IP098	Transco, south of Patteson Road	0.57	Yes	62	47%	53%	80%	Yes	Yes	YES			< 25%		3	Danger to Most	Protected by the IFDMS. At residual risk of flooding. The site is entirely within the defended floodplain; safe access may be achievable along Patteson Road to the east in the event of a breach, depending on the time of the breach and the warning period. Safe refuge should

Table ite Reference	Address	Site Area	IP One	Dwellings	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	Maximum Hazard Rating on Site	Safety Framework
																	be provided above 5.3m AOD. FFL for habitable rooms should be set above 5.3m AOD (Table 7-1).
IP105	Depot, Beaconsfield Road	0.33	No	15	100%	0%	57%	Yes	Yes	YES	YES	YES	>= 25% <50%	Yes	10	-	Site located in Flood Zone 2. Development in this location is considered safe.
IP119	Land east of West End Road	0.61	Yes	28	42%	4%	3%	Yes	Yes	YES			>= 50% <75%	Yes	40	-	Most of the island at West End Road has ground levels between 4 and 5.5m AOD. Habitable floors to be above ground and >4mAOD. Compartment I (Table 7-1).

Table ite Reference	Address	Site Area	IP One	Dwellings	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	Maximum Hazard Rating on Site	Safety Framework
IP120b	Land west of West End Road	1.02	Yes	103	39%	8%	11%	Yes	Yes	YES			>= 50% <75%	Yes	24	-	Most of the island at West End Road has ground levels between 4 and 5.5m AOD. Habitable floors to be above ground and >4mAOD. Compartment I (Table 7-1).
IP132	Bridge Street, Northern Quays (west)	0.18	Yes	73	0%	100%	100%	Yes	Yes	YES	YES		>= 25% <50%		22	Danger to Most	Protected by the IFDMS. At residual risk of flooding. Due to proximity to River Orwell, safe access may not be achievable, depending on the location of the breach. Onset of flooding in the event of a breach could be within 1

Table ite Reference	Address	Site Area	IP One	Dwellings	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	Maximum Hazard Rating on Site	Safety Framework
																	hour (Appendix D). FFL should be set above maximum water level 4-5.3m AOD in Compartment H (Table 7-1).
IP133	South of Felaw Street	0.37	Yes	45	39%	51%	61%	Yes	Yes	YES	YES		>= 25% <50%		4	Caution	Protected by the IFDMS. At residual risk of flooding. Safe access likely to be achievable to the west along Vernon Street. FFL should be set above maximum water level 3.5m AOD in Compartment C (Table 7-1).

Table ite Reference	Address	Site Area	IP One	Dwellings	FZ 2 Proportion	FZ 3 Proportion	Area Benefitting from Defences	Within 300m of a Main River	Within 300m of an Ordinary	ROFSW Low	ROFSW Medium	ROFSW High	ASTGWF	Historic Flood Map	IBC Historic Flood	Maximum Hazard Rating on Site	Safety Framework
IP136	Silo, College Street	0.16	Yes	48	0%	100%	100%	Yes	Yes	YES	YES		>= 25% <50%		23	Danger to Most	Protected by the IFDMS. At residual risk of flooding. Due to proximity to River Orwell, safe access may not be achievable, depending on the location of the breach. Onset of flooding in the event of a breach could be within 1 hour (Appendix D). FFL should be set above maximum water level 4-5.3m AOD in Compartment H (Table 7-1).
IP178	Island House, Duke Street	0.09	Yes	8	44%	51%	50%			YES	YES		< 25%		6	Danger to Most	Protected by the IFDMS. At residual risk of

Table ite Reference	Address	Site Area	IP One	Dwellings	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	Maximum Hazard Rating on Site	Safety Framework
																	flooding. The site is on the edge of Flood Zone 3. Safe access achievable along Duke Street and to the east. FFL for habitable rooms should be set above 5.3m AOD for Compartment H (Table 7-1).
IP188	Websters saleyard site, Dock Street	0.1	Yes	9	17%	83%	94%	Yes	Yes	YES	YES	YES	>= 25% <50%		22	Caution	Protected by the IFDMS. At residual risk of flooding. Safe access may be possible to the south along Vernon Street depending on warning time available. Due to the proximity to the River

Table ite Reference	Address	Site Area	IP One	Dwellings	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	Maximum Hazard Rating on Site	Safety Framework
																	Orwell, safe refuge should be provided above 5.3m AOD. FFL should be set above maximum water level 3.5m AOD in Compartment C (Table 7-1).
IP226	Helena Road	1.85	Yes	337	2%	98%	100%	Yes	Yes	YES	YES		< 25%		3	Danger for All	Protected by the IFDMS. At residual risk of flooding. The site is entirely within the defended floodplain with limited opportunities for safe access in the event of a breach. Safe refuge should be provided above 5.3m

Table ite Reference	Address	Site Area	IP One	Dwellings	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	Maximum Hazard Rating on Site	Safety Framework
																	AOD. FFL for habitable rooms should be set above 5.3m AOD (Table 7-1).
IP279b(2)	South of former BT office, Bibb Way	0.62	Yes	29	18%	2%	1%	Yes	Yes	YES	YES		>= 50% <75%		39	-	Majority of the site is in Flood Zone 1, and safe for development. The southern edge of the site is at residual risk. FFL should be set above maximum water level 4m AOD in Compartment J (Table 7-1).
IP354	72 (Old Boatyard) Cullingham Road IP1 2EG	0.34	Yes	24	74%	26%	45%	Yes	Yes	YES			>= 50% <75%	Yes	39	-	Majority of the site is in Flood Zone 2, with some falling into Flood Zone 3. The

Table ite Reference	Address	Site Area	IP One	Dwellings	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	Maximum Hazard Rating on Site	Safety Framework
																	southern edge of the site is at residual risk. FFL should be set above maximum water level 4m AOD in Compartment J (Table 7-1).
IP355	77-79 Cullingham Road	0.06	Yes	6	90%	4%	62%	Yes	Yes	YES	YES		>= 50% <75%		24	-	Majority of the site is in Flood Zone 2,with a small section of Flood Zone 3 and Flood Zone 1 The southern edge of the site is at residual risk. FFL should be set above maximum water level 4m AOD in Compartment J (Table 7-1).

10. Flood risk management

10.1 Overview

Further to the Safety Framework for development in Flood Zones 2 or 3 set out in Section 8, this section provides information and guidance on flood risk management measures that should be applied when considering development in Ipswich.

10.2 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 8) 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.

10.2.1 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.

10.3 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 can not enter the car park during a 1 in 100 year (1% AEP) plus climate change flood event.

10.4 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[34].

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[35].

10.5 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.

10.6 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 10-1. 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 10-1 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

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

	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.

10.7 Surface Water Management

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)[36]. 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;

[36] 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/

- 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[37] 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[38] the risk of contaminating groundwater and control measures required to mitigate this should be considered, in accordance with IBC Supplementary Planning Document (SPD).
- **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.

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.

10.7.1 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. An assessment of suitability for infiltration should be undertaken to demonstrate the impact of infiltration SuDS on ground conditions;
- 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.

[37] CIRIA C697 SuDS Manual. Available from: http://www.ciria.org/Resources/Free_publications/the_suds_manual.aspx
[38] Groundwater Source Protection Zones, http://apps.environment-agency.gov.uk/wiyby/37833.aspx

- Attenuation SuDS should be designed to attenuate to a controlled discharge rate. The design should demonstrate the outfall (i.e. sewer network, receiving watercourse) has sufficient capacity. 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.
- 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[39].
- Best practice guidance in the Suffolk Flood Risk Management Partnership (SFRMP)[40] SuDS guidance requires discharge rates from new developments should be restricted to Greenfield runoff rates.
- The SFRMP guidance for Brownfield sites indicates where a site is previously developed, Suffolk CC will expect discharge rates to be restricted as close to greenfield rates as reasonably practical. Alternatively, the brownfield 1yr, 30yr and 100yr peak runoff rates are be used with a betterment of at least 30% – as per section 3.2.2 in CIRIA SuDS Manual C753.
- 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.

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

10.7.2 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 brown field 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.

[39] 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

[40] 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/

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 should identify sites such as wide verges or other open land that could be used for SUDS to provide strategic relief. Some such locations have been identified at Heath Rd (scheme installed 2009/10) and Bixley Rd.

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, some measures relating to new footway crossings are in place. The maps with this report should assist in development of policies.

10.8 Strategic Flood Risk Management

10.8.1 Natural Flood Management

Natural flood management (NFM) is when natural processes are used to reduce the risk of flooding. NFM should be an integral part of sustainable management and reduction of flood risk within Ipswich BC and should be incorporated into new developments where possible. The NPPF, paragraph 157, specifically cites considering opportunities for NFM where appropriate within new developments to reduce the causes and impacts of flooding.

There are three main mechanisms for NFM that can be used to mitigate flooding. These are:

- Increasing infiltration
- Storing water
- Slowing flows

Further guidance on NFM can be sought from the Environment Agency[41].

10.8.2 River Restoration

One of the methods for reducing flooding using natural flood management is river restoration. During the last century, many rivers were modified using hard engineering techniques to often straighten or canalise them. The disadvantages of these techniques have now become apparent which include the damage to the environment and ecosystems as well as an increase in flooding.

River restoration contributes to flood risk management by supporting the natural capacity of rivers to retain water. By re-connecting brooks, streams and rivers to floodplains, former meanders and other natural storage areas, and enhancing the quality and capacity of wetlands, river restoration increases natural storage capacity and reduces flood risk. Excess water is stored in a timely and natural manner in areas where values such as attractive landscape and biodiversity are improved and opportunities for recreation can be enhanced.

Returning rivers to a more natural state can often include the removal of structures such as weirs or culverts which can have multiple benefits for biodiversity in addition to improving the flow regime[42].

There may be opportunities to restore the river channel and banks to a more natural form in the Ipswich Village area, if it can be shown that there is no longer a functional requirement for the former flood defences in these areas for fluvial or tidal flood risk management, over a development lifetime.

[41] Working with natural processes to reduce flood risk, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/681411/Working_with_natural_processes_evidence_directory.pdf

[42] European Centre for River Restoration http://www.ecrr.org/RiverRestoration/Floodriskmanagement/HealthyCatchments-managingforfloodriskWFD/Environmentalimprovementscasestudies/Removeculverts/tabid/3125/Default.aspx

Further guidance on river restoration is available from the Environment Agency[43].

10.8.3 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 in to 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[44].

Appendix A Figure 18 identified areas in Ipswich where there are existing flood storage features, and where there may be a need for flood storage infrastructure in the future.

[43] Environment Agency, Fluvial Design Guidance Chapter 8 http://evidence.environment-agency.gov.uk/FCERM/en/FluvialDesignGuide/Chapter8.aspx?pagenum=4
[44] Environment Agency, Fluvial Design Guidance Chapter 10 http://evidence.environment-agency.gov.uk/FCERM/en/FluvialDesignGuide/Chapter10.aspx?pagenum=2

11. Guidance for FRAs

11.1 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.

11.2 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.

11.3 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.

Table 11-1 presents the different levels of site-specific FRA as defined in the Construction Industry Research and Information Association CIRIA publication C624[45] and identifies typical sources of information that can be used.

Table 11-1 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 • Flood Map for Planning (Rivers and Sea)

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

- Environment Agency Standing Advice
- NPPF Tables 1, 2 and 3

Level 2 Scoping Study

To be undertaken if the Level 1 FRA indicates that the site may lie within an area that is at risk of flooding, or the site may increase flood risk due to increased run-off. This study should confirm the sources of flooding which may affect the site. The study should include:

- An appraisal of the availability and adequacy of existing information;
- A qualitative appraisal of the flood risk posed to the site, and potential impact of the development on flood risk elsewhere; and
- An appraisal of the scope of possible measures to reduce flood risk to acceptable levels.

The scoping study may identify that sufficient quantitative information is already available to complete a FRA appropriate to the scale and nature of the development.

Typical **sources of information** include those listed above, plus:

- Local policy statements or guidance.
- 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.

11.4 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.

11.5 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.

11.6 Flood Risk Assessment Checklist

Table 11-2 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 11-2 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 1 and 12
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 11-1 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, Figures 10a, and 10b. 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 20a and Figure 20b 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.	SFRA Section 5.2 and Section 5.3
Exception Test	Determine whether the Exception Test is necessary. Where the Exception Test is necessary, present details of:	SFRA Section 5.4 Refer to IBC Development and Flood Risk

	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'.)	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 7.2
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[46] Section 8.16 and 8.17 for design flood levels supported by text within Section 7.3	SFRA Section 7.3 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 7.5
Flood Resilience	Details of flood resilience measures that have been incorporated into the design. Include design drawings where appropriate.	SFRA Section 7.6
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 flooding. 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 Section 7.7 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 7.12
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 7.13
Surface Water Management	Pre application advice from IBC should be sought to gain advice on suitable SuDS and drainage for individual development sites.	SFRA Section 7.17

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

Greenfield Sites with permeable soils Greenfield Sites impermeable soils	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 inflitration 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 outlined 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. .	
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 7.14 and SFRA Table 2-1
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 developments lifetime.	SPD Chapter 7

11.7 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.

- Environment Agency: https://www.gov.uk/government/publications/pre-planning-application-enquiry-form-preliminary-opinion (a charged service)
- 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 .

12. Flood Risk Policy and Development Management Approach

12.1 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.

12.2 Policy Approach

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

12.2.1 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.

12.2.2 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.

12.2.3 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.

12.2.4 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.

12.2.5 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.

12.2.6 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.

12.2.7 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.

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.

In accordance with the PPG, self-contained dwellings or bedrooms at basement level in Flood Zone 3 should not be permitted due to the vulnerability of users. Basements, basement extensions, conversions of basements to a higher vulnerability classification or self-contained units are not acceptable in Flood Zone 3b. 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 100 year (1% AEP) flood level including an allowance for climate change.

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.

12.3 Development Management Measures

Table 12-1 sets out the measures that should be considered for different types of proposed development within each NPPF Flood Zone. Before consulting Table 12-1, refer to development vulnerability classification (Table 7-1) to determine the vulnerability classification of the proposed development.

Table 12-1 Development Management Measures Summary Table

	All Development	Minor development				Other development				SFRA section
	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 Mole Vulnerable development. Highly Vulnerable development can be considered.	No restrictions.	Section 5.2

<table>
<tr><td>Basements</td><td>Not permitted.</td><td>Basements, basement extensions, conversions of basements to a higher vulnerability classification or self-contained units are not permitted.</td><td colspan="2">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.</td><td>No restrictions.</td><td>Basements, basement extensions, conversions of basements to a higher vulnerability classification or self-contained units are not permitted.</td><td>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.</td><td>No restrictions.</td><td>Section 8.2.7</td></tr>
<tr><td>Flood Risk Assessment</td><td>Yes – for Essential Infrastructure</td><td colspan="3">Yes – key outcomes must be:
• How the development is likely to be affected by current or future flooding from any source
• What measures are 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</td><td>Required if site > 1 hectare, or there is evidence of a localised flood source.</td><td colspan="2">Yes – key outcomes must be
• How the development is likely to be affected by current or future flooding from any source
• What measures are 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</td><td>Required if site > 1 hectare, or there is evidence of a localised flood source.</td><td>Section 6.2</td></tr>
<tr><td>Sequential Test</td><td>Not required.</td><td>Not required</td><td>Not required</td><td>Not required</td><td>N/A</td><td colspan="2">Yes – if not addressed at the Local Plan level and development type is not included in the list of exemptions</td><td>N/A</td><td>Section 5.2</td></tr>
</table>

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	Section 5.4
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.	Section 5.2
Finished Floor Levels	N/A	For More Vulnerable development, floor levels should be set 300mm above modelled 1 in 100-year (1% AEP) flood level including an allowance for climate change. Floor levels may not need to be raised for new non-residential (Less Vulnerable) development as such development can be designed to be floodable. However, it is strongly recommended that internal access is provided to upper floors (first floor or mezzanine) to provide safe refuge. Sleeping accommodation should be restricted to first floor or above to ensure 'safe place'. Apply sequential approach within the building.			No minimum level specified. Floor levels should take account of any localised flood risk from surface water ponding.	For More Vulnerable development, floor levels should be set 300mm above modelled 1 in 100-year (1% AEP) flood level including an allowance for climate change. Floor levels may not need to be raised for new non-residential (Less Vulnerable) development as such development can be designed to be floodable. However, it is strongly recommended that internal access is provided to upper floors (first floor or mezzanine) to provide safe refuge. Sleeping accommodation should be restricted to first floor or above to ensure 'safe place'. Apply sequential approach within the building.			No minimum level specified. Floor levels should take account of any localised flood risk from surface water ponding.	Section 7.3

		Where permitted, basements will require internal access to a floor 300m above the 1 in 100-year (1% AEP) AEP flood event including an allowance for climate change.				Where permitted, basements will require internal access to a floor 300m above the 1 in 100-year (1% AEP) flood event including an allowance for climate change.				
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.	Section 7.5
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.	Section 7.6
Safe access/ egress	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 • Safe refuge for people 'Dry' access/egress is a route located above the 1 in 100-year (1% AEP) flood event 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 • Safe refuge for people 'Dry' access/egress is a route located above the 1 in 100-year (1% AEP) flood event including an allowance for climate change.			Safe means of escape must be provided in relation to risk of flooding from other sources.	Section 7.7

Floodplain compensation storage	N/A	Yes - Development must not result in a net loss of flood storage capacity in relation to the 1% annual probability) 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).	Not required.	Yes - Development must not result in a net loss of flood storage capacity in relation to the 1in 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).	Not required.	Section 7.9
Flood voids	N/A	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.	Not required.	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.	Not required.	Section 7.10

<table>
<tr><td>Flow routing</td><td>N/A</td><td>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><td>Section 7.12</td></tr>
<tr><td>Riverside development</td><td></td><td>Yes – Retain an 8m wide buffer strip alongside Main Rivers and seek opportunities for riverside restoration. Retain a 5m wide buffer strip alongside Ordinary Watercourses. All new development within 8m of a Main River or Ordinary Watercourse will require consent from the Environment Agency or Suffolk County Council (as LLFA) respectively.</td><td>Section 7.13</td></tr>
<tr><td>Surface water management</td><td>N/A</td><td>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'[47], 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 body for the 1 in 1 year rainfall event and the 1 in never exceed the peak greenfield runoff rate for t</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</td><td>Where reasonably practicable, the runoff volume drain, sewer or surface water body in the 1 in 10(should never exceed the greenfield runoff volume</td></tr>
</table></td><td>Section 7.17</td></tr>
</table>

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

		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. Where this is not reasonably practicable, the runoff volume must be discharged at a rate that does not adversely affect flood risk.		Where this is not reasonably practicable, the runoff volume must be discharged 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[48]. 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	Section 7.14

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

					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.	Section 8.2

Consult the Environment Agency[49] 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 waste water treatment plant or a sewage	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	Section 6.7

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

						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.	Stateme nt'. -If develop ment is within 8m of an Ordinary Waterco urse	

13. Abbreviations and Glossary

13.1 Abbreviations

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
RoFfSW	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

13.2 Glossary of Terms

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 7.1.
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 7.3for 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.
Impounded Reservoir	A reservoir with outlets controlled by gates that release stored surface water as needed in dry months; may also store water for domestic or industrial use or for flood control. Also known as storage reservoir.

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 Flood Map

Figure 3- Trunk Sewers

Figure 4- Highways and Railway Drains

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

Figure 6- Flood Zones

Figure 7-Modelled Flood Outlines- Climate Change

Figure 8- Belstead Brook flood risk extents

Figure 9- Belstead Brook flood hazard

Figure 10a- Risk of Flooding from Surface water

Figure 10b- Risk of Flooding from Surface water

Figure 11- Bedrock Geology

Figure 12- Superficial Deposits

Figure 13- Areas Succeptible 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 19A to AF- Breach modelling – Flood Hazard Mapping for present day and climate change scenarios for 0.5% and 0.1% AEP

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