Anglian River Basin District Flood Risk Management Plan 2021 to 2027

December 2022

This is a joint plan prepared by the following Risk Management Authorities:

Cambridgeshire County Council
Environment Agency
Essex County Council
Leicestershire County Council
Lincolnshire County Council
Milton Keynes Council
Norfolk County Council
North Northamptonshire Council
Peterborough City Council
Rutland County Council
Southend-on-Sea Borough Council
Suffolk County Council
West Northamptonshire Council

We are the Environment Agency. We protect and improve the environment.

We help people and wildlife adapt to climate change and reduce its impacts, including flooding, drought, sea level rise and coastal erosion.

We improve the quality of our water, land and air by tackling pollution. We work with businesses to help them comply with environmental regulations. A healthy and diverse environment enhances people's lives and contributes to economic growth.

We can't do this alone. We work as part of the Defra group (Department for Environment, Food & Rural Affairs), with the rest of government, local councils, businesses, civil society groups and local communities to create a better place for people and wildlife.

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Foreword

The Anglian River Basin District (RBD) covers 27,900 square kilometres. It extends from Lincolnshire in the north to Essex in the south, and from Northamptonshire in the west to the East Anglian coast. Over 6.4 million people live and work in the predominately rural area, the majority of which reside in urban centres that include:

- Cambridge
- Chelmsford
- Lincoln
- Northampton

There are more than 530,000 people at risk of flooding from rivers and the sea, and over 680,000 people at risk of flooding from surface water in the Anglian RBD. Some people live in areas at risk of flooding from one source, while others are at risk from multiple sources of flooding.

Flood risk presents complex challenges for all Risk Management Authorities. Flooding can be unpredictable and dynamic, and the impacts can be devastating. In England, for every person who suffers flooding, around 16 others are affected by a loss of services, such as transport and power. The floods of winter 2020/21 had significant impacts on some communities, businesses, infrastructure, rural areas, and the environment within the Anglian RBD. With a rapidly changing climate, the need to plan together to improve the overall resilience of our local places is more important than ever before.

Partnerships are key. The more we plan together, the more we can deliver together for local people, places and our environment. The Anglian Flood Risk Management Plan is ambitious and represents a step forward in developing an integrated, strategic approach to flood risk management across the RBD.

Over the last 3 years we, have worked with Lead Local Flood Authorities (LLFAs) and other partners to develop these Flood Risk Management Plans (FRMPs). This has been a challenging time with winter flooding and the impacts of coronavirus. These tests have served as a reminder, reinforcing how precious the environment around us is for our health and wellbeing, and the importance of protecting and enhancing it.

The FRMPs mark an important contribution towards helping to deliver the ambitions of the 'National Flood and Coastal Erosion Risk Management Strategy for England' and the government's 25-Year Environment Plan. They focus on the more significant areas of flooding and describe the risk of flooding now and in the future.

These plans will help us:

- identify actions that will reduce the likelihood and consequences of flooding
- update plans to improve resilience whilst informing the delivery of existing flood programmes
- work in partnership to explore wider resilience measures, including nature-based solutions for flood and water
- set longer-term, adaptive approaches to help improve our nation's resilience

To support these plans, we have developed the Flood Plan Explorer. Our goal is that this will lead to further collaboration across all we do.

We recognise that there are areas at risk of flooding outside those detailed in the plan. Be assured that all RMAs will continue to plan and manage the risk of flooding to all communities.

Together with our partners, we have achieved so much already:

- gathering data to inform carbon baselining which will support development of tactical plans for the Fens 2100+ strategy
- developing strong partnerships, achieving environment and sustainability ambitions for the Oxford to Cambridge (OXCAM) Arc
- working collectively with partners to secure long-term water management and identify multi-sector benefits through the South Lincolnshire Water Partnership

We've listened to what you have told us during the consultation that we carried out in October 2021, and we value what you value too. The importance of partnerships to deliver actions, the need to strengthen a catchment approach so we work with and value our land and environment better, and rising to the challenge of making infrastructure resilient to flooding whilst reducing carbon use.

I’m pleased we can share this FRMP for the Anglian River Basin, an important milestone on our journey. Let’s keep looking ahead. We must continue to work in partnership and keep putting communities at the centre of what we do so they can adapt and thrive.

Sam Lumb
Director Operations South and East,
Environment Agency

Contents

Introduction to the Flood Risk Management Plan

You should read this Flood Risk Management Plan (FRMP) with Part A: National Overview of Flood Risk Management in England for Second Cycle FRMPs. Part A is a high-level overview of the FRMP and flood risk management in England.

You can find all the FRMP documents for the Anglian River Basin District on GOV.UK. The plan is supported by the:

- Anglian River Basin District Second Cycle Flood Risk Management Plan Habitats Regulations Assessment – a report on the findings of the habitats regulations assessment (HRA)
- Anglian River Basin District Second Cycle Flood Risk Management Plan Habitats Regulations Assessment non-technical summary – a summary of the findings in the full HRA report
- Anglian River Basin District Statement of Environmental Particulars (SOEP) – a report on the potential impacts on people and the environment when implementing the measures in the FRMP
- Annex 1 spreadsheet – a list containing the implementation status of each measure published in the first FRMP cycle

You can use Flood Plan Explorer, a new, interactive mapping tool that displays information about the measures included within this plan.

Approach to the FRMP

The second cycle FRMP is a plan to manage significant flood risks in designated flood risk areas (FRAs) within the Anglian River Basin District (RBD). Producing the plan for these areas is a requirement of the Flood Risk Regulations (2009). However, it's recognised that there are areas at risk of flooding outside of these FRAs. Therefore, the Environment Agency and other Risk Management Authorities (RMAs) will continue to plan for and manage the risk of flooding to all communities. This is regardless of whether they are in an FRA or not. For example, RMAs carry out flood risk management interventions, such as warning and informing and capital investment and maintenance programmes. Therefore, the plan has been expanded to show what is happening across the RBD, and as well as FRAs includes measures for the RBD, strategic areas and management catchments. This is similar to how the first cycle of FRMPs were developed. The first cycle of FRMPs covered the period 2015 to 2021.

The Environment Agency and other RMAs, in particular Lead Local Flood Authorities (LLFAs) worked together to develop the first cycle FRMP. This was in order to create a plan to manage the risk from all sources of flooding. The second cycle FRMP will build on this approach. The ambition is that the FRMP is a strategic, place-based plan which shows what is happening in flood risk management across the RBD. It's closely aligned with the:

- government's ‘25 year Environment Plan’
- Environment Agency's Flood and Coastal Erosion Risk Management (FCERM) Strategy for England

The second cycle FRMP will encourage closer ways of working between RMAs that will help to achieve its revised objectives and measures. These revised objectives and measures align with the ambitions of the FCERM strategy. They also support achieving wider environmental and growth ambitions of society. The FRMP is also aligned with the River Basin Management Plan for the Anglian RBD. Together, these plans set the strategic goals and approaches to managing water and flood risk within the RBD. More information on the background to FRMPs, the Flood Risk Regulations and how FRAs were identified is in Part A National Overview of Flood Risk Management in England for second cycle FRMPs.

Contributors to the FRMP

The Environment Agency has worked with LLFAs and other RMAs to develop the FRMP. The Environment Agency and those LLFAs with a surface water FRA within their administrative area must produce a FRMP. These FRAs are listed below and in table 1 respectively. Other RMAs without FRAs have also contributed to the FRMP. This is to show what is happening to manage the risk of flooding across the Anglian RBD.

This second cycle FRMP for the Anglian RBD identifies measures across the RBD, for FRAs, strategic areas and management catchments. Strategic areas are areas with a similar geography or strategic ambition where it is important to consider flood risk management across administrative boundaries and river catchments. There are two strategic areas within the Anglian FRMP which are listed below. Management catchments are based on Water Framework Directive (WFD) management catchments and have been used so that we can take a catchment-based approach when developing measures. There are 10 management catchments within the Anglian FRMP which are listed below.

The second cycle FRMP measures for the Anglian RBD cover all sources of flood risk and have been developed with contributions from other RMAs as listed below. This includes contributions from RMAs that do not have FRAs and have therefore volunteered to be part of the FRMP development. Whilst the ambition of the plan is to be a strategic placed based plan that covers all sources of flood risk, there may be places and flood risk management activities that are not included. This is due to the strategic nature of the second cycle FRMP and does not change anything planned for those places. All RMAs across the Anglian RBD will continue to plan for and manage the risk of flooding as appropriate. You can find information about national-level measures that the Environment Agency and LLFAs carry out as part of their routine day to day work in the interactive mapping tool – Flood Plan Explorer.

Developing the FRMP has been impacted by the extraordinary events of the past few years. Despite these challenges, the Environment Agency and RMA partners have set out measures for FRAs, ensuring that the requirements of the ‘Flood Risk Regulations 2009’

are met. Where we have been able to do so in the time available, we have taken a place-based approach when developing these measures for FRAs. For the rest of the RBD we have:

- included relevant place-based measures from the first cycle FRMP that have not been completed - either individually or aggregated
- included new measures - mostly reflecting where we already had plans to work in the period 2021-2027, several of which have been developed using a strategic place-based approach
- included water and biodiversity objectives wherever possible in measures

Our ambition for the period 2021-2027 is to continue to drive catchment-based delivery in the Anglian RBD that offers multiple benefits to communities and the environment. This catchment-based approach is a key part of the Environment Agency's ambition to meet net zero carbon, along with low carbon innovation and carbon offsetting. It is also integral to achieving the Environment Agency's biodiversity net gain targets which support the ambitions of the government's '25 Year Environment Plan'.

Environment Agency flood risk areas for main rivers and the sea

- Alconbury
- Alconbury Weston
- Boston
- Great Yarmouth
- Horncastle
- Hunstanton
- King's Lynn
- Lincoln
- Lowestoft
- Mablethorpe
- Northampton
- Oakington
- Saffron Walden
- Skegness
- Spalding
- Wisbech

There is a London and Thames Estuary FRA for river and sea flooding which spans both the Anglian and Thames RBDs. It is described solely within the second cycle Thames FRMP.

There is a Louth FRA for rivers and sea flooding which spans both the Anglian and Humber RBDs. It is described solely within the second cycle Humber FRMP.

LLFAs with surface water FRAs within their administrative boundary

Table 1: Lead Local Flood Authority Flood Risk Areas within the Anglian River Basin District

Flood risk area name	LLFA name(s)
Cambridge	Cambridgeshire County Council
Chelmsford	Essex County Council
Colchester	Essex County Council
Huntingdon	Cambridgeshire County Council
Ipswich	Suffolk County Council
March	Cambridgeshire County Council
Market Harborough	Leicestershire County Council
Milton Keynes	Milton Keynes Council
Northampton	West Northamptonshire Council
Norwich	Norfolk County Council
Oakham	Rutland County Council
South Essex	Essex County Council, Southend-on-Sea Council

The Dunstable surface water FRA spans both the Anglian and Thames RBDs. It is described solely within the second cycle Thames FRMP.

If your LLFA does not appear in the above list, this LLFA has no statutory duty to develop a Flood Risk Management Plan. If your LLFA does not have a statutory duty to develop this plan it does not mean that your LLFA does not have its own set of measures to address flood risk. Please review your LLFAs 'Local Flood Risk Management Strategy' for further information on its action plan.

Strategic Areas

- Fens and Lowlands

- Oxford to Cambridge Arc

The Oxford to Cambridge Arc spans both the Anglian and Thames RBDs and is described in both FRMPs. The Fens and Lowlands Strategic Area spans both the Anglian and Humber RBDs and is described in both FRMPs.

Management Catchments

- Broadland Rivers
- Cam and Ely Ouse
- Combined Essex
- East Suffolk
- Nene
- North Norfolk Rivers
- North West Norfolk
- Upper and Bedford Ouse
- Welland
- Witham

For the purposes of the second cycle Anglian FRMP all measures that would have been developed for the Old Bedford and Middle Level management catchment have been included in the Fens and Lowland strategic area. Therefore, the Old Bedford and Middle Level management catchment is not referenced specifically to avoid duplication.

Other RMAs that have contributed to the FRMP

1. Anglian Water
2. Bedford Borough Council
3. Bedford Group of Internal Drainage Boards
4. Borough Council of King's Lynn and West Norfolk
5. Broads (2006) Internal Drainage Board
6. Central Bedfordshire Council
7. Coastal Partnership East
8. East Suffolk Internal Drainage Board
9. Huntingdonshire District Council
10. King's Lynn Internal Drainage Board
11. Lincolnshire County Council
12. Norfolk Rivers Internal Drainage Board
13. North Northamptonshire Council
14. Peterborough City Council
15. South Cambridgeshire District Council
16. Thurrock Borough Council
17. Uttlesford District Council
18. Waveney Lower Yare and Lothingland Internal Drainage Board

It should be noted that whilst not all RMAs, catchment partners and groups were involved in the development of the plan, they are all valuable partners in the delivery of outcomes to reduce flood risk.

Developing the FRMP

In preparing the FRMP, RMAs reviewed the first cycle FRMP objectives and measures together with existing and evolving national and local plans and strategies. For this FRMP, relevant plans and strategies include the:

- Cambridgeshire's Local Flood Risk Management Strategy
- Anglian River Basin Management Plan (RBMP): updated 2022
- Essex and South Suffolk Shoreline Management Plan (SMP)
- Essex Local Flood Risk Management Strategy
- evolving Anglian Water company Drainage and Wastewater Management Plan (DWMP)
- evolving Broadland Futures Initiative Strategy
- evolving Great Ouse Strategic Flood Risk Intervention Study
- evolving Future Fens Flood Risk Management Strategy
- Flamborough Head to Gibraltar Point SMP
- Gibraltar Point to Hunstanton SMP
- Great Yarmouth Local Plan: Core Strategy 2013-2030
- Hunstanton to Kelling Hard SMP
- Kelling Hard to Lowestoft SMP
- Lincolnshire Local Flood Risk and Water Management Strategy
- Lowestoft to Felixstowe SMP
- Lowestoft Town Centre Masterplan (June 2020)
- Milton Keynes Local Flood Risk Management Strategy
- Norfolk Local Flood Risk Management Strategy
- Peterborough Local Flood Risk Management Strategy
- Saltfleet to Gibraltar Point Strategy
- Steeping Catchment Action Plan
- Suffolk Flood Risk Management Strategy
- Thames Estuary TE2100 Plan
- Wash East Coastal Management Strategy
- Waveney Local Plan (adopted March 2019)

For the second cycle of FRMP, there is nationally consistent set of objectives which are closely linked to the:

- Flood Risk Regulations (2009)
- FCERM strategy
- 25 year Environment Plan

The full list of these objectives is in the Part A National Overview of Flood Risk Management in England for Second Cycle FRMPs.

In drawing the objectives and measures together, RMAs have:

- revisited the priorities
- ensured there is a shared understanding of the main flood risks and how best to manage them

Delivery in partnership is the most effective way to address the issues of flooding and climate change and to deliver multiple benefits. The Environment Agency and many other RMAs work with partners in the River Basin District including:

- catchment partnerships
- landscape partnerships
- catchment based groups
- non-government organisations
- Flood Action Groups
- other active community organisations

We value the contribution these partners make, including:

- linking people and groups
- bringing in local knowledge, data and expertise
- developing and delivery of projects

We intend to continue to develop and strengthen this partnership working to collaboratively identify, develop and deliver solutions to increase resilience to flooding and climate change in the River Basin District. The Flood Risk Management Plans are not intended to cover the detail of this partnership working.

The Anglian River Basin District

Overview of the Anglian River Basin District

The Anglian River Basin District (RBD) covers 27,900km^2. It extends from Lincolnshire in the north to Essex in the south and from Northamptonshire in the west to the east coast of Norfolk, Suffolk, and Essex. In total, over 6.4 million people live and work within the district. It includes the urban centres of:

- Cambridge
- Chelmsford
- Ipswich
- Lincoln
- Milton Keynes
- Northampton
- Norwich

The Anglian RBD has a rich diversity of wildlife and habitats, supporting many species of global and national importance. It is recognised as a rich region for wetland wildlife, with the Norfolk Broads being Britain's largest nationally protected wetland of international importance for wintering wildfowl and waders. The Lincolnshire, Norfolk, Suffolk, and Essex coasts also contain a wide range of designated sites that are internationally important for wildlife as well as supporting a significant tourism industry.

The management catchments that make up the RBD include many interconnected rivers, lakes, groundwater and coastal waters. These range from chalk and limestone ridges to the extensive lowlands of the Fens and East Anglian coastal estuaries and marshes. The river basin district is a predominantly rural catchment, with more than 50% of land used for agriculture and horticulture. East Anglia is a popular tourist destination, particularly for water recreation including boaters, kayakers, beach goers, and anglers. The Norfolk Broads and coastal destinations contribute significantly to the local economy.

Within the Anglian RBD there are:

- 16 Flood Risk Areas (FRAs) for significant risk of flooding from main rivers and the sea (Figure 1)
- 12 FRAs for significant risk of flooding from surface water (Figure 2)

Each of these defined areas are described in more detail in the FRA sections of this report.

For further information about the Anglian RBD, please read the accompanying Environmental Report. This includes information on topics such as the landscape, geology and cultural heritage of the Anglian RBD.

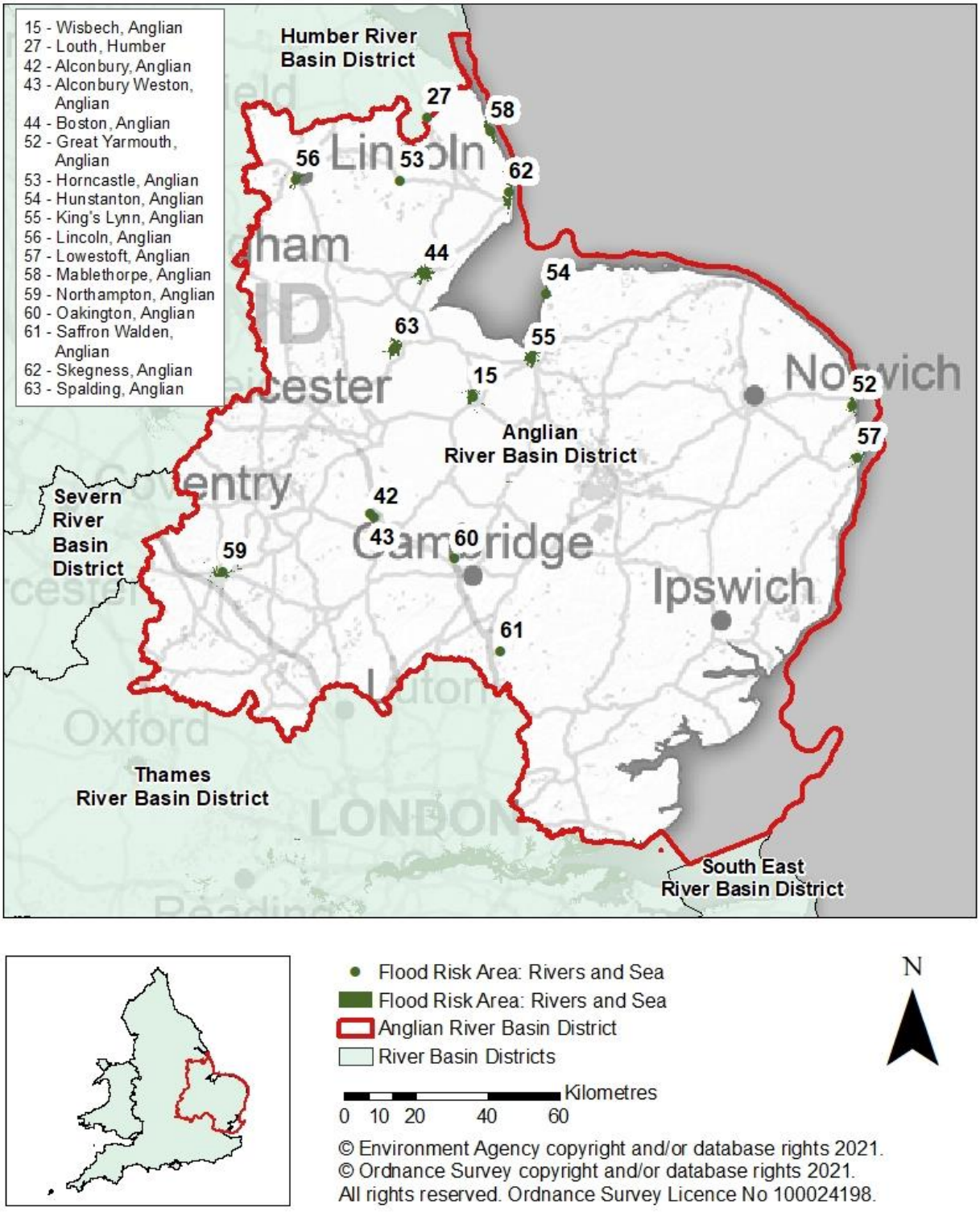


Figure 1: a map showing the Rivers and Sea Flood Risk Areas in the Anglian River Basin District

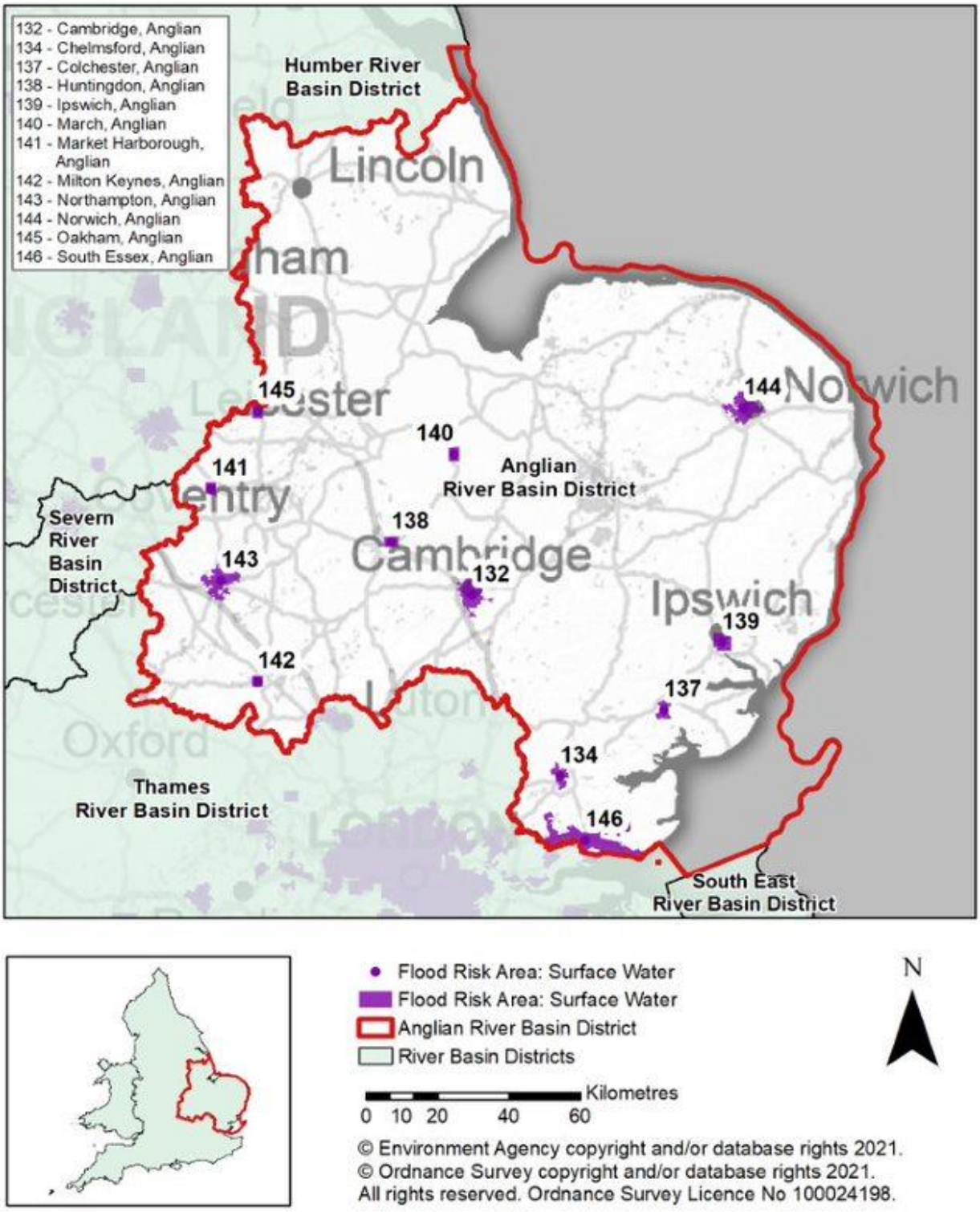


Figure 2: a map showing the Surface Water Flood Risk Areas in the Anglian River Basin District

The main flood risk issues and changes in the Anglian River Basin District

River, coastal, and tidal flood risk

Many areas across the River Basin District (RBD) are at risk from a variety of different sources of flooding.

The geography and topography of the RBD mean that it is particularly susceptible to large scale river flooding. There are a number of extensive rivers in the RBD, often with multiple tributaries. Very large fluvial events have occurred across the RBD, with some of these affecting multiple rivers at the same time. The most recent example of this type of flooding was in December 2020, when a significant amount of rain fell during a short space of time on a saturated catchment, which contributed to the rapid reaction of rivers.

The discharge from some of these rivers is also dependent upon tidal conditions, which means the rivers can become tide locked and unable to discharge river water during some high-tide periods.

Low-lying areas of land adjacent to the coast, often located behind raised sea defences, are susceptible to tidal surges. Many of these areas were previously marshlands which have been drained and re-claimed from the sea. Coastal surges can result in sea defences being overtopped when sea levels are high enough to combine with wind direction and wave heights. The most recent example of this type of flooding was the east coast tidal surge in December 2013. Surge tides are a particular threat when combined with strong north easterly winds and high waves.

The 16 Flood Risk Areas (FRAs) identified as being at significant risk of flooding from main rivers and the sea are all new. They were not identified in the first cycle Flood Risk Management Plan (FRMP). The FRAs reflect the different types of flood risk within the RBD.

9 FRAs are at risk of tidal flooding. FRAs at residual risk in the event of overtopping or breaching of coastal and tidal defences that protect the areas include:

- Boston
- Great Yarmouth
- Hunstanton
- King's Lynn
- Mablethorpe
- Skegness
- Spalding
- Wisbech

At present, there are no formal flood defences in the Lowestoft FRA, so the area is reliant on the deployment of temporary flood barriers.

7 FRAs are at risk of fluvial flooding from main rivers. Generally, these are near to tributary watercourses which respond quickly following heavy rainfall and can result in channel capacities being exceeded and water flowing onto the floodplain. Channel constrictions within the FRAs can also play a notable role in exacerbating flooding issues. Lincoln, Horncastle and Northampton all have upstream flood storage areas to manage flows through the FRA.

Surface water flood risk

Surface water is defined as rainwater on the ground surface that hasn't entered a watercourse, drain, or sewer. Surface water flooding is a problem in many towns and cities across the Anglian RBD. This type of flooding can begin to occur within minutes of intense rain and is often closely linked to the nature of the local drainage system. The rapid onset and considerable variability in location and extent make it almost impossible to forecast and difficult to manage. Surface water flooding is of particular concern in urban areas. This is because the high proportion of impermeable surfaces limits the amount of infiltration that can take place. Surface water usually only lasts a short time (a few hours) and is relatively shallow (less than 0.5m) unless combined with flooding from other sources. However, increasingly wet winters with prolonged rainfall can also produce significant surface water issues, with flooding lasting for longer periods. This can be further exacerbated in areas with groundwater issues.

South Essex was identified as an FRA for surface water flooding in the first cycle FRMP. It remains a surface water FRA in this second cycle FRMP. Further surface water FRAs have been identified for this second cycle FRMP in:

- Cambridge
- Chelmsford
- Colchester
- Huntingdon
- Ipswich
- March
- Market Harborough
- Milton Keynes
- Northampton
- Norwich
- Oakham

Lead Local Flood Authorities (LLFA) are responsible for producing a Local Flood Risk Management Strategy for managing surface water flooding, along with flooding from other local sources within their area.

The Environment Agency and LLFAs work closely with local planning authorities and developers to ensure that the drainage systems of new developments do not increase the risk of surface water flooding. Developers are encouraged to design and build natural surface features to store and control surface water. These are known as sustainable drainage systems (SuDS). Storage of surface water in this way keeps it separate from sewerage systems. This reduces the risk of flooding from storm overflows.

Groundwater flood risk

Groundwater is naturally stored in the ground below the water table level. When the water table rises and reaches ground level, water begins to emerge on the surface and flooding can occur. Once on the surface, this groundwater may flow or pond.

Groundwater flooding is closely linked to underlying geology. The porous nature of chalk means that water can infiltrate quickly and move freely within these rocks. When the rocks become saturated, water rises to the surface and can then start flowing above ground. This can give rise to groundwater flooding when there have been prolonged spells of wet weather.

Groundwater flooding is generally experienced over a longer timescale than river and coastal flooding, often extending over several months. The areas that are most susceptible to groundwater flooding within the Anglian RBD include:

- Burwell
- Bury St. Edmunds
- Newmarket
- Scopwick
- Sheringham
- Sleaford

Historically, water has been abstracted from rivers and boreholes for use by industry. However, a decline in manufacturing has caused groundwater levels in some areas to rise.

The Environment Agency produces Catchment Abstraction Management Plans, which seek a sustainable approach. They aim to avoid the problem of over-abstraction and falling groundwater levels, which can result in saline intrusion into groundwater in coastal/tidal areas.

Sewer flood risk

Anglian Water Services is the principal sewer operator within the RBD and they manage a vast network of sewer pipes, pumping stations and drainage systems. These systems play an important role in managing flood risk from sewers and surface water across the RBD.

Sewer flooding can occur because sewerage systems are not designed to cope with flows from unusually prolonged rainfall or exceptional storm events, which may impact the sewer

networks through ingress of surface or groundwater. Blockages or failures within the sewer system will also increase the risk of flooding.

Water and wastewater companies in England and Wales have committed to produce Drainage and Wastewater Management Plans (DWMPs). These are new plans that will set out how water and wastewater companies intend to extend, improve, and maintain a robust and resilient drainage and wastewater system.

Evolving DWMPs will have strong links with FRMPs, River Basin Management Plans (RBMP) and other local plans produced by local authorities such as Local Flood Risk Management Strategies. They will help improve water quality and drainage systems and reduce flooding and pollution. In the Anglian RBD, Anglian Water is developing a DWMP, which is expected to be published in 2023.

There are no statistics contained within this plan relating to sewer flooding.

Canal flood risk

Canals are fed by reservoirs, or the wider catchment along them, to compensate for minor water losses due to leakage and evaporation and the water used as boats ascend and descend canal locks. Surface water run-off from areas near to canals also drains into them. Overflow weirs at intervals along canal banks help to maintain the water level within a normal operating range or zone, and these structures pass surplus water into watercourses passing nearby or underneath.

Canals can alleviate flood risk due to the large storage volume represented by a small level increase along several kilometres of waterbody. They can also move water artificially within or between a catchment and delay the timing of flood peaks. However, canals constitute linear impoundments of significant bodies of water between locks and potential temporary closure points. Flood risk can arise if an embankment breaches where a canal is above the level of nearby property, or a culvert beneath the canal collapses. The Canal & River Trust manages and maintains its network to minimise the risk of asset failure.

The Trust is not a designated Risk Management Authority (RMA) within the Flood and Water Management Act (2010). However, they have various responsibilities to manage the canals and waterways for which it is a navigation authority. RMAs may also have a role in relation to such watercourses.

Most canals in the Anglian RBD that are also main rivers are managed accordingly to minimise flood risk. Flood risk from canals is included in risk from main rivers and the sea to allow catchments to be considered as one system.

The Trust is responsible for maintaining navigation along sections of watercourses within the Anglian RBD. These include:

- Fossdyke Canal
- River Witham
- Sections of the Grand Union Canal

Although typically much less variable than rivers, canal water levels can still respond relatively rapidly. Monitoring of levels and flows on main rivers by the Environment Agency is used to inform flood alerts and warnings. This monitoring also informs the Trust where navigation along canals and rivers is unsafe and stoppages are in place.

Reservoir flood risk

The Environment Agency is the enforcement authority in England for the Reservoirs Act (1975). All large raised reservoirs must be inspected and supervised by specialist reservoir engineers. This helps reduce the risks associated with uncontrolled escapes of water from large raised reservoirs. At time of writing, there are 411 registered reservoirs currently in operation in the Anglian RBD.

Reservoir flooding is extremely unlikely to happen. There has been no reservoir flooding in England resulting in a loss of life since 1870. The Risk of Flooding from Reservoirs map shows the extent of flooding if a reservoir were to fail and release the water it holds. It shows the worst case scenario; it is very unlikely that this would happen and that any flood would be this large. The reservoir maps provide an option to view flood water depth and velocity for the areas at each level of flood risk. They do not show any indication of the likelihood that such an event could occur.

We have not identified any FRAs for reservoir flooding because the likelihood of reservoir flooding is much lower than the likelihood of river and sea flooding.

Land management and flooding

The Anglian RBD is one of Britain's prime agricultural areas, with a long tradition of agriculture and horticulture, which remains strong today.

Rural areas face specific challenges in relation to flood risk management. Agriculture and horticulture are economically significant land uses that are vulnerable to extreme weather and climate change. Significant flooding can impact on food production, particularly arable crops.

Arable farming requires well drained soils and is the main reason for many of the modifications to watercourses within the RBD. The peat and alluvium soils, where the high-grade agricultural land is located, hold water on the land.

To support agriculture on these fertile soils, a network of drainage ditches, pumping stations and raised watercourses have been constructed. This network maintains dry conditions in an area that would otherwise be very wet, thus facilitating farming. Many rural areas, particularly low-lying and pumped drained areas can be at high risk of flooding from rivers, the sea and surface water. Maintaining existing flood risk assets can help to reduce the risk in agricultural areas.

Land use and land management is important to flood risk management. Improved land drainage increases the rate at which water gets into rivers. Impeding drainage to hold water on the land can help to manage flood risk.

Land management practices can help control erosion, increase soil moisture and reduce the transport of nutrients in field runoff. Such practices include:

- the use of buffer strips adjacent to watercourses
- strip cropping
- contour farming
- fencing watercourses from livestock
- reduced stocking densities

These practices can reduce runoff at the field scale, which can benefit flood risk management through reducing the quantities of water, sediment and pollutants entering the watercourses.

Measures have been created with a focus on engagement with landowners to support and develop natural flood management projects. There is growing evidence that natural flood management (NFM) helps to slow down or even reduce flood flows. NFM measures implemented upstream of areas of flood risk, including the headwaters of catchments, can complement conventional flood or sea defences to enhance flood and coastal resilience. Natural flood management and nature-based solutions can also have other multiple benefits. These, and the various types of NFM, are described in Part A: National Overview of Flood Risk Management in England for Second Cycle Flood Risk Management Plans.

A combination of incentive, advisory and regulatory measures help farmers and other land managers protect the environment. Farming has a key role to play in flood management. The introduction of the Environmental Land Management Scheme may offer greater opportunities to maximise both environmental benefits and reductions in flood risk.

Coastal erosion

Coastal erosion occurs along the length of the RBD's coastline and is dependent on the nature of the area. Examples of where the coastline is retreating include parts of northeast Norfolk and parts of Suffolk. Local authorities have operational powers relating to managing coastal erosion under the Coast Protection Act (1949) and the Flood and Water Management Act (2010). Local Authorities lead on coastal risk management activities and undertake works on sea flooding and coastal erosion where they are best placed to do so. This is undertaken in collaboration with the Environment Agency.

Shoreline Management Plans (SMP) are non-statutory, high level planning documents that provide large scale assessments of the risk associated with coastal processes. They provide a policy framework to reduce these risks to people and the developed, historic and natural environment in a sustainable manner. They set the strategic direction for managing the coast over the next 100 years. SMPs identify the most sustainable approaches to managing coastal erosion and flooding risks in the short, medium, and long term.

Whilst the second cycle Anglian FRMP has considered coastal erosion, it is covered in more detail within SMPs. The FRMP has considered high level links with SMPs, in particular where coastal erosion risk is closely linked to managing flood risk from the sea.

History of flooding

This section of the FRMP provides a summary of significant flood events and their consequences since the first cycle FRMP in 2015. Significant is defined as an event which affected more than 20 residential properties. The first cycle FRMP for the Anglian RBD contains information on historic flood events and their consequences before this date. More detailed information on why flood records and evidence are important and how they are used is in Part A National Overview of Flood Risk Management in England for Second Cycle FRMPs.

Table 2 below provides information on the impacts we are aware of, including:

- location of flooding – entry is for counties with several communities affected
- the approximate number of properties flooded internally
- the source of flood water

There have been several significant flood events in the Anglian RBD since 2015, as shown in Table 2.

December 2020

December 2020 saw widespread flooding impacts across East Anglia. Up to 60mm of rain fell on an already saturated catchment on 23 and 24 December ahead of the arrival of Storm Bella on 27 December. The majority of rain fell during a short space of time and this intensity of rainfall contributed to the rapid reaction of watercourses.

High river levels were observed across East Anglia.

Antecedent conditions contributed to higher in-channel levels, which culminated in significant flooding from river, surface water, and groundwater sources.

November 2019

Widespread and sustained rainfall through autumn and winter of 2019 generated high river levels and flows on the River Witham. Overtopping was reported at numerous locations, as well as 4 breaches of flood defences. Extensive areas of agricultural land were flooded for a prolonged period, as well as isolated flooding of properties.

June 2019

Significant rainfall across the catchment of the River Steeping, particularly during 10 and 11 June, led to extensive resultant overtopping of the banks of the Wainfleet Relief Channel. This culminated in a breach in the bank on 12 June. 90 properties, and large

areas of farmland, were flooded across the Steeping catchment from river and surface water sources.

May 2018

A significant rainfall event on 27 May 2018 resulted in widespread flooding impacts across Milton Keynes. The very intense summer storm, which was in excess a 1% Annual Exceedance Probability (AEP) event and, in some areas, in excess of a 0.5% AEP event, overwhelmed capacity of the drainage network resulting in surface water flows gravitating towards low points in local topography. The resulting local flooding throughout south-central and the rural north of Milton Keynes caused significant impacts in local communities, affecting residential and commercial properties, as well as critical infrastructure.

March 2016

On 9 March 2016, 37 properties were flooded in Cambridgeshire and Bedfordshire area as a result of heavy rain falling on the upper reaches of the River Great Ouse catchment. Up to 40mm of rainfall fell on an already saturated catchment, equating to average expected rainfall for the whole of March.

July 2015

In July 2015, 30 properties adjacent to Kirkley Stream were flooded in Lowestoft. A significant amount of rain (82mm) fell over a 24 hour period, which exceeded the design capacity of the Suffolk County Council highway drainage and Anglian Water surface water drainage systems. The impact of rainfall was exacerbated by blockages caused by debris and excessive vegetation within Kirkley Stream and the inability of some surface water outlets to discharge due to their position at bed level within the channel.

Table 2: Historical flood events that resulted in internal flooding to 20 or more properties. Number of properties rounded to the nearest 10.

Date of flood	Location and approximate number of properties affected shown in brackets	Source of flood water
July 2015	Lowestoft (30)	Ordinary watercourse, surface water
March 2016	Cambridgeshire (30) Northamptonshire (25)	Main river
June 2016	Norfolk County (multiple locations) (250)	Surface water, ordinary watercourse

Date of flood	Location and approximate number of properties affected shown in brackets	Source of flood water
June 2016	Milton Keynes (50)	Surface water
May 2018	Milton Keynes (500), Northamptonshire (180)	Surface water
June 2019	East Lindsey District (90)	Main river, surface water, ordinary watercourse
October 2019	Norfolk County (multiple locations) (100), Lowestoft and Beccles in Suffolk County (30)	Surface water, ordinary watercourse
August 2020	Norfolk (60), Cambridgeshire (30), Northamptonshire (80)	Surface water, ordinary watercourse
Winter 2020/21 (December-February)*	Cambridgeshire (340), Bedford Borough (60), Buckinghamshire (42), Essex (30) Milton Keynes Borough (100), Norfolk (300), Northamptonshire (140)	Surface water, groundwater, main river, ordinary watercourse
June 2021	Milton Keynes (60)	Surface water and sewer
July 2021	Peterborough (80)	Surface water

*At the time of writing, the investigation and recovery work from December 2020 flooding is still ongoing. The final numbers of properties affected for Winter 2020/21 (December-February) in Table 2 may differ.

The Environment Agency, Lead Local Flood Authorities and supporting Risk Management Authorities, such as Anglian Water, will work together to ensure that this level of flooding affects fewer homes in the future.

Climate change and the Anglian River Basin District

This section sets out what we know are likely to be the implications of climate change in the Anglian River Basin District (RBD). We use allowances for different climate scenarios over different epochs, or periods of time, over the coming century.

A percentile describes the proportion of possible scenarios that fall below an allowance level. The:

- central allowance is based on the 50th percentile
- higher central allowance is based on the 70th percentile
- upper end allowance is based on the 95th percentile

An allowance based on the 50th percentile is exceeded by 50% of the projections in the range. At the 70th percentile it's exceeded by 30%. At the 95th percentile it is exceeded by 5%. The 'H++' allowance is an extreme climate change scenario which applies up to 2100.

As the data that is used to predict the impact of climate change is constantly changing the most up to date information has been used at the time of publishing. Over the next 6 years this information is likely to change so the most up-to date information should be used.

Coastal flood risk

As sea levels rise, it means that coastal flooding will become more frequent. This is because higher water levels will be seen more often. Predicting coastal flooding is complicated because it's a combination of:

- a still water level
- a surge component
- wave conditions

Future changes in sea level are primarily accounted for by increases to mean sea level. Changes in storminess and wave conditions are not as well understood or are not likely to change significantly. Future changes in wave conditions are thought to be heavily variable by geographical area and are an area of further research. Table 3 sets out how we expect mean sea level to rise along the coastline by 2125.

Table 3: cumulative mean sea level rise between 2000 and 2125 (metres)*

Allowance	Sea level rise
Extreme (H++)	1.90m**
Upper end	1.60m
Higher central	1.20m

*Data source: flood risk assessments: climate change allowances

** This applies up to the year 2100.

Fluvial (river) flood risk

Rainfall intensity is expected to increase in the future, which will cause river flows to increase. Flood risk assessments: climate change allowances sets out how much we expect peak river flows might increase by 2125 for management catchments. A 'Management Catchment' is a designated river catchment designated under the Water Framework Directive (The Water Environment (Water Framework Directive) Regulations 2017); this subdivides river catchment areas for easier management within the River Basin District.

As river flows increase, it means that fluvial flooding will become more frequent. This is because higher river flows will be seen more often.

RBDs cover large areas. We know that some areas will be more affected by climate change than others. The range of increases for the Anglian RBD for the upper end scenario for 2080s epoch (2070-2125) is from 36% to 72%. This range reflects a difference in anticipated change across management catchments within the RBD.

Surface water flood risk

In winter, more rainfall and 'wet days' are projected. In summer less rainfall and fewer 'wet days' are projected. For all seasons, rainfall intensity is projected to increase.

Intense rainfall can cause surface water flooding. Particularly when the ground is already wet or following a prolonged dry spell. This is when clay soils can form an impermeable crust. As rainfall intensity increases, it means that surface water flooding will become more frequent, because higher rainfall totals will be seen more often.

Flood risk assessments: climate change allowances set out how much we expect rainfall intensity might increase by 2125 for management catchments in the Anglian RBD. The range of increases for the Anglian RBD for the upper end scenario for the 2070s epoch (2061-2125) is 40%.

How our understanding of the impact of climate change on flood risk might change

Our understanding of the impact of climate change on flood risk will evolve as more climate modelling and research is undertaken. The climate change allowances provided are based on the latest UK climate change projections in UKCP18 and UKCP Local (2.2km). We will review, and where needed update, the climate change allowances as new climate change projections and research is published, working with the Met Office and other experts such as at universities.

Our climate changes naturally over time, alongside human influence since the industrial revolution, due to the emission of greenhouse gases. As well as climate change, there are other factors that can affect how severe a flood is. This includes how wet the ground already is when heavy rain starts to fall. This means that it's difficult to be sure about how much more likely a certain size of flood will be in the future.

Traditional methods used to estimate the likelihood and size of floods assume 'stationarity' of extreme events. This means that flooding in the past is assumed to represent the behaviour of future flooding.

Due to recent large-scale flood events on our rivers and coasts, many hydrologists are now considering 'non-stationarity'. This recognises statistically significant changes over time.

More information on climate change considerations in the FRMPs is in 'Part A: National Overview of Flood Risk Management in England for Second Cycle Flood Risk Management Plans'.

Progress review of implementing the first cycle Flood Risk Management Plan

This section assesses the achievements and what has happened across the Anglian River Basin District (RBD) since the first cycle Flood Risk Management Plan (FRMP) was produced in 2015. It describes how the first cycle FRMP was reviewed.

It reports on the status of the measures and a summary of progress made towards achieving the objectives in the 2015 FRMP. It gives reasons if progress has not been made.

How we assessed progress

The Flood Risk Regulations (2009) require that the Environment Agency and Lead Local Flood Authorities (LLFAs) review the first cycle FRMP. The Regulations state that this review must:

- include an assessment of the progress made towards implementing the measures
- include a statement of the reasons why any measures proposed in the previous flood risk management plan have not been implemented

The Environment Agency and LLFAs used the following steps to complete the review within the Anglian RBD:

- the status of each measure was reviewed and assigned an estimated implementation status as of 31 March 2021
- for measures assigned an implementation status of 'not started' or 'superseded' reasons were given for why they have not been progressed
- additional measures were identified that have implemented since 2015 which have made a material difference to achieving the first cycle FRMP objectives
- assessed how well the measures have contributed towards achieving the first cycle FRMP objectives

The review of first cycle FRMPs is presented in this section by:

- summary statistics to show an overview of measure implementation
- a selection of case studies to demonstrate what has been achieved since 2015
- a summary of additional measures implemented since 2015
- an overview of how well first cycle FRMP objectives have been met

Summary of progress of implementing the measures since 2015

Table 4 shows a summary of the estimated implementation status of all the measures in the Anglian RBD since 2015, as of 31 March 2021. Chart 1 also shows this in more detail.

Table 4: implementation status of measures for the Anglian RBD

Progress	Number of measures
Ongoing	612
Ongoing construction	5
Completed	240
Superseded	109
Not started - proposed	28
Not started - agreed	13

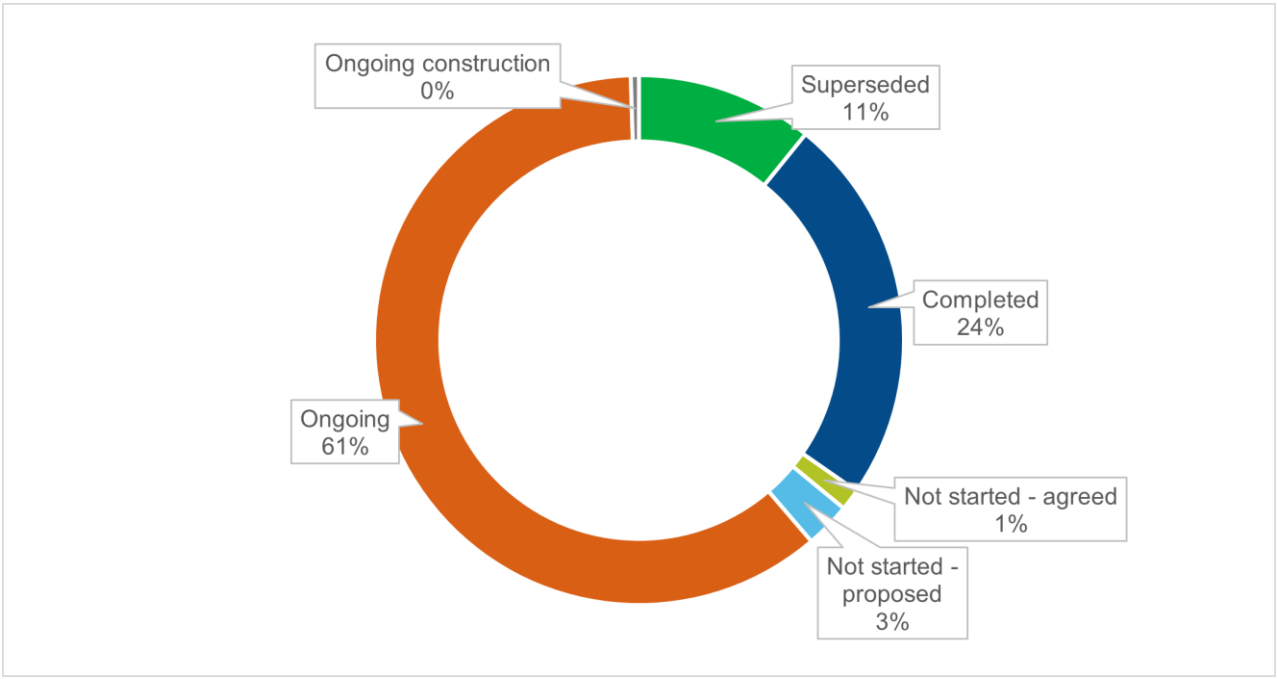


Chart 1: implementation status of measures for the Anglian RBD

Chart 1 shows the following statistics for the implementation status of measures for the first cycle Anglian RBD FRMP:

- 24% of the measures published in the first cycle FRMP have been completed
- 0.5% of the measures are ongoing in construction
- 61% of the measures are ongoing

31% of ongoing measures are day to day activities which have been carried out by risk management authorities in 2015-2021. These activities will be continuing in the period 2021-2027 and have been transitioned into the national level measures. These national level measures can be found in the interactive mapping tool – flood plan explorer.

49% of ongoing measures are actions from Shoreline Management Plans (SMPs). Measures in the first cycle FRMP included duplicate actions from the SMPs. SMP measures that have not been started have been classified as ongoing as they remain within the SMP action plans. These actions are not being transitioned to the second cycle FRMP as they will be considered through the SMPs and have been included in the national review process.

20% of the ongoing measures are either outside of day to day activities or are not included in the SMPs.

15% of the measures proposed in the first cycle FRMP have not been implemented. The reasons for this are:

- further work showed it was not viable
- it has been postponed
- it has been included in another piece of work
- it has been replaced by another measure
- it does not yet have funding

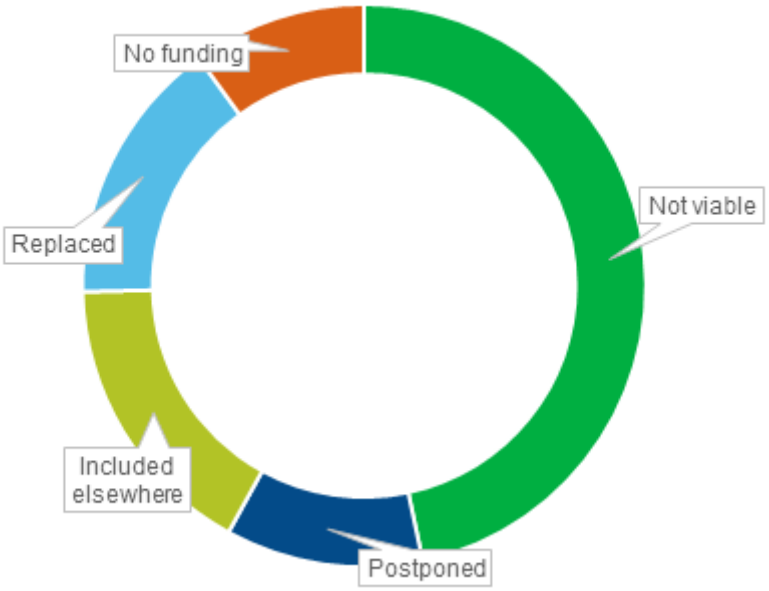


Chart 2: a summary of reasons for measures which have not been progressed in the Anglian RBD since 2015, as of 31 March 2021

Of measures that have not been progressed:

- The majority (47%) were shown to be unviable following further work
- 10% did not have required funding
- 17% have been included in another piece of work
- 11% have been postponed
- 15% have been replaced by a new measure in the second cycle FRMP

Each measure included in the published first cycle FRMP and its implementation status at the end of March 2021 can be found in Annex 1. Annex 1 also provides information on which measures from the first cycle FRMP have been transitioned to this second cycle FRMP.

How these measures were implemented and the main outcomes achieved

The Flood Risk Regulations (2009) state that the FRMP must include measures relating to:

- the prevention of flooding
- the protection of individuals, communities, and the environment against the consequences of flooding
- arrangements for forecasting and warning

In order to meet the requirements of the Regulations, measures included in the first cycle FRMP were grouped into themed approaches:

- preventing flooding
- protecting against flooding
- preparing for flooding
- recovery and review following flooding

Prevention

38% of completed measures have helped to prevent flooding. The following describes example measures that have been completed to achieve this.

For example, the Environment Agency has worked with East Suffolk council in the development of their Local Plan, which was adopted in March 2019. This has ensured that policies included in the plan promote sustainable development, ensuring no increase in flood risk and maximising opportunities to reduce flood risk.

Another example is where Northamptonshire County Council undertook a study to enhance knowledge and understanding of the extent of groundwater flood risk across the county. The outputs of this study assisted planners and developers when considering new development in areas which may be at risk of flooding.

Suffolk County Council have created a database of historic and modelled flood risk data for the area and disseminated this to the local planning authority to help better inform new developments in relation to flood risk.

The Environment Agency has undertaken a hydraulic modelling study of Houghton Field Drain in St. Ives. The outputs of the study have been used to update the Flood Map for Planning, providing an improved representation of the local flooding mechanism.

Protection

51% of completed measures have helped to protect individuals, communities, and the environment against the consequences of flooding. The following describes example measures that have been completed to achieve this.

For example, the construction of the Boston Barrier Tidal Gate, a £100m Environment Agency scheme which became fully operational in December 2020, provides an enhanced level of protection to more than 13,000 homes.

The Environment Agency has delivered a new £70m tidal flood defence barrier for Ipswich that better protects more than 1600 homes and 400 businesses from flooding.

The construction of a £27m new pumping station at Islington, delivered by King's Lynn IDB, will improve flood protection to almost 1472 residential properties. At the time of writing, the scheme is due to be completed in 2021.

The Environment Agency has delivered the second phase of the Great Yarmouth tidal defence project. The investment of approximately £32m in the town's flood defences better protects over 1,500 properties from flooding.

Norfolk County Council has completed Surface Water Management Plans (SWMPs) for locations across the county. They have also progressed the development of the EU Interreg pilot project 'CATCH' in the Norwich urban area. This project aims to reduce the amount of rainfall entering sewer systems by capturing it in thousands of water butts before releasing it slowly back into the sewers.

The Environment Agency has completed a project to automate control structures on the River Nene. The automation of structures increases the speed and efficiency at which river flows can be regulated.

Working in partnership with Cambridge City Council, Cambridgeshire County Council has delivered a £150k surface water flood risk scheme in Cherry Hinton. This has reduced the risk of flooding to 25 homes.

Essex County Council has completed SWMPs for locations across the county and delivered a number of flood alleviation schemes. This includes a £401k scheme in Kingswood that better protects 16 homes from flooding.

Through the development and subsequent delivery of the Wash East Coastal Management Strategy, the Environment Agency, in partnership with the Borough Council of King's Lynn and West Norfolk and the Community Interest Company, continue to maintain the standard of service provided by the shingle ridge between Wolferton Creek and Hunstanton. The works arising from the strategy better protect 75 homes from flooding.

The Environment Agency has progressed a project to repair and replace control structures and flood defences through Lincoln. The £4m project better protects nearly 1,500

properties from flooding and, at the time of writing, is due to be completed towards the end of 2021.

The Environment Agency has delivered a flood alleviation scheme for Horncastle. The scheme includes an upstream flood storage reservoir and the provision of Property Flood Resilience (PFR) measures to properties, better protecting 64 homes.

Preparedness

10% of completed measures have helped to prepare people for flooding. The following describes example measures that have been completed to help people prepare for flooding.

For example, Suffolk County Council have facilitated the creation of local flood and emergency planning groups across the county. This has helped to improve the understanding of flood risk and raised awareness of roles and responsibilities in managing risk.

Another example is that the Environment Agency has completed a scheme to install a tide gauge in the Wash Estuary. The gauge helps to improve forecasting of coastal flooding, ensuring that flood alerts and warnings are as timely and accurate as possible.

The Environment Agency has also developed flood risk guidance specifically for caravan owners, occupants, and businesses on the Essex and Suffolk coast. This is to raise awareness of risk and emergency plans and improve resilience.

Northamptonshire County Council has created a suite of guidance documents to assist in communications. Guidance is published on the council's flood toolkit website and includes information on riparian responsibilities, development and flood risk, and sources of flood risk.

Recovery and Review

1% of the completed measures have helped to support communities to recover from flooding.

In addition to the completed measures, the first cycle FRMP also included ongoing measures that reflect the day to day activities undertaken by RMAs which contribute to managing flood risk. These measures have continued throughout the period 2015-21. For example:

- RMAs continue to work with local planning authorities to influence strategic planning documents and new development sites to avoid inappropriate development and maximise opportunities to reduce flood risk
- RMAs continue to maintain flood risk assets and watercourses to minimise the risk of flooding

Additional measures implemented since 2015

In total, approximately £612m has been invested in in 786 projects completed by RMAs as part of the six year capital investment programme across 10 counties within the Anglian RBD. These projects have significantly reduced flood risk to almost 36,000 properties.

In addition to the aforementioned measures within the first cycle FRMP, a number of other measures have emerged since the publication of the first cycle plan. The following describes examples of these additional measures implemented since 2015.

Improvement works at Stow Fen Pumping Station have been delivered by the Downham Market Group of IDBs. The £1.5m project better protects 174 homes from flooding.

Bedford Borough Council have completed a flood warning and information project. Telemetry has been installed at causeways across the northern communities of the Borough where roads flood frequently. The system is used to send information to visual messaging signs on the state of the roads, providing communities, school transport, and road users with real time information on whether routes are flooded or passable.

The Environment Agency has delivered a scheme to provide Property Flood Resilience (PFR) measures to properties at risk of flooding in Oakington. The investment of almost £77k better protects 41 homes from flooding.

Essex County Council has delivered a surface water flood alleviation scheme in Braintree. The £580k project reduced flood risk to 39 properties.

The Environment Agency has installed a number of natural flood management (NFM) measures in the upper parts of the Alconbury Brook catchment as part of Defra's pilot programme. The measures have been installed to help reduce the risk of flooding, alongside other benefits such as increasing biodiversity, improving wildlife habitat, and reducing water pollution.

Cambridgeshire County Council worked in partnership with National Highways to deliver culvert improvements to provide an increased level of resilience to properties in Histon, north of Cambridge.

Essex County Council has delivered PFR projects across the county. The schemes reduce flood risk to 145 homes.

The Environment Agency, Central Bedfordshire Council, and Bedford Borough Council have worked in partnership to provide communities at risk of flooding with flood kits. The kits ensure that the right equipment is available to help communities be more resilient and respond effectively during a flood.

Anglian Water has developed and implemented a scheme in Newport Pagnell to reduce surface water flood risk, working in collaboration with Milton Keynes Highways.

The Lincolnshire County Council flood risk infrastructure programme has delivered 7 surface water schemes with a total investment value of almost £3.2m, increasing the level of protection to 252 homes.

How well these measures have achieved the first cycle FRMP objectives

The Flood Risk Regulations (2009) require the FRMP to include details of objectives for the purpose of managing flood risk and measures to set out how the objectives will be achieved. First cycle FRMP objectives were grouped into categories: social, economic, and environmental. Information on these objectives for the Anglian RBD can be found in Part B of the first cycle FRMP. Overall, the measures included in the first cycle FRMP have successfully achieved the objectives set out across the majority of categories, delivering a great improvement to the social, economic and environmental well-being of the Anglian RBD.

The first cycle FRMP showed which objective categories each measure would help to deliver. The following describes measures under the objective category which they primarily benefit. 22% of the completed measures have contributed to achieving more than one of the objective categories and the total of the percentages shown below therefore totals greater than 100%.

54% of completed measures contributed to achieving social objectives by helping to enhance community preparedness and resilience to flooding, working with Local Planning Authorities to ensure that new development does not increase the risk of flooding, and continuing to maintain assets and watercourses to minimise the risk of flooding to people and property. For example, the Environment Agency has undertaken work to refurbish the King's Lynn tidal defences, which included the replacement pf some flood gates at Fishers Fleet. Lead Local Flood Authorities have undertaken Surface Water Management Plans (SWMP) in locations across the river basin district to improve understanding of surface water flood risk and identify priority areas to invest in flood alleviation schemes.

49% of completed measures contributed to achieving economic objectives by helping to minimise the risk of flooding to transport services, considering the risk of flooding to agricultural land, and ensuring that flood risk management activities do not adversely affect the tourism industry. For example, the Environment Agency has evaluated options for the long term future of Denver sluice, which controls levels in the River Ely Ouse and prevents seawater from passing upstream of the structure during a high tide. This resulted in the completion of refurbishment works to the structure, better protecting 200 homes from flooding.

20% of completed measures contributed to achieving environmental objectives by minimising the negative impacts of flooding to designated nature conservation sites and designated heritage sites, and contributing to achieving Water Framework Directive objectives. For example, in partnership with Norfolk Rivers Trust, the Environment Agency

has undertaken restoration work in the catchment of the River Wensum in Norfolk to reduce flood risk and improve habitat.

In addition to the completed measures, ongoing measures that reflect day to day activities undertaken by RMAs in the period 2015-2021 have contributed to achieving the first cycle FRMP objectives. For example:

- the Environment Agency:
    - undertake flood risk maintenance activities, contributing to achieving social and economic objectives, whilst also seeking opportunities to naturalise watercourses to deliver environmental objectives
    - provide a flood warning service for main river, tidal, coastal, and groundwater flooding, and engage with communities to encourage sign up to flood warnings and develop personal and community flood plans-this contributes to achieving social objectives
- LLFAs:
    - prepare Local Flood Risk Management Strategies, contributing to the delivery of environmental, economic, and social objectives
    - continue to maintain assets and watercourses to minimise the risk of flooding from local sources contributing to achieving social and economic objectives, whilst also seeking opportunities to naturalise watercourses to deliver environmental objectives

These activities will continue to be carried out during the second cycle FRMP period 2021-2027.

Second cycle conclusions from the hazard and risk maps for the Anglian River Basin District

This section shows a summary of flood risk in the River Basin District (RBD) from:

- Rivers and sea
- Surface water

The data in tables 5 to 10 have been calculated from data available in December 2019. These data take into account the presence and condition of defences. The risk is presented in flood risk likelihood categories. These indicate the chance of flooding in any given year:

- high risk means that each year an area has a chance of flooding of greater than 3.3%
- medium risk means that each year an area has a chance of flooding between 1% and 3.3%
- low risk means that each year an area has a chance of flooding of between 0.1% and 1%
- very low risk means that each year an area has a chance of flooding of less than 0.1%

Table 5 summarises the risk of flooding from rivers and the sea to people in the RBD.

Table 5: summary of river and sea flood risk to people in the Anglian RBD

Risk to people	Total in RBD	High risk	Medium risk	Low risk	Very low risk
Number of people in RBD	6,404,735	39,880	166,798	272,003	58,925
Number of services	47,081	660	1,896	2,293	473

There are 6,404,735 people in the RBD, of these:

- 8.4% live in areas at risk of flooding from rivers and the sea
- 0.6% live in areas at high risk of flooding

There are 47,081 services in the RBD, of these:

- 11% are located in areas at risk of flooding from rivers and the sea
- 1% are located in areas at high risk of flooding

Table 6 summarises the risk of flooding from rivers and the sea to economic activity in the RBD.

Table 6: summary of river and sea flood risk to economic activity in the Anglian RBD

Risk to economic activity	Total in RBD	High risk	Medium risk	Low risk	Very low risk
Number of non-residential properties	255,953	4,453	10,141	16,004	3,646
Number of airports	3	1	0	0	0
Length of road (kilometres (km))	3,380	31.9	186.8	147.1	32.1
Length of railway (km)	1772.1	57.2	150.5	122.6	15.2
Agricultural land (hectares (ha))	2,163,577	90760	216,813.5	144,289.2	21,352

There are 255,953 non-residential properties in the RBD, of these:

- 13% are located in areas at risk of flooding from rivers and the sea
- 2% are located in areas at high risk of flooding

1 of the 3 airports in the RBD is at high risk of flooding from rivers and the sea.

There are 3,381 km of roads in the RBD, of these:

- 12% are located in areas at risk of flooding from rivers and the sea
- 1% are located in areas at high risk of flooding

There are 1,772 km of railways in the RBD, of these:

- 20% are located in areas at risk of flooding from rivers and the sea
- 3% are located in areas at high risk of flooding

There are 2,163,577 hectares of agricultural land in the RBD, of these:

- 22% are located in areas at risk of flooding from rivers and the sea
- 4% are located in areas at high risk of flooding

Table 7 summarises the risk of flooding from rivers and the sea to the natural and historic environment in the RBD.

Table 7: summary of river and sea flood risk to the natural and historic environment in the Anglian RBD

Risk to the natural and historic environment	Total in RBD	High risk	Medium risk	Low risk	Very low risk
Number of EU designated bathing waters within 50 metres (m)	13	10	0	0	0
Number of Environmental Permitting Regulations (EPR) installations within 50m	780	55	51	56	13
Area of Special Area of Conservation (SAC) within area (ha)	195,840.1	12,609.8	2,103.1	2,169.9	59.7
Area of Special Protection Area (SPA) within area (ha)	324,900.4	21,694.5	2,955.8	3,134.7	162.1
Area of Ramsar site within area (ha)	119,942.6	21,022.4	2,786	2,918	85.6

Risk to the natural and historic environment	Total in RBD	High risk	Medium risk	Low risk	Very low risk
Area of World Heritage Site within area (ha)	0	0	0	0	0
Area of Site of Special Scientific Interest (SSSI) within area (ha)	186,109	24,514.6	4,384.7	4163.5	316.4
Area of parks and gardens within area (ha)	27,942.2	586.5	516.2	114.6	23.4
Area of scheduled ancient monument within area (ha)	7404	348.6	503.3	272.1	37.1
Number of listed buildings within area	64,034	802	1,834	1,833	521
Number of licensed water abstractions within the area	7,411	1,858	1,090	524	48

Of the 13 EU designated bathing waters in this RBD, 77% are located in areas at high risk of flooding from rivers and the sea due to their fundamental features.

There are 780 Environmental Permitting Regulations (EPR) installations in the RBD, of these:

- 22% are located in areas at risk of river and sea flooding
- 7% are located in areas at high risk of flooding

There are 195,840 hectares of Special Area of Conservation (SAC) in the RBD, of these:

- 9% are located in areas at risk of flooding from rivers and the sea
- 6% are located in areas at high risk of flooding

There are 324,900 hectares of Special Protection Area (SPA) in the RBD, of these:

- 9% are located in areas at risk of flooding from rivers and the sea
- 7% are located in areas at high risk of flooding

There are 119,942 hectares of Ramsar sites in the RBD, of these:

- 22% are located in areas at risk of flooding from rivers and the sea
- 18% are located in areas at high risk of flooding

There are 186,108 hectares of Site of Special Scientific Interest (SSSI) in the RBD, of these:

- 18% are located in areas at risk of flooding from rivers and the sea
- 13% are located in areas at high risk of flooding

There are 27,942 hectares of parks and gardens in the RBD, of these:

- 4% are located in areas at risk of flooding from rivers and the sea
- 2% are located in areas at high risk of flooding

There are 7,404 hectares of scheduled ancient monument in the RBD, of these:

- 16% are located in areas at risk of flooding from rivers and the sea
- 5% are located in areas at high risk of flooding

There are 64,034 listed buildings in the RBD, of these:

- 8% are located in areas at risk of flooding from rivers and the sea
- 1% are located in areas at high risk of flooding

There are 7,411 licensed water abstractions in the RBD, of these:

- 47% are located in areas at risk of flooding from rivers and the sea
- 25% are located in areas at high risk of flooding

It should be noted that some of the environmentally designated sites at risk within the RBD are reliant to some degree on flooding. It is needed to maintain their interest features.

Table 8 summarises the risk of flooding from surface water to people in the RBD.

Table 8: summary of surface water flood risk to people in the Anglian RBD

Risk to people	Total in RBD	High risk	Medium risk	Low risk
Number of people in RBD	6,404,735	69,209	106,148	508,664
Number of services	47,081	444	723	2,678

Of the 6,404,735 people in the RBD:

- 11% live in areas at risk of flooding from surface water
- 1% live in areas at high risk of flooding from surface water

Of the 47,081 services in the RBD:

- 8% are located in areas at risk of flooding from surface water
- 1% are located in areas at high risk

Table 9 summarises the risk of flooding from surface water to economic activity in the RBD.

Table 9: summary of surface water flood risk to economic activity in the Anglian RBD

Risk to economic activity	Total in RBD	High risk	Medium risk	Low risk
Number of non-residential properties	255,953	3,767	5,767	23,973
Number of airports	3	3	0	0
Length of road (kilometres (km))	3381	120.1	117.1	388.1
Length of railway (km)	1772.1	91.2	74.8	196.4
Agricultural land (hectares (ha))	2,163,577	43,513.4	33,278.1	139,283.8

Of the 255,953 non-residential properties in the RBD:

- 13% are located in areas at risk of flooding from surface water
- 1% are located in areas at high risk

The 3 airports in the RBD are all located in areas at high risk of flooding from surface water.

Of the 3,381 km of roads in the RBD:

- 18% are located in areas at risk of flooding from surface water
- 4% are located in areas at high risk of flooding

Of the 1,772 km of railways in the RBD:

- 20% are located in areas at risk of flooding from surface water
- 5% are located in areas at high risk of flooding

Of the 2,163,577 hectares of agricultural land in the RBD:

- 10% are located in areas at risk of flooding from surface water
- 2% are located in areas at high risk of flooding

Table 10 summarises the risk of flooding from surface water to the natural and historic environment in the RBD.

Table 10: summary of surface water flood risk to the natural and historic environment in the Anglian RBD

Risk to the natural and historic environment	Total in RBD	High risk	Medium risk	Low risk
Number of EU designated bathing waters within 50 metres (m)	13	1	0	3
Number of Environmental Permitting Regulations (EPR) installations within 50m	780	250	111	198
Area of Special Area of Conservation (SAC) within area (ha)	195,840.1	280.1	269.1	1573.5
Area of Special Protection Area (SPA) within area (ha)	324,900.4	567.2	586.6	3407.9

Risk to the natural and historic environment	Total in RBD	High risk	Medium risk	Low risk
Area of Ramsar site within area (ha)	119,942.6	525.7	470.8	2605.9
Area of World Heritage Site within area (ha)	0	0	0	0
Area of Site of Special Scientific Interest (SSSI) within area (ha)	186,109	1398.5	1192.8	5703.1
Area of parks and gardens within area (ha)	27,942.2	667.2	387.2	1438.5
Area of scheduled ancient monument within area (ha)	7404	209.3	143.8	517.1
Number of listed buildings within area	64,034	420	311	2,053
Number of licensed water abstractions within the area	7,411	1,258	487	1322

4 of the 13 EU designated bathing waters in this RBD are located in an area at risk of flooding from surface water. 1 is in an area at high risk, the other 3 are in areas at low risk.

Of the 780 Environmental Permitting Regulations (EPR) installations in the RBD:

- 72% are located in areas at risk of surface water flooding

- 32% are located in areas at high risk of flooding

Of the 195,840 hectares of Special Area of Conservation (SAC) in the RBD:

- 1% are located in areas at risk of flooding from surface water
- 0.1% are located in areas at high risk of flooding

Of the 324,900 hectares of Special Protection Area (SPA) in the RBD:

- 1% are located in areas at risk of flooding from surface water
- 0.2% are located in areas at high risk of flooding

Of the 119,942 hectares of Ramsar sites in the RBD:

- 3% are located in areas at risk of flooding from surface water
- 0.4% are located in areas at high risk of flooding

Of the 186,109 hectares of Site of Special Scientific Interest (SSSI) in the RBD:

- 4% are located in areas at risk of flooding from surface water
- 1% are located in areas at high risk of flooding

Of the 27,942 hectares of parks and gardens in the RBD:

- 9% are located in areas at risk of flooding from surface water
- 2% are located in areas at high risk of flooding

Of the 7,404 hectares of scheduled ancient monument in the RBD:

- 12% are located in areas at risk of flooding from surface water
- 3% are located in areas at high risk of flooding

Of the 64,034 listed buildings in the RBD:

- 4% are located in areas at risk of flooding from surface water
- 1% are located in areas at high risk of flooding

Of the 7,411 licensed water abstractions in the RBD:

- 41% are located in areas at risk of flooding from surface water
- 17% are located in areas at high risk of flooding

Second cycle Flood Risk Management Plan (FRMP) objectives and measures

A full list of the objectives are in the Part A National Overview of Flood Risk Management in England for Second Cycle FRMPs.

In developing the FRMP, the Risk Management Authorities (RMAs) have:

- drawn conclusions from the hazard and risk maps and other sources of information - this helps us all to understand the risks or opportunities
- taken account of the likely impact of climate change on the occurrence of floods
- selected appropriate objectives from the national list to reduce the adverse consequences of flooding for human health, economic activity and the environment (including cultural heritage), and reduce the likelihood of flooding
- identified the likely approach (the measures) to achieve these objectives using the categories**:** preparing**,** preventing**,** protecting and recovery and review

In determining the proposed measures for the FRMP, the RMAs considered several different factors. The main ones are outlined in the Part A National Overview of Flood Risk Management in England for Second Cycle FRMPs.

Finding the second cycle measures

For this second cycle of flood risk management planning, the Environment Agency has developed a new interactive mapping tool called flood plan explorer. You can use Flood Plan Explorer to discover information about the measures proposed as part of this plan. This information mainly includes:

- where the measure is
- a description of the measure and what it is aiming to achieve
- which objectives the measure will help to achieve
- who is responsible for implementing the measure
- when the measure is planned to be implemented

National level objectives and measures

There are a number of measures which are applicable to every Flood Risk Area (FRA) in England. The Environment Agency will seek to implement these national-level measures as part of its routine day to day work as a RMA. The Environment Agency is responsible for the national-level measures that apply to every FRA for main rivers and the sea.

Lead Local Flood Authorities (LLFAs) are responsible for the national-level measures that apply to every FRA for surface water. Some of these measures are statutory (the work is required by law) and others are optional. LLFAs implement their day to day work in different ways depending on local priorities and resources. You should look at LLFA websites and their local flood risk management strategies for more information on how they carry out their day to day work.

You can find information about each of these measures in the interactive mapping tool. Flood Plan Explorer.

Flood Risk Area measures

There are 221 measures applicable to managing flood risk in the nationally identified Flood Risk Areas (FRA) in the Anglian River Basin District (RBD). This is 53% of the total number of measures in this Flood Risk Management Plan (FRMP). The full list of FRAs in the Anglian RBD can be found in the Introduction of this report. More information on how FRAs were identified can be found in the Part A National Overview of Flood Risk Management in England for the Second Cycle FRMPs. The FRAs are described in the subsequent sections of this report.

The Alconbury Rivers and Sea Flood Risk Area

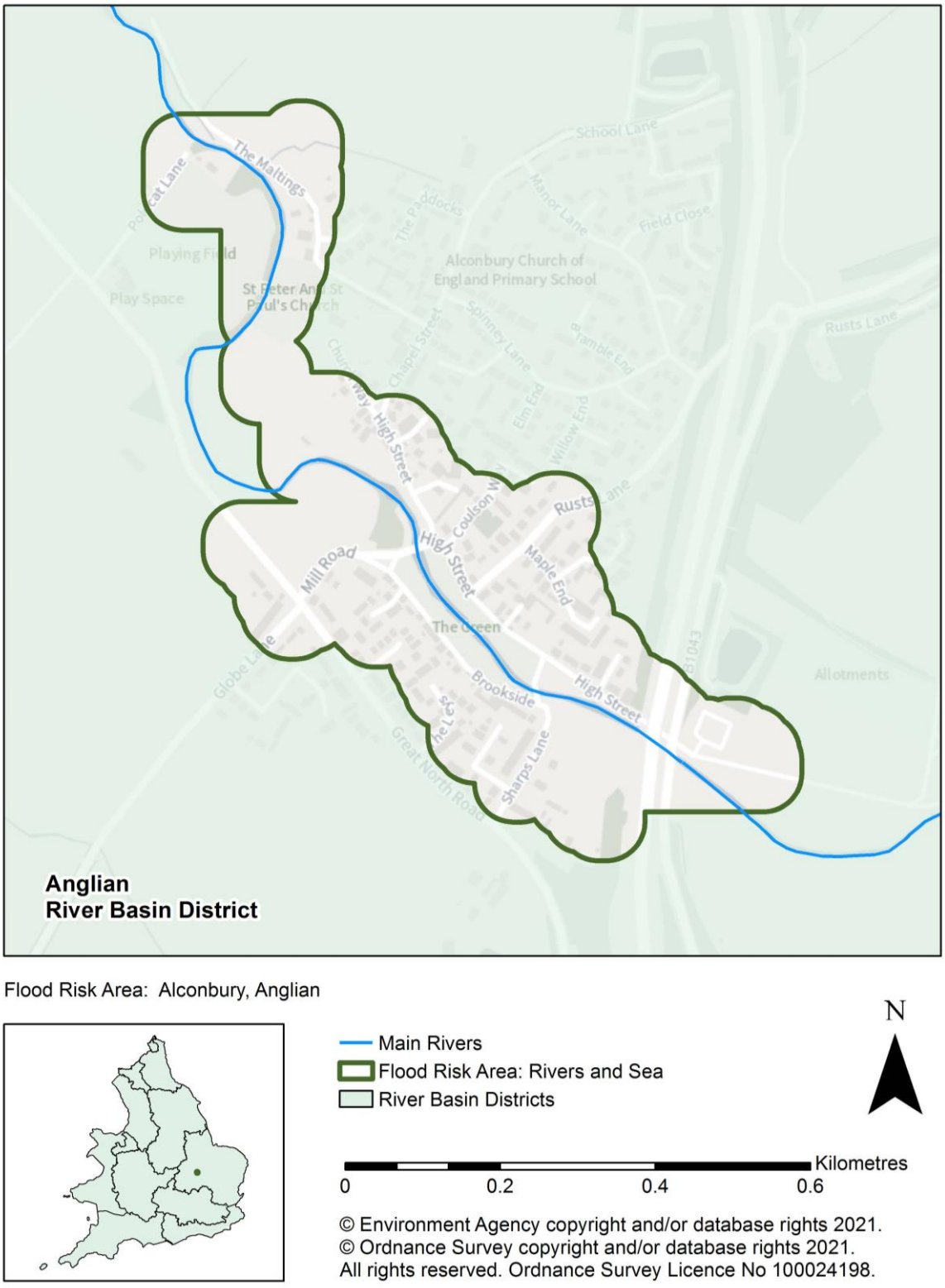


Figure 3: a map showing the boundary of the Alconbury Rivers and Sea Flood Risk Area

Introduction to the Alconbury Flood Risk Area

The Alconbury Flood Risk Area (FRA) has been identified as an FRA because the risk of flooding from main rivers is significant nationally for people, the economy, or the environment (including cultural heritage).

The Environment Agency leads on the development and delivery of the Flood Risk Management Plan (FRMP) for this FRA as the responsible authority for managing flood risk from main rivers and the sea.

Cambridgeshire County Council is the Lead Local Flood Authority (LLFA), whose remit includes flood risk from surface water and ordinary watercourses. The FRA also falls within the administrative boundaries of Huntingdonshire District Council and Alconbury and Ellington Internal Drainage Board (IDB).

Anglian Water is the sewerage company that owns, operates and maintains the sewer network and wastewater treatment infrastructure in the FRA.

Alconbury is a small rural village approximately 5km northwest of Huntingdon in Cambridgeshire and ~0.5km southeast of Alconbury Weston. The FRA covers a 0.3km^2 area of the village, which includes residential properties and agricultural land.

The principal source of flood risk to the area is from the Alconbury Brook, which is a main river. The catchment upstream comprises an area of approximately 80km^2, underlain by impervious clay substratum and characterised by mild slopes and arable land use.

The Alconbury Brook passes through the village in a single channel and conveys water to the confluence with the River Great Ouse. This is some 9km downstream and just upstream of Huntingdon. The water level in the Brook rises quickly in response to rainfall, which is somewhat a rarity within the wider catchment of the River Great Ouse. This reflects the high amount of runoff owing to the low levels of infiltration and the extensive land drainage in place to support agricultural production.

Previous studies investigating options to manage risk have identified the construction of embankments and channel re-profiling as potentially viable solutions. However, the negative impact on village aesthetics and low economic viability meant that this did not progress.

Current flood risk

Alconbury has an extensive history of flooding, notably in April 1998, when 67 properties flooded, and most recently in December 2020. Records indicate that properties in Alconbury have been internally flooded from the Alconbury Brook in:

- March 1947
- July 1968
- October 1987
- April 1998

- November 2000
- March 2016
- December 2020

During the March 2016 flood incident, a reported 10 properties flooded which had property level resilience (PLR) measures installed. The majority of the 38 PLR installations in the village were untested. Many of the properties in Alconbury are old and PLR measures have limited capability on these properties, as water can access through small cracks in masonry. It's also recognised that PLR is not a long-term resistance measure, providing resilience to flood water with a design life of around 20 years.

The flood risk and hazard maps show that, of the 578 people in the Alconbury FRA, 168 people live in areas at risk of flooding from main rivers. Of these people, 46% live in areas of high risk.

Also shown to be at risk of flooding from main rivers are:

- 1 non-residential property (pumping station)
- 1 of the 3 services in the FRA
- 0.1km of roads
- 4.54ha of agricultural land - of which 3.86ha are in areas deemed to be at high risk
- 10 listed buildings
- 0.04ha of Scheduled Ancient Monuments

The flood risk and hazard maps provide more detailed information on the likelihood and consequence of flooding for the Alconbury FRA

Based on this information, Risk Management Authorities (RMAs) have concluded that further steps should be taken to reduce the likelihood of flooding and the current and future impact it could have on the FRA.

How the risk is currently managed

The management of flood risk from main rivers is led by the Environment Agency in collaboration with other RMAs, including:

- Cambridgeshire County Council
- Huntingdonshire District Council
- Bedford Group of IDBs
- Anglian Water

A partnership framework has been set up across Cambridgeshire. The Cambridgeshire and Peterborough Flood and Water Partnership Group is chaired by Cambridgeshire County Council and involves all RMAs. This provides a coordinated and collaborative approach to the management of flood risk and water management.

Separately, the Cambridgeshire and Peterborough Local Resilience Forum (LRF) is a multi-agency partnership made up of representatives from local public services such as:

- emergency services
- local authorities
- NHS
- Environment Agency

Associated businesses, organisations and voluntary sector representatives are also involved. These organisations work together through the LRF to prepare for and respond to emergencies. The community risk register is a collection of assessments of emergencies that might happen locally within Cambridgeshire. Each potential emergency is rated in terms of its potential impact and likelihood of occurring. Flooding is included in this assessment.

There are no formal flood defences in Alconbury. Following severe flooding in 1998, a series of appraisals were undertaken from 1998 to 2007. These considered a wide range of engineering options to manage flood risk in Alconbury. A preferred scheme was identified, which involved channel re-profiling and construction of flood defences. However, this proved to be economically challenging and deemed socially unacceptable due to the negative impact on village aesthetics. Therefore, a flood alleviation scheme has not been progressed.

Huntingdonshire District Council led a PLR scheme in 2010 when the flood alleviation scheme was not progressed. As part of this, homes were primarily fitted with flood boards in front of doorways to help reduce the ingress of water into properties during a flood.

The Alconbury Brook was identified as a priority catchment to investigate reducing flood risk using natural flood management as part of Defra's pilot programme, which launched in 2016. Since then, several measures have been introduced in the upper parts of the catchment, including:

- leaky, woody structures and check dams in tributary watercourses to slow the flow of water
- attenuation ponds to store runoff during high rainfall events
- tree and hedgerow planting to increase water retention in soils and reduce overland surface water flow

The Alconbury Brook Flood Risk Management Partnership was established in 2017 to provide a coordinated approach to flood risk resilience activities in the catchment. The group includes all RMAs with flood risk management responsibilities in the catchment, as well Alconbury Parish Council. Regular meetings are held to share information and provide an opportunity for the community to raise issues. Since its formation, the partnership has:

- helped to deliver a more targeted flood warning service
- overseen the installation of CCTV to monitor flooding
- established a local flood group with a flood plan

Watercourse maintenance is undertaken by the Environment Agency and Bedford Group of IDBs. The current annual maintenance regime helps to maintain and improve

watercourse conveyance through weed spraying, grass cutting, and ad-hoc removal of channel blockages, such as fallen trees.

The Environment Agency monitor river and rainfall conditions at 5 sites in and near to the FRA:

- Alconbury A1 (river flow)
- Alconbury Weston (river level)
- Alconbury Green Lodge (river flow)
- Hamerton (river level)
- Great Gidding (precipitation)

This information is used to inform activities related to one flood alert and one flood warning area covering the FRA. These warn and inform the public when flooding may occur, providing time to act ahead of impacts occurring.

The water level and flow data are also used to inform and calibrate mathematical computer modelling of rivers. The Alconbury Brook is included in the Lower Ouse model which was updated in 2015.

The outputs from hydraulic modelling studies are used to inform the 'Flood Map for Planning (Rivers and Sea)' and the 'Risk of Flooding from Rivers and Sea' mapping, as well as a suite of other products. These are used to:

- advise the public and businesses of their risk of flooding
- inform potential developments and local planning authorities
- provide a basis for the assessment and design of flood risk management works

The impact of climate change and future flood risk

Rainfall intensity is expected to increase in the future, causing higher river flows and levels. The Alconbury Brook rises rapidly in response to rainfall and therefore an increase in rainfall intensity and frequency will lead to more recurrent flood events in Alconbury.

Please refer to the Climate Change and the Anglian River Basin District (RBD) section for more information on what we know are likely to be the implications of climate change in the Anglian RBD.

Objectives and measures for the Alconbury Flood Risk Area

Measures have been developed that apply specifically to the Alconbury FRA.

You can find information about all the measures that apply to the Alconbury FRA in the Flood Plan Explorer, an interactive mapping tool. This includes information on which national objectives each measure helps to achieve.

The Alconbury Weston Rivers and the Sea Flood Risk Area

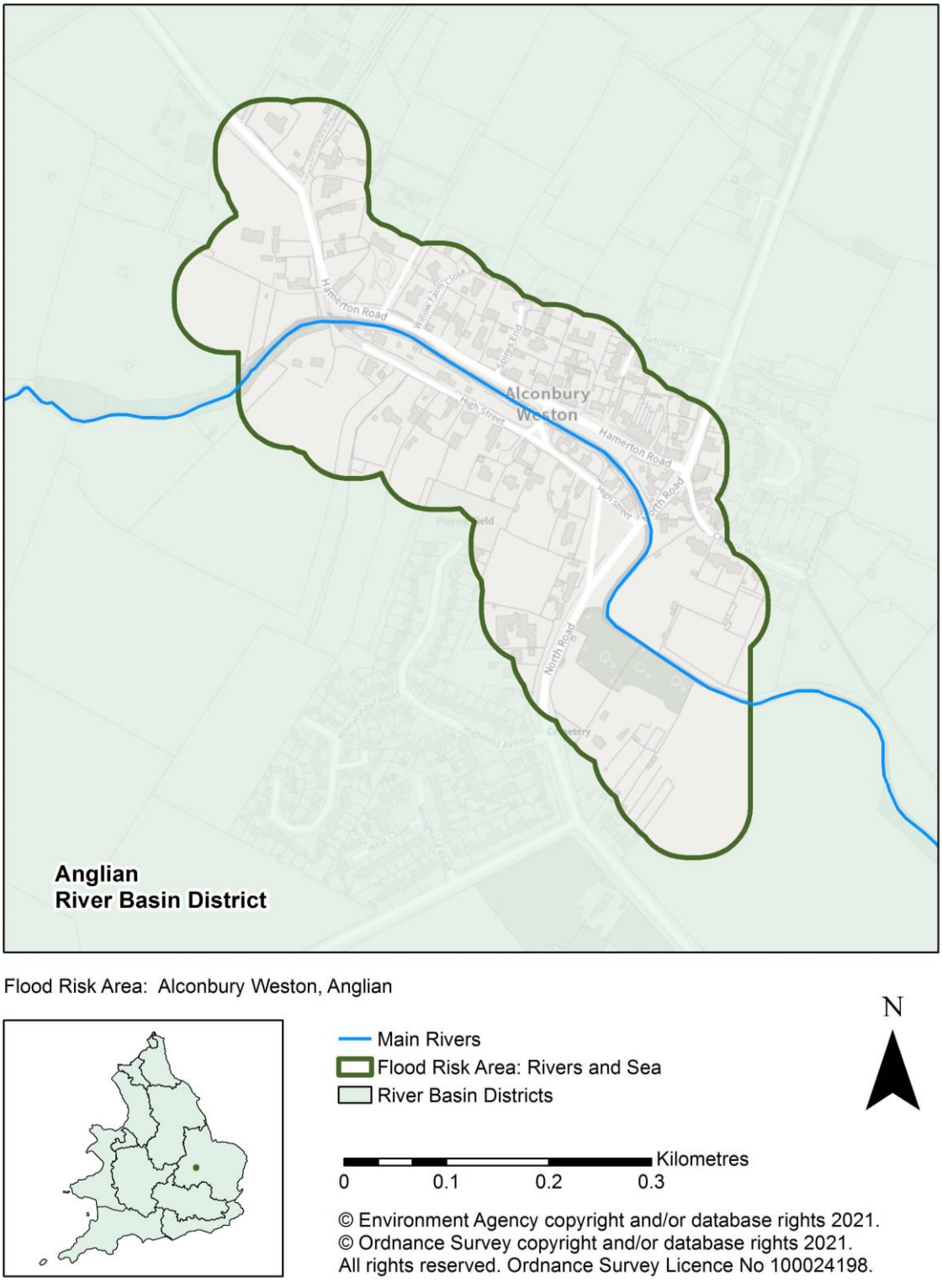


Figure 4: a map showing the boundary of the Alconbury Weston Flood Risk Area

Introduction to the Alconbury Weston Flood Risk Area

The Alconbury Weston Flood Risk Area (FRA) has been identified as an FRA because the risk of flooding from main rivers is significant nationally for people, the economy or the environment (including cultural heritage).

The Environment Agency lead on the development and delivery of the Flood Risk Management Plan (FRMP) for this FRA as the responsible authority for managing flood risk from main rivers and the sea.

Cambridgeshire County Council is the Lead Local Flood Authority, whose remit includes flood risk from surface water and ordinary watercourses. The FRA also falls within the administrative boundaries of Huntingdonshire District Council and Alconbury and Ellington IDB.

Anglian Water is the sewerage company that owns, operates and maintains the sewer network and wastewater treatment infrastructure in the FRA.

Alconbury Weston is a small rural village just under 6km northwest of Huntingdon in Cambridgeshire and ~0.5km northwest of the village of Alconbury. The FRA covers a 0.2km^2 area of the village, which includes residential properties and agricultural land.

The principal source of flood risk to the area is from the Alconbury Brook, which is a main river. The catchment upstream comprises an area of approximately 80km^2, underlain by impervious clay substratum and characterised by mild slopes and arable land use.

The Alconbury Brook passes through the village in a single channel and conveys water to the confluence with the River Great Ouse, some 10km downstream and just upstream of Huntingdon. The water level in the Brook rises quickly in response to rainfall, which is somewhat a rarity within the wider catchment of the River Great Ouse. This reflects the high amounts of runoff owing to the low levels of infiltration and the extensive land drainage in place to support agricultural production.

Current flood risk

Alconbury Weston has an extensive history of flooding, notably in April 1998 when 47 properties flooded. Records indicate that properties in Alconbury Weston have been internally flooded from the Alconbury Brook in:

- March 1947
- July 1968
- October 1987
- April 1998
- November 2000
- March 2016
- December 2020

The flood risk and hazard maps show that of the 204 people in the Alconbury Weston FRA, 76 people live in areas at risk of flooding from main rivers. Of these people, 75% live in areas of high risk.

Also shown to be at risk of flooding in the FRA from rivers are:

- 2 non-residential properties at high risk (including a pumping station)
- 1 out of 4 services
- 8.9ha of agricultural land - of which 7.6ha is at high risk
- 9 listed buildings - of which 8 are at high risk
- 0.01ha of Scheduled Ancient Monuments

The flood risk and hazard maps provide more detailed information on the likelihood and consequence of flooding for the Alconbury Weston FRA.

Based on this information, Risk Management Authorities (RMAs) have concluded that further steps should be taken to reduce the likelihood of flooding and the current and future impact it could have on the FRA.

How the risk is currently managed

The management of flooding risk from main rivers is led by the Environment Agency in collaboration with other RMAs, including:

- Cambridgeshire County Council
- Huntingdonshire District Council
- Bedford Group of IDBs
- Anglian Water

A partnership framework has been set up across Cambridgeshire. The Cambridgeshire and Peterborough Flood and Water Partnership Group is chaired by Cambridgeshire County Council and involves all RMAs. This provides a coordinated and collaborative approach to the management of flood risk and water management.

Separately, the Cambridgeshire and Peterborough Local Resilience Forum (LRF) is a multi-agency partnership made up of representatives from local public services such as:

- emergency services
- local authorities
- NHS
- Environment Agency

Associated businesses, organisations and voluntary sector representatives are also involved. These organisations work together through the LRF to prepare for and respond to emergencies. The community risk register is a collection of assessments of emergencies that might happen locally within Cambridgeshire. Each potential emergency is rated in terms of its potential impact and likelihood of occurring. Flooding is included in this assessment.

There are no formal flood defences in Alconbury Weston. Following severe flooding in 1998, a series of appraisals were undertaken from 1998 to 2007. They considered a wide range of engineering options to manage flood risk in Alconbury Weston. A preferred option was identified, which involved undertaking downstream works to improve conveyance, including the removal of fords in the village. However, this scheme was not progressed due to:

- the relatively low economic viability
- the fact that the level of protection provided would be exceeded in a repeat of the 1998 flood event
- the negative impact on village aesthetics

Huntingdonshire District Council led a property level resilience (PLR) scheme in 2010 when the flood alleviation scheme was not progressed. As part of this, 37 homes in Alconbury Weston were primarily fitted with flood boards in front of doorways to help reduce the ingress of water into properties during a flood.

The Alconbury Brook was identified as a priority catchment to investigate reducing flood risk using natural flood management as part of Defra's pilot programme, which launched in 2016. Since then, several measures have been introduced in the upper parts of the catchment, including:

- leaky, woody structures and check dams in tributary watercourses to slow the flow of water further upstream
- attenuation ponds to store runoff during high rainfall events
- tree and hedgerow planting to increase water retention in soils and reduce overland surface water flow

The Alconbury Brook Flood Risk Management Partnership was established in 2017 to provide a co-ordinated approach to flood risk resilience activities in the catchment. The group includes all RMAs with flood risk management responsibilities in the catchment, as well as Alconbury Weston Parish Council. Regular meetings are held to share information and provide an opportunity for the community to raise issues. Since its formation, the partnership has:

- helped to deliver a more targeted flood warning service
- overseen the installation of CCTV to monitor flooding
- established a local flood group with a flood plan

Watercourse maintenance is undertaken by the Environment Agency and Bedford Group of IDBs within the catchment. The current annual maintenance regime helps to maintain and improve watercourse conveyance through:

- weed spraying
- grass cutting
- ad-hoc removal of channel blockages (such as fallen trees)

The Environment Agency monitor river and rainfall conditions at 4 sites in and near to the FRA:

- Alconbury Weston (river level)
- Alconbury Green Lodge (river flow)
- Hamerton (river level)
- Great Gidding (precipitation)

This information is used to inform activities related to one flood alert and one flood warning area covering the FRA. These warn and inform the public when flooding may occur, providing time to act ahead of impacts occurring.

The water level and flow data are also used to inform and calibrate mathematical computer modelling of rivers. The Alconbury Brook is included in the Lower Ouse model which was most recently updated in 2015.

The outputs from hydraulic modelling studies are used to inform the 'Flood Map for Planning (Rivers and Sea)' and the 'Risk of Flooding from Rivers and Sea mapping', as well as a suite of other products. These are used to:

- advise the public and businesses of their risk of flooding
- inform potential developments and local planning authorities
- provide a basis for the assessment and design of flood risk management works

The impact of climate change and future flood risk

Rainfall intensity is expected to increase in the future and causing higher river flows and levels. The Alconbury Brook rises rapidly in response to rainfall and therefore an increase rainfall intensity and frequency will lead to more recurrent flood events in Alconbury Weston.

Please refer to the Climate Change and the Anglian River Basin District (RBD) section for more information on what we know are likely to be the implications of climate change in the Anglian RBD.

Objectives and measures for the Alconbury Weston Flood Risk Area

Measures have been developed that apply specifically to the Alconbury Weston FRA.

You can find information about all the measures that apply to the Alconbury Weston FRA in the Flood Plan Explorer, an interactive mapping tool. This includes information on which national objectives each measure helps to achieve.

The Boston Rivers and the Sea Flood Risk Area

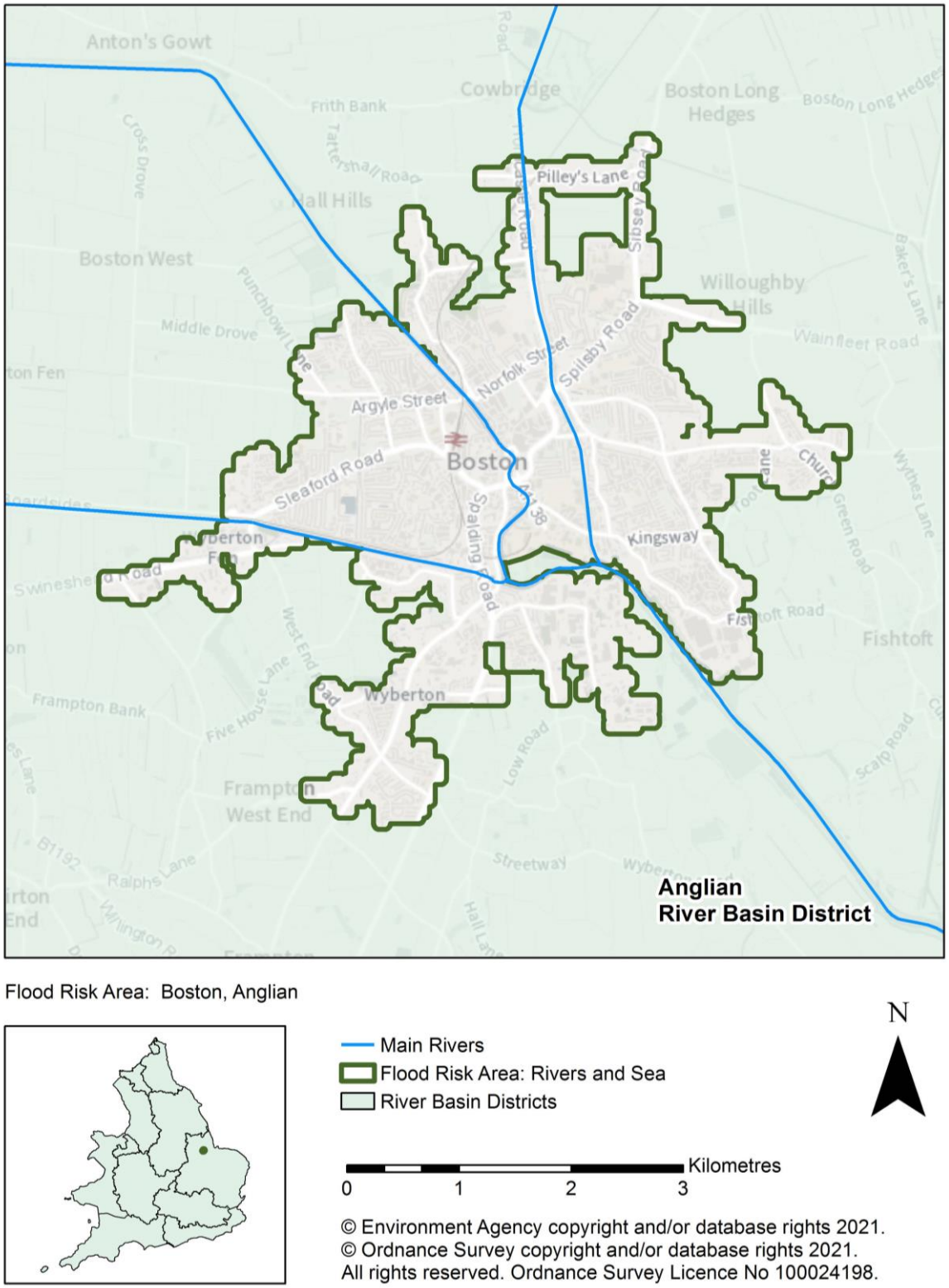


Figure 5: a map showing the boundary of the Boston Flood Risk Area

Introduction to the Boston Flood Risk Area

The Boston Flood Risk Area (FRA) has been identified as an FRA because the risk of flooding from main rivers and the sea is significant nationally for people, the economy, or the environment (including cultural heritage).

The Environment Agency leads on the development and delivery of the Flood Risk Management Plan (FRMP) for this FRA. Lincolnshire County Council are the LLFA responsible for managing flood risk from 'local' sources. These local sources include:

- surface water
- groundwater
- ordinary watercourses

The Environment Agency's remit covers flood risk from rivers and the sea.

Anglian Water Services is the water and sewage company that owns, operates and maintains the sewerage network and wastewater treatment infrastructure in the FRA.

The Black Sluice IDB and Witham Fourth District Internal Drainage Board (IDB) are responsible for land drainage in the FRA.

The Boston FRA is urban although set in a rural location. Areas of which are:

- residential
- business
- amenity

The FRA extends to include:

- Wyberton
- Frampton Fen
- Skirbeck

To the periphery the land is agricultural use. Grade 2 to the west, and grade 1 to the north, east and south of the FRA.

The predominant soil type is seasonally wet, deep silt. There are also significant deposits of seasonally wet, deep clay.

The FRA may include locations that are not connected to the main part of the FRA, and there may be small areas of 'dry islands', which are shown to be outside of the FRA. The reason for these seemingly anomalous areas relates to the methodology used to identify the FRA boundaries, which is detailed in Part A of the FRMP report.

It is important to note, however, that measures included for the FRA, particularly those associated with flood warning and evacuation procedures, are likely to apply to the FRA as a whole and will not be limited to the area shown in figure 5.

Located within the FRA is a moated site 480m north-east of Wyberton West Hospital. This is a Scheduled Ancient Monument. Havenside Local Nature Reserve also lies within the FRA.

Boston is a market town and port in Lincolnshire located on the River Witham in the heart of the Lincolnshire Fens.

The early medieval geography of The Fens was more fluid than today, and the River Witham did not flow near where Boston now stands. The River Witham is believed to have joined the Witham Haven after the flood of September 1014. The town originated in Skirbeck, and later developed in its current location where there was access to navigable water.

Boston has since served as a small port and market town since the thirteenth century, trading in:

- wool
- salt
- wine
- leather
- tin
- lead

In the eighteenth century draining of the Fens commenced in Boston. At the same time, the embanking and straightening of the fenland Witham began. The land proved to be fertile which allowed Boston to export cereals to London.

Boston's current industry reflects this. Its most important economic activity is centred on food production. The population has expanded over recent years to include both permanent and seasonal workers. The town also retains a port and centre for road haulage and logistics. This was made possible by new roads being built over the river in 1966.

Boston is the main outfall for drainage of the area's highly productive fenland arable land. The River Witham flows from the north-west through the FRA and out to sea through The Witham Haven at Boston. Inflows from the South Forty Foot Drain and Maud Foster Drain join the tidal Witham Haven in the town.

In the low-lying Fens between Lincoln and Boston, the fluvial flood risk comes from the main rivers and their tributaries. This risk is reduced through large embankments, with drainage influenced by several pumping stations.

Tidal sluices at the end of 3 main rivers close twice a day with the incoming tide. This is to prevent tidal inundation of the fens. As the tide recedes the sluices open to allow water from the uplands to discharge into the tidal Witham Haven. When the sluices are tide-locked they remain closed. During this time there remains a residual risk from flooding due to overtopping or breaching of defences. It's likely that this risk will increase with climate change.

The risk of tidal flooding in the Boston FRA has been reduced through the construction of:

- raised defences along the Wash frontage
- raised defences along the Witham Haven
- tidal barrier on the edge of Boston, completed in 2020

Significant fluvial flooding followed a snow melt in 1947.

The town has a history of significant tidal flooding in the last 100 years with parts flooded in 1953, 1978 and more recently 2013.

Current flood risk

Boston has experienced recent significant flood incidents in 5 December 2013, a tidal Surge resulted in 800 properties flooded across 55 streets.

The flood hazard and risk maps show that in the Boston FRA, 45,786 people live in areas at risk of flooding from rivers and the sea. Of these people, 26% live in areas of high risk.

Also shown to be in areas at risk of flooding from rivers and sea are:

- 1,932 non-residential properties - including community centres, hospitals, schools and colleges, retail parks and public utilities
- 12.01 km of roads - including parts of the A52, A16, A1137 and A1138
- 6.81 km of railway
- 692.22 ha of agricultural land
- 273 listed buildings
- 3.63ha parks and gardens
- 5 water abstraction points

The flood hazard and risk maps provide more detailed information on the likelihood and consequence of flooding for the Boston FRA.

Based on this information, Risk Management Authorities (RMAs) have concluded that further steps should be taken to reduce the likelihood of flooding and the current and future impact it could have on the FRA.

However, this should be reviewed as new data becomes available. Significant investment has recently been undertaken in projects. This will reduce flood risk in the area.

How the risk is currently managed

The management of flood risk from rivers and sea is led by the Environment Agency in collaboration with other RMAs. These include:

- Lincolnshire County Council
- Boston Borough Council
- Black Sluice IDB

- Witham Fourth District IDB

A partnership framework has been set up across Lincolnshire involving all RMAs to coordinate the management of flood risk and water management. Strategic direction is delivered by the Lincolnshire Flood Risk and Water Management Strategy Group. This is chaired by the Environment Agency.

The Management Group chaired by Lincolnshire County Council delivers the responsibilities of the LLFA. There are 4 Local Flood Risk and Drainage Management Groups chaired by Lincolnshire County Council Highways. These deliver flood risk and water management solutions to meet local circumstances.

The Boston FRA is covered by the Boston and South Holland Flood Risk and Drainage Management Group.

The Lincolnshire Local Resilience Forum (LRF) is a multi-agency partnership made of representatives from local public services such as:

- emergency services
- local authorities
- NHS
- Environment Agency

To help prepare for and respond to emergencies the LRF publish a community risk register. This provides information on the key risks that have the potential to cause disruption to the county. These include East Coast and inland flooding.

The drainage boards' networks of low-level drains and pumping stations drain both the arable land and urban areas within the FRA. These discharge into the main rivers. These embanked channels carry fluvial water safely out to the Witham Haven via the tidal sluices at low tide. During tide locked periods the fluvial water must be retained within the channels until such time as it can discharge. This can lead to very high river levels. There is a risk of overtopping and embankment breaching although this is of greater concern outside the FRA.

The Environment Agency monitor river and rainfall conditions at 3 sites in and near to the FRA:

- Boston Robin Hoods (precipitation)
- Boston Grand Sluice (levels)
- Skirbeck Black Sluice (precipitation and levels)

This information is used to inform activities related to 4 flood warning areas that cover the FRA. This enables people to receive a warning when flooding could occur. This data also informs the operational response during a flood incident.

Modelling of the Lower Witham fluvial system was undertaken in 2009. This is due to be updated in 2022. The Stonebridge catchment and South Forty Foot Catchment have both been modelled since 2016.

Coastal hazard mapping was undertaken in 2010. This shows the risk of flooding from breaches and overtopping of the sea defences for the present day and in the future. It considers the effects of climate change. This is due to be updated in 2022.

Flood risk maps are published based on the outputs from modelling to inform:

- the public and business of their flood risk
- potential developers and local planning authorities
- the assessment and design of flood risk management works

The Environment Agency operates and maintains flood risk management assets on the main watercourses in the FRA. These include:

- flood defence walls
- flood gates
- channels
- culverts
- debris screens

This work includes routine inspection and clearance activities as well as regular repair and replacement of assets.

Tidal flood risk is controlled by sluice gates on all the main rivers flowing into the Witham Haven. These include:

- Grand Sluice - where the Witham ends and the tidal Witham Haven begins
- Black Sluice - where the South Forty Foot drain joins the Witham Haven
- Maud Foster Sluice - where the Maud Foster Drain joins the Witham Haven

Flood risk improvement works that benefit the Boston FRA completed recently by the Environment Agency include:

- Boston Combined Strategy (Phase 3) provision of the tidal barrier - this barrier will reduce the risk of a tidal surge causing flooding in Boston (completed December 2020)
- works to raise the banks along the Witham Haven (completion in 2021)
- defence improvement works around the port to raise the defence level and help manage risks from climate change (due for completion 2023)

Further works are planned in the next FRMP cycle to reinforce the defences between Grand Sluice and Black Sluice upstream of the barrier. These works will ensure that moderate high tides, when the barrier is not used, cannot breach or overwhelm these defences.

The impact of climate change and future flood risk

The climate is changing, and this is likely to have an impact on flooding and coastal erosion.

Sea levels are rising, and winter rainfall may become more intense. More frequent and prolonged rainfall events could increase main river flows from the uplands. This could result in more water being stored in the lowland systems during extended periods of tide-lock. Increased and prolonged pressure will be put on the embankments whilst this is waiting to be discharged to the sea.

The Boston tidal barrier has been built to mitigate around 100 years of sea level rise. However, those higher sea levels will put more pressure on tidal defences around the Wash frontage and along the Witham Haven.

Increased sea levels and storminess will also reduce the saltmarshes. This provides the embankments around the Wash with additional protection from large waves.

Please refer to the Climate Change and the Anglian River Basin District (RBD) section for more information on what we know are likely to be the implications of climate change in the Anglian RBD.

Objectives and measures for the Boston FRA

Measures have been developed that apply specifically to the Boston FRA. These measures have been developed in addition to those covering a wider geographic area that also apply to the Boston FRA.

You can find information about all the measures that apply to the Boston FRA in Flood Plan Explorer, an interactive mapping tool. This includes information on which national objectives each measure helps to achieve.

The Cambridge Surface Water Flood Risk Area

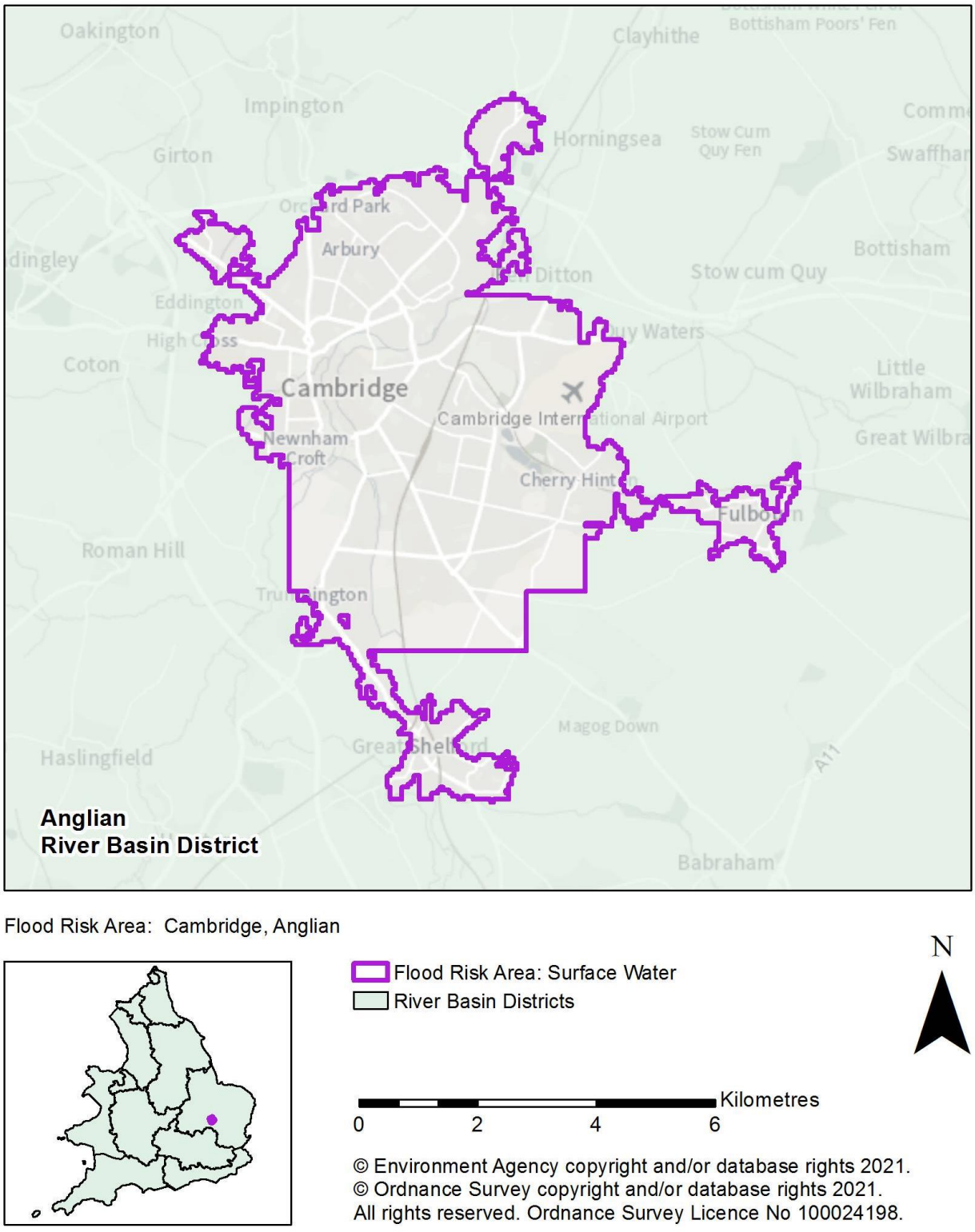


Figure 6: a map showing the boundary of the Cambridge Flood Risk Area

Introduction to the Cambridge Flood Risk Area

The Cambridge Flood Risk Area (FRA) has been identified as an FRA because the risk of flooding from surface water is significant nationally for people, the economy, or the environment (including cultural heritage).

Cambridgeshire County Council leads on the development and delivery of the Flood Risk Management Plan (FRMP) for this FRA as the responsible authority for managing flood risk from surface water.

Anglian Water is the Water and Sewerage Company that owns, operates, and maintains the sewer network and wastewater treatment infrastructure in the FRA

The city of Cambridge is a dense urban environment in Cambridgeshire. The city typically lies on chalky soils to the east, with sands and gravel to the centre and north of the city with some pockets of clay soils.

The City of Cambridge is in a designated Nitrate Vulnerable Zone. The protected site of Histon Road Site of Special Scientific Interest (SSSI) lies within the FRA. Also, Local Nature Reserve sites are located at Bramblefields, Coldham's Common, Barnwell, Barnwell II, Limekiln Close (and West Pit), Sheep's Green and Coe Fen, Logan's Meadow and Paradise. Within the FRA Fulbourn is located over a groundwater Source Protection Zone. There is also a designation of national green belt surrounding the city and the edges of the FRA.

The city is served by a combination of surface water, foul water and combined sewers, along with several culverted and open watercourses. Ownership of these assets is dispersed among many parties, both Risk Management Authorities (RMAs) and riparian. Flows from the surface water network are discharged into the River Cam or its tributaries.

Current flood risk

The most notable historic flood events on the Lead Local Flood Authority records for Cambridge occurred on 8 to 9 August 2014. In 2014 intense summer storms saw drainage infrastructure become overwhelmed leading to internal flooding in several residential properties across the city as well as in a hospital, school and college.

The flood risk and hazard maps show that, of the 152,640 people in the Cambridge FRA, 25,302 people live in areas at risk of flooding from surface water. Of these people, 12% live in areas considered to be at high risk.

Also shown to be at risk of flooding from surface water are:

- 906 non-residential properties
- 181 out of 1665 services - of which 31 are at high risk
- 5.03km of railways
- 3 sites regulated under the Environmental Permitting Regulations
- 7 licensed water abstraction sites

- 142.65ha of agricultural land, around 15ha of which are at high risk
- 54 listed buildings, of which 2 are at high risk
- 0.43ha of Scheduled Ancient Monuments
- 0.16km of roads
- 22.52ha of parks and gardens
- 2.33ha of SSSI
- 1 airport

The flood risk and hazard maps provide more detailed information on the likelihood and consequence of flooding for the Cambridge.

Based on this information, RMAs have concluded that further steps should be taken to reduce the likelihood of flooding and the current and future impact it could have on the FRA.

How the risk is currently managed

The management of surface water flood risk is led by Cambridgeshire County Council in collaboration with other RMAs and other stakeholders including:

- Cambridge City Council
- The Environment Agency
- Anglian Water

A partnership framework has been set up across Cambridgeshire. The Cambridgeshire and Peterborough Flood and Water Partnership Group is chaired by Cambridgeshire County Council and involves all RMAs. This provides a coordinated and collaborative approach to management of flood risk and water management.

Separately, the Cambridgeshire and Peterborough Local Resilience Forum (LRF) is a multi-agency partnership made up of representatives from local public services such as:

- emergency services
- local authorities
- NHS
- Environment Agency

Associated businesses, organisations and voluntary sector representatives are also involved. These organisations work together through the LRF to prepare for and respond to emergencies. The community risk register is a collection of assessments of emergencies that might happen locally within Cambridgeshire. Each potential emergency is rated in terms of its potential impact and likelihood of occurring. Flooding is included in this assessment.

Cambridge City Council incorporate flood risk into decisions on new developments and are responsible for the operation and maintenance of several watercourses and drainage

related assets in Cambridge. These assets include several sustainable drainage systems that they have adopted.

The Environment Agency have the strategic overview for flood risk management. Their local remit covers flood risk from main rivers, reservoirs and the sea.

Anglian Water is the water and sewerage company that owns, operates and maintains the sewer network and wastewater treatment infrastructure in the FRA.

A Surface Water Management Plan (SWMP) has previously been delivered for higher risk parts of this FRA; those wet spots are being monitored. Cambridge City Council, with support from the county council, have already delivered several flood risk management schemes such as Riverside and Cherry Hinton Property Level Resilience Schemes. Options have also been developed for other schemes in the city including at the Addenbrookes and Rosie Hospital, Brunswick Terrace and Kelvin Close.

The impact of climate change and future flood risk

Rainfall intensity is expected to increase in future, causing greater volumes of runoff and higher flows within watercourses. It is therefore likely that flooding will become more frequent.

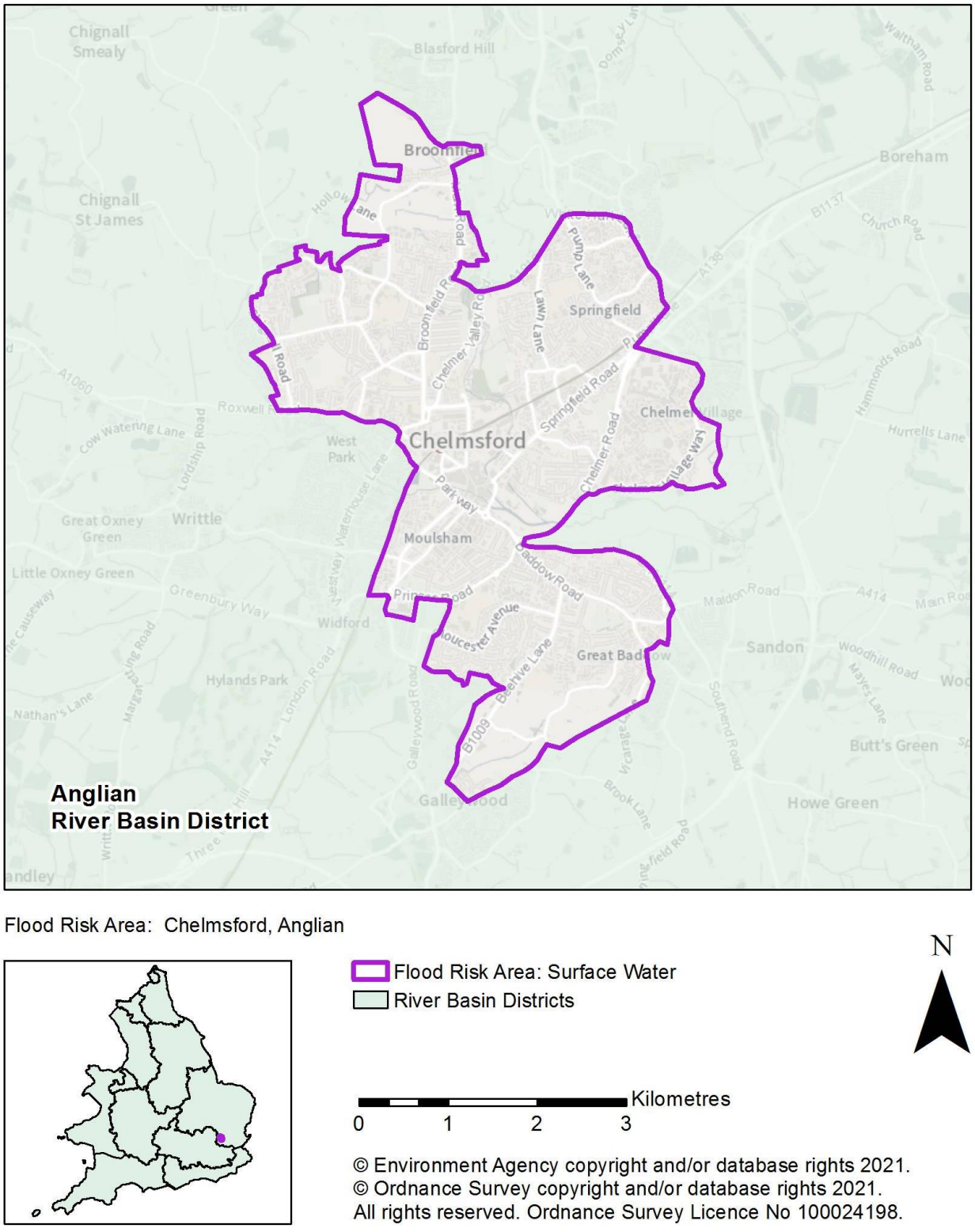
Please refer to the Climate Change and the Anglian River Basin District (RBD) section for more information on what we know are likely to be the implications of climate change in the Anglian RBD.

Objectives and measures for the Cambridge FRA

Measures have been developed that apply specifically to the Cambridge FRA.

You can find information about all the measures that apply to the Cambridge FRA in the Flood Plan Explorer, an interactive mapping tool. This includes information on which national objectives each measure helps to achieve.

The Chelmsford Surface Water Flood Risk Area



Flood Risk Area: Chelmsford, Anglian

Flood Risk Area: Surface Water
River Basin Districts

N

0 1 2 3 Kilometres

Figure 7: a map showing the boundary of the Chelmsford Flood Risk Area

Introduction to the Chelmsford Flood Risk Area

The Chelmsford Flood Risk Area (FRA) has been identified as an FRA because the risk of flooding from surface water is significant nationally for people, the economy or the environment (including cultural heritage).

The Chelmsford FRA sits within Chelmsford District Council which is within the administrative area of Essex County Council. Essex County Council is the Lead Local Flood Authority (LLFA) responsible for the district of Chelmsford and leads on the development and delivery of the Flood Risk Management Plan (FRMP) measures in this area.

The Environment Agency is the authority responsible for managing flood risk from main rivers and the sea in the FRA.

Anglian Water is the water and sewerage company that owns, operates, and maintains the sewer network and wastewater treatment infrastructure in the FRA.

The Chelmsford FRA covers an area of approximately 20km^2, which includes the main urban area of the city. There is a wide range of public and private schools and higher and further education establishments in the area, including Anglia Ruskin University, Chelmsford College and King Edwards Grammar School.

The area also includes or is adjacent to Broomfield Hospital, the main offices of Essex County Council, Essex Police Headquarters and Magistrates, Crown, and County Courts. Chelmsford also has 2 Park and Ride facilities (Chelmer Valley and Sandon). The Great Eastern Main Line provides rail services between London Liverpool Street and Chelmsford station. Green Wedges follow the river valleys within the urban area, which are protected from development and the Metropolitan Green Belt abuts its south and west edge.

Previous growth focused development on brownfield sites in Chelmsford City Centre and extended the city to the north for major development on greenfield sites. Chelmsford City Centre has recently seen a significant expansion through development of the Bond Street retail centre. A new Riverside Sports Centre has also been developed. In total, the Chelmsford Urban Area is planned to focus on the regeneration of around 2,400 new homes on Brownfield sites.

The higher ground in the Chelmsford FRA is located along ridge lines to the north and south. The topography of the area varies as it is located at the junction of four significant river valleys.

The solid geology is dominated by mudstone (London Clay Formation). The surface geology varies in line with the topography with Lowestoft Formation on the ridgelines and a combination of river terrace deposits and glacial deposits adjacent to the rivers and on natural flood plains.

There are various watercourses within the FRA with the largest being the River Chelmer which flows entirely through Essex, originating in Uttlesford and flowing south through the

FRA. It continues flowing to the east after joining the River Can. It then flows east through the borough and into Maldon & Heybridge until it meets the River Blackwater near Maldon. It discharges into the North Sea via the Blackwater Estuary.

As the Highways Authority, Essex County Council are responsible for maintaining an effective highway drainage system including kerbs, road gullies and pipes which connect road gullies to the trunk sewers and soakaways. The water and sewerage company, in this case Anglian Water are responsible for maintaining:

- the trunk network – including sewers (a mixture of combined and separated)
- manholes
- pumping stations
- outfalls

Current flood risk

The flood risk and hazard maps show that in the Chelmsford FRA, 12,134 of the 85,249 people live in areas at risk of flooding from surface water. Of these people, 8% live in areas considered to be at high risk.

Also shown to be at risk of flooding from surface water are:

- 523 non-residential properties
- 36 out of 516 services
- 2.21 km of railways
- 0.07km of roads
- 2 licensed water abstraction sites
- 18 listed buildings
- 82 ha of agricultural land - of which 13.76ha are at high risk

The flood risk and hazard maps provide more detailed information on the likelihood and consequence of flooding for the Chelmsford FRA.

Based on this information, Risk Management Authorities (RMAs) have concluded that further steps should be taken to reduce the likelihood of flooding and the current and future impact it could have on the FRA.

How the risk is currently managed

The management of surface water flood risk is led by Essex County Council in collaboration with other RMAs and stakeholders, including:

- the Environment Agency
- Anglian Water
- Essex Highways
- Chelmsford City Council

Separately, the Essex Local Resilience Forum is a multi-agency partnership made up of representatives from local public services such as:

- emergency services
- local authorities
- NHS
- Environment Agency

Associated businesses, organisations' and voluntary sector representatives are also involved. These organizations' work together through the LRF to prepare for and respond to emergencies. The community risk register is a collection of assessments of emergencies that might happen locally within Essex. Each potential emergency is rated in terms of its potential impact and likelihood of occurring. Flooding is included in this assessment.

Under the Flood and Water Management Act (2010), the LLFA is required to develop a strategy for managing surface water flood risk within their administrative area. Essex County Council commissioned Surface Water Management Plans (SWMP) for areas identified as being at highest risk. The Chelmsford SWMP was completed in March 2014.

The SWMP identified various measures for managing surface water flood risk within a detailed SWMP Action Plan. This included options for flood alleviation schemes that were fed into the 'Flood Capital Programme' for further assessment and delivery, where this was viable. Opportunities were also highlighted to work more closely with other RMAs to better manage the impacts of new development on surface water flooding through the provision of Sustainable Drainage Systems (SuDS).

Over 2018 to 20 a review of the SWMP modelling for Chelmsford was carried out, so that a better understanding of flood risk could be gained. The results of this included updated surface water flood risk mapping and the identification of 12 Critical Drainage Areas within the Chelmsford FRA.

Essex County Council has 10,176 records on its flood risk asset register, and a policy for designating assets

Essex County Council have published the 'Essex Green Infrastructure (GI) Strategy' (2020) setting out GI ambitions that:

- defines the different types of GI across Greater Essex
- aims to encourage stakeholder collaboration
- presents a co-ordinated approach to delivering and managing a green infrastructure network across Essex

Green space covers 21% of Chelmsford authority area. Planning for Chelmsford's GI is part of a wider planning process led by the Chelmsford Local Plan which establishes the framework for the City's growth. The GI Strategic Plan (2018) provides a framework for the planning and management of Chelmsford's GI resources both in terms of its protection and its enhancement.

Through good design, both existing and creation of new GI as part of the wider landscape GI network can contribute toward making areas less vulnerable to flood risk and improve water management, whilst ensuring development doesn't increase flood risk to third parties.

In 2019 the Essex Climate Action Commission (ECAC) was established. One of the agreed actions of the ECAC is to address the resilience of the County to extreme weather and flooding, and a key focus throughout is land use and green infrastructure. Emerging recommendations from the ECAC will help to manage the predicted sea level rise and increased rainfall intensity due to climate change in this area, and to become more resilient to future flood risk.

The impact of climate change and future flood risk

Rainfall intensity is expected to increase in future, causing greater volumes of runoff and higher flows within watercourses. It's therefore likely that flooding will become more frequent.

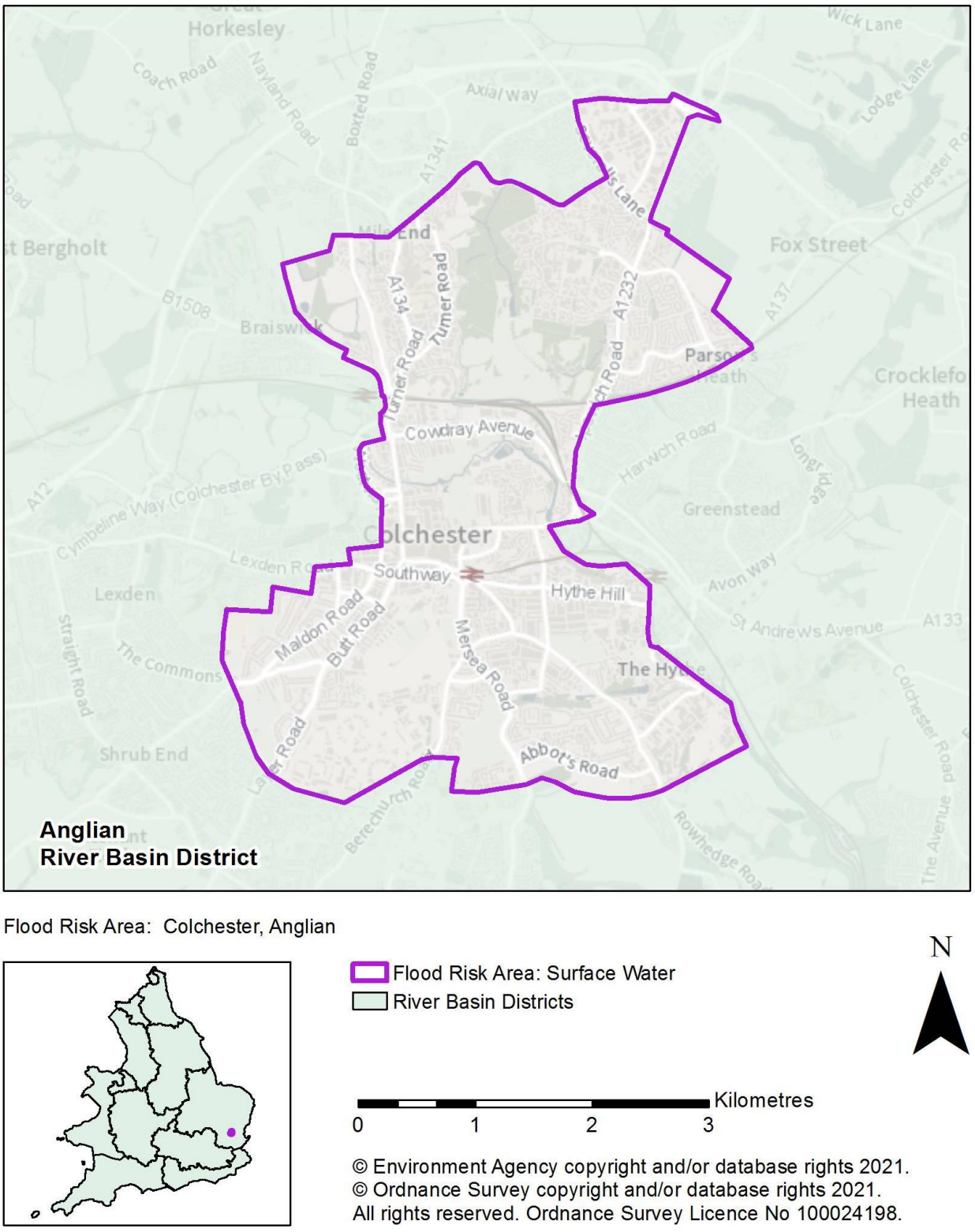
Please refer to the Climate Change and the Anglian River Basin District (RBD) section for more information on what we know are likely to be the implications of climate change in the Anglian RBD.

Objectives and measures for the Chelmsford Flood Risk Area

Measures have been developed that apply specifically to the Chelmsford FRA.

You can find information about all the measures that apply to the Chelmsford FRA in the Flood Plan Explorer, an interactive mapping tool. This includes information on which national objectives each measure helps to achieve.

The Colchester Surface Water Flood Risk Area



Flood Risk Area: Colchester, Anglian

Flood Risk Area: Surface Water
River Basin Districts

N

0 1 2 3 Kilometres

Figure 8: a map showing the boundary of the Colchester Flood Risk Area

Introduction to the Colchester Flood Risk Area

The Colchester Flood Risk Area (FRA) has been identified as an FRA because the risk of flooding from surface water is significant nationally for people, the economy or the environment (including cultural heritage).

The Colchester FRA sits within Colchester District Council which is within the administrative area of Essex County Council. Essex County Council is the Lead Local Flood Authority responsible for the district of Colchester and leads on the development and delivery of the FRMP measures in this area.

The Environment Agency is the authority responsible for managing flood risk from main rivers and the sea in the FRA.

Anglian Water is the water and sewerage company that owns, operates, and maintains the sewer network and wastewater treatment infrastructure in the FRA.

The Colchester FRA covers an area of approximately 16km^2. It includes the main town centre and parts of north, south and east Colchester urban area, Colchester acts as a regional centre and is the key focus for a wide range of development opportunities and challenges. The transport network in North Colchester is characterised by access to 2 strategic routes:

1. the A12 via junction 28 and 29
2. the A120

Colchester Station is a key gateway to Colchester with the mainline railway station facilitating high frequency services including intercity routes between Norwich and London and services to Clacton and Suffolk. Colchester North Station also acts as a gateway to the town centre and will be subject to further regeneration.

The University of Essex (and the Knowledge Gateway), to the eastern area of Colchester, has experienced a period of significant change and growth. The University is well located in relation to the new Tendring Colchester Borders Garden Community where the first new homes are expected to be completed in 2024 with construction continuing for many years. Colchester town centre will benefit from the development of new transport infrastructure serving the Garden Community, including the new A120/A133 Link Road, as well as a Rapid Transit System linking the new community to Colchester.

The Colchester urban area will continue to be a focus for growth due to its pre-eminent role as a centre for jobs, services and transport and has been the focus for regeneration over several years, with significant housing delivery at the Garrison, Stanway and North Colchester.

The new Local Plan seeks to provide around 14,720 new homes in Colchester Borough between 2017 and 2033, of which around 3,340 have already been completed and 6,200 have planning permission to start in March 2020. The new Local Plan also allocates new employment land at:

- North Colchester (10.4 ha)
- Stanway (5.4 ha)
- The Knowledge Gateway (7 ha)
- Colchester Town Centre (4.2 ha)

Tendring Colchester GC (3.5ha) and Colchester Town Centre will be the focus for additional retail floor space and other compatible town centre uses.

General topography of the Colchester town catchment varies between areas of high ground (35mAOD – 60mAOD) located in the south-western and north to north-western portions of the town through to areas which are at a lower elevation (0mAOD – 15mAOD) which are typically confined to the river corridors.

The solid geology of the area is dominated by London Clay, which is exposed along the sides of the river valley and at the ground surface in some areas. In locations where London Clay is overlain by drift deposits these are composed of the Lowestoft Formation, head deposits, alluvium and river terrace deposits. It's thought that the London Clay formation slopes from west to east, indicating that the River Colne may flow through alluvium deposits. Kesgrave Sands and Gravels, river terrace deposits and alluvial deposits are found in and around river channels.

The River Colne dominates the catchment, flowing in a south-eastern direction through the centre of the town. Of the four main tributaries that discharge into the River Colne, the Salary Brook and Roman River are located within the FRA. In addition to these, there are several smaller tributaries, creeks and brooks, particularly within the tidal reaches of the watercourses. The River Colne converges with the Blackwater Estuary at Mersea Island and Brightlingsea.

As the Highways Authority, Essex County Council are responsible for maintaining an effective highway drainage system including kerbs, road gullies and pipes which connect road gullies to the trunk sewers and soakaways. The water and sewerage company, in this case Anglian Water, are responsible for maintaining:

- the trunk network – including sewers (a mixture of combined and separated)
- manholes
- pumping stations
- outfalls

Current flood risk

The flood risk and hazard maps show that in the Colchester FRA, 5,728 of the 59,030 people live in areas at risk of flooding from surface water. Of these people, 10% live in areas considered to be at high risk.

Also shown to be at risk of flooding from surface water are:

- 355 non-residential properties
- 8 out of 399 services

- 2.54 km of railways
- 0.54 km of roads
- 2 licensed water abstraction sites
- 13 listed buildings
- 55.98ha of agricultural land - of which 7.6ha are at high risk
- 6.98 ha of parks and gardens
- 3.11 ha of Scheduled Ancient Monuments
- 0.01ha of SSSI

The flood risk and hazard maps provide more detailed information on the likelihood and consequence of flooding for the Colchester FRA.

Based on this information, Risk Management Authorities (RMAs) have concluded that further steps should be taken to reduce the likelihood of flooding and the current and future impact it could have on the FRA.

How the risk is currently managed

The management of surface water flood risk is led by Essex County Council in collaboration with other RMAs and stakeholders, including:

- the Environment Agency
- Anglian Water
- Essex Highways
- Colchester Borough Council

Separately, the Essex LRF is a multi-agency partnership made up of representatives from local public services such as:

- emergency services
- local authorities
- NHS
- Environment Agency

Associated businesses, organisations and voluntary sector representatives are also involved. These organisations work together through the LRF to prepare for and respond to emergencies. The community risk register is a collection of assessments of emergencies that might happen locally within Essex. Each potential emergency is rated in terms of its potential impact and likelihood of occurring. Flooding is included in this assessment.

Surface Water Management Plans (SWMPs) were commissioned for areas identified as being at highest risk of flooding. The SWMP for Colchester was completed in July 2013.

The SWMP identified various measures for managing surface water flood risk within a detailed SWMP Action Plan, including options for flood alleviation schemes that were fed into the Flood Capital Programme for further assessment and delivery, where this was

viable. Opportunities were also highlighted to work more closely with other RMAs to better manage the impacts of new development on Surface Water flooding through the provision of SuDS.

From 2018 to 2020, a review of the SWMP modelling for Colchester was carried out so that a better understanding of flood risk could be gained. The results of this included updated surface water flood risk mapping and the identification of 11 Critical Drainage Areas within the Colchester FRA.

Essex County Council has 10,176 records on its flood risk asset register and has a policy for designating assets.

There are several notable flood alleviation schemes that have been delivered or are progressing in the Colchester Flood Risk Area through the Flood Capital Programme. For example:

- improvement of efficiency and configuration of existing drainage system on Distillery Lane
- installation of leaky dams within a watercourse at Wivenhoe
- deployment of temporary flood defence barriers at The Lane, West Mersea

Essex County Council have published the 'Essex Green Infrastructure (GI) Strategy' (2020) setting out GI ambitions that:

- defines the different types of GI across Greater Essex
- aims to encourage stakeholder collaboration
- presents a co-ordinated approach to delivering and managing a green infrastructure network across Essex

Green space covers 26% of Colchester authority area. The Colchester GI Strategy (2011) has a particular focus on opportunities for GI improvements within the growth areas of Colchester Town. The strategy looks for synergies with GI initiatives in neighbouring authorities.

Through good design, both existing and creation of new GI as part of the wider landscape GI network can contribute toward making areas less vulnerable to flood risk and improve water management, whilst ensuring development doesn't increase flood risk to third parties.

In 2019, the Essex Climate Action Commission (ECAC) was established. One of the agreed actions of the ECAC is to address the resilience of the County to extreme weather and flooding, and a key focus throughout is land use and green infrastructure. Emerging recommendations from the ECAC will help to manage the predicted sea level rise and increased rainfall intensity due to climate change in this area, and to become more resilient to future flood risk.

The impact of climate change and future flood risk

Rainfall intensity is expected to increase in future, causing greater volumes of runoff and higher flows within watercourses. It is therefore likely that flooding will become more frequent.

Please refer to the Climate Change and the Anglian River Basin District (RBD) section for more information on what we know are likely to be the implications of climate change in the Anglian RBD.

Objectives and measures for the Colchester Flood Risk Area

Measures have been developed that apply specifically to the Colchester FRA.

You can find information about all the measures that apply to the Colchester FRA in the Flood Plan Explorer, an interactive mapping tool. This includes information on which national objectives each measure helps to achieve.

The Great Yarmouth Rivers and Sea Flood Risk Area

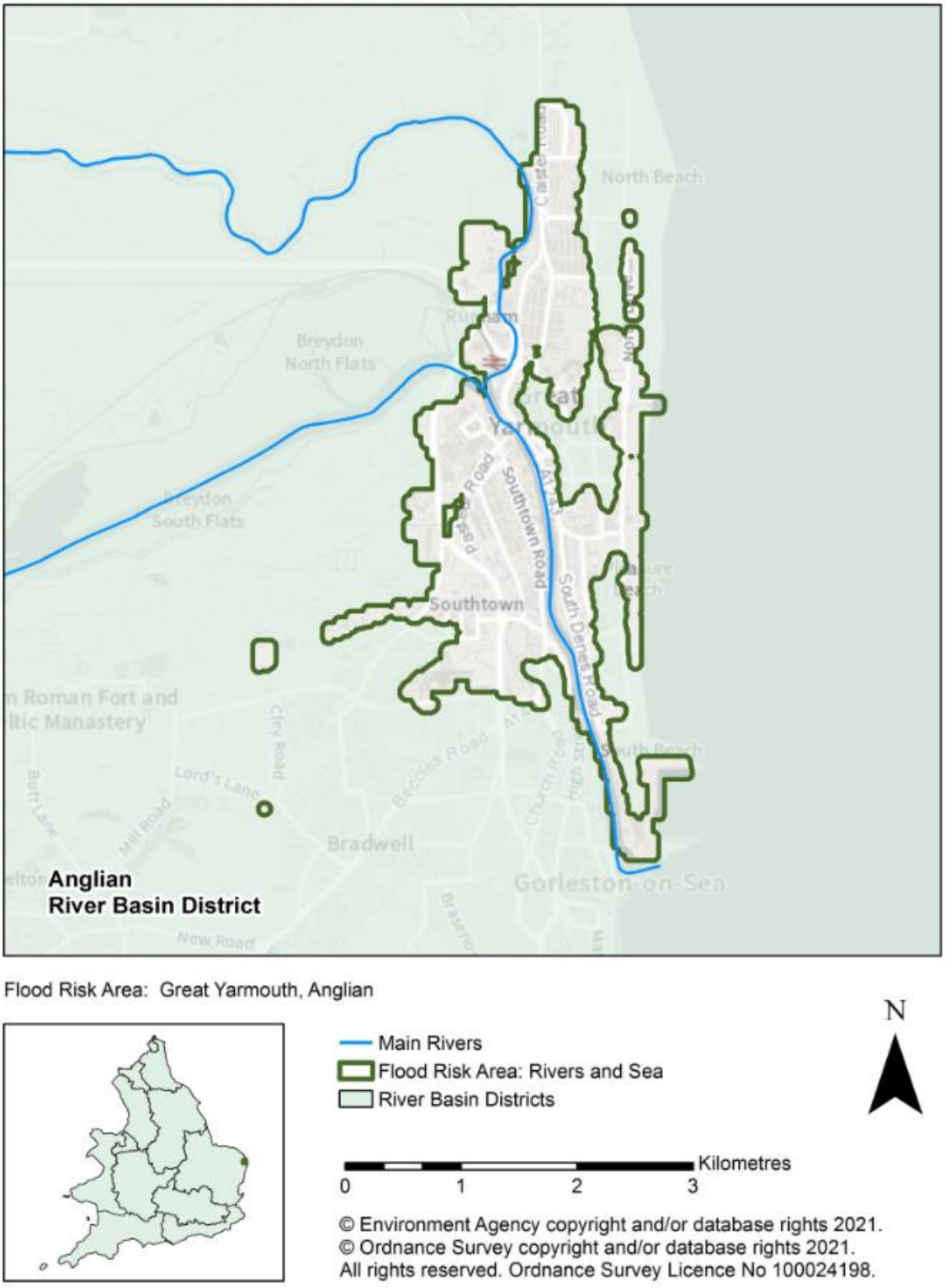


Figure 9: a map showing the boundary of the Great Yarmouth Flood Risk Area

Introduction to the Great Yarmouth Flood Risk Area

The Great Yarmouth Flood Risk Area (FRA) has been identified as an FRA because the risk of flooding from main rivers and the sea is significant nationally for people, the economy, or the environment (including cultural heritage).

The Environment Agency leads on the development and delivery of the Flood Risk Management Plan (FRMP) for this FRA as the responsible authority for managing flood risk from main rivers and the sea.

Norfolk County Council is the Lead Local Flood Authority, whose remit includes flood risk from surface water and ordinary watercourses. The FRA also falls within the administrative boundaries of:

- Great Yarmouth Borough Council
- Waveney Lower Yare and Lothingland Internal Drainage Board (IDB)

Anglian Water is the sewerage company that owns, operates and maintains the sewer network and wastewater treatment infrastructure in the FRA.

Great Yarmouth Borough Council is responsible for managing sections of the coastline in this area. This includes the seafront defence assets along the Gorleston and Great Yarmouth seafront.

Great Yarmouth is a coastal town in Norfolk, approximately 30km east of Norwich. The FRA covers a 7km^2 area of the town, which includes Southtown, Cobholm Island, Runham, and parts of Newtown. The FRA primarily covers the urban areas of Great Yarmouth, which includes residential and business areas, as well as areas of coastal frontage. The FRA includes several locations that are not connected to the main part of the FRA (particularly to the west of the main FRA and on the coast). The reason for these seemingly anomalous areas relates to the methodology used to identify the FRA boundary, which is detailed in Part A of the FRMP report. It's important to note, however, that measures included for the FRA will apply to Great Yarmouth as a whole and will not be limited to the area shown in Figure 9. The extensive Outer Thames Estuary Special Protection Area (SPA) passes through the FRA and an area of The Broads National Park covers parts of the main watercourses in the FRA, with the wider National Park further inland.

The principal source of flooding to the area is from the Rivers Yare and Bure. The River Bure converges with the River Yare on the western fringes of Great Yarmouth from where the Yare continues as a stretch known as the Haven, through the town to the sea. These rivers are the main outfall of the Norfolk Broads which extends westwards from the town.

Much of Great Yarmouth is at risk of tidal flooding. The combination of the arrival of a high tide with a storm surge, caused by a low-pressure system within the North Sea, results in a rise in water level in the rivers. Some parts of the town, particularly the Cobham and Southtown areas are up to 2m below the level of mean high spring tides. Fluvial flooding from the Yare and Bure is not a significant issue in Great Yarmouth. This is because the

flow capacity of the channels is large and the banks of the upstream channels in the Broads will overtop before fluvial flows reach the town.

Although Great Yarmouth benefits from the presence of flood defence walls, the residual risk of overtopping or a breach of the defences remains. The condition and type of these defences varies, and a phased project to manage the defences and address issues is ongoing and planned over the next 40 years. The flood defences are key to supporting economic growth and development in Great Yarmouth. They also support the borough council's ambitions for regeneration as a modern coastal town, taking advantage of its coastal and riverside location.

Current Flood Risk

Great Yarmouth has an extensive history of flooding, notably in:

- 1953 (the most damaging event on record)
- 1978
- 2007
- 2013

The December 2013 event was the most extreme event in recent times and saw the largest tidal surge along the east coast since 1953. Approximately 9,000 people were recommended to evacuate their homes, though the good performance of flood defences limited flood damage to 20 properties.

The flood risk and hazard maps show that of the 21, 761 people in the Great Yarmouth FRA, 15,360 people live in areas at risk of flooding from main rivers and the sea. Of these people, a small minority (0.8%) are in areas of high risk.

The majority (97%) are either in areas of low (10%) or very low (87%) flood risk, owing to the presence of flood defences through the town and highlighting the important role they play in managing the risk of flooding. Within the FRA, 24 of the 133 services are at risk of flooding, notably Northgate Hospital, which is at very low risk.

Also shown to be at risk of flooding from main river and the sea are:

- 877 non-residential properties, which - including several shops and businesses
- 24 of the 133 services
- 2.76km of roads, including parts of the A47
- 0.99km of railway
- 54.83ha of agricultural land, of which around 6.36ha are in areas deemed to be at high risk
- 5 sites regulated under the Environmental Permitting Regulations
- 2 licensed water abstraction sites
- 58 listed buildings
- 3.63ha of parks and gardens
- 49.47ha of the Outer Thames Estuary Special Protection Area

- 0.21ha of Scheduled Ancient Monuments
- 1.11ha of Sites of Special Scientific Interest
- 0.1ha Special Areas of Conservation

The flood risk and hazard maps provide more detailed information on the likelihood and consequence of flooding for the Great Yarmouth FRA.

Based on this information, Risk Management Authorities (RMAs) have concluded that further steps should be taken to reduce the likelihood of flooding and the current and future impact it could have on the FRA.

How the risk is currently managed

The management of flood risk from main rivers and the sea is led by the Environment Agency in collaboration with other RMAs, including:

- Norfolk County Council
- Great Yarmouth Borough Council
- Anglian Water
- Waveney Lower Yare and Lothingland IDB

Separately, the Norfolk LRF is a multi-agency partnership made up of representatives from local public services such as:

- emergency services
- local authorities
- NHS
- Environment Agency

Associated businesses, organisations and voluntary sector representatives are also involved. These organisations work together through the LRF to prepare for and respond to emergencies. The community risk register is a collection of assessments of emergencies that might happen locally within Norfolk. Each potential emergency is rated in terms of its potential impact and likelihood of occurring. Flooding is included in this assessment.

In March 2017 the first 5 year phase of works (Epoch 1) to replace over 630 metres of quayside piling and refurbish a further 85 metres was completed. The work cost £28 million and better protects over 500 residential properties.

In February 2019 the next phase of work (Epoch 2) commenced and is due to complete at the end of 2021. This involves works to 40 flood defence walls covering approximately 4 kilometres, divided up across several different locations across the town. It will better protect 2000 residential properties. The project is focusing on repairing and refurbishing walls to extend their life as they already provide a good level of flood protection. Works taking place to the Southtown and Cobholm frontage will include raising the height of the flood walls. In some locations we will be constructing new walls set back from the river frontage.

Planning has started for the next phase of work, Epoch 3. A condition survey of 2.6km of walls has identified that 1730m of wall are reaching the end of their useful life, with approximately 220m of the walls in the worst condition requiring urgent attention. The next phase will investigate economically viable and affordable ways to manage the flood risk. It's likely there will be a significant partnership funding contribution required.

The Environment Agency maintain the flood defences in Great Yarmouth, which requires routine inspection and repairs. This includes management of the various flood gates and repairing ship damage to flood walls and numerous outfalls. In addition, the Environment Agency carry out flood patrols and operate the various pedestrian and vehicular gates when required.

The Environment Agency monitor river and rainfall conditions at 4 sites in and near to the FRA:

- Great Yarmouth T.S. (tidal level)
- Haven Bridge (river level)
- Three Mile House (river level)
- Caister STW (precipitation)

This information is used to inform activities related to 1 flood alert and 7 flood warning areas covering the FRA. These warn and inform the public when flooding may occur, providing time to act ahead of impacts occurring.

The water level and flow data are also used to inform and calibrate mathematical computer modelling of rivers and the coast. The Rivers Yare and Bure are included in the East Anglia Coastal Modelling, which cover flood risk from the coast and were most recently updated in 2018. The fluvial flood risk to the area was modelled as part of the Broads modelling in 2018, which is owned by Broadland Environmental Services (BESL). The Environment Agency is embarking on a new model build as part of the wider Broadland Futures Initiative strategy (BFI). This initiative is a partnership for future flood risk management in the Broadland area. The main goal is to agree a framework for future flood risk management that better copes with our changing climate and rising sea level. Flooding can affect many aspects of community life; tourism, recreation, the natural environment, agriculture and where we live and work can all suffer adverse impacts as a result of flooding. The Initiative will make sure that these interlinked interests are all considered, with the full involvement of local communities and other stakeholders.

The outputs from hydraulic modelling studies are used to inform the 'Flood Map for Planning (Rivers and Sea)' and the 'Risk of Flooding from Rivers and Sea' mapping, as well as a suite of other products. These are used to:

- advise the public and businesses of their risk of flooding
- inform potential developments and local planning authorities
- provide a basis for the assessment and design of flood risk management works

The impact of climate change and future flood risk

Like many coastal communities, Great Yarmouth is at risk from the impacts of climate change. According to the latest UK Climate Projections (UKCP18), sea level rise of between 1.20 and up to 1.90m (in the most extreme scenario) will be experienced on the East Anglia coastline over the next 100 years. Flooding will therefore become much more frequent, and all coastal towns will need to adapt.

Please refer to the Climate Change and the Anglian River Basin District (RBD) section for more information on what we know are likely to be the implications of climate change in the Anglian RBD.

Objectives and measures for the Great Yarmouth Flood Risk Area

Measures have been developed that apply specifically to the Great Yarmouth FRA.

You can find information about all the measures that apply to the Great Yarmouth FRA in the Flood Plan Explorer, an interactive mapping tool. This includes information on which national objectives each measure helps to achieve.

The Horncastle Rivers and the Sea Flood Risk Area

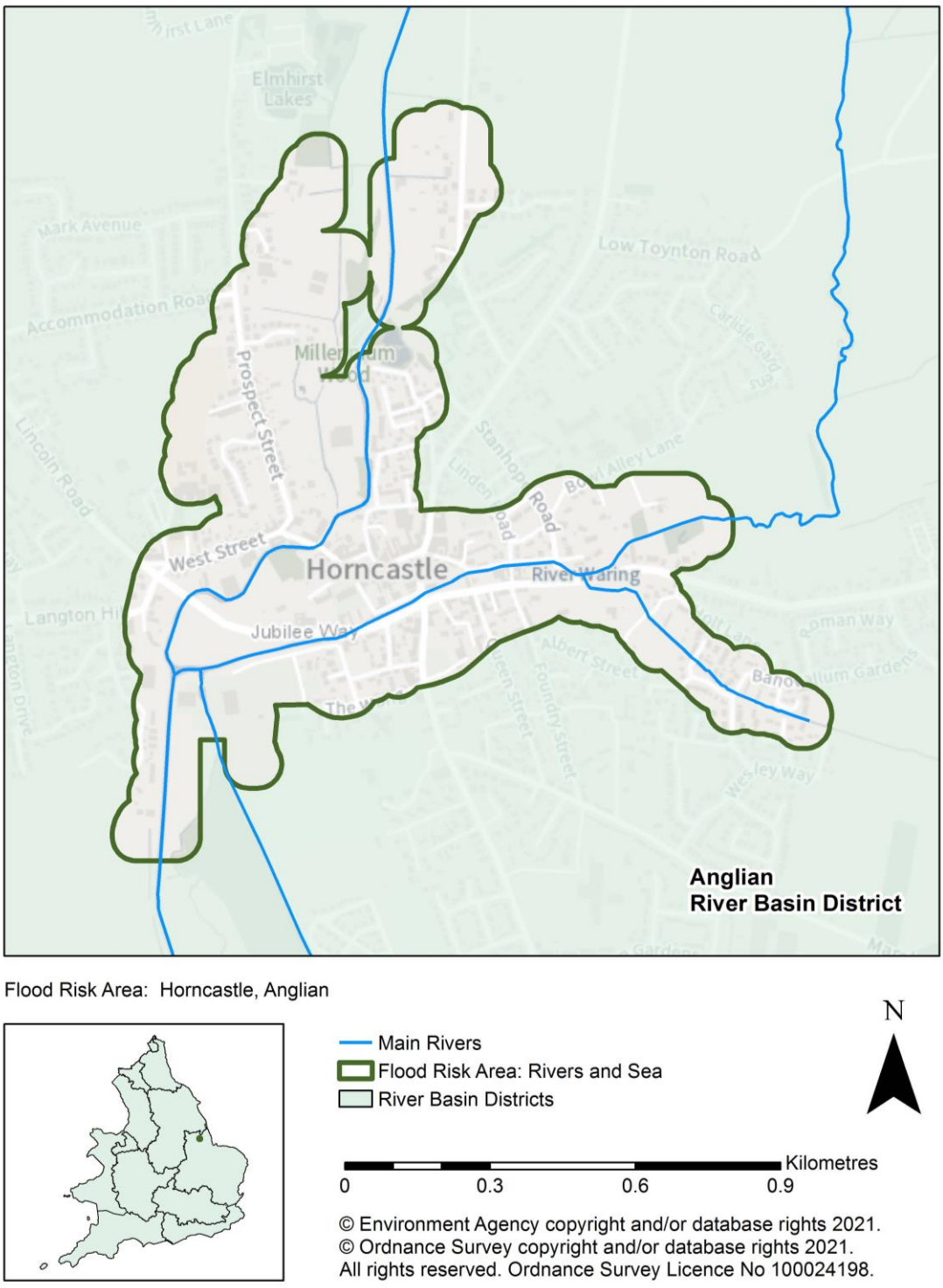


Figure 10: a map showing the boundary of the Horncastle Flood Risk Area

Introduction to the Horncastle Flood Risk Area

The Horncastle Flood Risk Area (FRA) has been identified as an FRA because the risk of flooding from main rivers and the sea is significant nationally for people, the economy, or the environment (including cultural heritage).

The Environment Agency leads on the development and delivery of the Flood Risk Management Plan (FRMP) for this FRA. Lincolnshire County Council is the Lead Local Flood Authority (LLFA) responsible for managing flood risk from 'local' sources. These local sources include:

- surface water
- groundwater
- ordinary watercourses

The Environment Agency's remit covers flood risk from rivers and the sea. Anglian Water is the water and sewage company that owns, operates and maintains the sewerage network and wastewater treatment infrastructure in the FRA.

Witham Third Internal Drainage Board is responsible for land drainage in this FRA.

Horncastle FRA covers the largely urban centre of the town, with grade 3 agricultural land to the periphery. The predominant soil type is deep loam.

The FRA may include locations that are not connected to the main part of the FRA, and there may be small areas of 'dry islands', which are shown to be outside of the FRA. The reason for these seemingly anomalous areas relates to the methodology used to identify the FRA boundaries, which is detailed in Part A of the FRMP report.

It is important to note, however, that measures included for the FRA, particularly those associated with flood warning and evacuation procedures, are likely to apply to the FRA as a whole and will not be limited to the area shown in Figure 10.

Within the FRA lies the remains of Banovallum Roman Wall which is a Scheduled Ancient Monument. The south of the FRA extends to include part of the Horncastle Canal Grassland local wildlife site. Banovallum Carr Woodland Trust site is also within the FRA.

The market town of Horncastle is located just south-west of the Lincolnshire Wolds within the Lower Witham catchment. It was originally the site of a Roman fort on the River Bain that was part of the Roman network of coastal defences. The River Bain was the principal route of access to the town.

In 1802, the River Bain was deepened and widened to form an 11 mile canal. This allowed boats to access Horncastle. It also linked the town to the River Witham and out to sea at The Wash. With the addition of wharves, the canal barges were able to transport:

- wool
- grains
- passengers

This canal continued to prosper until the railway arrived in 1855. The canal eventually closed in 1878.

The River Bain rises in the chalk and sandstone of the Lincolnshire Wolds at approximately 125m AOD (above Ordnance Datum). It then flows south through villages including:

- Ludford
- Burgh on Bain
- Donington on Bain
- Goulceby

It passes through the recently completed Horncastle Flood Storage Reservoir (FSR) just upstream of Hemingby before reaching Horncastle. It continues south through the town of Horncastle passing over Victoria Mill weir and through an urban landscaped area.

After passing under the road bridge near Conging Street, the river becomes more constrained until the channel widens below Bridge Street Bridge. It then passes under Jubilee Way where the River Waring joins the River Bain. It continues its passage south out of the FRA before finally joining the River Witham at Dogdyke. Here the land is only around 5m AOD.

From the confluence of the River Bain and River Waring at Horncastle, the river was engineered into a navigation channel between April 1793 and September 1802. Consequently, the river is embanked and there is reduced connectivity between the river and the floodplain. The old river channel is used as a land drainage ditch adjacent to the canal.

The River Waring rises near Belchford at a height of 137m AOD and flows in a generally southerly direction towards Horncastle. The river then flows in a westerly direction through the town towards the confluence with the River Bain at a level of 35m AOD. The river has been heavily engineered through the town and is contained within a concrete channel and associated bridges. Thunker Drain is a tributary of the River Waring. It enters the Waring through a brick culvert under Spilsby Road and East Street in Horncastle.

The town has been susceptible to flooding, notably:

- 1920 – Rivers Bain and Waring
- 1960 – River Waring including property flooding
- 1981 – Horncastle Canal and River Bain with 110 properties flooded in Horncastle
- 1993 – Rivers Bain and Waring
- 2007 – River Bain
- 2019 – River Waring with 5 properties flooded

The main flood risk within the FRA is from fluvial sources. Some parts of the town have also experienced surface water flooding.

Current flood risk

The flood hazard and risk maps show that in the Horncastle FRA, 1,315 people live in areas at risk of flooding from rivers and the sea. Of these people, 27% live in areas of high risk.

Also shown to be in areas at risk of flooding from rivers and sea are:

- 150 non-residential properties - including community centres, schools and businesses.
- 1.05 km of roads - including parts of the A158.
- 11.24 ha of agricultural land
- 0.3ha Scheduled Ancient Monuments
- 76 listed buildings
- 1 water abstraction point

The flood hazard and risk maps provide more detailed information on the likelihood and consequence of flooding for the Horncastle FRA.

Based on this information, Risk Management Authorities (RMAs) have concluded that further steps should be taken to reduce the likelihood of flooding and the current and future impact it could have on the FRA.

This will be reviewed when further data is available. Recent capital projects have been undertaken to benefit the FRA.

How the risk is currently managed

The management of flood risk from rivers and sea is led by the Environment Agency in collaboration with other RMAs and stakeholders. These include:

- Lincolnshire County Council
- Witham Third Internal Drainage Board
- East Lindsey District Council
- Horncastle Town Council

A partnership framework has been set up across Lincolnshire involving all RMAs to coordinate the management of flood risk and water management. Strategic direction is delivered by the Lincolnshire Flood Risk and Water Management Strategy Group. This is chaired by the Environment Agency.

The Management Group chaired by Lincolnshire County Council delivers the responsibilities of the LLFA. There are 4 Local Flood Risk and Drainage Management Groups chaired by Lincolnshire County Council Highways. These deliver flood risk and water management solutions to meet local circumstances.

The Horncastle Flood Risk Area is covered by the East Lindsey Council District Flood Risk and Drainage Management Group.

The Lincolnshire LRF is a multi-agency partnership made of representatives from local public services such as:

- emergency services
- local authorities
- the NHS
- Environment Agency

To help prepare for and respond to emergencies the LRF publish a community risk register. This provides information on the key risks that have the potential to cause disruption to the county. These include East Coast and inland flooding.

The Environment Agency monitor river conditions at 2 sites in and near to the FRA:

- Victoria Mill (Flow)
- Banks Road (Flow)

This information is used to inform activities related to 2 flood warning areas that cover the FRA. This enables people to receive a warning when flooding could occur. This data also informs the operational response during a flood incident.

Modelling and mapping was undertaken on the River Bain sub-catchment in 2009. It was subsequently updated for the purpose of assessing options for the Horncastle Flood Alleviation Scheme in 2014. The Environment Agency has recently commissioned works to update the current model including new survey data.

Flood risk maps are published based on the outputs from modelling to inform:

- the public and business of their flood risk
- potential developers and local planning authorities
- the assessment and design of flood risk management works

The Environment Agency operates and maintains flood risk management assets on the main watercourses in the FRA. These include:

- flood defence embankments
- weirs
- tilting gates
- sluice gates

This work includes routine inspection and clearance activities as well as regular repair, replacement and improvement of assets. Outside the FRA is the Horncastle Flood Storage Reservoir (FSR). This is significant to managing flood risk within its boundary.

Flood risk improvement works that benefit the Horncastle FRA completed recently by the Environment Agency in partnership with Lincolnshire County Council and Horncastle Town Council include:

- Horncastle FAS – completed in 2017, this upstream flood storage area will reduce flood risk from the River Bain to 64 properties

- property level protection was made available in 2015 to 15 properties along the River Waring

In 2017 the Horncastle FSR was completed. This significantly reduced flood risk from the River Bain in Horncastle to a 1% chance of occurring in any one year.

Whilst a scheme could not be justified on the River Waring, property level protection measures were offered to several properties. Flood risk from the River Waring is a 10% chance of occurring in any one year.

In 2019, five properties adjacent to the River Waring flooded. No properties flooded from the River Bain. The current 6 year programme (2021 to 2027) is looking to support an initiative to improve flood risk to these properties on the River Waring.

The impact of climate change and future flood risk

Rainfall intensity is expected to increase in future which will cause river flows to increase and the effectiveness of the upstream flood storage reservoir will reduce.

Please refer to the Climate Change and the Anglian River Basin District (RBD) section for more information on what we know are likely to be the implications of climate change in the Anglian RBD.

Objectives and measures for the Horncastle FRA

Measures have been developed that apply specifically to the Horncastle FRA. These measures have been developed in addition to those covering a wider geographic area that also apply to the Horncastle FRA.

You can find information about all the measures that apply to the Horncastle FRA in Flood Plan Explorer an interactive mapping tool. This includes information on which national objectives each measure helps to achieve.

The Hunstanton Rivers and Sea Flood Risk Area

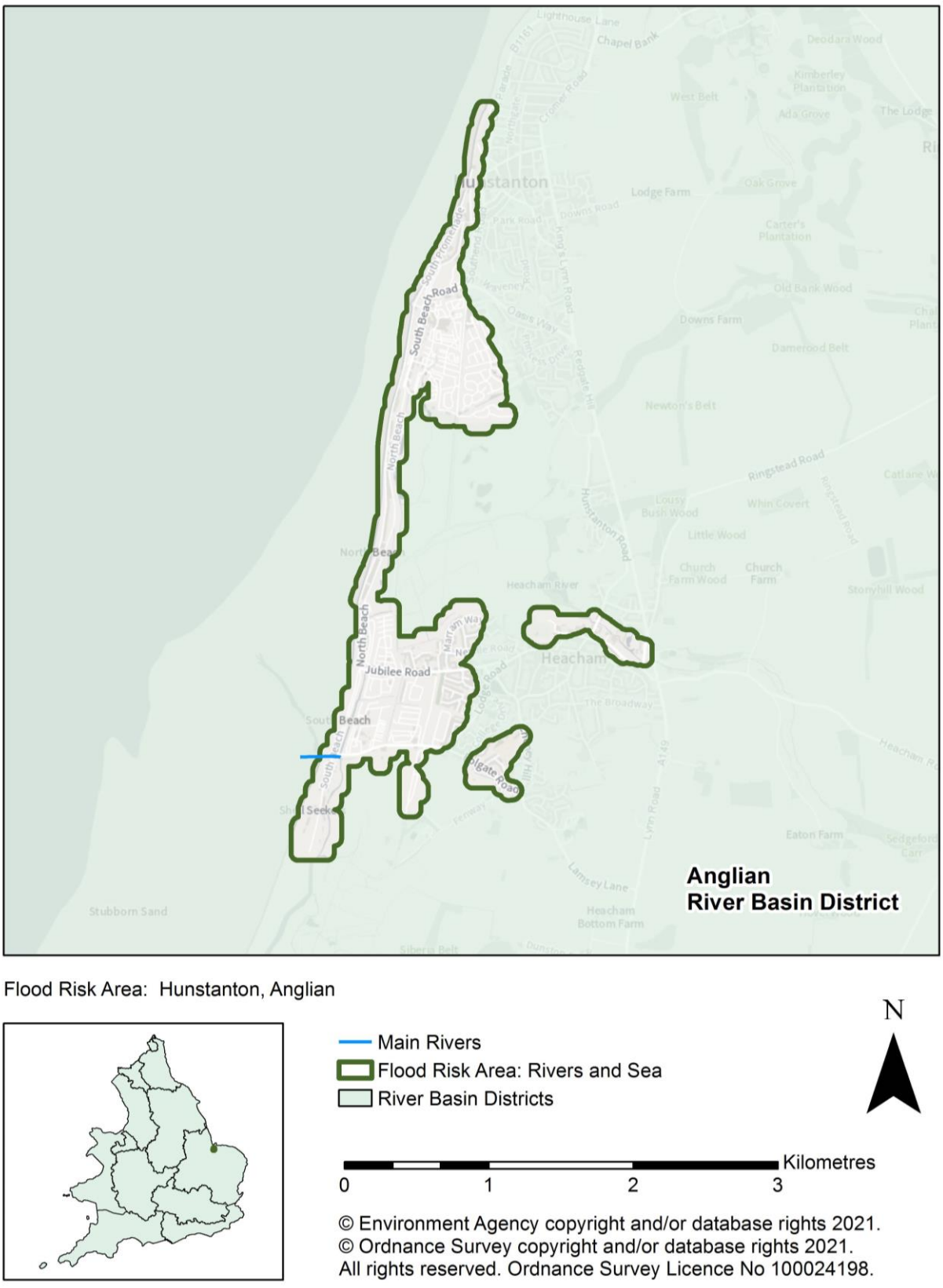


Figure 11: a map showing the boundary of the Hunstanton Flood Risk Area

Introduction to the Hunstanton FRA

The Hunstanton Flood Risk Area (FRA) has been identified as an FRA because the risk of flooding from the sea is significant nationally for people, the economy, or the environment (including cultural heritage).

The Environment Agency leads on the development and delivery of the Flood Risk Management Plan (FRMP) for this FRA.

The section of the FRA from South Hunstanton along the coast to Heacham South Beach is at risk of sea flooding and the Environment Agency is responsible for maintaining the coastal flood defence in this section.

The Borough Council of King's Lynn and West Norfolk work alongside other Risk Management Authorities (RMAs) to understand the risk of flooding. They are responsible for coastal protection and the defences in the Hunstanton town part of the FRA. The Borough Council of King's Lynn and West Norfolk is also the Local Planning Authority. Further information on coastal erosion is covered by The Wash SMP.

North Norfolk County Council is the Lead Local Flood Authority, whose remit includes flood risk from surface water and ordinary watercourses.

Anglian Water is the sewerage company that owns, operates and maintains the sewer network and wastewater treatment infrastructure in the FRA.

King's Lynn Internal Drainage Board (IDB) maintain ordinary watercourses that flow through the FRA. They maintain infrastructure within these watercourses such as water level control structures.

The Hunstanton FRA covers the coastline from Hunstanton town centre to Heacham South Beach. Parts of the main urban area of south Hunstanton and parts of the village of Heacham are included within the FRA. The FRA includes residential, business and amenity areas. There are also caravan sites, holiday homes and an important brackish habitat within the FRA.

The FRA includes a few locations that are not connected to the main part of the FRA, particularly the outer areas of Heacham to the east of the main FRA. The reason for these seemingly anomalous areas relates to the methodology used to identify the FRA boundaries, which is detailed in Part A of the FRMP report. It is important to note, however, that measures included for the FRA will apply to all areas within Hunstanton as a whole and will not be limited to the area shown in Figure 11.

The underlying solid geology of the FRA is chalk, sandstone and mudstone. Towards Heacham this is overlain by sand, silt, clay and gravel.

The extensive Wash Site of Special Scientific Interest (SSSI) and Special Protection Area (SPA) encroaches the Hunstanton FRA on the coastal frontage, as well as the Wash & North Norfolk Coast Special Area of Conservation (SAC) and Greater Wash SPA.

Other watercourses flow through the FRA and drain smaller more local areas. These include:

- the Heacham River
- Heacham Main Drain

The FRA is at risk of sea/tidal flooding and several notable events have occurred in the past, as described in the current flood risk section. South Hunstanton and Heacham South Beach could pose a significant risk to life due to the presence of a large community in a low-lying area, directly behind the defences. The Borough Council of King's Lynn and West Norfolk Strategic Flood Risk Assessment (SFRA) also identifies surface water flood risk within the flood risk area.

Current flood risk

Within the Hunstanton FRA there have been some notable flood events:

- on the 31 January to 1 February 1953, the East Coast of the UK was hit by a storm surge. The earth embankments around The Wash were overtopped and 65 people died along the coastline between Snettisham and South Hunstanton
- in 1978, a storm surge breached the sea wall at Heacham North Beach and significant damage to property occurred. The storm surge is reported to have overturned hundreds of caravans in the Hunstanton area
- in 2001, a flood caused severe erosion of the shingle ridge and damage to flood defences
- in June 2009, several roads in Heacham were cut off and properties suffered internal flooding as a result of heavy rainfall
- on 5 to 6 December 2013, a high spring tide and a low-pressure system in the North Sea resulted in a tidal surge. Extreme tides and waves cascaded down the east coast overtopping defences and flooding properties. Hunstanton seafront flooded as the storm surge breached sea defences. Hunstanton Sealife Sanctuary was severely damaged. Environment Agency records indicate that 7 properties flooded in Hunstanton
- on 14 August 2014, 7 January 2016 and June 2017, Norfolk County Council flood records show evidence of internal property flooding. There is no record on the source of flooding for these events

The flood risk and hazard maps show that in the Hunstanton FRA, 1,730 of the 2500 people live in areas at risk of flooding from rivers and the sea. Of these people, 15% live in areas considered to be at high risk.

Also shown to be at risk of flooding from rivers and the sea are:

- 157 non-residential properties - of which 97 are at high risk
- 4 out of 21 services
- 58.49ha of agricultural land
- 2 bathing water sites

- 1 listed building
- 9.87ha of Ramsar Sites and SAC
- 10.08ha of SPA
- 10.14ha of SSSI

The flood risk and hazard maps provide more detailed information on the likelihood and consequence of flooding for the Hunstanton FRA.

Based on this information, Risk Management Authorities (RMAs) have concluded that further steps should be taken to reduce the likelihood of flooding and the current and future impact it could have on the FRA.

How the risk is currently managed

The management of flood risk from rivers and the sea is led by the Environment Agency in collaboration with other RMAs and other stakeholders, including:

- Norfolk County Council
- The Borough Council of King's Lynn and West Norfolk
- King's Lynn IDB
- Anglian Water

Separately, The Norfolk Local Resilience Forum (LRF) is a multi-agency partnership made up of representatives from local public services such as:

- emergency services
- local authorities
- NHS
- Environment Agency

Associated businesses, organisations and voluntary sector representatives are also involved. These organisations work together through the LRF to prepare for and respond to emergencies. The community risk register is a collection of assessments of emergencies that might happen locally within Norfolk. Each potential emergency is rated in terms of its potential impact and likelihood of occurring. Flooding is included in this assessment.

The Environment Agency monitors river and rainfall conditions at 12 sites in and immediately adjacent to the FRA. These collect data on river levels (10 sites), river flows (2 sites) and rainfall (2 sites).

This information is used to inform activities related to 3 flood warning areas and 3 flood alert areas that cover the FRA.

These flood warnings enable people to receive a warning when flooding could occur. The Hunstanton and Heacham frontage is covered by a Precautionary Evacuation Notice (PEN). The Environment Agency and the Borough Council of King's Lynn and West Norfolk have put in place enhanced flood warning and evacuation procedures because of

the large number of caravans and properties between the shingle ridge and the secondary flood bank.

The water level and flow information are also used to inform and calibrate mathematical modelling of the coast and river network. The Hunstanton area is covered by the Wash hydraulic model, published in 2018, which stretches along the eastern and southern sides of the Wash. The Wash model predicts tidal water levels but does not contain any breach data at present. At the time of writing, breach modelling from the Tidal Hazard Mapping model (2015) is still used to assess the residual risk of tidal defences breaching in this area.

Flood risk maps are published based on the outputs from the mathematical modelling to inform:

- the public and businesses of their flood risk
- potential developers and local planning authorities
- the assessment and design of flood risk management works

Within Hunstanton town the coastal defences consist of a sea wall and promenade which is fronted by a beach with groynes. These defences are the responsibility of the Borough Council of King's Lynn and West Norfolk (except for the rear wave wall between the Power Boat Ramp and Fairground which is the responsibility of the Environment Agency) and provide protection against erosion for this section of the FRA.

The coastal defences have been developed since the original defence failed during the storm surge of 1953. The December 2013 storm surge resulted in significant flooding on and behind the promenade and caused exposure of construction joints and cracks.

South of Hunstanton to Heacham South Beach, the coastal defences are the responsibility of the Environment Agency. The sea defences have been developed since the existing natural defence failed catastrophically during the storm surge of 1953.

A secondary landward flood embankment was constructed after 1953. Breaching of the sea defences occurred again in 1978 and major defence works (construction of hard defences and beach recharge) were undertaken in 1990/91 and again between 2001 and 2006. There are now two lines of defences that protect the low-lying land between South Hunstanton and Heacham South Beach from flooding.

The first line of defence between South Hunstanton and Heacham North Beach is a hard (concrete) structure. From Heacham North Beach this becomes a soft shingle ridge. Parts of the beach are supported by groynes. The shingle ridge and beaches need continuous maintenance to provide a flood defence. This maintenance involves annual beach recycling and re-profiling and repairs following specific storm damage. The Heacham river outfall is built through the shingle ridge.

Behind the first line of defence is a second line of defence, which is an earth embankment. There are sluice gates associated with local drains built into the embankment.

The Wash East Coastal Management Strategy (WECMS) was completed in 2015. The strategy was carried out to identify the preferred strategic coastal management approach for the frontage between Hunstanton and Wolferton Creek, on the Norfolk coast of The Wash. The Hunstanton FRA covers parts of units B (Hunstanton Promenade) and C (South Hunstanton to Wolferton Creek) of the WECMS.

Following on from the WECMS, a 15 year project was developed to undertake beach management work along the shingle ridge between South Hunstanton and Wolferton Creek. The project started in 2016. The project involves beach recycling and re-profiling works which are normally carried out in late February/early March each year. At some point within the 15 year project, beach recharge may be needed. Beach recharge is carried out when there is no longer enough beach material to continue beach recycling activities. The beach management works are funded by contributions from:

- Flood & Coastal Erosion Risk Management Grant in Aid (FCERM GiA)
- The Borough Council of King's Lynn and West Norfolk
- the East Wash Coastal Management Community Interest Company (EWCM CIC)
- Anglian Water

The EWCM CIC was set up to provide partnership funding for the 15 year beach recycling and recharge programme. It is a registered company with directors from local businesses and landowners. A significant amount of funding has been collected by the CIC.

The current project and funding for the beach management work will come to an end in 2031. Therefore, during the lifetime of this second cycle FRMP (2021-2027), a review of the WECMS and beach recycling work will need to be considered. This review will determine the preferred strategic coastal management approach beyond 2031.

The impact of climate change and future flood risk

Like many coastal communities, Hunstanton is at risk from the impacts of climate change. According to the latest UK Climate Projections (UKCP18), sea level rise of between 1.20 and up to 1.90m in the most extreme scenario will be experienced on the East Anglia coastline over the next 100 years. Although future changes in storminess and wave conditions are more uncertain, flooding will become much more frequent, and all coastal towns will need to adapt.

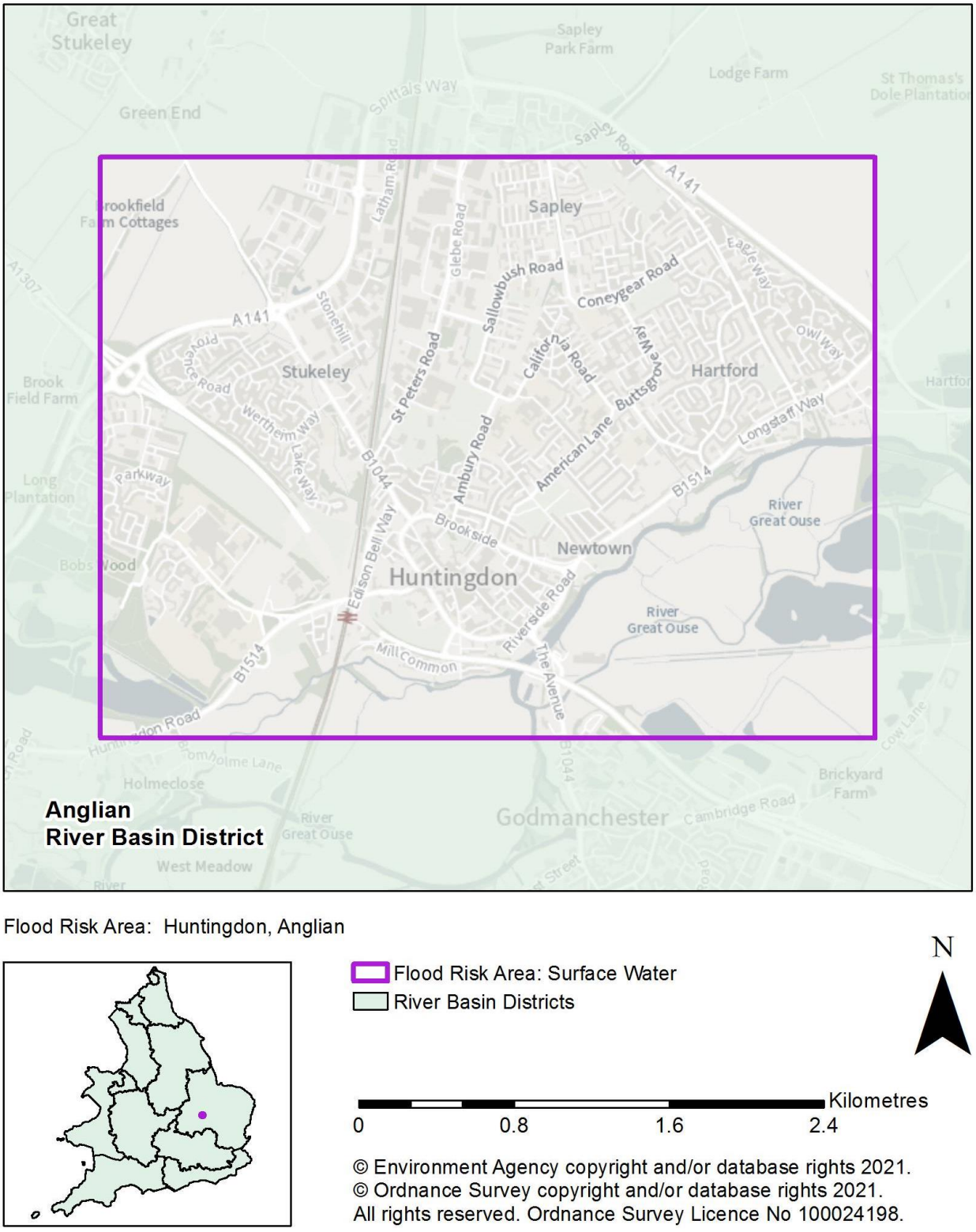
Please refer to the Climate Change and the Anglian River Basin District (RBD) section for more information on what we know are likely to be the implications of climate change in the Anglian RBD.

Objectives and measures for the Hunstanton Flood Risk Area

Measures have been developed that apply specifically to the Hunstanton FRA. These measures have been developed in addition to those covering a wider geographic area, but also apply to the Hunstanton FRA.

You can find information about all the measures that apply to the Hunstanton FRA in the Flood Plan Explorer, an interactive mapping tool. This includes information on which national objectives each measure helps to achieve.

The Huntingdon Surface Water Flood Risk Area



Flood Risk Area: Huntingdon, Anglian

Flood Risk Area: Surface Water
River Basin Districts

N

Kilometres
0 0.8 1.6 2.4

Figure 12: a map showing the boundary of the Huntingdon Flood Risk Area

Introduction to the Huntingdon FRA

The Huntingdon Flood Risk Area (FRA) has been identified as an FRA because the risk of flooding from surface water is significant nationally for people, the economy, or the environment (including cultural heritage).

Cambridgeshire County Council leads the development and delivery of the Flood Risk Management Plan (FRMP) for this FRA.

Huntingdon is a market town in Cambridgeshire within the Huntingdonshire District Council area, with a population of approximately 25,000 people.

Huntingdon is in the valley of the River Great Ouse and is typically underlain with clay soils to the north of the town, with sand and gravel deposits along the river corridor to the south of Huntingdon.

The protected site of Great Stukeley Railway Cutting Site of Special Scientific Interest (SSSI) lies either side of the railway line in the north of the FRA. The Town of Huntingdon is in a designated Nitrate Vulnerable Zone. Huntingdon FRA is in a Drinking Water Protected Area with the eastern most edge of the FRA being covered by a Source Protection Zone.

The town is served by a combination of surface water, foul water and combined sewers, along with several culverted and open watercourses. Ownership of these assets is dispersed among many parties, both Risk Management Authorities (RMAs) and riparian. Flows from the surface water network are discharged into the River Great Ouse or its tributaries.

Current flood risk

Likelihood of flooding is relatively low based on existing surface water flood risk mapping. Huntingdon has been highlighted as an FRA based on the number of important pieces of critical infrastructure in the town and the significance a flood event would have if those assets were affected.

Until recently there have not been many reports of internal residential property flooding, therefore focus is on understanding future risk because of the number of receptors of importance in Huntingdon.

The flood risk and hazard maps show that in the Huntingdon FRA, 4,512 of the 25,674 people live in areas at risk of flooding from surface water. Of these people, 5% live in areas considered to be at high risk.

Also shown to be at risk of flooding from surface water are:

- 250 non-residential properties
- 15 out of 265 services
- 1.16km of railways

- 2.72km of roads
- 2 sites regulated under the Environmental Permitting Regulations
- 1 licensed water abstraction site
- 6 listed buildings
- 84.04ha of agricultural land - of which 15.62ha are at high risk
- 0.24ha of Scheduled Ancient Monuments
- 7.56ha of Special Areas of Conservation
- 10.08ha of SSSI

The flood risk and hazard maps provide more detailed information on the likelihood and consequence of flooding for the Huntingdon FRA.

Based on this information, RMAs have concluded that further steps should be taken to reduce the likelihood of flooding and the current and future impact it could have on the FRA.

How the risk is currently managed

The management of surface water flood risk is led by Cambridgeshire County Council in collaboration with other RMAs and other stakeholders including:

- the Environment Agency
- Anglian Water
- Cambridgeshire Highways Authority
- Huntingdonshire District Council

A partnership framework has been set up across Cambridgeshire. The Cambridgeshire and Peterborough Flood and Water Partnership Group is chaired by Cambridgeshire County Council and involves all RMAs. This provides a coordinated and collaborative approach to management of flood risk and water management.

Separately, the Cambridgeshire and Peterborough Local Resilience Forum (LRF) is a multi-agency partnership made up of representatives from local public services such as:

- emergency services
- local authorities
- NHS
- Environment Agency

Associated businesses, organisations and voluntary sector representatives are also involved. These organisations work together through the LRF to prepare for and respond to emergencies. The community risk register is a collection of assessments of emergencies that might happen locally within Cambridgeshire. Each potential emergency is rated in terms of its potential impact and likelihood of occurring. Flooding is included in this assessment.

The Environment Agency’s remit covers flood risk from main rivers and the sea.

Anglian Water is the Water and Sewerage Company that owns, operates and maintains the sewer network and wastewater treatment infrastructure in the FRA.

Cambridgeshire Highway Authority operate and maintain drainage infrastructure serving the adopted highway network.

Huntingdonshire District council incorporate flood risk into decisions on new developments.

The impact of climate change and future flood risk

Rainfall intensity is expected to increase in future, causing greater volumes of runoff and higher flows within watercourses. It is therefore likely that flooding will become more frequent.

Please refer to the Climate Change and the Anglian River Basin District (RBD) section for more information on what we know are likely to be the implications of climate change in the Anglian RBD.

Objectives and measures for the Huntingdon Flood Risk Area

Measures have been developed that apply specifically to the Huntingdon FRA.

You can find information about all the measures that apply to the Huntingdon FRA in the Flood Plan Explorer, an interactive mapping tool. This includes information on which national objectives each measure helps to achieve.

The Ipswich Surface Water Flood Risk Area

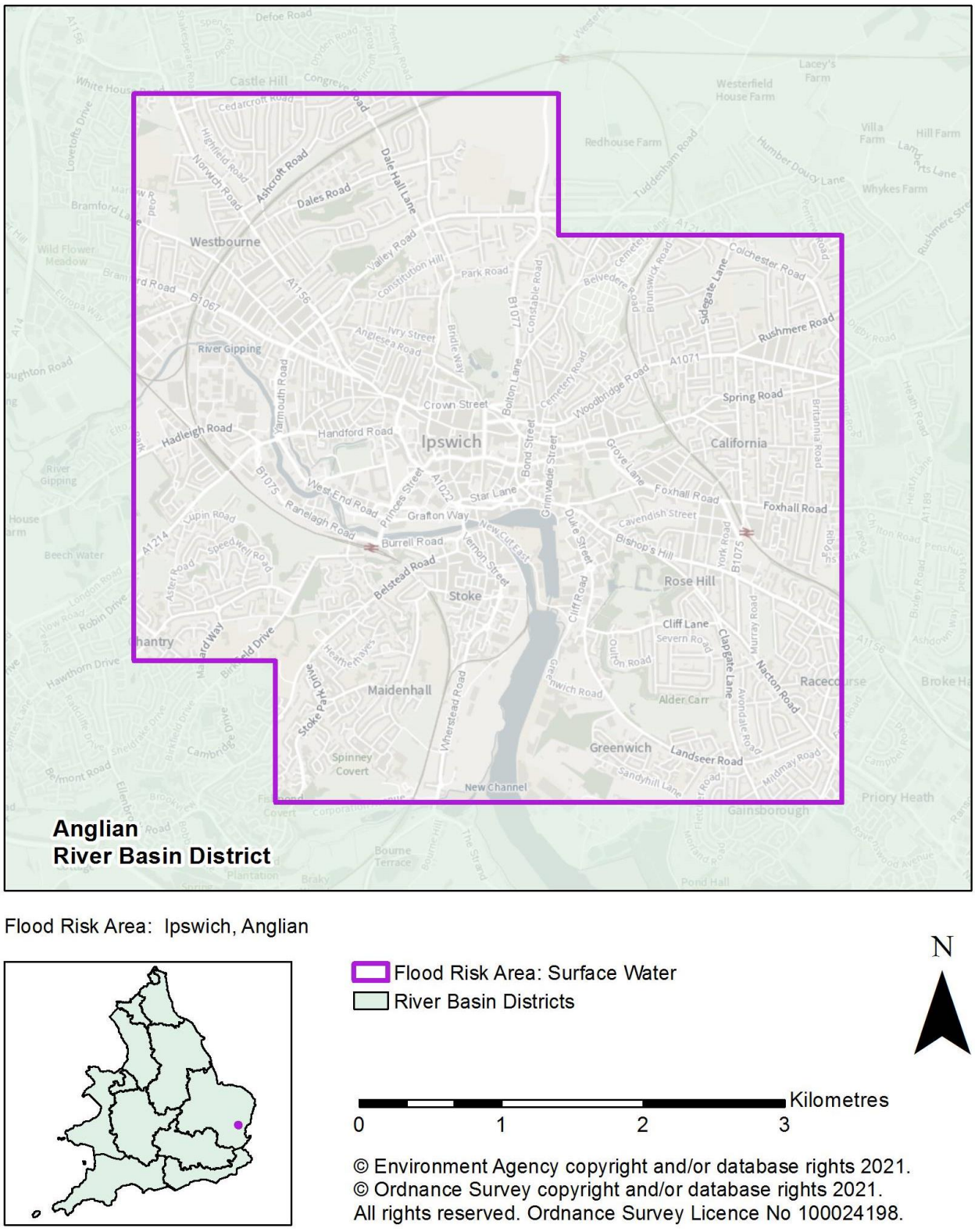


Figure 13: a map showing the boundary of the Ipswich Flood Risk Area

Introduction to the Ipswich Flood Risk Area

The Ipswich Flood Risk Area (FRA) has been identified as an FRA because the risk of flooding from surface water is significant nationally for people, the economy, or the environment (including cultural heritage). The primary source of flood risk in this FRA is surface water, however there is also risk from tidal, fluvial, and groundwater flooding.

Suffolk County Council leads the development and delivery of the Flood Risk Management Plan (FRMP) for this FRA as the responsible authority for managing flood risk from surface water. Risk from main rivers and the sea is managed by the Environment Agency.

Anglian Water is the water and sewerage company that owns, operates and maintains the sewer network and wastewater treatment infrastructure in the FRA.

Ipswich is a historic town located in the county of Suffolk, which is 66 miles north-east of London.

Ipswich is sited where the freshwater River Gipping becomes the tidal River Orwell. The Orwell Estuary downstream from Ipswich is a wildlife site of international importance, designated Site of Special Scientific Interest (SSSI), Ramsar, Special Protection Area and an Area of Outstanding Natural Beauty.

The catchment of the River Gipping includes the towns of Stowmarket, Needham Market, Claydon, Bramford, Sproughton and Western parts of Ipswich but is predominantly rural. At Horseshoe sluice (Yarmouth Road) the river divides, with the tidal Orwell on the West side and the freshwater Gipping on the East side of an island. The island is defended against tidal flooding but not fluvial flooding. The Gipping spills over Handford sluice (off West End Road) to join the Orwell.

Tidal flooding is caused by the combination of the arrival of a high tide with a storm surge caused by a low-pressure system within the North Sea. The active port and docklands area and parts of the urban area adjacent to the Orwell are low lying and at risk of tidal flooding. In response to the risk of tidal flooding affecting Ipswich, a new tidal flood defence barrier was officially opened in February 2019.

Underlying geological conditions, 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

- Upper Orwell Street

Some watercourses were used to create the ponds in Christchurch Park, Holywells Park and Chantry Park. Along the western boundary of Holywells Park, a canal, with water retained by an earth embankment up to 3m high, originally fed the Cliff Brewery. This is now drained via an old Anglian Water storm overflow Sewer to the Orwell.

Problems have recently arisen with high water levels or falling trees threatening to breach the embankment, with leaks flooding across parking areas in adjacent premises. The canal embankment presents a residual flood risk to adjacent areas. Land drainage systems (intended to drain ground water using porous pipes) have been installed in valley bottoms in several areas to help drain gardens. Examples can be found at:

- Tuddenham Avenue
- Cavendish Street
- Ancaster Road
- Gippeswyck Park
- 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.

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

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. Later, flows from villages outside Ipswich at Blakenham, Bramford & Claydon were pumped into the system. Stormwater 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.

The Anglian Water system in Ipswich 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 northwest and central Ipswich is therefore complex.

The most significant recent historic growth has been at Ravenswood south-east Ipswich with 1200 homes built. The site incorporates Sustainable Drainage Systems (SuDS) features throughout.

The ‘Ipswich Local Plan’ identifies development sites in the Ipswich plan area showing a required growth in residential development of some 8600 dwellings over the plan period to 2036. In the order of 3500 of these will be provided by the Ipswich Garden Suburb

Development on the northern fringe of the town. The remainder of development is divided between the IP-One area comprising 300 hectares of low-lying land adjacent to the River Orwel and numerous smaller sites across the borough area.

Current flood risk

Details of flood risk and events can be found in the ‘Ipswich Strategic Flood Risk Assessment’.

Sources of flooding in Ipswich include river flooding from:

- The River Gipping
- Belstead Brook
- Mill River
- Alderman Canal
- Westfield Watercourse
- Holywells Park Canal
- other watercourses

Tidal flooding is from the River Orwell Estuary and Wet Dock. Other sources of flooding include:

- surface water
- sewerage systems
- groundwater
- highway or railway drains

Historic events include flooding from the River Gipping in 1947 and 1939, from the Orwell Estuary tidal flooding (storm surge) in 1927/28 and 1938 with more recent events of 1976, 1978 and 1983 being controlled by flood defences built between 1971 and 1983. In 2013 the East Coast tidal surge caused flooding around the Ipswich waterfront area.

Surface water flooding occurs in the town from surface water runoff, overloading of soakaways, piped systems, watercourses and ground water. A SWMP was developed for the town in 2012 and will be updated by 2024.

The flood risk and hazard maps show that in the Ipswich FRA, 15,239 of the 100,931 people live in areas at risk of flooding from surface water. Of these people, 10% live in areas considered to be at high risk.

Also shown to be at risk of flooding from surface water are:

- 813 non-residential properties
- 26 out of 612 services
- 5.81km of railways
- 2 sites regulated under the EPR
- 10 listed buildings
- ~0.2ha of agricultural land

- 3.9ha of parks and gardens
- 0.3ha of Scheduled Ancient Monument
- 0.1ha of SSSI

The flood risk and hazard maps provide more detailed information on the likelihood and consequence of flooding for the Ipswich FRA.

Based on this information, Risk Management Authorities (RMAs) have concluded that further steps should be taken to reduce the likelihood of flooding and the current and future impact it could have on the FRA.

How the risk is currently managed

The management of surface water flood risk is led by Suffolk County Council in collaboration with other RMAs and stakeholders, including:

- Ipswich Borough Council
- Anglian Water
- The Environment Agency

Separately, the Suffolk Local Resilience Forum (LRF) is a multi-agency partnership made up of representatives from local public services such as:

- emergency services
- local authorities
- NHS
- Environment Agency

Associated businesses, organisations and voluntary sector representatives are also involved. These organisations work together through the LRF to prepare for and respond to emergencies. The community risk register is a collection of assessments of emergencies that might happen locally within Suffolk. Each potential emergency is rated in terms of its potential impact and likelihood of occurring. Flooding is included in this assessment.

The town is at risk of flooding from surface water runoff and exceedance of the local drainage network. In some localised areas (along spring lines and in some tributary valleys) the underlying ground conditions influence flood risk with some areas susceptible to groundwater emergence. In locations close to the tidal estuary, surface water may not be able to drain away during high tide conditions.

The main factors contributing to surface water flooding in the town are the impermeable urban townscape, capacity of the underground drainage infrastructure, combined in certain areas with ground water conditions and the proximity of fluvial and tidal waters.

The 2012 Ipswich Surface Water Management Plan modelled surface water flood risk in the town and identified locations and areas requiring interventions to reduce this risk.

Suffolk County Council as LLFA received 117 reports of surface water related issues in 2020 with 171 in 2019.

The areas considered to be at greatest risk from surface water flooding include:

- Swinburne Road
- Norwich Road
- Monton Rise
- Bridgewater Road
- Ellenbrook Road
- Bixley Road
- Holywells Road
- Duke Street
- Portman Road area
- Maidenhall

Suffolk County Council as the LLFA continues to work with the highway authority and Anglian Water Services on capacity and infrastructure maintenance measures together with advising communities and individuals of actions to reduce flood risk and impacts.

In response to the risk of tidal flooding affecting Ipswich, the Environment Agency constructed a new tidal flood defence barrier in February 2019. The barrier, in combination with 1,100m of new/refurbished flood walls and flood gates are designed to reduce the risk of flooding to 1,608 homes and 422 businesses as well as key infrastructure.

The barrier provides protection to the town for the 0.33% annual probability tidal flood event accounting for climate change uplift to tidal levels to the year 2118. The risk of tidal flooding to Ipswich is therefore a ‘residual risk’. For example, it’s only at risk of tidal flooding in the event of a breach in the flood defences or a failure of the operation of the barrier.

The impact of climate change and future flood risk

Rainfall intensity is expected to increase in future, causing greater volumes of runoff and higher flows within watercourses. It is therefore likely that flooding will become more frequent.

Please refer to the Climate Change and the Anglian River Basin District (RBD) section for more information on what we know are likely to be the implications of climate change in the Anglian RBD.

Objectives and measures for the Ipswich FRA

Measures have been developed that apply specifically to the Ipswich FRA.

You can find information about all the measures that apply to the Ipswich FRA in the Flood Plan Explorer, an interactive mapping tool. This includes information on which national objectives each measure helps to achieve.

The King's Lynn Rivers and Sea Flood Risk Area

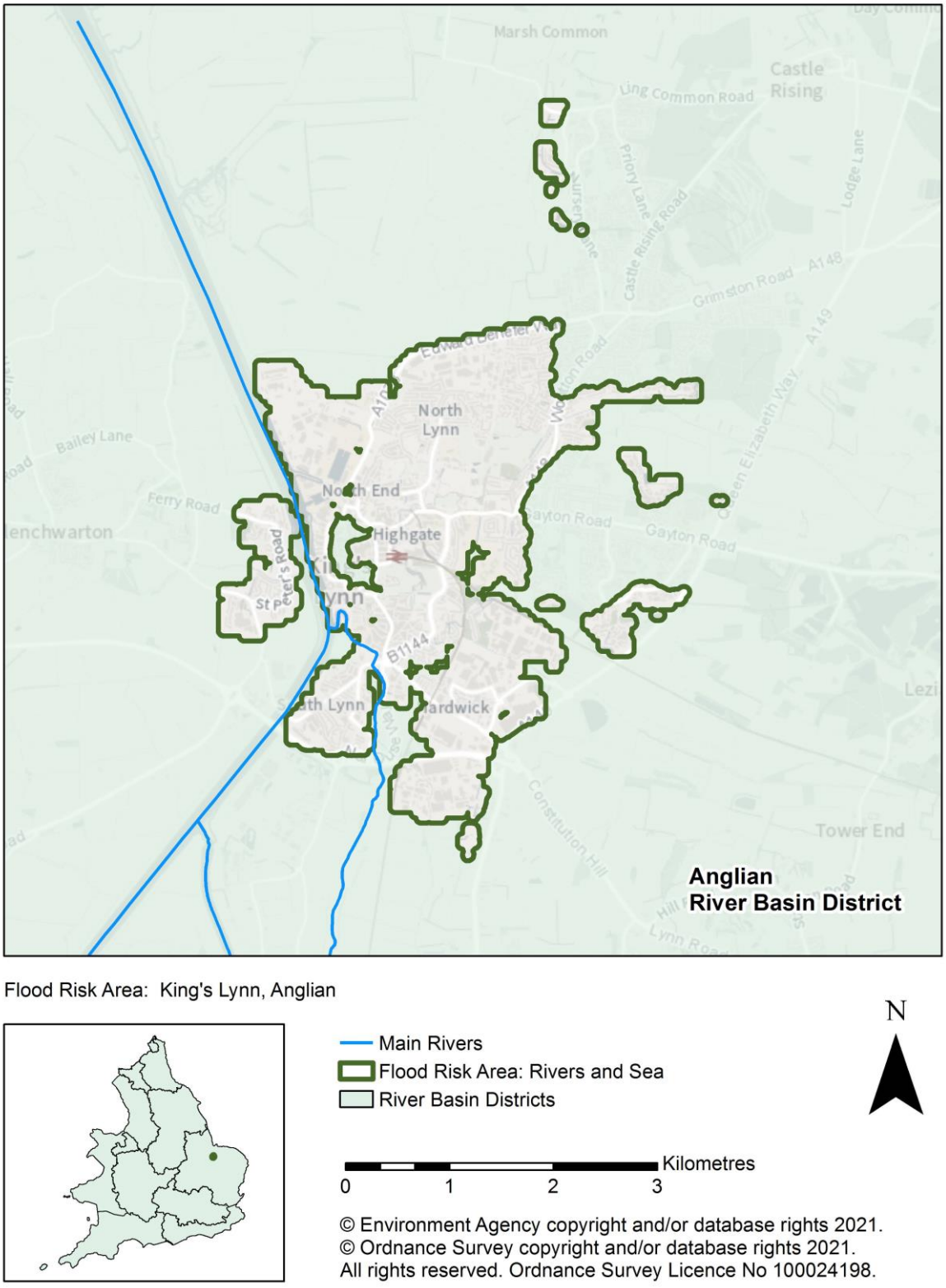


Figure 14: a map showing the boundary of the King's Lynn Flood Risk Area

Introduction to the King's Lynn Flood Risk Area

The King's Lynn Flood Risk Area (FRA) has been identified as an FRA because the risk of flooding from rivers and the sea is significant nationally for people, the economy, or the environment (including cultural heritage).

The Environment Agency leads on the development and delivery of the Flood Risk Management Plan (FRMP) for this FRA.

King's Lynn Internal Drainage Board (IDB) (part of the Water Management Alliance) maintains critical ordinary watercourses that flow through the FRA. They operate and maintain infrastructure within these watercourses such as pumping stations and water level control structures.

Norfolk County Council is the Lead Local Flood Authorities (LLFA), whose remit includes flood risk from surface water and ordinary watercourses.

The Borough Council of King's Lynn and West Norfolk work alongside other Risk Management Authorities (RMAs) to understand the risk of flooding. They carry out work to manage the flood risk in the FRA and are the Local Planning Authority.

Anglian Water is the sewerage company that owns, operates and maintains the sewer network and wastewater treatment infrastructure in the FRA.

The King's Lynn FRA covers the main urban extent of King's Lynn and West Lynn and small parts of the North and South Wootton parishes. The FRA includes residential, business and amenity areas and is surrounded by a green belt of mainly farmland.

The FRA includes several locations that are not connected to the main part of the FRA. For example, small areas at North Wootton, Gaywood, and Fairstead. In addition, there are small areas of 'dry islands', which are shown to be outside of the FRA, particularly within the urban area of King's Lynn. The reason for these seemingly anomalous areas relates to the methodology used to identify the FRA boundaries, which is detailed in Part A of the FRMP report. It's important to note, however, that measures included for the King's Lynn FRA, particularly those associated with flood warning and evacuation procedures, will apply to King's Lynn as a whole and will not be limited to the area shown in Figure 14.

The underlying solid geology of the FRA is mudstone, siltstone and sandstone. This is overlain by tidal flat deposits which are made up of clay and silt.

The River Nar Site of Special Scientific Interest (SSSI) lies just upstream of the King's Lynn FRA. The Wash SSSI and Special Protection Area and The Wash & North Norfolk Coast Special Area of Conservation lies some 2.5km downstream of the FRA.

The coastline is approximately 5km to the north of the FRA. The Tidal Great Ouse flows through the FRA towards its estuary in The Wash. The Great Ouse flows between the urban areas of King's Lynn and West Lynn. Through the FRA the Great Ouse conveys

water from its upper catchment, some 8,376km². This includes drainage from the Fens which surround the FRA (to the south, east and west) and drain into the Great Ouse.

Other watercourses flow through the FRA and drain smaller more local areas. These include:

- the River Nar (main river)
- the Gaywood River (ordinary watercourse, IDB maintained)
- West Lynn drain (ordinary watercourse, IDB maintained)
- Pierrepoint drain (ordinary watercourse, IDB maintained)
- Bawsey drain (ordinary watercourse, IDB maintained)
- West Lynn Drain
- Middleton Stop Drain (ordinary watercourse, IDB maintained)

Due to the relatively flat topography in the FRA, the surface water drainage network is supported by pumps, particularly at times of high river levels.

The Alexandra and Bentinck Docks are part of the port of King's Lynn and are accessed from the tidal River Great Ouse. King's Lynn has a long historical link with the maritime trade and today it remains one of the key industries in the town. The port is owned and operated by Associated British Ports and is a major centre for the import and export of a range of mainly bulky goods and materials.

The King's Lynn FRA is a low-lying area at risk of tidal, river and surface water flooding. The town has a long history of flooding with the most significant floods being caused by high spring tides coinciding with North Sea storm surges. In response to flooding, defences have been built, which include:

- demountable defences (flood gates, doors and seats)
- existing buildings
- earth embankments

Following their construction, the defences have protected King's Lynn during subsequent floods.

The Borough Council of King's Lynn and West Norfolk Strategic Flood Risk Assessment indicates a moderate to high risk of surface water flooding in King's Lynn.

Current flood risk

The King's Lynn FRA has a long history of flooding. The main reports of flooding are:

- on the 31 January to 1 February 1953, the East Coast of the UK was hit by a storm surge. Records suggest the storm surge height reached almost 3 metres at King's Lynn. During this significant flood, 15 people lost their lives in King's Lynn
- in 1978, Environment Agency records indicate that a tidal surge flooded 500 properties in King's Lynn. Flood damages were estimated at £5.5 million

- on 12 November 1993, Environment Agency records report that the River Nar breached its banks. This caused flooding between Lynn Road and New Road.
- on 5 to 6 December 2013, a high spring tide and a low-pressure system in the North Sea resulted in a tidal surge. Extreme tides and waves cascaded down the east coast overtopping defences and flooding properties. At its peak, the King's Lynn tidal gauge reached 6.17m above Ordnance Datum. This tide was higher than the devastating floods of 1953 and 1978 and corresponded to a 0.1% Annual Exceedance Probability. In King's Lynn the defences held but there was seepage and wave overtopping. This resulted in limited flooding behind the flood walls. Records of property flooding indicate that 15 properties flooded in King's Lynn, of which 8 were residential
- on 10 July 2014, 16 September 2015 and 30 November 2016, Norfolk County Council flood records show evidence of internal property flooding. No source of flooding is recorded
- in June 2017, surface water flooding throughout King's Lynn was reported

The flood risk and hazard maps show that in the King's Lynn FRA, 26,807 of the 30,921 people live in areas at risk of flooding from rivers and the sea. Of these people, 0.7% live in areas considered to be at high risk.

Also shown to be at risk of flooding from rivers and the sea are:

- 1289 non-residential properties - of which 6 are at high risk
- 4.75km of railways
- 0.33km of roads
- 68 out of 200 services
- 150ha of agricultural land
- 7 sites regulated under the EPR
- 2 licensed water abstraction sites
- 152 listed buildings - of which 4 are at high risk
- 14.48ha of parks and gardens
- 1.6 ha of Scheduled Ancient Monuments
- 0.03ha of SSSI

The flood risk and hazard maps provide more detailed information on the likelihood and consequence of flooding for the King's Lynn FRA.

Based on this information, RMAs have concluded that further steps should be taken to reduce the likelihood of flooding and the current and future impact it could have on the FRA.

How the risk is currently managed

The management of flood risk from rivers and the sea is led by the Environment Agency in collaboration with other RMAs and other stakeholders, including:

- Norfolk County Council

- The Borough Council of King's Lynn and West Norfolk
- King's Lynn IDB
- Anglian Water

The Norfolk LRF is a multi-agency partnership made up of representatives from local public services such as:

- emergency services
- local authorities
- NHS
- Environment Agency

Associated businesses organisations and voluntary sector representatives are also involved. These organisations work together through the LRF to prepare for and respond to emergencies. The community risk register is a collection of assessments of emergencies that might happen locally within Norfolk. Each potential emergency is rated in terms of its potential impact and likelihood of occurring. Flooding is included in this assessment.

The Environment Agency monitor river and rainfall conditions at 10 sites in and within the vicinity of the FRA:

These collect data on river level, river flow, and rainfall:

- King's Lynn South Quay (level)
- Mill Fleet Sluice (level)
- Nar Outfall Sluice (level)
- Freebridge (level)
- Tail Sluice (level)
- Nar Diversion Channel (level)
- Setchey Bridge (level)
- Magdalen Bridge (level)
- St Germans Pumping Station (flow)
- Kilhams Bridge (level)
- South Wootton (rainfall)
- Ashwicken (rainfall)

This information is used to inform activities related to 6 flood warning areas and 2 flood alert areas that cover the FRA which enable people to receive a warning when flooding could occur.

The water level and flow data are also used to inform and calibrate hydraulic models of the river network. There are 4 models that cover King's Lynn:

1. The Wash model was published in 2019 and simulates tidal flooding.
2. There are a series of tidal breach scenarios which determine the areas at risk of flooding were the defences to fail during a 0.5% AEP event run as part of an earlier modelling study (Tidal Hazard Mapping) published in 2015.

3. The Fenland model (published in 2016) simulates the risk of river flooding along the Great Ouse.
4. The Eastern Rivers Nar Model simulates the risk of river flooding on the River Nar.

Flood risk maps are published based on the outputs from the mathematical modelling to inform:

- the public and businesses of their flood risk
- potential developers and local planning authorities
- the assessment and design of flood risk management works

Following the 1978 flood, 60 flood gates and flood barriers were built to protect the community. The main urban area of King's Lynn is protected by 11.3km of raised tidal defences. These defences consist mainly of flood walls and flood banks with berms and are located on both banks of the Tidal River Great Ouse. The tidal defences have a 0.5% AEP standard of protection. Most of the tidal defences are owned, operated and maintained by the Environment Agency.

There are other raised defences located on the River Nar and along parts of the Tidal River Great Ouse. These consist mainly of natural flood banks, flood banks with berms, and embankments. These defences have a 0.5% AEP standard of protection, and the majority are owned and maintained by the Environment Agency.

The King's Lynn IDB has been active in managing improvements to local drainage by installing and maintaining pumping stations to discharge water during high flow events. In 2020 the IDB refurbished its North Lynn pumping station.

The LLFA and Anglian Water similarly maintain assets that perform a flood risk management function on the drainage network.

Routine channel maintenance activities are carried out in the FRA by the Environment Agency and King's Lynn IDB and include grass cutting and weed control.

The impact of climate change and future flood risk

Like many coastal communities, King's Lynn is at risk from the impacts of climate change. According to the latest UK Climate Projections (UKCP18), sea level rise of between 1.20 and up to 1.90m in the most extreme scenario will be experienced on the East Anglia coastline over the next 100 years. Future changes in storminess and wave conditions are more uncertain. Pressure on tidal defences will increase and flooding will become much more frequent, meaning that all coastal towns will need to adapt.

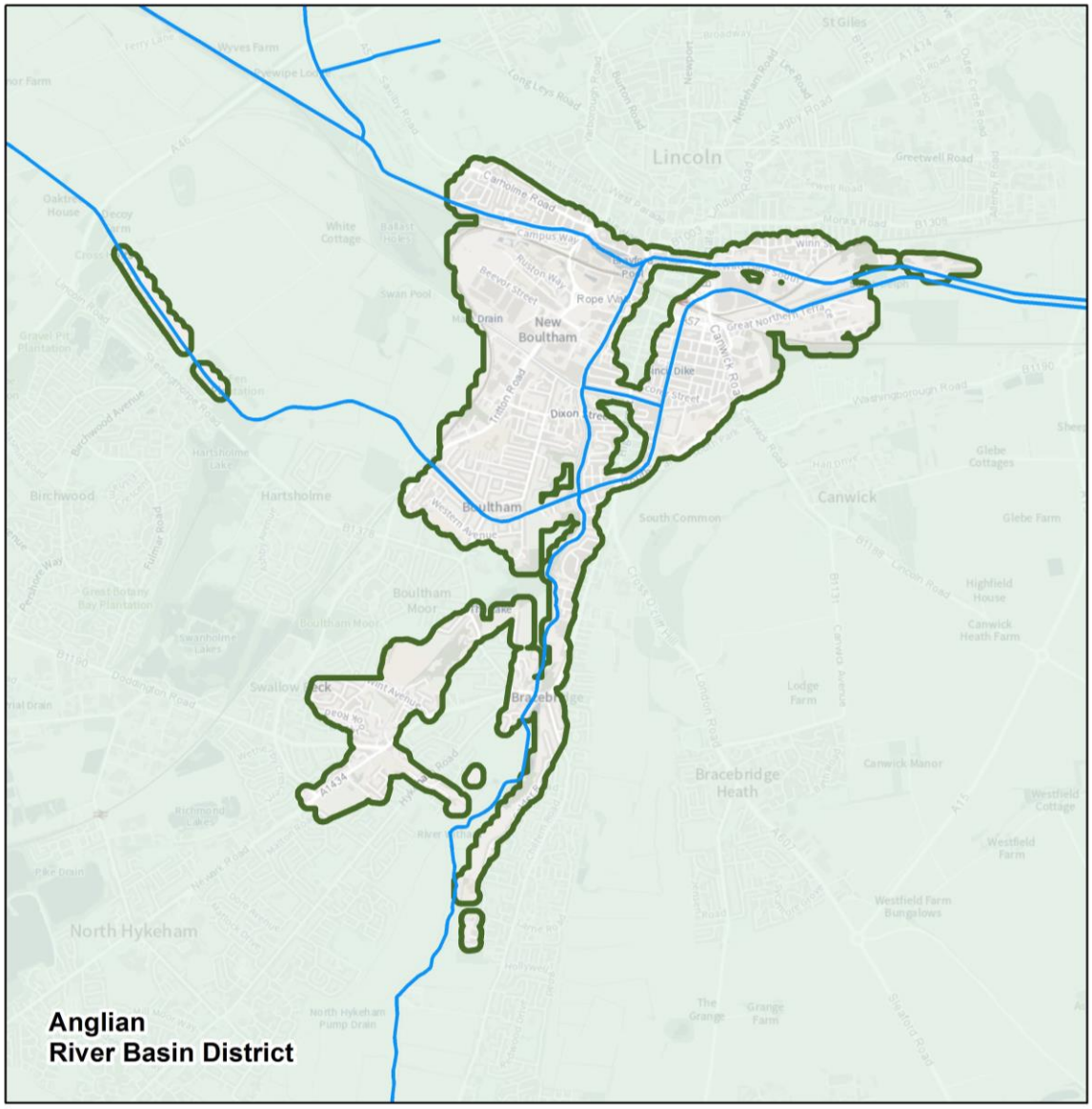
Please refer to the Climate Change and the Anglian River Basin District (RBD) section for more information on what we know are likely to be the implications of climate change in the Anglian RBD.

Objectives and measures for the King’s Lynn FRA

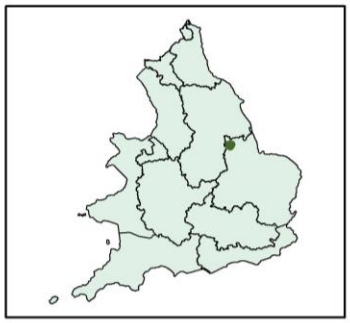
Measures have been developed that apply specifically to the King’s Lynn FRA. These measures have been developed in addition to those covering a wider geographic area, but also apply to the King’s Lynn FRA.

You can find information about all the measures that apply to the King’s Lynn FRA in the Flood Plan Explorer, an interactive mapping tool. This includes information on which national objectives each measure helps to achieve.

The Lincoln Rivers and the Sea Flood Risk Area



Flood Risk Area: Lincoln, Anglian



Main Rivers
Flood Risk Area: Rivers and Sea
River Basin Districts

N

Kilometres
0 1 2 3

Figure 15: a map showing the boundary of the Lincoln Flood Risk Area

Introduction to the Lincoln Flood Risk Area

The Lincoln Flood Risk Area (FRA) has been identified as an FRA because the risk of flooding from rivers and the sea is significant nationally for people, the economy, or the environment (including cultural heritage).

The Environment Agency leads on the development and delivery of the Flood Risk Management Plan (FRMP) for this FRA. Lincolnshire County Council is the Lead Local Flood Authority (LLFA) responsible for managing flood risk from 'local' sources. These local sources include:

- surface water
- groundwater
- ordinary watercourses

The Environment Agency's remit covers flood risk from rivers and the sea.

Anglian Water Services is the water and sewage company that owns, operates and maintains the sewerage network and wastewater treatment infrastructure in the FRA.

The Lincoln FRA is characterised by its urban nature and includes areas that are:

- residential
- commercial
- amenity

Only the south of the city is designated as an FRA below the A57 south. It includes:

- New Boultham
- St Catherine's
- Bracebridge

There is also a small area to the west of the main FRA along the Boultham Catchwater Drain. This includes the northern part of the Birchwood Estate.

The FRA may include locations that are not connected to the main part of the FRA, and there may be small areas of 'dry islands', which are shown to be outside of the FRA. The reason for these seemingly anomalous areas relates to the methodology used to identify the FRA boundaries, which is detailed in Part A of the FRMP report.

It is important to note, however, that measures included for the FRA, particularly those associated with flood warning and evacuation procedures, are likely to apply to the FRA as a whole and will not be limited to the area shown in Figure 15.

The predominant soil type is seasonally wet, deep and sandy. There are also significant areas of seasonally wet, deep clay. The underlying geology of the catchment is mudstones to the west of Lincoln and clays to the east. There is a ridge of limestone running north-south through Lincoln. Several storage reservoirs exist in the upper catchments.

Heritage at risk within the FRA includes:

- Gowts Bridge
- West Parade
- southern parts of the Cathedral and City Centre Conservation area

Located within the FRA are High Bridge and Monk's Abbey Scheduled Ancient Monuments. There are numerous listed buildings. Local Wildlife Sites within the FRA include:

- Boultham Park
- Witham Leas
- Brayford Pool
- Witham Corridor

Lincoln is an historic cathedral city and the county town of Lincolnshire. It lies on the River Witham, within the escarpment which runs north to south through central Lincolnshire. This steep slope is a prominent landscape feature in a generally flat portion of the county.

Historically, Lincoln was developed from an Iron Age settlement on the River Witham. This was built in a deep pool which is now known as the modern day Brayford Pool. It became a major and flourishing settlement and was accessible from the sea both through the River Trent and the River Witham.

Throughout history Lincoln has benefited from several industries including:

- cloth and wool
- import of coal and other raw materials
- heavy engineering
- war production

Today, Lincoln's economy is based mainly on:

- public administration
- commerce
- arable farming
- tourism
- education
- health

The River Witham flows northwards into Lincoln. It is joined by Boultham Catchwater Drain before it reaches Brayford Pool where it is joined by the Fossdyke Canal flowing from the west. The River Witham then turns east and flows out of the city towards to the Lower Witham fens.

The Canal & River Trust maintain navigable passage through the FRA via the Fossdyke Canal and River Witham downstream of Brayford Pool. The Environment Agency has a legal obligation to maintain a minimum water level for this navigation. This is maintained by using 3 sluice gates in the city.

In order to safely pass high flows through the city the sluice gates are automatically fully lifted out of the water.

During 1947 one sixth of Lincoln was reported as under water and approximately 3,000 properties were flooded. Large areas were again flooded in 1958. High flows and flooding to parts of the city were experienced in 1977 and 1981.

As a result, two upstream flood storage washlands were created to control the flows into the city. One is on the River Till with the other at the confluence of the River Witham and River Brant.

In November 2000, the Witham Washlands were operated for the first time. The Till Washlands were also operated during:

- January 2008
- November 2012
- winter of 2019-2020

Current flood risk

Recent years have seen high river levels through Lincoln on several occasions. The use of the upstream flood storage areas has prevented significant flooding in the city. However, the raised defences through the city have been stressed and there has been seepage through the defences in places. A significant amount of work has been required to recover the condition of the raised defences to pre-2019 level.

There has also been flooding from surface water which has been unable to outfall into full rivers.

The flood hazard and risk maps show that in the Lincoln FRA, 23,895 people live in areas at risk of flooding from rivers and the sea. Of these people, 2% live in areas of high risk.

Also shown to be in areas at risk of flooding from rivers and sea are:

- 599 non-residential properties - including community centres, schools, retail parks and public utilities
- 0.77 km of roads - including parts of the A15, A57, A192, and A1434
- 5.55 km of railway
- 23.09 ha of agricultural land
- 8 listed buildings
- 4.67ha parks and gardens
- 4 water abstraction points

The flood hazard and risk maps provide more detailed information on the likelihood and consequence of flooding for the Lincoln FRA.

Based on this information, Risk Management Authorities (RMAs) have concluded that further steps should be taken to reduce the likelihood of flooding and the current and future impact it could have on the FRA.

This will be reviewed as new evidence becomes available.

How the risk is currently managed

The management of flood risk from rivers and sea is led by the Environment Agency in collaboration with other RMAs and other stakeholders. These include:

- City of Lincoln Council
- The Canal and River Trust

A partnership framework has been set up across Lincolnshire involving all RMAs to coordinate the management of flood risk and water management. Strategic direction is delivered by the Lincolnshire Flood Risk and Water Management Strategy Group. This is chaired by the Environment Agency.

The Management Group chaired by Lincolnshire County Council delivers the responsibilities of the LLFA. There are 4 Local Flood Risk and Drainage Management Groups chaired by Lincolnshire County Council Highways. These deliver flood risk and water management solutions to meet local circumstances.

The Lincoln Flood Risk Area is covered by the West Lindsey and Lincoln City Flood Risk and Drainage Management Group.

The Lincolnshire LRF is a multi-agency partnership made of representatives from local public services such as:

- emergency services
- local authorities
- NHS
- Environment Agency

To help prepare for and respond to emergencies the LRF publish a community risk register. This provides information on the key risks that have the potential to cause disruption to the county. These include East Coast and inland flooding.

The Environment Agency monitor river and rainfall conditions at 7 sites in and near to the FRA:

- Fossdyke (Level & Flow)
- Brayford Pool (Level)
- Stamp End Sluice (Level)
- Monson Street (Level & Flow)
- Sewells Walk (Flow)
- Bargate (Level)

- Bracebridge (Level)

This information is used to inform activities related to 2 flood warning areas that cover the FRA. This enables people to receive a warning when flooding could occur. This data also informs the operational response during a flood incident.

The Upper Witham Lincoln was modelled in 2008 and updated in 2015. Lincoln breach modelling was undertaken in 2013. Mapping to show the hazard, depth and velocity associated with flood water resulting from a breach of the Witham defences is available. Breach mapping for the Trent was also undertaken in 2018. This could affect the west of the FRA.

Flood risk maps are published based on the outputs from modelling to inform:

- the public and business of their flood risk
- potential developers and local planning authorities
- the assessment and design of flood risk management works

The Environment Agency operates and maintains flood risk management assets on the main watercourses in the FRA. These include:

- flood defence walls
- flood gates
- channels
- culverts
- debris screens

This work includes routine inspection and clearance activities as well as regular repair and replacement of assets.

The Canal & River Trust maintains the Fossdyke Canal and River Witham downstream of Brayford Pool as a navigable waterway.

Flood risk improvement works that benefit the Lincoln FRA include the Lincoln Defences project, which is due for completion in 2022.

Work began in 2019 to refurbish 3 key control structures through Lincoln and complete repairs and improvements to areas of defences along the River Witham and Fossdyke Canal. This will maintain the level of protection offered.

A programme of recovery works is due for completion in 2022. Locations include:

- Sincil Dyke
- Boultham Catchwater
- Great Gowts Drain

This work will ensure the level of protection is maintained.

Automation of the ‘Washlands’ was undertaken in 2020. This automation will improve incident response control.

Control structures are used to manage river levels. This ensures the watercourses remain navigable and are kept in good health to support fish and biodiversity. Flood risk to householders lying near the river and its tributaries is managed. This is particularly important along the lower reaches of the Boultham Catchwater drain where many properties bound the watercourse.

The impact of climate change and future flood risk

Rainfall intensity is expected to increase in future which will cause river flows to increase. Please refer to Climate Change and the Anglian River Basin District (RBD) section for more information on what we know are likely to be the implications of climate change in the Anglian River Basin District.

Objectives and measures for the Lincoln FRA

Measures have been developed that apply specifically to the Lincoln FRA. These measures have been developed in addition to those covering a wider geographic area that also apply to the Lincoln FRA.

You can find information about all the measures that apply to the Lincoln FRA in the Flood Plan Explorer, an interactive mapping tool. This includes information on which national objectives each measure helps to achieve.

The Lowestoft Rivers and the Sea Flood Risk Area

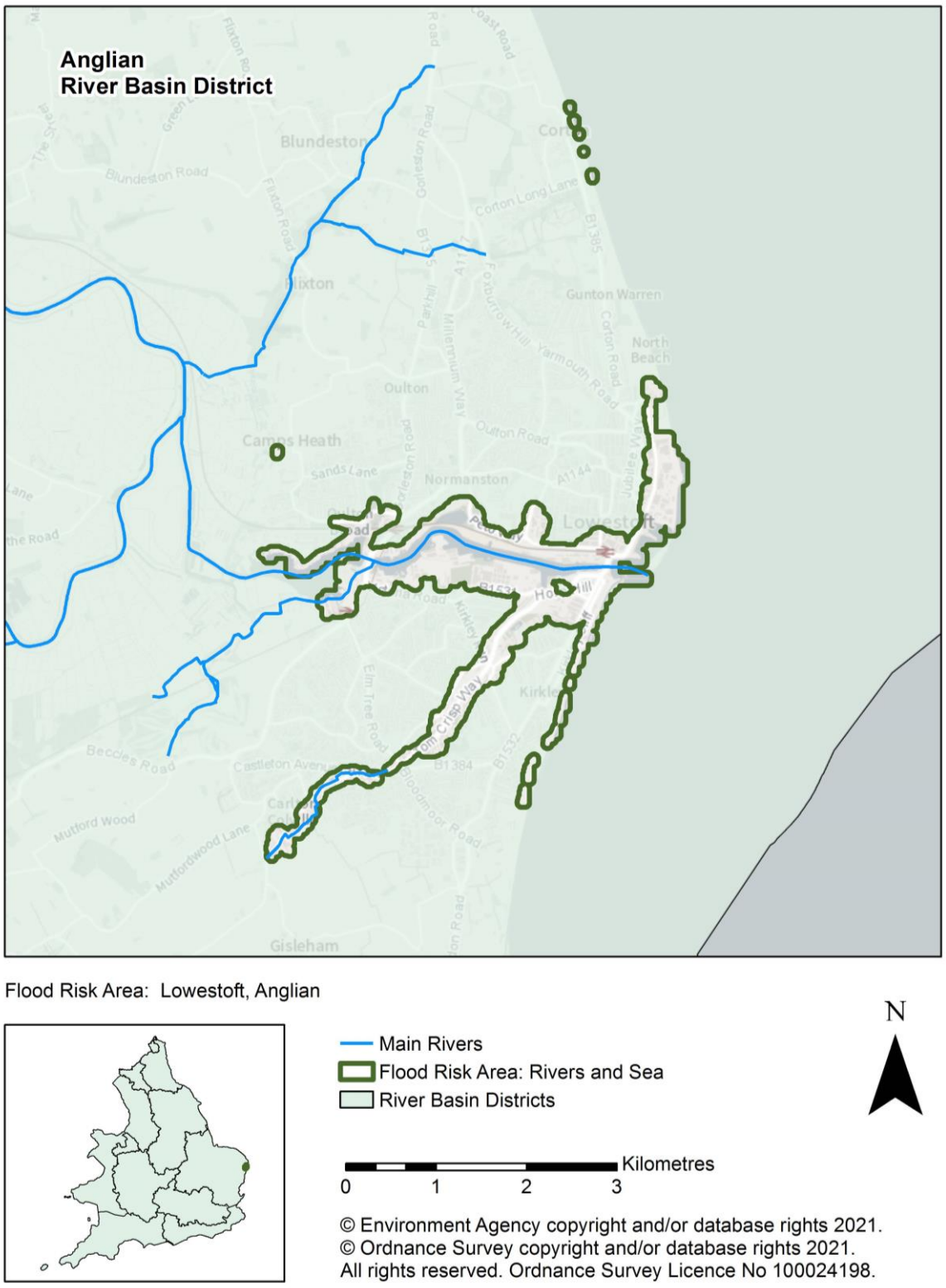


Figure 16: a map showing the boundary of the Lowestoft Flood Risk Area

Introduction to the Lowestoft Flood Risk Area

The Lowestoft Flood Risk Area (FRA) has been identified as an FRA because the risk of flooding from main rivers and the sea is significant nationally for people, the economy, or the environment (including cultural heritage).

The Environment Agency leads on the development and delivery of the Flood Risk Management Plan (FRMP) for this FRA, as the responsible authority for managing flood risk from main rivers and the sea.

Suffolk County Council is the Lead Local Flood Authority, whose remit includes flood risk from surface water and ordinary watercourses. The FRA also falls within the administrative boundary of East Suffolk Council.

Anglian Water is the sewerage company that owns, operates and maintains the sewer network and wastewater treatment infrastructure in the FRA.

Lowestoft is a town in Suffolk located on the east coast, approximately 30km south-east of Norwich. The FRA covers a 5km2 area of the town, which includes areas adjacent to Lake Lothing and Kirkley Stream, as well as areas of coastal frontage. The FRA covers residential and commercial areas as well as sections of the A12 (Tom Crisp Way).

The FRA boundary includes several locations that are not connected to the main part of the FRA. For example, Camps Heath near Oulton and small areas on the coast at Corton. The reason for these seemingly anomalous areas relates to the methodology used to identify the FRA boundaries, which is detailed in Part A of the FRMP report. It's important to note, however, that measures included for the Lowestoft FRA will apply to Lowestoft as a whole and will not be limited to the area shown in Figure 16.

The town is at risk from:

- tidal flooding
- river flooding
- surface water flooding

Tidal flooding is caused by the combination of the arrival of a high tide with a storm surge caused by a low-pressure system within the North Sea. This results in a rise in water level in Lake Lothing, which is the main river passing through the centre of the town. Lake Lothing is tidal up to Mutford Lock, which is located at the crossing of the A1117. Oulton Broad to the west of Mutford Lock is also tidal but influenced by water levels in the tidal River Waveney. The lock acts as a control structure limiting the tidal influence and allowing navigation between Lake Lothing and The Broads to the west of the FRA.

The main source of fluvial risk is from the Kirkley Stream. This is a small tributary that drains the urban area of Kirkley before discharging into Lake Lothing. The watercourse is a main river near the source in Carlton Colville, until just upstream of the A12 (Tom Crisp Way), where it becomes an ordinary watercourse. This section of the watercourse is in the

ownership of Suffolk County Council and historically managed as a public sewer by Anglian Water.

The channel features several culverted sections before it reaches its downstream extent. This consists of an Anglian Water culvert leading to a pumping station discharging through a culvert outlet with a flap valve to prevent the inundation of tidal water.

Fluvial flooding can occur following heavy rainfall. Kirkley Stream has a small, narrow channel (less than 2m in places) with very limited fall. Therefore, it has limited capacity to manage flood water.

Surface water flood risk is widely spread across the town in localised pockets of risk. The risk is determined by the topography of the land and local drainage systems.

Current flood risk

Lowestoft has an extensive history of flooding, which includes incidents in:

- 1953
- 1993
- 1995
- 1996
- 2005
- 2007
- 2013
- 2015

The December 2013 tidal surge caused internal flooding of over 160 homes and businesses, as well as significant disruption to roads and railways.

In July 2015, 33 properties adjacent to Kirkley Stream flooded following a period of intense rainfall, which resulted in the channel capacity being exceeded.

The flood risk and hazard maps show that, of the 9,442 people in the Lowestoft FRA, 3,218 live in areas at risk of flooding from main rivers. Of these people, 16% live in areas considered to be at high risk.

Also shown to be at risk of flooding from rivers and the sea are:

- 681 non-residential properties
- 7 listed buildings
- 18 services - including water pumping stations, electricity substations, and education facilities
- 2.32km of railway
- 3.79km of roads - including parts of the trunk road network
- 17.46ha of agricultural land
- 2 sites regulated under the Environmental Permitting Regulations
- 9.84ha of Special Area of Conservation

- 10.44ha of Special Protection Area
- 0.15ha of Scheduled Ancient Monuments
- 0.43ha of Sites of Special Scientific Interest

The flood risk and hazard maps provide more detailed information on the likelihood and consequence of flooding for the Lowestoft FRA.

Based on this information, Risk Management Authorities (RMAs) have concluded that further steps should be taken to reduce the likelihood of flooding and the current and future impact it could have on the FRA.

How the risk is currently managed

The management of flood risk from rivers and the sea is led by the Environment Agency in collaboration with other RMAs, including:

- Suffolk County Council
- East Suffolk Council
- Coastal Partnership East
- Anglian Water

Separately, the Suffolk Local Resilience Forum (LRF) is a multi-agency partnership made up of representatives from local public services such as:

- emergency services
- local authorities
- NHS
- Environment Agency

Associated businesses organisations and voluntary sector representatives are also involved. These organisations work together through the LRF to prepare for and respond to emergencies. The community risk register is a collection of assessments of emergencies that might happen locally within Suffolk. Each potential emergency is rated in terms of its potential impact and likelihood of occurring. Flooding is included in this assessment.

Lowestoft has no existing flood defences. Temporary flood barriers were delivered in 2016 and are deployed when a flood warning is issued. Deployment of the temporary barriers is led by East Suffolk Council with support from the Water Management Alliance. They were successfully used during the tidal surge in January 2017. Although the tide did not reach the heights predicted, the barrier deployment was tested in some extreme weather conditions.

Other key structures include a pumping station towards the downstream end of Kirkley Stream to pump fluvial flows into Lake Lothing. This helps prevent water backing up into Kirkley Stream, reducing the risk of fluvial flooding when tide locking arises.

The Environment Agency monitor river and rainfall conditions at 3 sites in, and immediately adjacent to, the FRA. Data on river levels and rainfall is collected at:

- Oulton Broad (level)
- Lake Lothing (level)
- Lowestoft Rain gauge (rainfall)

The information is used to inform activities related to 6 flood warning areas that cover the FRA. These include:

- Lowestoft seafront and docks
- Lowestoft Riverside Business Park and Kirkley
- the north bank of Lake Lothing (from Mutford Bridge to Bascule Bridge)
- the south bank of Lake Lothing
- isolated, low-lying properties along the tidal River Waveney
- Oulton Broad (near Mutford Lock)

This enables people to receive a warning when flooding could occur.

Water level and flow data are also used to inform and calibrate mathematical modelling of the river network. The watercourses in the FRA are covered by hydraulic models. The risk from the sea was modelled as part of the East Anglia Coastal Modelling, updated in 2018 and utilised by the Lowestoft Flood Risk Management Project. The fluvial flood risk model associated with the Kirkley Stream was updated in 2021. A pluvial flood risk model was created in 2016 and updated in 2019 for the urban area of Lowestoft.

The Lowestoft Flood Risk Management Project will help to reduce the risk of flooding from multiple sources in the area. Once complete, it'll help support the sustainable economic growth and regeneration of the town.

The £67 million project is being led by East Suffolk Council in partnership with:

- Coastal Partnership East
- New Anglian Local Enterprise Partnership
- Anglian Water
- Suffolk County Council
- the Environment Agency

Phase 1 of the works was completed in summer 2021. This was to construct a sheet piled wall for approximately 300m along Kirkley Stream to reduce the risk of flooding from the river.

A new pumping station and outfall, which will be adopted by Anglian Water, has also been constructed adjacent to the wall. This is to manage surface water from the existing drainage system during significant rainfall events.

In addition, over 130 properties at risk of surface water flooding across the town have had Property Flood Resilience measures installed to reduce the consequences of future rainfall events.

Phase 2 will include the construction of a tidal barrier and new or improved flood walls to provide protection against flooding from the sea. The project was fully funded in July 2020, and construction of the first phase of tidal walls started in May 2021.

The second phase of tidal wall construction starts in October 2021 and both phases will be complete by May 2022. The target date for completing the tidal barrier is 2025.

The impact of climate change and future flood risk

Like many coastal communities, Lowestoft is at risk from the impacts of climate change. According to the latest UK Climate Projections (UKCP18), sea level rise of between 1.20 and up to 1.90m in the most extreme scenario will be experienced on the East Anglia coastline over the next 100 years. Future changes in storminess and wave conditions are more uncertain. Flooding will become much more frequent, meaning that all coastal towns will need to adapt. The suite of flood risk management measures that are to be delivered as part of the Lowestoft Flood Risk Management Project will be key in protecting Lowestoft from future flood risk.

Please refer to the Climate Change and the Anglian River Basin District (RBD) section for more information on what we know are likely to be the implications of climate change in the Anglian RBD.

Objectives and measures for the Lowestoft Flood Risk Area

Measures have been developed that apply specifically to the Lowestoft FRA.

You can find information about all the measures that apply to the Lowestoft FRA in the Flood Plan Explorer, an interactive mapping tool. This includes information on which national objectives each measure helps to achieve.

The Mablethorpe Rivers and the Sea Flood Risk Area

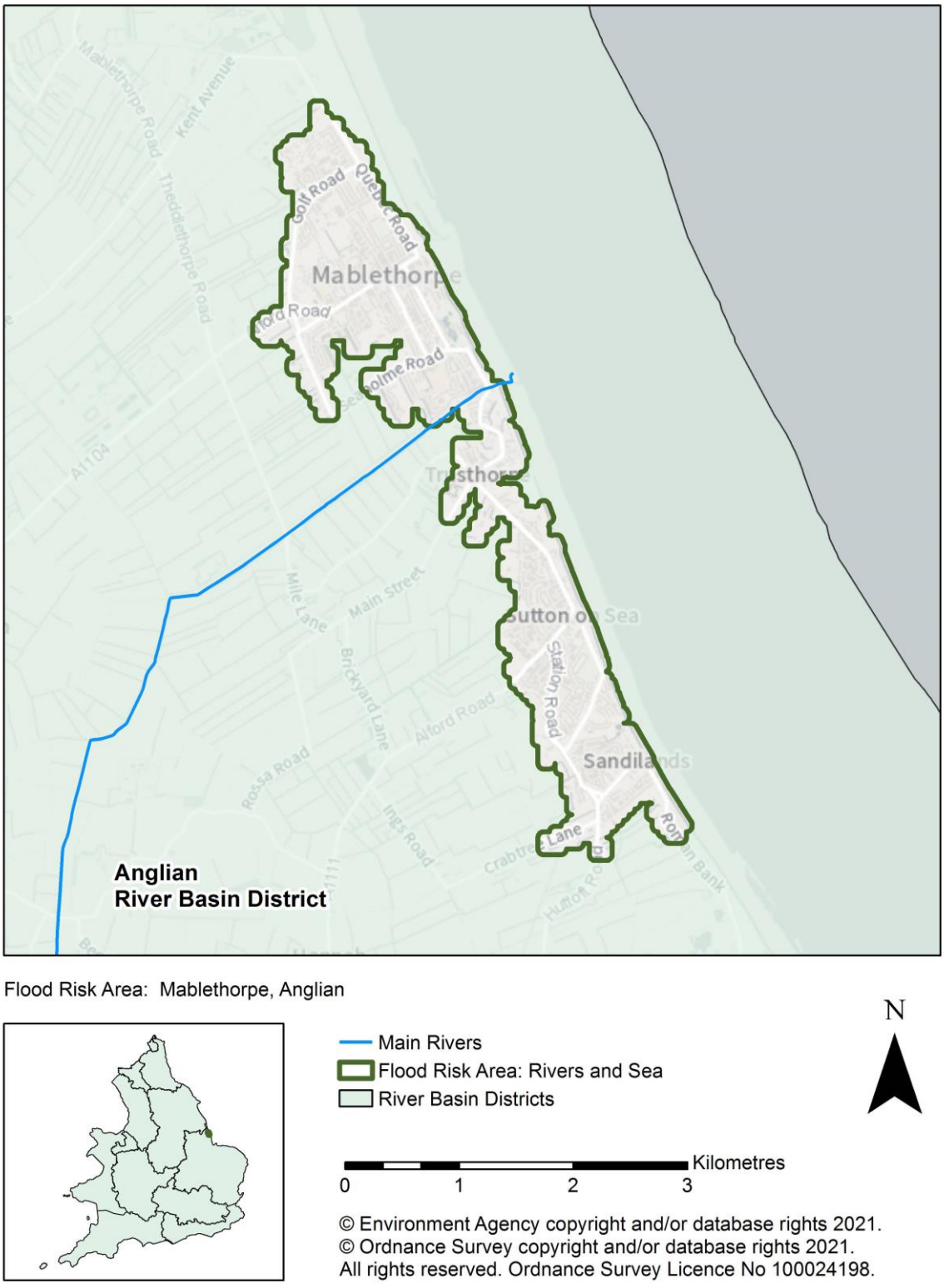


Figure 17: a map showing the boundary of the Mablethorpe Flood Risk Area

Introduction to the Mablethorpe Flood Risk Area

The Mablethorpe Flood Risk Area (FRA) has been identified as an FRA because the risk of flooding from main rivers and the sea is significant nationally for people, the economy, or the environment (including cultural heritage).

The Environment Agency leads on the development and delivery of the Flood Risk Management Plan for this FRA. Lincolnshire County Council is the Lead Local Flood Authority (LLFA) responsible for managing flood risk from 'local' sources. These local sources of flooding are:

- surface water
- groundwater
- ordinary watercourses

The Environment Agency's remit covers flood risk from rivers and the sea.

Anglian Water Services is the water and sewage company that owns, operates and maintains the sewerage network and wastewater treatment infrastructure in the FRA.

The Lindsey Marsh Drainage Board are responsible for land drainage in this FRA.

The Mablethorpe FRA extends down the coast to include:

- Trusthorpe
- Sutton on Sea
- Sandilands

It's primarily urban with grade 3 agricultural land at the periphery. The predominant soil type is seasonally wet deep clay.

The Greater Wash is a SPA within the FRA and there are 2 bathing water areas, at Mablethorpe town and Sutton on Sea. Sandilands golf course and dunes is a local wildlife site that begins at the south of the FRA. Sea Bank Clay Pits SSSI is partially within the Mablethorpe FRA.

The Steeping and Eaus catchment is predominately rural with small settlements and historic market towns. To the east the catchment becomes coastal floodplain and the watercourses flow to the North Sea. The Lincolnshire coastal resort of Mablethorpe is within this catchment. The Woldgrift Drain main river flows through the FRA and out to sea between Mablethorpe and Trusthorpe.

The town of Mablethorpe has existed on the banks of the North Sea for many centuries. It suffered many devastating tidal flood events through the thirteenth and fifteenth centuries, which repeatedly broke through the sea banks and claimed land and lives.

In more recent times it was a centre for ship breaking through the winter. In 1953, Mablethorpe was hit by the disastrous East Coast Floods. The flood defences were breached, and 42 victims lost their lives.

The town has been a popular seaside resort for centuries and remains largely reliant on tourism and its seasonal economy. Several caravan parks and guest houses provide tourist accommodation, and the risks from tidal flooding remain at the forefront of planning considerations.

The main risk within the FRA is from tidal sources.

Current flood risk

The flood hazard and risk maps show that in the Mablethorpe FRA, 16396 people live in areas at risk of flooding from rivers and the sea. Of these people, 3% live in areas of high risk.

Also shown to be in areas at risk of flooding from rivers and sea are:

- 1107 non-residential properties - including community centres, hospitals, schools and colleges, retail parks and public utilities
- 228.58ha of agricultural land
- 9 listed buildings
- 1 water abstraction point

The flood hazard and risk maps provide more detailed information on the likelihood and consequence of flooding for the Mablethorpe FRA.

Based on this information, Risk Management Authorities (RMAs) have concluded that further steps should be taken to reduce the likelihood of flooding and the current and future impact it could have on the FRA.

How the risk is currently managed

The management of flood risk from rivers and the sea is led by the Environment Agency in collaboration with other RMAs. These include:

- East Lindsey District Council
- Lincolnshire County Council
- Lindsey Marsh Drainage Board
- Anglian Water

A partnership framework has been set up across Lincolnshire involving all RMAs to coordinate the management of flood risk and water management. Strategic direction is delivered by the Lincolnshire Flood Risk and Water Management Strategy Group (chaired by the Environment Agency).

The Management Group (chaired by Lincolnshire County Council) delivers the responsibilities of the LLFA. There are 4 Local Flood Risk and Drainage Management Groups (chaired by Lincolnshire County Council Highways) that deliver flood risk and water management solutions to meet local circumstances. The Louth FRA is covered by the East Lindsey Flood Risk and Drainage Management Group.

Lincolnshire LRF is a multi-agency partnership made of representatives from local public services, such as:

- emergency services
- local authorities
- NHS
- Environment Agency

To help prepare for and respond to emergencies the LRF publish a community risk register.

It provides information on the key risks that have the potential to cause disruption to the county. These include East Coast and inland flooding.

There are 4 flood warning areas that cover the FRA. This enables people to receive a warning when flooding could occur. This data also informs the operational response during a flood incident.

Updated Modelling and mapping of the Woldgrift drain was undertaken in 2019. Coastal hazard mapping has also been undertaken in 2010 to show the risk of flooding from breaches and overtopping of the sea defences. This is for the present day and the future, which consider the effects of climate change.

Flood risk maps are published based on the outputs from modelling to inform:

- the public and businesses of their flood risk
- potential developers and local planning authorities
- the assessment and design of flood risk management works

The Environment Agency operates and maintains flood risk management assets on the main watercourses and sea defences in the FRA. These include:

- flood defence walls
- fluvial outfall tunnels
- flood gates
- channels
- culverts
- debris screens

This work also includes routine inspection and clearance activities, as well as regular repair and replacement of assets.

Flood risk improvement works that benefit the Mablethorpe FRA completed recently by the Environment Agency include the:

Trusthorpe Outfall Improvements project, which was completed in 2021. This included installation of a new electronically operated control structure to prevent sea water flooding inland.

The Saltfleet to Gibraltar Point Beach Management scheme annually places around 380,000 cubic metres of sand in key locations along a 20km frontage of the Lincolnshire east coast. We've been artificially supplying sand to recharge the beach in this area since 1994. This scheme, in combination with the existing hard defences, reduces the risk of tidal flooding with a 0.5% chance of occurring in any one year. This flood risk management approach benefits:

- 20,000 households
- 24,500 static caravans
- 1,700 businesses
- 35,000ha of agricultural land

Approval of the Saltfleet to Gibraltar Point Strategy outlines how flood risk will be managed over the next 100 years. In the short term this will see a continuation of nourishment. Enhancing the Lincolnshire Coast project will develop the future project investments, running in parallel with the Beach Management Scheme. It will also deliver a project to 'pilot' rock structures on the beach to complement the nourishment.

The impact of climate change and future flood risk

As sea levels rise, coastal flooding will become more frequent as higher water levels will be seen more often.

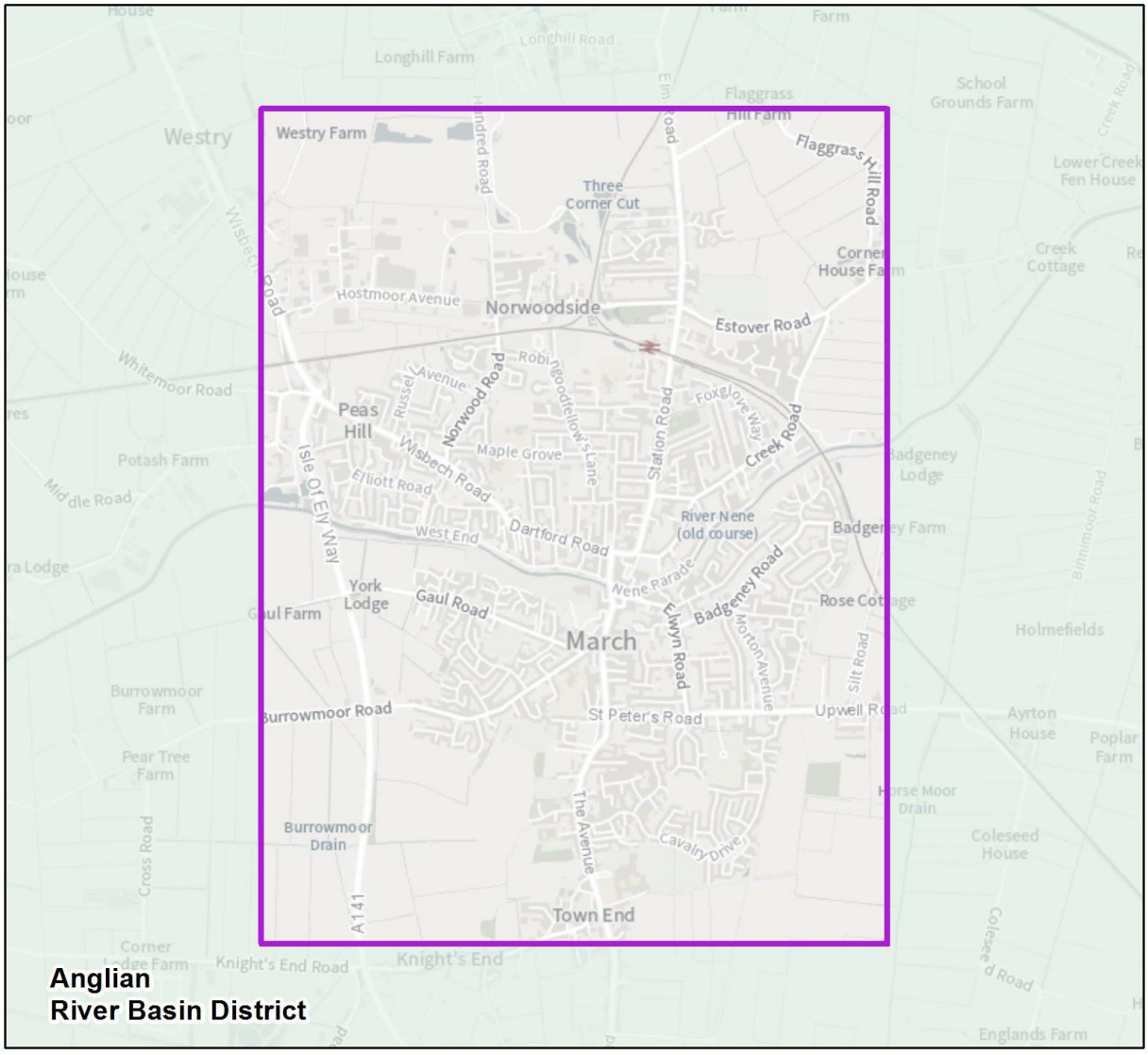
Please refer to Climate Change and the Anglian River Basin District (RBD) section for more information on what we know are likely to be the implications of climate change in the Anglian River Basin District.

Objectives and measures for the Mablethorpe FRA

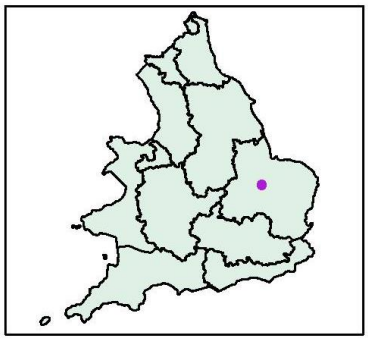
Measures have been developed that apply specifically to the Mablethorpe FRA. These measures have been developed in addition to those covering a wider geographic area, which also apply to the Mablethorpe FRA.

You can find information about all the measures that apply to the Mablethorpe FRA in Flood Plan Explorer, an interactive mapping tool. This includes information on which national objectives each measure helps to achieve.

The March Surface Water Flood Risk Area



Flood Risk Area: March, Anglian



Flood Risk Area: Surface Water
River Basin Districts

N

Kilometres
0 0.8 1.6 2.4

Figure 18: a map showing the boundary of the March Flood Risk Area

Introduction to the March Flood Risk Area

The March Flood Risk Area (FRA) has been identified as an FRA because the risk of flooding from surface water is significant nationally for people, the economy or the environment (including cultural heritage).

Cambridgeshire County Council leads on the development and delivery of the Flood Risk Management Plan for this FRA.

March is a market town in the North of Cambridgeshire within the Fenland District Council area, with a population of approximately 23,000 people.

March is on elevated ground, surrounded by low-lying Fens. The town typically lies on clay soils with pockets of sand and gravel deposits. The low-lying nature of the town and its geology can lead to high water tables following prolonged wet periods. This can exacerbate local flood risk as ground water can infiltrate the local drainage network.

March is in a designated Nitrate Vulnerable Zone. The town is served by a combination of:

- surface water drains
- foul water drains
- combined sewers
- culverted watercourses
- open watercourses

Ownership of these assets is dispersed among many parties, both Risk Management Authorities (RMA) and riparian. Flows from the surface water network are discharged into Internal Drainage Board (IDB) catchments that surround the area. The foul and combined sewer network is supported by several pumping stations.

Current flood risk

March has experienced flooding on several occasions. These include:

- 2006
- 2009
- 2012
- 2014
- 2016
- 2018
- 2020

The most notable historic flood events on the LLFA records occurred on 8 to 9 August 2014 and on 23 December 2020.

In 2014 internal flooding was experienced on 28 different streets in the March FRA and in 2020 across 12 streets.

There are several flood risk mechanisms taking place in March that include:

- an absence of infrastructure and blocked assets
- cross connections of foul and surface water sewers

More details on the current understanding of flooding mechanisms can be found in the March Flood Risk Investigation on the county council website.

The flood risk and hazard maps show that in the March FRA, 3,095 of the 23,281 people live in areas at risk of flooding from surface water. Of these people, 25% live in areas considered to be at high risk.

Also shown to be at risk of flooding from surface water are:

- 74 non-residential properties
- 2 out of 140 services
- 2 sites regulated under the Environmental Permitting Regulations
- 2 licensed water abstraction sites
- 120.4ha of agricultural land - of which around 47.8ha are at high risk
- 0.29ha of Scheduled Ancient Monuments
- 0.59km of railway
- 0.12km of roads

The flood risk and hazard maps provide more detailed information on the likelihood and consequence of flooding for the March FRA.

Based on this information, RMAs have concluded that further steps should be taken to reduce the likelihood of flooding and the current and future impact it could have on the FRA.

How the risk is currently managed

The management of surface water flood risk is led by Cambridgeshire County Council in collaboration with other RMAs and other stakeholders, including:

- the Environment Agency
- Anglian Water
- Cambridgeshire Highways Authority
- Fenland District Council
- Middle Level Commissioners

A partnership framework has been set up across Cambridgeshire. The Cambridgeshire and Peterborough Flood and Water Partnership Group is chaired by Cambridgeshire County Council and involves all RMAs. This provides a coordinated and collaborative approach to management of flood risk and water management.

Separately, the Cambridgeshire and Peterborough Local Resilience Forum is a multi-agency partnership made up of representatives from local public services such as:

- emergency services
- local authorities
- NHS
- Environment Agency

Associated businesses, organisations and voluntary sector representatives are also involved. These organisations work together through the LRF to prepare for and respond to emergencies. The community risk register is a collection of assessments of emergencies that might happen locally within Cambridgeshire. Each potential emergency is rated in terms of its potential impact and likelihood of occurring. Flooding is included in this assessment.

Anglian Water is the water and sewerage Company that owns, operates and maintains the sewer network and wastewater treatment infrastructure in the FRA.

Cambridgeshire Highway Authority operates and maintains drainage infrastructure serving the adopted highway network.

Middle Level Commissioners manage the water level in several watercourses in the area, including the Old River Nene.

Fenland District Council incorporates flood risk into decisions on new developments and are responsible for several watercourses in March. Operation and maintenance of the watercourses are delivered in partnership with North Level District IDB.

A Surface Water Management Plan has previously been developed for March which identified several potential interventions. Some projects have been put into the programme pipeline, however due to significant deliverability issues, those projects have not progressed. Cambridgeshire County Council are now working with partners to look at better understanding of the wider catchment and to identify ways in which barriers to project delivery can be overcome.

The impact of climate change and future flood risk

Rainfall intensity is expected to increase in the future, causing greater volumes of runoff and higher flows within watercourses. It’s therefore likely that flooding will become more frequent.

Please refer to the Climate Change and the Anglian River Basin District (RBD) section for more information on what we know are likely to be the implications of climate change in the Anglian RBD.

Objectives and measures for the March Flood Risk Area

Measures have been developed that apply specifically to the March FRA.

You can find information about all the measures that apply to the March FRA in the Flood Plan Explorer, an interactive mapping tool. This includes information on which national objectives each measure helps to achieve.

The Market Harborough Surface Water Flood Risk Area

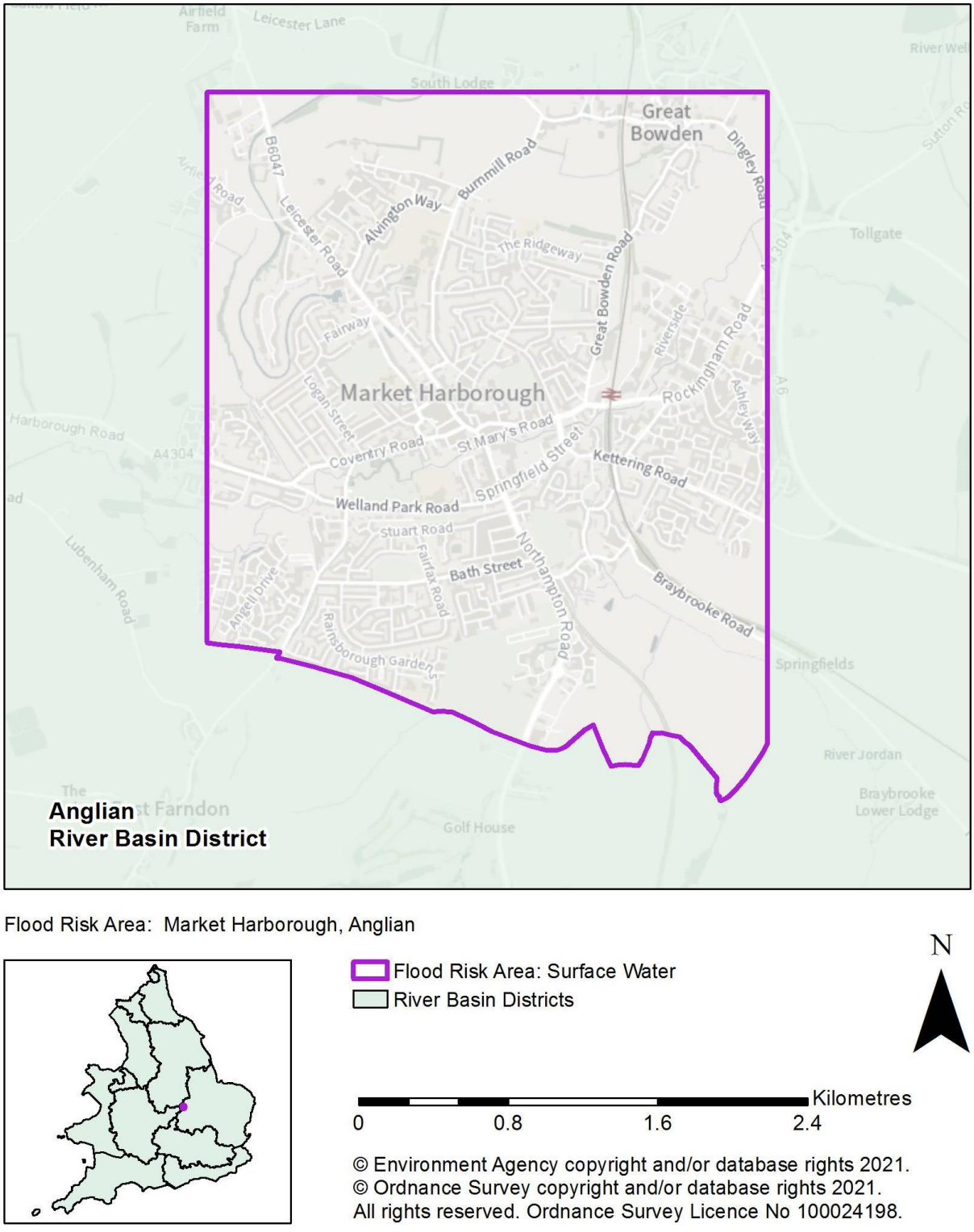


Figure 19: a map showing the boundary of the Market Harborough Flood Risk Area

Introduction to the Market Harborough Surface Water Flood Risk Area

The Market Harborough Flood Risk Area (FRA) has been identified as an FRA because the risk of flooding from surface water is significant nationally for people, the economy, or the environment (including cultural heritage).

Leicestershire Council leads on the development and delivery of the Flood Risk Management Plan for this FRA as they're the Lead Local Flood Authority (LLFA) responsible for managing flood risk from 'local' sources. These local sources of flooding include:

- surface water
- groundwater
- ordinary watercourses

The Environment Agency's remit covers flood risk from rivers and the sea.

Anglian Water Services is the water and sewage company that owns, operates and maintains the sewerage network and wastewater treatment infrastructure in the FRA. Severn Trent Water is responsible for the potable water supply within the FRA.

The Market Harborough FRA is mainly urban and includes land use areas that are:

- residential
- business
- amenity areas

The FRA is surrounded by agricultural land. Great Bowden lies to the north of the FRA with Little Bowden to the south.

The seasonally wet silt and clay is slowly permeable. This can lead to seasonal waterlogging. The agricultural land peripheral to Market Harborough in generally grade 3.

Market Harborough is a market town located in south-east Leicestershire on the River Welland. It is close to the Northamptonshire border. The land on which the town stands rises from the river to its highest point around 250ft above sea level.

Historically, Market Harborough was founded as a small village by the Saxons. By 1204 a market had been established. This market has been held on Tuesdays ever since 1221 and eventually gave the town its name of Market Harborough. In the 1800s Harborough Wharf became a distribution centre for coal and corn. Other industries also flourished such as:

- gas
- carpet making
- brickworks
- breweries
- coaches

Current industries in Market Harborough include:

- rubber
- textiles
- light engineering

Compared to the rest of the UK it has a greater proportion of smaller organisations with fewer than 10 employees.

The catchment of the River Welland is in the East of England and extends from the river headwaters around Market Harborough. Market Harborough has a history of river and surface flooding. Following some serious flooding in 1958, a flood relief scheme began and the riverbed was straightened and deepened.

Flood risk in the catchment today is managed by flood defences such as storage reservoirs and flood walls. Surface water drainage and sewer flooding has also occurred in parts of Market Harborough, notably in 2004.

The majority of the Market Harborough FRA are serviced by separate surface water and foul drainage networks. The greatest density of surface water drainage is to the newest developments at the periphery of the FRA. Several outfalls from the system discharge into:

- River Welland
- Brookfield Drain
- River Jordan
- West Brook

Several sewer assets and networks with the FRA are noted as being critical components. This is where failure of the asset will lead to a much higher risk of flooding. These include:

- the ordinary watercourse tributary to the River Welland, Farndon Fields
- culverted ordinary watercourse tributary to the River Welland, Rugby Close, Market Harborough
- Anglian Water attenuation tank, Commons Car Park, Market Harborough

The River Welland (Kettering branch) bisects the FRA with inflows from the Brookfield drain and River Jordan. West Brook is an inflow to the River Jordan in the south of the FRA.

The Market Harborough Arm of the Grand Union Canal lies in the north-west of the FRA and is maintained by the Canal & River Trust. It is also recorded as a Local Wildlife Site.

Current flood risk

Recent Incidents include:

- March 2016 - 20 properties experienced flooding as a result of surface water and river flooding.

- December 2020 - significant rainfall led to internal property flooding to 3 properties and external property flooding to a further 4 properties. Flooding was from surface water.

There are also several minor flooding incidents recorded which led to numerous incidents of property flooding from surface water, fluvial or foul sources:

- February 2016
- August 2017
- July 2019

The flood hazard and risk maps show that in the Market Harborough FRA, 6,887 people live in areas at risk of flooding from surface water. Of these people, 9% live in areas of high risk.

Also shown to be in areas at risk of flooding from surface water are:

- 690 non-residential properties - including community centres, hospitals, schools, colleges, retail parks and public utilities
- 2.53 km of roads - including parts of the A508 and A4304
- 1.31 km of railway
- 121.92 ha of agricultural land
- 36 listed buildings
- 1 water abstraction point

The flood hazard and risk maps provide more detailed information on the likelihood and consequence of flooding for the Market Harborough FRA. Based on this information, Risk Management Authorities (RMAs) have concluded that further steps should be taken to reduce the likelihood of flooding and the current and future impact it could have on the FRA.

This is being addressed through Leicestershire County Councils SWMP.

How the risk is currently managed

The management of surface water flood risk is led by Leicestershire County Council in collaboration with other RMAs and other stakeholders. These include:

- Harborough District Council
- Environment Agency
- Welland Valley Rivers Trust
- Anglian Water

The Leicestershire LRF is a multi-agency partnership made of representatives from local public services, such as:

- emergency services
- local authorities
- NHS

- Environment Agency

Partners are required to respond in the event of emergencies in their respective roles. Jointly they safeguard and mitigate the consequential impacts on:

- property
- wellbeing of residents
- communities
- businesses

Flooding is one of the risks addressed by the LRF through community flood preparation.

The LLFA is a member of the Welland Valley Partnership which is led by the Welland Valley Rivers Trust. This partnership is focused on the identification and delivery of ecologically beneficial flood schemes across the Welland Valley. Several schemes are currently being led by the partnership. These are focused on the headwaters of the Welland and will have an impact on reducing fluvial flood risk within the FRA area.

The Environment Agency monitors river flows at 4 locations in the centre of the FRA. Rainfall is also monitored at 2 locations to the north of the FRA. This information is used to inform activities related to 4 flood warning areas that cover the FRA. This enables people to receive a warning when flooding could occur. This data also informs the operational response during a flood incident.

Leicestershire County Council commissioned a Phase 1 and Phase 2 Surface Water Management Plan (SWMP) in 2018. This sits alongside the Environment Agency's Long Term Flood Risk Maps. The SWMP includes a high-level modelling exercise. This looks at potential options to mitigate flooding within the Market Harborough FRA area from future flooding.

Phase 1 and Phase 2 of the SWMP has concluded that there are 15 critical drainage areas within Market Harborough. Potential options should be investigated and explored. Leicestershire County Council is working in partnership to review the outputs of the SWMP and identify possible mitigation options and partnership schemes. Partners include:

- Environment Agency
- Anglian Water
- Welland Valley Rivers Partnership

Leicestershire County Council and Anglian Water Services operate and maintain assets that perform a flood risk management function on the drainage network. Leicestershire County Council also maintain several highway culverts within the county.

The Environment Agency similarly operates and maintains flood risk management assets on the main watercourses in the FRA. These include:

- flood defences
- channels
- culverts

- debris screens

This work includes routine inspection and clearance activities as well as regular repair and replacement of assets.

The Canal & River Trust maintains the Grand Union Canal as a navigable waterway.

The impact of climate change and future flood risk

As rainfall intensity increases, it means that surface water flooding will become more frequent as higher rainfall totals will be seen more often.

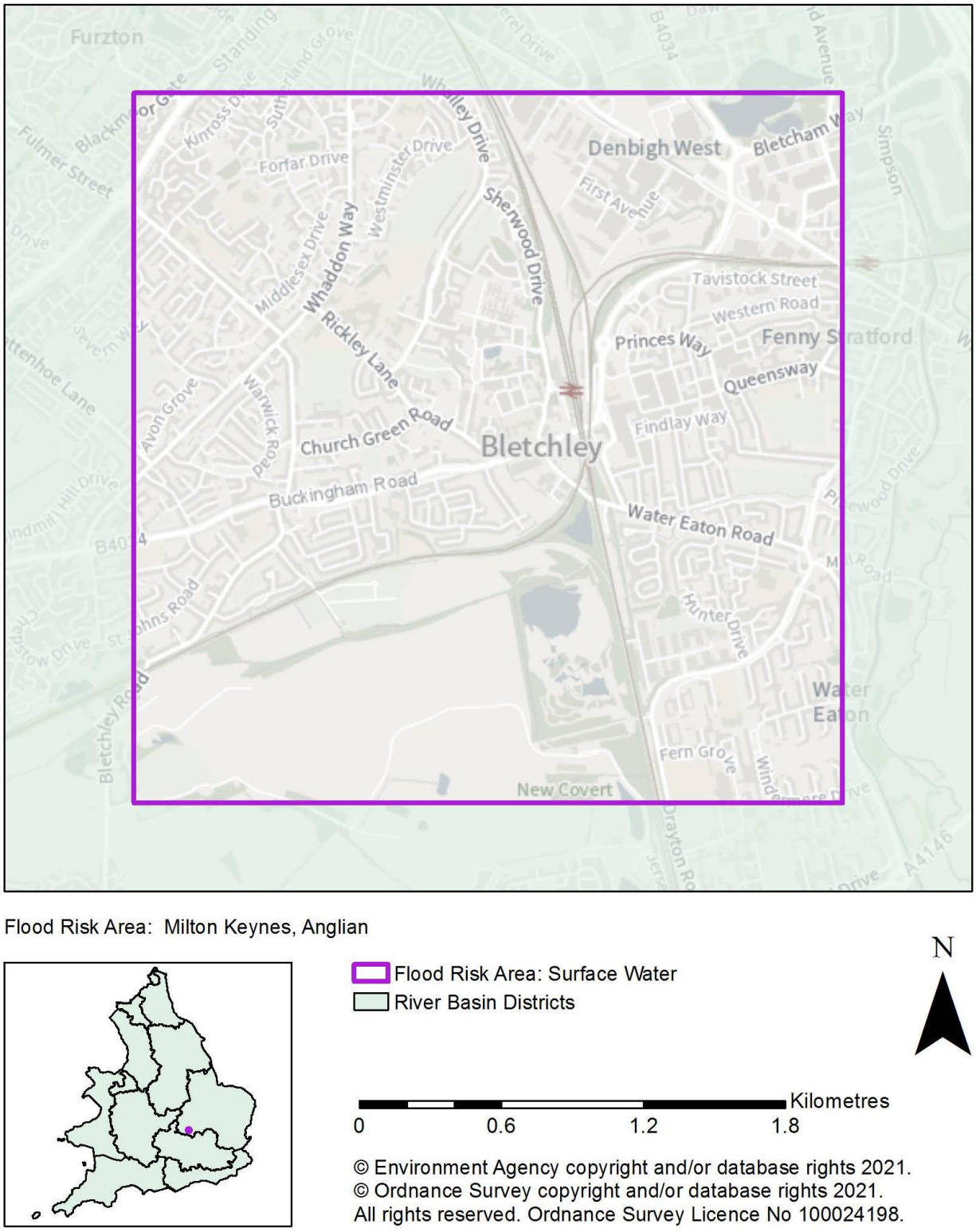
Please refer to Climate Change and the Anglian River Basin District (RBD) section for more information on what we know are likely to be the implications of climate change in the Anglian RBD.

Objectives and measures for the Market Harborough FRA

Measures have been developed that apply specifically to the Market Harborough FRA. These measures have been developed in addition to those covering a wider geographic area that also apply to the Market Harborough FRA.

You can find information about all the measures that apply to the Market Harborough FRA in Flood Plan Explorer, an interactive mapping tool. This includes information on which national objectives each measure helps to achieve.

The Milton Keynes Surface Water Flood Risk Area



Flood Risk Area: Milton Keynes, Anglian

Flood Risk Area: Surface Water
River Basin Districts

N

Kilometres
0 0.6 1.2 1.8

Figure 20: a map showing the boundary of the Milton Keynes Flood Risk Area

Introduction to the Milton Keynes Flood Risk Area

The Milton Keynes Flood Risk Area (FRA) has been identified as an FRA because the risk of flooding from surface water is significant nationally for people, the economy, or the environment (including cultural heritage).

Milton Keynes Borough Council leads on the development and delivery of the Flood Risk Management Plan for this FRA as the responsible authority for managing flood risk from surface water.

Milton Keynes Council works in partnership with all Risk Management Authorities (RMAs), partner organisations and neighbouring authorities that support to facilitate flood risk reductions and enhance flood resilience.

The Environment Agency's remit covers flood risk from main rivers and the sea.

Anglian Water is the water and sewerage company that owns, operates and maintains the sewer and balancing lake network and wastewater treatment infrastructure in the FRA.

The Milton Keynes FRA shown in Figure 20 covers an area of approximately 9km^2. However, the FRA should also encompass the wider area of Milton Keynes described here.

The flood risk across the overall area varies according to the geography and terrain. The areas at risk have been split into rural north and urban south.

The north of Milton Keynes is rural, and the predominant land use is agriculture. The north of Milton Keynes consists of rural villages that are drained by ordinary watercourses. The primary cause of the flooding in this area is associated with ordinary watercourses.

The south of Milton Keynes is highly urbanised with residential and commercial use. Approximately 110,000 properties are drained by Anglian Water via a network of sewers and balancing lakes. The River Ouzel flows through the eastern part of the urban area and outfalls to the River Great Ouse to the north. Designated sites include the Blue Lagoon, which is in the South of Milton Keynes Council area, and is identified as a Local Nature Reserve.

Milton Keynes is the fastest growing new town in the U.K. The creation of Milton Keynes was commissioned in the 1960s, and it was identified at an early stage that the creation of the town could exacerbate flood risk to downstream communities. To mitigate this risk, a network of balancing lakes was created. Future Growth of Milton Keynes is anticipated to continue at a rate of 5% a year.

The underlying geology across the Borough of Milton Keynes predominantly consists of clay. The rural north is permeable when ground conditions are not saturated or baked. The urban South is 60% to 70% impermeable and is drained via a sewer network and balancing lakes. Both catchments respond rapidly in saturated and baked soil conditions.

Milton Keynes Borough Council has been working in partnership with Anglian Water to review the condition of the sewer network. The council has identified and shared several flooding hotspots with Anglian Water. The council has also reviewed the flooding in this area and identified areas for surveying which has resulted in major remediation works in these locations resulting in a reduction in flooding.

The sewer network is strategic and consists of large sewers (which exceed 2m in diameter in some locations) and balancing lakes.

Current flood risk

Flooding has occurred in the town on several occasions recently in:

- January 2021
- December 2020
- October 2020
- May 2018
- June 2016

The May 2018 incident was particularly severe. 500 properties flooded across the Borough of Milton Keynes following significant rainfall resulting in surface water flooding. The main impacted areas included:

- Coffeehall
- Beanhill
- Oldbrook
- Netherfield
- Tinkers Bridge
- Stoke Goldington

The flood risk and hazard maps show that in the Milton Keynes FRA, 2,365 of the 26,136 people live in areas at risk of flooding from surface water. Of these people, 9% live in areas considered to be at high risk.

It's important to note that these stats relate to the area shown in Figure 20 only and do not include the wider area of Milton Keynes.

Also shown to be at risk of flooding from surface water are:

- 155 non-residential properties
- 12 out of 174 services
- 3.1km of railways
- 0.1km of roads
- 1 site regulated under the EPR
- 1 listed building
- 60.8ha of agricultural land - of which 10.2ha is at high risk

The flood risk and hazard maps provide more detailed information on the likelihood and consequence of flooding for the Milton Keynes FRA.

Based on this information, Risk Management Authorities (RMAs) have concluded that further steps should be taken to reduce the likelihood of flooding and the current and future impact it can have on the FRA.

How the risk is currently managed

The management of surface water flood risk is led by Milton Keynes Borough Council in collaboration with other RMAs and other stakeholders, including:

- Anglian Water
- Bedford Group of Internal Drainage Boards
- The Environment Agency
- Milton Keynes Highways
- the Parks Trust

Flood risk management is coordinated in partnership with other flood RMAs. At an operational level, Milton Keynes Council identifies flooding hotspots, and shares these with other RMAs to inspect and review the condition of existing drainage systems. At strategic level the council supports with the creation of flooding schemes and resource allocation.

The borough council jointly monitors surface water/sewer flooding risk with Anglian Water.

The Milton Keynes FRA includes 48 local Parish Councils. The Parish Councils have been assisting Milton Keynes Council and other Category 1 responders to respond to flooding incidents and reduce impacts. Milton Keynes Council is working with local Parish Councils to develop community flood plans.

Separately, the Thames Valley LRF is a multi-agency partnership made up of representatives from local public services, such as:

- emergency services
- local authorities
- NHS
- Environment Agency

Associated businesses organisations and voluntary sector representatives are also involved. These organisations work together through the LRF to prepare for and respond to emergencies. The community risk register is a collection of assessments of emergencies that might happen locally within Milton Keynes. Each potential emergency is rated in terms of its potential impact and likelihood of occurring. Flooding is included in this assessment.

Milton Keynes Council is undertaking hydraulic modelling in Lavendon and has been comparing the existing risk mapping with flooding hotspots. This analysis has identified some unmapped areas of flood risk.

Milton Keynes Council Highways owns and operates 80,000 gullies and associated infrastructure across the Borough of Milton Keynes. Flood defences have been constructed in Stoke Goldington and Tathall End. The urban area of Milton Keynes is also based on a grid system and to facilitate this, the Development Corporation integrated significant infrastructure spanning across the river network. This infrastructure is owned and operated by Milton Keynes Council through the Council's Highways department. This infrastructure has a significant impact on surface water and main river risk.

As part of the development of Milton Keynes a surface water and foul sewer network was developed to drain the urban area in the south of Milton Keynes. Surface water sewers drain the highways infrastructure and residential and commercial properties through a strategic sewer and balancing lake network. This infrastructure is maintained by Anglian Water. These are extremely important aspects which can have a significant impact on surface water and main river flood risk.

Milton Keynes consists of linear parks that link the network of balancing lakes. These are owned by Milton Keynes Council,and are leased to the Parks Trust. A corridor of gauging stations also exists along the linear parks which measure inflows and outflows. These gauging stations are extremely critical to the management of flood risk. Anglian Water have installed a larger sewer on Wolverton Road, Newport Pagnell which has reduced the flooding in this area.

The impact of climate change and future flood risk

Rainfall intensity is expected to increase in future, causing greater volumes of runoff and higher flows within watercourses. It's therefore likely that flooding will become more frequent.

The anticipated rate of growth within Milton Keynes may also impact the risk of flooding. Although planning policy dictates that new development must not increase flood risk, an increase in impermeable surfaces may result in greater volumes of runoff being generated, potentially increasing the risk of surface water flooding.

Please refer to the Climate Change and the Anglian River Basin District (RBD) section for more information on what we know are likely to be the implications of climate change in the Anglian RBD.

Objectives and measures for the Milton Keynes FRA

Measures have been developed that apply specifically to the Milton Keynes FRA.

You can find information about all the measures that apply to the Milton Keynes FRA in the Flood Plan Explorer, an interactive mapping tool. This includes information on which national objectives each measure helps to achieve.

The Northampton Rivers and Sea Flood Risk Area

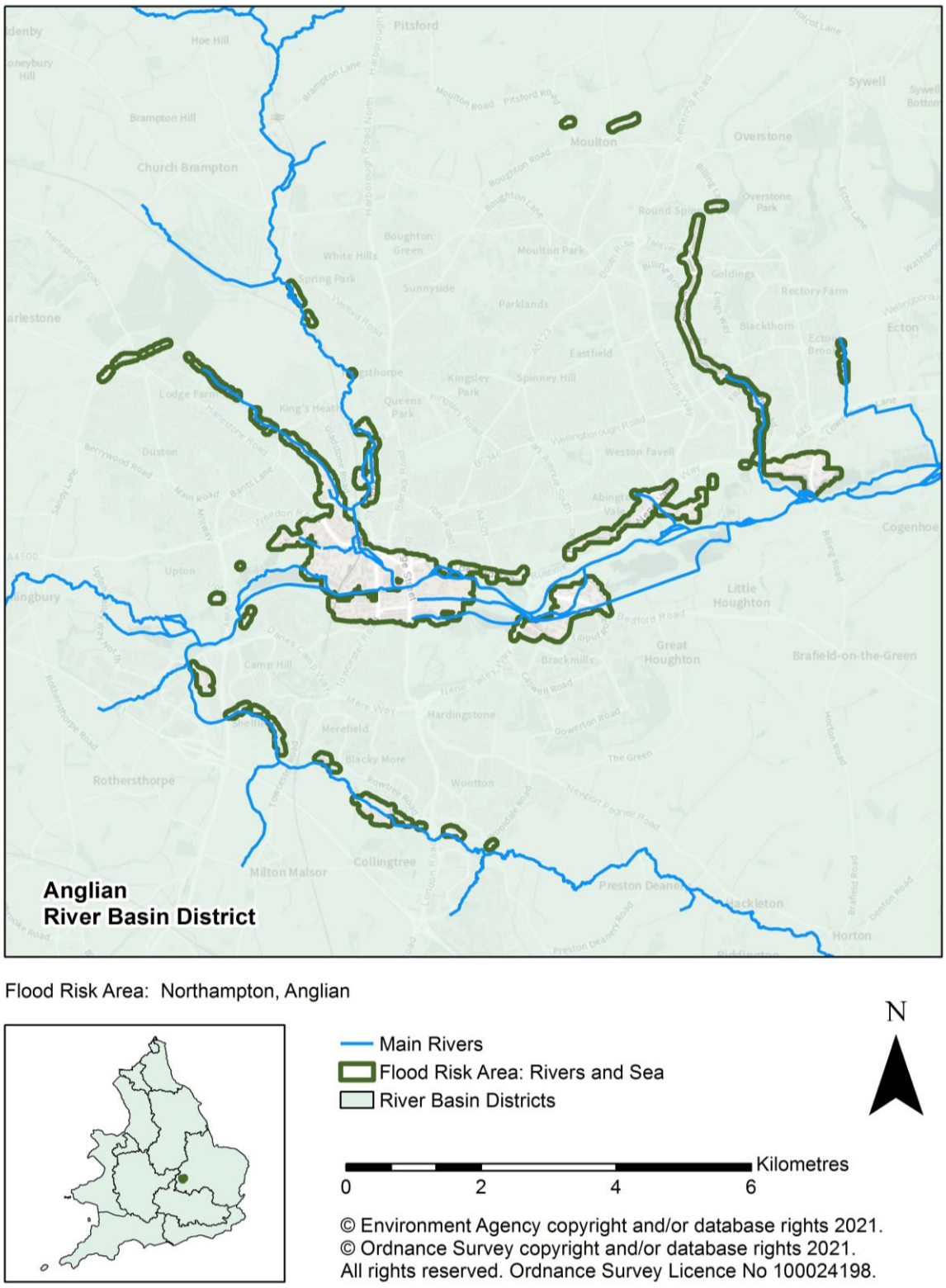


Figure 21: a map showing the boundary of the Northampton Rivers and Sea Flood Risk Area

Introduction to the Northampton Rivers and Sea Flood Risk Area

The Northampton Flood Risk Area (FRA) has been identified as an FRA because the risk of flooding from main rivers is significant nationally for people, the economy, or the environment (including cultural heritage).

The Environment Agency take the lead on the development and delivery of the Flood Risk Management Plan (FRMP) for this FRA. West Northamptonshire Council are the Lead Local Flood Authority responsible for managing flood risk from 'local' sources. These local sources include:

- surface water
- groundwater
- ordinary watercourses.

The Environment Agency's remit covers flood risk from rivers and the sea.

Anglian Water is the water and sewage company that owns, operates and maintains the sewerage network and wastewater treatment infrastructure in the FRA.

The Northampton FRA is mainly urban and includes areas of use, such as:

- residential
- business
- amenity

It's surrounded by agricultural land.

The seasonally wet silt and clay over shale is slowly permeable. This leads to seasonal waterlogging to the west of the FRA. To the east of the FRA the fine loamy soils are deep and permeable. They are variably affected by groundwater. Several reservoirs exist in the upper catchments.

The Northampton Rivers and Sea FRA includes several locations that are not connected to the main part of the FRA. In addition, there are small areas of 'dry islands', which are shown to be outside of the FRA. The reason for these seemingly anomalous areas relates to the methodology used to identify the FRA boundaries, which is detailed in Part A of the FRMP report. It is important to note that the mapping is limited to developed areas at risk of main river flooding, and measures included for the FRA may relate to the wider area.

Part of the Northampton arm of the Grand Union canal lies within the FRA. This is owned and maintained by the Canal & River Trust.

Located within the FRA are local nature reserves including:

- Kingsthorpe
- Scrub Field
- Hills and Holes

- Lings Wood
- Barnes Meadow

Scheduled monuments within the FRA include the Multivillate hillfort at Hunsbury Hill. There is also a Saxon palace and Saxon and Medieval deposits in the centre of Northampton. The historic battlefield of the ‘Battle of Northampton in 1460’ lies partly within the FRA.

Present day Northampton began as a settlement in the Bronze Age. It rose to national significance during the Middle Ages due to its location in the centre of England. It was largely destroyed in 1675 by the Great Fire of Northampton.

In 1762, the Nene Navigation Company made the River Nene navigable from King's Lynn up to Northampton. In 1815 the Grand Union Canal reached the town.

Northampton was designated a New Town after World War II and the M1 motorway opened to the south-west of the town. These events and rail links helped Northampton’s growth as a commuter town and the population expanded.

Brampton Branch is one of the main Nene tributaries. It flows into Northampton from the north where it then joins the River Nene.

The area is predominately rural with mixed arable and livestock farming, but urban through Northampton. The water bodies within this catchment are predominately at poor to moderate status. Other main river tributaries of the Nene include:

- Wootton Brook
- Dallington Brook
- Billing Brook
- Abington Brook
- Ecton Brook

Current flood risk

Northampton experienced significant flood incidents on:

- Good Friday 1998 - severe flooding with the areas of Far Cotton and St James particularly badly affected. Two people were killed, and thousands of homes were affected
- 24 December 2020 – approximately 140 properties flooded internally across Northamptonshire. Approximately 10 were within the Northampton FRA. Flooding was from surface water and river flooding following high rainfall on saturated catchments

The flood hazard and risk maps show that in the Northampton FRA, 7,911 people live in areas at risk of flooding from rivers and the sea. Of these people, 2% live in areas of high risk.

Also shown to be in areas at risk of flooding from rivers and sea are:

- 777 non-residential properties - including community centres, hospitals, schools and colleges, retail parks and public utilities
- 4.28km of roads
- 0.76km of railway
- 104.56ha of agricultural land
- 2.04ha environmental designated sites – SPA, Ramsar and SSSI
- 5 listed buildings
- 4 water abstraction points

The flood hazard and risk maps provide more detailed information on the likelihood and consequence of flooding for the Northampton rivers and the sea FRA. Based on this information, Risk Management Authorities (RMAs) have concluded that further steps should be taken to reduce the likelihood of flooding and the current and future impact it could have on the FRA.

How the risk is currently managed

The management of flood risk from rivers and sea is led by the Environment Agency in collaboration with other RMAs including West Northamptonshire Council.

A partnership framework has been set up across Northamptonshire involving all RMAs to coordinate the management of flood risk and water management. Strategic direction is provided by the Strategic Flood Risk Management Board which is chaired by the Environment Agency. The Local Flood Risk Operational Group is chaired jointly by West and North Northamptonshire Councils. This delivers the responsibilities of the LLFA.

The Northamptonshire Local Resilience Forum (LRF) is a multi-agency partnership made of representatives from local public services. Such as:

- emergency services
- local authorities
- NHS
- Environment Agency

Flooding is one of the risks addressed through community flood preparation.

The Environment Agency monitor river and rainfall conditions at 4 sites in and near to the FRA:

- Geldart Mill (Flow)
- Moulton Park (Precipitation)
- St Andrews Mill Bypass (Flow)
- South Bridge (Flow)

This information is used to inform activities related to 4 flood warning areas that cover the FRA. This enables people to receive a warning when flooding could occur. This data also informs the operational response during a flood incident.

The River Nene catchment is covered by strategic hydraulic modelling. The Nene Catchment Strategic Model comprises of a suite of several fluvial models. The River Nene was updated in 2016. Wootton Brook and Dallington Brook were updated in 2013. Fluvial breach modelling and mapping to show the residual flood risk associated with the flood defences was carried out in 2010.

Flood risk maps are published based on the outputs from modelling to inform:

- the public and business of their flood risk
- potential developers and local planning authorities
- the assessment and design of flood risk management works

The Environment Agency operates and maintains flood risk management assets on the main watercourses in the FRA. These include:

- flood defence walls
- flood gates
- channels
- culverts
- debris screens

This work includes routine inspection and clearance activities as well as regular repair and replacement of assets.

Through the urban area of Northampton there are a series of flood defences along the River Nene. These consist of earth embankments and concrete and brick walls. These line the Nene from Upton through to the Nunn Mills and Bedford Road area., The Upton Flood Attenuation Area was constructed upstream of Northampton. This mitigates for the increase in flows and the loss of floodplain storage.

A strategic approach to development was devised when Northampton was designated as a New Town. Much of the ‘south-west sector’ including the Hunsbury areas, drains to Wootton Brook. Areas to store surface water runoff and slow the flow to Wootton Brook include:

- Shelfleys and Swan Lakes
- Duston Flood Storage Reservoir

Surface water from the south-eastern areas of Northampton flows into Hardingstone Dyke. This passes south of Northampton Washlands Flood Storage Reservoir and discharges to the River Nene at Billing Aquadrome. The flows into the River Nene are limited by the pipe under the main river channel. When this is at capacity there is storage available in the Hardingstone Dyke flood storage reservoir.

The Northampton Washlands Flood Storage Reservoir was also constructed to store the surface water run-off which resulted from the expansion of Northampton. This helps to replace floodplain lost to development in the 1970s. This delays the onset of flooding downstream on the River Nene.

The Canal & River Trust maintains the Grand Union Canal as a navigable waterway.

The impact of climate change and future flood risk

As rainfall intensity increases, it means that surface water flooding will become more frequent as higher rainfall totals will be seen more often.

Please refer to Climate Change and the Anglian River Basin District (RBD) section for more information on what we know are likely to be the implications of climate change in the Anglian River Basin District.

Objectives and measures for the Northampton FRA

Measures have been developed that apply specifically to the Northampton FRA. These measures have been developed in addition to those covering a wider geographic area that also apply to the Northampton FRA.

You can find information about all the measures that apply to the Northampton FRA in Flood Plan Explorer, an interactive mapping tool. This includes information on which national objectives each measure helps to achieve.

The Northampton Surface Water Flood Risk Area

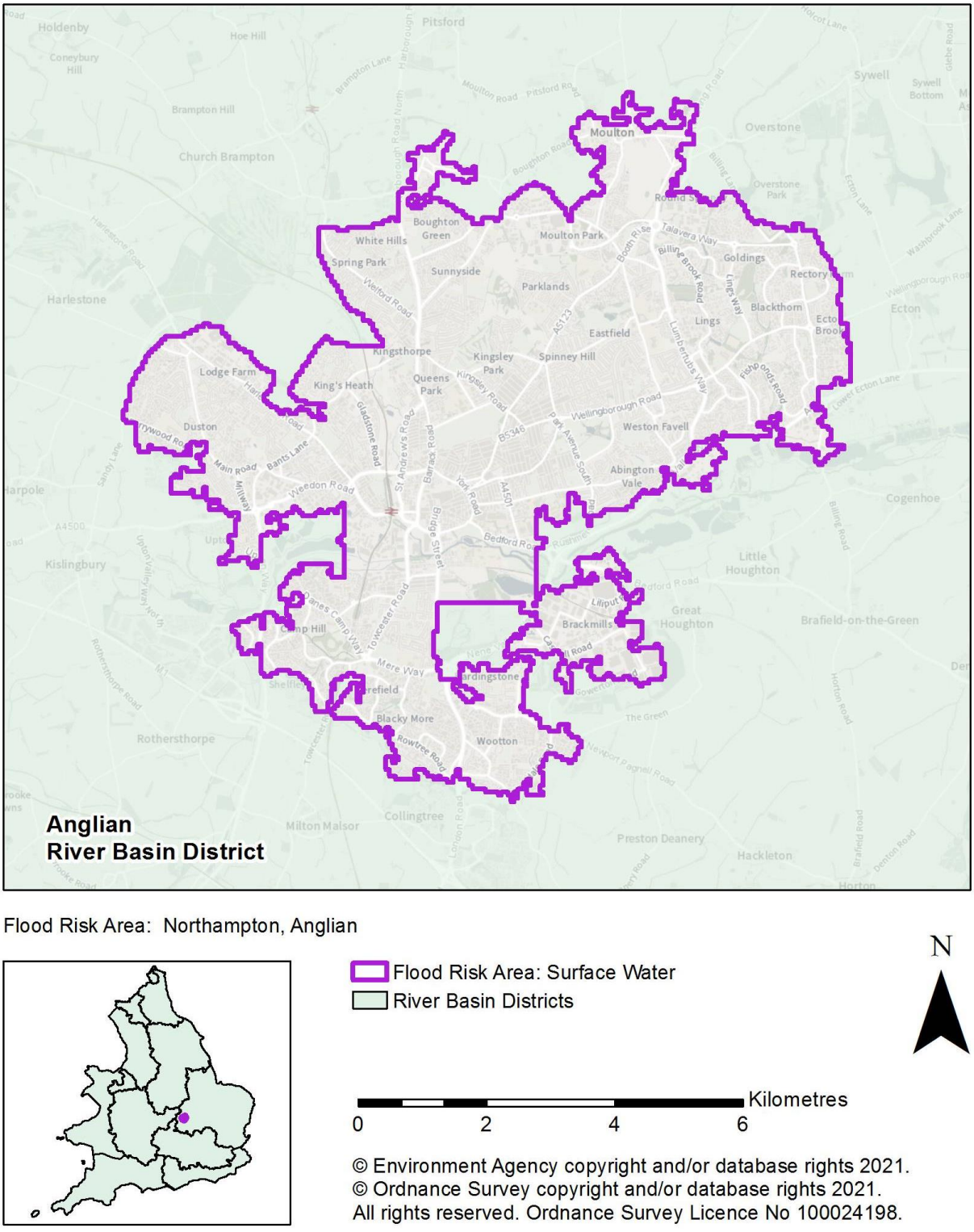


Figure 22: a map showing the boundary of the Northampton Surface Water Flood Risk Area

Introduction to the Northampton Surface Water Flood Risk Area

The Northampton Flood Risk Area (FRA) has been identified as an FRA because the risk of flooding from surface water is significant nationally for people, the economy, or the environment (including cultural heritage).

West Northamptonshire Council leads on the development and delivery of the Flood Risk Management Plan for this FRA. They're the Lead Local Flood Authority (LLFA) responsible for managing flood risk from 'local' sources. These local sources of flooding are:

- surface water
- groundwater
- ordinary watercourses

The Environment Agency's remit covers flood risk from rivers and the sea.

Anglian Water Services is the water and sewage company that owns, operates and maintains the sewerage network and wastewater treatment infrastructure in the FRA.

The Northampton FRA is mainly urban and includes:

- residential
- business
- amenity areas
- surrounding agricultural land

The seasonally wet silt and clay is slowly permeable, leading to seasonal waterlogging to the west of the FRA. To the east of the FRA the mainly fine loamy soils are deep and permeable and are variably affected by groundwater. Several reservoirs exist in the upper catchments.

Part of the Northampton arm of the Grand Union canal lies within the FRA and is owned and maintained by the Canal & River Trust.

Local nature reserves located within the FRA are:

- Kingsthorpe
- Scrub Field
- Hills and Holes
- Lings Wood
- Barnes Meadow

Scheduled monuments within the FRA include the Multivillate hillfort at Hunsbury Hill, and the Saxon palace and Saxon and medieval deposits in the centre of Northampton. The historic battlefield of the 'Battle of Northampton in 1460' lies partly within the FRA.

Present day Northampton began as a settlement in the Bronze Age. It rose to national significance during the Middle Ages due to its location in the centre of England. However, it was largely destroyed in 1675 by the Great Fire of Northampton.

In 1762, the Nene Navigation Company made the River Nene navigable from King's Lynn up to Northampton, and in 1815 the Grand Union Canal reached the town.

After World War II, Northampton was designated a New Town and the M1 motorway opened to the south-west of the town. These events and the new railway link helped Northampton's growth as a commuter town and the population expanded.

On Good Friday 1998, Northampton suffered severe flooding, particularly in the areas of Far Cotton and St James. Two people were killed, and thousands of homes were affected.

Central Northampton is serviced by a combined (foul and surface water) sewerage system, particularly in the older parts of the FRA where the capacity is limited. More modern parts of the town have separate foul and surface water systems. These include:

- Wootton
- Dallington
- Spinney Hill
- Abington
- Weston Favell

Several outfalls from the system discharge into the:

- River Nene
- Wootton Brook
- Dallington Brook
- Billing Brook
- Abington Brook
- Ecton Brook

Brampton Branch is one of the main Nene tributaries, flowing into Northampton from the north, where it joins the River Nene. It's predominately rural with mixed arable and livestock farming, but is urban through Northampton. The water bodies within this catchment are predominately at poor to moderate status. Other main river tributaries of the Nene which ordinary watercourses feed into include:

- Wootton Brook
- Dallington Brook
- Billing Brook
- Abington Brook
- Ecton Brook

Following the 1998 floods, a flood defence scheme was installed along the River Nene through Northampton. The Northampton Washlands and Upton flood attenuation area now compensate for the effect of upstream development on flow downstream. However, there

remains a significant risk of surface water flooding behind the defences, particularly in the historic areas of town. Furthermore, emergence of groundwater after prolonged periods of rain, and seepage of high river flows through riverine gravels, also contribute to the flood risk in the FRA.

Current flood risk

Since 2015, Northampton has experienced 2 significant flood incidents:

27 May 2018

- approximately 180 properties flooded internally across Northamptonshire
- the significant majority of these within the FRA
- this resulted in surface water flash flooding following heavy rainfall

24 December 2020

- approximately 140 properties flooded internally across Northamptonshire
- of which approximately 10 were within the Northampton FRA
- this resulted in surface water and fluvial flooding following high rainfall on saturated catchments

The flood hazard and risk maps show that in the Northampton FRA, 22,229 people live in areas at risk of flooding from surface water. Of these people, 12% live in areas of high risk.

Also shown to be in areas at risk of flooding from surface water are:

- 1867 non-residential properties - including community centres, hospitals, schools and colleges, retail parks and public utilities
- 12.93km of roads including parts of the A43, A5076, A5199, A428, A4500
- 4.05km of railway
- 236.89ha of agricultural land
- 2.04ha environmental designated sites – SPA, Ramsar and SSSI
- 5 listed buildings
- 4 water abstraction points

The flood hazard and risk maps provide more detailed information on the likelihood and consequence of flooding for the Northampton FRA.

Based on this information, Risk Management Authorities (RMAs) have concluded that further steps should be taken to reduce the likelihood of flooding and the current and future impact it could have on the FRA.

How the risk is currently managed

The management of surface water flood risk is led by West Northamptonshire Council in collaboration with other RMAs and stakeholders. An organisational framework is in place

via the Local Flood Risk Management Strategy. This is to ensure that partnerships are managed in ways that enhance the co-ordination of policy and actions, providing strong accountability and transparency. For example, this includes a clear demonstration of cooperation and the ‘added value’ of partnership working.

The framework consists of a Strategic Flood Risk Management Board and a Local Flood Risk Operational Group. Both feed into partnerships that include:

- Regional Flood and Coastal Committees
- Cabinet and Scrutiny Committees
- Local Resilience Forum

The Northamptonshire LRF is a multi-agency partnership made of representatives from local public services, such as:

- emergency services
- local authorities
- NHS
- Environment Agency

Flooding is one of the highest rated risks in the Northamptonshire Community Risk Register and is managed through the Multi-Agency Flood Plan. The Northamptonshire LRF coordinates the response to major flood incidents and is triggered by flood warnings and severe weather warnings.

The Environment Agency monitor river and rainfall conditions at 4 sites in and near to the FRA:

- Geldart Mill (Flow)
- Moulton Park (Precipitation)
- St Andrews Mill Bypass (Flow)
- South Bridge (Flow)

This information is used to inform activities related to 4 flood warning areas that cover the FRA. This enables people to receive a warning when flooding could occur and informs the operational response during a flood incident.

Detailed hydraulic modelling of the FRA was undertaken as part of a Surface Water Management Plan for the town in 2014. It was recently updated in 2020 as part of the ‘Boosting Action for Surface Water’ initiative.

West Northamptonshire Council and Anglian Water Services operate and maintain assets that perform a flood risk management function on the drainage network.

The Environment Agency similarly operates and maintains flood risk management assets on the main watercourses in the FRA. These include:

- flood defence walls
- flood gates

- channels
- culverts
- debris screens

This work includes routine inspection and clearance activities as well as periodic repair and replacement of assets.

Most structures on ordinary watercourses are the responsibility of the riparian owner.

The Canal & River Trust maintains the Grand Union Canal as a navigable waterway.

Far Cotton was the area of the FRA worst affected by the surface water flooding in May 2018. Work is underway to design a catchment-wide surface water management scheme to benefit Far Cotton and specifically St Leonard's Road. This would reduce the risk of surface water flooding to approximately 80 properties.

A flood resilience project has also been proposed within the Wootton Brook catchment as part of the Innovative Resilience programme for 2021 to 2028.

Other flood risk improvement works completed recently by the Environment Agency that benefit the Northampton FRA include Natural Flood Management Project. Delivery is in the Wooton Brook catchment, due for completion in 2021.

The impact of climate change and future flood risk

As rainfall intensity increases, it means that surface water flooding will become more frequent as higher rainfall totals will be seen more often.

Please refer to Climate Change and the Anglian River Basin District (RBD) section for more information on what we know are likely to be the implications of climate change in the Anglian River Basin District.

Objectives and measures for the Northampton Surface Water FRA

Measures have been developed that apply specifically to the Northampton FRA. These measures have been developed in addition to those covering a wider geographic area, but also apply to the Northampton FRA.

You can find information about all the measures that apply to the Northampton FRA in Flood Plan Explorer, an interactive mapping tool. This includes information on which national objectives each measure helps to achieve.

The Norwich Surface Water Flood Risk Area

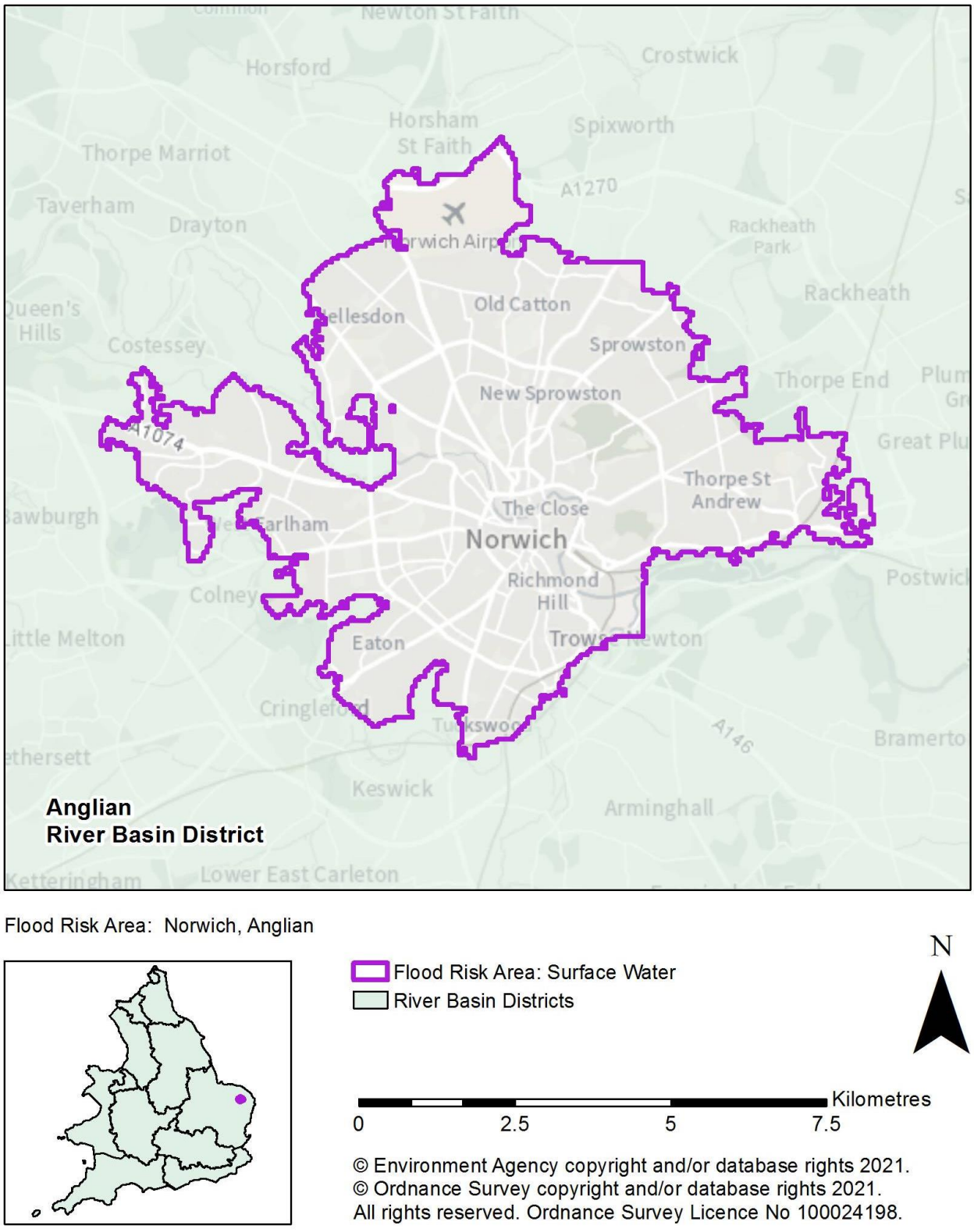


Figure 23: a map showing the boundary of the Norwich Surface Water Flood Risk Area

Introduction to the Norwich Flood Risk Area

The Norwich Flood Risk Area (FRA) has been identified as an FRA because the risk of flooding from surface water is significant nationally for people, the economy, or the environment (including cultural heritage).

Norfolk County Council leads on the development and delivery of the Flood Risk Management Plan for this FRA, working with:

- Anglian Water
- Norwich City Council
- Broadland District Council
- South Norfolk District Council

The Environment Agency's remit covers flood risk from main rivers and the sea.

Anglian Water is the water and sewerage company that owns, operates and maintains the sewer network and wastewater treatment infrastructure in the FRA.

The Norwich FRA covers an area of approximately 54km^2. It incorporates the city of Norwich and several suburban areas on the western, northern and eastern sides of the city, which includes:

- Cringleford
- New Costessey
- Hellesdon
- Old Catton
- Sprowston
- Thorpe St Andrew

The land use is primarily residential and commercial but does include some large open areas, such as:

- Mousehold Heath
- River Yare and Wensum river valleys
- small areas of Ancient Woodland
- Sites of Special Scientific Interest (SSSI)
- Special Areas of Conservation (SAC)

Parts of Norwich are underlain by chalk and there's a history of sinkholes, which limits the options for infiltration measures for surface water.

Large-scale residential growth has occurred and is continuing to the south and west of Norwich in Cringleford and Costessey. This is planned to the north and north-east of Norwich up to the boundary of Broadland Northway.

Much of the Norwich urban area is served by Anglian Water combined sewers, which collect:

- highway surface water runoff
- private surface water
- foul water

The sewer system falls towards the River Wensum, before being pumped to Whitlingham Water Recycling Centre. In other areas, separate highways, surface water, and foul systems exist. The highways and surface water sewers outfall into the Rivers Wensum and Yare or in some areas discharge via infiltration.

Current flood risk

Since 2011 there have been 328 reports of flooding, 143 of which were for internal property flooding. Most of these reports occurred in May and July 2014, June 2016 and October 2019 and were concentrated in:

- central Norwich
- Hellesdon
- Sprowston
- Thorpe St Andrew

The flood risk and hazard maps show that in the Norwich FRA, 26,136 of the 225,387 people live in areas at risk of flooding from surface water. Of these people, 10% are in areas of high risk.

Also shown to be at risk of flooding from surface water are:

- 1,685 non-residential properties
- 1 airport
- 60 out of 1290 services
- 2.89km of railways
- 9.62km of roads
- 4 sites regulated under the Environmental Permitting Regulations
- 3 licensed water abstraction sites
- 30 listed buildings
- 92.7ha of agricultural land - of which around 13.6ha are at high risk
- 5.32ha of parks and gardens
- 0.8ha of SAC
- 0.4ha of Scheduled Ancient Monument
- 1.1ha of SSSI

Based on this information, Risk Management Authorities (RMA) have concluded that further steps should be taken to reduce the likelihood of flooding and the current and future impact it could have on the FRA.

How the risk is currently managed

The management of surface water flood risk is led by Norfolk County Council in collaboration with other RMAs and other stakeholders including:

- Anglian Water
- Norwich City Council
- Broadland District Council
- South Norfolk District Council

Separately, the Norfolk Local Resilience Forum (LRF) is a multi-agency partnership made up of representatives from local public services such as:

- emergency services
- local authorities
- NHS
- Environment Agency

Associated businesses, organisations and voluntary sector representatives are also involved. These organisations work together through the LRF to prepare for and respond to emergencies. The community risk register is a collection of assessments of emergencies that might happen locally within Norfolk. Each potential emergency is rated in terms of its potential impact and likelihood of occurring. Flooding is included in this assessment.

Most of the sewer network is owned and maintained by Anglian Water. Norfolk County Council Highways is responsible for the gullies in areas of combined sewers and for the whole system where it takes highways water only.

Between 2010 and 2014, Norfolk County Council and stakeholders worked to produce Surface Water Management Plans (SWMP) for the Norwich Urban Area.

Detailed modelling of extreme rainfall events and surveying was undertaken to identify areas that are more susceptible to surface water flooding.

All relevant stakeholders who could be affected by or have an input towards mitigating surface water flooding were contacted during the project, and workshops were held in each of the Critical Drainage Catchments. These helped to shape the outputs of the project.

The feasibility of a range of potential surface water management options were assessed. The results of the cost - benefit assessment showed that of the options investigated, property level resilience (PLR) and Sustainable Drainage Systems (SuDS) retrofit would score highly enough to be likely to be considered as a priority target for Flood and Coastal Risk Management Grant in Aid funding. For the other options investigated, if partial funding from other sources were to become available, then the resulting partnership funding score may achieve the required value for consideration.

Flood mitigation measures of attenuation SuDS in the form of water butts or PLR are options that could be applied across the wider Norwich urban area. The modelling and cost benefit assessments show that these measures provide the greatest benefit in terms of reduction in flood risk to the immediate area (and in the case of water butts the downstream areas). To reduce the implication of funding these measures for the whole of Norwich, which would be significant, the measures could be rolled out gradually and prioritised in areas of greatest need.

This study has highlighted several options which could be implemented across the Norwich urban area. Each of the options modelled has a notable benefit to the local flood risk. The wide scale implementation of retrofit SuDS systems, along with large capital schemes, could cumulatively result in wide scale benefit.

The impact of climate change and future flood risk

Rainfall intensity is expected to increase in the future, causing greater volumes of runoff and higher flows within watercourses. It's therefore likely that flooding will become more frequent.

Please refer to the Climate Change and the Anglian River Basin District (RBD) section for more information on what we know are likely to be the implications of climate change in the Anglian RBD.

Objectives and measures for the Norwich Flood Risk Area

Measures have been developed that apply specifically to the Norwich FRA.

You can find information about all the measures that apply to the Norwich FRA in the Flood Plan Explorer, an interactive mapping tool. This includes information on which national objectives each measure helps to achieve.

The Oakham Surface Water Flood Risk Area

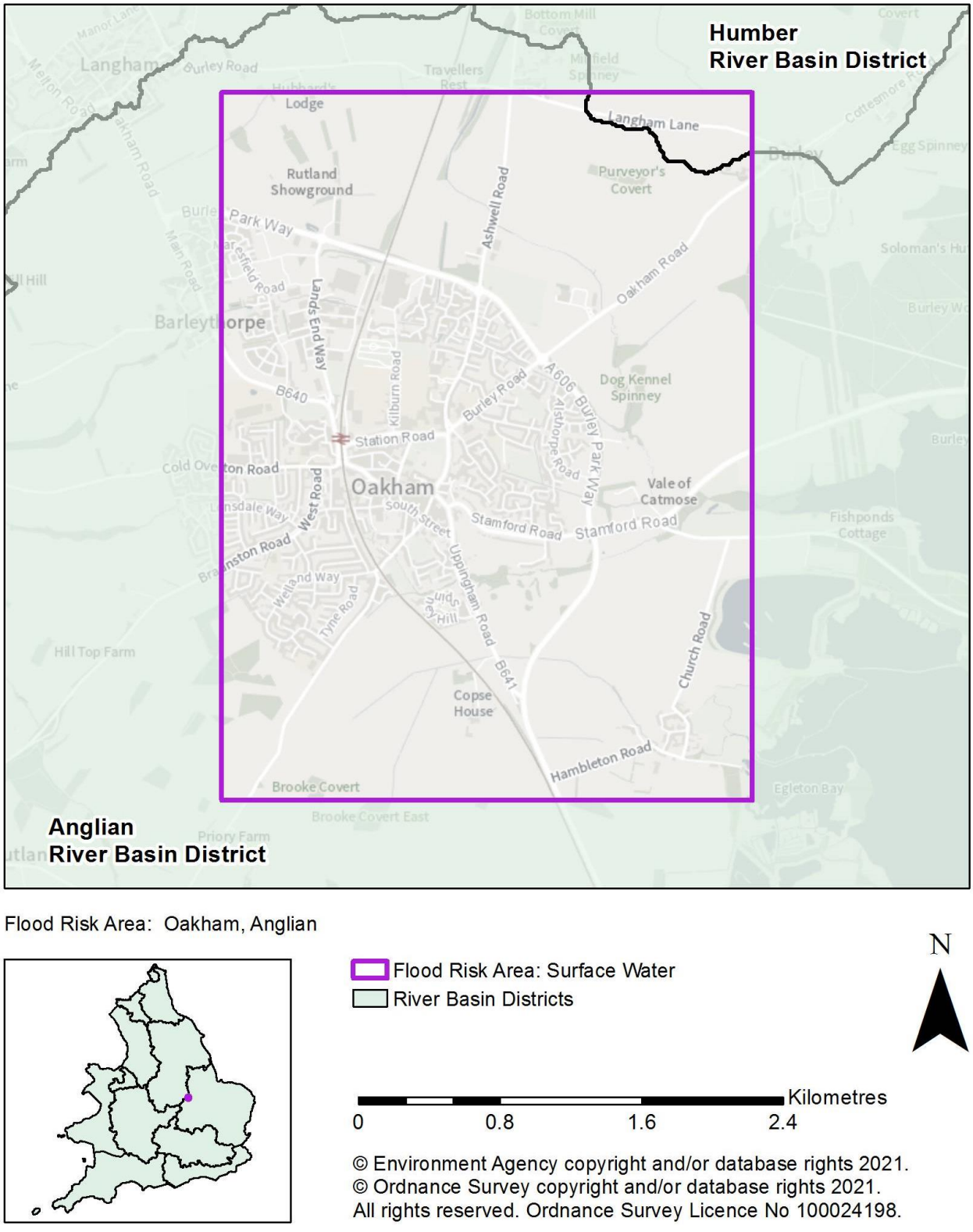


Figure 24: a map showing the boundary of the Oakham Surface Water Flood Risk Area

Introduction to the Oakham Flood Risk Area

The Oakham Flood Risk Area (FRA) has been identified as an FRA because the risk of flooding from surface water is significant nationally for people, the economy, or the environment (including cultural heritage).

Rutland Council take the lead on the development and delivery of the Flood Risk Management Plan (FRMP) for this FRA as they are the Lead Local Flood Authority responsible for managing flood risk from 'local' sources. These local sources include:

- surface water
- groundwater
- ordinary watercourses

The Environment Agency's remit covers flood risk from rivers and the sea.

Anglian Water Services is the water and sewage company that owns, operates and maintains the sewerage network and wastewater treatment infrastructure in the FRA.

The FRA is urban in central Oakham and extends west to encompass parts of Barleythorpe. It includes areas that are:

- residential
- business
- amenity

Grade 1 and 2 agricultural land surrounds central Oakham with grade 3 agricultural land to the periphery. The FRA extends to the south to include the rural village of Egleton.

The predominant soil type is loam over sandstone. There are significant deposits of seasonally wet deep clay.

Located within the FRA are parts of Rutland Water and Burley and Rushpit Woods. These are both SSSI. Rutland Water is also a Ramsar site. Scheduled monuments within the FRA include Oakham motte and bailey castle and medieval gardens.

Rutland is a rural upland area and the smallest historic county in England. Rutland is mentioned in the Domesday Book as a detached part of Nottingham. By the nineteenth century Rutland had been divided into two districts:

- Oakham Rural District
- Uppingham Rural District

The geology of the area, named the 'Rutland Formation', was formed from muds and sands carried down by rivers. This occurs as bands of different colours.

In the late 1970s, the largest reservoir in Great Britain was created called Rutland Water. During its construction, the Gwash Valley was flooded as well as the side valley at which lies Oakham. The reservoir is filled by pumping from the River Nene and River Welland. Rutland Water provides water to the East Midlands.

In the past, maintenance work has been carried out on the rivers flowing through Oakham. This has reduced fluvial flood risk. There is still a concentration of people and property within the floodplain. Oakham remains at risk of flooding from surface water.

Central Oakham is serviced by a combined foul and surface water sewerage system. This is also found in the older parts of the FRA. More modern parts of the town have separate foul and surface water systems. Extensive surface water drainage exists to the south-west and north-east. Several outfalls from the system discharge into the River Gwash and Barleythorpe Brook.

New developments throughout central Oakham are implementing sustainable drainage schemes where possible. By utilising infiltration measures this helps prevent any additional flows entering the River Gwash or Barleythorpe Brooke.

The River Gwash (North Arm) flows west to east through the FRA with inflow from the Barleythorpe Brook. Barleythorpe Brook extends almost 3 km from Barleythorpe to join the River Gwash at the Vale of Catmose.

Current flood risk

The flood hazard and risk maps show that in the Oakham FRA, 1,783 people live in areas at risk of flooding from surface water. Of these people, 9% live in areas of high risk.

Also shown to be in areas at risk of flooding from rivers and sea are:

- 109 non-residential properties - including community centres retail parks and public utilities
- 1.83 km of roads - including parts of the A606 and A6003
- 0.69 km of railway
- 140.13 ha of agricultural land
- 10ha environmental designated sites (Ramsar and SSSI)
- 1 listed building
- 0.92ha scheduled ancient monuments
- 0.42ha parks and gardens

The flood hazard and risk maps provide more detailed information on the likelihood and consequence of flooding for the Oakham FRA.

Based on this information, Risk Management Authorities (RMAs) have concluded that further steps should be taken to reduce the likelihood of flooding and the current and future impact it could have on the FRA.

How the risk is currently managed

The management of surface water flood risk is led by Rutland Council in collaboration with other RMAs.

The Leicestershire LRF is a multi-agency partnership made of representatives from local public services, such as:

- emergency services
- local authorities
- NHS
- Environment Agency

Partners are required to respond in the event of emergencies in their respective roles. Jointly they safeguard and mitigate the consequential impacts on:

- property
- wellbeing of residents
- communities
- businesses

Flooding is one of the risks addressed through community flood preparation.

Rutland County Council Flood Risk Management Plan forms the basis for how flooding is dealt with within the county.

The Environment Agency monitor river and rainfall conditions at 1 site near to the FRA, which is Oakham (Level).

This information is used to inform activities related to 1 flood warning area that covers the FRA. This enables people to receive a warning when flooding could occur. This data also informs the operational response during a flood incident.

Rutland Council and Anglian Water Services operate and maintain assets that perform a flood risk management function on the drainage network. Rutland Council also maintain several other structures and defences on ordinary watercourses.

The Environment Agency similarly operates and maintains flood risk management assets on the main watercourses in the FRA. This work includes routine inspection and clearance activities as well as regular repair and replacement of assets.

Rutland County Council capital programme focuses on general maintenance of assets across the FRA. In particular, it works to reduce highway flooding. Landowner engagement also takes place to manage flood risk to properties from overland flows.

The impact of climate change and future flood risk

As rainfall intensity increases, it means that surface water flooding will become more frequent as higher rainfall totals will be seen more often.

Please refer to the Climate Change and the Anglian River Basin District (RBD) section for more information on what we know are likely to be the implications of climate change in the Anglian RBD.

Objectives and measures for the Oakham FRA

Measures have been developed that apply specifically to the Oakham FRA. These measures have been developed in addition to those covering a wider geographic area that also apply to the Oakham FRA.

You can find information about all the measures that apply to the Oakham FRA in Flood Plan Explorer, an interactive mapping tool. This includes information on which national objectives each measure helps to achieve.

The Oakington Rivers and Sea Flood Risk Area

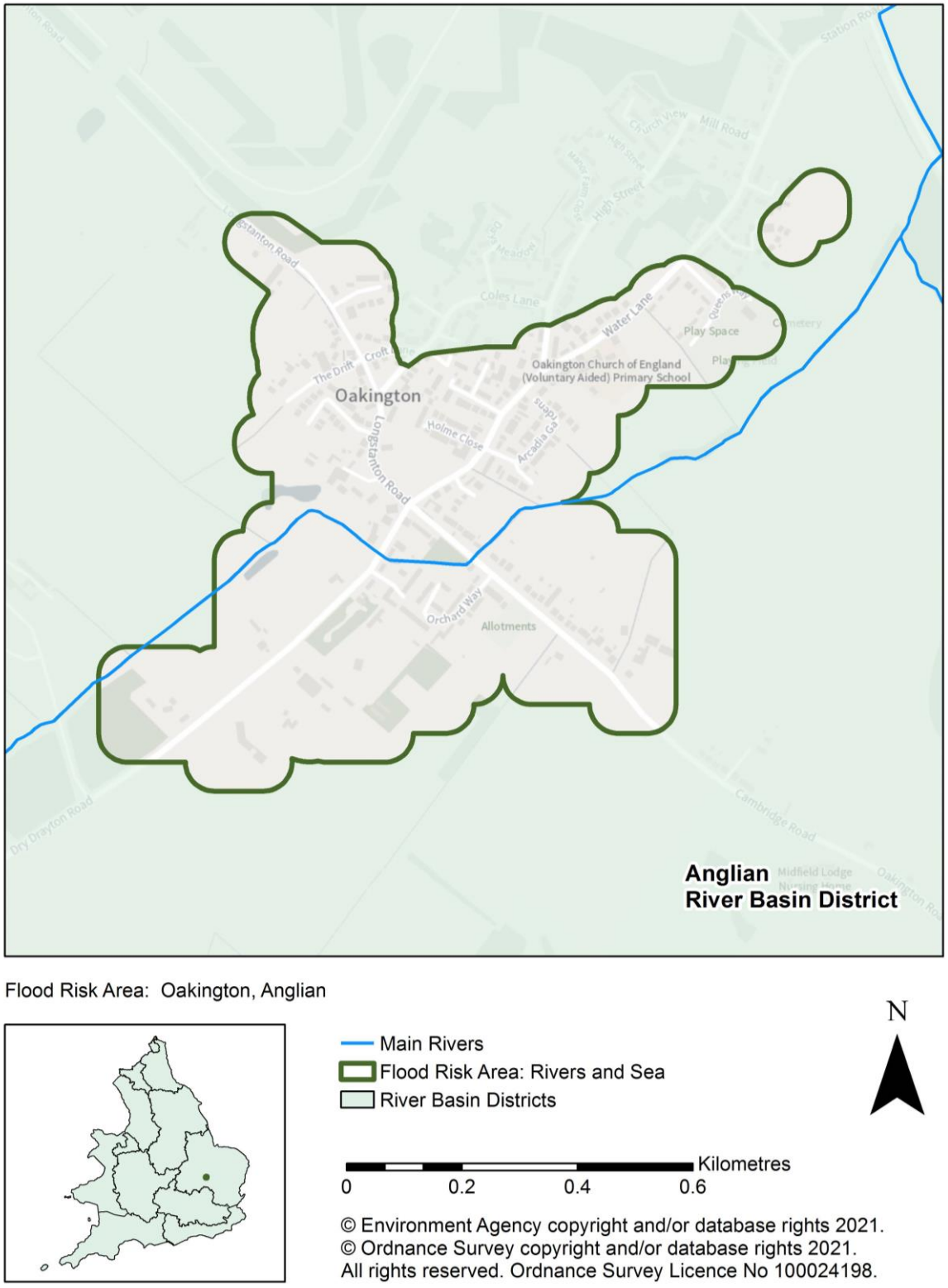


Figure 25: a map showing the boundary of the Oakington Rivers and Sea Flood Risk Area

Introduction to the Oakington Flood Risk Area

The Oakington Flood Risk Area (FRA) has been identified as an FRA because the risk of flooding from main rivers is significant nationally for people, the economy, or the environment (including cultural heritage).

The Environment Agency leads on the development and delivery of the Flood Risk Management Plan for this FRA.

Cambridgeshire County Council is the Lead Local Flood Authority, whose remit includes flood risk from surface water and ordinary watercourses. The FRA also falls within the administrative boundary of South Cambridgeshire District Council.

Anglian Water is the water and sewerage company that owns, operates, and maintains the sewer network and wastewater treatment infrastructure in the FRA. This includes a foul water pumping station near the centre of Oakington.

The FRA includes most of the village of Oakington, which includes residential, business and amenity areas surrounded by a green belt of mainly farmland. Oakington is a small rural village 11km north-west of Cambridge in South Cambridgeshire. Located to the north of the village is Oakington Barracks (formerly an airfield) that closed in 1999 and was converted into an immigration reception centre. The site is now being redeveloped as a new town (Northstowe) that'll eventually have up to 10,000 homes.

The underlying solid geology is mudstone in the northern half of the FRA and sandstone in the south. Alluvium overlays the sandstone bedrock along Oakington Brook as it flows downstream of Longstanton Road.

Oakington Brook is a main river that flows through the village from south-west to north-east, before joining the Beck Brook downstream of the village at Westwick. Upstream of the village, Oakington Brook is a steep-sided channel that flows between open fields. In the centre of Oakington village the brook has a series of sharp bends and flows under 2 bridges. Downstream of the village centre the brook continues to flow in a steep-sided channel through fields to its confluence with the Beck Brook.

A network of smaller watercourses is also present within the village. Some of these watercourses are designated as 'Award Drains' and are maintained by South Cambridgeshire District Council. Others are road drains and field drains.

The catchment area upstream of Oakington and Westwick covers approximately 45km^2 and includes the large village of Bar Hill. Levels in the Oakington Brook can rise significantly and quickly following heavy rainfall.

There are 2 main sources of flood risk to the village of Oakington:

- surface water – following heavy rainfall the smaller watercourses and drains are overwhelmed, and water flows overland towards the Oakington Brook

- river flooding – when levels are very high in the Oakington Brook, they spill out upstream of the village and flow down Dry Drayton Road flooding properties on Broadway

Due to the bends and constrictions (bridges) in the centre of the village, floodwater is forced out affecting properties on:

- Cambridge Road
- Orchard Way
- Longstanton Road
- Kettles Close
- Water Lane
- Arcadia Gardens

Flooding affects the foul water pumping station on Arcadia Gardens meaning sewage backs up, further affecting properties.

Current flood risk

Oakington has a steady history of flooding. Over the past 100 years, at least 6 major flood events have been recorded in:

- 1947
- 1953
- 1978
- 1998
- 2001
- 2014

During the August 2014 flood event around 140mm of rain (3 times the average for the whole of August) fell in about 6 hours. It was noted that the rainfall caused two waves of flooding. Surface water flooding that inundated properties was caused by the rainfall in Oakington village, despite the Oakington Brook remaining low.

Once the rainfall from the whole catchment started reaching the brook, further property flooding occurred, this time from the brook itself. In total, 57 properties flooded internally with a further 40 to 50 having floodwater in their garage or outbuildings.

The flood risk and hazard maps show that in the Oakington FRA, 671 out of 851 people live in areas at risk of flooding from rivers and the sea. Of these people, 49% live in areas considered to be at high risk.

Also shown to be at risk of flooding from rivers and the sea are:

- 28 non-residential properties - 10 are high risk and 18 are medium risk
- 3 out of 6 services
- 49.7ha of agricultural land
- 1 listed building

The flood risk and hazard maps provide more detailed information on the likelihood and consequence of flooding for the Oakington FRA.

Based on this information, Risk Management Authorities (RMAs) have concluded that further steps should be taken to reduce the likelihood of flooding and the current and future impact it could have on the FRA.

How the risk is currently managed

The management of flood risk from rivers and the sea is led by the Environment Agency in collaboration with other RMAs and other stakeholders including:

- Cambridgeshire County Council
- South Cambridgeshire District Council
- Anglian Water

A partnership framework has been set up across Cambridgeshire. The Cambridgeshire and Peterborough Flood and Water Partnership Group is chaired by Cambridgeshire County Council and involves all RMAs. This provides a coordinated and collaborative approach to management of flood risk and water management.

Separately, the Cambridgeshire and Peterborough Local Resilience Forum (LRF) is a multi-agency partnership made up of representatives from local public services such as:

- emergency services
- local authorities
- NHS
- Environment Agency

Associated businesses, organisations and voluntary sector representatives are also involved. These organisations work together through the LRF to prepare for and respond to emergencies. The community risk register is a collection of assessments of emergencies that might happen locally within Cambridgeshire. Each potential emergency is rated in terms of its potential impact and likelihood of occurring. Flooding is included in this assessment.

The main gauge used to monitor water levels in the FRA is an ultrasonic gauging station on the Oakington Brook, approximately 700m upstream of Oakington. The ultrasonic gauge was installed in 2014 to better inform the flood warning system for Oakington.

Information from the monitoring network is used to inform activities related to Oakington Brook and Beck Brook for the Oakington and Westwick flood warning area that covers the FRA. This flood warning area enables people to receive a warning when flooding could occur.

Due to the limited time the gauge has been in place, more data is required on high flows to better validate trigger levels for issuing flood alerts and warnings. Following the issue of flood alerts and warnings in recent years, discussions have taken place between the

Environment Agency and the Oakington and Westwick Flood Mitigation Group. This is to improve the flood warning accuracy and dissemination.

The Cottenham Lode hydraulic model, published in 2003 covers the Oakington Brook and Cottenham Lode system. This model is still considered to be the best available river flood model for this system. The model is due to be replaced in 2021 with an updated version using the latest river modelling techniques.

Flood risk maps are published based on the outputs from the mathematical modelling to inform:

- the public and businesses of their flood risk
- potential developers and local planning authorities
- the assessment and design of flood risk management works

Maintenance of the Oakington Brook is carried out by the Environment Agency. Annual grass cutting and in channel weed control is supplemented by a cycle of bushing works and blockage removal.

Annual maintenance is carried out by South Cambridgeshire District Council on their network of Awarded Watercourses. They also respond to reports of blockages.

As the banks of the Oakington Brook, and other main watercourses in the wider catchment, are steep and prone to slippages, a study is planned to investigate how these banks can be managed and potentially modified in future.

A property level resilience (PLR) scheme was completed in 2014 providing increased resilience to 53 properties. This scheme was partially complete when the village flooded in August 2014. Investigation of the effectiveness of the flood resilience measures showed that it was effective in some properties but not in others. The reasons for the measures not working included ineffective deployment of the pumps and gates in some cases due to residents not being trained in how to use the equipment and some measures not being fitted as the scheme had not been completed. Some properties were also impacted as not all potential ingress routes had been identified. This was subsequently rectified.

The impact of climate change and future flood risk

As seen during the August 2014 event, Oakington is highly susceptible to flash flooding from heavy summer downpours. A warmer climate, with more energy in the atmosphere is likely to lead to more frequent, intense rainfall indicating a risk of recurrent flood events.

Increased risk could also be expected due to the amount of growth within this part of South Cambridgeshire. Although planning policy dictates that new development must not increase flood risk, increased hard standings, exceedance of new drainage systems or lack of maintenance of drainage features have the potential to result in rainwater reaching watercourses quicker and exacerbating risk.

Please refer to the Climate Change and the Anglian River Basin District (RBD) section for more information on what we know are likely to be the implications of climate change in the Anglian RBD.

Objectives and measures for the Oakington Flood Risk Area

Measures have been developed that apply specifically to the Oakington FRA.

You can find information about all the measures that apply to the Oakington FRA in the Flood Plan Explorer, an interactive mapping tool. This includes information on which national objectives each measure helps to achieve.

The Saffron Walden Rivers and Sea Flood Risk Area

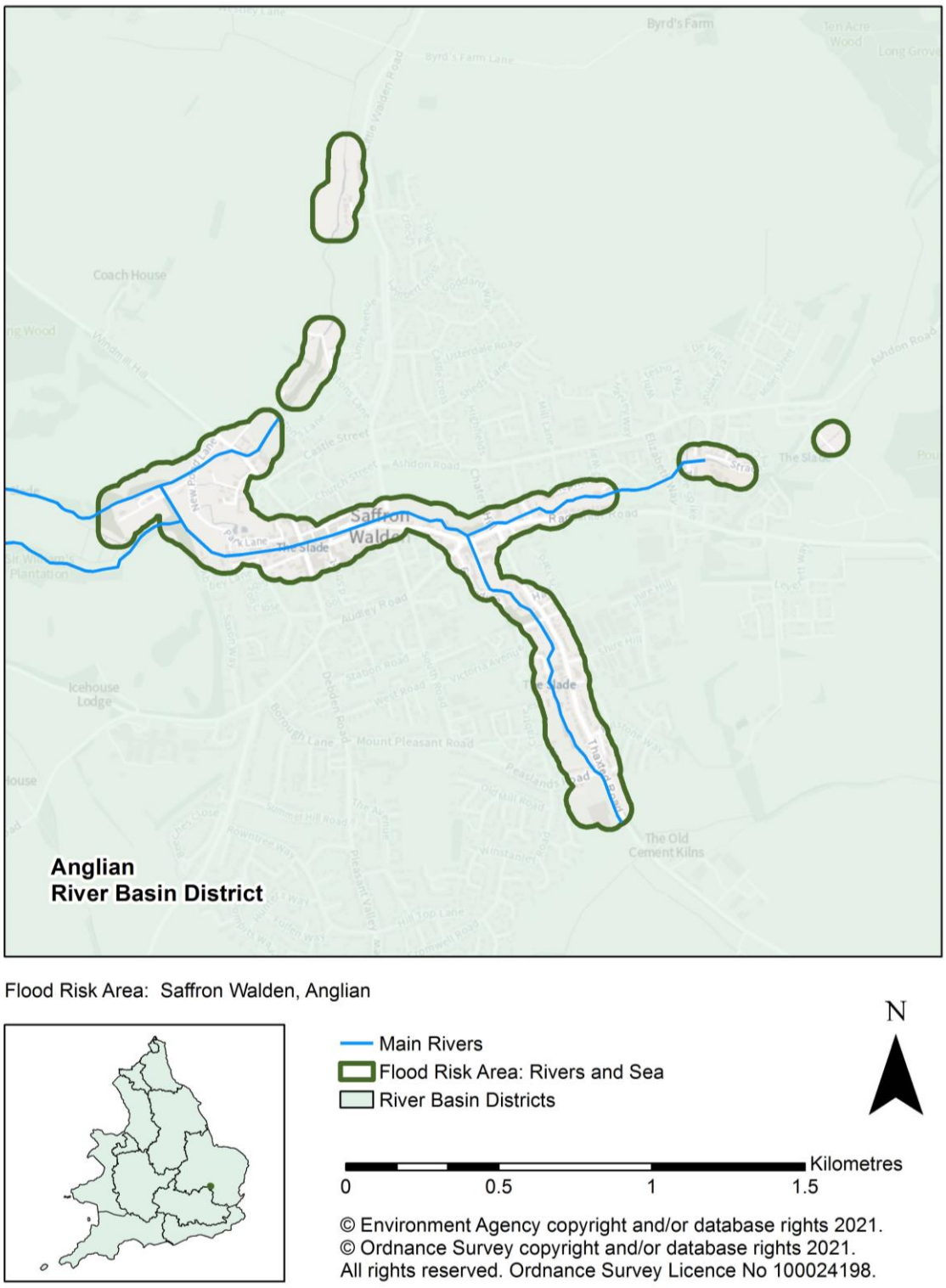


Figure 26: a map showing the boundary of the Saffron Walden Rivers and Sea Flood Risk Area

Introduction to the Saffron Walden Flood Risk Area

The Saffron Walden Flood Risk Area (FRA) has been identified as an FRA because the risk of flooding from main rivers is significant nationally for people, the economy, or the environment (including cultural heritage).

The Environment Agency leads on the development and delivery of the Flood Risk Management Plan (FRMP) for this FRA.

Essex County Council is the Lead Local Flood Authority whose remit includes flood risk from surface water and ordinary watercourses. The FRA also falls within the administrative boundaries of Uttlesford District Council and Saffron Walden Town Council.

Anglian Water is the water and sewerage company that owns, operates and maintains the sewer network and wastewater treatment infrastructure in the FRA.

The FRA covers the Slade River network, a main river, which flows through Saffron Walden town centre and along the outskirts of the town. The FRA includes residential, business and amenity areas which are surrounded by the urban area of Saffron Walden.

The FRA is focused on the area close to the main river and does not include the wider urban area of Saffron Walden. The reason for this relates to the methodology used to identify the FRA boundaries, which is detailed in Part A of the FRMP report. It is important to note, however, that measures included for the Saffron Walden FRA will apply to Saffron Walden as a whole and will not be limited to the area shown in Figure 26.

The underlying solid geology of the FRA is chalk which is overlain by a sedimentary rock made up of clay, silt, sand and gravel.

The Slades watercourse system is a network of interconnecting channels and culverts. The system conveys river flows and surface water from the built-up areas of Saffron Walden into the headwaters of the River Cam. There are three main watercourses which flow through the FRA together making up the Slade system:

- King’s Slade - which flows from east to west through the centre of the town to its confluence with Madgate Slade
- Thaxted Road Slade - which flows northwards to its confluence with King’s Slade in the town centre at The Common
- Madgate Slade - which flows south from the Little Walden direction through the outskirts of Saffron Walden. It flows through Bridge End Garden before it joins the King’s Slade

Flooding from the Slades system is the main source of flood risk in the Saffron Walden FRA. The Slades river system is relatively steep and therefore responds rapidly to rainfall.

The Slades system is mostly culverted through the town, with the main Town Centre culvert (King’s Slade) running under the high street. Blockages associated with the Town Centre culvert are known to cause flooding. The Town Centre culvert in Saffron Walden

mostly takes the form of a low brick arch. This has been extended at various times as the town has expanded over the river. It was initially constructed as early as the sixteenth century although most of it is thought to date from the eighteenth century. The culvert is 545m long, with a trash screen located at the inlet (at the southern side of the Common Hill car park) to prevent any debris entering and blocking the culvert. If the culvert/trash screen became blocked there is a very significant risk of flooding to properties within the town.

Current flood risk

Saffron Walden has a long history of flooding with reports of flooding in:

- November 1875
- August 1917
- September 1960
- October 2001
- January 2003
- January 2007
- February 2014
- July 2017

Recent modelling suggests that if the Town Centre culvert/trash screen became blocked there could be a very significant risk of flooding to 50 residential and 72 non-residential properties within the town. There are reports that flooding due to debris blocking the trash screen occurred in 2001, 2007, 2014 and the most recently in July 2017 flood.

The July 2017 flood was a result of a summer thunderstorm. The nearest rain gauge in Ashdon recorded 28.52mm of rainfall over a 90 minute period. The Slades responded quickly with debris building up and blocking the trash screen to the entrance of the town centre carpark. Several highway gullies were also blocked. Approximately 10 properties were internally flooded during this incident. After the flood, several tonnes of silt and rubbish were removed from the trash screen at the entrance of the town centre carpark.

The flood risk and hazard maps show that in the Saffron Walden FRA, 521 people live in areas at risk of flooding from rivers and the sea. Of these people, 55% live in areas considered to be at high risk.

Also shown to be at risk of flooding from rivers and the sea are:

- 96 non-residential properties - of which 92 are at high risk
- 3 services at high risk
- 9.4ha of agricultural land
- 41 listed buildings - of which 31 are at high risk
- 2.9ha of parks and gardens

The flood hazard and risk maps provide more detailed information on the likelihood and consequence of flooding for the Saffron Walden FRA and can be found here.

Based on this information, Risk Management Authorities (RMAs) have concluded that further steps should be taken to reduce the likelihood of flooding and the current and future impact it could have on the FRA.

How the risk is currently managed

The management of flood risk from main rivers and the sea is led by the Environment Agency in collaboration with other RMAs and stakeholders including:

- Essex County Council
- Uttlesford District Council
- Saffron Walden Town Council
- Anglian Water

Separately, the Essex Local Resilience Forum is a multi-agency partnership made up of representatives from local public services such as:

- emergency services
- local authorities
- NHS
- Environment Agency

Associated businesses, organisations and voluntary sector representatives are also involved. These organisations work together through the LRF to prepare for and respond to emergencies. The community risk register is a collection of assessments of emergencies that might happen locally within Essex. Each potential emergency is rated in terms of its potential impact and likelihood of occurring. Flooding is included in this assessment.

The Environment Agency has no river level monitoring equipment in Saffron Walden. Rainfall conditions are collected at Ashdon and Elmdon sites which are near to the FRA. This rainfall information is used to inform the Slades at Saffron Walden flood warning area, which covers the FRA. This enables people to receive a warning when flooding could occur.

Hydraulic models published in 2012 cover the main rivers that constitute the Slades system, including:

- the King's Slade
- Thaxted Road Slade
- Madgate Slade

The King's Slade model was further developed in 2013 and then in 2017 to examine the impacts of a blockage on King's Slade culvert.

The outputs from hydraulic modelling studies are used to inform the Flood Map for Planning (Rivers and Sea) and the Risk of Flooding from Rivers and Sea mapping, as well as a suite of other products. These are used to:

- advise the public and businesses of their risk of flooding
- inform potential developments and local planning authorities
- provide a basis for the assessment and design of flood risk management works

There are no formal flood defences in Saffron Walden. Within the FRA the Environment Agency work with Essex County Council and other partners to respond to incidents by clearing debris and blockages to reduce the risk of flooding. Essex County Council and Anglian Water maintain assets that perform a flood risk management function on the drainage network. The trash screen on the inlet to the Town Centre culvert is maintained by Saffron Walden Town Council.

Partners have come together to develop a programme of works to address the concerns with the Town Centre trash screen and culvert. These partners include:

- Essex County Council
- Uttlesford District Council
- Saffron Walden Town Council
- Anglian Water

The first phase of the works to replace the trash screen to the Town Centre culvert inlet was delivered in 2021. Further works to repair the Town Centre culvert are currently under investigation or in preparation for delivery between 2021 and 2027.

The impact of climate change and future flood risk

Rainfall intensity is expected to increase in the future, causing higher river flows and levels. Flooding from rivers will therefore become more frequent. Recent flood incidents in Saffron Walden have been associated with culvert blockages, highlighting the importance of asset maintenance in the town. An increase in rainfall intensity will increase pressure on the culvert system so it is important to seek opportunities to reduce this through upstream interventions.

Please refer to the Climate Change and the Anglian River Basin District (RBD) section for more information on what we know are likely to be the implications of climate change in the Anglian RBD.

Objectives and measures for the Saffron Walden FRA

Measures have been developed that apply specifically to the Saffron Walden FRA.

You can find information about all the measures that apply to the Saffron Walden FRA in the Flood Plan Explorer, an interactive mapping tool. This includes information on which national objectives each measure helps to achieve.

The Skegness Rivers and the Sea Flood Risk Area

Figure 27: a map showing the boundary of the Skegness Rivers and Sea Flood Risk Area

Introduction to the Skegness Flood Risk Area

The Skegness Flood Risk Area (FRA) has been identified as an FRA because the risk of flooding from rivers and the sea is significant nationally for people, the economy, or the environment (including cultural heritage).

The Environment Agency leads on the development and delivery of the Flood Risk Management Plan (FRMP) for this FRA. Lincolnshire County Council is the Lead Local Flood Authority (LLFA) responsible for managing flood risk from 'local' sources. These local sources of flooding are:

- surface water
- groundwater
- ordinary watercourses

The Environment Agency's remit covers flood risk from rivers and the sea.

Anglian Water Services is the water and sewage company that owns, operates and maintains the sewerage network and wastewater treatment infrastructure in the FRA.

The Lindsey Marsh Drainage Board is responsible for land drainage in this FRA.

The Skegness FRA extends along the coastline to include:

- Chapel St Leonards
- Ingoldmells
- Seathorpe
- Winthorpe
- Skegness
- Seacroft
- Bramble Hills

The Skegness FRA is largely urban with non-agricultural land use along the coast. The agricultural land in the north of the FRA is grade 3 with some land to the south-east being of grade 2.

The FRA may include locations that are not connected to the main part of the FRA, and there may be small areas of 'dry islands', which are shown to be outside of the FRA. The reason for these seemingly anomalous areas relates to the methodology used to identify the FRA boundaries, which is detailed in Part A of the FRMP report.

It is important to note, however, that measures included for the FRA, particularly those associated with flood warning and evacuation procedures, are likely to apply to the FRA as a whole and will not be limited to the area shown in Figure 27.

The predominant soil type is seasonally wet deep clay. However, to the southern tip of the FRA below Seacroft, dune sand dominates. Two bathing water areas lie to the east of the FRA at Ingoldmells South and Skegness.

The southern extent of the FRA partially covers the Gibraltar Point SSSI and the Saltfleetby-Theddlethorpe Dunes and Gibraltar Point SAC. The Greater Wash SPA also extends along the coastline. Three local wildlife sites lie partially within the FRA.

The Steeping and Eaus operational catchment is predominately rural with small settlements and historic market towns. To the east the catchment becomes coastal floodplain and the watercourses flow to the North Sea.

The Lincolnshire coastal resort of Skegness is within this catchment.

The Willoughby High Drain main river flows through Chapel St Leonards at the north of the FRA. Orby Drain main river feeds into Willoughby High Drain, which then flows out to sea through Chapel Basin.

Historically Skegness was once a Haven town, built on a raised promontory with a harbour. Timber and other merchandise was traded until the early 1500s when the port was washed away. The storm tide broke up the raised ground that's now buried up to a mile seaward.

The town was rebuilt but was home to few inhabitants making a living from agriculture and fishing. However, in the 1800s it became fashionable for gentry to bring their families to indulge in sea-bathing in the summer months. In 1873, the railway reached Skegness and visitors from the Midlands began arriving in great numbers.

Skegness was relatively unscathed by the great East Coast Flood of 1953, but the sea defences were then strengthened, and new promenades built on the sea walls.

In 1978, another great storm almost destroyed the pier, but what remains has recently been repaired and improved. The town remains largely reliant on tourism and its seasonal economy. Several caravan parks and guest houses provide tourist accommodation, and the risks from tidal flooding remain at the forefront of planning considerations.

The main risk within the FRA is from tidal sources.

Current flood risk

The flood hazard and risk maps show that in the Skegness FRA, 31,843 people live in areas at risk of flooding from rivers and the sea. Of these people, 8% live in areas of high risk.

Also shown to be in areas at risk of flooding from rivers and sea are:

- 3450 non-residential properties - including community centres, hospitals, schools and colleges, retail parks and public utilities
- 4.19km roads - including parts of the A52 and A158
- 1.7km of railway
- 899.06ha of agricultural land
- 5.21ha Environmental Designations (SSSI and SAC)

- 18 listed buildings
- 6 water abstraction points

The flood hazard and risk maps provide more detailed information on the likelihood and consequence of flooding for the Skegness FRA.

Based on this information, Risk Management Authorities (RMAs) have concluded that further steps should be taken to reduce the likelihood of flooding and the current and future impact it could have on the FRA.

How the risk is currently managed

The management of flood risk from rivers and the sea is led by the Environment Agency in collaboration with other RMAs. These include:

- East Lindsey District Council
- Lincolnshire County Council
- Lindsey Marsh Drainage Board
- Anglian Water

A partnership framework has been set up across Lincolnshire involving all RMAs to coordinate the management of flood risk and water management. Strategic direction is delivered by the Lincolnshire Flood Risk and Water Management Strategy Group (chaired by the Environment Agency).

The Management Group (chaired by Lincolnshire County Council) delivers the responsibilities of the LLFA. There are 4 Local Flood Risk and Drainage Management Groups (chaired by Lincolnshire County Council Highways) that deliver flood risk and water management solutions to meet local circumstances. The Skegness FRA is covered by the East Lindsey Flood Risk and Drainage Management Group.

The Lincolnshire Local Resilience Forum (LRF) is a multi-agency partnership made of representatives from local public services, such as the:

- emergency services
- local authorities
- NHS
- Environment Agency

To help prepare for and respond to emergencies the LRF publish a community risk register.

It provides information on the key risks that have the potential to cause disruption to the county. These include East Coast and inland flooding.

The Environment Agency monitor river and rainfall conditions at 1 site in and near to the FRA is Chapel St Leonards (Flow).

This information is used to inform activities related to 6 flood warning areas that cover the FRA. This enables people to receive a warning when flooding could occur. This data also informs the operational response during a flood incident.

Modelling and mapping of the Willoughby High Drain was undertaken in 2018. Coastal hazard mapping has also been undertaken in 2010 to show the risk of flooding from breaches and overtopping of the sea defences. This is for the present day and the future, which considers the effects of climate change.

Flood risk maps are published based on the outputs from modelling to inform:

- the public and business of their flood risk
- potential developers and local planning authorities
- the assessment and design of flood risk management works

The Environment Agency operates and maintains flood risk management assets on the main watercourses and sea defences in the FRA. These include:

- flood defence walls
- fluvial outfall tunnels
- flood gates
- channels
- culverts
- debris screens

This work includes routine inspection and clearance activities as well as periodic repair and replacement of assets.

Flood risk improvement works that benefit the Skegness FRA completed recently by the Environment Agency include Ingoldmells outfall chamber improvements, undertaken to prevent sand ingress (completed in 2020). This could have blocked the outfall and prevented the fluvial system from discharging to sea.

The Saltfleet to Gibraltar Point Beach Management scheme annually places around 380,000 cubic metres of sand in key locations along a 20km frontage of the Lincolnshire east coast. We've been artificially supplying sand to recharge the beach in this area since 1994. This scheme, in combination with the existing hard defences, reduces the risk of tidal flooding with a 0.5% chance of occurring in any one year. This flood risk management approach benefits:

- 20,000 households
- 24,500 static caravans
- 1,700 businesses
- up to 35,000ha of agricultural land

We've received approval for the Saltfleet to Gibraltar Point Strategy for how flood risk will be managed over the next 100 years. In the short term this will see a continuation of nourishment.

Enhancing the Lincolnshire Coast project will develop the future project investments, running in parallel with the Beach Management Scheme. It'll also deliver a project to 'pilot' rock structures on the beach to complement the nourishment.

The impact of climate change and future flood risk

As sea levels rise, it means that coastal flooding will become more frequent as higher water levels will be seen more often.

Please refer to Climate Change and the Anglian River Basin District (RBD) section for more information on what we know are likely to be the implications of climate change in the Anglian River Basin District.

Objectives and measures for the Skegness FRA

Measures have been developed that apply specifically to the Skegness FRA. These measures have been developed in addition to those covering a wider geographic area, but also apply to the Skegness FRA.

You can find information about all the measures that apply to the Skegness FRA in Flood Plan Explorer, an interactive mapping tool. This includes information on which national objectives each measure helps to achieve.

The Spalding Rivers and the Sea Flood Risk Area

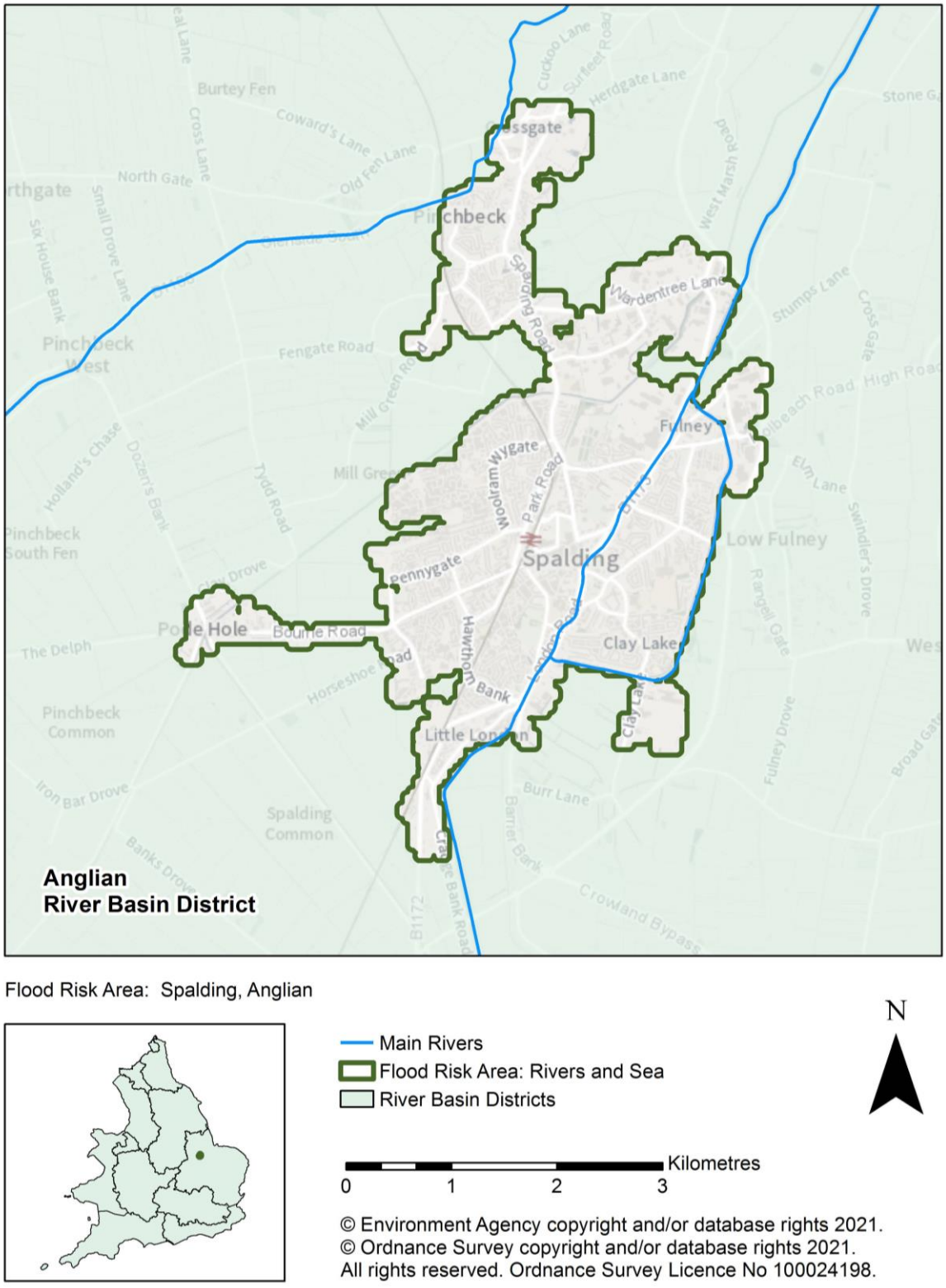


Figure 28: a map showing the boundary of the Spalding Rivers and Sea Flood Risk Area

Introduction to the Spalding Flood Risk Area

The Spalding Flood Risk Area (FRA) has been identified as an FRA because the risk of flooding from rivers and the sea is significant nationally for people, the economy, or the environment (including cultural heritage).

The Environment Agency leads on the development and delivery of the Flood Risk Management Plan (FRMP) for this FRA.

Lincolnshire County Council is the Lead Local Flood Authority (LLFA) whose remit includes flood risk from surface water and ordinary watercourses. These local sources include:

- surface water
- groundwater
- ordinary watercourses

Anglian Water is the water and sewerage company that owns, operates and maintains the sewer network and wastewater treatment infrastructure in the FRA.

The Spalding FRA covers many of the urban districts of Spalding. It extends to include areas of:

- Pinchbeck
- Fulney
- Clay Lake
- Little London

The FRA is surrounded by a green belt of mainly farmland. Vernatts local nature reserve lies to the north-east of the FRA.

The soil type is predominantly wet deep silt. It provides rich grade 1 agricultural land peripheral to Spalding and is important to the economy of the area.

The FRA may include locations that are not connected to the main part of the FRA, and there may be small areas of ‘dry islands’, which are shown to be outside of the FRA. The reason for these seemingly anomalous areas relates to the methodology used to identify the FRA boundaries, which is detailed in Part A of the FRMP report.

It is important to note, however, that measures included for the FRA, particularly those associated with flood warning and evacuation procedures, are likely to apply to the FRA as a whole and will not be limited to the area shown in Figure 28.

The land is flat and relies upon a series of pumped drainage networks. These are provided by the Welland and Deepings Internal Drainage Board (IDB) and the South Holland IDB.

The Lower Welland catchment starts below Stamford. It collects urban run-off from northern Peterborough before becoming the embanked wide Welland across the Fens.

Through Spalding FRA it becomes tidal for over 1.5km before eventually discharging out into the Wash.

The Welland here is an important coarse fishery and has some limited boating activity at the lower end. It is an important source of water for agricultural use and is used to feed internal board drains. These supply agricultural water to the important arable and horticultural industries.

The Glen is an embanked waterbody. It lies to the north of the FRA above Pinchbeck and flows across the Fens into the tidal Welland at Surfleet. The Glen is an important water source for agricultural use. It is used as a coarse fishery nearer to Pinchbeck and has limited boating.

Historical evidence suggests a settlement has existed in Spalding since Roman times when the area was used for production of salt. It was coastal silt land. The town developed as a linear settlement around the River Welland, and grew as land was reclaimed from the wetlands.

Spalding is located at the centre of a major region of flower and vegetable cultivation due to the rich silty soil. The land mainly comprises of drained and recovered marshland or estuary.

The catchment wide flood in 1947 prompted engineering works along the watercourses to manage river flows and reduce flood risk. Works included:

- widening and straightening embankments
- embankment raising along the Rivers Welland and Glen in the fenland areas
- construction of the Maxey Cut to provide a bypass for the River Welland around Market Deeping
- construction of the Greatford Cut to transfer water from the River West Glen to the River Welland at Market Deeping
- construction of the Coronation Channel to bypass the River Welland around Spalding
- improvements to Crowland and Cowbit Washes to control peak water levels downstream in Spalding

Spalding was subject to frequent flooding until the opening of the Coronation channel 1953. The area around the banks has been developed for residential and business use and this area has become heavily built up. There’s much recreational use of the river and fishing is still popular.

Current flood risk

The flood hazard and risk maps show that in the Spalding FRA, 33,938 people live in areas at risk of flooding from rivers and the sea. Of these people, less than 1% live in areas of high risk.

Also shown to be at risk of flooding from rivers and the sea are:

- 1341 non-residential properties - including hospitals, schools and public utilities.
- 1.17km of roads - including sections of the A16
- 5.7km of railway
- 764.1ha of agricultural land
- 149 listed buildings
- 3 water abstraction points

The flood hazard and risk maps provide more detailed information on the likelihood and consequence of flooding for the Spalding FRA. Based on this information, Risk Management Authorities (RMAs) have concluded that further steps should be taken to reduce the likelihood of flooding and the current and future impact it could have on the FRA.

How the risk is currently managed

The management of flood risk from rivers and the sea is led by the Environment Agency in collaboration with other RMAs and other stakeholders. These include:

- Lincolnshire County Council
- Welland and Deepings IDB
- South Holland IDB

A partnership framework has been set up across Lincolnshire involving all RMAs to coordinate the management of flood risk and water management. Strategic direction is delivered by the Lincolnshire Flood Risk and Water Management Strategy Group. This is chaired by the Environment Agency.

The Management Group chaired by Lincolnshire County Council delivers the responsibilities of the LLFA. There are 4 Local Flood Risk and Drainage Management Groups chaired by Lincolnshire County Council Highways. These deliver flood risk and water management solutions to meet local circumstances.

The Spalding Flood Risk Area is covered by the Boston and South Holland Flood Risk and Drainage Management Group.

The Lincolnshire Local Resilience Forum (LRF) is a multi-agency partnership made of representatives from local public services such as:

- emergency services
- local authorities
- NHS
- Environment Agency

To help prepare for and respond to emergencies the LRF publish a community risk register. It provides information on the key risks that have the potential to cause disruption to the county. These include East Coast and inland flooding.

The Environment Agency monitor river and rainfall conditions at 2 sites in and near to the FRA:

- Spalding (Precipitation)
- Pode Hole (Precipitation)

This information is used to inform activities related to 4 flood warning areas that cover the FRA. This enables people to receive a warning when flooding could occur.

Fluvial modelling was undertaken in 2016 for the fluvial Welland. This is the Welland Catchment Strategic Model. Tidal and fluvial breach modelling was carried out for the South Holland Strategic Flood Risk Assessment in 2010 and updated in 2016.

Flood risk maps are published based on the outputs from modelling to inform:

- the public and business of their flood risk
- potential developers and local planning authorities
- the assessment and design of flood risk management works

The Environment Agency maintain flood risk management assets such as:

- river channels
- flood defence walls
- embankments

The main assets that benefit Spalding FRA are:

- tidal control at Marsh Road Sluice on the Coronation Channel
- tidal control at Fulney Lock on the River Welland
- tidal flood banks on the River Welland downstream of Spalding
- fluvial flood banks that form the Coronation Channel through Spalding
- Crowland and Cowbit washlands on the River Welland upstream of Spalding

The tidal assets protect around 11,000 properties to a 0.5% annual probability standard of protection. The fluvial assets provide a 1% annual probability standard of protection.

The LLFA and Anglian Water similarly maintain assets that perform a flood risk management function on the drainage network.

The impact of climate change and future flood risk

As sea levels rise, it means that coastal flooding will become more frequent as higher water levels will be seen more often. Rainfall intensity is expected to increase in future which will cause river flows to increase.

Please refer to Climate Change and the Anglian River Basin District (RBD) section for more information on what we know are likely to be the implications of climate change in the Anglian River Basin District.

Objectives and measures for the Spalding FRA

Measures have been developed that apply specifically to the Spalding FRA. These measures have been developed in addition to those covering a wider geographic area that also apply to the Spalding FRA.

You can find information about all the measures that apply to the Spalding FRA in Flood Plan Explorer, an interactive mapping tool. This includes information on which national objectives each measure helps to achieve.

The South Essex Surface Water Flood Risk Area

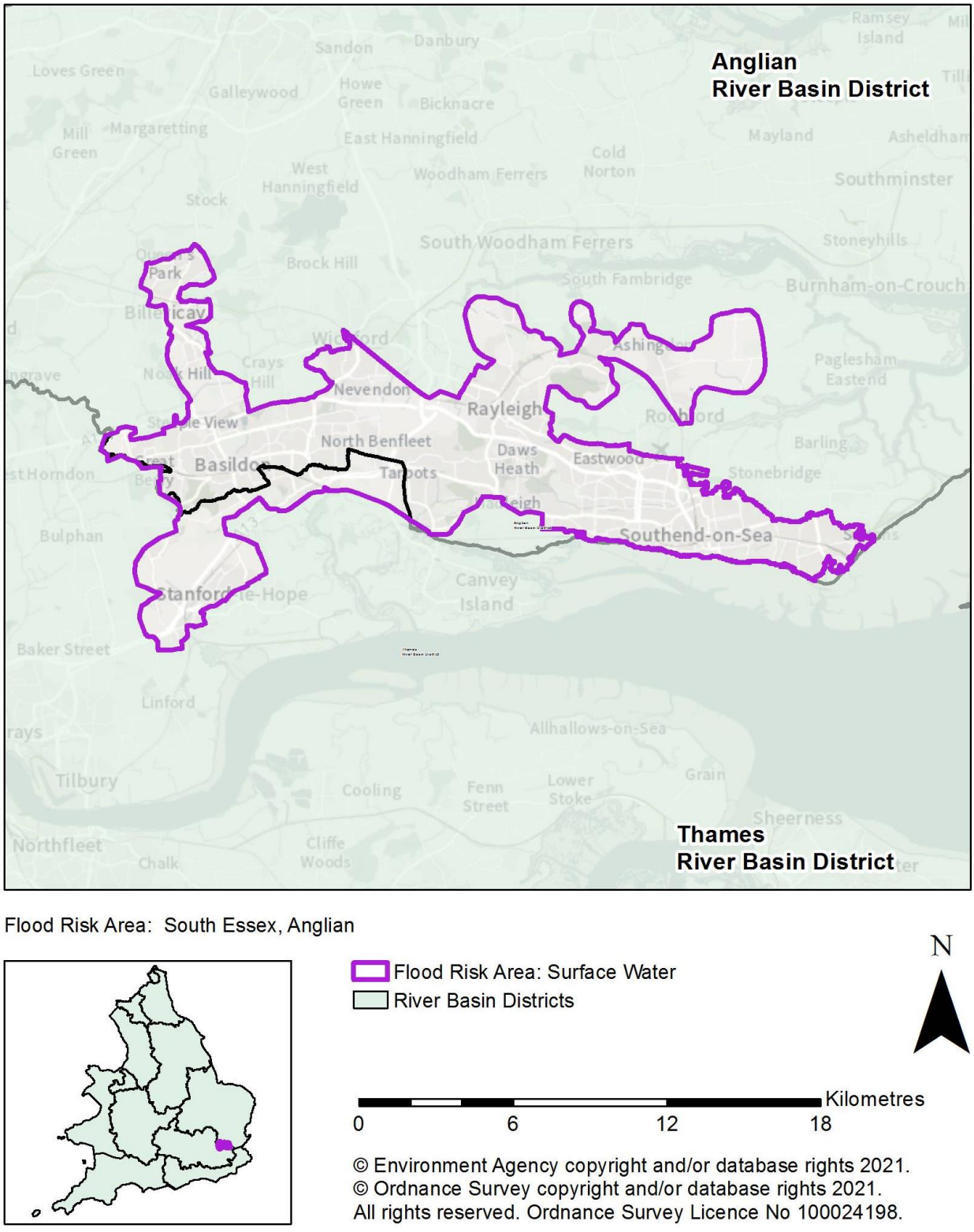


Figure 29: a map showing the boundary of the South Essex Flood Risk Area

Introduction to the South Essex Surface Water Flood Risk Area

The South Essex Flood Risk Area (FRA) has been identified as an FRA because the risk of flooding from surface water is significant nationally for people, the economy, or the environment (including cultural heritage).

The South Essex FRA incorporates the districts of Rochford, Castle Point and Basildon which are within the administrative area of Essex County Council. It also includes the unitary authorities of Thurrock and Southend on Sea.

Essex County Council, Southend Borough Council, and Thurrock Borough Council work in partnership on the development of the Flood Risk Management Plan (FRMP) for this FRA due to the area it covers, with each authority taking responsibility for the delivery of actions in their respective administrative areas.

The Environment Agency is the authority responsible for managing flood risk from main rivers and the sea in the FRA.

Both Anglian and Thames Water operate as the water and sewerage companies that own, operate, and maintain the sewer network and wastewater treatment infrastructure across the FRA.

The FRA covers both the Anglian and Thames River Basin District (RBD). However, as most of the area is within the Anglian RBD, information for the entire FRA is included with the Anglian FRMP.

The South Essex FRA covers an area of approximately 164km^2, extending between Southend-on-Sea in the east, to Basildon in the west and north, encompassing the towns of Billericay and villages of Ashingdon and Hockley. The urban areas of Rayleigh, Benfleet, Hadleigh and Thundersley are also encompassed within the FRA.

Basildon is the largest economy in the South Essex sub-region and home to the A127 Enterprise Parks Corridor, which is the largest concentration of employment in Essex. The area is home to a range of public and private schools and higher and further education establishments, including South Essex College’s new campus in Basildon Town Centre. The area includes Basildon Hospital, part of the mid and South Essex Hospital Trust.

Within the FRA there are approximately 42 kilometres of major trunk roads including the:

- A127
- A130
- A130/A127 interchange
- A13/A130 interchange

There are around 41km of railway lines in the FRA, including of the C2C and Greater Anglia railway lines connecting London to Southend Central and Southend Victoria/Shoebury, respectively. Key transport infrastructure improvements include the

A127/A130 Fairglen Interchange (short and long-term schemes) and the Lower Thames Crossing.

There's approximately 12km of shoreline that falls under the responsibility of Southend Borough Council. This includes the ownership and maintenance of sea walls, groynes and other coastal defences.

The predominant land use cover is urbanised which is mostly residential mixed with some local commercial areas. Basildon and Southend-on-Sea have some larger defined commercial and industrial areas. The remaining areas constitute greenbelt, villages, woodland, farmland and open space such as parks, allotments and golf courses.

The FRA contains several major watercourses and main rivers, including the Prittlewell and Eastwood Brooks, and the upper reaches and tributaries of the River Crouch. The area has several combined sewers and pumping stations with storm water tanks which have emergency overflows discharging into the estuary; these are in the ownership of Anglian Water.

The underlying geology of the area is predominantly clay, the porosity of which is low. This can result in reduced infiltration rates and increased surface water run-off. In urban areas, this can exacerbate potential issues related to surface water flooding.

The area contains 4 Sites of Special Scientific Interest (SSSI) and the entire Southend foreshore is a SSSI, Special Protection Area, and Ramsar.

The emerging 'South Essex Joint Strategy Plan', being prepared by Association of South Essex Local Authorities, seeks to bring forward sustainable growth in south Essex to deliver at least 90,000 homes and 58,000 jobs.

Current flood risk

The flood hazard and risk maps show that in the South Essex FRA, 88,176 of the 479,110 people live in areas at risk of flooding from surface water. Of these people, 18% live in areas considered to be at high risk.

Also shown to be at risk of flooding from surface water are:

- 3,400 non-residential properties
- 1 airport
- 167 out of 2,428 services
- 20.68 km of railways
- 11.67 km of roads
- 2 bathing water sites
- 5 sites regulated under the Environmental Permitting Regulations
- 11 licensed water abstraction sites
- 38 listed buildings
- ~1508 ha of agricultural land - of which around 526ha is at high risk

- ~0.1 ha of Special Area of Conservation
- ~0.1 ha of SPA
- ~6.75 ha of Scheduled Ancient Monument
- ~59.34 ha of SSSI
- ~0.16 ha of Ramsar sites

The flood risk and hazard maps provide more detailed information on the likelihood and consequence of flooding for the South Essex FRA.

Based on this information, Risk Management Authorities (RMAs) have concluded that further steps should be taken to reduce the likelihood of flooding and the current and future impact it could have on the FRA.

How the risk is currently managed

The management of surface water flood risk in the South Essex FRA is led by Southend Borough Council and Essex County Council in collaboration with other RMAs and stakeholders, including:

- the Environment Agency
- Thurrock Borough Council
- Anglian Water
- Thames Water
- Essex Highways
- the District/Borough Councils

Separately, the Essex Local Resilience Forum (LRF) is a multi-agency partnership made up of representatives from local public services such as:

- emergency services
- local authorities
- NHS
- Environment Agency

Associated businesses organisations and voluntary sector representatives are also involved. These organisations work together through the LRF to prepare for and respond to emergencies. The community risk register is a collection of assessments of emergencies that might happen locally within Essex. Each potential emergency is rated in terms of its potential impact and likelihood of occurring. Flooding is included in this assessment.

Surface Water Management Plans (SWMP) have been commissioned for areas identified as being at highest risk of flooding. The ‘South Essex SWMP’ was completed in April 2012, whilst the ‘Southend-on-Sea SWMP’ was completed in 2015 and is currently scheduled to be reviewed and updated.

The SWMPs identify various measures for managing surface water flood risk within a detailed ‘SWMP Action Plan’, including options for flood alleviation schemes that were fed into the Flood Capital Programme for further assessment and delivery, where this was viable. Opportunities were also highlighted to work more closely with other Risk Management Authorities to better manage the impacts of new development on surface water flooding through the provision of Sustainable Drainage Systems (SuDS).

The ‘Southend-on-Sea SWMP’ identified 6 Critical Drainage Areas (CDA). Several Initial Assessments (IA) were undertaken in 2019 to review the data and recommendations for each CDA and to confirm if viable options existed to address surface water flooding. Following the completion of the IAs, the Eastwood Brook scheme is being developed and is currently at the detailed modelling stage following the completion of onsite surveys.

Over 2018 to 2020 a review of the SWMP modelling for South Essex was carried out so that a better understanding of flood risk could be gained. The results of this included updated surface water flood risk mapping and the identification of 35 CDAs within the South Essex FRA.

There are several notable Flood Alleviation schemes that have been delivered in the South Essex FRA through the Flood Capital Programme. For example, the:

- construction of an attenuation bund as part of the new development off Hart Road in East Thundersley
- construction of attenuation bunds in Pitsea, Basildon
- construction of a retaining wall and attenuation bund at Sweyne Park School and Sweyne Park
- installation of check dams within the watercourse at Hockley
- installation of a flood defence bund within West Wood, East Thundersley
- installation of measures to capture and manage rainfall to ease pressure on surface water sewers in the High Street and Lifstan Way areas of Southend

The ‘Catchment to Coast’ project is being undertaken jointly between Southend Borough Council and Thurrock Borough Council to reduce surface water flood risk to locations including Prittlewell and Shoebury thorough the use of upper catchment natural flood management and land management measures. The project will also seek to reduce coastal erosion in locations of historic landfill sites, including:

- Hadleigh
- Two Tree Island
- Leigh on Sea

Coastal flood risk is managed through the 2018 Shoreline Management Strategy with the shoreline divided into 9 discrete sections. Each has a management policy assigned aligning with those contained in the Shoreline Management Plans. Only one section, covering Two Tree Island, has been assigned as do minimum with the remaining sections all falling under sustain or upgrade policies.

Southend Borough Council owns and maintains all the coastal sea defences within the borough, constituting roughly 8 miles of coastline. These are significant assets which protect large areas of Southend from coastal flooding. All coastal assets are subjected to full inspections annually with all visually inspected monthly. Repairs are currently undertaken on a reactive basis when problems are discovered.

Essex County Council have published the 'Essex Green Infrastructure (GI) Strategy' (2020) setting out GI ambitions, defining the different types of GI across Greater Essex and importantly, aims to encourage stakeholder collaboration and a coordinated approach to delivering and managing a GI network across Essex. Green space covers 33% of South Essex Local authority area (Basildon, Rochford, Castle Point, Southend-on-Sea and Thurrock). Of the total green space, 8% (43.7km2) is blue infrastructure comprising of ponds, lakes and reservoirs and coastal features and 10% (52.4km2) of natural and semi natural open green space.

The 'South Essex Green and Blue Infrastructure Study' (2020) sets an inspired vision for an integrated green and blue infrastructure network across South Essex. The vision is the creation of one single park system that encompasses all South Essex and comprises of 5 project areas. One of these is Central Marshlands, which is situated at South Essex's heart and is a rich zone of habitats, flood alleviation, watercourses and reclaimed industrial sites. Central Marshlands offers a green and blue infrastructure solution that enhances current flood defence proposals, provides flood storage, complements and improves existing habitat sites, aligns with developing coastal path plans.

Through good design, both existing and creation of new GI as part of the wider landscape GI network can contribute toward making areas less vulnerable to flood risk and improve water management, whilst ensuring development doesn't increase flood risk to third parties.

The Essex Climate Action Commission (ECAC) in 2019. One of the agreed actions of the ECAC is to address the resilience of the County to extreme weather and flooding, and a key focus throughout is land use and green infrastructure.

Emerging recommendations from the ECAC will help to manage the predicted sea level rise and increased rainfall intensity due to climate change in this area, and to become more resilient to future flood risk.

The impact of climate change and future flood risk

Rainfall intensity is expected to increase in future, causing greater volumes of runoff and higher flows within watercourses. It's therefore likely that flooding will become more frequent.

Please refer to the Climate Change and the Anglian River Basin District (RBD) section for more information on what we know are likely to be the implications of climate change in the Anglian RBD.

Objectives and measures for the South Essex Flood Risk Area

Measures have been developed that apply specifically to the South Essex FRA.

You can find information about all the measures that apply to the South Essex FRA in the Flood Plan Explorer, an interactive mapping tool. This includes information on which national objectives each measure helps to achieve.

The Wisbech Rivers and the Sea Flood Risk Area

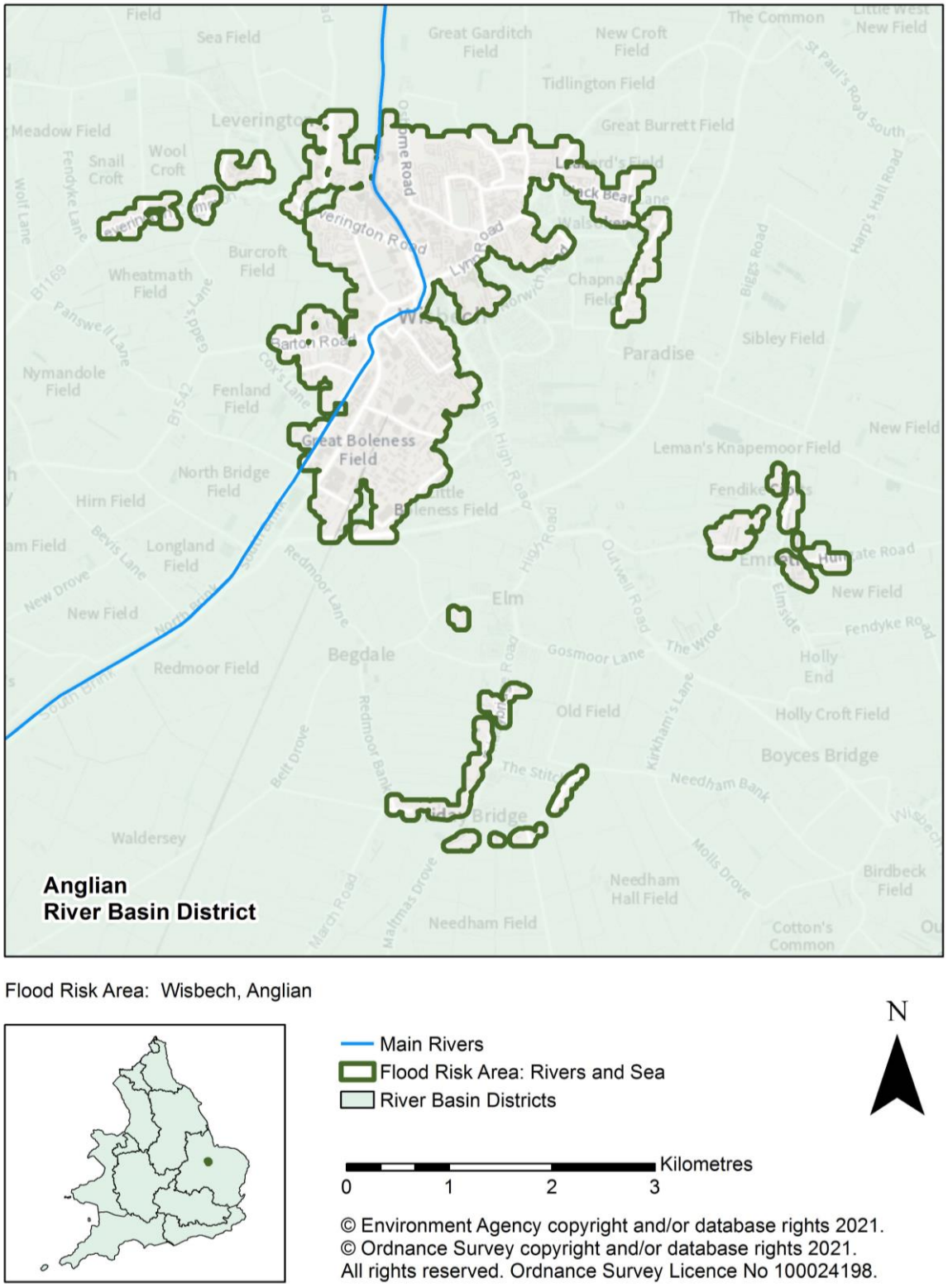


Figure 30: a map showing the boundary of the Wisbech Rivers and Sea Flood Risk Area

Introduction to the Wisbech Flood Risk Area

The Wisbech Flood Risk Area (FRA) has been identified as an FRA because the risk of flooding from rivers and the sea is significant nationally for people, the economy, or the environment (including cultural heritage).

The Environment Agency leads on the development and delivery of the Flood Risk Management Plan (FRMP) for this FRA.

Cambridgeshire and Norfolk County Councils are the Lead Local Flood Authority (LLFA), whose remit includes flood risk from 'local' sources. These local sources include:

- surface water
- groundwater
- ordinary watercourses

Anglian Water is the water and sewerage company that owns, operates and maintains the sewer network and wastewater treatment infrastructure in the FRA.

The Wisbech FRA covers many of the urban districts of Wisbech and areas in:

- Walsoken
- Friday Bridge
- Emneth
- Leverington

These are surrounded by a green belt of mainly farmland.

The soil type is predominantly wet deep and silt. It provides rich grade 1 and 2 agricultural land, which is important to the economy of the area. The land is flat and relies upon a series of pumped drainage networks.

The FRA may include locations that are not connected to the main part of the FRA, and there may be small areas of 'dry islands', which are shown to be outside of the FRA. The reason for these seemingly anomalous areas relates to the methodology used to identify the FRA boundaries, which is detailed in Part A of the FRMP report.

It's important to note that measures included for the FRA, particularly those associated with flood warning and evacuation procedures, are likely to apply to the FRA. They will not be limited to the area shown in Figure 30.

Historically Wisbech is thought to have gained its name from word 'bec', meaning bank, and 'wisc', meaning by the marshy meadow.

In medieval times it was busy as a port village. At that time, it lay only 4 miles from the sea whereas today it is more than 11 miles away. From the mid-seventeenth century Wisbech grew rapidly as the Fens were drained. The newly claimed land was fertile and productive. Agricultural products were exported from Wisbech to London. Other industry included:

- wood working industry

- brewing
- production of farm machinery

Through the 1800s the port of Wisbech continued to prosper with new wharves built and the banks of the tidal Nene strengthened by piling. In more recent times leisure craft have increased in popularity and Wisbech port is popular for yachts.

The River Nene rises near Daventry and flows 169km to the Wash. It's the tenth longest river in the country. It passes through Northampton and becomes tidal below Peterborough. It then travels almost 4.5km passing through Wisbech and on to the Wash.

The main risk to the FRA is from tidal sources.

Current flood risk

Wisbech has experienced significant flood incidents in:

- 1947 widespread fluvial flooding
- 1953 tidal surge
- 1978 tidal surge

The flood hazard and risk maps show that in the Wisbech FRA, 13,122 people live in areas at risk of flooding from rivers and the sea. Of people these, none are at high risk.

Also shown to be at risk of flooding from rivers and the sea are:

- 755 non-residential properties - including hospitals, schools and public utilities
- 2.19km of roads - including the A1101
- 1.28km of railway
- 374.26ha of agricultural land
- 0.32ha scheduled ancient monuments
- 132 listed buildings
- 1 water abstraction point

The flood hazard and risk maps provide more detailed information on the likelihood and consequence of flooding for the Wisbech FRA.

Based on this information, Risk Management Authorities (RMAs) have concluded that further steps should be taken to reduce the likelihood of flooding and the current and future impact it could have on the FRA.

How the risk is currently managed

The management of flood risk from rivers and the sea is led by the Environment Agency in collaboration with other RMAs and other stakeholders including:

- Cambridge County Council Council
- Norfolk County Council

- Fenland District Council
- North Level District Internal Drainage Board (IDB)
- Middle Level Commissioners
- Hundred of Wisbech IDB
- Kings Lynn IDB

A partnership framework has been set up across Cambridgeshire. The Cambridgeshire and Peterborough Flood and Water Partnership Group is chaired by Cambridgeshire County Council and involves all RMAs. This provides a coordinated and collaborative approach to management of flood risk and water management.

The Cambridgeshire and Peterborough LRF is a multi-agency partnership made up of representatives from local public services such as:

- emergency services
- local authorities
- NHS
- Environment Agency

Associated businesses organisations and voluntary sector representatives are also involved. These organisations work together through the LRF to prepare for and respond to emergencies. The community risk register is a collection of assessments of emergencies that might happen locally within Cambridgeshire. Each potential emergency is rated in terms of its potential impact and likelihood of occurring. Flooding is included in this assessment.

The Environment Agency monitor river and rainfall conditions at 1 site in and near to the FRA, which is Marshlands St James (Precipitation).

This information is used to inform activities related to 6 flood warning areas that cover the FRA. This enables people to receive a warning when flooding could occur.

Breach modelling and mapping for the Tidal Nene was completed in 2011. Additional Overtopping modelling and mapping was completed in 2016.

Flood risk maps are published based on the outputs from modelling to inform:

- the public and business of their flood risk
- potential developers and local planning authorities
- the assessment and design of flood risk management works

The Environment Agency maintain flood risk management assets through the FRA, such as:

- river channels
- flood defence walls
- embankments

The LLFA and Anglian Water similarly maintain assets that perform a flood risk management function on the drainage network.

The town of Wisbech is protected from tidal flooding to a standard of a 0.5% annual probability event, by a system of flood defences mainly comprising flood walls and flood gates. The walls are either of concrete or steel sheet pile construction and in some cases are clad with brickwork.

Some of the walls are set within the busy port area of the town where access to the quayside and related properties and businesses is required. Pedestrian and vehicular access is provided via several flood gates built into the walls.

Under normal circumstances the flood gates are left open. When the predicted tidal water level reaches a trigger level they are closed by our staff.

The impact of climate change and future flood risk

As sea levels rise, it means that coastal flooding will become more frequent as higher water levels will be seen more often.

Please refer to Climate Change and the Anglian River Basin District (RBD) section for more information on what we know are likely to be the implications of climate change in the Anglian River Basin District (RBD).

Objectives and measures for the Wisbech FRA

Measures have been developed that apply specifically to the Wisbech FRA. These measures have been developed in addition to those covering a wider geographic area that also apply to the Wisbech FRA.

You can find information about all the measures that apply to the Wisbech FRA in Flood Plan Explorer, an interactive mapping tool. This includes information on which national objectives each measure helps to achieve.

River Basin District level objectives and measures

Measures have been developed that apply to the Anglian River Basin District (RBD) as a whole or to areas within the RBD. These measures have been developed in addition to those that cover other spatial scales.

You can find information about each of these measures in Flood Plan Explorer, an interactive mapping tool. This includes information on which national objectives each measure helps to achieve.

There are 43 measures that apply to the Anglian RBD. This is 10% of the total number of measures in this Flood Risk Management Plan (FRMP). These measures focus on the high level challenges and opportunities facing the RBD during the lifecycle of the FRMP and beyond. They include how Flood and Coastal Risk Management activities can contribute to achieving the Environment Agency's target to be a net zero carbon organisation by 2030. They also include how holistic water management can achieve better resilience to floods and droughts.

Strategic Area objectives and measures

Measures have been developed that apply specifically to 2 strategic areas within the Anglian River Basin District (RBD) – The Fens and Lowlands, and The Oxford to Cambridge Arc. These measures have been developed in addition to those covering a wider geographic area, but also apply to the strategic areas.

You can find information about all the measures that apply to the strategic areas in Flood Plan Explorer, an interactive mapping tool. This includes information on which national objectives each measure helps to achieve.

There are 25 measures that apply to the strategic areas. This is 6% of the total number of measures in this Flood Risk Management Plan (FRMP). The strategic areas are described below.

The Fens and Lowlands Strategic Area

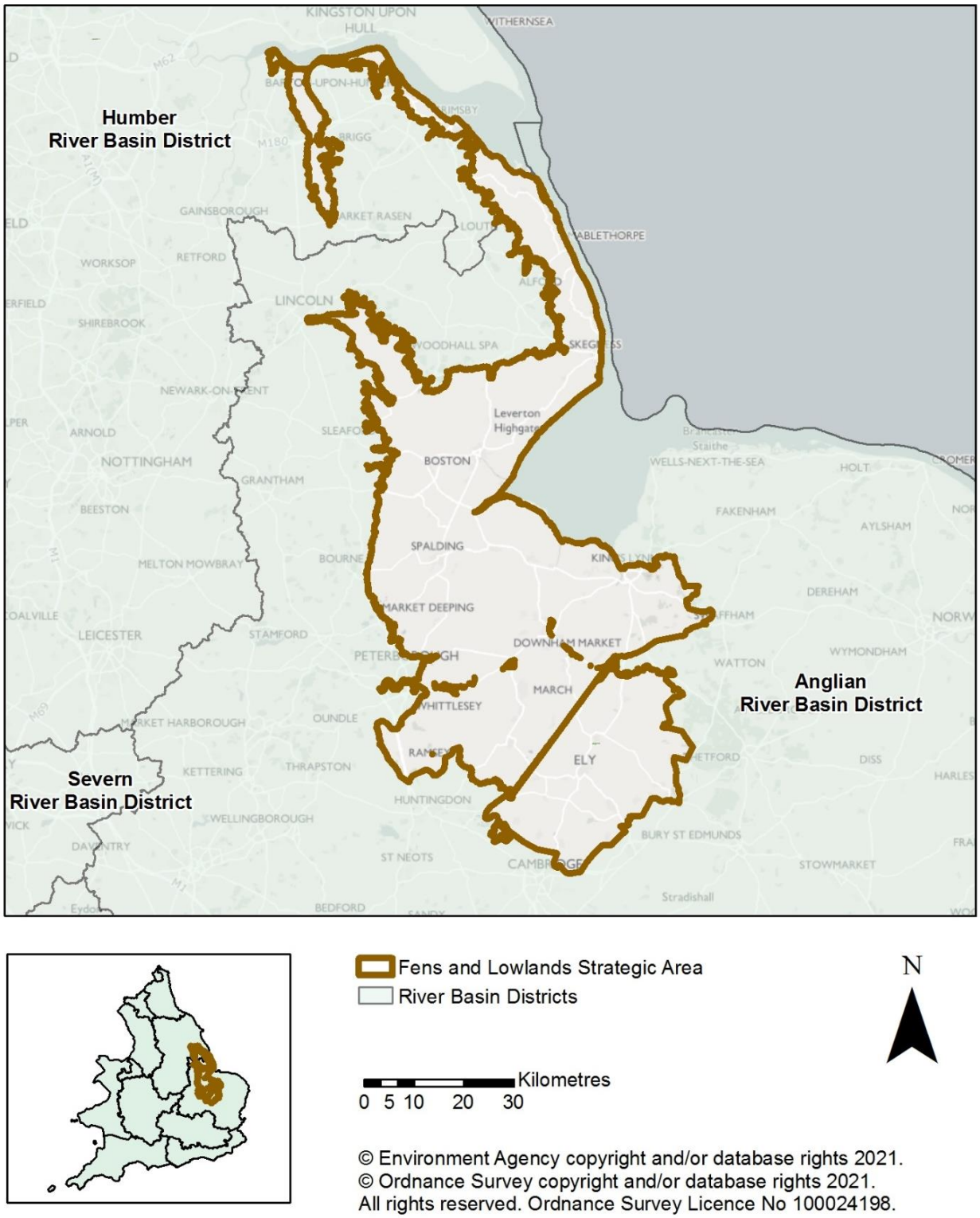


Figure 31: a map showing the boundary of the Fens and Lowlands Strategic Area

Introduction to the Fens and Lowlands Strategic Area

The Fens Strategic Area (SA) has been extended since the publication of the first cycle Flood Risk Management Plan (FRMP). It now includes most land below the 6 metre above Ordnance Datum (aOD) contour line within Greater Lincolnshire, Norfolk and Cambridgeshire, and was renamed the Fens and Lowlands SA. The area straddles both the Anglian and Humber River Basin District (RBD).

The Fens and Lowlands SA is an area where it is important to consider flood risk management across more than 1 sub-area. This is so that interested parties can work in a co-ordinated way to set out conclusions, objectives and measures to manage risk. The National Flood and Coastal Erosion Risk Management (FCERM) strategy includes a measure to develop a long-term plan for managing future flood risk in the Fens, highlighting the importance of the area. The Anglian FRMP measures provide local actions to contribute to delivering this measure.

The underlying geology of the area broadly encompasses impermeable clays and mudstones. This geology, combined with the level topography of the area, results in standing water over the land. The soils of the area are typically characterised as peaty and/or alluvial silts, sands and gravels.

Four river catchments carry water from surrounding uplands, through the Fens and out into The Wash:

- Witham
- Welland
- Nene
- Great Ouse

The extended lowland area includes the main rivers:

- New River Ancholme
- Steeping River
- Coastal rivers along the East Coast and South Humber Bank

This area contains around 640,000 people, covering an area of around 4950km^2, divided between 17 district and 7 county councils.

The Fens and Lowlands SA covers 2 Environment Agency Administrative Areas: Lincolnshire and Northamptonshire Area and East Anglia Area. Both areas have partnership arrangements with Lead Local Flood Authorities (LLFAs), Internal Drainage Boards (IDBs) and other Risk Management Authorities (RMA).

The Fens are an artificial, man-made landscape that has been reclaimed from coastal and estuarine wetlands over many centuries. These marsh areas, which are at or below sea level, have been artificially drained and continue to be protected from floods by flood banks, land drainage channels and pumps. With the support of this drainage system, the Fens and Lowlands have become a major arable agricultural region in Britain for grains

and vegetables. These drainage systems also provide flood protection to many Fenland and Lowland settlements and properties, and to the infrastructure that serves those communities.

IDBs play a critical role in managing land drainage and flood defences within these low-lying areas. The IDBs within the Fens and Lowlands have been in existence for many years due to the unique water level, drainage and flood risk management needs within this area.

Farming contributes significantly to the success of the local economy, supporting many businesses involved in the production of food and rural tourism. The area accounts for 50% of the Grade 1 agricultural land in England, producing 37% of all vegetables and 24% of all potatoes grown in the country, as well as 17% of its sugar beet and 38% of its bulbs and flowers.

The area also supports significant dairy farming, livestock and outdoor pig production as well as producing approximately 18 million hens, ducks, turkeys and geese in the Lincolnshire Fens alone. This in turn supports a large well-established food processing industry throughout the area. It is critical, therefore, that appropriate flood risk and drainage management measures are taken to protect this nationally important food production area.

In addition to food production the Fens and Lowlands are popular for tourism, attracting significant numbers of visitors each year, particularly to sites along the Lincolnshire and Norfolk coastline.

The area provides a unique and rich habitat for wildlife and includes the Ouse and Nene Washes which, whilst acting as flood storage reservoirs, also provide important wetland areas for birds. The area forms three sides of the Wash Site of Special Scientific Interest (SSSI), which is internationally designated for animal and plant biodiversity. There are also numerous inland local sites of importance ranging from SSSI to Local Nature Reserves.

The risk of river flooding in the area is from the rivers Ancholme, Steeping, Witham, Welland, Glen, Nene and Great Ouse and their tributaries. Many lengths of these rivers are ‘high level carriers’ that transport water through the Fens with normal water levels retained way above ground levels within the Fens. Flood embankments are therefore working 24/7 365 days a year.

As the communities have expanded, development has increasingly taken place on land at higher risk of flooding. This provides opportunities for innovative sustainable drainage solutions to reduce flood risk to these areas.

Significant historical flood events in the SA include:

- 1937 – river flooding
- 1947 – river flooding
- 1953 – tidal flooding
- 1978 – tidal flooding

- 1981 – river flooding
- 1988 – river flooding
- 2013 – tidal flooding

Current flood risk

Flooding from Rivers and Sea

With approximately 645km of coastal and tidal defences and 2,073km of main river defences, the area is classified as a defended flood plain.

Tidal flooding from breaching or overtopping of tidal defences could inundate communities along the East Coast, The Wash but also potentially 20 to 30km inland. Breaching or failure of main river embankments poses a significant flood risk. This type of flooding is difficult to predict, and while the likelihood of this happening is low, the consequences could be significant, resulting in the rapid inundation of the areas immediately behind the embankments leading to a severe risk to life.

Major transport networks including road and rail, as well as residential property and critical infrastructure (water, gas and electricity) would be affected if the area were to flood.

High rainfall events have led to flooding within the area in recent years, caused by both overtopping and breaches of the defences.

Recent flood events include:

- 2019 – Steeping Catchment
- 2019 – Lower Witham Catchment
- 2020 – Lower Witham Catchment
- 2020 – Nene Catchment
- 2021 – Great Ouse Catchment

More details on significant (affecting 20 or more properties) recent flood events in the Anglian RBD can be found in the History of Flooding section of this plan.

Tables 11, 12, and 13 summarise the risk of flooding from rivers and the sea to people, the economy, and the environment in the Fens and Lowlands SA. The information has been derived using existing data and risk assessment information from December 2019. The data are static. It provides information on the likelihood and consequence of flooding from rivers and the sea for the SA.

The risk is presented in flood risk likelihood categories. These indicate the chance of flooding in any given year:

- high risk means that each year an area has a chance of flooding of greater than 3.3%
- medium risk means that each year an area has a chance of flooding between 1% and 3.3%

- low risk means that each year an area has a chance of flooding of between 0.1% and 1%
- very low risk means that each year an area has a chance of flooding of less than 0.1%

The flood risk and hazard data shows that in the Fens and Lowlands SA, 381,506 people live in areas at risk from flooding from main rivers and the sea. Of these people, 6% live in areas considered to be at high risk.

Also shown to be in areas at risk of flooding from main rivers and the sea are:

- 20,131 non-residential properties - including community centres, hospitals, schools and colleges, retail parks and public utilities.
- 288.39km of roads
- 259.49km of railway
- 367,622ha of agricultural land
- areas of environmental designated sites - listed buildings, parks and gardens and water abstraction points

Table 11: summary of river and sea flood risk to people in the Fens and Lowlands Strategic Area

Risk to people	Total in Strategic Area	High risk	Medium risk	Low risk	Very low risk
Number of people in area	640,798	23,342	122,631	173,062	62,471
Number of services	5,627	291	1,196	1,343	444

Table 12 summary of river and sea flood risk to economic activity in the Fens and Lowlands Strategic Area

Risk to economic activity	Total in Strategic Area	High risk	Medium risk	Low risk	Very low risk
Number of non-residential properties	31,910	907	6,929	7,903	3,571
Number of airports	0	0	0	0	0
Length of road (kilometres (km))	499.68	10.63	124.10	122.22	31.45

Risk to economic activity	Total in Strategic Area	High risk	Medium risk	Low risk	Very low risk
Length of railway (km)	331.27	19.99	104.04	90.92	27.24
Agricultural land (hectares (ha))	461,126.03	52,034.09	177,608.37	117,077.19	20,902.93

Table 13: summary of river and sea flood risk to the natural and historic environment in the Fens and Lowlands Strategic Area

Risk to the natural and historic environment	Total in Strategic Area	High risk	Medium risk	Low risk	Very low risk
Number of EU designated bathing waters within 50 metres (m)	1	0	0	0	1
Number of Environmental Permitting Regulations (EPR) installations within 50m	184	40	60	36	14
Area of Special Area of Conservation (SAC) within area (ha)	4,605.39	344.88	339.95	148.71	4.78
Area of Special Protection Area (SPA) within area (ha)	8,576.13	3,817.13	369.61	133.97	34.42
Area of Ramsar site within area (ha)	8,349.45	3,900.68	576.76	120.92	3.78
Area of World Heritage Site within area (ha)	0	0	0	0	0
Area of Site of Special Scientific Interest (SSSI) within area (ha)	10796.47	4136.20	992.17	331.77	131.83
Area of parks and gardens within area (ha)	243.08	17.80	39.89	19.98	14.64

Risk to the natural and historic environment	Total in Strategic Area	High risk	Medium risk	Low risk	Very low risk
Area of scheduled ancient monument within area (ha)	1,088.03	70.93	176.20	160.58	37.28
Number of listed buildings within area	2,466	101	496	739	126
Number of licensed water abstractions within the area	1,772	752	519	259	57

Flooding from Surface Water

Tables 14, 15, and 16 summarise the risk of flooding from surface water to people, the economy, and the environment in the Fens and Lowlands SA. The information has been derived using existing data and risk assessment information from December 2019. The data are static. It provides information on the likelihood and consequence of flooding from rivers and the sea for the SA.

- high risk means that each year an area has a chance of flooding of greater than 3.3%
- medium risk means that each year an area has a chance of flooding between 1% and 3.3%
- low risk means that each year an area has a chance of flooding of between 0.1% and 1%

The flood risk and hazard maps show that in the Fens and Lowlands SA, 56,596 people live in areas at risk from flooding from surface water. Of these people, 5% are in areas of high risk.

Also shown to be in areas at risk of flooding from surface water are:

- 2,512 non-residential properties - including community centres, hospitals, schools and colleges, retail parks and public utilities
- 31.86km of roads
- 7.5km of railway
- 37,382.06ha of agricultural land
- areas of designated environmental sites - listed buildings, parks and gardens and water abstraction points

Table 14: summary of surface water flood risk to people in the Fens and Lowlands Strategic Area

Risk to people	Total in Strategic Area	High risk	Medium risk	Low risk
Number of people in area	640,798	2,614	6,103	47,879
Number of services	5,627	28	46	222

Table 15: summary of surface water flood risk to economic activity in the Fens and Lowlands Strategic Area

Risk to economic activity	Total in Strategic Area	High risk	Medium risk	Low risk
Number of non-residential properties	31,910	134	264	2,114
Number of airports	0	0	0	0
Length of road (kilometres (km))	499.68	4.27	5.10	22.51
Length of railway (km)	331.27	0.83	1.26	5.43
Agricultural land (hectares (ha)	461,126.03	3,923.53	4,901.65	28,556.74

Table 16: summary of surface water flood risk to the natural and historic environment in the Fens and Lowlands Strategic Area

Risk to the natural and historic environment	Total in Strategic Area	High risk	Medium risk	Low risk
Number of EU designated bathing waters within 50 metres (m)	1	0	0	0
Number of Environmental Permitting Regulations (EPR) installations within 50m	184	26	37	72
Area of Special Area of Conservation (SAC) within area (ha)	4,605.39	13.20	23.75	137.94

Risk to the natural and historic environment	Total in Strategic Area	High risk	Medium risk	Low risk
Area of Special Protection Area (SPA) within area (ha)	8,576.13	4.29	13.12	133.53
Area of Ramsar site within area (ha)	8,349.45	12.68	27.44	183.68
Area of World Heritage Site within area (ha)				
Area of Site of Special Scientific Interest (SSSI) within area (ha)	10,796.47	35.21	56.15	323.51
Area of parks and gardens within area (ha)	243.08	13.09	3.60	18.59
Area of scheduled ancient monument within area (ha)	1,088.03	19.12	16.99	67.28
Number of listed buildings within area	2,466	11	7	36
Number of licensed water abstractions within the area	1,772	563	209	354

Flooding from Reservoirs

There are several large, raised reservoirs within the SA, including the Ouse Washes and Nene Washes. These are used directly for flood storage and wetland habitat.

The likelihood of flooding from reservoirs is extremely low. However, in the unlikely event that a reservoir embankment failed, a large volume of water may be released, and flooding could happen with little or no warning.

Flooding from Groundwater

Groundwater levels within the SA are normally kept artificially low by the activities of the IDBs. While this management activity continues, the risk of groundwater flooding in the lowlands is low, although recently it has been noticed that as prolonged wet periods continue, groundwater does become an increasing issue, particularly in low lying settlements or other areas not specifically drained by the agricultural drainage system.

Conclusions

Based on the information, flooding within the SA could have a significant impact on people, the economy and the environment. In particular, the risk of flooding from rivers and the sea is highlighted by the data and is the focus for strategic planning within the area.

It's recommended that landscape scale adaptation plans are developed, specifically for the Fens and Lowlands SA catchments. This will allow development of a sustainable, integrated and long-term flood risk management approach for this landscape area.

How the risk is currently managed

As the Fens and Lowlands SA is largely below 6m aOD, it is protected from both tidal inundation and fluvial (river) flooding through a network of drainage channels, water control structures and embanked defences. Without these interventions the area would revert to marshy fens and lowlands, subject to frequent flooding from both the sea and rivers. The impact of this would be that homes and businesses in the area would have to be abandoned, as well as a significant loss in productivity of prime agricultural land.

There are 7 LLFAs within the Fens and Lowlands SA:

- North Lincolnshire Council
- North East Lincolnshire
- Cambridgeshire County Council
- Lincolnshire County Council
- Norfolk County Council
- Peterborough City Council
- Suffolk County Council

The Environment Agency will work with the LLFAs to ensure the Fens and Lowlands is reflected within updated versions of their local flood risk management strategies.

Local flood risk management strategies, produced by LLFAs, will incorporate the interests of the affected communities with those of the rest of the LLFA area, and aim to promote a consistent approach across the SA as a whole. This consistency is crucial to all RMAs, who often span more than one local authority and whose practices will be similar throughout their area.

The Environment Agency has strategic overview of flood risk across the SA and provide the tactical management and operational delivery for the risk from rivers and the sea. This is done in collaboration with the LLFAs and Internal Drainage Boards (IDBs). Further support is given to Anglian Water who manage the sewerage network. The flood risk management investment is coordinated through the two Regional Flood and Coastal Committees (RFCC), Anglian (Northern) and Anglian (Great Ouse).

Across the SA, the Environment Agency and several IDBs have in place public sector co-operation agreements, which enables both parties to undertake works on the others'

behalf should it be more efficient and cost-effective for them to do so. Cambridgeshire, Lincolnshire, North Lincolnshire, North-East Lincolnshire, Peterborough, and Norfolk have in place flood risk management partnerships comprising local RMA partners who meet to co-ordinate the approach to local flood risk management.

There are multiple pieces of work already being undertaken across the Fens and Lowlands to consider how best to manage this complex area in face of the climate emergency.

The Future Fens Integrated Adaptation taskforce (led by Anglian Water, Water Resources East and the Environment Agency) is a multi-sector taskforce which is seeking to create an integrated approach to water management for the Fenlands Landscape that will deliver resilience and adaptation to the changing climate. Alongside this, the Environment Agency will continue to build on work undertaken through the Future Fens: Flood Risk Management. We aim to work in partnership to extend our asset baseline understanding across all the Fens and Lowlands catchments. This will then support development of long-term catchment adaptation plans which will outline future investment requirements for Flood and Coastal Risk Management.

The impact of climate change and future flood risk

The climate is changing, and this will have an impact on flooding and coastal erosion. As sea levels rise, coastal and tidal flooding will become more frequent as higher water levels will be seen more often. For the Fens and Lowlands this will also mean increased pressure on embankments and reduced ability to discharge river water to the sea. More frequent and prolonged rainfall events will increase main river flows from the uplands. This combined with longer periods of tide lock due to sea level rise, will result in more water being stored in the lowland systems and affect communities at the edges of the Fens and Lowlands. Whilst this is waiting to be discharged to the sea, increased and prolonged pressure will be placed on the embankments. Changes in weather patterns and an increase in rainfall intensity is likely to increase flood risk from surface water and ordinary watercourses as well as from main rivers.

Despite being low-lying, the extensive artificial drainage networks mean that the Fens and Lowlands SA is currently relatively resilient during normal rainfall events. However, the changing climate means that these defences and drainage systems will have to cope with more water, more frequently. Maintenance and improvements are therefore important to ensure that these assets can withstand the pressures from future climate change.

At the same time, there will be longer periods of dry weather, resulting in scarcity of water resources in the area. This could have serious consequences for the water environment, and the water-dependant horticultural and arable industries located in the area. Dry periods can also damage earth embankments as they dry out and fissure.

Climate change poses a serious threat and an enhanced programme of investment and maintenance in flood defences and drainage systems will be needed if society wishes for existing standards of protection - including provision for climate change - to be maintained in the medium and long term.

Please refer to Climate Change and the Anglian River Basin District (RBD) section for more information on what we know are likely to be the implications of climate change in the Anglian River Basin District.

The Oxford to Cambridge Arc Strategic Area

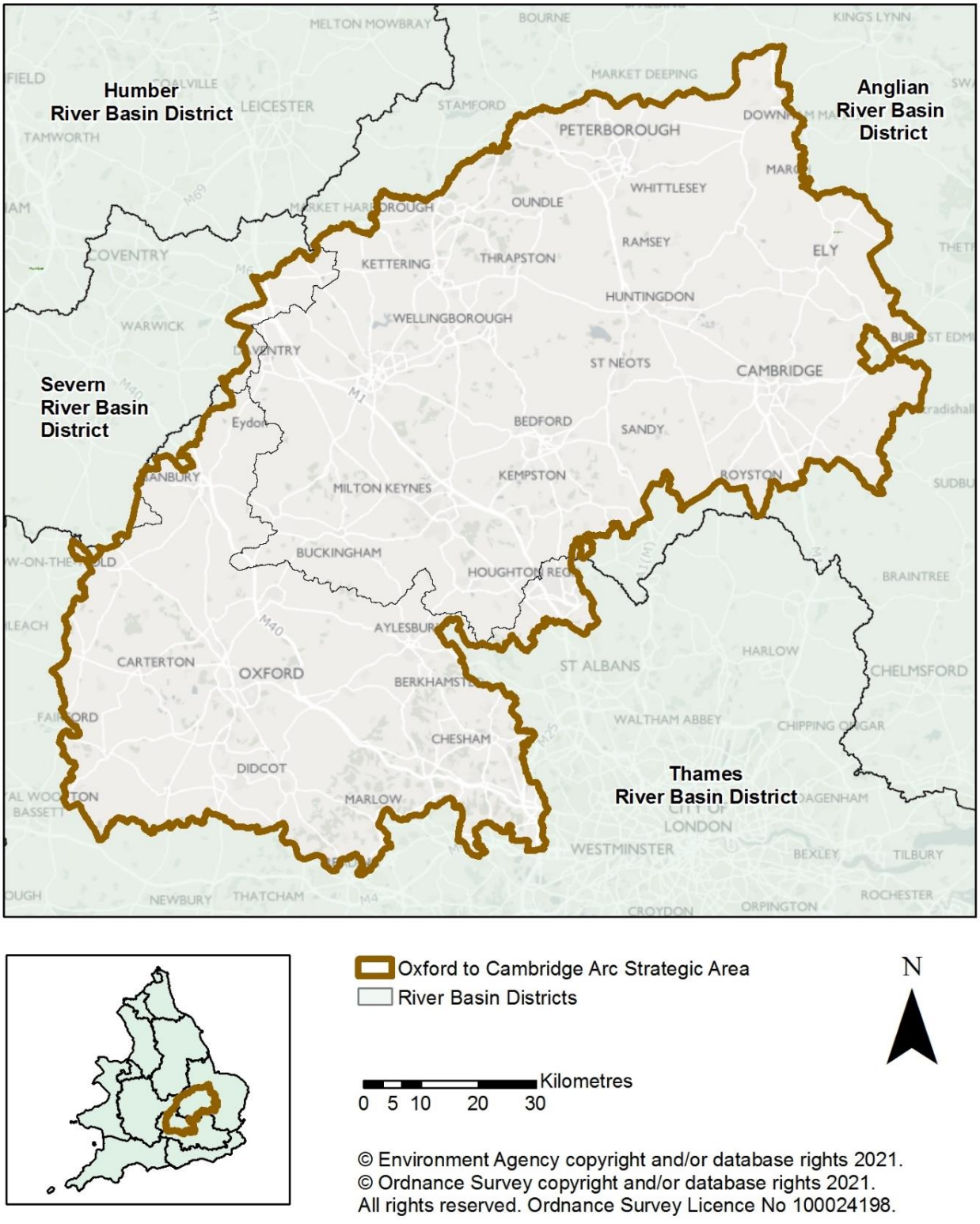


Figure 32: a map showing the boundary of the Oxford to Cambridge Arc Strategic Area

Introduction to the Oxford to Cambridge Arc Strategic Area

The Oxford to Cambridge Arc (OxCam Arc) Strategic Area (SA) is a globally significant area between Oxford, Milton Keynes and Cambridge. It is formed of five ceremonial counties:

- Oxfordshire
- Bedfordshire
- Buckinghamshire
- Northamptonshire
- Cambridgeshire

The OxCam Arc SA covers 4 Environment Agency Administrative Areas:

- East Anglia
- Hertfordshire and North London
- Lincolnshire and Northamptonshire
- Thames

The OxCam Arc covers 2 River Basin Districts and is therefore included in both the Anglian and Thames Flood Risk Management Plans.

The OxCam Arc is the name given to a cross-government initiative that supports planning for the future up until 2050 and represents a unique opportunity to put the Government's 25 Year Environment Plan into action. The SA was not identified using a method identified by Defra. It was recommended for inclusion given its national significance.

The OxCam Arc is a largely agricultural landscape, with 54% of the area being cultivated / disturbed land and 19.6% improved grassland. The OxCam Arc's agricultural picture mirrors that of England: arable to the east and livestock to the west. Approximately 20% of England's Class 1 agricultural land is within the OxCam Arc. Woodland cover in the SA is concentrated in the Chilterns, which covers the headwaters of the River Thames.

The topography of the OxCam Arc is strongly influenced by the Cotswolds to the west, the Chilterns to the south and the lowlands of the Cambridgeshire Fens to the east.

The lower areas include the north-east of Cambridgeshire (where land drops below sea level in parts and is widely below 6m above Ordnance Datum (aOD). Elsewhere, the land rises to above 200m aOD, in areas of the Cotswolds and the Chilterns.

The geology tends to run in south-west to north-east bands. The south-east of the OxCam Arc is underlain by chalk and is home to valuable Chalk Streams. The next band north is the upper greensand, which is followed by a series of clays, including the Kimmerridge and Oxford. Moving into North Oxfordshire and Northamptonshire we see a less structured pattern, with the geology comprising of:

- Great Oolite
- Inferior Oolite
- Upper Lias

- Middle Lias

Within chalk and limestone areas, water can infiltrate quickly and move within and through these rocks forming part of the major groundwater resources. This groundwater provides a significant base flow component to the rivers. The impact of rainfall will be spread out over a relatively long period of time. Conversely, infiltration rates within clay areas are slow, which leads to increased surface water run-off. In an urban environment, this can exacerbate the potential issues for surface water flooding.

There are 20,000ha of Sites of Special Scientific Interest (SSSI) designated land across the OxCam Arc, with under half of it being in favourable condition.

The OxCam Arc also encompasses the Chilterns, Cotswolds, and North Wessex Downs Areas of Outstanding Natural Beauty (AONB). These AONB only cover a small part of the land area, however they represent important landscapes that are protected to conserve and enhance their natural beauty.

Local Enterprise Partnerships have been created to shape the SA's economic plans in support of the vision and the UK's industrial strategy. A new strategic infrastructure board has also been created to build on the work of the Transport Forum to develop arc-wide strategic infrastructure plans covering transport, digital, utilities and flood management.

There are three main river catchments that flow within the OxCam Arc. These main rivers dominate the landscape, from the wide Thames Valley flowing through historic market towns, to the Ouse Washes, which is an internationally important area for wildlife:

- the River Thames and associated tributaries – including the Evenlode, the Cherwell, the Thame and the Ock
- the Great River Ouse and associated tributaries – including the River Ouzel, River Ivel and the River Cam
- the River Nene and associated tributaries – including the River Ise, Harpers Brook and Willow Brook

The tributary rivers located within the Arc are in mostly rural areas. These tend to be picturesque streams which wind their way through small settlements, including the internationally important chalk streams in the Chilterns.

The main rivers run through large urban areas. The River Thames runs through Oxford and then out of the Arc into Reading, before it returns through:

- Henley
- Marlow
- Maidenhead

The River Nene runs through the centre of Northampton and out through Peterborough. The River Great Ouse runs through:

- Buckingham
- Milton Keynes

- Bedford
- St. Neots

This chapter should be read in conjunction with other relevant local plans. There are several relevant regional and local key policies which have been considered within the creation of this Flood Risk Management Plan and its measures, such as:

- The Oxford-Cambridge Arc Spatial Framework Policy Paper
- The Oxford-Cambridge Arc: government ambitions and joint declaration between government and local partners
- Government response to 'Partnering for Prosperity: a new deal for the Cambridge-Milton Keynes-Oxford Arc'
- National Infrastructure Commission report: 'Partnering for Prosperity: a new deal for the Cambridge-Milton Keynes-Oxford Arc (PDF)
- Government plan to transform Oxford-Cambridge Arc into UK's fastest growing economic region

Current flood risk

The primary source of flood risk across the OxCam Arc varies, but the main risk is from river flooding.

Flooding from rivers

Gradient is one factor in determining hydrological response. In steeper catchments, water levels within watercourses can rise quickly after rainfall, with little advanced warning. The main rivers within the SA are generally slow responding. For example, flooding on the River Thames and in the Ouse Washes can last many weeks. Floodplains are extensive and provide important floodplain grazing marsh and floodplain meadow habitats. The rivers are dominated by wide river valleys, with gently sloping hills to the west of the area and very flat land to the east. Tributary watercourses in the upper parts of catchments tend to rise more quickly in response to rainfall, which can result in rapid onset flooding.

There have been numerous large floods across the area in recent years. There was large-scale river flooding in Oxford in the winter of 2013/14 as well as widespread flooding in winter 2020/21.

On 23 December 2020, Storm Bella tracked across large parts of the UK, causing significant rainfall on already saturated ground. In total, enough rain fell on the River Great Ouse catchment on the 23 December to fill Grafham Water 5 times. In the River Great Ouse catchment, which was the catchment most affected, over 500 properties were flooded, many with a combination of river, surface water, sewer and groundwater flooding. Affected areas included:

- Buckingham
- Stony Stratford

- Newport Pagnell
- St. Neots and surrounding areas
- Alconbury
- St. Ives
- March

Many roads were closed, including the A14 near Ellington in Cambridgeshire. Due to the severe flood risk, people in over 1,300 properties were advised to evacuate on Christmas Day, 2020.

Tables 17, 18, and 19 summarise the risk of flooding from rivers and the sea to people, the economy, and the environment in the OxCam Arc SA. The information has been derived using existing data and risk assessment information from December 2019. The data are static. It provides information on the likelihood and consequence of flooding from rivers and the sea for the SA.

The risk is presented in flood risk likelihood categories. These indicate the chance of flooding in any given year:

- high risk means that each year an area has a chance of flooding of greater than 3.3%
- medium risk means that each year an area has a chance of flooding between 1% and 3.3%
- low risk means that each year an area has a chance of flooding of between 0.1% and 1%
- very low risk means that each year an area has a chance of flooding of less than 0.1%

Within the Arc, 155, 285 people live in areas at risk of flooding from rivers and the sea, representing 4% of the total population. This includes 10,849 non-residential properties and approximately 16% of the agricultural land at risk of flooding from rivers and the sea. Approximately 37% of SSSI and 92% of Ramsar sites are also at risk of flooding from rivers and the sea in the SA.

Table 17: summary of river and sea flood risk to people in the Oxford to Cambridge Arc Strategic Area

Risk to people	Total in Strategic Area	High risk	Medium risk	Low risk	Very low risk
Number of people in SA	3,750,818	16,663	72,583	50,356	15,683
Number of services	29,351	274	1,096	517	150

Table 18: summary of river and sea flood risk to economic activity in the Oxford to Cambridge Arc Strategic Area

Risk to economic activity	Total in Strategic Area	High risk	Medium risk	Low risk	Very low risk
Number of non-residential properties	140,473	1,074	5,390	3,276	1,109
Number of airports	3	0	0	0	0
Length of road (kilometres (km))	1,995.9	13.9	104.1	25.4	12
Length of railway (km)	1035.4	15.4	105.5	31.7	6.4
Agricultural land (hectares (ha))	945,883	21,037.9	103,399.4	22,018.8	4,751

Table 19: summary of river and sea flood risk to the natural and historic environment in Oxford to Cambridge Arc Strategic Area

Risk to the natural and historic environment	Total in Strategic Area	High risk	Medium risk	Low risk	Very low risk
Number of EU designated bathing waters within 50 metres (m)	0	0	0	0	0
Number of Environmental Permitting Regulations (EPR) installations within 50m	248	17	23	8	3
Area of Special Area of Conservation (SAC) within area (ha)	2,967.3	683.5	307.3	4.1	2.4
Area of Special Protection Area (SPA) within area (ha)	4,630.4	4,394.7	129.7	17.7	2.7
Area of Ramsar site within area (ha)	5,249.6	4,480.6	346.7	17.7	5.1
Area of World Heritage Site within area (ha)	933.1	53.6	3	0.03	0

Risk to the natural and historic environment	Total in Strategic Area	High risk	Medium risk	Low risk	Very low risk
Area of Site of Special Scientific Interest (SSSI) within area (ha)	20,246.3	6,121.4	1,237.2	89.7	42.5
Area of parks and gardens within area (ha)	20,731.5	507.6	534.7	60	11.4
Area of scheduled ancient monument within area (ha)	5,550.8	364.3	502.7	153.9	23.2
Number of listed buildings within area	37,315	491	1,324	618	275
Number of licensed water abstractions within the area	2,460	632	696	125	21

Flooding from surface water

Flood risk from surface water tends to be concentrated on major urban centres within the OxCam Arc. The high proportion of impermeable ground cover leads to greater volumes of storm water runoff, which can flood properties before it enters a watercourse, drain or sewer.

When Milton Keynes was developed as a new town, it was understood that building a new town meant far quicker runoff from storm water into rivers than would naturally occur. For this reason, a strategic drainage network, comprising linear parks and balancing lakes was developed. The Milton Keynes model is a demonstration of what managing surface water flood risk and reducing river flood risk could look like.

Tables 20, 21, and 22 summarise the risk of flooding from surface water to people, the economy, and the environment in the OxCam Arc SA. The information has been derived using existing data and risk assessment information from December 2019. The data are static. It provides information on the likelihood and consequence of flooding from rivers and the sea for the SA.

The risk is presented in flood risk likelihood categories. These indicate the chance of flooding in any given year:

- high risk means that each year an area has a chance of flooding of greater than 3.3%
- medium risk means that each year an area has a chance of flooding between 1% and 3.3%
- low risk means that each year an area has a chance of flooding of between 0.1% and 1%

Within the SA, 408,681 people live in areas at risk of flooding from surface water, representing 11% of the total population. This includes 20,509 non-residential properties and approximately 10% of the agricultural land at risk of flooding from surface water. Approximately 11% of SSSI and 9% of Ramsar sites are at risk of flooding from surface water in the SA.

Table 20: summary of surface water flood risk to people in the Oxford to Cambridge Arc Strategic Area

Risk to people	Total in Strategic Area	High risk	Medium risk	Low risk
Number of people in SA	3,750,818	38,894	61,814	307,972
Number of services	29,351	274	526	1,768

Table 21: summary of surface water flood risk to economic activity in the Oxford to Cambridge Arc Strategic Area

Risk to economic activity	Total in Strategic Area	High risk	Medium risk	Low risk
Number of non-residential properties	140,473	2,157	3,936	14,416
Number of airports	3	3	0	0
Length of road (kilometres (km))	1,996	85.2	72.9	237.2
Length of railway (km)	1,035.4	52.1	40.3	106.1
Agricultural land (hectares (ha))	945,883.8	19,860.6	15,004.4	62,645.6

Table 22: summary of surface water flood risk to the natural and historic environment in the Oxford to Cambridge Arc Strategic Area

Risk to the natural and historic environment	Total in Strategic Area	High risk	Medium risk	Low risk
Number of EU designated bathing waters within 50 metres (m)	0	0	0	0
Number of Environmental Permitting Regulations (EPR) installations within 50m	248	83	37	66

Risk to the natural and historic environment	Total in Strategic Area	High risk	Medium risk	Low risk
Area of Special Area of Conservation (SAC) within area (ha)	2,967.3	35.5	36.3	169.8
Area of Special Protection Area (SPA) within area (ha)	4,630.4	36.3	55.5	316.2
Area of Ramsar site within area (ha)	5,249.6	42.2	70.1	380.6
Area of World Heritage Site within area (ha)	933.1	1.1	2.2	46
Area of Site of Special Scientific Interest (SSSI) within area (ha)	20,246.3	446.1	338.5	1,514.9
Area of parks and gardens within area (ha)	20,731.5	570.6	323.8	1,210.9
Area of scheduled ancient monument within area (ha)	5,550.8	125	93.1	362.7
Number of listed buildings within area	37,315	319	244	1,242
Number of licensed water abstractions within the area	2,460	551	167	390

Conclusions

Based on this information, flooding within the SA could have a significant impact on people, the economy, and the environment. Widespread development across the OxCam Arc, as well as the impact of climate change, will increase pressure on flood risk infrastructure within the area in the future.

Strategic studies are being undertaken to consider options to improve floodplain storage and runoff management that will support the management of flood risk in the future, as well as providing potential environmental benefits. The nature of the river catchments within the area means that there is good potential to manage water in the upper reaches, though due to the large volume of water that flows through the catchments, engineered solutions will need to be considered.

It’s important to ensure the future effectiveness of any solutions considered. Taking further action to reduce risk will require further appraisal to assess whether options are socially and environmentally sustainable, technically viable and economically justified.

How the risk is currently managed

There are ten Lead Local Flood Authorities (LLFAs) within the Arc:

- Bedford
- Buckinghamshire
- Cambridgeshire
- Central Bedfordshire
- Luton
- Milton Keynes
- North Northamptonshire
- Oxfordshire
- Peterborough
- West Northamptonshire

Local flood risk management strategies, produced by LLFAs, will incorporate the interests of the affected communities with those of the rest of the LLFA area, and aim to promote a consistent approach across the SA. This consistency is crucial to all Risk Management Authorities (RMAs), who often span more than one local authority and whose practices will be similar throughout their area.

The Environment Agency has strategic overview of flood risk across the SA and provide the tactical management and operational delivery for the risk from rivers and the sea. This is done in collaboration with the LLFAs and Internal Drainage Boards (IDBs). Further support is given to Anglian Water who manage the sewerage network. The flood risk management investment is co-ordinated through the 3 Regional Flood and Coastal Committees (RFCC):

- Anglian (Northern)
- Anglian (Great Ouse)
- Thames

The Arc includes key flood defence infrastructure in:

- Aylesbury
- Banbury
- Bedford
- Ely
- Godmanchester
- Kings Lynn
- Marlow
- Newport Pagnell
- The Ouse Washes
- St Ives and the Hemingfords
- St Neots

The Environment Agency is working with partners to develop several schemes and studies. These include the:

- Oxford Flood Alleviation Scheme
- River Nene Storage Study
- River Great Ouse Strategic Flood Risk Intervention Study
- Bedford to Milton Keynes Waterway Park project
- Thames Valley Flood Scheme

Government has committed to developing a spatial framework for the OxCam Arc. This is a long-term strategic plan to help coordinate the infrastructure, environment and new developments in the area. Growth of up to 1 million new homes by 2050 is envisaged, which is a significant increase from the current 1.6 million dwellings within the area. Consideration is being given to the creation of multiple development corporations to oversee these developments in various locations.

The Ministry of Housing, Communities and Local Government is creating a spatial framework to decide on these locations, with a draft due to be published for consultation in autumn 2022.

The impact of climate change and future flood risk

The climate is changing, and this will have an impact on flooding within the OxCam Arc. Changes in weather patterns and an increase in frequency, intensity, and duration of rainfall events will increase main river flows. This will increase the pressure on flood defence infrastructure, and river flooding will become more frequent. The increase in rainfall intensity will also increase the likelihood of surface water flooding due to the increase in storm water runoff.

As sea levels rise, tidal flooding will become more frequent as higher water levels will be seen more often. This will have an impact in the eastern areas of the OxCam Arc in Cambridgeshire and Peterborough, where watercourses are tidally influenced. Longer periods of tide lock, combined with an increase in main river flows, will result in increased and prolonged pressure on flood defence infrastructure.

In the context of the SA, with up to 1 million new homes planned to be built by 2050, it is critical that climate change is robustly considered to ensure the sustainability of future investment in the area.

The Environment Agency has been working with the Infrastructure Transitions Research Consortium (a consortium of seven UK universities led by the University of Oxford) to spatially map the future development across the arc. The study is using high level flood modelling to look at which areas will be affected by flood risk now, and in the future, considering several climate change scenarios.

Whilst the OxCam Arc is set to be developed over the next 50 years, partners are committed to set a long-term approach to managing flood risk. The area is intended to

become a leading example of a climate adaptation strategy which enables practitioners and policy makers to plan, monitor and review how to adapt to flood risk over time.

When looking at flood risk during the development of the OxCam Arc, partners will need to ensure that decisions and evidence are based on assessing data at a catchment scale, be it smaller catchments or across river basins. Increased urbanisation, if not managed sustainably, enables the ground to reach saturation point faster, increasing overland flow and peak discharge.

Please refer to Climate Change and the Anglian River Basin District (RBD) section for more information on what we know are likely to be the implications of climate change in the Anglian River Basin District.

Management Catchment objectives and measures

Measures have been developed that apply specifically to places within Management Catchments in the Anglian River Basin District (RBD), as well as measures that apply to Management Catchments as a whole. These measures have been developed in addition to those that cover other spatial scales.

There are 127 measures applicable to managing flood risk in Management Catchments within the Anglian RBD. This is 31% of the total number of measures in this Flood Risk Management Plan.

You can find information about all the measures that apply to the Management Catchments in Flood Plan Explorer, an interactive mapping tool. The Management Catchments are described in the sections below.

The Broadland Rivers management catchment

Introduction to the Broadland Rivers management catchment

The Broadland Rivers catchment covers an area of approximately 3,200km^2. This includes around two thirds of Norfolk and part of north Suffolk. Much of the area is rural with pockets of urban settlements ranging from cities and towns to rural hamlets.

The management catchment comprises of 4 main watercourses, each with numerous tributaries that drain the area:

- The River Bure - receives tributary water from the Rivers Ant, Thurne, and Spixworth Beck
- The River Wensum - receives tributary water from the River Tud, and joins the River Yare downstream of Norwich
- The River Yare - receives tributary water from the Rivers Tiffey, Tas, and Chet

- The River Waveney - receives tributary water from the River Dove in its upper reaches and several other tributaries downstream

Partnership working

The main Lead Local Flood Authorities within the catchment are Norfolk County Council and Suffolk County Council.

There are 3 Internal Drainage Boards (IDBs) in the management catchment:

- Norfolk Rivers IDB
- Broads (2006) IDB
- Waveney, Lower Yare, and Lothingland IDB

Current flood risk

Flooding from rivers and the sea

The flood hazard and risk maps show that approximately 38,500 people are at risk of flooding from rivers and the sea within the Broadland Rivers management catchment. This represents 5% of the total population. Around 3,400 non-residential properties and approximately 10% of the agricultural land within the catchment are at risk of flooding from rivers and the sea. Approximately 78% of Sites of Special Scientific Interest (SSSIs) and 94% of Ramsar sites are at risk of flooding from rivers and the sea.

Flooding from surface water

The flood hazard and risk maps show that approximately 77,000 people are at risk of flooding from surface water within the Broadland Rivers management catchment. This represents almost 10% of the total population. Around 3,900 non-residential properties and approximately 8% of the agricultural land within the catchment are at risk of flooding from surface water. Approximately 11% of SSSIs and more than 7% of Ramsar sites are at risk of flooding from surface water.

The impact of climate change and future flood risk

The climate is changing and this is likely to have an impact on flooding and coastal erosion. Sea levels are rising and winter rainfall may become more intense. Changes in weather patterns and, in particular, more torrential rainfall is likely to increase flood risk from surface water and ordinary watercourses as well as rivers. Communities within the Broadland Rivers catchment have experienced an increase in both severity and frequency of existing flooding problems and communities that have not flooded previously have been affected in recent years. It is likely that this pattern will continue. Surface water and sewer flooding may increase due to more intense summer rainfall events.

The main areas of flood risk remain the three urban areas of Norwich, Great Yarmouth and Lowestoft. Due to the low-lying nature of the Broads, climate change will increase the probability of tidal flooding and increase the length of time watercourses will not be able to flow freely to the sea at high tide, causing tide-locking. In addition, surface water outfalls will remain tide-locked for lengthier durations where these discharge to tidal rivers via flap-valved sluices, heightening the risks of surface water flooding during storm rainfall events.

Please refer to Climate Change and the Anglian River Basin District (RBD) section for more information on what we know are likely to be the implications of climate change in the Anglian River Basin District.

The Cam and Ely Ouse management catchment

Introduction to the catchment

The Cam and Ely Ouse catchment covers an area of approximately 3,600km2 extending from Swaffham in the north, to Royston and Saffron Walden in the south, and from Potton in the west, to Attleborough in the east. The catchment comprises of 4 main tributaries of the River Great Ouse:

- the River Cam and its tributaries
- the River Lark and its tributaries
- the Little Ouse and its tributaries - includes the Thet and the Sapiston/Black Bourn
- the River Wissey and its tributaries

Partnership working

The main Lead Local Flood Authorities within the catchment are:

- Central Bedfordshire Council
- Essex County Council
- Hertfordshire County Council
- Norfolk County Council
- Suffolk County Council

There are 18 Internal Drainage Boards (IDBs) in the management catchment:

- Ely Group of IDBs, which is a group of 10 smaller IDBs within the catchment
- East Harling IDB
- Middle Level Commissioners, which is a group of 2 smaller IDBs within the catchment
- Downham Market Group of IDBs, which is a group of 5 smaller IDBs within the catchment

Current flood risk

Flooding from rivers

Approximately 18,000 people are at risk of flooding from rivers within the Cam and Ely Ouse catchment, representing 2.6% of the total population. Around 1,600 non-residential properties and approximately 20% of the agricultural land within the catchment are at risk of flooding from rivers. Approximately 4% of SSSIs and more than 35% of Ramsar sites are at risk of flooding from rivers in the area.

Flooding from surface water

Approximately 76,000 people are at risk of flooding from surface water within the Cam and Ely Ouse catchment, representing 11.2% of the total population. Around 3,272 non-residential properties and approximately 9% of the agricultural land within the catchment are at risk of flooding from surface water. Approximately 3% of SSSIs and more than 5.4% of Ramsar sites are at risk of flooding from surface water in the area.

The impact of climate change and future flood risk

The climate is changing and this is likely to have an impact on flooding and coastal erosion. Sea levels are rising and winter rainfall may become more intense. Changes in weather patterns and, in particular, more torrential rainfall is likely to increase flood risk from surface water and ordinary watercourses as well as rivers. Communities within the Cam and Ely Ouse catchment could experience an increase in both the severity and frequency of existing flooding problems, and communities that have not flooded previously could be affected in the future. It is likely that this pattern will continue through the effects of climate change.

The city of Cambridge and many smaller communities are likely to be affected by an increase in the risk of surface water flooding caused by higher levels of rainfall. Risk of flooding may also increase during winter as a result.

Please refer to Climate Change and the Anglian River Basin District (RBD) section for more information on what we know are likely to be the implications of climate change in the Anglian River Basin District.

The Combined Essex Management Catchment

Introduction to the catchment

The Combined Essex catchment covers an area of approximately 3,400km^2; most of the county of Essex, stretching from the Thames Estuary in the south to the Suffolk tributaries of the River Stour which flow from the north. The Combined Essex catchment includes a significant proportion of south Suffolk, including Sudbury, Haverhill, Hadleigh and Lavenham.

The management catchment comprises 6 main watercourses, each with numerous tributaries that drain the area:

- The River Stour - receives tributary water from the Rivers Glem, Box, Brett, Stour Brook and Bumstead Brook.
- The River Colne – receives tributary water from Bourne Brook, Toppesfield Brook, and Roman River, and is tidally influenced downstream of East Mill, Colchester.
- The River Pant – becomes the River Blackwater north of Braintree and receives tributary water from the River Brain. The River Blackwater is tidally influenced just upstream of Maldon.
- The River Chelmer – receives tributary water from the Rivers Ter, Wid, and Can, and outfalls to the tidal reaches of the River Blackwaterjust upstream of Maldon.
- The River Crouch – receives tributary waters from Basildon and Nevendon Brooks and is tidally influenced downstream of Wickford.
- The River Roach – receives tributary waters from Noble's Green Ditch, Eastwood Brook and Prittle Brook and is tidally influenced downstream of Rochford.

The management catchment is characterised by rural agricultural areas to the north contrasting with urban areas to the south. The area south of the River Crouch is significantly more urban in nature, which contributes to the risk of flooding. The predominately hard surfaces reduce infiltration, resulting in a rapid response to heavy rainfall, which influences surface water and river flooding in major urban areas.

Partnership working

The main Local Lead Flood Authorities within the catchment are Essex County Council and Southend-on-Sea Borough Council. Suffolk County and a small area of Cambridgeshire County also lie partly within the catchment.

Current flood risk

Flooding from rivers and the sea

Over 60,000 people are at risk of flooding from rivers and the sea within the Combined Essex catchment, representing 4% of the total population. Around 5,700 non-residential properties and approximately 9.4% of the agricultural land within the catchment are at risk of flooding from rivers and the sea. Approximately 66.7% of Sites of Special Scientific Interest (SSSIs) and 81.7% of Ramsar sites are at risk of flooding from rivers and the sea in the area.

Flooding from surface water

Almost 180,000 people are at risk of flooding from surface water within the Combined Essex catchment, representing 12% of the total population. Around 8,220 non-residential properties and approximately 12.2% of the agricultural land within the catchment are at

risk of flooding from surface water. Approximately 19.6% of SSSIs and 18% of Ramsar sites are at risk of flooding from surface water in the area.

The impact of climate change and future flood risk

The climate is changing and this is likely to have an impact on flooding and coastal erosion. Sea levels are rising and winter rainfall may become more intense. Changes in weather patterns and, in particular, more torrential rainfall is likely to increase flood risk from surface water and ordinary watercourses as well as rivers. Prolonged tide-locking of surface water and drainage outfalls to tidal rivers and estuaries is likely to increase the risks of surface water flooding due to increased sea levels and more intense rainfall events as a consequence of climate change.

Communities within the Combined Essex management catchment have experienced an increase in both severity and frequency of existing flooding problems and communities that have not flooded previously have been affected in recent years. It is likely that this pattern will continue.

Rising sea levels mean that waves and storm surges could cause a greater risk of coastal erosion to vulnerable beaches along the Tendring peninsular and the soft cliff frontage in the Stour and Blackwater estuary. Changes to the currents acting on the coast could also lead to changes in the movement of coastal sediments, affecting both coastal deposition and erosion. This could expose new risks from coastal flooding, lead to a greater risk of coastal defences failing and increase the need for maintenance work on defences and more extensive warning systems.

The East Suffolk Management Catchment

Introduction to the catchment

The East Suffolk catchment covers an area of approximately 1,600km^2. This includes the Suffolk coast and estuaries from Kessingland to Landguard Point, Felixstowe and the rivers that drain eastwards into the North Sea between those two points. It is a predominantly rural catchment and the county town of Ipswich is the largest settlement.

The management catchment comprises 6 main watercourses, each with numerous tributaries that drain the area:

- Lothingland Hundred River.
- River Blyth – receives tributary water from Chediston Watercourse, Walpole River, Bramfield Watercourse, the River Wang, and Dunwich River, and is tidally influenced downstream of Blyford.
- Minsmere River.
- River Alde – receives tributary water from the Rivers Ore and Fromus, and is tidally influenced downstream of Snape.

- River Deben – receives tributary water from the Rivers Lark and Fynn, Mill River, and Framsden Watercourse, and is tidally influenced downstream of Ufford.
- River Gipping, which receives tributary water from Rattlesden River, Haughley Watercourse, Bacton Watercourse, EarlStonham Watercourse, Somersham Watercourse, and Belstead Brook, becoming the tidally influenced River Orwell downstream of Horseshoe Sluice in Ipswich.

The vast majority of the coastline is a designated Area of Outstanding Natural Beauty. Most of the coastal settlements are at tidal flood risk. The rivers are mostly small with few properties at risk from river flooding but rather more from risk of tidal flooding in the estuaries. In the south of the county, the River Gipping is the most significant river in the catchment.

Key flood risk management infrastructure within the management catchment includes:

- the Ipswich tidal flood barrier, which was completed in 2019. The 200-tonne rotating barrier helps to keep the town safe from tidal surges during storms, ensuring that more than 1,600 homes and 400 businesses are protected from flooding and the impacts of climate change.
- The A14 flood storage area and the Rattlesden River flood storage area, which are both upstream of Stowmarket and are Reservoirs Act structures.

Partnership working

The Lead Local Flood Authority within the catchment is Suffolk County Council.

There are 2 Internal Drainage Boards (IDBs) in the management catchment:

- Waveney, Lower Yare, and Lothingland IDB
- East Suffolk IDB

Current flood risk

Flooding from rivers and the sea

Approximately 15,750 people are at risk of flooding from rivers and the sea within the East Suffolk management catchment, representing 4% of the total population. Around 3,000 non-residential properties and approximately 7.2% of the agricultural land within the catchment are at risk of flooding from rivers and the sea. Approximately 38.7% of Sites of Special Scientific Interest (SSSIs) and 67.9% of Ramsar sites are at risk of flooding from rivers and the sea.

Flooding from surface water

Over 40,000 people are at risk of flooding from surface water within the East Suffolk management catchment, representing around 10% of the total population. Around 2,425 non-residential properties and approximately 9% of the agricultural land within the

catchment are at risk of flooding from surface water. Approximately 6% of SSSIs and Ramsar sites are at risk of flooding from surface water.

The impact of climate change and future flood risk

The climate is changing and this is likely to have an impact on flooding and coastal erosion. Sea levels are rising and winter rainfall may become more intense. Changes in weather patterns and, in particular, more torrential rainfall is likely to increase flood risk from surface water and ordinary watercourses as well as rivers.

Communities within the East Suffolk management catchment have experienced an increase in both severity and frequency of existing flooding problems and communities that have not flooded previously have been affected in recent years. It is likely that this pattern will continue.

Rising sea levels mean that waves and storm surges could cause greater coastal erosion. This may also influence the discharge of surface water from urban drainage systems where those systems discharge to tide via flapped outfalls (increased period of tide-locking). Fluvial watercourses that discharge to estuaries or the coast via tidal sluices could also be affected by prolonged tide-locking in future. Changes to the currents acting on the coast could also lead to changes in the movement of coastal sediments, affecting both coastal deposition and erosion. This could expose new risks from coastal flooding, lead to a greater risk of coastal defences failing and increase the need for maintenance work on defences and more extensive warning systems.

The Nene Management Catchment

Introduction to the catchment

The catchment of the river Nene is located in the east of England. It extends eastwards from Daventry through Northampton, Wellingborough and Peterborough to its outfall into The Wash.

The Nene Catchment includes the major tributaries of:

- Kislingbury Branch
- Brampton Branch
- Wootton Brook
- River Ise
- Willow Brook
- Harpers Brook

The river Nene passes through the low-lying fens area downstream of Peterborough, where the river is embanked and heavily modified.

Internal Drainage Boards (IDBs) undertake a critical role in managing land drainage within these low-lying fenland areas and maintaining high-quality arable land.

Partnership working

The main Lead Local Flood Authorities within the catchment are:

- West Northamptonshire Council
- North Northamptonshire Council
- Peterborough City Council

The river Nene catchment also includes small areas covered by:

- Cambridgeshire County Council
- Lincolnshire County Council
- Bedfordshire Borough Council
- Norfolk County Council

There are 6 IDBs in the management catchment:

- North level District IDB
- Feldale IDB
- South Holland IDB
- Kings Lynn IDB
- Waldersey IDB
- Hundred of Wisbech IDB

Current flood risk

Flooding from rivers and the sea

Approximately 62,000 people are at risk of flooding from rivers and the sea within the Nene management catchment, representing 7% of the total population. Around 3800 non-residential properties and approximately 10% of the agricultural land within the catchment are at risk of flooding from rivers and the sea. Approximately 56% of Sites of Special Scientific Interest (SSSIs) and 88% of Ramsar sites are at risk of flooding from rivers and the sea.

Flooding from surface water

Approximately 77,000 people are at risk of flooding from surface water within the Nene management catchment, representing almost 9% of the total population. Around 5000 non-residential properties and approximately 10% of the agricultural land within the catchment are at risk of flooding from surface water. Approximately 15% of SSSIs and more than 11% of Ramsar sites are at risk of flooding from surface water.

The impact of climate change and future flood risk

The climate is changing and this is likely to have an impact on flooding and coastal erosion. Sea levels are rising and rainfall is becoming more intense. Changes in weather

patterns, especially more torrential rainfall, are likely to increase flood risk from surface water and ordinary watercourses as well as rivers. Communities within the Nene catchment have experienced an increase in both severity and frequency of existing flooding problems, and communities that have not flooded previously have been affected in recent years. It is likely that this pattern will continue through the effects of climate change.

Changes to currents and sea levels may also lead to changes in the movement of sediment. In the Nene catchment this could increase build-up and could expose the catchment to new coastal flood risk. This may lead to a greater risk of coastal defences failing, increase the need for maintenance work on defences and require more extensive warning systems. With the coastal area of the Nene Catchment already at risk from tidal flooding up to 27km inland, climate change will present increased challenges to those trying to reduce tidal flood risk in this area.

Urban areas within the Nene catchment such as Northampton, Wellingborough, Kettering, Corby and Peterborough are likely to suffer an increase in the risk of surface water flooding caused by higher levels of rainfall. Risk of flooding may also increase during winter as a result.

The North Norfolk Rivers Management Catchment

Introduction to the catchment

The North Norfolk Rivers catchment covers an area of approximately 481km^2. The area stretches from Brancaster in the west to Mundesley in the east. It is predominantly a rural catchment, characterised by small villages and market towns. The management catchment comprises 3 main watercourses, each with tributaries that drain the area:

- the River Burn - tidally influenced downstream of Burnham Overy, north of the sluice within the Burnham Norton Bank.the River Stiffkey, which is tidally influenced downstream of the Stiffkey Outfall Tidal Embankment
- the River Glaven - receives tributary water from Waterlane Watercourse and is tidally influenced downstream of Cley Outfall Bank to the north of the A149 coast road at Cley next the Sea

The larger rivers rise in the south of the catchment and are generally small and steep in their upper reaches. In the lower reaches, the geography is flatter and the rivers become wider. The watercourses discharge to tide through sluices within coastal flood defence embankments.

Partnership working

The Lead Local Flood Authority within the catchment is Norfolk County Council. The Norfolk Rivers Internal Drainage Board area is within the management catchment boundary.

Current flood risk

Flooding from rivers and the sea

Around 2,100 people are at risk of flooding from rivers and the sea within the North Norfolk Rivers management catchment, representing 3.4% of the total population. Over 4,000 non-residential properties and approximately 4.6% of the agricultural land within the catchment are at risk of flooding from rivers and the sea. Approximately 72.4% of Sites of Special Scientific Interest (SSSIs) and 82.3% of Ramsar sites are at risk of flooding from rivers and the sea.

Flooding from surface water

Approximately 5,479 people are at risk of flooding from surface water within the North Norfolk Rivers management catchment, representing almost 8.7% of the total population. 410 non-residential properties and approximately 3.9% of the agricultural land within the catchment are at risk of flooding from surface water. Approximately 2.9% of SSSIs and more than 2.6% of Ramsar sites are at risk of flooding from surface water.

The impact of climate change and future flood risk

The climate is changing and this is likely to have an impact on flooding and coastal erosion. Sea levels are rising and winter rainfall may become more intense. Changes in weather patterns and, in particular, more torrential rainfall is likely to increase flood risk from surface water and ordinary watercourses as well as rivers. Communities within the North Norfolk Rivers catchment have experienced an increase in both severity and frequency of existing flooding problems.

Rising sea levels mean that waves and storm surges could cause greater coastal erosion. Changes to the currents acting on the coast could also lead to changes in the movement of coastal sediments, affecting both coastal deposition and erosion. This could expose new risks from coastal flooding, lead to a greater risk of coastal defences failing and increase the need for maintenance work on defences and more extensive warning systems. With sea level rising there will be an increase the probability of tidal flooding and increase the length of time of tide-locking of sluices on the rivers Glaven, Stiffkey, Burn, Weybourne Beck and the Cley watercourses.

The North West Norfolk Management Catchment

Introduction to the catchment

The North West Norfolk catchment covers an area of approximately 1,000km^2. The area stretches from Denver (near Downham Market) to the coast at Hunstanton, and west into the Fenland region as far as the River Nene. Large urban areas include King's Lynn, Downham Market and Hunstanton. The management catchment comprises 3 main watercourses:

- the Tidal River Great Ouse - forms a continuous reach with the 100ft river from Earith to The Wash estuary
- the Relief Channel - runs adjacent and parallel to the Tidal River Great Ouse. The Relief Channel was constructed in the 1960s to act as a flood storage reservoir, filling at Denver Sluice and discharging into the Tidal River Great Ouse at the Tail Sluice, just south of King's Lynn
- the River Nar - flows east to west and discharges into the Tidal River Great Ouse via gravity though tidal flaps during periods of low tide

The relatively small stretch of coastline within the catchment is primarily low lying with the exception of shallow cliffs at Hunstanton. The area is vulnerable to erosion and tidal surges. Coastal sea and tidal defences protect the coastline from inundation.

Partnership working

The main Lead Local Flood Authority within the catchment is Norfolk County Council. A small area of Cambridgeshire County Council also lies within the catchment.

There are 2 mains groups of Internal Drainage Boards (IDBs) in the management catchment:

- The Water Level Management Alliance
- The Downham Market Group of IDBs

In addition to these main IDB groups, the Middle Level Commissioners also play a significant role in the management of the catchment.

Current flood risk

Flooding from rivers and the sea

Approximately 48,753 people are at risk of flooding from rivers and the sea within the North West Norfolk catchment, representing 31.8% of the total population. Around 2,287 non-residential properties and approximately 40.5% of the agricultural land within the catchment are at risk of flooding from rivers. Approximately 63.2% of Sites of Special

Scientific Interest (SSSIs) and more than 71.9% of Ramsar sites are at risk of flooding from rivers in the area.

Flooding from surface water

Approximately 12,047 people are at risk of flooding from surface water within the North West Norfolk catchment, representing 7.9% of the total population. Around 460 non-residential properties and approximately 4.7% of the agricultural land within the catchment are at risk of flooding from surface water. Approximately 10.1% of SSSIs and more than 3.9% of Ramsar sites are at risk of flooding from surface water in the area.

The impact of climate change and future flood risk

The climate is changing and this is likely to have an impact on flooding and coastal erosion. Sea levels are rising and winter rainfall may become more intense. Changes in weather patterns, especially more torrential rainfall, are likely to increase flood risk from surface water and ordinary watercourses, as well as rivers. Communities within the North West Norfolk catchment could experience an increase in both the severity and frequency of existing flooding problems, and communities that have not flooded previously could be affected in the future. It is likely that this pattern will continue through the effects of climate change.

Rising sea levels increase the risk of overtopping of the tidal defences in Kings Lynn. The higher sea levels will also mean that waves and storm surges could cause greater coastal erosion, exacerbating existing problems between Heacham and Hunstanton. Changes to currents acting on the coast could also lead to changes in the movement of coastal sediments, affecting both coastal deposits and erosion. This could expose communities to new risks from flooding, lead to a greater risk of coastal defences failing, and increase the need for maintenance on defences and more extensive warning systems. With the coastal area of the North West Norfolk Catchment already at risk from tidal flooding up to 25 km inland, climate change will present increased challenges to those trying to reduce tidal flood risk to this area.

The town of King's Lynn and many smaller communities are likely to be affected by an increase in the risk of surface water flooding caused by higher levels of rainfall.

The Upper and Bedford Ouse management catchment

Introduction to the catchment

The Upper and Bedford Ouse catchment covers an area of approximately 3,043 km^2 and stretches from Brackley in the south across to Letchworth in the east and Earith in the north. Major urban centres include Milton Keynes, Bedford, and Huntingdon. The main watercourse in the catchment is the River Great Ouse and a number of its tributaries:

- downstream of Brackley the Great Ouse flows in an easterly direction before being joined by the Padbury and Claydon Brooks (together known as The Twins) near Buckingham, and the Rivers Tove and Ouzel at Newport Pagnell
- the Great Ouse is joined by the Ivel and its tributaries the River Hiz, River Flit and Campton Brook (known locally as the River Hit) at Sandy. These rivers are fed by the chalk and the Woburn Sands
- the last major tributaries, the River Kym and Alconbury Brook join the Great Ouse upstream of Huntingdon

The tidal limit of the river Great Ouse is reached at Brownshill, close to the downstream boundary of the catchment at Earith.

Partnership working

There are 3 main Lead Local Flood Authorities within the catchment:

- Bedford Borough Council
- Central Bedfordshire Council
- Milton Keynes Council

There are also LLFAs which lie partly within the catchment:

- Cambridgeshire County Council
- Hertfordshire County Council
- Northamptonshire County Council
- Buckinghamshire County Council
- Oxfordshire County Council

The Bedford Group is the main group of Internal Drainage Boards (IDBs) within the catchment. There are a few smaller IDBs in the north-east of the area.

Current flood risk

Flooding from rivers

Approximately 39,000 people are at risk of flooding from rivers within the Upper and Bedford Ouse catchment, representing 4% of the total population. Around 2,100 non-residential properties and approximately 7% of the agricultural land within the catchment are at risk of flooding from rivers. Approximately 25% of Sites of Special Scientific Interest (SSSIs) are at risk of flooding from rivers in the management catchment.

Flooding from surface water

Approximately 122,000 people are at risk of flooding from surface water within the Upper and Bedford Ouse catchment, representing 12% of the total population. Around 2,200 non-residential properties and approximately 7% of the agricultural land within the catchment

are at risk of flooding from surface water. Approximately 16% of SSSIs are at risk of flooding from surface water in the area.

The impact of climate change and future flood risk

The climate is changing and this is likely to have an impact on flooding and coastal erosion. Sea levels are rising and winter rainfall may become more intense. Changes in weather patterns, especially more torrential rainfall, are likely to increase flood risk from surface water and ordinary watercourses, as well as rivers. Communities within the Upper and Bedford Ouse catchment could experience an increase in both the severity and frequency of existing flooding problems, and communities that have not flooded previously could be affected in the future. It is likely that this pattern will continue through the effects of climate change.

The towns of Bedford, Milton Keynes and Buckingham, together with many smaller communities are likely to be affected by an increase in the risk of surface water flooding caused by higher levels of rainfall. Risk of flooding may also increase during winter as a result.

The Welland Catchment

Introduction to the catchment

The catchment of the Welland is located in the east of England. It extends eastward from Market Harborough through Stamford and Spalding to its outfall into the Wash. The catchment includes the major tributaries of the West Glen and East Glen rivers, plus a number of other tributaries including:

- Eye Brook
- River Chater
- River Gwash

The River Welland passes through the low-lying fens where the river is embanked and heavily modified.

Internal Drainage Boards (IDBs) play a critical role in managing land drainage within these low-lying fenland areas and maintaining high-quality arable land.

Partnership working

The main Lead Local Flood Authorities within the catchment are:

- West Northamptonshire Council
- North Northamptonshire Council
- Peterborough City Council
- Rutland County Council

There are 2 IDBs in the management catchment:

- South Holland
- Welland and Deepings

Current flood risk

Flooding from rivers and the sea

Approximately 65,000 people are at risk of flooding from rivers and the sea within the Welland management catchment, representing 21% of the total population. Around 2500 non-residential properties and approximately 32% of the agricultural land within the catchment are at risk of flooding from rivers and the sea. Approximately 3% of Sites of Special Scientific Interest (SSSIs) and less than 1% of Ramsar sites are at risk of flooding from rivers and the sea.

Flooding from surface water

Approximately 30,000 people are at risk of flooding from surface water within the Welland management catchment, representing around 10% of the total population. Around 1700 non-residential properties and approximately 8% of the agricultural land within the catchment are at risk of flooding from surface water. Approximately 19% of SSSIs and more than 24% of Ramsar sites are at risk of flooding from surface water.

The impact of climate change and future flood risk

The climate is changing and this is likely to have an impact on flooding and coastal erosion. Sea levels are rising and rainfall may become more intense. Changes in weather patterns, especially more torrential rainfall, are likely to increase flood risk from surface water and ordinary watercourses, as well as rivers. Communities within the Welland catchment have experienced an increase in both severity and frequency of existing flooding problems, and communities that have not flooded previously have been affected in recent years. It is likely that this pattern will continue through the effects of climate change.

Changes to currents and sea levels may also lead to changes in the movement of sediment. In the Welland catchment this could increase silt build-up further inland and could expose the catchment to new coastal flood risk. It may also increase the need for maintenance work on defences and require more extensive warning systems. With the coastal area of the Welland Catchment already at risk from tidal flooding up to 17.5km inland, climate change will present increased challenges to those trying to reduce tidal flood risk in this area.

Urban areas such as Bourne, Oakham, Stamford and Market Harborough are likely to suffer an increase in the risk of surface water flooding caused by higher levels of rainfall. Risk of flooding may also increase during winter as a result.

The Witham Catchment

Introduction to the catchment

The River Witham is a predominantly rural catchment that extends from Grantham to Lincoln and Boston. The total population within the catchment is approximately 578,000. There are 2 ridges of relatively high ground; the Lincolnshire Limestone Ridge roughly in the centre of the catchment and the Lincolnshire Wolds in the north-east. The remainder of the catchment is primarily made up of low-lying land.

Internal Drainage Boards (IDBs) play a key role in draining these lower lying areas and maintaining high-quality arable land.

In addition to the River Witham, the catchment includes many main rivers, such as:

- River Brant
- River Till
- Fossdyke Canal
- Barlings Eau
- River Bain
- South Forty Foot Drain
- Stonebridge Drain
- Steeping River
- Great Eau and many other smaller watercourses

Partnership working

The main Lead Local Flood Authority within the catchment is Lincolnshire County Council.

There are six IDBs in the management catchment:

- Black Sluice IDB
- Lindsey Marsh IDB
- Upper Witham IDB
- Witham 1st IDB
- Witham 3rd IDB
- Witham 4th IDB

Locally there are also river partnership groups, who link between the Risk Management Authorities and volunteer action groups. The Lincolnshire Chalk Streams Partnership and the Lincolnshire Rivers Trust are 2 examples in the catchment.

Current flood risk

Flooding from rivers and the sea

Approximately 176,000 people are at risk of flooding from rivers and the sea within the Witham management catchment, representing 30% of the total population. Around 8300 non-residential properties and approximately 37% of the agricultural land within the catchment are at risk of flooding from rivers and the sea. Approximately 8% of Sites of Special Scientific Interest (SSSIs) and 7% of Ramsar sites are at risk of flooding from rivers and the sea.

Flooding from surface water

Approximately 51,500 people are at risk of flooding from surface water within the Witham management catchment, representing almost 9% of the total population. Around 2200 non-residential properties and approximately 11% of the agricultural land within the catchment are at risk of flooding from surface water. Approximately 5% of SSSIs and more than 1% of Ramsar sites are at risk of flooding from surface water.

The impact of climate change and future flood risk

The climate is changing, and this is likely to have an impact on flooding and coastal erosion.

Sea levels are rising and winter rainfall may become more intense. More frequent and prolonged rainfall events could increase main river flows from the uplands. This, combined with longer periods of tide lock due to sea level rise, could result in more water being stored in the lowland systems. Whilst this is waiting to be discharged to the sea, increased and prolonged pressure will be put on the embankments. Greater use of the flood storage washlands upstream of Lincoln and Horncastle is likely to be needed, in order to manage flows and protect homes and businesses.

Changes in weather patterns are also likely to increase flood risk from surface water and ordinary watercourses, as well as rivers. Communities within the Witham catchment have experienced an increase in both severity and frequency of existing flooding problems. Communities that have not flooded previously have been affected in recent years. It is likely that this pattern will continue through the effects of climate change.

Rising sea levels increases the risk of overtopping of tidal defences and dependency of communities in these areas on these defences. The higher sea levels will also mean that waves and storm surges could cause greater coastal erosion, exacerbating existing problems between Mablethorpe and Skegness. Changes to currents acting on the coast could also lead to changes in the movement of coastal sediments, affecting both coastal deposits and erosion. This could expose communities to new risks from flooding, lead to a greater risk of coastal defences failing. This may increase the need for maintenance on defences and more extensive warning systems. With the risk from tidal flooding already up

to 15km inland, climate change will present increased challenges to those trying to reduce tidal flood risk to this catchment.

Urban areas are likely to be affected by an increase in the risk of surface water flooding due to higher levels of intense rainfall.

Risk of flooding may also increase due to increased groundwater from prolonged wet periods, which already affects large parts of the catchment.

Links between the FRMP and the RBMP

Coordination of FRMPs and River Basin Management Plans (RBMPs)

Alongside flood risk management planning, the Environment Agency works with others to protect and improve the quality of the water environment. The Environment Agency has co-ordinated production of the FRMPs and the River Basin Management Plans (RBMPs) to encourage better join-up in the management of flood risk and the water environment. This will help to deliver more integrated outcomes with multiple benefits.

The aim of RBMPs is to enhance nature and the natural water assets that are the foundation of everyone's wealth, health and wellbeing, and the things people value, including culture and wildlife. The RBMPs contain legally binding local objectives for the water environment and describe the evidence base that informs regulatory, investment and development planning decisions. The current Defra 25YEP target of 75% of waters being in a close to natural state is based on these plans.

The consultation on the draft RBMPs ended on 22 April 2022. We received 270 responses to the consultation; 187 of which were from organisations. We are now reviewing them and considering how we can improve the final plans accordingly. Consultation responses from the respondents who gave permission are available online.

The Environment Agency are on target aims to submit the proposed updates to the updated RBMPs to the Secretary of State in autumn 2022 and aim to publish approved RBMPs by December 2022. These updated plans, and the statutory environmental objectives they contain, will at that point then replace the plans published in 2016. The third and final consultation on the draft river basin management plans ended on 22 April 2022. Local and national teams reviewed the responses and used them to help improve the plans.

It is clear the public are really engaged with the water environment. There is a strength of feeling that things need to change if we are to deliver the ambitions of the 25YEP for 'clean and plentiful water'. The Environment Agency has worked with LLFAs and other RMAs to develop joint measures in both FRMPs and RBMPs to reduce flood risk and improve the wider water environment.

The Environment Agency has worked with LLFAs and other RMAs to develop joint measures to reduce flood risk and improve the wider water environment. Aligning measures also helps to simplify the delivery of outcomes and make it more efficient. You can find out more information on the RBMP objectives and measures by visiting the Anglian RBMP.

How we will monitor implementation of the FRMP

For the duration of the second cycle (2021 to 2027), the Environment Agency will work with LLFAs and other RMAs to monitor progress in achieving all of the measures set out in the FRMP. This is a summary of the steps we will follow:

1. The implementation status of each measure in the FRMP will be reviewed and updated every year. This will be done by the authority responsible for implementing the measure.
2. This updated information will be collated by the Environment Agency and analysed to identify any trends in the data. This will allow the identification of possible common interventions which may help measure delivery.
3. Summary statistics will be produced to show how much progress has been made in that year.
4. These statistics and other key messages will be included in the annual report produced under section 18 of the Flood and Water Management Act (2010). This report is published each year and submitted to the relevant Regional Flood and Coastal Committee for review. It will also be available online to the public.
5. The updated status of each measure will also be viewable in flood plan explorer.
6. At the end of the 6 year planning cycle, the FRMP will be reviewed and a summary of implementation progress over the duration of the planning cycle will be included. This is a requirement of the Flood Risk Regulations (2009).

List of abbreviations

This list of abbreviations is intended as a reference tool. It includes the main abbreviations and terms used in the second cycle flood risk management plans.

Short form	Long form
AONB	Area of Outstanding Natural Beauty
CaBA	Catchment Based Approach
CDE	Catchment Data Explorer
Defra	Department for Environment, Food and Rural Affairs
DWMP	Drainage and Wastewater Management Plan
EIA	Environmental Impact Assessment
ELMS	Environmental Land Management Scheme
EPR	Environmental Permitting Regulations
FAG	Flood Action Group
FCERM	Flood and coastal erosion risk management
FPE	Flood Plan Explorer
FRA	Flood Risk Area (as identified under the Flood Risk Regulations 2009)
FRM	Flood Risk Management
FRMP	Flood Risk Management Plan
FRR	Flood Risk Regulations 2009
FWMA	Flood and Water Management Act 2010
HRA	Habitats Regulations Assessment

Short form	Long form
IDB	Internal Drainage Board
LEP	Local Enterprise Partnership
LFRMS	Local Flood Risk Management Strategy
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
MHCLG	Ministry of Housing, Communities and Local Government
MMO	Marine Management Organisation
NaFRA	National Flood Risk Assessment
NFM	Natural Flood Management
NNR	National Nature Reserve
NPPF	National Planning Policy Framework
NRW	Natural Resources Wales
PFRA	Preliminary Flood Risk Assessment
RBD	River Basin District
RBMP	River Basin Management Plan
RFCC	Regional Flood and Coastal Committee
RMA	Risk Management Authority
RoFSW	Risk of Flooding from Surface Water
SAC	Special Area of Conservation
SEA	Strategic Environmental Assessment

Short form	Long form
SEPA	Scottish Environment Protection Agency
SMP	Shoreline Management Plan
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
SuDS	Sustainable Drainage Systems
SWMP	Surface Water Management Plan
UKCP18	UK Climate Projections 2018
WFD	Water Framework Directive

Glossary

This glossary is intended as a reference tool. It includes the main terms used in the second cycle flood risk management plans and a short description of what they are.

25 Year Environment Plan

A plan produced by government which sets out goals for improving the environment, within a generation and leaving it in a better state. It details how government will work with communities and businesses to do this over the next 25 years.

Catchment

The area from which precipitation contributes to the flow from a borehole spring, river or lake. For rivers and lakes this includes tributaries (a river or stream flowing into a large river or lake) and the areas they drain.

Coastal erosion

The loss of land due to the effects of waves and, in the case of coastal cliffs, slope processes (such as high groundwater levels). This may include cliff instability, where coastal processes result in landslides or rock falls.

Flood Risk Area

Areas identified through the PFRA process where the risk of flooding is significant nationally for people, the economy or the environment (including cultural heritage).

Flood Risk Management Plan

A statutory plan prepared by the Environment Agency and LLFAs under the Flood Risk Regulations 2009. The plans are reviewed and updated every 6 years. The current plans cover the period 2021 to 2027.

Flood Risk and Hazard Mapping

Maps prepared under the Flood Risk Regulations 2009 to show potential risks and impacts of flooding in identified Flood Risk Areas. They are reviewed and updated every 6 years. The current maps use data and risk assessment data available in December 2019.

Flood Plan Explorer

A new, online, map-based tool which displays all of the measures proposed as part of the second cycle of flood risk management plans in England.

Fluvial flooding

Flooding from/of rivers.

Groundwater flooding

Occurs when water levels in the ground rise above the natural surface. Low-lying areas underlain by permeable layers are particularly susceptible.

Internal Drainage Board

A public body that manages water levels in areas known as internal drainage districts.

Internal Drainage District

Areas where there are special drainage needs, managed by internal drainage boards.

Lead Local Flood Authority

These are County, Unitary or Metropolitan Boroughs that are responsible for managing flooding from surface water, smaller watercourses and groundwater. There are 152 in England.

Local Flood Risk Management Strategy

Statutory strategies produced by Lead Local Flood Authorities under the Flood and Water Management Act 2010.

Main river

A watercourse shown as such on the main river map. They are usually the larger rivers and streams, and for which the Environment Agency has responsibilities and powers.

Management catchment

An amalgamation of a number of river water body catchments that provide a management unit.

National Flood and Coastal Erosion Risk Management Strategy

A statutory strategy prepared under the Flood and Water Management Act 2010, by the Environment Agency for England.

Ordinary watercourse

A watercourse that does not form part of a main river and is not shown on the main river map. LLFAs, district councils and internal drainage boards may carry out flood risk management work on ordinary watercourses.

Preliminary Flood Risk Assessment

The first stage in the six-year planning cycle to deliver the Flood Risk Regulations. The latest PFRAs were reviewed in 2017 for local sources of flood risk and 2018 for main rivers, the sea and reservoirs.

Preparedness measure

A measure (action) which aims to prepare people for flooding. Examples include flood forecasting and warning, flood emergency response planning and improving public preparedness for flooding.

Prevention measure

A measure (action) which aims to avoid putting people or the environment at risk of flooding. Examples include watercourse regulation, flood risk modelling and mapping and development planning and control.

Protection measure

A measure (action) which aims to better protect people from the risk of flooding. Examples include building flood defences, nature based solutions and asset maintenance.

Recovery and review measure

A measure (action) which aims to use learning from flood incidents. Examples include reviewing lessons learnt from flood response, supporting communities businesses and the environment to recover from flooding.

Reservoirs

A natural or artificial lake where water is collected and stored until needed. Reservoir owners and operators (‘undertakers’) must meet certain requirements under the Reservoir Act 1975.

River Basin District

Large river catchments in England. They cover an entire river system, including river, lake, groundwater, estuarine and coastal water bodies.

River Basin Management Plan

Statutory plans developed by the Environment Agency which set out how organisations, stakeholders and communities will work together to improve the water environment.

River flooding

Occurs when water levels in a channel overwhelms the capacity of the channel.

Services

Services include schools, hospitals, nursing/care/retirement homes, police stations, fire and ambulance stations, prisons, sewerage treatment works and electricity installations.

Sewer flooding

Flooding as a result of overloading of the sewerage system due to limited system capacity or failure of sewer asset.

Strategic Area

A locally defined area included in the Flood Risk Management Plans. They are areas with a similar geography or strategic ambition where it is important to consider flood risk management across administrative boundaries and river catchments.

Surface water flooding

Occurs when intense rainfall overwhelms local drainage capacities.

Tidal flooding

The temporary inundation of coastal areas during exceptionally high tides or storm surges.

Tide locking

Occurs when the level of the incoming high tide stops the river water from flowing out to sea. This can increase the risk of river flooding.

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