



Northumbria River Basin District Flood Risk Management Plan 2021 to 2027

December 2022

This is a joint plan prepared by the following risk management authorities



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 Northumbria River Basin District (RBD) covers an area of over 9,000 km² from the Scottish Border to just south of Guisborough, and from the Pennines in the west to the North Sea. The RBD comprises of four catchments (Tees, Wear, Tyne and Northumberland Rivers). The catchments vary: some are very natural, while others have been significantly changed due to urbanisation or by draining the land to improve agricultural production. This variety in landscapes causes the area to be at risk of mainly river, surface water and coastal flooding. Currently, there are over 39,000 people at risk of flooding from rivers and the sea, and over 175,000 people at risk of flooding from surface water in the Northumbria River Basin District (RBD).



The floods of 2015 and 2012 had significant impacts on some communities, businesses, infrastructure, rural areas and the environment. 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.

Over the last 2 years we have worked in partnership with Lead Local Flood Authorities 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'll reduce the likelihood and consequences of flooding
- refresh 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 nations resilience

To support these plans, we have developed the '[Flood Plan Explorer](#)'. This new, online, map-based tool will make plans more accessible and show all the second cycle measures in a visual format. It'll also help people to see what's planned, where and when. This means we can stimulate even more opportunities for collaboration and co-operation across all we do.

We've listened to what you 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 while reducing carbon use.

The Environment Agency knows the next 5 years will be both exciting and challenging. We need to innovate and adapt, making sure our thinking and actions change faster than our climate. The Flood and Coastal Erosion Risk Management Strategy Roadmap to 2026 (Strategy Roadmap) will help us do that by providing practical ways in which flood and coastal investments can contribute to wider priorities including local nature recovery, carbon reduction and more integrated water solutions that also help with drought resilience.

I'm pleased we have this opportunity to share the final FRMPs: an important milestone but not the end. We cannot do any of this alone and you've told us you want to get involved – please do. We must continue to work in partnership and keep putting communities at the centre of what we do so they can adapt and thrive.

A handwritten signature in black ink that reads "S. Longstone". The signature is written in a cursive, slightly informal style.

Sue Longstone, Director of Operations (North), Environment Agency.

Contents

Foreword	4
Introduction to the FRMP	8
Approach to the FRMP	8
Contributors to the FRMP	9
Developing the FRMP	11
The Northumbria RBD	12
Overview of the Northumbria RBD	12
The main flood risk issues and changes in the Northumbria RBD	16
River flood risk	16
Coastal, tidal flood risk and coastal erosion	16
Surface water flood risk	18
Groundwater flood risk	19
Sewer flood risk	19
Reservoir flood risk	20
Land management and flooding	20
Managing flood risk in rural and urban areas	21
History of flooding	22
Climate change and the Northumbria RBD	24
Northumbria Region	24
Coastal flood risk	24
Fluvial (river) flood risk	25
Surface water flood risk	25
How our understanding of the impact of climate change on flood risk might change	26
Progress review of implementing the first cycle FRMP	27

How we assessed progress.....	27
Summary of progress of implementing the measures since 2015	27
How these measures were implemented and the main outcomes achieved	30
Additional measures implemented since 2015	31
How well these measures have achieved the FRMP1 objectives.....	34
Second cycle summary from the hazard and risk maps for the Northumbria RBD ...	36
Rivers and the Sea	36
Surface Water Flooding.....	36
Second cycle objectives and measures	41
Finding the second cycle measures	41
National level objectives and measures	41
RBD level objectives and measures	42
The Newcastle City Centre Flood Risk Area.....	43
Current flood risk	45
Surface Water.....	46
Rivers and Sea	46
How the risk is currently managed.....	47
The impact of climate change and future flood risk	48
Objectives and measures for the Newcastle FRA	48
Links between the FRMP and the RBMP 2022	49
How we will monitor implementation of the FRMP	49
List of abbreviations.....	51
Glossary	54

Introduction to the FRMP

You can find all the FRMP documents for the [Northumbria River Basin District](#) on GOV.UK. The plan is supported by the:

- Northumbria River Basin District Second Cycle Flood Risk Management Plan Habitats Regulations Assessment – a report on the findings of the habitats regulations assessment (HRA)
- Northumbria 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
- Northumbria 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 the Flood Risk Areas (FRAs) identified within the Northumbria River Basin District (RBD).

Producing the plan for these areas is a requirement of the Flood Risk Regulations (2009). However, it is 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 like 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 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 is closely aligned with the:

- government's 25 year environment plan
- National Flood and Coastal Erosion Risk Management Strategy for England (FCERM strategy)

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 Northumbria 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.

There are many communities in the Northumbria RBD that are at risk of and have experienced flooding that are outside of FRAs. This plan for the Northumbria RBD has therefore been expanded to include measures that apply to all or specific areas of the RBD. This allows us to target actions where needed across the RBD and helps us to provide appropriate support to all our communities that are at risk of flooding. This is similar to how the first cycle of FRMPs were developed. The first cycle of FRMPs covered the period 2015 to 2021.

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 (see table 1). This is to show what is happening to manage the risk of flooding across the Northumbria RBD.

The second cycle FRMP measures for the Northumbria 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.

Developing the FRMP has been impacted by the extraordinary events of the past 2 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. Whilst the ambition of the plan is to be a strategic place-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 Northumbria RBD will continue to plan for and manage the risk of flooding as appropriate.

Our ambition for the period 2021-2027 is to continue to drive catchment-based delivery in the Northumbria 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’.

Working in partnership is the most effective way to address the issues of flooding and climate change and to deliver multiple benefits. During the period 2021-2027 the Environment Agency and RMA partners will continue to work together to produce strategic plans such as the:

- evolving drainage and wastewater management plans - led by water companies
- review of the local flood risk management strategies - led by LLFAs
- review of the Shoreline Management Plans - led by the relevant Coastal Groups

The Environment Agency and many other RMAs work with partners in the River Basin District including:

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

We value the contribution these partners make, including in

- 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.

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’](#). There are no identified FRAs for significant risk of flooding from main rivers and the sea and therefore the plan will focus on a River Basin District Level.

LLFAs with surface water FRAs within their administrative boundary

Table 1: Northumbria River Basin Districts LLFA FRAs

Flood risk area name	LLFA name
Newcastle upon Tyne	Newcastle City Council

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.

For more information about how flood risk is managed in your area please review the National Level Measure on the Flood Plan Explorer which covers the whole Northumbrian River Basin District.

The [Preliminary Flood Risk Assessment for England](#) has more information on how Flood Risk Areas were created.

Developing the FRMP

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

- National Flood and Coastal Erosion Risk Management Strategy for England
- Northumbria River Basin Management Plan 2022 (RBMP)
- Northumberland County Council Local Flood Risk Management Strategy
- Newcastle City Council Local Flood Risk Management Strategy
- North Tyneside Council Local Flood Risk Management Strategy
- South Tyneside Council Flood and Coastal Risk Management Strategy (2017-2022)
- Gateshead Council Local Flood Risk Management Strategy
- Sunderland City Council Local Flood Risk Management Strategy
- Durham County Council Local Flood Risk Management Strategy
- Hartlepool Borough Council Local Flood Risk Management Strategy
- Stockton-on-Tees Borough Council Local Flood Risk Management Strategy
- Darlington Borough Council Local Flood Risk Management Strategy
- Middlesbrough Council Local Flood Risk Management Strategy
- Redcar & Cleveland Borough Council Flood Risk Strategy
- Northumbrian Water Limited Drainage and Wastewater Management Plan
- SMP 1 Scottish border to the River Tyne (Northumberland and North Tyneside) Shoreline Management Plan
- SMP 2 The Tyne to Flamborough Head (North East) Shoreline Management Plan

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

- Flood Risk Regulations 2009
- National Flood and Coastal Erosion Risk Management (FCERM) Strategy and Roadmap
- 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 Flood Risk Management Plans](#).

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

The Northumbria RBD

Overview of the Northumbria RBD

The Northumbria river basin district covers an area of 9,000km², extending from the Scottish border in the north through Northumbria to Stockton-on-Tees in the south. It includes parts of Cumbria to the west and extends to North Sea to the east.

The district includes Holy Island and the Farne Islands. Approximately 2.9 million people live in the region, mainly in the areas of Tyne and Wear and the Tees Valley.

The major urban centres of the district are:

- Newcastle
- Gateshead
- Sunderland
- Middlesbrough

The Northumbria river basin district has a particularly rich diversity of wildlife and habitats, supporting many species of global and national importance.

The landscape is highly varied, ranging from highly industrial urban areas in the east, across the moors, hills and valleys of Northumberland National Park, to the Heritage coast and the Pennine Area of Outstanding Natural Beauty. Generally, the west of the region is mostly rural with the main settlements to the east, along the coastal fringes. There are four main water management catchments in the Northumbria River Basin District (RBD) they are:

- Northumberland Rivers
- Tyne
- Wear
- Tees

While the Tyne, Wear and Tees are all single catchments with all tributaries draining to the main river and on into the North Sea, the Northumberland Rivers are a group of separate rivers and includes individual catchments such as:

- Blyth
- Wansbeck
- Coquet
- River Aln

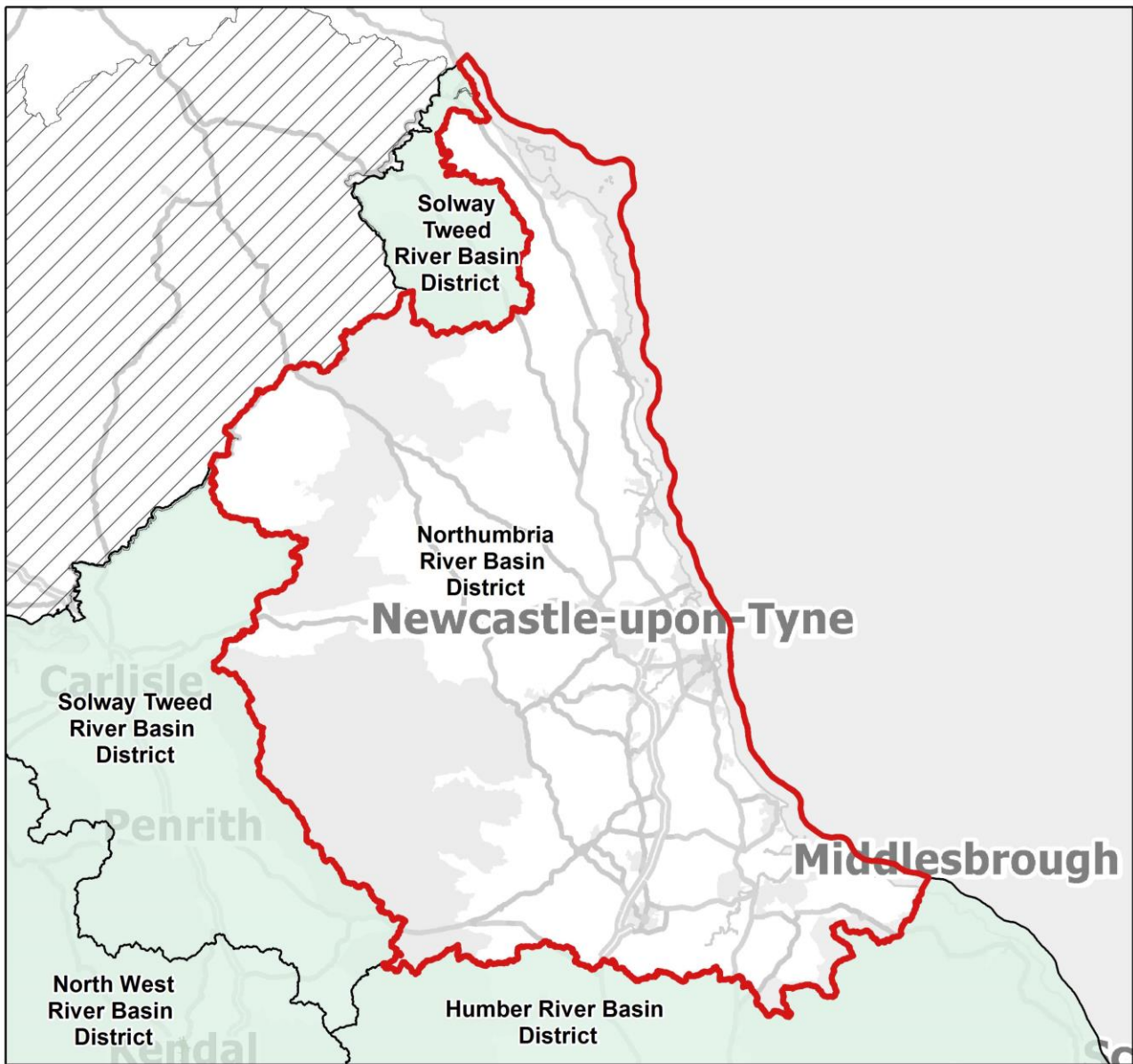
There are also several smaller coast streams in the county of Northumberland. It does not include the tributaries of the River Tweed, including the Till and Breamish catchment, which are covered by a separate FRMP.

Around 67% of the river basin district is farmed or used for forestry, with a mixture of arable and livestock production including sheep, and on higher ground moorland, management for grouse and forestry. The main industries are chemical, petrochemicals, food, drink, transport equipment and metal sectors. Although agriculture only makes up a small part of the regional economy it is a critical element of the rural economy.

Within the Northumbria RBD there are:

- 0 FRAs for significant risk of flooding from main rivers and the sea
- 1 FRAs for significant risk of flooding from surface water (Figure 1)

The defined area is discussed in more detail in section 'The Newcastle City Centre Flood Risk Area'.



- Northumbria River Basin District
- River Basin Districts outside England
- River Basin Districts
- Flood Risk Area: Rivers and Sea

0 10 20 40 60 Kilometres



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Figure 1: Map showing the FRAs in the RBD

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

The main flood risk issues and changes in the Northumbria RBD

River flood risk

River flooding (fluvial) usually occurs when a river cannot cope with the amount of water draining into it. This is likely to come from either intense or prolonged rainfall within the catchment. This level of risk isn't the same across all the Northumbria River Basin District. The Northumberland and Tees catchments are at higher risk when compared to Wear and Tyne catchments.

The geographic position of the region, between the Pennines and the North Sea means that rainfall across the district varies greatly, with the highest rainfall in the west around the Pennines.

The flood risk in areas of Middlesbrough and Stockton can be flashy in nature due to a series of urban rivers. More flashy catchments in the upper reaches of the catchments can lead to erosion of river channels and deposition of gravel. This is a natural process but can be a problem in some areas, where it can reduce the watercourse's capacity to convey flows and cause higher water or flood levels. Gravel deposition occurs where flows slow down but doesn't necessarily increase flood risk. Lowland and flatter watercourses flow more slowly and can deposit silt rather than gravel.

Storage reservoirs also exist, both for water supply, such as at Kielder on the river North Tyne, and Fontburn on the river Font. Barrages exist on the river Wansbeck and on the river Tees.

While many towns benefit from flood defences, flood risk remains and effects significant areas. Some of the catchments still retain much of their natural character, whereas others have been significantly modified over time because of industry, navigation and agriculture. Flood risk is increased where the watercourses have been artificially straightened or constricted, such as through culverting. Where the catchments retain their natural rural floodplain, the floodplains provide vital natural flood storage.

Coastal, tidal flood risk and coastal erosion

The coastline of the river basin district runs from just north of Berwick, running through the coastal authorities of:

- Northumberland
- North and South Tyneside
- Sunderland
- County Durham
- Hartlepool
- Redcar

- Cleveland

While not on the coast, Newcastle, Gateshead, Stockton and Middlesbrough all have areas of land which can be impacted by high tides within the estuaries of the main rivers. While coastal flooding has been limited in the past, communities from Berwick in the north to Redcar in the south have been affected by tidal and coastal flood risk. However, the coastline is largely rural in nature and the flood risk is often to small numbers of properties in small settlements.

The Shoreline Management Plans (SMP) are developed by extensively consulting a range of partners and the public. The North East Coast Group represent stakeholders from the Scottish border to Flamborough Head in Yorkshire and manage the non-statutory SMP 1 and SMP2. The SMPs set the strategic direction for how the coast is wanted to be managed 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.

SMPs provide a large-scale, high-level assessment of the risks associated with coastal evolution including the added pressures from sea level rise. They present a policy framework to address these risks to people and the developed, historic and natural environment in a sustainable manner.

The framework allows coastal risk management authorities (RMAs) and the Environment Agency to plan for coastal adaptation and influence decisions on:

- investment
- development
- infrastructure

They are a vital tool in providing the evidence for:

- resilience building
- local engagement
- consultation
- adaptation

Since 2019, the Environment Agency has been working with coastal authorities to update the SMPs. This process, known as the SMP Refresh, will be completed by 2023. One of the improvements will be the development of SMP Explorer, an online tool to make the plans more accessible.

Flood risk and coastal erosion management measures can also have an impact on wetland and coastal environments and their conservation interest. Schemes such as those at Greatham have worked to increase intertidal habitat and ongoing monitoring will aid future tidal schemes.

Surface water flood risk

Localised intense rainfall can cause sudden flooding, particularly in urban areas, which have a faster rate and greater percentage of run-off. Whilst Surface water systems are not designed to handle local, intense rainfall events. Impermeable surfaces (roads, car parks, buildings, pavements) can exacerbate fluvial flooding by increasing the volume of storm run-off, reducing travel times to watercourses and increasing flood peaks. This type of flooding occurs when rainfall overwhelms the drainage system or is of such intensity that it flows overland.

Surface water runoff is also a source of pluvial flooding. It can occur in both rural and urban areas, though its effects are more pronounced and damaging in the latter. Urban areas can be inundated by flow from adjacent farmland or parkland after periods of prolonged rainfall when the ground is saturated and natural (undeveloped) areas react to rainfall in a similar way to paved areas. It is therefore inevitable that the capacities of sewers, covered urban watercourses and other piped systems will sometimes be exceeded.

Surface water risk represents the greatest single source of flooding across the River Basin District (RBD). All the Lead Local Flood Authorities (LLFAs) within the Northumbria RBD have reported issues with surface water flooding.

Newcastle city centre has been identified as a Flood Risk Area (FRA) for Surface Water which is further discussed in the Newcastle City Centre Flood Risk Area section of this document. The primary source of flooding within this FRA was identified as runoff from roads, playing fields or grassed areas. This area was most recently affected by severe surface water flooding in 2012, locally known as Thunder Thursday, in which hundreds of residents and businesses reported internal flooding to properties.

Lead Local Flood Authorities (LLFAs) 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. These strategies provide:

- details of locations at risk
- the nature of the flood risk
- history of flooding
- associated actions planned to reduce or mitigate the effects of local flooding

LLFAs across the RBD work closely with local planning authorities and developers to ensure that new developments do not increase the risk of surface water flooding. This work is supported by the Environment Agency. Developers are encouraged to design and build natural surface features to store and control surface water, including:

- ponds
- wetlands
- ditches

These are known as sustainable drainage systems or SuDS. Storage of surface water in this way keeps it separate from sewerage systems. This reduces the risk of flooding from storm overflows. SuDS can also:

- improve water quality
- create new habitat
- increase biodiversity

Groundwater flood risk

Historically groundwater flooding has been rare in the Northumbria River Basin District partially due to the extensive mining heritage in the river basin district. Large scale pumping of mine water has lowered the groundwater levels over much of the area however this activity ceased in 1976 in County Durham and 2009 in Northumberland.

Since pumping ceased the water levels have been rebounding. In some areas these water levels have now fully recovered, in others they are still rising and, in some areas, artificial control measures are in place to prevent mine water outbreaks.

Recent wetter climates, including an increased number of storm events, have led to higher than normal recharge rates. Historically, the ground has provided a drainage pathway for excess water. However, in locations where groundwater is close to the surface this may no longer be the case. In some areas the change has led to increased pollution risks, a higher likelihood of flood events and a range of development constraints including impacting foundation and drainage scheme designs.

The Coal Authority and Environment Agency have combined their data to create an online screening tool to identify specific mining and groundwater related constraints on the coal fields within the Northumbria River Basin District.

The Environment Agency also produce [monthly water situation reports](#) based on data provided by themselves, the Met Office and water companies.

Sewer flood risk

Sewers are the main channels for conveying surface-water runoff in the urban areas of the UK. Sewer flooding is generally a mixture of raw sewage and stormwater and has two main causes: Hydraulic overload through lack of system capacity and the impact of wider fluvial flooding from rivers and watercourses. Very heavy rain can result in severe, but localised flooding, often made worse by surface run-off over impermeable urban environments. There is a clear link between surface water flooding and foul sewer flooding, which occurs where sewers become blocked or overloaded.

Northumbrian Water are responsible for the sewers which take away wastewater and any surface water which drains into these sewers across the Northumbria River Basin District.

Northumbrian Water produces their own computer modelling and collaborates and support modelling by others where there is flood risk from multiple sources, especially in those locations with higher risk.

More information can be found on the [Northumbrian Water Limited's evolving Drainage and Wastewater Management Plan](#) (cycles). 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.

Reservoir flood risk

In Northumbria River Basin District there are 83 large, raised reservoirs that hold at least 25,000m³ of water above natural ground level. The hazard maps show the largest area that might flood if a reservoir were to fail. The chances of a reservoir failing and causing flooding are very low; however, the extent of flooding from a reservoir can be up to 50 miles from its source. This is because the local geography, such as valleys, can channel flood water long distances. Kielder reservoir is the largest artificial reservoir in the UK by capacity and covers an area of 11km².

Existing reservoirs can also be adapted for flood storage even if this is not its primary purpose. Flood storage reservoirs are most effective when they form part of a catchment-wide approach to managing flood risk.

Land management and flooding

There have been significant modifications to rivers in the river basin district to manage flood risk from rivers and the sea, and to drain land for agriculture. Many rivers have been straightened, widened, culverted and embanked to reduce flood risk, and this has altered the flow of water.

There are significant areas of rural land use and forestry planting in the catchments which slow down the speed at which water reaches rivers. However, many of the catchments such as the Wear and South Tyne are very steep and rocky, and as such respond rapidly to significant rainfall events. In addition to this, historic land draining in the North Pennine Moors and the Northumberland National Park has increased the speed at which water reaches river systems.

The relationship between soils and flooding is complex and depends on several different factors. In general, the amount of water in the soil and the speed it flows through it (permeability) is controlled by the texture of the soil. The soils vary across the river basin district but generally clay based soils dominate the area, with peaty soils in the uplands. The Peaty soils, in their natural state, can act as a natural store for rainfall and release runoff slowly. However, large areas of the river basin district peat soils have been artificially drained over the years, leading to much more rapid runoff and sediment transfer into the receiving watercourses.

The general clay based soils are less able to absorb rainfall and as such lead to rapid runoff across the catchments, typically around 40% of rainfall is converted to runoff across large parts of the river basin district due to the limited absorption into the soils.

As understanding and experience of Natural Flood Management (NFM) has increased since the first cycle FRMP, these approaches have become increasingly important to managing flood risk across the RBD. They are also an important component in the RBMP. NFM can provide wide ranging environmental benefits, including improving water quality, and supporting the restoration and resilience of aquatic habitats and species. To identify opportunities to make catchments more resilient for the future, RMAs are working in partnership with:

- catchment partnerships
- landowners
- farmers
- other stakeholders

Several NFM projects are being planned and delivered across the RBD. For example, the Weardale NFM demonstrator project which has long term ambitions to deliver natural features across an 100km² area of landscape that will hopefully reduce the risk of flooding for around 140 properties, encourage carbon capture, improve water quality, and create a haven for wildlife to thrive.

Managing flood risk in rural and urban areas

The preferred approach to manage flood is through partnership working and looking at catchments strategically to consider future management. This requires partnership working between local residents, community groups, land owners and farmers and RMAs.

The Northumbria Integrated Drainage Partnership (NIDP) is an innovative approach, it brings 13 Lead Local Flood Authorities across the Northumbria River Basin District together with the EA and NWL to reduce flood risk and promote sustainable drainage.

NIDP partners work together to prioritise and jointly fund integrated flood risk studies and joint delivery schemes to tackle flooding from sewers, rivers and surface water affecting communities across the Northumbria River Basin District.

By managing risk from all sources and across all partners, the NIDP approach can deliver far greater benefits than simply flood reduction. Habitat creation and water quality improvements are regular additional aspects to the schemes delivered to date. Advantages of the NIDP include when projects that are not viable as single-stakeholder projects can be developed jointly by partners to reduce flood risk.

The NIDP has developed a 10 year programme of integrated flood risk management studies aimed at delivering a pipeline of integrated flood risk reduction projects across the north east region. The study programme is funded through contributions from all partners

and forms a key component of North East Regional Flood and Coastal Committee (RFCC) 6 year programme.

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, particularly on land used for arable farming and horticulture can have potential to affect food production.

Investment in flood risk management is prioritised according to government policy, the National Flood and Coastal Erosion Risk Management (FCERM) Strategy and HM Treasury Green Book on economic appraisal.

FCRM Resources are currently targeted where flood risk to people and property is highest. In rural areas where the flood hazard to people and flood damage to property is low the Environment Agency may reduce its flood risk management activities on some watercourses. The Environment Agency is in contact with affected landowners about this, to look at the options and strike the right balance.

The Government are introducing Environmental Land Management Schemes to support the rural economy. These are aimed at achieving the goals of the 25 Year Environment Plan and a commitment to net zero emissions by 2050. The Environment Agency are working with other organisations to understand how such support can be used to complement FCRM activity, such as NFM techniques. The Environment Agency will continue to work with farmers and other land managers maximise the flood risk benefit of this opportunity.

History of flooding

Since the first cycle FRMP was published there have been no flooding events that would be classified as significant. Significant is defined as an event which affected more than 20 residential properties. The [first cycle FRMP for the Northumbria RBD](#) contains information on historic flood events and their consequences before first cycle was published. 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 Flood Risk Management Plans](#).

Many of the communities affected by flooding are now benefiting from formal defences to reduce the risk of flooding, such as:

- Hexham
- Morpeth
- Rothbury
- Yarm
- West Auckland
- Stockton-on-Tees (Lustrum Beck)

The last significant flood event was during December 2015, where a series of storms brought record breaking rainfall totals to parts of the Northumbria RBD as well as many other parts of the country. During this storm event, we recorded the highest river flows at many of our gauging stations, primarily in the Tyne catchment. These levels in many locations appear to be second only to the 1771 flood for parts of the River Tyne in Northumberland when compared to the long term flood history. Over 250 properties were flooded across the Tyne Catchment, including tributaries, with defences in Haydon Bridge and Corbridge overtopping.

There have been multiple reports of minor flooding throughout the River Basin District over the previous cycle however these have been largely localised events primarily affecting road networks.

Climate change and the Northumbria RBD

Northumbria Region

This section sets out what we know are likely to be the implications of climate change in the Northumbria RBD. We use allowances for different climate scenarios over different periods of time, over the coming century.

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

- 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's exceeded by 5%. The 'H++' allowance is an extreme climate change scenario which applies up to the year 2100 for sea level rise.

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 as this changes the most up-to date information should be used.

Coastal flood risk

As sea levels rise, it means 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 levels are primarily accounted for by increases to the 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 2 sets out how we expect mean sea levels to rise along the coastline by 2125.

Table 2: cumulative mean sea level rises between 2000 and 2125 (metres)*

Allowance	Sea level rise
Extreme (H++)	1.90m**
Upper end	1.43m
Higher central	1.03m

* 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 Northumbria RBD for the upper end scenario for 2080s epoch (2070-2125) is from 50% to 66%. 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 Northumbria RBD. The range of increases for the Northumbria RBD for the upper end scenario for the 2070s epoch (2061-2125) is from 40% to 45%.

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.

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 of the National Overview of Flood Risk Management in England for Second Cycle FRMPs](#).

Progress review of implementing the first cycle FRMP

This section assesses the achievements and what has happened across the Northumbria River Basin District (RBD) since the first cycle 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 (FRR) require that the Environment Agency and Lead Local Flood Authorities (LLFAs) review the first cycle FRMP. The FRRs 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 followed these steps to complete the review within the Northumbria RBD:

1. the status of each measure was reviewed and assigned an estimated implementation status as of 31 March 2021
2. for measures assigned an implementation status of not started or superseded reasons were given why they have not been progressed
3. additional measures were identified that have implemented since 2015 which have made a material difference to achieving the first cycle FRMP objectives
4. 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 3 shows a summary of the estimated implementation status of all the measures in the Northumbria RBD since 2015, as of 31 March 2021. Chart 1 also shows this in more detail.

The doughnut chart below entitled Implementation Status shows the proportion of measures by implementation status. It shows that the majority of the measures have been complete.

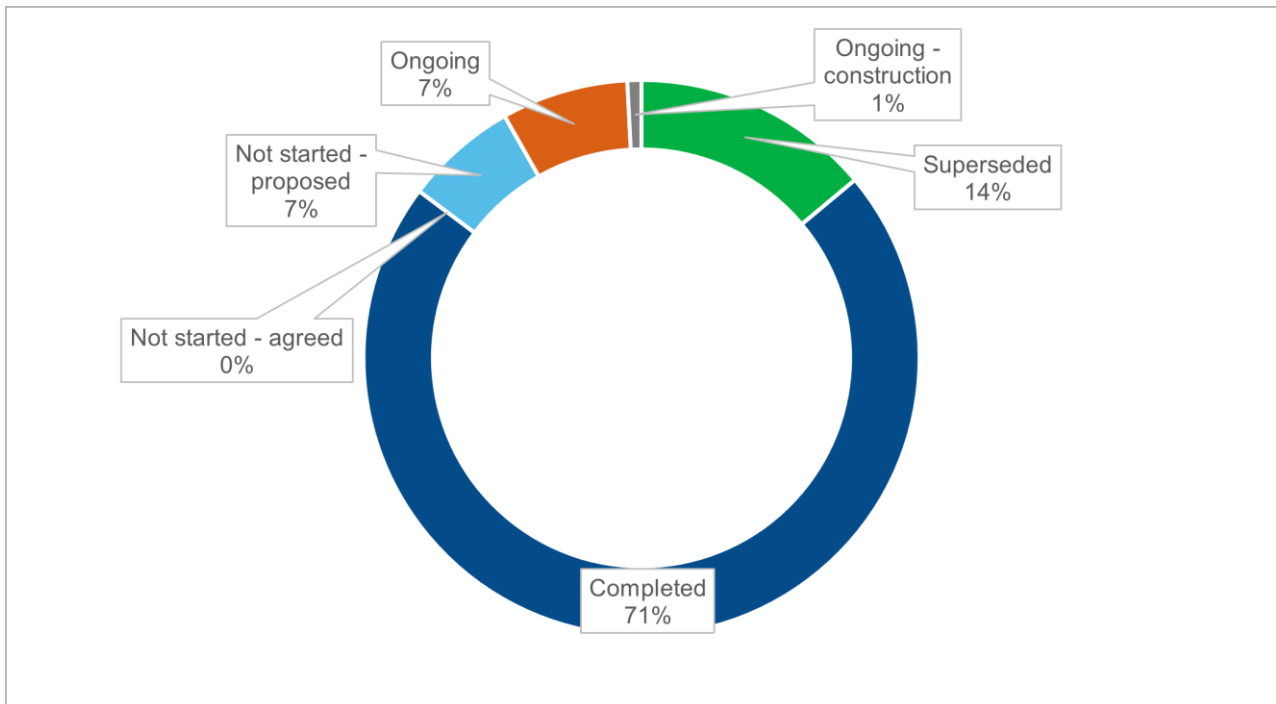


Chart 1: implementation status of measures for the Northumbria RBD

Table 3: implementation status of measures for the Northumbria RBD

Progress	Number of measures
Ongoing	9
Ongoing construction	1
Completed	87
Superseded	17
Not started - proposed	8
Not started - agreed	0

The doughnut chart below 'Reasons for not progressing measures' shows the breakdown of reasons for measures which have not been progressed. It shows that 32% of measures have been delivered through other measures, 19% have no funding and 19% were not viable

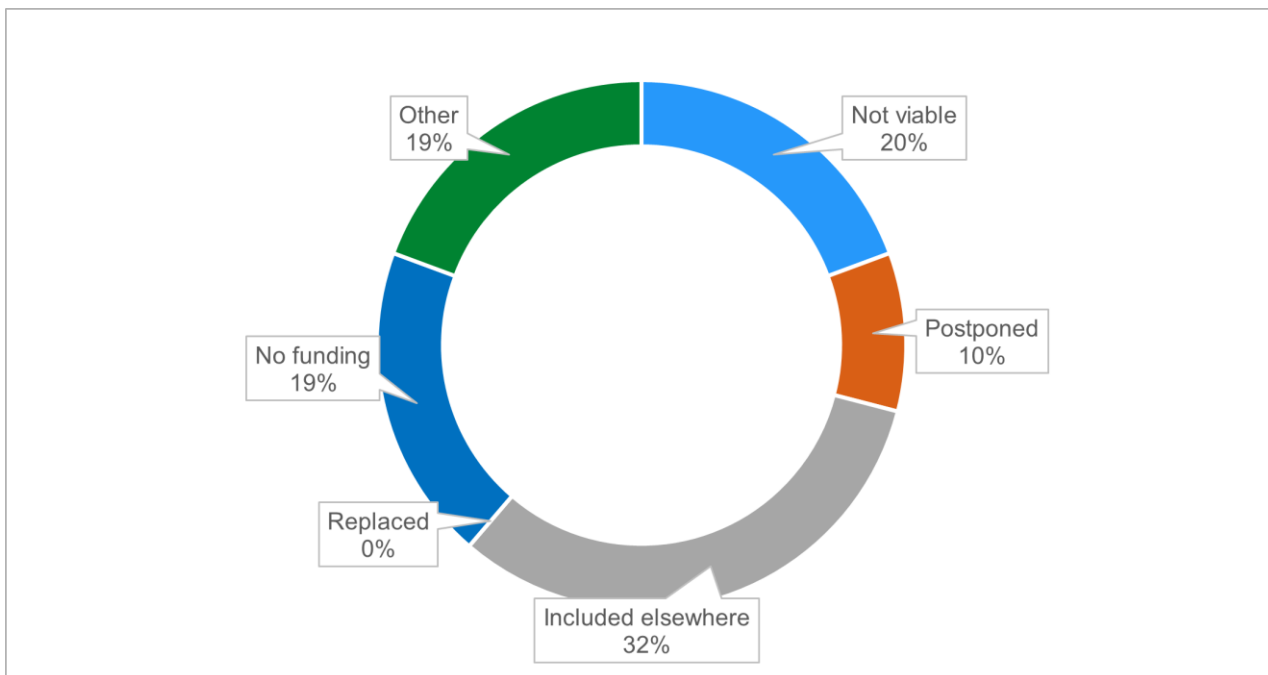


Chart 2: Reason for not progressing measures for the Northumbria RBD

Table 4: Reason for not progressing measures for the Northumbria RBD

Progress	Number of measures
Not viable	6
Postponed	3
Included elsewhere	10
Replaced	0
No funding	6
Other	6

71.3% of the measures published in the first cycle FRMP have been completed. 0.8% of the measures are ongoing in construction. 7.4% of the measures are ongoing. Of these ongoing measures, 55.6% 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](#)'. 44.4% of the ongoing measures are outside of day to day activities. 13.9% of the measures proposed in the first cycle FRMP have not been implemented. The reasons for this are some measures:

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

How these measures were implemented and the main outcomes achieved

The Flood Risk Regulations (FRR) 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, and arrangements for forecasting and warning. To meet the requirements of the FRR, 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

21.8% of completed measures have contributed to the prevention of flooding. For example, Risk Management Authorities (RMA) have established and maintained a register of structures or features which are likely to have a significant effect on flood risk in the area together with information about them. This register has identified the location of pinch points where flood water may overflow within the Tees and Wear Catchments.

27.6% of completed measures have helped to protect individuals, communities, and the environment against the consequences of flooding. This includes approximately £139m invested in 107 No Risk Management Authority projects completed across the Northumbrian River Basin District. These projects have significantly reduced flood risk to 7,280 residential properties. For example, within the Northumberland Rivers catchment opportunities were found for habitat creation opportunities and to improve flood plain connectivity. The removal of redundant flood banks to recreate natural flood plain provides more natural flood storage within the catchment to reduce peak flows downstream.

49.4% of completed measures have helped to prepare people for flooding. RMAs have worked closely with communities within the Wear catchment such as Wolsingham to ensure that they created and implemented Rapid Response Catchment Action Plans. These actions plans are very important within our rapid response (flashy) catchments where conventional flood defence may not be viable and the issuing of flood warning alone may not keep people safe. Flood wardens on the parish council have a better understanding of their flood risk and are therefore able to respond more effectively to flooding.

1.1% of the completed measures have helped to support communities to recover from flooding. For example, within the Tees catchment on the Leven, a protocol and process for

the recording and monitoring of assets implicated in significant local flood risk has been created. Improved knowledge of watercourse network and drainage infrastructure is expected to lead to future improvements as assets are identified and strategies developed.

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 will continue to assess the vulnerability of key infrastructure such as roads, schools, community buildings and prepare suitable measures to ensure the assets are resilient and are able to remain open or be open rapidly during and after flood events. These activities will continue to be carried out during the second cycle period from 2021-2027.

Additional measures implemented since 2015

Measures have been implemented which have emerged since the publication of the first cycle flood risk management plan. These measures have had multiple outcomes in delivering both reduced flood risk to communities and improving the environment. An example of this is on the Tees Estuary for the Port Clarence and Greatham South Scheme completed in October 2018. It protects 358 residential properties and industrial infrastructure. It also created about 36ha of intertidal habitat and 12ha of freshwater habitat. It protects nearby properties in Port Clarence to the 0.5% event including an allowance for climate change over the next 50 years.



Figure 2: Greatham South Scheme. Creation of intertidal habitat, predominantly upper salt marsh with mudflats and tidal creeks after existing embankment was purposefully breached and realigned.

Within the Northumbria River Basin District a number of flood alleviation schemes have been delivered between 2015 -2021 which have not been included as FRMP1 measures. An example for such a scheme is the Chester-le-Street Flood Alleviation Scheme. The Chester Burn flowed through a twin bore culvert which ran under the town market place. The culvert would get blocked by debris during high flow events causing water to spill out of bank upstream of the culvert affecting nearby residential properties and businesses. The scheme opened a 90m stretch of the Chester Burn and landscaped the opened area to include new footpaths and seating, providing a haven for wildlife and storage for flood water during severe storms.



Figure 3: Chester-le-Street Scheme. Previously culverted, scheme has 'day lighted' the Chester Burn through Chester-le-Street.

One scheme which falls outside of the FRMP1 measures was the innovative multi-site partnership project in Killingworth and Longbenton. The Environment Agency with North Tyneside Council and Northumbria Water Group delivered a project which provides biodiversity, new habitat creation and educational facilities. Over 3,500 properties in Killingworth and Longbenton have benefitted from increased flood protection from the sewer network, surface water and river improvements as a result of this scheme. In addition to the flooding and drainage benefits, the scheme has provided a wide range of benefits to the local community. Projects of this kind are a major component of our next cycle with a partnership across all RMAs in the North East working together to identify, develop and implement integrated solutions to flood risk.



Figure 4: Killingworth and Longbenton Scheme. Floating islands help to keep the lake's water clear naturally, with the growing plant roots sucking up excess nutrients and creating important new nesting areas for water birds.

Another scheme was the £3 Million pound project to better protect 150 homes in the Lustrum Beck area of Stockton. This involved the creation of a new screen to the Primrose Hill Culvert, replacement of a road bridge, new flood walls, new flood embankments and the innovative use of Natural Flood Management (NFM) in the upper catchment. Three storage basins store water upstream at Coatham Wood, before slowly draining back into a tributary, contributing to reduced flood risk in the town downstream.

Not only have flood alleviation schemes been developed which were not FRMP1 measures but also new ways of working have been implemented. The creation of the Northumbria Integrated Drainage Partnership (NIDP) has been integral in bringing RMA partnership working together to reduce flood risk and promote sustainable drainage. The NIDP partners work together to prioritise and jointly fund integrated flood risk studies and joint delivery schemes to tackle flooding from sewers, rivers and surface water affecting communities across the Northumbria River Basin District. The partnership is made up of by the Environment Agency, Northumbrian Water Group and all of the Lead Local Flood Authorities (LLFAs) within the RBD.

The North East Regional Flood & Coastal Committee (RFCC) has also funded the appointment of four Community Engagement Officers in 2017. The role of the Community Engagement Officers is to improve flood resilience in communities at risk of flooding. The Community Engagement Officers have achieved this by assisting communities build flood response plans and educate young people on flood risk and climate change. Some of the key measurements of the Community Engagement Officers are:

- helped develop 15 community flood plans
- recruited 121 new flood wardens
- worked with 220 schools and 604 businesses
- engaged with 18,564 children and young people, 592 people aged 65+, 701 people with a disability, 309 people who speak English as a second language and 9,058 adults

The Environment Agency issued 109 flood warnings between 2016 and 2021, warning and informing the public of the risk to give time to prepare. Improvements to this service are continually being sought. For example, since 2016 we have added 1,018 properties to our flood alert areas and 2,497 to our flood warning areas. We have also created 12 new flood warning areas since the first cycle.

How well these measures have achieved the FRMP1 objectives

The FRR 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. FRMP1 objectives were grouped into categories: social, economic, and environmental. Information on these objectives for the Northumbria River Basin District FRMP1 can be found in [Part B of the FRMP1](#). Overall, the measures included in FRMP1 have successfully achieved the

objectives set out across all of categories, delivering a great improvement to the social, economic and environmental well-being of the Northumbria River Basin District.

The following describes measures under the objective category which they primarily benefit. 6.9% 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%.

88.5% 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, working to assess the vulnerability of key infrastructure such as roads, schools, community buildings and prepare suitable measures to ensure the assets are resilient and can remain open or be open rapidly during and after flood events.

13.8% 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, undertaking an assessment of assets to determine if abandonment or reduced maintenance is justified to both be cost beneficial and also reduce flows peak flows downstream providing additional standard of protection.

9.2% 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, seeking locations to promote the creation of flood plain woodland where the research indicates that it would have a beneficial impact on flood risk.

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 FRMP1 objectives. For example, continuing to make improvements to the flood warning service. Opportunities will continue to be exploited when identified to make improvements the flood warning service so more communities at risk are given adequate and accurate flood forecasts. These activities will continue to be carried out during the FRMP2 period 2021-2027.

The measures detailed within Northumbria River Basin District FRMP1 do not comprehensively reflect all the achievements undertaken by RMAs during the first cycle of the FRMP. The reasons are due to the format in which the FRMP1 measures were produced and updated throughout the life cycle of FRMP1. To ensure the measures within the Northumbria River Basin District FRMP2 better encapsulate all the work scoped, the measures will be written to be more outcome focussed. Not only will these measures show the aspirations of the RMAs, the measures will also have multiple outcomes. The Northumbria River Basin District FRMP2 measures will be both the National level measures and the River Basin District Level measures.

Second cycle summary from the hazard and risk maps for the Northumbria RBD

Rivers and the Sea

Of the 2.9 million people who live within the River Basin District, there are over 39,000 (less than 2%) at risk from flooding from rivers or the sea. This compares to the 175,000 people who are at some surface water flood risk. This level of risk isn't the same across all the catchments with risk being higher for Northumberland and Tees when compared to Wear and Tyne, this indicates that much of the development has been able to be built in less risk prone areas.

When looking at non-residential properties the risk rises to just under 4% of properties across the River Basin District at risk possibly indicating the historic reasons for many commercial enterprises requiring easy access to ports and water. Key industries include agriculture and manufacturing. Over 6% of all agricultural land is at risk of flooding from rivers and the sea. 13% of Environmental Permitting Regulation sites, which include heavy manufacturing industry, intensive agriculture, waste and landfill sites, and aggregate industries, are at risk from river and sea flooding.

On average, 4% of primary roads and 9% of railways are at risk from fluvial or tidal flooding.

Surface Water Flooding

Surface water risk represents the greatest single source of flooding across the River Basin District with 175,000 people shown as at risk of some level of surface water flood risk. Surface water flooding is included as part of the Local Flood Risk Management Strategies which have been developed by the Lead Local Flood Authorities. The Environment Agency will work with the other RMAs to develop an understanding of risk across the RBD. Given the significantly higher number of people at risk from surface water flooding it is important that the nature of this risk is more fully understood and look for opportunities to develop multiple flood source schemes. One example of this is the creation of the Northumbria Integrated Drainage Partnership (NIDP) which is discussed in the 'Managing flood risk in rural and urban areas' section above.

The data in tables 5 to 10 is from the [updated flood hazard and risks maps](#) published in December 2019. This data considers 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: summary of river and sea flood risk to people in the Northumbria RBD

Risk to people	Total in RBD	High risk	Medium risk	Low risk	Very low risk
Number of people in RBD	2922490	3105	16244	18962	1557
Number of services	16179	100	232	244	37

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

Risk to economic activity	Total in RBD	High risk	Medium risk	Low risk	Very low risk
Number of non-residential properties	93818	727	2183	1808	181
Number of airports	2	1	0	0	0
Length of road (kilometres (km))	1132	11	21	13	1
Length of railway (km)	645	17	26	12	1
Agricultural land (hectares (ha))	359426	10551	10276	2437	46

Table 7: summary of river and sea flood risk to the natural and historic environment in the Northumbria 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)	18	14	0	0	0

Risk to the natural and historic environment	Total in RBD	High risk	Medium risk	Low risk	Very low risk
Number of Environmental Permitting Regulations (EPR) installations within 50m	205	8	4	14	1
Area of Special Area of Conservation (SAC) within area (ha)	121220	5337	546	253	0
Area of Special Protection Area (SPA) within area (ha)	123273	6417	548	246	41
Area of Ramsar site within area (ha)	6152	4872	65	237	41
Area of World Heritage Site within area (ha)	23108	254	367	15	0
Area of Site of Special Scientific Interest (SSSI) within area (ha)	124853	8434	1350	775	57
Area of parks and gardens within area (ha)	6226	324	318	21	0
Area of scheduled ancient monument within area (ha)	4180	45	77	13	0
Number of listed buildings within area	12282	410	458	257	14
Number of licensed water abstractions within the area	345	80	12	20	0

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: summary of surface water flood risk to people in the Northumbria RBD

Risk to people	Total in RBD	High risk	Medium risk	Low risk
Number of people in RBD	2922490	13016	25432	136619
Number of services	16179	102	144	762

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

Risk to economic activity	Total in RBD	High risk	Medium risk	Low risk
Number of non-residential properties	93818	795	119	5814
Number of airports	2	2	0	0
Length of road (kilometres (km))	1132	47	37	125
Length of railway (km)	645	32	25	66
Agricultural land (hectares (ha))	359426	8648	4250	15123

Table 10: summary of surface water flood risk to the natural and historic environment in the Northumbria 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)	18	0	0	1
Number of Environmental Permitting Regulations (EPR) installations within 50m	205	51	25	67
Area of Special Area of Conservation (SAC) within area (ha)	121220	1273	716	4092
Area of Special Protection Area (SPA) within area (ha)	123273	1219	669	3873
Area of Ramsar site within area (ha)	6152	7	7	40

Risk to the natural and historic environment	Total in RBD	High risk	Medium risk	Low risk
Area of World Heritage Site within area (ha)	23108	484	246	866
Area of Site of Special Scientific Interest (SSSI) within area (ha)	124853	1871	994	5020
Area of parks and gardens within area (ha)	6226	187	73	244
Area of scheduled ancient monument within area (ha)	4180	66	37	158
Number of listed buildings within area	12282	327	85	277
Number of licensed water abstractions within the area	345	46	7	35

Second cycle 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 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 all 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 several 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 risk management authority. 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

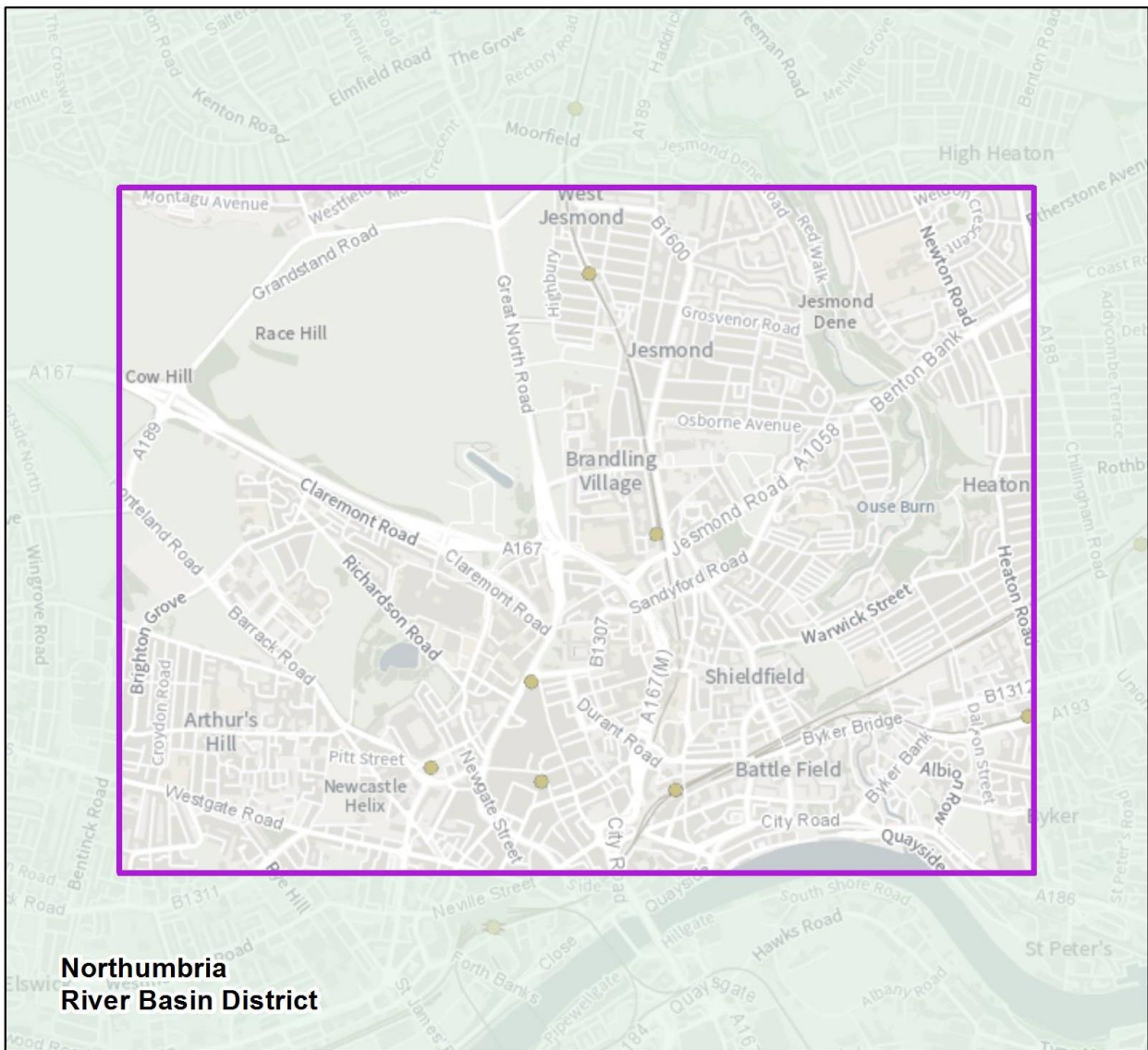
websites and their local flood risk management strategies for more information on how they carry out their day to day work.

You can find information about each of these measures in the interactive mapping tool - ['Flood Plan Explorer'](#).

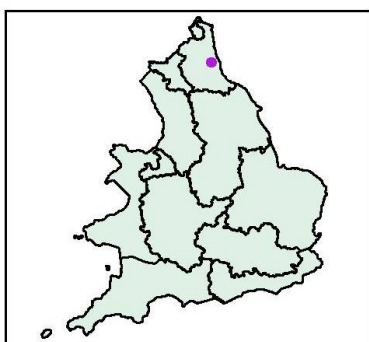
RBD level objectives and measures

Measures have been developed which apply specifically to the whole Northumbria River Basin District (RBD) or apply to areas within the RBD. These measures have been developed in addition to measures which cover other spatial scales. You can find information about each of these measures in the interactive mapping tool - ['Flood Plan Explorer'](#).

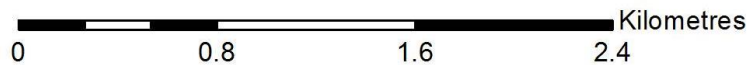
The Newcastle City Centre Flood Risk Area



Flood Risk Area: Newcastle upon Tyne, Northumbria



- Flood Risk Area: Surface Water
- River Basin Districts



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Figure 5: Map showing boundary of Newcastle City Centre FRA

The Newcastle City Centre Flood Risk Area (FRA) is nationally significant. It's been identified as being at risk of flooding from surface water.

Newcastle City Council take the lead on the development and delivery of the FRMP 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.

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

The FRA area covers:

- Newcastle City Centre
- outlying areas of South Jesmond
- Sandyford
- Spital Tongues
- western suburbs of Wingrove
- Arthurs Hil
- Town Moor, 340ha of green belt land to the north
- Lower Ouseburn catchment to the east.

The primary surface water drainage system in the area is the River Tyne which is classified as a main river for which the EA has a continuing role to manage fluvial flood risk. The Ouseburn is a Tyne tributary that rises in the north west of the City and flows east across the northern suburbs before turning south to meet the Tyne about a mile to the east of Newcastle Quayside.

The secondary surface water drainage system is a combination of highway drains and public sewers which manage surface water run-off from land and properties. Much of the area drains to the combined sewer network which is managed by Northumbrian Water. Northumbrian Water is actively promoting the removal of surface water from the combined sewer network to reduce stress on the downstream sewers, combined sewer overflows, sewage pumping stations and the sewage treatment works at Howdon.

Major development is ongoing to the west of the city which may impact on flood risk in the Lower Ouseburn. The development of these sites is controlled by the National Planning Policy Framework (NPPF) and the [Newcastle Core Strategy](#). Within the Core Strategy, policy CS17 sets out the requirements to control, separate and minimise surface water discharges from development.

Newcastle suffered severe flooding as a result of extreme rainfall on the 28th June 2012, known as The Toon Monsoon where 50mm of rain fell in 2 hours. Hundreds of residents

and businesses reported internal flooding to properties, which resulted in an estimated damage cost of £78m. There were problems with the ability of the city's road network to cope under these severe flood conditions resulting in traffic being brought to a standstill in critical locations for several hours.

This event, and a similar one in August 2012 where 40mm of rain fell in 90 minutes, increased pressure on the local Flood Risk Management Authorities (RMAs) to identify, justify and implement an integrated and coherent plan for the management of flood risk for the city, facilitate further growth and futureproof against the effects of urban creep and climate change.

Although the 2012 flooding event was an extreme event, it alerted the RMAs to the potential issues within Newcastle. It is unlikely that the implementation of any flood management strategies will eliminate the risk of flooding from an event of a similar intensity to the one experienced in 2012, but it will improve the overall level of risk throughout the city.

Based on this information it is concluded that further steps should be taken to reduce the likelihood of flooding and the impact it can have on people, the economy and the environment both for now and the future.

Current flood risk

The flood hazard and risk maps show that in the Newcastle FRA, 3,311 people are in areas at risk of flooding from surface water. Of this, 5.2% are in areas of high risk. Also shown to be in areas at risk of flooding from surface water are:

- 332 non-residential properties – including community centres, hospitals, schools and colleges, retail and commercial units
- 2.81km of roads – including parts of the A167(M) (Central Motorway East) and A1058 (Coast Road)
- 3.2km of railway
- 6.42ha parks and gardens
- 2.18ha area of World Heritage Site within area (ha)
- 13 listed buildings

The risk of flooding from rivers in the FRA is markedly less with mostly non-residential properties within the Newcastle Quayside area at risk of flooding from the River Tyne. Further non-residential properties are at risk from the Ouseburn. With climate change, those at risk is likely to increase.

The flood risk and hazard maps provide more detailed information on the likelihood and consequence of flooding for the Newcastle FRA and can be found in the [updated flood hazard and risks maps](#) published in December 2019.

Surface Water

The 2012 storm was categorised as a 1% Annual Exceedance Probability (AEP) event and the work that took place in the aftermath enabled Newcastle City Council to carry out a citywide appraisal of the effect of a storm of that magnitude on the city. Subsequent storms have confirmed the flood mapping that was developed from the 2012 event, and findings have been used to validate flood modelling software developed by Newcastle University.

Over 1,200 properties (including homes, businesses, schools and other non-residential properties) were affected by flooding in over 100 locations around Newcastle, with over 500 homes being flooded internally. Many residents experienced the additional difficulties associated with having to move out of their homes while repairs took place, or not having flood insurance in place. Over 50 non-residential properties were flooded with around 40% of these forced to close temporarily.

These numbers are based on a citywide questionnaire carried out in the aftermath and highly likely to be under-reported, given the ramifications for insurance premiums for property owners. Flood risk maps also indicate a higher number of at-risk properties which increases again when adjusted for climate change. The estimated damages include damage to property and infrastructure, economic damages and the effect on the health and wellbeing of residents.

The areas at highest risk of surface water flooding within the FRA area include Spital Tongues, Arthur's Hill and Forth Yards to the west of the city centre as well as the centre itself. There is a long-term aspiration to develop a surface water route to the Tyne along St James Boulevard; a new outfall is planned as part of [Forth Yards Development Framework](#); and work on a business case for a scheme in Arthur's Hill in the upper catchment is due to be completed.

The Pandon Burn is an historical watercourse rising on the Town Moor to the north of the city centre and - now mainly culverted – running under Newcastle University, the Civic Centre and the Central Motorway before meeting the main interceptor sewer in the city that takes foul water to Howden sewerage treatment works in North Tyneside.

The Town Moor is both a contributor to city centre flooding and the best storage opportunity area in the city, particularly for nature-based solutions. The land is largely grazed with heavy boulder clay soil, offering very poor infiltration rates and high volumes of surface water run off during storm events. Until now, land ownership constraints and narrow economic considerations have limited the use of the Moor as a flood asset.

Rivers and Sea

The River Tyne is tidal and Newcastle's Quayside is vulnerable to rising sea levels. The last major inundation was during a North Sea storm surge in January 2013 which flooded roads and properties on the Quayside and the Lower Ouseburn. The low point of the

Quayside under the Swing Bridge sees overtopping regularly from spring tides. Currently this is managed by the Environment Agency and NCC and impacts are minimised.

Flooding from the Ouseburn has affected properties throughout the catchment, including at [Brunton Park](#), Whitebridge Park and South Gosforth. Major development has taken place in the catchment over the last 15 years, with the LLFA assessing planning applications to ensure that flood risk will not increase because of development.

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 Risk Management Authorities (RMAs) and other stakeholders including the Tyne Catchment Partnership, the Ouseburn Catchment Partnership and the Tyne Rivers Trust. The [Blue Green Cities Project](#) has been based in Newcastle since 2015 looking at the best ways to incorporate Blue Green Infrastructure into the urban landscape. Signatories to the Blue Green Cities pledge include the Environment Agency, NCC, NW, Newcastle University and Northumbria Wildlife Trust.

The LLFA and their RMA partners for the Newcastle area have been engaged at a strategic and project level for many years and cooperate strategically through the FCERM process and via the [Northumbria Integrated Drainage Partnership](#). The NIDP identifies areas susceptible to flooding from a combination of factors - primarily sewers and surface water – and looks to deliver integrated solutions.

Partnership working has delivered a number of studies that have given us a better understanding of flood risk: the Tyneside Sustainable Sewerage Study; [Newcastle and Gateshead Surface Water Management Plan](#); [Strategic Flood Risk Assessments](#); Newcastle and Gateshead Core Strategy and the [City Centre Strategic Surface Water Management Plan](#).

A current project for Newcastle aims to take the findings from the latter report and develop an investment plan for the City to address resilience in the face of climate change.

The [Ouseburn Surface Water Management Plan](#) was produced in 2015 by NCC, the EA and NWG. The plan modelled flood risk in the Ouseburn catchment, projected for climate change to 2030, and looked at opportunities for storage throughout the catchment and their effect. Further modelled flooding in the Lower Ouseburn will be a future study area for an integrated scheme between the NCC and Northumbrian Water through the Northumbria Integrated Drainage Partnership.

Flood defences have been improved in the Ouseburn catchment in recent years. The £7m Brunton Park Flood Alleviation scheme better protected nearly 100 properties from fluvial and surface water risks and was delivered in partnership between the Environment Agency, NW and NCC. Flood walls have been built in the South Gosforth area and property flood resilience measures have been put in place in Whitebridge Park and the Lower Ouseburn.

NCC and the Environment Agency share information on river levels in the Tyne and Ouseburn with data from several monitoring sites. Currently protection from flooding at Newcastle Quayside is provided by a temporary barrier, which has been deployed on multiple occasions in recent years. An ongoing project to create a permanent barrier is being led by the Environment Agency.

Newcastle University's [Urban Observatory](#) collects and provides open source data including river level monitoring and rainfall gauges.

Flood risk maps are published based on the outputs from mathematical 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 for example river channels, flood defence walls or embankments, throughout the FRA. The LLFA and NW similarly maintain assets such as tanks, ponds and channels that perform a flood risk management function on the drainage network. The Port of Tyne is responsible for maintaining the River Tyne as a navigable waterway.

The impact of climate change and future flood risk

Rainfall intensity is expected to increase in future and causing higher river flows and levels. Flooding from rivers and the sea will become more frequent and impactful without strategic mitigation and resilience measures. As rainfall intensity increases, it means that surface water flooding will become more frequent as higher rainfall totals will be seen more often.

Newcastle published its [Net Zero Action Plan](#) in September 2020, to reduce CO2 emissions and address the climate change adaptation requirements needed to make Newcastle a resilient city in the future.

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

Objectives and measures for the Newcastle FRA

Measures have been developed which apply specifically to the Newcastle FRA. These measures are in addition to measures covering a wider geographic area but which also apply to the Newcastle FRA.

You can find information about all measures that apply to the Newcastle FRA in the [‘Flood Plan Explorer’](#), an interactive mapping tool. This includes information on which national objectives each measure helps to achieve.

Links between the FRMP and the RBMP 2022

In parallel to flood risk management planning, the Environment Agency works with others to protect and improve the quality of the water environment. It does this through river basin management. The Environment Agency aims to co-ordinate the Flood Risk Management Plans (FRMPs) and the [River Basin Management Plans 2022 \(RBMPs\)](#) so that all organisations can do more for the environment. By developing the plans together, ways to achieve objectives for flood risk and drought management, and the water environment, including water quality and biodiversity, can be joined together wherever possible.

This is particularly important to achieve the main aim of the Water Environment (Water Framework Directive (WFD) England and Wales) Regulations 2017. The main aim of these regulations is to establish a framework for the protection of inland surface waters, estuaries, coastal waters and groundwater. You can find more information about this in the [Northumbria RBMP](#).

In a consultation in 2019/20, the Environment Agency sought views on:

- challenges that our waters face
- choices and changes we all need to make to help tackle those challenges

Further information on the responses received can be found in the [Challenges and Choices consultation summary report](#).

The Environment Agency has worked with Lead Local Flood Authorities (LLFAs) and other Risk Management Authorities (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.

By visiting the [Northumbria RBMP](#), you can find out more information on the objectives and measures for the Northumbria RBMP 2022.

How we will monitor implementation of the FRMP

For the duration of the second cycle (2021 to 2027), the Environment Agency will work with Lead Local Flood Authorities (LLFAs) and other RMAs to monitor progress in achieving all the measures set out in the FRMP. This is a summary of the steps we will follow:

1. implementation status of each measure in the FRMP will be reviewed and updated every year, this is done by the authority responsible for implementing the measure
2. updated information will be collated by the Environment Agency and analysed to identify any trends in the data, and 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. 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. 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
LFRRMS	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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