



Solway Tweed (English Catchments) River Basin District Flood Risk Management Plan 2021 to 2027

December 2022

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

Cumbria County Council

Environment Agency

Northumberland County Council

Northumbrian Water

United Utilities

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 cannot 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

Nearly 450,000 people in England live in the Solway Tweed River Basin District, which spans the England and Scotland border incorporating the Scottish Borders, Dumfries and Galloway and parts of Cumbria and Northumberland.

More than 18,000 people who live in the English portion of the Solway Tweed River Basin District are at risk of flooding from rivers and the sea, and over 10,000 people are at risk of flooding from surface water. The floods of 2015 and 2020 had some significant impacts on:

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

FRMPs are an important contribution towards delivering 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 both now and in the future. They will help to:

- identify actions that will 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 nation's resilience

To support these plans, we have developed the [Flood Plan Explorer](#), which is a new, online, map-based tool. It will make plans more accessible and show all the proposed actions in a visual format. It will also help people to see what is planned, where and when.



The aim is to stimulate even more opportunities for collaboration and co-operation in local places.

I am pleased to have this opportunity to share the Solway Tweed FRMP and I encourage you all to get involved and have your say.

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

Sue Longstone, Operations Director for (North) Environment Agency

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Introduction to the FRMP

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

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

- Solway Tweed River Basin District Second Cycle Flood Risk Management Plan Habitats Regulations Assessment – a report on the findings of the habitats regulations assessment (HRA)
- Solway Tweed 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
- Solway Tweed 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.

Developing the FRMP

The principal purpose of a flood risk management plan (FRMP) is to set out how to manage flood risk in areas where the risk has been identified as significant nationally for people, the economy, or the environment (including cultural heritage). These areas are called Flood Risk Areas (FRAs). Producing the plan for these areas is a requirement of the [Flood Risk Regulations \(2009\)](#). The Solway Tweed River Basin District (RBD) is located partly in England and partly in Scotland. No FRAs were identified in the English catchments of the Solway Tweed 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](#)'.

Although there are no FRAs in the English catchments of the Solway Tweed RBD, it is recognised that there are areas at risk of, and have experienced, flooding outside of FRAs. Therefore, the Environment Agency, the Scottish Environment Protection Agency (SEPA) and other risk management authorities (RMAs) will continue to plan for and manage the risk of flooding to all communities across the RBD. 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.

The plan for the Solway Tweed RBD has been developed to include measures that apply to all or specific areas of the RBD. This allows RMAs to target actions where they are needed across the RBD. This helps provide appropriate support to all 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.

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 (RBMPs) for the Solway Tweed RBD. Together, these plans set the strategic goals and approaches to managing water and flood risk within the RBD.

Contributors to the FRMP

This FRMP relates to the English catchments of the Solway Tweed RBD only. The RBD extends across both Scotland and England and the Environment Agency and Scottish Environmental Protection Agency work together to manage flood risk in the Solway Tweed RBD and a formal agreement sets out how we do this. We do take different approaches, but we share data and regularly liaise on the planning and delivery of Flood Risk Management (FRM) services. For example, we work together to forecast and warn for floods as they pass through the Solway Tweed catchment and we make sure that flood schemes do not make flooding worse up or downstream.

There's a Scotland/England cross border group to oversee our work under the Regulations and ensure it is joined up. For the Solway Tweed RBD we work together to co-ordinate our activities to deliver flood risk management.

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.

There are no FRAs within the English catchments of the Solway Tweed RBD, but RMAs without FRAs have contributed to the FRMP. This is to show what is happening to manage the risk of flooding across the English catchments of the Solway Tweed RBD.

This second cycle FRMP for the English catchments, Solway Tweed RBD identifies some measures that are applicable across all the English catchments of the Solway Tweed RBD and some that apply to parts of the RBD.

The second cycle FRMP measures for the English catchments of the Solway Tweed RBD cover all sources of flood risk and have been developed with contributions from other RMAs as listed below. These RMAs do not have FRAs and have therefore volunteered to be part of the FRMP development. Whilst the ambition of the plan is to be a strategic 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 Solway Tweed RBD will continue to plan for and manage the risk of flooding as appropriate. You can find information about national level measures that the Environment Agency and LLFAs carry out as part of their daily work in the interactive mapping tool, [Flood Plan Explorer](#).

Developing the FRMP has been impacted by the extraordinary events of the past few years. Despite these challenges, the Environment Agency and RMA partners have set out measures for FRAs, ensuring that the requirements of the '[Flood Risk Regulations 2009](#)' are met. Where we have been able to do so in the time available, we have taken a place-based approach when developing these measures for FRAs. For the rest of the RBD we have:

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

We have engaged with LLFAs, Northumbrian Water and United Utilities during the development of the second cycle FRMP. We have identified the measures in which they would like to be involved.

Our ambition for the period 2021-2027 is to continue to drive catchment-based delivery in the Solway Tweed 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 '[North West Shoreline Management Plan](#)' - led by the relevant Coastal Groups

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

- catchment partnerships
- landscape partnerships
- catchment based groups
- non-government organisations
- Flood Action Groups
- 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 developing and strengthening our working with others to identify, develop and deliver solutions that will increase resilience to flooding and climate change and aid nature recovery in the River Basin District. The FRMPs are not intended to cover the detail of this partnership working.

Other RMAs and organisations that have contributed to the FRMP

1. SEPA
2. National Highways
3. United Utilities
4. Northumbrian Water
5. Cumbria County Council
6. Northumbria County Council
7. Northwest and Northumbria River Flood and Coastal Committee
8. North West Coastal Group

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

- [National Flood and Coastal Erosion Risk Management Strategy for England](#)
- [Solway Tweed River Basin Management Plan](#) (RBMP)
- United Utilities and Northumbrian Water emerging drainage and wastewater management plans
- [North West Shoreline Management Plan](#) (Great Ormes Head to Scotland - North West England and North Wales)
- Local plans

- National Planning Policy Framework (NPPF)

For the second cycle of FRMPs, there's a 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 FRMPs](#).

In drawing the objectives and measures together, RMAs have:

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

The Solway Tweed RBD

Overview of the Solway Tweed RBD

The Solway Tweed river basin is a cross border river basin that includes Scottish and English waterbodies that flow into the Solway and Tweed estuaries. The river basin is jointly managed by the Environment Agency and the Scottish Environment Protection Agency. This Flood Risk Management Plan (FRMP) covers the English portion of the Solway Tweed River Basin District (RBD) only. You can find out more about the flood risk management planning process in Scotland by visiting the [Scottish Environment Protection Agency](#).

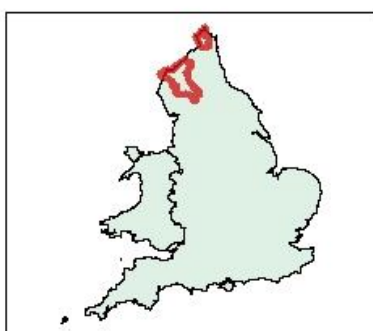
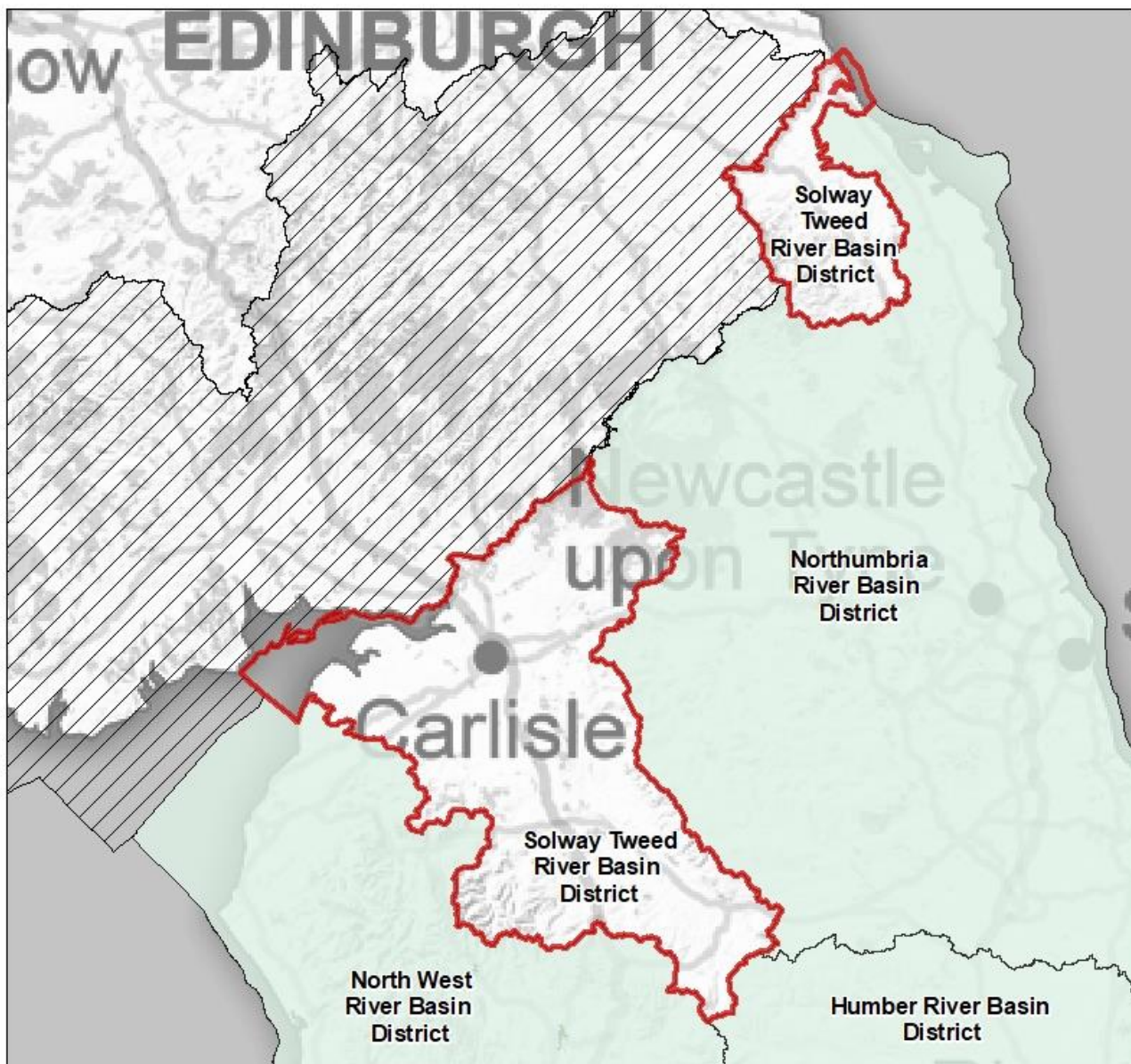
The river basin has an area of around 17,500km², and incorporates the Scottish Borders, Dumfries and Galloway and parts of Cumbria and Northumberland. The river basin includes the important salmon rivers of the Tweed, the Eden and those within Dumfries and Galloway. The natural characteristics of these waters vary considerably from upland streams running over granite rocks to the wide-open mud flats of the Solway estuary.

The area is home to approximately 450,000 people and important economic activities include:

- agriculture
- tourism
- forestry
- manufacturing

The water environment is a major part of the Solway Tweed's best known and loved landscapes, including parts of the Southern Uplands and the Lake District and

Northumberland National Parks. The river basin is largely rural and supports a wide range of internationally important habitats and wildlife with many of the waterbodies designated as Special Areas of Conservation and Special Protection Areas. There are no Flood Risk Areas (FRAs) within the English portion of the Solway Tweed RBD. Figure 1 and Figure 2 shows the Rivers and Sea and Surface Water FRAs close to the Solway Tweed RBD.



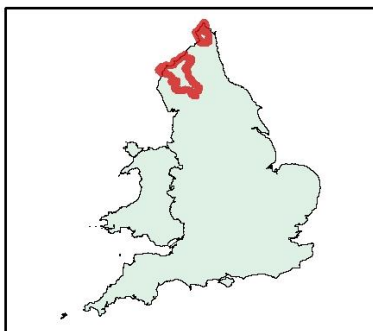
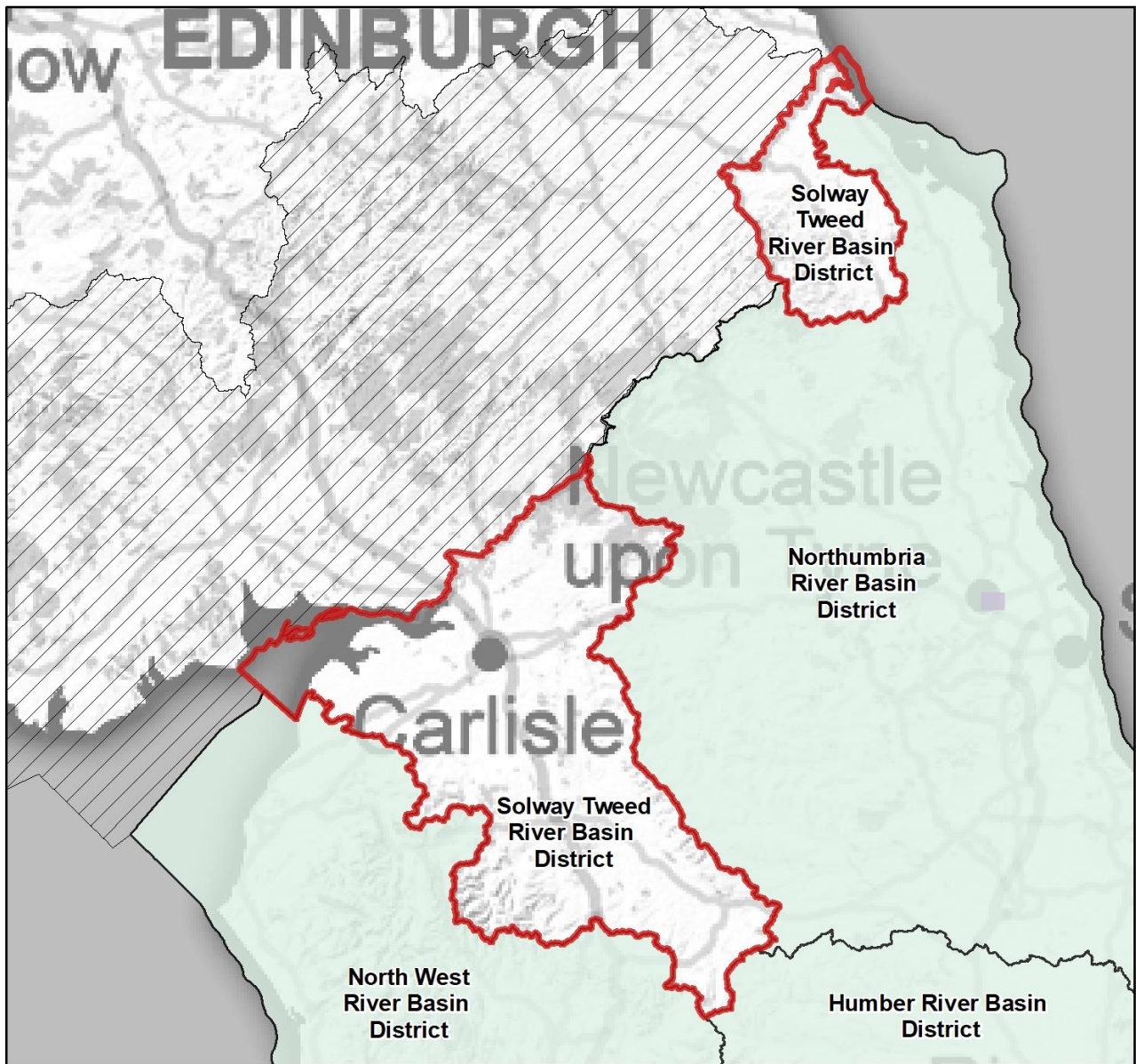
- Flood Risk Area: Rivers and Sea
- Solway Tweed River Basin District
- River Basin Districts
- River Basin Districts outside England

0 10 20 40 60 Kilometres



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Figure 1: a map showing the rivers and sea flood risk areas close to the Solway Tweed River Basin District



- Flood Risk Area: Surface Water
 - Flood Risk Area: Surface Water
 - ▭ Solway Tweed River Basin District
 - ▭ River Basin Districts
 - ▨ River Basin Districts outside England
- 0 10 20 40 60 Kilometres



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Figure 2: a map showing the surface water flood risk areas close to the Solway Tweed River Basin District

For further information about the Solway Tweed (English catchments) RBD, please read the accompanying [Strategic Environmental Assessment report](#). This includes information on topics such as the landscape, geology and cultural heritage of the Solway Tweed RBD.

The main flood risk issues and changes in the Solway Tweed RBD

In the English Solway Tweed River Basin District (RBD) around 29,000 people are estimated to live in areas at risk of flooding. Of these people, 2,500 live in areas considered to be high risk of flooding. High risk is defined as up to a 1 in 30 chance of flooding in any given year.

A further 5,500 people are estimated to live in areas at moderate risk of flooding. Moderate risk is defined as between a 1 in 30 and 1 in 100 chance of flooding in any given year.

Flooding in the Solway Tweed arises from multiple sources. These are primarily flooding from:

- rivers
- the coast
- the tide (low-lying areas, such as street level)
- surface water
- sewers

There's also some risk of flooding from groundwater and reservoirs.

Risk Management Authorities (RMA) work together to help reduce the risk of flooding across the River Basin District and to help communities respond and recover during and after flooding.

Risks of flooding from different sources are managed by different Risk Management Authorities. Further information is available from [Flood and coastal erosion: risk management authorities](#).

River flood risk

River flooding occurs when the volume of water in a river channel is too great to be contained and it overflows on to surrounding land. This is often a result of prolonged or heavy rainfall, where waterlogging of the surrounding land prevents rainfall from draining into the ground. The risk and consequence of flooding from rivers is influenced by a range of factors including the:

- topography of the surrounding land
- permeability of the underlying geology
- proximity of communities to natural flood plains

Over time the rivers have been modified to serve a variety of purposes, including:

- reservoir dams for flood storage
- weirs for power supply or navigation
- realignment, river walls, bridges and land raising for industrial or housing development
- flood plain drainage and realignment to improve agriculture

Managing the risk of flooding from rivers can involve a variety of different activities, including:

- estimating the level of flood risk on the river network both now and into the future
- supporting businesses and communities to understand the risk they face, to be prepared to respond to and recover from flooding
- providing a flood warning service to alert people that flooding could occur
- maintaining river channels free from obstructions
- planning, designing, and constructing works with communities to reduce the risk of flooding
- operating, inspecting, maintaining, and repairing flood risk management assets
- advising planning authorities and developers on the siting and nature of development

The Solway Tweed (English catchments) RBD is made up of 6 main river catchments. These are the Eden and Esk, and Waver and Wampool catchments in Cumbria, and the Till and English Tweed catchments in Northumbria.

The Eden and Esk catchment have 2 significant river systems:

1. The Esk.
2. The Eden.

The main flood risk on the Eden catchment is at Carlisle and Appleby, Eamont Bridge on the River Eamont and in Penrith on Thacka Beck. On the Esk, it's Longtown where there's also a risk of tidal flooding. Elsewhere there could be localised flooding problems almost anywhere in the catchment due to the topography and high rainfall totals experienced.

The main risk area in the Waver and Wampool catchment is Wigton which floods from Wiza Beck, Black Beck and Speet Gill.

In the Till and English Tweed catchments flood risk is widely spread with small numbers of isolated areas at risk. Although, the Wooler area has historic flooding with other small areas of flood risk being around Powburn, Kirknewton and Norham.

Flood risk from rivers is estimated by the Environment Agency using computer models that are calibrated and validated using locally collected rainfall, river level and river flow data. These models are also used to predict how this risk could increase as a consequence of climate change. This information is used not only to inform FCRM investment and activity, but also to inform the:

- public
- businesses
- developers
- planning authorities

Of the main river network in the northwest of England, 87% has been modelled. Of the 5,676km, 21% has been updated since 2015.

The Environment Agency works together with Scottish Environment Protection Agency (SEPA) and other RMAs to plan and undertake activities that increase the resilience of communities to flooding. These activities include helping communities to respond to and recover from flooding.

The Environment Agency operate a Flood Warning Service to alert and warn communities at risk of flooding when there's an increased likelihood of this happening. The warnings are informed by river level forecasts based on computer models and real time of rainfall and river level measurements. There are flood warning areas in the English catchments of the Solway Tweed RBD that enable specific warnings to be provided to properties at risk of flooding.

Public awareness campaigns are run regularly to promote the flood warning service to increase the uptake by people and businesses. In the northwest of England, the average uptake is 72%. More generic flood alerts are also issued that cover all locations at risk of flooding. Rivers in the RBD take many forms ranging from a fully natural state through to being heavily modified through the construction of river channel assets. These include river walls, weirs, and culverts amongst others.

Natural processes that see the transportation and deposition of sediment within the channel that can have implications for flood risk. Similarly, the growth of vegetation in and adjacent to the river channel can obstruct flows or provide materials that contribute to the formation blockages downstream. In urban areas other materials, for example, shopping trolley and garden waste, can also contribute to such blockage risks.

Blockage of culverts on main rivers can be a significant source of flood risk. These structures can be particularly susceptible to blockage and are often fitted with debris screens to prevent woody debris and other detritus being washed into the culvert. These screens are cleared periodically and in advance and during high flow events. Significant resources are needed to clear blockages during flooding incidents. Where culverts are no longer required the Environment Agency liaise with land owners and Local Planning Authorities to seek their removal.

The Environment Agency undertake routine river channel inspection and vegetation management activities, prioritised on locations with the greatest susceptibility to flooding from this. Periodic sustainable maintenance activity can also be undertaken by RMAs to manage river shoals or siltation where there are flood risk implications. RMAs will also work with owners of river channel assets in poor condition that'll increase flood risk if they fail, to remedy the situation.

The Environment Agency is an accredited asset management organisation and considers assets over their whole life from their inception through to their decommissioning or demolition.

New flood risk management works on rivers are delivered by the RMAs in line with government policy and funding criteria. They can take many forms ranging from flood defence walls or embankments to river pumping stations or upstream flood storage. Flood risk management assets are regularly inspected and maintained. Defects identified are repaired and any more significant issues could lead to assets being replacement or upgrade.

The Environment Agency and Lead Local Flood Authorities (LLFAs) provide advice to Local Planning Authorities (LPAs) about proposed development within areas considered to be at risk of flooding. The Environment Agency responded to over 1,100 planning applications in the northwest of England during the year. The Environment Agency and LLFAs also work closely with Combined Authorities and LPAs to ensure flood risk is properly accounted for in their long-term strategic plans for the area.

Coastal and tidal flood risk and coastal erosion

The Solway coast is generally low-lying with intertidal mudflats and extensive salt marsh and sand dune habitats, wide sandy beaches and spectacular views across estuaries and bays. In contrast there are also areas of vegetated shingle on the Cumbrian coast. On the North East coast only a small area of coastline is included within the river basin district.

Due to a generally soft sedimentary coast and a large tidal range of around 10m, the coastline is highly dynamic. This is illustrated by the constant moving and reshaping of the tidal flats and channels in the estuary and the erosion of unprotected cliffs.

There's a small flood risk associated with tidal flooding in Berwick and Tweedmouth. Communities along the coastline of the catchment are at risk of flooding from the sea. Properties at Silloth and Skinburness, Kirkbride and Anthorn have flooded historically. There are many people and properties behind sea and tidal defences, which reduce the risk of them being affected by flooding. In these locations the natural ground is quite flat, and the floor levels of many properties are such that that would flood if not for the sea defences that protect them. Many of these also protect against coastal erosion too.

Defences can be over topped by an extreme flood event or could failure. Such events could pose a major hazard to people and property due to possible sudden inundation. To guard against this, defences are regularly inspected and maintained and replaced when they can no longer provide the necessary protection.

The Environment Agency has a Strategic Overview of the coast in England. The coastal overview joins up coastal management activities to ensure flooding and erosion risk is managed effectively. The overview encourages authorities to work together in partnership to achieve effective management of flooding from the sea and coastal erosion.

Coastal and tidal flood risk and coastal erosion is managed through the [North West Shoreline Management Plan](#), published in 2010 (SMP2). This provides a broad scale assessment of the risk associated with coastal processes to people and the developed, historic, and natural environment. It also provides a policy framework for managing these risks in a sustainable manner into the future. The implementation of the plan is overseen by the North West Coastal Group. This group is made up of RMAs with powers for coast protection or flood risk. It includes the Environment Agency and relevant LLFAs.

Some of the River Basin District measures included in this Flood Risk Management Plan (FRMP) reflect actions in the SMP2. The SMP measures included in this FRMP are those that are most relevant to flooding from the sea. Further information is available at [North West SMP2](#).

Surface water flood risk

Surface water flooding can occur across the Solway Tweed River Basin District. It can occur suddenly within minutes of intense rain and affect small localised areas. It can have several contributing factors, which include:

- storm intensity and duration
- ground topography, permeability, and saturation
- inadequacy of drainage systems including insufficient capacity, damage or blockage
- high river levels that impede drainage into them

Forecasting surface water flooding is difficult, particularly in summer months when dynamic thunderstorm conditions arise.

Surface water flooding is a problem across the Solway Tweed, whether due to run-off from fields and down roads in rural and semi-rural areas, or from roofs and paved surfaces in built-up areas, sometimes due to insufficient capacity of drains and sewers. Notable surface water flooding in recent times was in 2020, December 2015, summer 2012, and in Cumbria in 2009.

Managing surface water flood risk for new development plays a key role in managing the risks of surface water flooding. Lead Local Flood Authorities (LLFA) provide local planning authorities with comments on surface water management for new development. Many LLFAs have developed specific strategies to manage surface water flood risk, and these documents are referenced in on [The Flood Hub](#).

In the long-term, Sustainable Drainage Systems (SuDS) may relieve some pressures, and Local Councils encourage the use of sustainable drainage in new developments. SuDS are usually above ground and can limit site run-off and filter out some silt and contaminants. Discharge of surface water to sewer is generally only acceptable if preferable approaches such as infiltration, attenuation or discharge to watercourse are impractical.

Groundwater and sewer flood risk

Groundwater is naturally stored in the ground below the water table level. Where the water table reaches ground level, water starts to emerge onto the surface and flooding can happen. Once on the surface this groundwater may flow or pond. Groundwater flooding is closely linked to ground conditions and is not as widespread an issue in the Solway Tweed River Basin District (RBD) as it is in other parts of England.

Sewers can flood because of hydraulic incapacity, that is sewers are not big enough for the flows that now enter them. They can also flood from other causes including sewer collapse, sewer blockage, loss of power supply to a pumping station, or a failure of mechanical or electrical plant.

United Utilities and Northumbrian Water supply water across the Solway Tweed RBD and are responsible for the sewers (including newly adopted private sewers) which take away wastewater and any surface water which drains into these sewers. To help minimise sewer flood risk they undertake substantial programmes of:

- sewer improvement works
- maintenance activities
- property level flood protection
- raising public awareness

They also take action to mitigate damage during sewer flooding incidents and are involved in recovery work so that communities can return to normality.

Groundwater and sewer flooding have occurred in some areas of the Solway Tweed RBD and caused road flooding and some property flooding. These are localised issues and flood risk from these sources are considered to be low at the RBD scale.

Reservoir flood risk

There are 15 large, raised reservoirs with the potential to flood areas of the Solway Tweed River Basin District (RBD).

Not all of these reservoirs are located within the English catchments of the Solway Tweed RBD. However, downstream areas within the RBD could be flooded if a large reservoir were to fail.

Few catastrophic reservoir failures have occurred in the UK and there has been no loss of life due to dam disasters here since 1925. Since then, however, there have been embankment failures. Thankfully catastrophic failure was averted through the preparedness and prompt response of relevant authorities and the owner.

Land management and flooding

How our land is managed is important to the sustainable management of flood risk as it increases, due to climate change. The Environment Agency, LLFAs and other RMAs work with Local Planning Authorities (LPAs) to influence their strategic development plans so they fully account for flood risk. We engage with property and landowners to help them improve their resilience to flooding and contribute to the resilience of their communities. This can include the reduction of impermeable surfaces and the introduction of vegetated buffer strips adjacent to watercourses to trap soil runoff.

The Environment Agency work with LLFAs, Local Flood Partnerships, Rivers Trusts and community groups to reduce flood risk by using Natural Flood Management (NFM) techniques. The aim of these techniques is to reduce, slow and store runoff, particularly in minor watercourses and upper catchments to reduce the risk of downstream flooding. The techniques include:

- 'soft-stopping' small channels with large woody debris to slow the flow
- creating space for a river to adopt a more natural channel profile with increased flood capacity
- tree or bankside vegetation planting, which can reduce erosion and downstream sedimentation risk

NFM approaches are typically easy and cost-effective to install and maintain and can bring additional benefit to water quality and biodiversity. NFM can help address the increase risk from climate change as well as form an important component of major FRM schemes.

Managing flood risk in rural areas

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 Strategy](#)' (FCERM) and HM Treasury Green Book on economic appraisal.

Flood and Coastal Risk Management (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 to maximise the flood risk benefit of this opportunity.

Managing flood risk in urban areas

Development in larger settlements has resulted in many man-made structures affecting the river environment, including river channel retaining walls, weirs, and culverts. These structures are as prevalent in towns and suburbs including Carlisle. Effective flood risk management requires the holistic management of culverted systems. However, culverts and other assets within a system may have multiple owners and the existence and location of culverted watercourses is not always known. This can present serious challenges for new development or if collapses and blockages occur.

Risk Management Authorities work to both reduce current day flood risk and meet future challenges of increasing risk due to climate change. The Environment Agency encourages Local Planning Authorities to adopt a Green Infrastructure approach in the context of planning for flood risk. It should be planned and managed in a similar way to critical infrastructure. It should set out the climate change adaptation response that builds a community's overall resilience to climate change. A Green Infrastructure strategy, as with other approaches to natural flood risk management, should be developed with consideration of broad scale ecological connectivity.

Sustainable Drainage Systems form a significant aspect of this. These are typically swales, ditches or ponds that temporarily store water that either infiltrates the ground or is subsequently released at an acceptable rate into the drainage system. These water environments can make a significant improvement to the local environment and public amenity. They can also be formed of buried tanks located for example under car parks.

History of flooding

This section of the Flood Risk Management Plan (FRMP) provides a summary of significant flood events and their consequences since the first cycle FRMP in 2015. Significant is defined as an event which affected more than 20 residential properties. The [first cycle FRMP for the Solway Tweed River Basin District](#) contains information on historic flood events and their consequences before this date. More detailed information on why flood records and evidence are important and how they are used is in '[Part A: National Overview of Flood Risk Management in England for second cycle FRMPs](#)'.

In the Solway Tweed RDB there have been several substantial and widespread periods of flooding between 2015 and 2021, with many thousands of properties affected. These are typically associated with either prolonged periods of heavy winter rainfall or intense summer storms.

Table 1: historical flood events from all sources since 2015 and the number of properties rounded to the nearest 10

Date of flood	Location and approximate number of properties affected shown in brackets	Source of flood water
November 2015	Cumbria (6)	Main river
December 2015	Carlisle (2190), Eden (430)	Main river
February 2020	Cumbria (36)	Main river, surface water, ordinary watercourse
June 2020	Cumbria (Penrith)(4)	Combined surface water/sewer
August 2020	Eden, Carlisle (20), Allerdale	Surface water, groundwater
November 2020 – December 2020	Cumbria (Carlisle, Wetheral, Penrith, Cumwhinton, Alston) (6)	Surface water, sewer, Ordinary Watercourse, damaged culvert, blocked drain

Climate change and the Solway Tweed RBD

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

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

- central allowance is based on the fiftieth percentile
- higher central allowance is based on the seventieth percentile
- upper end allowance is based on the ninety-fifth percentile

An allowance based on the fiftieth percentile is exceeded by 50% of the projections in the range. At the seventieth percentile it's exceeded by 30%. At the ninety-fifth 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.

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 and Table 3 set out how we expect mean sea levels to rise along the coastline by 2125. As the Solway Tweed River Basin District (RBD) does not have its own sea level rise allowances, both the North West RBD and Northumbria RBD allowances are used:

- North West RBD allowances apply to the Solway Tweed RBD on the west coast of England
- Northumbria RBD allowances apply to the Solway Tweed RBD on the east coast of England

Table 2: cumulative mean sea level rises between 2000 and 2125 (metres) for the North West River Basin District*

Allowance	Sea level rise
Extreme (H++)	1.90m**
Upper end	1.41m
Higher central	1.01m

Table 3: cumulative mean sea level rises between 2000 and 2125 (metres) for the Northumbria River Basin District*

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 Solway Tweed RBD for the upper end scenario is from 77% to 103%. 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 Solway Tweed RBD.

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

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

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

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

We're working with universities to actively research what this might mean for future increases in flood risk. This means that our understanding of how likely extreme floods will be in the future, and what contributes to this, is likely to change.

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

Progress review of implementing the first cycle FRMP

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

It reports on the status of the measures and a summary of progress made towards achieving the objectives in the first cycle 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
- 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 Solway Tweed RBD:

1. The status of each measure was reviewed and assigned an 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. Measures were assessed based on how well they have contributed towards achieving the first cycle FRMP objectives.

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

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

Summary of progress of implementing the measures since 2015

Table 4 shows a summary of the implementation status of all the measures in the Solway Tweed River Basin District (RBD) since 2015, as of 31 March 2021.

Table 4: implementation status of measures for the Solway Tweed RBD

Progress	Number of measures
Ongoing	25
Ongoing construction	0
Completed	2
Superseded	12
Not started - proposed	4
Not started - agreed	0

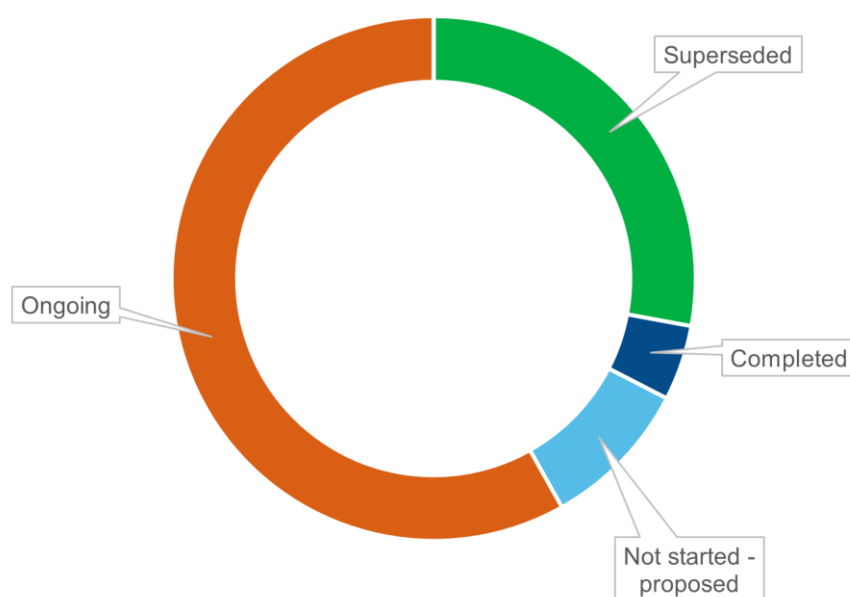


Chart 1: implementation status of measures for the Solway Tweed RBD

Chart 1 shows the proportion of measures by implementation status. It shows that 5% of the measures published in the first cycle FRMP have been completed. None of the measures are ongoing in construction. Over half (58%) of the measures are ongoing. These measures include day to day activities which have been carried out by risk management authorities in 2015 to 2021. These measures have contributed to achieving the objectives of the first cycle FRMP. These activities will be continuing in the period 2021 to 2027 and have been included in National Level or River Basin District wide measures. These national level measures can be found in the interactive mapping tool, [Flood Plan Explorer](#).

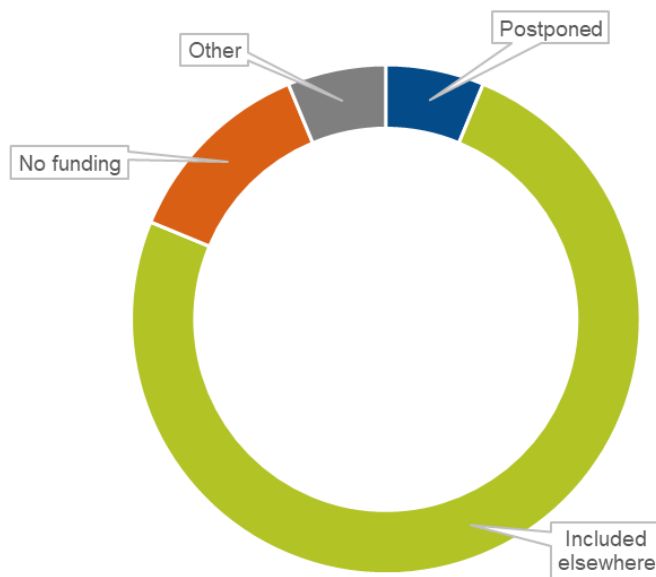


Chart 2: reasons for not progressing measures for the Solway Tweed RBD

Some of the measures proposed in the first cycle FRMP have not been implemented. These include the measures that are not started – agreed, not started – proposed and superseded. About 92% of the superseded measures are measures superseded due to being included within the '[North West Shoreline Management Plan](#)' (SMP).

Chart 2 shows the breakdown of reasons for measures which have not been progressed and their proportion. The reasons for this are it:

- has been postponed
- has been included in another piece of work
- 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:

- prevention of flooding
- protection of individuals, communities, and the environment against the consequences of flooding
- 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

Prevention of flooding

Within the Solway Tweed River Basin District (RBD), 32% of ongoing measures have contributed to the prevention of flooding. For example, in the River Till catchment there was a measure to undertake an assessment of agricultural assets and those which provide no flood defence function. This was to determine if abandonment or reduced maintenance is justified to improve flood risk resilience.



Figure 3: this picture shows a 'log matrix' technique used on the River Breamish where the section of bank was longer and higher.



Figure 4: this picture shows the section of the River Glen where the existing flood bank is being set back.

The [River Glen Restoration Project](#) was awarded funding in 2018 from the Water Environment Grant. The project covers 3 km of River Glen, part of the River Tweed Special Area of Conservation (SAC) and Site of special scientific Interest (SSSI), and involves the removal of 660m of agricultural flood embankments and the setting-back of 900m of flood embankments, which will allow approximately 70 ha of floodplain to be better-connected to the river (Figure 3). Embankment set-back, ditch infilling, road lowering, and creation of a gravel ford will improve flood-risk resilience to properties and infrastructure (roads and powerlines).

Protection from flooding



Figure 5: this picture shows the ‘root-wad’ technique used on the River Breamish to stabilise riverbanks and where the risk is more focused and localised.

50% of completed measures and 40% of ongoing measures have helped to protect individuals, communities, and the environment against the consequences of flooding. These projects have significantly reduced flood risk to residential properties. For example, in the River Till catchment a measure to consider the vulnerability of key infrastructure such as roads, schools, community buildings so improving flood risk to people and/or places is continuing. And to prepare suitable measures to ensure the assets are resilient and are able to remain open or be open rapidly during and after flood events is continuing.

Three sites for soft-engineered green riverbank protection were completed between 2015 and 2021 on the Wooler Water and River Breamish, part of the River Tweed SAC and SSSI. In total, 330m of innovative log-matrix (Figure 4) and root-wad (Figure 5) riverbank protection was completed to protect infrastructure (e.g. roads), whilst minimising impact to the morphology of the river and providing habitat for wildlife. It is hoped that these methods and tree establishment will provide long term riverbank protection.

Preparation for flooding

Within the Solway Tweed RBD, 50% of completed and 28% of ongoing measures have helped to prepare people for flooding. For example, in the River Eden Catchment where a measure to identify locations where properties would be benefit from improvements in flood resilience. It provides owners with information to assist them to protect themselves

and their property is continuing. Community resilience engagement has taken place in all communities flooded in Storm Desmond. Activities to help people prepare for flooding have included personal and community emergency planning and resilience and resistance promotion.

[The Flood Hub](#) is a dedicated website which supports our communities to manage flood and coastal risk. It was developed by Newground on behalf of the North West RFCC and the Risk Management Authorities (RMAs). It has been designed to be a one stop shop for flood information and resources to support householders, businesses, and communities in becoming more flood resilient. It pulls together multiple sources of guidance to produce a hub of information that gives an overview of flood resilience and its many related topics.

In the last year, the [Flood Hub](#) has been visited over 115,000 times by some 42,500 users, who downloaded almost 10,000 resources. It provides an invaluable facility to support our community engagement work and direct members of the public to who want to learn more about flooding.

The [Knowledge Hub](#) contains a variety of downloadable flood risk information and guidance document. The [Your Local Area](#) pages provide information on community groups, flood works and events on an easy to use interactive map. The [Flood Risk Management Schemes](#) pages is where RMAs can share up to date information and progress reports on proposed and ongoing flood schemes.

Recovery from flooding

Whilst none of the completed and ongoing measures had a primary theme of helping to support communities to recover from flooding, several have contributed to achieving this objective. For example, a measure to promote awareness within local residents regarding action to protect themselves and their property from flooding and providing owners with information so that they can protect themselves and their property. This is continuing and happened during 2016/17 in locations that flooded during Storm Desmond as Local Authorities' administered Property Level Protection grants, and the Environment Agency promoted and supported the take up of these to encourage increased resilience.

Ongoing measures that have contributed to managing flood risk

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 to 2021. For example,

- RMAs have operated/maintained flood risk assets to help protect individuals, communities, and the environment
- The Environment Agency issued flood warnings between 2015 and 2021, which warned and informed the public of the risk of flooding

Also, day to day activities carried out in 2015 to 2021 that have contributed to preventing flooding include:

- determining Flood Risk Activity Permits
- carrying out our roles as statutory consultee in the planning process
- continuing our modelling programme
- continuing our publishing of updates to flood risk mapping
- continuing monitoring of the Northwest Regional Coastal Monitoring Programme
- repairing and refurbishing flood risk management assets – includes projects in the 2015 to 2021 capital investment programme that are additional to the completed measures above that have significantly reduced the risk of flooding homes
- continuing of routine maintenance of flood risk management assets
- reservoir management and regulation
- capital schemes
- incident response including:
 - monitoring and operating defences
 - erecting demountable and temporary barriers
 - clearing debris from watercourses to allow water to flow freely

Day to day activities carried out in 2015 to 2021 that have helped people to prepare for flooding include:

- maintenance and improvement of river recording gauges used to warn and inform
- improvements to flood forecasting
- continued maintenance and improvement of the Environment Agency's flood warning service

In flood events the Environment Agency:

- has monitored rainfall and river levels, and professional partners have worked closely to use this information as an integral part of decision making for their emergency response
- has forecast and issued flood warnings for river flooding on numerous occasions throughout 2015-2021 - including issuing flood warnings to many thousands of people during winter floods in 2015/16 and 2019/20
- along with partners have provided briefings to the media and stakeholders to help keep the public informed

In addition to the measure in the first cycle FRMP, the following day to day activities carried out in 2015 to 2021 have aided communities to recover from flooding by:

- ensuring projects included on the 2015-2021 capital investment programme to repair flood risk management assets damaged during flooding
- engaging during flooding – such as visits by Environment Agency staff to communities during flooding

- engaging after flooding – RMAs have continued to work together to hold site visits and drop in events with communities, including flooded businesses, affected by flooding
- ensuring RMAs continue to work together during and after flooding to help communities recover from flooding - including reviews of flooding incidents to help further improve our response

All RMAs will continue to carry out day to day activities to manage the risk of flooding during the second cycle FRMP period 2021 to 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 have arisen due to flooding experienced, preliminary investigations completed or new partnership investment opportunities. They're typically relatively small scale and would today be considered as covered by the national level measures.

There are 6 additional measures for the Solway Tweed RBD since 2015, 4 of which are ongoing and 2 of which have been completed. These measures are all protection measures which undertook studies and investigations to enable the development of future projects to reduce flood risk to communities within the RBD.

How well these measures have achieved the first cycle FRMPs objectives

The Flood Risk Regulations (FRR) require the Flood Risk Management Plan (FRMP) to include details of objectives for the purpose of managing flood risk and measures to set out how the objectives will be achieved. First cycle FRMPs objectives were grouped into categories:

- social
- economic
- environmental

Information on these objectives for the Solway Tweed River Basin District (RBD) first cycle FRMPs can be found in Part B of the first cycle FRMPs.

Overall, the measures included in first cycle FRMPs have successfully achieved objectives set out across all of categories, delivering improvements to the social, economic and environmental well-being of the Solway Tweed RBD. The completed measures have contributed to achieving the economic objective. Outcomes delivered by on-going measures have contributed towards achieving both these and the environment category.

For example, the completed measure at Cummersdale, a village in Cumbria, just outside the southern outskirts of Carlisle, resulted in a private Flood Alleviation Scheme delivered

with aid from Cumbria County Council Local Enterprise Partnership to protect isolated commercial development.

In addition to the completed measures, ongoing measures that reflect day to day activities undertaken by RMAs in the period 2015 to 2021 have contributed to achieving the first cycle FRMPs objectives. For example, an ongoing measure to identify locations where properties would benefit from improvements in flood resilience. This provides owners with information to assist them to protect themselves and their property has contributed to social objectives.

Activities also include personal and community emergency planning and resilience and resistance promotion. This is ongoing with community resilience engagement underway in all communities flooded in Storm Desmond.

Another ongoing measure was to undertake an assessment of agricultural assets and those which provide no flood defence function to determine if abandonment or reduced maintenance is justified. Making sure that any works or decisions undertaken are compatible with River Tweed SAC / Tweed Catchment SSSI and the 'River Restoration Plan and Actions' and this has contributed to environmental objectives.

There are several structures throughout the catchment which serve little flood risk benefit but stop the river system from acting in a natural manner by disconnecting the river from its floodplain. There's a long-term restoration plan for the River Till and we will continue to align our actions with this plan where flood risk to people and property is not adversely affected.

By removing artificial barriers to natural processes, the catchment will be allowed to return to a more natural form while allowing the floodplain to return to its natural function.

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

Second cycle summary of flood risk for the Solway Tweed RBD

This section shows a summary of flood risk in the River Basin District (RBD) from rivers and the sea, and surface water.

The data in tables 5 to 10 has been calculated from data available 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, showing that:

- 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: a summary of the risk of flooding from rivers and the sea to people in the Solway Tweed RBD

Risk to people	Total in RBD	High risk	Medium risk	Low risk	Very low risk
Number of people in RBD	223,159	1,628	3,790	12,983	55
Number of services	1,962	43	61	100	1

There are 223,159 people in the RBD. Of these people:

- 8.3% are in areas at risk of flooding from rivers and the sea
- 0.7% are in areas at high risk of flooding

There are 1,962 services in the RBD. Of these people:

- 10.4% are in areas at risk of flooding from rivers and the sea
- 2.2% are in areas at high risk

Table 6: a summary of the risk of flooding from rivers and the sea to the economic activity in the Solway Tweed RBD

Risk to economic activity	Total in RBD	High risk	Medium risk	Low risk	Very low risk
Number of non-residential properties	12,455	242	280	1,383	12
Number of airports	1	0	0	0	0
Length of road (kilometres (km))	312	5	11	8	<1
Length of railway (km)	234	4	9	2	0
Agricultural land (hectares (ha))	170,710	8,594	7,713	2,653	132

There are 12,455 non-residential properties in the RBD. Of these people:

- 15.4% are in areas at risk of flooding from rivers and the sea
- 1.9% are in areas at high risk of flooding

One airport in the RBD is outside the areas at risk of flooding from rivers and the sea.

There are 312 km of roads in the RBD. Of these people:

- 7.6% are in areas at risk of flooding from rivers and the sea
- 1.7% are in areas at high risk of flooding

There are 234 km of railways in the RBD. Of these people:

- 6.2% are in areas at risk of flooding from rivers and the sea
- 1.5% are in areas at high risk of flooding

There are 170,710 hectares of agricultural land in the RBD. Of these people:

- 11.1% are in areas at risk of flooding from rivers and the sea
- 5% are in areas at high risk of flooding

Table 7: a summary of the risk of flooding from rivers and the sea to the natural and historic environment in the Solway Tweed 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)	2	2	0	0	0
Number of Environmental Permitting Regulations (EPR) installations within 50m	49	4	2	4	0
Area of Special Area of Conservation (SAC) within area (ha)	58,607	7,486	402	57	<1
Area of Special Protection Area (SPA) within area (ha)	35,868	4,882	108	50	<1
Area of Ramsar site within area (ha)	23,618	4,855	63	50	<1
Area of World Heritage Site within area (ha)	63,640	5,690	1,979	1,304	140

Risk to the natural and historic environment	Total in RBD	High risk	Medium risk	Low risk	Very low risk
Area of Site of Special Scientific Interest (SSSI) within area (ha)	56,626	7,790	615	72	<1
Area of parks and gardens within area (ha)	1,547	78	57	5	0
Area of scheduled ancient monument within area (ha)	2,534	21	28	29	<1
Number of listed buildings within area	4,076	154	176	143	6
Number of licensed water abstractions within the area	367	40	21	7	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.

The 2 EU designated bathing waters in this RBD are in areas at high risk of flooding from rivers and the sea due to their fundamental features.

There are 49 Environmental Permitting Regulations (EPR) installations in the RBD. Of these:

- 20.4% are in areas at risk of river and sea flooding
- 8.2% are in areas at high risk of flooding

There are 58,607ha of Special Area of Conservation (SAC) in the RBD. Of these:

- 13.6% are in areas at risk of flooding from rivers and the sea
- 12.8% are in areas at high risk of flooding

There are 35,868ha of Special Protection Area (SPA) in the RBD. Of these:

- 14% are in areas at risk of flooding from rivers and the sea
- 13.6% are in areas at high risk of flooding

There are 23,618ha of Ramsar sites in the RBD. Of these:

- 21% are in areas at risk of flooding from rivers and the sea
- 20.5% are in areas at high risk of flooding

There are 63,640ha of World Heritage Site in the RBD. Of these:

- 14.3% are in areas at risk of flooding from rivers and the sea

- 8.9% are in areas at high risk of flooding

There are 56,626ha of Site of Special Scientific Interest (SSSI) in the RBD. Of these:

- 15% are in areas at risk of flooding from rivers and the sea
- 13.8% are in areas at high risk of flooding

There are 1,547ha of parks and gardens in the RBD. Of these:

- 9% are in areas at risk of flooding from rivers and the sea
- 5% are in areas at high risk of flooding

There are 2,534ha of scheduled ancient monument in the RBD. Of these:

- 3% are in areas at risk of flooding from rivers and the sea
- 0.8% are in areas at high risk of flooding

There are 4,076 listed buildings in the RBD. Of these:

- 11.8% are in areas at risk of flooding from rivers and the sea
- 3.8% are in areas at high risk of flooding

There are 367 licensed water abstractions in the RBD. Of these:

- 18.5% are in areas at risk of flooding from rivers and the sea
- 10.9% are in areas at high risk of flooding

Table 8: a summary of the risk of flooding from surface water to people in the Solway Tweed RBD

Risk to people	Total in RBD	High risk	Medium risk	Low risk
Number of people in RBD	223,159	799	1,773	7,921
Number of services	1,962	3	9	45

Of the 223,159 people in the RBD:

- 4.7% are in areas at risk of flooding from surface water
- 0.4% are in areas at high risk of flooding

Of the 1,962 services in the RBD:

- 2.9% are in areas at risk of flooding from surface water
- 0.2% are in areas at high risk

Table 9: a summary of the risk of flooding from surface water to economic activity in the Solway Tweed RBD

Risk to economic activity	Total in RBD	High risk	Medium risk	Low risk
Number of non-residential properties	12,455	95	141	684
Number of airports	1	1	0	0
Length of road (kilometres (km))	312	5	6	20
Length of railway (km)	234	6	7	19
Agricultural land (hectares (ha))	170,710	2,448	1,441	5,697

Of the 12,455 non-residential properties in the RBD:

- 7.4% are in areas at risk of flooding from surface water
- 0.8% are in areas at high risk of flooding

The 1 airport in the RBD is in areas at high risk of flooding from surface water.

Of the 312 km of roads in the RBD:

- 10% are in areas at risk of flooding from surface water
- 1.6% are in areas at high risk of flooding

Of the 234 km of railways in the RBD:

- 13.8% are in areas at risk of flooding from surface water
- 2.8% are in areas at high risk of flooding

Of the 170,710 hectares of agricultural land in the RBD:

- 5.6% are in areas at risk of flooding from surface water
- 1.4% are in areas at high risk of flooding

Table 10: a summary of the risk of flooding from surface water to the natural and historic environment in the Solway Tweed 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)	2	0	0	0

Risk to the natural and historic environment	Total in RBD	High risk	Medium risk	Low risk
Number of Environmental Permitting Regulations (EPR) installations within 50m	49	8	6	11
Area of Special Area of Conservation (SAC) within area (ha)	58,607	1,152	491	1,863
Area of Special Protection Area (SPA) within area (ha)	35,868	107	67	473
Area of Ramsar site within area (ha)	23,618	22	12	66
Area of World Heritage Site within area (ha)	63,640	1,564	706	2,538
Area of Site of Special Scientific Interest (SSSI) within area (ha)	56,626	1,314	545	2,075
Area of parks and gardens within area (ha)	1,547	29	9	36
Area of scheduled ancient monument within area (ha)	2,534	24	14	47
Number of listed buildings within area	4,076	83	19	80
Number of licensed water abstractions within the area	367	24	5	32

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

Neither of the 2 EU designated bathing waters in this RBD are in areas at risk of flooding from surface water.

Of the 49 Environmental Permitting Regulations (EPR) installations in the RBD:

- 51% are in areas at risk of surface water flooding
- 16.3% are in areas at high risk of flooding

Of the 58,607 hectares of Special Area of Conservation (SAC) in the RBD:

- 6% are in areas at risk of flooding from surface water
- 2% are in areas at high risk of flooding

Of the 35,868 hectares of Special Protection Area (SPA) in the RBD:

- 1.8% are in areas at risk of flooding from surface water
- 0.3% are in areas at high risk of flooding

Of the 23,618 hectares of Ramsar sites in the RBD:

- 0.4% are in areas at risk of flooding from surface water
- 0.1% are in areas at high risk of flooding

Of the 63,640 hectares of World Heritage Site in the RBD:

- 7.6% are in areas at risk of flooding from surface water
- 2.5% are in areas at high risk of flooding

Of the 56,626 hectares of Site of Special Scientific Interest (SSSI) in the RBD:

- 6.9% are in areas at risk of flooding from surface water
- 2.3% are in areas at high risk of flooding

Of the 1,547 hectares of parks and gardens in the RBD:

- 4.9% are in areas at risk of flooding from surface water
- 1.9% are in areas at high risk of flooding

Of the 2,534 hectares of scheduled ancient monument in the RBD:

- 3.3% are in areas at risk of flooding from surface water
- 1% are in areas at high risk of flooding

Of the 4,076 listed buildings in the RBD:

- 4.5% are in areas at risk of flooding from surface water
- 45.6% are in areas at high risk of flooding

Of the 367 licensed water abstractions in the RBD:

- 16.7% are in areas at risk of flooding from surface water
- 6.5% are in areas at high risk of flooding

Second cycle objectives and measures

A full list of the objectives is in the [‘Part A: National Overview of Flood Risk Management in England for the second cycle FRMPs’](#) (FRMPs).

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

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

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

Measures that have been included in the second cycle are strategic. The FRMP is not intended to cover all detail of the measure. Further, the level of the detail that is included may vary depending on whether the measure is at the planning or implementation stage. Not all measures have secured funding and so they are not guaranteed to be implemented.

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

You can find more information on how to use Flood Plan Explorer within the tool itself. This will be updated with additional instructions over time.

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.

There are no FRAs in the Solway Tweed River Basin District (RBD). However, they are still useful for understanding the day-to-day activities of LLFAs in managing flood risk.

RBD level objectives and measures

Measures have been developed which apply specifically to the whole Solway Tweed (English Catchments) 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](#).

To set overall objectives for the management of flood risk and to develop a plan to achieve them involved stepping back from day to day operations. It also involved considering in what direction flood risk management is headed and what its priorities should be, to determine the approach to take.

The RBD measures were developed and refined at a series of workshops by an extended group of practitioners and stakeholders. The workshops were focussed on long-term ambitions as set out in the Flood and Coastal Erosion Risk Management (FCERM) strategy for England, on different themes that reflected the FRMP Objectives. The themes were:

- Flood Resilient Places
- Adaptive Pathways
- Environmental Enhancement
- Growth and Development
- Infrastructure Resilience
- Ready to Respond and Recovery

Flood risk within the Solway Tweed RBD continues to be from a variety of sources. These include:

- rivers
- the sea
- surface water

- ordinary watercourses
- reservoirs
- sewers

The information from the hazard and risk maps was considered by experienced practitioners and recognised experts from different Risk Management Authorities and stakeholders in the Solway Tweed RBD. This consideration also captured their knowledge of the practical challenges that exist within the flood risk management community in the Solway Tweed RBD. They concluded that strategy River Basin District measures would be beneficial in directing FRM activity in the Solway Tweed RBD over the next 6 years.

Links between the FRMP and the RBMP

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](#) (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 wherever possible.

This is particularly important in order to achieve the main aim of the Water Environment (Water Framework Directive (WFD) England and Wales) Regulations 2017. The main aim of the WFD 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 [‘Solway Tweed RBMP’](#).

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

- 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 [‘Solway Tweed RBMP’](#), you can find out more information on the objectives and measures for the Solway Tweed RBMP.

How we will monitor implementation of the FRMP

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

1. The implementation status of each measure in the FRMP will be reviewed and updated every year. This will be done by the authority responsible for implementing the measure.
2. This updated information will be collated by the Environment Agency and analysed to identify any trends in the data. This will allow the identification of possible common interventions which may help measure delivery.
3. Summary statistics will be produced to show how much progress has been made in that year.
4. These statistics and other key messages will be included in the annual report produced under section 18 of the 'Flood and Water Management Act (2010)'. This report is published each year and submitted to the relevant regional flood and coastal committee for review. It will also be available online to the public.
5. The updated status of each measure will also be viewable in [Flood Plan Explorer](#).
6. At the end of the 6 year planning cycle, the FRMP will be reviewed and a summary of implementation progress over the duration of the planning cycle will be included. This is a requirement of the 'Flood Risk Regulations (2009)'.

List of abbreviations

This list of abbreviations is intended as a reference tool. It includes the main abbreviations and terms used in the second cycle flood risk management plans.

Short form	Long form
AONB	Area of Outstanding Natural Beauty
CaBA	Catchment Based Approach
CDE	Catchment Data Explorer
Defra	Department for Environment, Food and Rural Affairs
DWMP	Drainage and Wastewater Management Plan
EIA	Environmental Impact Assessment
ELMS	Environmental Land Management Scheme
EPR	Environmental Permitting Regulations
FAG	Flood Action Group
FCERM	Flood and coastal erosion risk management
FPE	Flood Plan Explorer
FRA	Flood Risk Area (as identified under the Flood Risk Regulations 2009)
FRM	Flood Risk Management
FRMP	Flood Risk Management Plan
FRR	Flood Risk Regulations 2009
FWMA	Flood and Water Management Act 2010
HRA	Habitats Regulations Assessment

Short form	Long form
IDB	Internal Drainage Board
LEP	Local Enterprise Partnership
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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