Environment Agency

Using the power of nature to increase flood resilience

This report explains the benefits of the Natural Flood Management Programme and celebrates its successes

Overview

Natural flood management (NFM) helps manage flood and coastal erosion risk. It does this by protecting, restoring and emulating the natural processes of catchments, rivers, floodplains and coasts. NFM can include:

- planting trees and hedges to absorb more water, catch rainfall and slow the flow of water on the ground surface when there is excess rainwater
- covering the ground with plants to reduce water pollution and surface water run-off
- diverting high water flows and creating areas to store water
- creating leaky barriers to slow water flow in streams and ditches
- restoring salt marshes, mudflats, and peat bogs

Reducing flood risk through nature-based solutions is not new to flood and coastal risk management practitioners. For years, we have managed many of our beaches to take the energy out of stormy seas to protect our coasts. Many places around the country have also reconnected rivers with their natural floodplain to make space for water away from vulnerable built-up areas.

What is changing is our understanding of how to work with others to implement the most effective blend of measures in the right locations. Too often, people talk about making a choice between hard (conventional defences) or nature-based solutions – as if there were conflict or competition between them. The NFM Programme has helped us understand the role that NFM can play in complementing conventional flood or sea defences to enhance flood and coastal resilience.

We know that NFM can reduce flood risk, build resilience into hard defences, and reduce the impacts of climate change. Investing in NFM can also provide wider benefits. These include improving habitats and biodiversity, increasing water quality and availability of drinking water, and improving health and wellbeing. The Working with Natural Processes (WwNP) Evidence Directory published by the Environment Agency in 2017 sets out the evidence from that time. We have built on this learning through the NFM Programme and celebrate its successes in this report.

We will keep working with partners to collect data to monitor the long term benefits of the programme. We will publish an evaluation of the NFM programme and update the Working with Natural Processes Evidence Directory in 2022.

Natural flood management techniques

1. In stream structures for example woody debris
2. Blocking of moorland drainage channels
3. Woodland planting
4. Land and soil management practices, cover crops, hedgerows, suitable crops
5. River morphology and floodplain restoration for example removal of embankments and remeandering
6. Inland storage ponds and wetlands
7. Protecting riverbanks for example stock fencing
8. Sustainable urban drainage systems for example swales, wetlands in urban areas, green roofs, permeable pavements, detention ponds, filter strips
9. Saltmarsh restoration
10. Coastal managed realignment
11. Coastal change management

Taken from the National Flood and Coastal Erosion Risk Management Strategy for England

A nation ready for, and resilient to, flooding and coastal change

We are currently implementing the flood and coastal investment plan for 2021 to 2027. This will invest £5.2 billion of government funding in new projects to better protect 336,000 properties from flooding and coastal erosion.

We must continue to do what we have been doing: building and maintaining strong defences to reduce the risk of places being flooded. But managing future climate risks by building bigger defences will not always be the right approach. We need to use all the tools available, including nature-based solutions. This is particularly the case as the changing climate causes more frequent, intense flooding and sea level rise.

The Environment Agency published the Flood and coastal erosion risk management (FCERM) Strategy for England in July 2020. This strategy calls for the nation to embrace a broad range of resilience actions alongside better protection to flooding and coastal change. In the face of a changing climate, we also need to make our places more resilient to flooding and coastal change. Being more resilient means that when flooding happens it will cause much less harm to people, less damage, and life can get back to normal much quicker.

The strategy helps to implement the government's Flood and coastal erosion risk management: policy statement. The goal of the policy statement is to better protect and prepare the country for flooding and coastal erosion. This includes harnessing the power of nature to reduce flood and coastal erosion risk and achieve multiple benefits. The policy statement commits to doubling the number of government funded projects which include nature-based solutions to reduce flood and coastal erosion risk.

Natural Flood Management Programme

Since 2017 we have invested £15 million of funding from government to benefit people and learn more about NFM through 60 pilot projects across England. Of these 26 are catchment scale projects led by risk management authorities and 34 are community scale projects led by local community groups and charities. The primary aims of the pilots were to:

- reduce flood or coastal erosion risk to homes
- improve habitats and increase biodiversity
- support and develop partnership working with and between communities
- contribute to research and development

Working with the Catchment Based Approach (CaBA), we have developed an online tool to coordinate the monitoring and evaluation of the projects. This shows that the pilot projects have installed over 4,500 NFM measures across England. Our partners have brought expertise, contributed funding and provided thousands of hours of voluntary time. This has helped us achieve so much more than we would have done alone. Some of the projects are continuing to install NFM measures with funding from other sources. Most projects will collect data for many years to come.

We will continue to update the online tool with this data and also include projects from outside the NFM Programme.

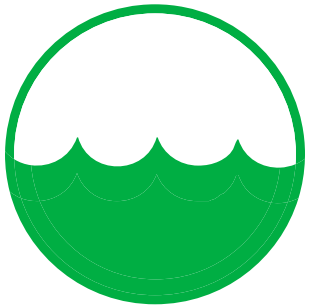
The projects and associated research have taught us a lot about how to use NFM effectively and its contribution in enhancing flood and coastal resilience. See the Environment Agency's report Natural Flood Management Programme – interim lessons learnt and Defra's research about Factors enabling or preventing natural flood management projects.

The main achievements from the natural flood management programme between 2017 and 2021

slowing and storing water upstream of **15,000 homes** in areas at risk of flooding (the equivalent of 1.6 million cubic metres)

attracting **£6 million** of funding contributions

involving **85 partners** - including government agencies, charities, local community groups and environment non-government organisations



improving **610 kilometres** of river

improving **4,000 hectares** of habitat

planting **100 hectares** of woodland

NFM programme: summary of main findings

The measures in the programme provide flood risk and wider benefits for communities. They:

- reduce the impacts of flooding by slowing the flow of water heading towards communities downstream and reducing peak flood flows
- can work well to reduce flood risk in combination with more conventional, engineered flood and sea defences
- are typically low in cost, though multiple NFM measures will often be needed across a large catchment area to have a meaningful impact on flood risk
- provide multiple benefits including improving habitats and biodiversity and capturing carbon
- can enable integrated water management, providing resilience to flooding when there is too much water, and resilience to drought when there is too little water

The NFM projects have also harnessed the power of partnership to build community resilience:

- by working with communities to maximise the benefits for people and wildlife
- by making best use of local expertise and knowledge, particularly of land owners and farmers
- through the creation of strong partnerships (but it takes time to build trust)
- by enabling the projects to benefit from funding from a variety of sources

Managing flood risk to achieve wider benefits for communities

NFM reduces flood risk by storing and slowing the flow of water. NFM measures hold back water and release it slowly, reducing flood heights downstream and reducing pressure on other defences. The NFM Programme as a whole has created 1.6 million cubic metres of water storage. That is the equivalent of around 670 Olympic size swimming pools. This was achieved through the cumulative impact of many NFM measures.

In the right circumstances, NFM measures can play a supporting role in tackling more significant floods and coastal erosion. The majority (over 70%) of measures in the NFM Programme are in the upper reaches of catchments on smaller watercourses. Here they can help to slow the flow of water through the catchment.

The most popular measures in the NFM Programme involve leaky barriers. Tree planting and woodland management are common measures too. NFM measures give the greatest flood reduction when they are used across a catchment using a variety of different techniques to increase the cumulative impact.

Individual NFM measures are often lower cost when compared to many other flood risk management measures. However, multiple NFM measures are usually needed to have a meaningful impact on risk across a catchment. The overall costs will depend on the scale and objectives for the NFM project.

NFM measures do more than reduce flood risk. They can help communities to be more resilient so that when flooding happens, they can recover much faster. They can also provide benefits for integrated water management, from source to sea. NFM projects can enhance community resilience to flooding when there is too much water and resilience to drought when there is too little water.

NFM also provides a wide range of environmental benefits to people and wildlife. Alongside water storage, the NFM Programme has improved 4,000 hectares of habitat and 610 kilometres of river. In doing so, the NFM pilots have helped to improve water quality, reduce soil erosion, and enhance biodiversity in the places where they are located.

Many NFM measures capture carbon, such as tree planting. The NFM Programme has planted more than 100 hectares of woodland. Woodlands make the ground surface rougher which slows the flow of surface water run-off during high rainfall events. This reduces flooding downstream because less water arrives at the same time. Trees provide a climate benefit by capturing carbon from the atmosphere. Using research findings from the Environment Agency's review of carbon offsetting approaches, we estimate that the woodland planted through the NFM Programme will capture 55,000 tonnes of carbon over 50 years.

The Evenlode project – providing multiple benefits

The Evenlode Catchment Partnership and Environment Agency initially developed this project to improve water quality in Littlestock Brook and achieve Water Framework Directive targets. By changing how the land is managed, the project team realised they could also reduce flooding as well as soil and nutrient run-off. This created the opportunity to be part of the NFM programme.

The project took place on a tributary of the River Evenlode, in Oxfordshire's lowland agricultural landscape. The project team worked with farmers to trial a suite soft engineering measures. They have created:

- 10 nutrient retention ponds
- 1.1 kilometres of sediment traps
- 15 field corner bunds storing 30,000 cubic metres of floodwater
- 27 leaky woody barriers
- 14.4 hectares of tree planting
- a new footpath and interpretation boards for the local community

The project team also removed 100 metres of culverts from the watercourse.

Hydraulic modelling and a comprehensive monitoring network have been installed as part of the project. This is generating evidence on how effective the NFM measures are for reducing flood risk and providing multiple benefits such as improving water quality and biodiversity.

The project has received a total of £585,000 of funding. This is made up of £140,000 from the NFM Programme, with the rest from other sources. In addition, the project has benefitted from £175,000 of in-kind partner contributions.

Jo Old, the Environment Agency Project manager, said:

"It's been inspiring to work with the Evenlode Catchment Partnership to create nature-based solutions in the landscape which not only benefit water quality, but also reduce flood risk to 12 homes in Milton-under-Wychwood.

This project would not have been possible without the enthusiasm of the local community, and supportive farmers ensuring the measures are maintained in the landscape. The importance of partner relationships and the power of positive landowner experiences is critical if we are to make our catchments climate resilient places.

We will continue to monitor the features for some time, but we're already seeing water quality improvements, new habitats for wildlife and recreation and reduced flood risk."

Cumbria – taking a catchment based approach

The Cumbria NFM project has sought to find what types of NFM work best in 14 different types of landscape. Cumbria has a variety of geology, soil depth, agricultural use, and altitudes which impact the choice and effectiveness of different NFM measures. In addition, they wanted to assess which NFM measures would be acceptable to farmers and landowners at risk and the implications for farming practices.

The primary focus was to see which types of NFM would make the biggest difference to flood risk. The project team wanted to demonstrate how NFM measures could effect changes to river discharge (water in the river). They partnered with Lancaster University to help with data collection and analysis.

The project team aimed to slow or store 10,000 cubic metres of water per square kilometre. This enabled the trialling of a variety of NFM measures across different landscapes. The team worked with a variety of landowners and agricultural operations to better understand the measures trialled, which included:

- farmers carrying out subsoiling (de-compacting the soil to help water infiltrate)
- changing overland flow routes
- building earth dams, bunds and swales
- re-designing a drystone wall to hold water
- building leaky barriers, with different materials and designs – including with living material
- planting 8,000 trees
- planting hedgerows
- creating offline flood storage ponds (about 4,000 cubic metres)
- working with the Forestry Commission to create over 100 leaky wooden barriers or different designs

David Kennedy, NFM Project Manager for the Cumbria project said:

"It has been fascinating and empowering to be able to trial a range of NFM across the catchments and landscape types. Being able to tailor what we do in some areas means we've maximised the outputs for the environment and people."

The power of partnership and building community resilience

NFM relies on many local partners working together to achieve a shared vision for how they can reduce flood risk and improve their local environment. The NFM Programme had more than 85 partners involved in carrying out and supporting the projects including:

- local authorities
- catchment based partnerships
- charities, farmers
- land owners
- community groups
- schools
- Environment Agency staff

A lesson learnt from the NFM Programme is that every project should have a project champion or chairperson who is responsible for the project's success. They will need to make decisions and facilitate compromise between all the stakeholders. Many successful projects have been led by:

- community groups
- charities, such as Rivers Trusts, Wildlife Trusts or National Trust
- other organisations, such as a National Park Authority

A high level of engagement is important in generating strong partnerships and inspiring others to get involved. The NFM projects have shown that it takes time and effort to build and sustain these partnerships. Project teams may need to use a significant proportion of the project budget on engagement and consultation with the community and other local stakeholders. Community representatives on the project partnership can play an important role in building trust locally. Involving schools can also inspire young people to better understand how NFM can help their local communities plan and adapt to climate change.

What we have learnt from the NFM projects has been the importance of local project teams listening to and working alongside the local community and local experts. Their knowledge is important when considering which NFM measures to install and where best to locate them.

Land managers are critical to the success of NFM projects. Farmers and landowners must agree to what is proposed and built on their land. Farmers can use advice on planting winter covering crops, soil management and ploughing along slopes which can help to reduce flood risk. It is also vital that project teams consider the impact of NFM measures on farm businesses. This includes doing the work outside of busy times, for example, harvest or lambing season.

It is important that project teams do not only plan for the upfront costs of installing NFM measures. It is equally important that project teams agree with local partners, including land owners, who is responsible for maintaining the measures once built and who will fund this.

Shipston Area Flood Action Group (SAFAG) – The power of partnerships

Shipston Area Flood Action Group (SAFAG) is a community led volunteer team. Their vision is to reduce flooding to homes and businesses using NFM measures across the River Stour in Warwickshire.

The group formed in 2014 and has members from 6 communities. They started to put NFM measures in place in 2017. They now have over 700 leaky barriers, and ponds to slow the flow of water during heavy rainfall. This has reduced the flood risk to 17 villages and towns.

The project has cost £312,000 of which £275,000 has come from the NFM programme, and £37,000 from partners. This does not include the time, materials and land donated to the project.

The group won the Environment Agency Flood and Coast Excellence 2021 Award for Community Partnership. The SAFAG Chairman Phil Wragg said:

"This award gives SAFAG recognition at national level. It is the culmination of 5 years work by a fantastic volunteer group and wouldn't have happened without the willing support of over 40 farmers and landowners to whom we give huge thanks. Thanks also to the Environment Agency for their unstinting support and also to relevant Parish, Town, District and County Council's and many others who have played a part."

Sustainable Urban Drainage Systems (SuDS) in Sutton Schools – community engagement in urban environments

The South East Rivers Trust (SERT) and the London Borough of Sutton are working in partnership to install SuDS within the London Borough of Sutton's schools. SERT were awarded £50,000 as part of the NFM Programme to create a range of SuDS measures in 6 schools. These measures will reduce flood risk to the schools and other properties, whilst also improving the water quality of the River Wandle, a chalk stream. Defra NFM funding helped unlock a further £40,000 of additional funding to allow the work to go ahead.

SuDS capture run-off from surfaces like roofs, roads and pavements to prevent the drainage network from becoming overwhelmed. They slow the flow of run-off to the drains and filter out contaminants before the water enters the drain and flows into the river.

The work in Sutton included the installation of features such as rain gardens and planters. These not only reduce flood risk, but provide interest and biodiversity benefits as well as opportunities for outdoor education. The project will disconnect nearly 4.3 hectares of hard surfaces (such as roads, paths, roofs) from the drainage network flowing into the River Wandle. This is helping to reduce surface water flooding and reduce pollution.

Partners in addition to the Environment Agency, SERT and the London Borough of Sutton include Thames Water, the Greener City Fund and the Thames Restoration Fund.

Charlene Duncan, Education and Community Outreach Officer at SERT, said:

"This funding was vital for securing school commitment to the wider SuDS in Sutton's Schools project. It enabled the South East Rivers Trust to engage stakeholders and design SuDS features that met the needs of the schools, providing the necessary incentive for schools to support SuDS on site."

Using nature-based solutions to reduce flooding in your area

The Environment Agency has produced practical advice for people wanting to develop nature-based solutions to reduce flooding. It builds on the learning from the NFM Programme.

Risk management authorities seeking government funding should follow the Environment Agency guidance when developing and submitting FCERM proposals. This guidance can also help community groups and other local partners plan and generate further investment. It may also be a basis for applying for grants from the National Lottery or other funders.

Projects will need to provide evidence of the likely impact of nature-based solutions on flood risk. This should follow a proportionate approach based on the size of the proposed investment. For small projects, relatively simple modelling can indicate the outcomes that may be achieved. For large value projects or those with complex features like flood storage areas, there will need to be more detailed modelling, assessment, and plans.

There are tools which can help to identify the most appropriate nature-based flood risk management projects and where to install them. Some are simple, while others are bespoke for more complex projects. These tools also show the benefits NFM may achieve. Example tools include the:

- Environment Agency's Long Term Flood Risk Information Service which provides information about flood risk by postcode area in England and the possible causes of flooding
- JBA Trust Mapping website which contains data about nature-based flood risk management projects across the UK
- Catchment Based Approach (CABA) National Evidence Package with datasets to help organisations achieve integrated catchment management
- MAGIC website which provides geographic information about the natural environment – it covers rural, urban, coastal and marine environments across Great Britain
- B£ST (Benefits Estimation Tool) which helps to value the benefits of nature-based solutions which includes NFM

Site visits with a resident farmer or land owners with local knowledge can also be a very effective planning approach. They often have invaluable local knowledge and working with them can identify potential NFM benefits which modelling, and desk-based tools alone cannot. In addition, land owners are often able to advise which ideas may be practical and which may not.

There are also guides on how to plan and use NFM. The US Army Corps of engineers have published the International Guidelines on Natural and Nature Based Features for Flood Risk Management.

Projects may need to get permissions, consents, and licences before a NFM project can go ahead. Find out more about the permissions, consents and licences you may need.

Next steps

The NFM programme will continue to collect data for several years to assess the longer term effectiveness of NFM. We are particularly keen to monitor and understand the ongoing maintenance needs for NFM measures.

We will publish an evaluation of the NFM programme and update the Working with Natural Processes Evidence Directory in 2022. As part of the Environment Agency's action planning for the FCERM Strategy we will also be working with partners to develop guidance and tools so that NFM can become an everyday choice. This work will continue to 2025 and will include:

- updating the appraisal guidance to encourage NFM and help projects secure funding from the flood investment programme where appropriate
- enhancing our digital advice services on NFM for practitioners
- building skills and capabilities through training materials and courses on NFM for policy makers and practitioners

Cover: An offline pond in Cumbria that provides large volume storm water storage.
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