

# **FINANCING NATURAL FLOOD MANAGEMENT**

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# About the report

As part of a broader work package on financing UK nature recovery, the Department for Environment, Food & Rural Affairs (Defra) commissioned the Green Finance Institute (GFI) to explore how private sector sources of finance could be unlocked to help facilitate the delivery of natural flood management at scale across England.

In mid-2023, the GFI brought together a cross-sectoral, multi-disciplinary Strategic Working Group of 20 members (below) to identify barriers to private capital being deployed into natural flood management (NFM), and to co-create and recommend actionable solutions to be included in this report. To develop the report, the GFI convened the Strategic Working Group regularly, in addition to hosting public workshops and liaising with over one hundred individuals from the private, public and third sectors.

Early on in the report process, it became clear that upfront financing or investment in natural flood management projects from the finance sector is available. Rather, the key challenge is that limited demand from the private sector in buying flood risk reduction, means that there are often no revenue streams that would enable upfront investment to be paid back. It is a lack of buyers of NFM outcomes, therefore that is the biggest hurdle to overcome if we hope to see private sector finance engaged for NFM projects in the UK. A set of barriers to increasing this demand were identified by the Group, under the themes of Confidence, Co-Benefits, and Coordination. To address these barriers, this report sets out the background to flood risk management and spend in the UK, in addition to the findings of the Group's work as follows:

- The **seven key enabling solutions** identified by the Strategic Working Group to remove these barriers and unlock private sector co-investment in NFM at scale, alongside recommendations for implementation and considerations around challenges.
- Suggested **further work and further recommendations** recommending areas for further investigation.

This report has been put together thanks to the guidance and input from the Co-Chairs and Strategic Working Group members below. ***The organisations on page two have contributed to the development of this report and support its broad recommendations. Because the report has been produced collaboratively, the individual recommendations may not always represent the views of every individual contributing organisation.***

## Co-Chairs

| Organisation             | Name           | Role   |
|--------------------------|----------------|--|
| Lake District Foundation | Keith Ashcroft | Chair  |
| Marsh                    | Dr Bev Adams   | Head of Climate Resilience & Strategy Practice |

## Strategic Working Group Members

| Organisation                           | Name                   | Role   |
|--|------------------------|--|
| ARUP                                   | Felicia Rhodes         | Associate, Nature Based Solutions                    |
| Association of British Insurers        | Rebecca Lea            | Senior Policy Advisor                                |
| AVIVA                                  | Kelly Whittington      | Director of Property and Speciality Claims           |
| Environment Agency                     | Jon Hollis             | NFM Programme Manager                                |
| Environment Agency                     | Keith Davie            | Project manager and Senior External Funding Lead     |
| Finance Earth                          | Caleb Wheeler Robinson | Senior Associate                                     |
| Flood Re                               | Jonathan Kassian       | Head of Research                                     |
| Greater Manchester Combined Authority  | Sam Evans              | Head of Natural Environment                          |
| JBA Consulting                         | Steve Maslen           | Director   |
| Markerstudy Insurance Group            | Gary Hueting           | Chief Operating Officer                              |
| North East Cotswold Farmer Cluster CIC | Tim Field              | Founder and Facilitator                              |
| Spains Hall Estate                     | Archie Ruggles-Brise   | Rural Estate Manager                                 |
| Surrey County Council                  | Adam Brown             | Surrey Nature Recovery Strategy Lead                 |
| Swiss Re                               | Aidan Kerr             | Director, Public Sector Solutions                    |
| The Rivers Trust                       | Dan Turner             | Technical Lead – Land Management and Market Creation |
| Triodos Bank UK                        | Tom Dyke               | Corporate Finance Manager                            |
| Triodos Bank UK                        | Whitni Thomas          | Head of Corporate Finance                            |
| United Utilities                       | James Airton           | Natural Capital Planning and Strategy Manager        |
| University of Lancaster                | Nick Chappell          | Reader in Hydrological Processes                     |
| WWF-UK                                 | Lucy Lee               | UK Chief Advisor                                     |

# Foreword

**Over the last 10 years we have seen the impacts of climate change accelerate globally and locally with devastating consequences for communities and businesses through the impacts of increasingly regular “extreme and unprecedented” events. Flooding is the UK’s number one climate threat with wide-ranging social, economic and infrastructure impacts and legacies. The annual disruption and damages caused by flooding is now estimated to cost £2.2bn each year – a figure predicted to increase by 27% by 2050.**

While modelling projections indicate the situation is set to worsen, in parallel, strategic approaches are evolving with a focus on resilience and adaptation, diversifying our risk management toolkit beyond building flood defences ever higher. Natural Flood Management (NFM) considers wider land and catchment processes to store and slow the flow of water upstream, to reduce the potential impact of flooding to downstream communities.

Flood risk reduction is only one aspect of climate resilience and adaptation. The co-benefits delivered by nature-based flood management could become an important driver for positive environmental change and ecosystem resilience, inter-woven with biodiversity gains and carbon capture/offsetting initiatives. Encouraged by green incentives and ESG (Environmental Social and Governance) regulatory reporting and accountability, investors, lenders, and entrepreneurs are leaning in as never before to explore delivering outcomes while instigating commercial growth.

Funding to manage flood risk to communities and businesses has increased in recent years, but the volume of work and delivery cost are accelerating at a significantly faster rate. While local flood risk management schemes are sometimes being funded through collaboration with the private sector, financing has not yet expanded beyond piloting to a catchment or wider regional/national scale.

This important report draws together evidence and perspectives from the nation’s leading experts in their fields to understand the status quo with respect to blockers, investigate the art-of-the-possible, and spotlight priority next steps towards a structured, scalable, and sustainable financing paradigm for NFM.

Key barriers have emerged through this study which will need further strategic engagement and discussion, including the below:

**Confidence:** Will NFM deliver a measurable reduction in flood risk to justify investment? How can NFM be incorporated into modelling to analyse flood risk reduction and to build the data and evidence base?

**Co-benefits:** NFM alone may not provide a commercial imperative for investment, although it is often closely aligned with potential biodiversity and carbon credits. There is, however, no clear mechanism for ‘stacking’ benefits.

**Coordination:** There is no coordination framework for private sector buyers and investors spanning national, local and even international scales, which could potentially attract more strategic investment. We thank the Green Finance Institute’s (GFI) Nature Programmes team for their hard work and diligent approach to helping shape the UK’s future NFM strategy with this exploratory study.

Signed,

**Dr Bev Adams and Keith Ashcroft MBE**

# Executive summary

## Context

**Flooding is the UK's number one natural hazard, with damages and the associated investment in flood risk reduction costing the UK around £2.2 billion annually.** Beyond these costs, flooding impacts the economy, business, homes, people, and physical and mental health. As the climate changes, managing flood risk is likely to cost significantly more in the following decades. Indeed, flooding has been identified as a priority risk by the UK Committee on Climate Change. Continued investment in traditional flood risk infrastructure, even at today's record levels, will not be enough to cover potential costs. A more holistic approach to flood risk management and how it is funded, will be required going forward.

**Natural flood management is a complementary approach to traditional flood risk infrastructure.**

Natural flood management (NFM) involves working with the natural processes of a catchment to reduce flood risk, for example by improving soil management, planting of wet woodland, and creating retention ponds and wetlands in urban environments. These measures can reduce the burden on traditional flood infrastructure, prolonging the useful life of hard flood defences. NFM measures can also deliver a host of wider environmental co-benefits such as carbon sequestration, biodiversity uplift and water quality improvements. NFM has been highlighted as key to reducing flood risk by the UK Government within the current capital programme, and as part of the Third National Adaptation Programme. However, it currently receives a small proportion of all flood risk management spending and will require increased funding going forward if it is to be delivered at the scale required to address the challenges associated with climate change.

**There is the opportunity for NFM to attract private sector capital, relieving some of the burden on the public purse.** There are examples in the UK of NFM projects where the private sector has paid for flood risk reduction such as the Wyre River Natural Flood Management project, in which a water company United Utilities was part of a buyer consortium.

**The environmental co-benefits generated by NFM projects also play an important role in attracting private sector capital for NFM projects.** In some cases, payments for the potential flood risk reduction alone may be insufficient for an NFM project to reach financial viability. The purchase of co-benefits, such as carbon sequestration, water quality, and/or water resource improvements, may generate sufficient revenues to pay for the capital and maintenance requirements, or allow for upfront financial investment to be repaid with interest.

**At present, however, there is limited buy-side demand for the flood risk reduction or ecosystem services generated by NFM. Proposed NFM projects, in which the private sector is a provider of capital, often as a co-funder with the public sector, are stalling.** Over the course of several months, the Green Finance Institute brought together a cross-sector Working Group to identify the barriers to scaling private capital into NFM, and to propose actionable solutions, outlined in this report. Over one hundred external stakeholders also provided their insights.

## Barriers

The barriers have been categorised under three key themes: Confidence, Coordination and Co-Benefits.

### Confidence

For a beneficiary of reduced flood risk to contribute to the capital and/or revenue requirements of an NFM project, confidence in NFM's ability to reduce flood risk is essential. However, concerns around data and evidence, a lack of standards, and a lack of clear government guidance on resilience, are all impacting that confidence.

**Insufficient data and evidence:** At present, there is a perception that NFM has not been fully evidenced as being an effective delivery method for flood risk reduction and wider environmental co-benefits. Furthermore, the evidence required by buyers can often be bespoke and costly. For investors or lenders providing upfront capital to projects, investable NFM propositions are also too nascent, or too few, to have confidence in the risk-return profiles.

**No nationally accepted design standards:** At present, there is no overarching, nationally accepted standard to which NFM projects must adhere, ensuring that projects are designed and monitored to deliver the stated outcomes for both flood risk reduction and co-benefit generation. Records of NFM assets, their purpose, as well as maintenance records, are also not held centrally or easily accessible. These factors lead to legal and reputational risks for those entities paying for delivery of these projects.

**Lack of clear government guidance:** There is currently no government strategy that highlights how NFM supports, or interacts with, the wider environmental, social, and economic priorities in a region. NFM buyers therefore lack confidence that payments for ecosystem services and flood risk reduction are in line with broader targets. There can also be a concern that NFM projects may not be being designed in a location where they would deliver maximum impact. In addition, there are currently no resilience targets set out by government for the private sector.

### Co-Benefits

As mentioned above, flood risk reduction alone may not be enough to secure the financing required to pay for the delivery of the project and ongoing costs. The sale of environmental co-benefits to private sector buyers is, therefore, vital in ensuring that NFM projects are financially viable.

However, at present, barriers remain that are preventing the sale of these co-benefits. These have been identified as:

**Limitations of the partnership funding structure:** Within the Environment Agency's partnership funding programme, co-benefits do not confer sufficient value to meet cost-benefit requirements to secure funding. These co-benefits are bundled into NFM projects, rather than sold separately as tradeable units that the private sector would be incentivised to purchase. For example – the sale of carbon credits or Biodiversity Net Gain (BNG) units cannot easily be added to the revenue stack to attract more buyers. This limits the number of potential private sector buyers, and therefore reduces the overall potential private sector partnership funding secured to deliver the Flooding and Coastal Erosion Risk Management (FCERM) capital programme.

Ecosystem service stacking clarity: A lack of clarity on the ability to stack revenue streams from multiple ecosystem services alongside flood risk reduction through NFM, reduces the potential pool of paying beneficiaries which may only be interested in paying for a single ecosystem service. For example, it is currently unclear if a project that plants trees to increase infiltration and reduce flood risk can also sell carbon credits for the carbon sequestered by those trees.

Natural capital assessment tool framework: The valuation of natural capital for NFM project is imperative to highlight the multiple ecosystem service opportunities potentially available to buyers. However, there are many natural capital assessment tools in use and in development with no overarching framework to which these tools must adhere. This can also reduce confidence that NFM projects will deliver high integrity outcomes.



## Coordination

Scaling demand for NFM will require multiple beneficiaries, as covered above, and therefore a coordinated approach is required. Challenges included under coordination are as follows:

**Country-wide strategic NFM prioritisation:** As mentioned above, there is no overarching guidance from government about where NFM interventions would be most effective, complement traditional flood risk management plans, and deliver against wider environmental, social, and economic priorities. Buyers are not given the confidence that the projects they fund will deliver the maximum benefit for both flood risk reduction and environmental outcomes.

**Stakeholder mapping:** There is currently no standardised or strategic mapping of potential beneficiaries of reduced flood risk and wider environmental co-benefits within a region.

**Coordinated buyer engagement:** There is currently no centrally managed process to bring together potential private sector buyers with other key NFM stakeholders around NFM priorities within a geography.

## Key Enabling Solutions

Seven key enabling solutions have been identified that could unlock these demand-side barriers, and result in an increase in private sector co-funding of NFM projects. These are set out below.

| # | Solution  | Overview  | Barriers Addressed         |
|---|---|---|----------------------------|
| 1 | <b>Strategic prioritisation of NFM</b>                            | A free and open-access mapping software to prioritise NFM opportunities across England, and to capture where NFM can deliver for flood risk reduction and wider environmental outcomes. | Confidence<br>Coordination |
| 2 | <b>Natural flood management asset database</b>                    | An NFM asset database to record NFM asset information for all projects across the country.  | Confidence                 |
| 3 | <b>Natural capital assessment tool framework</b>                  | A framework to guide the development of natural capital assessment tools, to provide a comparable approach to co-benefit valuation.   | Confidence<br>Coordination |
| 4 | <b>Funding for buyer facilitation and partnership development</b> | Funding for the effective facilitation of buyer engagement and demand aggregation for the development of NFM projects   | Confidence<br>Coordination |
| 5 | <b>NFM design standards and guidance</b>                          | Development of UK Government-backed NFM standards to ensure high integrity.   | Confidence                 |
| 6 | <b>Clarity on ecosystem service stacking</b>                      | Clarity provided for the stacking of individual ecosystem services alongside NFM.   | Confidence<br>Coordination |
| 7 | <b>Update to FCERM grant-in-aid partnership funding processes</b> | Co-benefits of FCERM schemes valued as verified credits/units available for third-party purchase  | Confidence<br>Coordination |

## Further Work

While the above solutions capture an overarching view of how to unlock private sector capital to pay for flood risk reduction or ecosystem services delivered by NFM, there are specific demand drivers that will need to be addressed based on the type or sector of buyer. The Working Group has, therefore, recommended a series of more detailed work to be taken, prioritising the below sectors that have a natural interest in reducing flood risk.

**Insurance sector deep dive:** Throughout the course of this project, the potential role(s) of the insurance sector in scaling delivery of NFM as either buyers of reduced flood risk, or investors in NFM projects, were discussed. While the sector is seen as a potential key stakeholder in flood risk, there are multiple challenges that are preventing these roles being fully realised. The GFI will be exploring these and potential solutions in more detail in a follow up report.

**Water sector deep dive:** As key stakeholders in the management of flood risk and water resources, further investigation into the barriers preventing the water sector from acting as a buyer of flood risk reduction and water resources benefits from NFM, should be considered. For example, the way in which water companies value nature-based solutions is currently prohibiting widespread adoption of NbS to reduce flood risk, protect water resources, and improve water quality.

**Mortgage sector deep dive:** The increased risk of flooding will have a detrimental effect on people and properties, and the affordability of flood insurance. This will have a marked impact on affordability of homes. Increasing the knowledge base within the sector (and within the lending sectors more widely) on NFM and how it could be a cost-effective method of reducing risk across mortgage portfolios could increase demand from the sector as a buyer of flood risk reduction.

Also, as mentioned previously, there are still gaps in the evidence base for how NFM can reduce flood risk. More work, therefore, needs to be done on the causal links between catchment-based NFM interventions and downstream effects where impacts on people, properties and businesses would be felt.



## Further Recommendations

Finally, over the course of the working group, other key recommendations were uncovered:

**Development of evidence for NFM:** Developing the evidence base for the efficacy of NFM is important if NFM is to become an intervention of choice alongside traditional flood risk infrastructure. Further research should be done in partnership with the private sector, to build a common understanding of the benefits of NFM within the private sector. Consideration should be given to mandating evidence capture across all NFM projects receiving grant funding.

**The need for governance and suitable institutional structures:** If private finance is to help scale nature-based solutions across the landscape alongside public money, a more coordinated and systems thinking approach to the delivery and financing of NbS will be required, alongside appropriate governance and institutional structures that include representatives from multiple stakeholders.

**Targets and guidance for delivery of NFM:** There are still no explicit targets or government signals that set out the potential future funding gap due to increased flood risk from climate change. Nor have there been targets set for the proportion of that gap that will need to be delivered through NFM, and through private investment. This results in a lack of urgency and direction within the private sector, slowing engagement and therefore delivery of NFM via private capital.

**Multifunctional Land Use Framework:** NFM will need to be delivered across large areas and at a certain intensity, and this will come up against several competing priorities for land including food production, housing, and tourism. Therefore, we strongly recommend that the creation of a suitable Land Use Framework be prioritised.

**Community engagement:** Communities are an important stakeholder and a key beneficiary of a reduction in flood risk. As with the private sector, NFM is a relatively new concept for communities and presents as an unfamiliar option to preventing the flooding of their homes. It is important that communities are engaged and empowered during the process of scaling delivery of NFM across the landscape, including when private finance is involved. There are numerous groups that can be engaged such as Local Flood Action Groups, the National Flood Forum, and Climate Action Groups.



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# Introduction



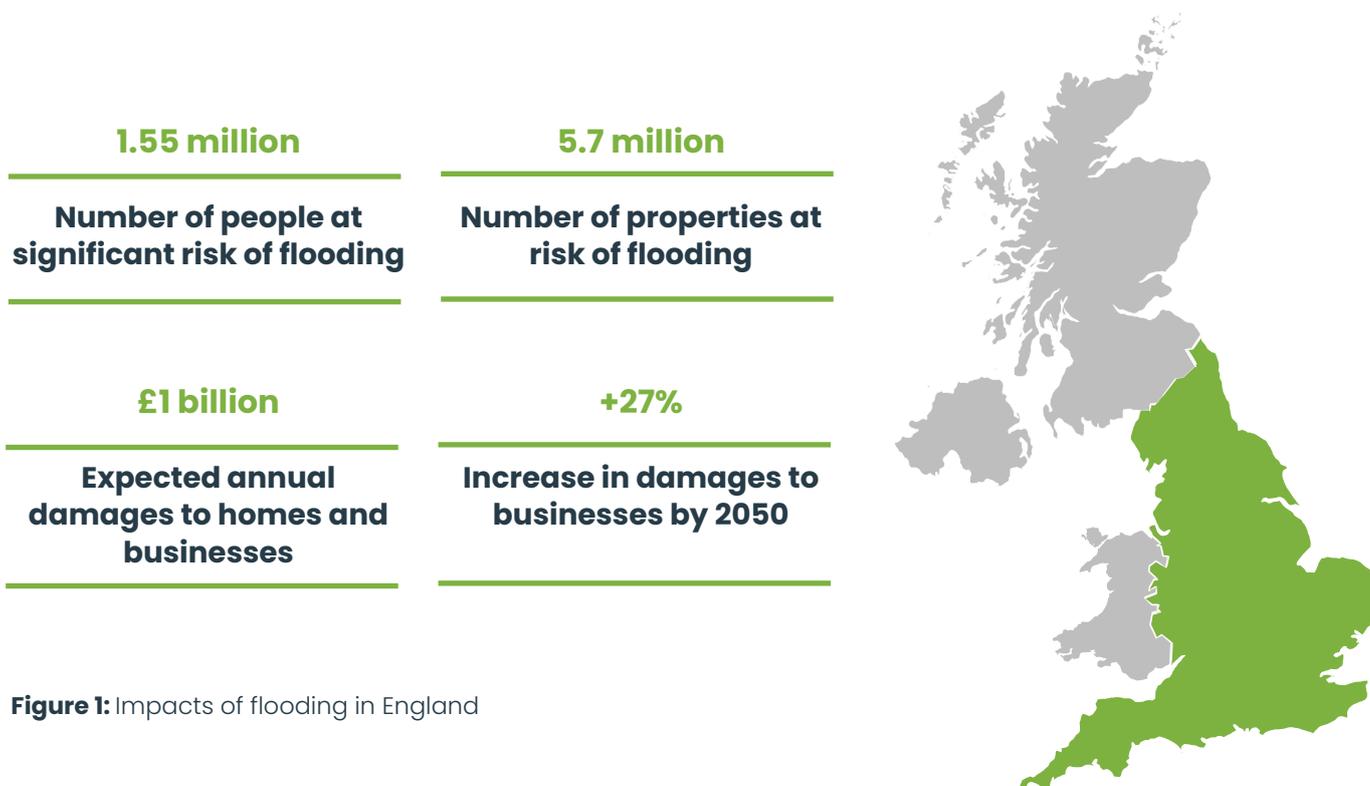
# Introduction

Flooding has been identified as the number one natural hazard for the UK<sup>1</sup> evidenced by a number of catastrophic flood events having occurred in recent decades.

In the first four months of the 2023/24 storm season alone, the UK had already suffered 10 named storms – only one named storm away from equalling 2015/16 numbers with more than five months remaining in the season (at the time of writing).<sup>2</sup>

As climate change intensifies, temperatures are likely to rise in England by 1.3oC by 2025 and between 1.4oC and 2.4oC by 2080. This is expected to have a marked impact on rainfall, with winters becoming much wetter, and summers becoming much drier. Furthermore, when these rain events do occur, they are likely to be more extreme in their nature.<sup>3</sup> This will have a significant impact on people, properties, and businesses.

The damage and disruption caused by flooding, and the expense of managing it, already costs the UK around £2.2 billion each year.<sup>4</sup> Even with current flood defences, the Expected Annual Damages (EAD – see Box 1 for explanation) caused by flooding to both residential and non-residential properties in England alone is estimated to be more than £1 billion.<sup>5</sup>



**Figure 1:** Impacts of flooding in England

<sup>1</sup> Environment Agency, 2009. Flooding in England: A National Assessment of Flood Risk.  
<sup>2</sup> <https://www.metoffice.gov.uk/weather/warnings-and-advice/uk-storm-centre/index>  
<sup>3</sup> UK Climate Risk. Evidence for the third UK Climate Change Risk Assessment (CCRA3). Summary for England.  
<sup>4</sup> <https://assets.publishing.service.gov.uk/media/5a74c78de5274a3f93b48beb/04-947-flooding-summary.pdf>  
<sup>5</sup> Environment Agency. Flooding in England: A National Assessment of Flood Risk

Unless further action is taken, under all projected climate change scenarios, flood risk could significantly increase by 2050 when there could be up to 59% more precipitation in winters.

In a 2°C warming scenario, the EAD for residential properties from river and surface water flooding is expected to increase by 137% by the 2050s and 269% by the 2080s. For non-residential properties the figure is projected to increase by 36% by 2050 and 50% by 2080.<sup>6</sup>

### Expected Annual Damages

An estimation of the expected annual damages in economic terms from flood events. EAD combines the probability of a property (residential and non-residential) being flooded, and the associated direct and indirect economic damages including direct damages, indirect damages such as disruption to economic networks, and intangible damages such as mental health impacts and trauma.

**Box 1:** Expected Annual Damages (EAD) definition.<sup>7</sup>

## Risk to people and properties

Flood risk is a serious threat to people and properties in England and damages can come from multiple sources of flooding as highlighted in Table 1. Between 2022 and 2023, the EA estimates that 5.7 million properties were at risk of flooding, 500,000 more than at the last National Flood Risk Assessment in 2009. Over the same time period, the number of properties at medium- or high-risk of flooding from rivers and seas increased by 78,000 to 900,000. Surface water flooding is the most widespread source of flooding in England, with ~3.4 million properties at risk, with some residential properties facing risks from multiple sources of flooding.<sup>8,9</sup>

| People at significant risk of flooding and direct residential EAD |         |         |               |             |
|---|---------|---------|---------------|-------------|
|   | Fluvial | Coastal | Surface Water | All Sources |
| <b>Number of people</b>   | 476,000 | 102,000 | 976,000       | 1,554,000   |
| <b>EAD (£m)</b>   | 172     | 59.5    | 59.8          | 291.3       |

**Table 1:** Number of people currently at significant risk of flooding, and direct residential EAD as at today.<sup>10</sup>

Beyond the economic and financial impacts to people and properties, the mental health impacts of flooding on communities can be significant. According to Public Health England the prevalence of probable depression amongst those whose homes that were flooded was 20.1%, anxiety was 28.3% and post-traumatic stress disorder (PTSD) was 36.2%.

These numbers are six times higher compared to those people whose homes were not flooded, and the prevalence of these conditions remains high up to two years after the flood event (depression 10.6%, anxiety 13.6%, and PTSD 24.5%).<sup>11</sup>

<sup>6</sup> UK Climate Risk. Evidence for the third UK Climate Change Risk Assessment (CCRA3). Summary for England.

<sup>7</sup> UK Climate Change Risk Assessment 2022: Evidence Report: Flood risk: Appendix B – Risk Metrics March 2020: Sayers and Partners LLP.

<sup>8</sup> National Audit Office. 2023. Resilience to Flooding

<sup>9</sup> Environment Agency, Flood and coastal erosion risk management report: 1 April 2022 to 31 March 2023, September 2023.

<sup>10</sup> Adapted from UK Climate Risk Independent Assessment – CCRA3 2022 – Technical Report

<sup>11</sup> Public Health England, 2020. The English National Study of Flooding and Health. Summary of the evidence generated to date.

## Risks to businesses

According to the latest Climate Change Risk Assessment (CCRA3), flooding is the costliest hazard to businesses in England, resulting from damage to sites, business interruption and lost production time, as can be seen in Table 2. There is also a general lack of understanding within businesses of the risks associated with surface water, groundwater and drainage-related flooding when compared to river and coastal flooding.

|                      | Residential  |  |                                     |                                    | Non-residential, business properties               |  |                                     |                                    |
|----------------------|--|--|-------------------------------------|------------------------------------|--|--|-------------------------------------|------------------------------------|
|                      | Estimated number of properties damaged by flooding | Estimate of economic damages (£ million) | Average financial cost per property | Average economic cost per property | Estimated number of properties damaged by flooding | Estimate of economic damages (£ million) | Average financial cost per property | Average economic cost per property |
| 2015 – 2016 (winter) | 16,000   | 350                                      | 35,000                              | 18,000                             | 5,000  | 513                                      | 153,000                             | 99,000                             |
| 2013 – 2014 (winter) | 10,500   | 320                                      | 44,000                              | 23,000                             | 3,100  | 270                                      | 127,000                             | 82,000                             |
| 2007 (summer)        | 48,000   | 1,500                                    | 31,000                              | 19,000                             | 7,000  | 900                                      | 113,000                             | 75,000                             |

**Table 2:** Estimated economic costs of the 2015/2016 floods.<sup>12</sup>

## Future impacts of flooding

As discussed previously, flood risk is set to increase significantly for all parts of society. Table 3 below highlights the expected increases in EAD by 2050 and by 2080 based on a 20C warming scenario. Geographically, those regions that currently face the highest risk will likely see the largest percentage increase in the annual costs of flood damages going forward. These are the north-west and south-east of England.<sup>13</sup>

| Expected Annual Damages | Non-residential | Residential   |
|-------------------------|-----------------|---------------|
| Today (£m)              | 463             | 291.3         |
| 2050 (£m)               | 588 (+27%)      | 690.4 (+137%) |
| 2080 (£m)               | 648.2 (+40%)    | 1,074 (+269%) |

**Table 3:** EAD (% change) for non-residential and residential properties today, by 2050 and by 2080. (Based on a 20C increase in global temperatures and assuming no further adaptation measures are put in place).<sup>14</sup>

<sup>12</sup> Reproduced from Environment Agency, 2018. Estimating the economic costs of the 2015 to 2016 winter floods.

<sup>13</sup> UK Climate Risk Independent Assessment – CCRA3 2022 – Technical Report.

<sup>14</sup> Adapted from UK Climate Risk Independent Assessment – CCRA3 2022 – Technical Report.

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**Areas with the highest risk of flood now, will continue to do so in the future unless no further action is taken.**

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**Figure 2:** Map showing the areas of highest likely increases in EAD caused by flooding in a 1.8oC warming scenario.

## Flood risk management in England

In the context of this report, it is important to understand who is responsible for flood risk management in England and how it is currently funded.

The management of flood risk in England involves multiple bodies with differing responsibilities. The Department for Environment, Food & Rural Affairs (Defra) has overall national responsibility for policy on flood and coastal erosion risk management and provides funding for flood risk management authorities through grants to the Environment Agency (EA) and local authorities.

The EA supervises and works with other organisations to manage the risk of flooding and coastal erosion in England. The EA is responsible for taking a strategic overview of the management of all sources of flooding and coastal erosion. This includes, for example, setting the direction for managing the risks through strategic plans; providing evidence and advice to inform Government policy and support others; working collaboratively to support the development of risk management skills and capacity; and providing a framework to support local delivery.

It has operational responsibility for managing the risk of flooding from main rivers, reservoirs, estuaries and the sea, as well as being a coastal erosion risk management authority. As part of its strategic overview role, the EA has published a National Flood and Coastal Risk Management Strategy for England. The strategy provides a lot more information designed to ensure that the roles of all those involved in managing risk are clearly defined and understood.<sup>15</sup>

The Flood and Water Management Act (2010) places a duty on all flood Risk Management Authorities (RMAs), including the Environment Agency, to co-operate with each other, and to aim to contribute towards the achievement of sustainable development when exercising their flood and coastal erosion risk management functions. RMAs include Lead Local Flood Authorities, district councils, internal drainage boards, highways authorities, and water and sewerage companies. [See **Appendix** for descriptions]

<sup>15</sup> <https://www.gov.uk/government/collections/flood-and-coastal-erosion-risk-management-authorities>

# Public sector funding of flood risk management

Before discussing a more holistic approach to the delivery and funding of flood risk management in England, it is important to understand how it is currently funded.

Central government is the largest source of flood and coastal erosion risk management (FCERM) funding in England. The bulk of this funding comes from Defra and is provided to the EA as Grant-in-Aid (GiA). This is predominantly spent on directly managing flood risk, but some funding is also passed on as capital grants to local authorities or Internal Drainage Boards. Other sources of funding include (but are not limited to) a local levy on local authorities raised by the EA, drainage charges, levies paid to internal drainage boards, and partnership funding (see **Box 2**).<sup>16</sup>

## Partnership Funding

An approach to encouraging more local contributions to flood defence schemes. Government can provide money to pay a share of the flood defence schemes, dependant on the level of benefits provided by the scheme. If full government funding is not available, due to high-costs or lower benefits than required, local authorities and communities can decide priorities and seek co-funding from other sources, including from non-public sources. For example, developers looking to build major housing or commercial developments can be asked to contribute to funding the improved defense of those new areas.

### Box 2: Partnership funding

In 2020, the UK Government committed to investment in flood defences of £5.2 billion for the six-year capital programme between 2021 and 2027, doubling the commitment from the previous six-year period (2015 to 2021).<sup>17</sup> This capital programme aims to better protect 336,000 homes and non-residential properties, such as shops, businesses and industrial premises, from flooding by 2027.

A further £200 million was announced for the Flood and Coastal Resilience Innovation Fund, including £150 million to the Flood and Coastal Resilience Innovation Programme (FCRIP) to support 25 local areas to demonstrate how practical innovative actions can work to improve resilience to flooding and coastal erosion. These actions include nature-based solutions (NbS) to flooding and sustainable drainage systems, among others.<sup>18</sup>

As the risk of flooding increases with climate change, so too will the costs of addressing these risks. Building further traditional flood risk infrastructure such as walls can only go so far,<sup>19</sup> and a more holistic approach to flood risk management in England is therefore required.

<sup>16</sup> <https://researchbriefings.files.parliament.uk/documents/CBP-7514/CBP-7514.pdf>

<sup>17</sup> House of Commons Library. Research Briefing. Flood risk management and funding.

<sup>18</sup> <https://www.gov.uk/guidance/flood-and-coastal-resilience-innovation-programme#fcip>

<sup>19</sup> Moody's RMS, Flood Re. Evaluating the Performance of UK Flood Defences Under Climate Change

# What is Natural Flood Management?

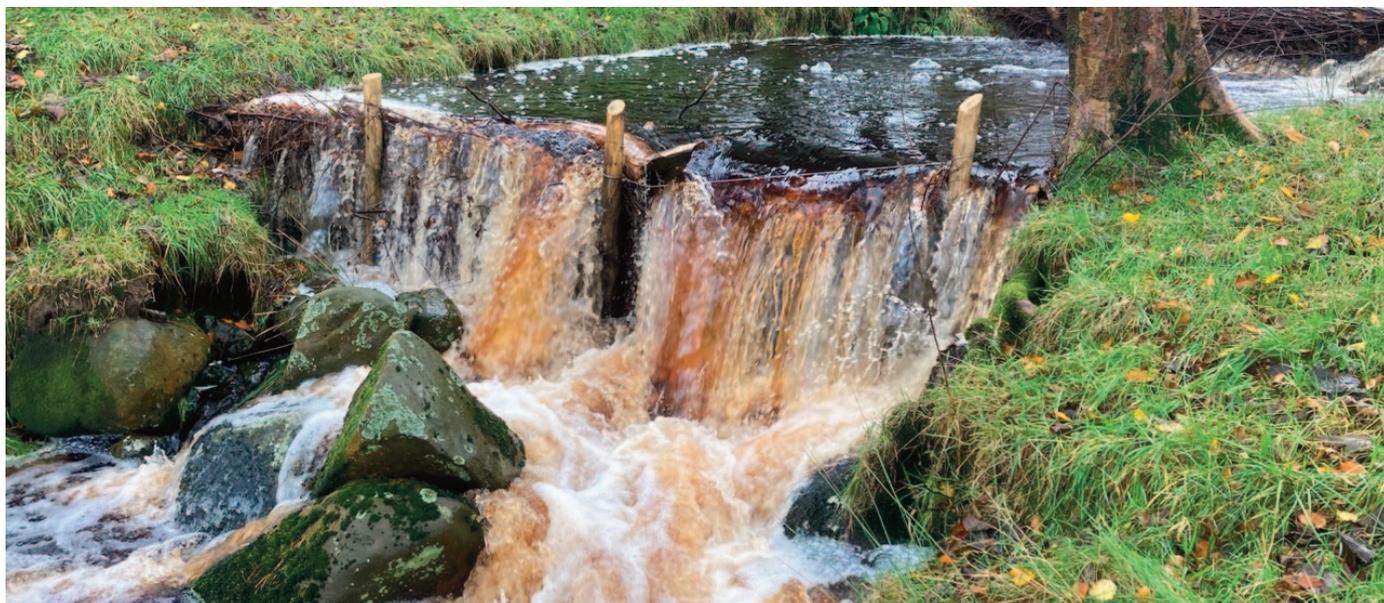
# What is natural flood management?

Natural flood management (NFM) is increasingly being cited as a means of complementing traditional approaches to reducing flood risk and building resilience, and simultaneously meeting environmental targets through the generation of co-benefits.

It is worth noting that other terms are used to describe NFM. The EA, for example, refers to NFM as Working with Natural Processes (WWNP), while others may refer to it as nature-based solutions for flood mitigation, soft engineering, green infrastructure, engineering with nature, nature-based sustainable drainage, and runoff attenuation, for example.

NFM involves working with nature to increase the beneficial roles that healthy habitats and resilient landscape features can perform in reducing flood risk for communities, businesses and infrastructure. These natural processes protect, restore, and mimic the natural functions of catchments, floodplains, and the coast to slow the rate at which water runs into rivers, and reduce the volume of that water, to help reduce flooding downstream.<sup>20</sup>

NFM can be implemented or enhanced in both urban and rural areas, on rivers, estuaries and coasts. Its primary aim is to reduce the maximum volume of a flood – also known as the peak flood flow – and/or delay the arrival of the flood peak downstream, therefore increasing the time available to prepare for flooding.<sup>21</sup>



**Figure 3:** A leaky barrier in high flow conditions. A number of fascines (bundles) have been placed in the river to help slow the flow and store water behind the barrier during periods of heavy rainfall, helping to reduce downstream river levels. (©Sam Hope, Wyre Rivers Trust)

It works in a number of ways, including by increasing the interception of rainfall, increasing the infiltration of water into soils, temporarily holding water in the environment to be released slowly into water courses, and increasing evapotranspiration from surfaces during rain events.

<sup>20</sup> [https://www.gov.uk/guidance/natural-flood-management-programme#:~:text=Natural%20flood%20management%20\(NFM\)%20uses,river%20and%20floodplain%20management](https://www.gov.uk/guidance/natural-flood-management-programme#:~:text=Natural%20flood%20management%20(NFM)%20uses,river%20and%20floodplain%20management)

<sup>21</sup> <https://catchmentbasedapproach.org/learn/what-is-natural-flood-management/>

From increasing the surface roughness of moorlands to the creation of new dry heathland and intertidal habitats, good habitat management and habitat design can be highly impactful for flood risk. Healthy soils with good structure and soil ecology can perform important roles in improving water infiltration rates and, within many landscapes, are critical for reducing localised flood risk. Interventions such as creating beetle banks across the slope of an expansive arable field, reinstating a network of traditional earth banked hedges, or reengaging straightened rivers with their floodplains and increasing floodplain storage can all create additional flood risk benefits.

Other key measures include the creation of temporary ponds, wetlands and wet woodlands, scrapes and other attenuation features. Innovative approaches to delivering reduced flood risk through natural processes are also being trialled across the country, including the use of beavers as ‘ecosystem engineers’ to deliver flood risk reduction and wider environmental improvements in an area. [See **The role of ecosystem engineers in natural flood management** case study]



**Figure 4:** A panoramic view of a Wyre Natural Flood Management Project site. In the foreground is an area of woodland creation. Beyond that are two ponds created to store water from surface flows. In the background is an area of lowland peat restoration. All these interventions are helping to store water and restore critically important habitats. (©Sam Hope, Wyre Rivers Trust).

While NFM interventions upstream of populated centres can reduce flood risk to those areas, restoring or creating habitats and natural processes within the urban environment itself will also contribute to reducing flood risk. Some sustainable drainage systems (SuDS) in urban areas use or emulate natural processes to reduce the risk of flooding from stormwater, by slowing and reducing peak flows into local watercourses. Examples of these interventions include wetlands, shallow, marshy areas filled mostly with aquatic vegetation and swales, shallow and broad vegetated channels, that provide temporary storage, infiltration, and conveyance of storm water runoff. The IGNITION project in Greater Manchester is an example of implementing sustainable drainage systems in an urban environment, details of which can be found in the **Case Study** section.

NFM may also help to extend the operational life and effectiveness of traditional flood defences, when used as part of a holistic approach to flood risk management. For example, implementing NFM alongside flood embankments may reduce the required height of those embankments, and the maintenance burden going forward.<sup>22</sup>

The EA’s Working with Natural Processes (WWNP) Evidence Directory includes a list of NFM interventions and descriptions of how these interventions impact the flow of water.<sup>23</sup> An extract of NFM interventions considered in this report can be found in the **Appendix**.

<sup>22</sup> <https://www.sepa.org.uk/media/163560/sepa-natural-flood-management-handbook1.pdf>

<sup>23</sup> Environment Agency, 2016. Working with Natural Processes – Evidence Directory

## Co-benefits of NFM projects

NFM projects can deliver a host of wider environmental and social co-benefits, alongside flood risk reduction. NFM is therefore not only a mechanism to reduce flood risk, but a vehicle through which multiple environmental outcomes can be achieved. For example, improvement to land management practices such as managing crop and livestock rotation to reduce compaction, or planting winter cover crops, and wetland creation designed to reduce flood risk, can deliver wider environmental and social benefits that include:

- Increased biodiversity
- Increased habitat connectivity
- Carbon sequestration and abatement
- Localised water resource benefits
- Water quality improvements
- Increased access to green-blue spaces

Beyond the environmental co-benefits, NFM interventions can have positive impacts on mental health and wellbeing. Taking the example of wetlands again, research has shown that wetland creation in a publicly-accessible urban environment can improve mental health and wellbeing for those already experiencing stress.<sup>24</sup>

| NFM Intervention                                 | Co-benefits   |
|--|---|
| <b>Remeandering of rivers</b>                    | Increased habitat provision for fish species; improved community amenity value.   |
| <b>Arable reversion to dry heathland habitat</b> | Improved water quality; increased biodiversity; carbon sequestration; improved groundwater recharge; increased local drought resilience; reduced sediment loading onto public highways. |
| <b>Creation of wet woodland</b>                  | Increased biodiversity; carbon sequestration; access to green spaces; improved community amenity value.   |
| <b>Improved soil and land management</b>         | Reduce topsoil loss; carbon sequestration and abatement; increased soil biodiversity; increased productivity; drought and water resource resilience.                                    |

**Table 4:** Examples of NFM interventions and associated environmental and social co-benefits (not exhaustive).<sup>25,26</sup>

<sup>24</sup> Reeves, J.P.; Knight, A.T.; Strong, E.A.; Heng, V.; Neale, C.; Cromie, R.; Vercammen, A.; The application of wearable technology to quantify health and wellbeing co-benefits from urban wetlands. *Front. Psychol.* 2019,10, doi:10.3389/fpsyg.2019.01840.

The UK Government has committed to a number of environmental targets within the Environmental Improvement Plan 2023 (EIP). As shown above, NFM provides a possible vehicle through which many of the targets within the EIP could be met, including the apex goal of ‘Thriving plants and wildlife’. For example, planting trees for the reduction of flood risk can contribute to the targets of increasing the hectareage of wildlife-rich habitat, and to the establishment of 3,000 hectares of new woodlands along England’s rivers.<sup>27</sup> However, there are no specific targets within the EIP for the use of NFM in delivering flood risk reduction.

The UK Government has also set a target to attract £500 million per year of private finance into nature’s recovery by 2027, increasing to £1 billion annually by 2030.<sup>28</sup> NFM has the potential therefore to contribute to addressing these targets, as well as targets for reducing flood risk for people, properties and businesses across the country.



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<sup>25</sup> Scottish Environment Protection Agency, 2015. Natural Flood Management Handbook

<sup>26</sup> Environment Agency, 2018. Working with Natural Processes – Evidence Directory

<sup>27</sup> HM Government. Environmental Improvement Plan 2023.

<sup>28</sup> HM Government. Mobilising Green Investment. 2023 Green Finance Strategy. March 2023

| EIP Goal  | Target(s)  | NFM Intervention(s)  | Crossover  |
|---|--|--|--|
| <p><b>Goal 1: Thriving plants and wildlife</b></p>  | <p>Restore or create more than 500,000 hectares of wildlife-rich habitat by 2042.</p> <p>Restore or create 140,000 hectares of wildlife-rich habitats outside protected sites by 2028, compared to 2022 levels.</p> <p>Increase tree canopy and woodland cover from 14.5% to 16.5% of total land area in England by 2050</p> | <p>Tree planting</p> <p>Wetland creation</p> <p>River restoration</p> <p>Floodplain restoration</p> <p>Agricultural cropping changes (e.g. changing arable to grassland)</p> | <p>Tree planting, wetland creation, river restoration, agricultural changes, and floodplain restoration all involve increasing available habitat for wildlife.</p> |
| <p><b>Goal 7: Mitigating and adapting to climate change</b></p>                               | <p>Restore over 35,000 hectares of peatlands in England by 2025 through the Nature for Climate Peatland Grant Scheme</p>   | <p>Peatland restoration</p>  | <p>Improving headwater drainage through peatland restoration sequesters carbon to mitigate climate change.</p>   |
| <p><b>Goal 8: Reduced risk of harm from environmental hazards</b></p>                         | <p>Reduce the impact of droughts to ensure supply of drinking water</p>  | <p>Floodplain restoration</p> <p>Wetland creation</p> <p>Tree planting</p> <p>River restoration</p>  | <p>Increased groundwater recharge.</p> <p>Pollution attenuation and reduction</p>  |
| <p><b>Goal 10: Enhanced beauty, heritage, and engagement with the natural environment</b></p> | <p>Commitment that everyone should live within 15 minutes' walk of a green or blue space.</p>  | <p>River restoration</p> <p>Tree planting</p>  | <p>River restoration and woodland creation projects create opportunities for recreation and relaxation, particularly in urban areas</p>                            |

**Table 5:** Examples of Environmental Improvement Plan goals and NFM interventions that can help meet those goal.<sup>29</sup>

<sup>29</sup> HM Government. Environmental Improvement Plan 2023.

Co-benefits may also be of interest to the private sector. For example, a water company may be interested in reducing flood risk to its assets to avoid damage costs from flooding. The company may also be interested in the water quality improvements that can be achieved through wetland creation to meet regulatory targets, and the carbon sequestration benefits that can be achieved through tree planting (among other interventions).

In this report, the co-benefits generated by NFM projects have been highlighted as crucial in ensuring that NFM projects reach financial viability, and in scaling the delivery of NFM across the landscape.

| Sector              | Driver   | NFM Co-Benefits  |
|---------------------|--|--|
| Property developers | Biodiversity Net Gain requirements.  | If applicable, offsite BNG units could be sourced from NFM projects that create additional or improve existing habitat.  |
| Water sector        | Increased requirements for use of NbS to improve water quality.<br>Water resource benefits.<br>Increased requirements for use of NbS to improve water quality.<br><br>Water resource benefits. | Wetland creation for flood risk reduction can improve water quality in rivers subject to wastewater discharges, to meet regulatory nutrient management requirements.<br><br>Improved soil and land management practices in catchment can contribute to aquifer recharge. |
| Large corporates    | Large corporates<br>Voluntary disclosures such as Task Force on Climate-related Financial Disclosures (TCFD) and Taskforce on Nature-related Financial Disclosures (TNFD).                     | NFM provides an opportunity for large corporates to assess and mitigate climate- and nature-related risks within their supply chain, including biodiversity loss and damage to assets (for example).   |
| Financial services  | Reduce nature-related risks.   | Alongside flooding, NFM can deliver enhanced biodiversity, water storage, and improved soil and land management (for example). This can therefore reduce the nature-related risks associated with soil degradation, drought, and biodiversity loss. <sup>30</sup>        |

**Table 6:** Private sector drivers to deliver co-benefits of NFM projects

<sup>30</sup> University of Cambridge Institute for Sustainability Leadership (CISL 2020). Biodiversity Loss and Land Degradation: An Overview of the Financial Materiality.

## How is NFM currently funded?

NFM is predominantly funded from a number of public sector sources as part of the overall spending on flood risk management described previously. Alongside these sources, a major funding source for NFM is through agri-environment schemes, such as Countryside Stewardship. Other sources can include specific NFM-focussed projects such as Defra's £25 million NFM Programme and Peatland Restoration grants. NFM can also be funded through Flood Defence Grant-in-Aid (FDGiA) partnership funding and local levy funding raised by RFCCs.<sup>31</sup>

Agri-environment schemes, such as the Environmental Land Management schemes (ELMs) are also major sources of funding for NFM. The schemes offer financial incentives to farmers to implement certain measures on farm, beyond minimal regulatory compliance, that benefit the wider natural environment while fitting in with their farm business.

Countryside Stewardship for example aims to protect and enhance the natural environment by increasing biodiversity, improving water quality, and reducing flood risk through natural flood management. Farmers can receive payments to reduce soil compaction on their land, to plant winter cover crops, to create buffer strips, and to implement riparian tree planting. All these interventions will help reduce flood risk. As roughly 70% of England's land is farmed, it is likely that a large amount of flood risk funding currently comes from agri-environment payments to farmers.

There are some examples of funding for NFM from private sector entities, including Aviva's partnership with WWF and Trent Rivers Trust in the River Soar,<sup>32</sup> RSA Insurance's partnership with Gloucestershire Wildlife Trust,<sup>33</sup> and National Highways Natural Flood Management Fund.<sup>34</sup>

For NFM projects to be implemented, two sources of funding are usually required.

**Capital funding** is an upfront payment at the outset of the project that traditionally pays for items involved in the installation of flood risk infrastructure. In the case of NFM this can include items such as tree stocks for woodland creation, wood for leaky dams, funding for the creation of wetlands, and for the fencing-off of riparian corridors.<sup>35</sup> Currently, most government-led funding schemes prefer to pay for capital items at the outset of the project.

**Revenue funding** is sourced to cover the annual charges associated with the ongoing upkeep and maintenance of those NFM assets, to ensure they continue to deliver the desired flood risk reduction and/or co-benefits over a given time period. Revenue funding is also used to cover project management costs, cyclical soil aeration, required profit (if applicable), and data management. Due to short term funding settlement approaches,<sup>36</sup> revenue funding beyond three years is typically not included within government-led funding schemes.

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<sup>31</sup> <https://catchmentbasedapproach.org/learn/find-funding-for-natural-flood-risk-management-projects/>

<sup>32</sup> <https://www.trentriverstrust.org/nfm-soar>

<sup>33</sup> <https://www.rsainsurance.co.uk/news/rsa-updates/continuing-our-commitment-to-building-climate-resilient-communities/>

<sup>34</sup> [https://catchmentbasedapproach.org/learn/he-nfm-fund/#:-:text=Welcome%20to%20the%20Highways%20England,A%20roads%20and%20motorways\).](https://catchmentbasedapproach.org/learn/he-nfm-fund/#:-:text=Welcome%20to%20the%20Highways%20England,A%20roads%20and%20motorways).)

<sup>35</sup> Land adjacent to water courses taken out of agricultural production, increasing the roughness of the overland flow pathways, and slowing the flow of water into the main river channel. (Yorkshire Dales Rivers Trust)

<sup>36</sup> [https://assets.publishing.service.gov.uk/media/5a7ca9e9ed915d7c983bc249/LGFS\\_Guide.pdf](https://assets.publishing.service.gov.uk/media/5a7ca9e9ed915d7c983bc249/LGFS_Guide.pdf)

# Current spend on natural flood management

The UK Government has made positive signals for the widespread implementation of NFM, committing to double the number of government-funded NFM projects to deliver 260 NFM projects within the current capital period.<sup>37</sup> The National Infrastructure Commission has also highlighted the potential importance of nature-based solutions in reducing flood risk as well as their ability to deliver multiple environmental and social co-benefits.<sup>38</sup>

As part of the last Long Term Investment Scenarios in 2019, the EA estimated that an indicative optimum level of investment in NFM alongside traditional FRM approaches, could be 7% of the total optimum annual level of investment in FCERM costs (currently between £1.0 – £1.2 billion per year).<sup>39</sup> Based on these levels, optimum investment in NFM could equate to between £70 and £84 million per year.

Recent examples of government funding available for the delivery of NFM include the programmes listed in **Table 7** below:

| Programme  | Number of NFM projects | Funding Available for NFM (£m)        | Period      | Status  |
|--|------------------------|---------------------------------------|-------------|---------|
| <b>FCERM Capital Programme</b>                               | 144                    | Unknown                               | 2021 – 2027 | Ongoing |
| <b>FCRIP<sup>40</sup></b>                                    | 20                     | 150 (for all FRM incl. NFM)           | 2021 – 2027 | Ongoing |
| <b>NFM Pilot Programme<sup>41</sup></b>                      | 60                     | 15                                    | 2017 – 2021 | Ongoing |
| <b>NFM Programme<sup>42</sup></b>                            | 40                     | 25                                    | 2024 – 2027 | Ongoing |
| <b>Nature for Climate Peatland Grant Scheme<sup>43</sup></b> | Assessing applications | Unknown                               | 2023 – 2025 | Ongoing |
| <b>Landscape Recovery<sup>44, 45</sup></b>                   | 56 in total            | 37 (for all activities including NFM) | 2022 – 2025 | Ongoing |

**Table 7:** Recent government funding available for NFM.

<sup>37</sup> Environment Agency, September 2023. Natural flood management programme

<sup>38</sup> National Infrastructure Commission, October 2023. The Second National Infrastructure Assessment.

<sup>39</sup> Environment Agency, July 2021. Long-term investment scenarios (LTIS).

<sup>40</sup> <https://engageenvironmentagency.uk/engagementhq.com/innovation-programme>

<sup>41</sup> Environment Agency, 2022. Natural Flood Management Programme. Evaluation report.

<sup>42</sup> Environment Agency, 2023. Natural flood management programme prospectus.

<sup>43</sup> <https://www.gov.uk/guidance/nature-for-climate-peatland-grant-scheme#contact-natural-england>

<sup>44</sup> <https://defrafarming.blog.gov.uk/2023/11/29/round-two-projects/>

<sup>45</sup> <https://defrafarming.blog.gov.uk/2022/12/08/an-update-on-the-first-round-of-landscape-recovery-projects/>

### UK Government £25 million NFM Programme

Between 2017 and 2021, the UK Government invested £15 million into an NFM pilot programme that funded 60 projects across England. Following on from this pilot initiative, a further £25 million was announced for eligible NFM projects in September 2023 for delivery between 2024 to 2027.

In February 2024, 40 projects were selected to receive funding covering a range of geographies, types of flood risk and NFM interventions. Alongside improving the evidence base for NFM and filling knowledge gaps, the Programme is also looking to explore and accelerate new and existing opportunities for NFM delivery and financing.

**Box 3:** UK Government NFM Programme.<sup>46, 47, 48</sup>



<sup>46</sup> Environment Agency, 2022. Natural Flood Management Programme. Evaluation report.

<sup>47</sup> Environment Agency, 2023. Natural flood management programme prospectus.

<sup>48</sup> Environment Agency, 2023.

# The private sector and NFM

# The private sector and NFM

## Future NFM funding requirements from the private sector

As discussed previously, the majority of funding for flood risk management comes from public sources, but as climate change continues and flooding events become more frequent and more intense, the public purse will come under increased pressure to protect the number of properties as set out in the FCERM strategy. As mentioned, a more holistic approach to the funding of flood risk management will be required going forward, and further funding will be needed from a wider pool of public and private sector sources, to ensure NFM is delivered at the scale required.

Before exploring the potential drivers for the private sector, it is important to set out who are the beneficiaries of publicly-funded flood risk management currently. Flood risk reduction activities benefit many different stakeholder groups within an area. The main beneficiaries are those that own or use land that is at risk of flooding, such as householders or businesses that have the potential to experience harm from flood risk. Different stakeholders experience these benefits in different ways, as set out below:

- **Direct monetary benefits**, for example cash flows to contractors for providing FCERM services and implementation.
- **Non-monetary direct benefits** which accrue to beneficiaries without them needing to take action, for example a reduction in expected household damages for homeowners.
- **Indirect benefits** requiring action on behalf of the beneficiary to realise those benefits, such as an increase in land-value for landowners.<sup>49</sup>

Reducing risk primarily benefits those with property and those who have a vested interest in land use and physical facilities or assets. Property developers for example, may benefit from the reduced flood risk from a planned mitigation scheme, by being able to develop in areas that were previously at a higher risk of flooding. Property owners also benefit from reduced flood risk from flood defences due to the potential increase in property values.<sup>50</sup> These are examples of indirect beneficiaries.

Examples of direct beneficiaries include infrastructure operators, such as rail and road. These organisations would benefit from reduced risk due to the reduction in expected damages from flooding, and reduced expected costs associated with restrictions to a service – such as rail delays. Further examples of beneficiaries are highlighted in [Table 12](#).

Private sector co-investment into the delivery of flood risk management (FRM) has historically been sourced as ‘partnership funding’ from the EA. According to the National Audit Office, £800 million of private sector partnership funding is still needed to meet the target of £2.3 billion required to deliver the current capital programme.<sup>51</sup>

<sup>49</sup> Environment Agency, Defra, 2008. Who Benefits from Flood Risk Management Policies.

<sup>50</sup> Bayes Business School, City, University of London. March 2023. The impact of flood risk on England’s property market.

<sup>51</sup> National Audit Office. 2023. Resilience to Flooding

# Private sector approaches to funding NFM

Alongside government-funded NFM projects, more recently, a number of innovative approaches to attracting private sector funding into NFM projects are underway in the UK.

In some examples, funding for NFM projects by the private sector is provided through the use of Corporate Social Responsibility (CSR), or Environmental, Social and Governance (ESG) capital grants. Examples of private sector initiatives such as this include Aviva's partnership with the World Wildlife Fund<sup>52</sup> and RSA's partnership with Gloucestershire Wildlife Trust<sup>53</sup> are given below.

Launched in 2021, the joint WWF-UK and Aviva partnership is delivering nature-based solutions across various habitats and landscapes in the UK with the aim of building healthier and more climate resilient communities, while working together to transform the UK finance sector in the face of the nature and climate crises.

To improve resilience to climate change, the partnership looks to provide grant funding to projects implementing NFM techniques to reduce flood risk. An example of this is the work undertaken by the Trent Rivers Trust (TRT) in the River Soar catchment in the East Midlands. The project will work with landowners and communities in targeted sub-catchments to promote the use of NFM and changes in land management in reducing flood risk. They will deliver a number of specific projects, and report back on the challenges on upscaling this type of approach at a landscape scale.

## Gissing Natural Flood Management Project

In December 2020, Norfolk received a month's worth of rain within 24-hours and severe flooding occurred in the village of Gissing in Norfolk, where six properties were internally flooded. Following these floods, the Norfolk Rivers Trust (NRT) and the River Waveney Trust (RWT) joined forces, in collaboration with WWF and Aviva, to proactively protect the village of Gissing in south Norfolk from flooding. The project also received funding from the Environment Agency and the Garfield Weston Foundation.

The Trusts collaborated with landowners, the local community, and the parish council to implement a programme of natural flood management measures to reduce the risk of flooding in Gissing. Completed in September 2023, the project included interventions such as reconnecting the River Waveney to its floodplain, a leaky dam, reconnection of dry historic channels to the river, and the creation of scrapes to slow and store water.

In October that same year, Storm Babet hit the UK, bringing with it intense rainfall to the south east of England, and high volumes of surface water runoff. The NFM interventions implemented by the project diverted water onto the floodplain where it could be stored and released gradually, reducing the flood peak. There have been seven named storms since Babet, and the interventions continue to have an effect with no flooding being reported in Gissing.

**Box 4:** Gissing natural flood management project<sup>54, 55</sup>

Launched in 2023, the two-year RSA Insurance and Gloucestershire Wildlife Trust partnership looks to implement an extensive NFM programme to reduce flood risk across Cheltenham and Gloucester, which RSA Insurance identified as two areas that have some of the most acute flood risk, based on extensive data analysis. The programme will showcase the use of NFM in reducing flood risk to Cheltenham and Gloucester, develop a network of connected green spaces across the area, and install urban green infrastructure to reduce surface water flooding and support urban wildlife. The initial investment from RSA Insurance will be £400,000.

<sup>52</sup> <https://www.aviva.com/sustainability/aviva-and-wwf/>

<sup>53</sup> <https://www.rsainsurance.co.uk/news/press-releases/2023/rsa-building-resilience-in-partnership-with-gloucestershire-wildlife-trust/>

<sup>54</sup> <https://theriverstrust.org/about-us/news/new-funding-for-rivers-trusts-to-protect-communities-from-flooding>

<sup>55</sup> [https://norfolkriverstrust.org/naturalfloodmanagement\\_gissing/](https://norfolkriverstrust.org/naturalfloodmanagement_gissing/)

Other examples of projects being developed are looking to sell flood risk reduction or environmental co-benefits to the private sector. The Natural Environment Investment Readiness Fund (NEIRF), for example, provides grant funding of up to £100,000 to multi-stakeholder projects to help them develop financial and operational models for nature projects in England to a point where private investment can be attracted.<sup>56</sup> Of those projects currently funded through NEIRF, more than half are looking to develop revenue streams from the sale of reduced flood risk outcomes and other ecosystem services delivered through NFM.

In a review undertaken in 2023, the Ecosystems Knowledge Network surveyed over 170 place-based nature projects looking to attract private sector finance through the sale of ecosystem services. Of those projects, 43% reported that they are generating or plan to generate revenue from payments for reduced flood risk through NFM,<sup>57</sup> whereby private and public sector beneficiaries, or ‘buyers’, can pay for the delivery of flood risk reduction through NFM.

| Project name   | Ecosystem services   | Hectares | Project aims   | Properties with reduced flood risk (estimates) |
|--|--|----------|--|--|
| <b>Wyre Natural Flood Management Project (Active)</b>                | Flood risk reduction   | 70       | 5% reduction in peak flood flow in a 2% AEP flood event                        | 120  |
| <b>Resilient Glenderamackin (Proposed)</b>                           | Planned sale of flood risk reduction, water quality improvement, biodiversity uplift, and carbon sequestration | 14,200   | Reduce peak flood flow by 10% in a present-day 1-in-30 year event              | Not available                                  |
| <b>Aire Resilience Company (Proposed)</b>                            | Planned sale of flood risk reduction   | 1,775    | Reduce peak flow in the Aire river into Leeds by a minimum of 5% in a 0.5% AEP | Not available                                  |
| <b>Spains Hall Estate Whole Farm Reservoir (Active)<sup>58</sup></b> | Biodiversity Net Gain units and voluntary biodiversity credits, planned sale of flood and water credits        | 500      | 15-30% reduction in peak flow and 5-10% increase in low summer flows           | 18   |

**Table 8:** Examples of NFM projects attracting private sector capital

These projects are innovative examples of bringing the public, private and third sectors together, to crowd in private sector capital to scale delivery of NFM across the country and at varying geographical scales. However, these projects will only work if there are enough ecosystem service buyers and if the public sector is willing to share co-benefits with private buyers. There needs to be a clear apportionment of NFM and co-benefits in all flood schemes to generate a sufficient level of demand from the private sector for flood risk reduction outcomes and associated co-benefits generated by NFM projects.

At present, there is currently insufficient demand from the private sector for the benefits outlined above. This lack of demand is reducing the number of potential buyers of reduced flood risk and co-benefits, meaning many projects cannot reach financial viability.

<sup>56</sup> <https://www.greenfinanceinstitute.com/gfihive/neirf/>

<sup>57</sup> Ecosystem Knowledge Network, 2023. Nature Finance Review. An Inaugural Review of the UK’s Project Pipeline.

<sup>58</sup> <https://www.spainshallestate.co.uk/water>

# Potential drivers for private sector co-investment into NFM projects

There are a number of potential drivers that could encourage the private sector to act as buyers of reduced flood risk provided through NFM projects. However, questions remain as to how effective these potential drivers are at securing funding from the private sector.

## Avoided costs

Some private sector entities will have assets in the landscape that may be at risk of flooding, and businesses can ascribe expected damages to their assets due to flooding. If the reduction in peak flood flow generated by an NFM project can be quantified, this can then be given a monetary value depending on the business. In the case of rail operators, for example, flooding costs the network operators a certain amount due to delays and cancellations over a given period. A reduction in the flood peak can therefore reduce the amount of time that the network is flooded and would ensure that operators can keep providing the level of service required and continue to generate revenue. If the cost associated with any deterioration in service due to flooding is more than the required funding from the business for the NFM project, then this could be a cost-effective way of reducing flood risk. In some instances, commercial property owners may be able to save money on surface water drainage charges, if they implement nature-based water attenuation and drainage features on their properties [see IGNITION case study].

Flooding costs local economies millions of pounds each year. In the Boxing Day floods of 2015, in Leeds alone the economic costs alone were estimated at £500 million. The costs for businesses and their supply chains were estimated to be almost £120 million for small and medium enterprises (SMEs). This does not include longer-term impacts such as the permanent loss of businesses and employment, and so the impact is likely to be much worse.<sup>59</sup>

Businesses that do not suffer direct flood damages can still suffer economic losses due to the wider impacts of flooding. For example, travel difficulties for employees and lost staff time due to employees coping with flood-damaged homes, have been highlighted as major factors affecting business continuity by SMEs.<sup>60</sup> Contributing to NFM projects within their regions, can enable local businesses to help build resilience to the increased likelihood of flooding due to climate change, and reduce future costs in an efficient manner.

## Co-benefits

As mentioned, NFM can deliver a host of other environmental and social co-benefits alongside flood risk reduction. Some businesses may not be directly interested in reducing flood risk through NFM. However, these businesses may be interested in securing the delivery of these wider co-benefits. For example, wetlands and woodlands are efficient at sequestering carbon, and local NFM projects could provide an opportunity for businesses to offset their residual carbon emissions locally.

The pollution removal and biodiversity improvement capabilities of some NFM interventions, such as wetlands, can also provide an access point for private sector organisations looking to reach nutrient neutrality. All of the above depend on the ability to stack ecosystem services together from a single project, and this is discussed in more detail later in this report. Demand for offsets and risk reduction generated by NFM projects could therefore become a valuable tool for corporate disclosure compliance.

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<sup>59</sup> West Yorkshire Combined Authority. Leeds City Region Flood Review Report. 2016

<sup>60</sup> Wedawatta, G., Ingirige, B. and Proverbs, D. (2014), SMEs and flood impacts. *J. Flood Risk Manage*, 7: 42-53. <https://doi.org/10.1111/jfr3.12031>

**Sustainability disclosures, ESG and CSR**

The Taskforce for Nature-related Financial Disclosures (TNFD) has developed a voluntary disclosure framework for corporates and financial institutions to assess their impacts and dependencies on nature. Businesses are encouraged to assess the value of flood mitigation to their operations as part of the TNFD's Locate-Evaluate-Assess-Prepare (LEAP) assessment. By encouraging organisations to integrate nature into their decision-making and supporting a shift in financial flows away from nature-negative outcomes towards nature-positive outcomes, the TNFD aims to improve greater awareness of NFM solutions from corporates and investors.

NFM projects can deliver a host of wider social and environmental co-benefits that can make them attractive to businesses looking to put ESG and CSR funding to work. For example, an NFM project may increase resilience to flooding for a community, and if that project is located within the urban environment, it could create wider access to natural spaces for the community if publicly accessible, which can lead to improvements in mental health and wellbeing. The Wildfowl and Wetland Trust's Blue Prescribing Project aims to improve mental health through participation of the local community in wetland-based group activities. In its pilot phase in Steart Marshes, 70% of participants experienced reduced anxiety.<sup>61</sup>

**Investment for financial return**

NFM is an emerging asset class, and there is only one example within the UK of an NFM project that has attracted upfront private investment and is expected to generate revenue streams to repay the investment plus interest [see [Wyre NFM Case Study](#)]. However, NFM projects that can successfully secure revenue streams through the sale of a stack of ecosystem services, can be designed as such to attract upfront repayable investment capital.

**Regulatory drivers**

Regulation can be a powerful driver for the private sector to implement environmental improvements. For example, mandating Sustainable Drainage Systems (SuDS) for new building developments will mean that novel methods for reducing urban surface water flooding, such as wetlands and rain gardens, will need to form part of the drainage plans before development can begin.

The UK water sector is required by regulation to minimise the number of combined sewer overflow incidents – whereby the sewer network is inundated with surface water that the system cannot handle, and so it is discharged along with raw sewerage into rivers and seas. Infrastructure upgrades to cope with increased storm water are costly, disruptive, and carbon intensive. Identifying the flood risk reduction and other co-benefits generated from NFM projects can highlight cost-effective opportunities for the water sector to reduce the number of combined sewer overflow incidents and adhere to regulation.

Water companies also face penalties from the EA for over-abstracting from water sources to provide drinking water. Improving the water holding capacity of the land through NFM techniques could reduce the risk of over abstraction and associated penalties for water companies.

Biodiversity Net Gain (BNG) is a mandatory approach to development that applies to property developers. BNG aims to ensure that a development project will result in at least a 10% net gain in natural habitat or quality of habitat compared with pre-development. A number of NFM interventions can deliver biodiversity improvements. By mandating BNG for developers in England, increased delivery of NFM interventions for biodiversity improvements may occur, and therefore flood risk reduction as a co-benefit.

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<sup>61</sup> M.E.L Research. Social Return on Investment (SROI) evaluation of Blue Prescribing at WWT Steart Marshes.

# The role of ecosystem service buyers in NFM projects

As discussed, NFM projects need to secure sufficient funding to cover both the capital and revenue costs to make the project financially viable. If all funding cannot be sourced from philanthropic and central government sources, projects experience a funding gap that needs to be filled from alternative sources, including from the private sector. As mentioned, there may be beneficiaries of flood risk reduction or environmental co-benefits from NFM within the private sector, which may be willing to pay. In this report, these beneficiaries will be referred to as 'buyers'.

Potential buyers can include those organisations willing to pay for reduced flood risk to their assets or supply chains, or for the wider environmental co-benefits generated as part of an NFM project. This reduction in flood risk can be measured as a percentage reduction in peak flood flow and can be used to estimate the potential avoided damage costs to their assets, or the potential savings that could be made if flooding was less severe. This financial estimation can therefore open up potential sources of funding for an NFM project to cover shortfalls in government funding.

Examples of projects where this approach is being trialled, include the Wyre River Natural Flood Management Project, Spains Hall Estate, the IGNITION project and the Aire Resilience Company (details of these can be found in the [Case Study](#) section).



These buyers can form part of what is known as a buyer group, or buyer consortium – a group of organisations which all have an interest in purchasing one or more ecosystem services generated by an NFM project. A selection of potential buyers of reduced flood risk are highlighted below.

| Potential buyers of flood risk reduction | Drivers to reduce flood risk   |
|--|--|
| <b>Real estate developers</b>            | Reducing flood risk in an area to allow for potential residential and commercial property development.   |
| <b>Commercial property owners</b>        | Increase in land value through reduced flood risk, lower insurance costs and/or exposure to potential damages, and green space amenity improvement.  |
| <b>Water companies</b>                   | Increased biodiversity; carbon sequestration; access to green spaces; improved community amenity value. Avoided costs of damages caused by flooding to water treatment plants; Avoided financial and reputational costs associated with flooding of combined sewer overflows (CSOs); Water Industry National Environment Programme drivers; and CSR drivers. |
| <b>Power companies</b>                   | Reduced damages to energy infrastructure.<br>Reduced compensation claims for power outages from customers.   |
| <b>Rail and road operators</b>           | Reduce damages to road and rail infrastructure, reduced impact on service levels and associated costs.   |
| <b>Mortgage providers</b>                | Reduce flood risk to their asset book, increased mortgage affordability.   |
| <b>Local businesses</b>                  | Reduce risk of flooding, increase community resilience, reduce disruption to business and employees.   |
| <b>Agrifood sector</b>                   | Increase supply chain resilience, reduce the frequency of flooding on supplier farms.  |
| <b>Tourism sector</b>                    | Increased bathing water quality during summer rainfall events.   |

**Table 9:** Examples of potential buyers of reduced flood risk generated by NFM projects, and their drivers to potentially fund flood risk reduction)

Each of these buyers will be impacted differently by flooding and so the value of NFM, and likely contributions to projects is likely to vary. For example, in the winter storms of 2013/14 damages to infrastructure and compensation claims from power outages caused by flooding cost utility companies between £630,000 and £1 million.

During the same period, the costs associated with direct damage to rail infrastructure was ~£22 million and the associated compensation payments to network operators and revenue losses amounted to ~£36 million.<sup>62</sup> This presents a challenge when identifying how much each buyer should pay when contributing to these projects, as the value of flood risk reduction varies for each buyer depending on circumstances.<sup>63</sup> Added to this are beneficiaries who benefit indirectly from flood risk management projects, such as property developers and property owners who may benefit from increased development potential and/or property and land prices.

Depending on the structure of a deal, buyers can pay for upfront capital interventions, and/or operational expenses such as maintenance and monitoring. In some instances, however, buyers may pay only once the reduced risk or environmental benefit is delivered.

In this case, upfront investment is required. This investment, however, will only be unlocked, if there are contracts in place with buyers who ultimately will create the revenue streams to repay the interest and investment through their final purchase of the risk reduction or credits. [see **Wyre River Natural Flood Management Project** case study].<sup>64, 65</sup>

An alternative model to channel private sector funding into NFM projects is that another ecosystem service is used as the primary (or anchor) saleable commodity, such as BNG units. This means that individual landowners or projects can generate sufficient revenue from developers to deliver the NFM as part of a wider nature recovery project, with flood risk reduction delivered as a co-benefit rather than as the primary benefit. This has the advantage of lower transaction costs, local support, simplified contracting structures and regulatory underpinning.

Which model is most suitable will depend on the specific circumstances and geography of the project.

Multiple stakeholders, payments, contracts and the overall delivery of the project will need to be managed centrally for those NFM projects attracting private sector capital. These projects may require a suitable legal structure to act as an intermediary vehicle, or Special Purpose Vehicle (SPV), to mitigate any financial or legal risks to any one organisation. This can be in the form of a Community Interest Company (for example). This removes the risk of any one stakeholder needing to repay investment in the case of losses.

### Community Interest Company

Community Interest Companies (CICs) were first established in the UK in 2005. They are a type of limited company that trades with a social purpose or carries out other activities for the benefit of a community but with the ability to pay out dividends within strict limits.

CICs are intended to use their assets, income and the majority of profits for the benefit of the community that they are formed to serve. They therefore have a number of additional features compared to a traditional limited company, including being subject to an 'asset lock' that ensures assets are retained within the company to support its activities or otherwise used to benefit the community. However, in contrast to a charitable organisation they can borrow and do offer the potential to issue repayments to investors. Case studies on the use of this structure can be found in the Appendix of this report.

#### Box 5: Partnership funding.<sup>66</sup>

<sup>62</sup> Environment Agency, 2016. The costs and impacts of the winter 2013 to 2014 floods.

<sup>63</sup> Green Alliance and National Trust, 2016. New markets for land and nature. How Natural Infrastructure Schemes could pay for a better environment.

<sup>64</sup> <https://therivertrust.org/our-work/our-projects/wyre-nfm-investment-readiness-project>

<sup>65</sup> <https://www.greenfinanceinstitute.com/gfihive/case-studies/the-wyre-river-natural-flood-management-project/>

<sup>66</sup> Green Finance Institute, March 2023. Financing a Farming Transition.

# The importance of co-benefits in attracting private sector buyers

In some instances, the benefits provided by reduced flood risk from NFM projects alone, may be insufficient to attract enough private sector buyers to make a project financially viable. However, buyers may be willing to pay for the wider co-benefits generated by NFM projects, depending on organisational drivers. These co-benefits can be worth more than the flood risk benefits alone, and can include biodiversity uplift, water resources, carbon sequestration and/or water quality improvements from tree planting and wetland creation (for example).

Work undertaken by the Natural Environment Research Council (NERC) on their Natural Flood Management Research Programme has found that, in some instances, the average annual flood risk reduction over a 50-year period would give per hectare benefits of only £200 per year. Whereas, across all the projects within the programme, the carbon and biodiversity benefits were valued between £2,630 and £6,390 per hectare per year.<sup>67</sup> These benefits however are greatly dependent on geography, the number and type of beneficiaries in the area, and the value of flood risk reduction to each of those beneficiaries.

**The wider environmental co-benefits generated by NFM projects can deliver a higher value than flood risk reduction alone.**



As the NFM market is relatively nascent, there are relatively few buyers of NFM ecosystem services. Therefore, government funding is required to support project delivery. Over time, as more benefits of NFM become monetisable, it is expected that the funding requirement from government and philanthropic sources will reduce as the private sector is able to pay for a greater proportion of the outcomes. However, there are a number of key barriers that need to be removed in order to get to this stage.

<sup>67</sup> Green Alliance, 2023. Going with the flow. Policy implications of new natural flood management research.

# Key Barriers



# Key Barriers

Generating sufficient demand for NFM outcomes and for associated co-benefits from the private sector was identified as a significant obstacle to developing sufficient revenue streams. Throughout our engagement with stakeholders, several key barriers preventing demand from the private sector were identified.

These barriers fall into three overarching categories:

1. **Confidence**
2. **Co-Benefits**
3. **Coordination**

## Confidence

Despite the growing evidence base for NFM as a flood risk management tool, it involves an increased level of hydrological complexity compared to traditional approaches to flood risk management. As such, there are several barriers that result in an overall lack of confidence in NFM, reducing demand for flood risk outcomes from NFM, and these are discussed below.



**Figure 5:** Confidence barriers.

## 1. Insufficient data and evidence

Evidence of the impacts of NFM on individual businesses and properties remains low.<sup>68</sup> When compared to traditional flood risk infrastructure, natural flood management interventions are still relatively new and untested ideas. Knowledge of their benefits, including for businesses, remains low.

Current approaches to assessing interventions to reduce flood risk, are based on properties protected during a certain level of flood event – for example in a one in 50-year event. Traditional flood risk infrastructure can provide this level of certainty. However, this process does not encourage the assessment of many smaller, incremental interventions that deliver an overall reduction in flood risk – such as NFM techniques. These incremental interventions may not stop flooding on their own, but they do reduce flood risk and a cumulative effect can be realised by implementing multiple solutions at scale across a landscape. This is where NFM provides value, but the assessment of flood risk using properties protected is inhibiting the wider uptake of NFM.

NFM contains many different specific interventions and measures, such as tree planting, improved soil and land management, reconnecting rivers to their floodplains, and leaky dams. The impact of NFM on reducing risk is highly dependent on what interventions are implemented, where those interventions take place, and in what density. To effect catchment-wide change in overall flood risk, a sufficiently large set of aligned interventions are required at a catchment scale.<sup>69</sup>

The publication of the EA's Working with Natural Processes (WWNP) evidence directory in 2017 brought together findings from literature reviews and more than 60 NFM case studies. This is set to be updated in 2024.

Key messages from the project include:

1. NFM is better suited to lower intensity, higher frequency floods in small to medium catchments, rather than to the larger, 1 in 200-year events.
2. NFM complements rather than replaces existing traditional flood risk infrastructure. By delaying and reducing the maximum flood peak, NFM can enhance the efficacy of traditional flood infrastructure.
3. NFM can generate multiple environmental benefits including carbon storage, biodiversity uplift and water quality improvements, among others.<sup>70</sup>

Many NFM interventions may be implemented some distance away from the main river channels and populated centres. There are many variables that can affect the flow of water between the upper catchments, and populated centres downstream. Consequently, calculating the reduction in risk generated by an NFM project for a single property or business, and constructing the business case for the beneficiary to co-fund such a project, becomes complicated, bespoke, and expensive.

This complexity creates a challenge for engaging with potential buyers of flood risk reduction, who require knowledge of how the NFM project will impact their risk of flooding, to assess the business co-funding these projects. In the Wyre River Natural Flood Management Project, for example, the baseline modelling for flood risk reduction outcomes took nearly a year to complete.<sup>71</sup>

Not having easy access to this information during project development hinders project developers' ability to make the case for investment in these projects from the private sector. This results in a lack of confidence and engagement from potential buyers, as the benefits and reasons for committing funding for NFM projects remain unclear.

There is also a very limited track record of investable propositions for potential investors to assess the risk-return profile of a project or group of projects for those NFM projects that require upfront financing or investment.

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<sup>68</sup> Chappell, N.A. and Beven, K.J. 2024. Nature-based Solutions for effective flood mitigation: potential design criteria. Environmental Research Letters, invited, forthcoming.

<sup>69</sup> Chappell et al, 2023. Illustrating the value of presenting NERC NFM programme findings as effective volumes at flood peaks, flood damages avoided and learning on soil as an NFM tool. NERC.

<sup>70</sup> CIWEM, October 2022. Natural Flood Management. Policy Position Statement

<sup>71</sup> The Green Finance Institute, 2023. Investment Readiness Toolkit – baselining and estimating ecosystem services – the Wyre River Natural Flood Management Project case study

## **2. No nationally accepted design standards**

There is currently no nationally adopted standard or overarching design and maintenance guidance or principles that NFM projects can follow to ensure continued delivery of flood risk reduction. This results in a lack of confidence from potential buyers or investors, reducing demand for NFM outcomes from the private sector.

Despite availability of best practice approaches to NFM and most funding schemes requiring adherence to these, there is no 'one' approach which means investors, for example, are unable to apply standard MRV processes across a portfolio of projects for impact reporting.

The lack of standards also creates reputational and legal risks for investors, buyers, and sellers when considering whether to engage with projects. For example, there is currently no way of ensuring that the flood risk benefit created by NFM interventions on one part of a farm, are not negated by changing land use elsewhere within the same farm holding. Such changes to the wider farm management can more than negate the value of what the NFM investment has sought to realise for flood risk reduction.

There is also no overarching guidance on standardised monitoring requirements for NFM projects, to ensure all projects are delivering the ecosystem services as agreed, and to identify if any adaptive management is needed. This risk is further complicated by a lack of clarity around maintenance responsibilities, and risks and liabilities created by implementing some NFM techniques. Some NFM interventions can introduce additional risk and liability and require future management interventions if they are to remain safe. At the moment, there is no overarching guidance on who holds the additional risk of failure (for example) and who is liable in the event of such a failure. This lack of certainty can prevent the widespread adoption of NFM techniques on farms.

There is currently no country-wide system whereby NFM assets are both recorded and inspected on a defined schedule. Authorities therefore do not have a complete overview of all NFM assets in the ground including delivery schedules, types of intervention, storage volumes and maintenance schedules. This lack of information hinders private sector buyers and investors, who need to know what interventions have been funded and how and when those assets are being maintained.

A lack of clarity around certain features required by cross compliance, such as uncultivated field margins around waterbodies, is also creating uncertainty around the regulatory baseline that land managers must meet, above which payments can be received from alternative sources, including the private sector.

## **3. Lack of clear government guidance**

A lack of a government-endorsed, strategic, country-wide prioritisation of NFM potential that considers the wider environmental, social, and economic priorities in a region, undermines the confidence of the private sector in purchasing ecosystem services generated by NFM projects.

Private sector buyers will want to know that the projects they are co-funding are delivering maximum benefits and are aligned with wider local and national priorities. Understanding where NFM fits within these local and national priorities would give the private sector confidence that their contributions align with broader regional targets.

For example, the current lack of a land use framework, laying out where land use in a region can be optimised to provide multiple benefits, may be preventing the private sector from committing to co-funding NFM projects due to uncertainty about local and national priorities.

A number of challenges exist when trying to attract private sector buyers of ecosystem services to build resilience. These are:

- a. A lack of a clear and explicit definition of resilience by the UK Government.
- b. A lack of a framework for measuring or assessing resilience.
- c. A lack of an overall UK-wide target or clear goal for resilience within regulation, standards, and policy.<sup>72</sup>

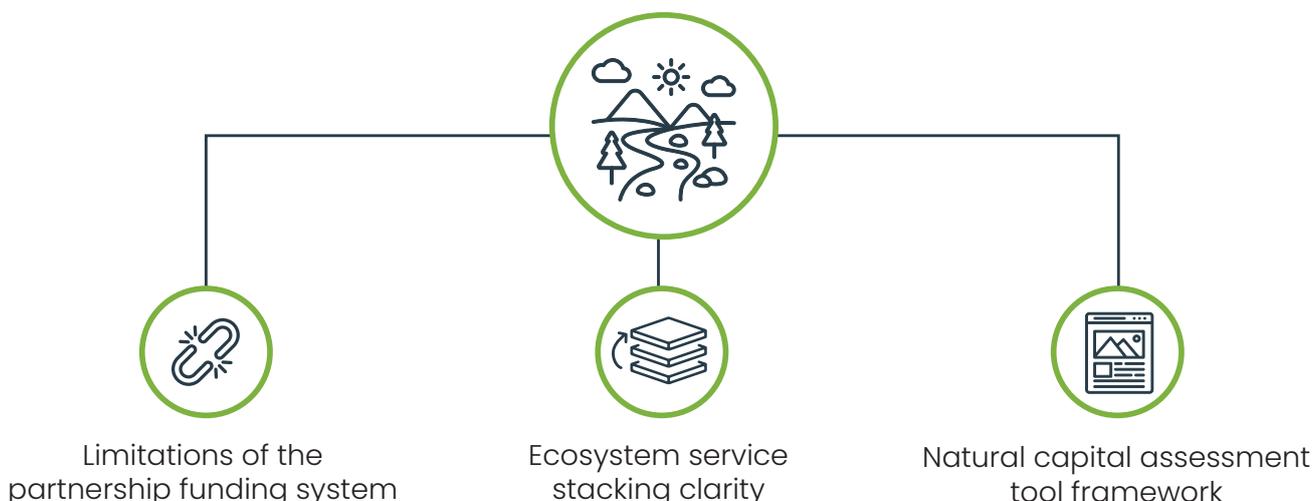
Taken together, the above are all preventing the private sector from deploying capital into NFM projects (and into NbS more broadly) as buyers of ecosystem services.

## Co-Benefits

As highlighted previously, flood risk alone may not be sufficient to secure the required financing from public or private sources to deliver an NFM project. Therefore, to increase demand, it is crucial that co-benefits generated by these projects are available for sale to a wide range of potential buyers, to secure the required revenue streams for financial viability. Equally, it is important that environmental projects where flood risk reduction is not the primary driver, but nevertheless generate flood risk outcomes, are also visible to the private sector.

Co-benefits of NFM have been found in some instances, to be considerably more valuable than the flood risk reduction benefits alone, as discussed in previously.

However, there are a number of barriers that are preventing the value of these environmental co-benefits from being realised by private sector buyers, reducing the potential demand for NFM projects.



**Figure 6:** Co-benefits barriers.

<sup>72</sup> National Audit Office, 2023. Resilience to Flooding.



## 1. Limitations of the Partnership Funding system

The current environmental assessment framework included in the Grant-in-Aid process, does not allow for the creation of readily available credits or units which potential buyers would be interested in purchasing to meet regulatory or voluntary requirements.

Within the EA's Flood Defence Grant-in-Aid (FDGiA) partnership funding programme, co-benefits are bundled into NFM projects rather than sold separately as either carbon credits or BNG units, for example. This limits the number of potential private sector buyers who may be directly benefiting from the flood risk reduction outcomes generated by projects, reducing the private revenue streams that could help pay for a project. This has the knock-on effect of continuing or increasing the reliance on public sector funding.

Through the Grant-in-aid process, potential NFM projects can secure a certain amount of grant funding from the EA based on the benefits that those projects will deliver. This is dictated by Outcome Measures within the partnership funding calculator. A description of the Outcome Measures can be found in **Table 10** below. The more benefits that a potential project can show, the greater amount of funding can be received from the EA.

| <b>Category</b>                   | <b>Outcome Measure</b> | <b>Description</b>   |
|-----------------------------------|------------------------|--|
| <b>Economic benefits</b>          | OM1                    | The average benefit cost ratio across the capital programme based upon the present value whole life costs and benefits of projects delivering in the Government spending review period.                                |
| <b>Households at flood risk</b>   | OM2                    | The number of households moved out of any flood probability category to a lower category.  |
|                                   | OM2b                   | The number of households for which the probability of flooding is reduced from the very significant or significant category to the moderate or low category.   |
|                                   | OM2c                   | The number of households in the 20% most deprived areas moved from the very significant or significant flood probability category to the moderate or low category.   |
| <b>Households at erosion risk</b> | OM3                    | The number of households better protected from coastal erosion.  |
|                                   | OM3b                   | The number of households protected against loss from coastal erosion in a 20-year period.  |
|                                   | OM3c                   | Number of households in the 20% most deprived areas protected against loss from coastal erosion in a 20-year period.   |
| <b>Water dependant habitat</b>    | OM4a                   | Area (in hectares) of intertidal habitat created to help meet the objectives of the EU Habitats/Birds Directives, Section 28 of the Wildlife & Countryside Act 1981, and the England Biodiversity Strategy             |
| <b>Intertidal habitat</b>         | OM4b                   | Area (in hectares) of intertidal habitat created to help meet the objectives of the EU Habitats/Birds Directives, Section 28 of the Wildlife & Countryside Act 1981, and the England Biodiversity Strategy             |
| <b>Protected rivers</b>           | OM4c                   | Length (in kilometres) of rivers protected under the EU Habitat Directive, EU Birds Directive or Section 28 of the Wildlife and Countryside Act 1981 improved to meet the objectives of the Water Framework Directive. |

**Table 10:** Definitions of FCERM Grant-in-Aid Outcomes Measures

The current FCERM funding framework is not structurally set up to allow the private sector to purchase specific environmental units or credits generated by co-funded FCERM NFM projects. The aim of Outcome Measure 4 (OM4) is to encourage flood risk management projects to, not only reduce flood risk, but to also deliver additional environment benefits. The method for valuing and assessing the co-benefits within OM4 is generalised and simplified<sup>73</sup> when compared to the valuation of environmental credits. The values given for these co-benefits are insufficient to meet the cost-benefit ratio required for partnership funding and as such, NFM projects struggle to secure partnership funding reducing the chance of reaching financial viability.

The environmental outcomes valued for government funding within OM4 in their current form do not translate into any recognisable tradeable commodities that the private sector would be incentivised to spend against – such as carbon credits or Biodiversity Net Gain units.

## 2. Ecosystem service stacking clarity

There is currently a lack of clarity provided by government around the stacking of flood risk reduction through NFM with other ecosystem services. This is stifling potential demand for the multiple ecosystem services created by NFM projects, from private sector entities who may be willing to pay for wider environmental outcomes.

Stacking is the process of valuing multiple different ecosystem services produced by the same activities on a piece of land and selling those benefits as separate outcomes, often through units or credits.<sup>74</sup> For example, the planting of a new native woodland will have carbon, biodiversity and possibly water quality benefits, in addition to flood risk reduction. In the UK, ecosystem markets are usually based on payments for these individual benefits, also known as ‘outcomes’. Demand for these individual outcomes is usually driven by regulatory or voluntary markets – for example, BNG, or the Woodland Carbon Code.<sup>75</sup> Stacking allows prices to be set individually for each ecosystem service, allowing these to be priced and sold individually to beneficiaries who may only have requirements for part or all of one or more of those benefits.<sup>76</sup>

Additionality (see **Box 5**) in public funding presents further complexity. The allocation of government funding is usually assessed on the actions taken, such as planting a woodland, and does not take into account the range of outcomes that tree planting can create. Justifying the added value for the co-benefits associated with this tree planting therefore becomes challenging.

While stacking is seen as important to expanding the potential buyers of ecosystem services, and is allowed in mandatory ecosystem service markets, existing voluntary ecosystem service markets do not currently permit this practice. This is due to challenges with being able to demonstrate actions or input-based additionality, as the other ecosystem services are assumed to be included in the unit price.

In the Woodland Carbon Code and the Peatland Code, for example, carbon sequestration is the primary ecosystem service sold. Other ecosystem services will inevitably be created by the actions taken, including flood risk reduction. However, these ecosystem services are bundled within the price for the carbon credit issued.<sup>77</sup> This is known as implicit bundling of ecosystem services.

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<sup>73</sup> Mott Macdonald, September 2020. Integrating natural capital into flood risk management appraisal.

<sup>74</sup> IEMA. Stacking and bundling in the finance of nature markets

<sup>75</sup> Defra, 2022

<sup>76</sup> Defra, 2022

<sup>77</sup> <https://woodlandcarboncode.org.uk/standard-and-guidance/1-eligibility/1-6-additionality>

Stacking an ecosystem service such as flood risk reduction alongside carbon sequestration in the form of a Woodland Carbon Unit, may result in one outcome being paid for twice, as the flood risk reduction would have already been included in the price of the Woodland Carbon Unit.

Guidance has been provided by Defra and Natural England confirming that BNG units can be sold alongside nutrient credits (both regulatory markets) generated from the same piece of land<sup>78</sup> so long as subsequent habitat improvement is delivered on top of an initial activity, and it does not negatively impact on the original project objective.<sup>79</sup> However, a similar position has not been confirmed for any non-flood risk co-benefits from NFM, and vice-versa (flood risk reduction benefits for non-flood risk BNG projects).

This lack of clarity on stacking NFM outcomes with other units or credits, and its implications for meeting additionality rules, is undermining confidence in the credibility of claims made by NFM projects about additionality.<sup>80</sup> This is suppressing potential demand for NFM outcomes from ecosystem service buyers.

### Additionality

**Legal Additionality:** Projects cannot issue credits where the activity generating the ecosystem services is being carried out to comply with an existing regulatory obligation on the part of the landowner. For example, if a land manager has been issued a re-stocking notice and plants a woodland, the same woodland cannot be used to create BNG units in the compliance market.

**Financial Additionality:** Projects can only issue ecosystem service credits if the income from selling these credits is required to make the projects financially viable.

**Box 6:** Definitions of legal and financial additionality.<sup>81</sup>

### 3. Natural capital assessment tool framework

A lack of a common framework for natural capital assessment of FCERM schemes, means that potential buyers or investors in NFM projects cannot compare projects across a portfolio, for example, to assess all natural capital benefits generated.

A natural capital assessment of a planned NFM project is often required, to assess and value the wider environmental and social benefits (and potential dis-benefits) that the planned project could create. While there are multiple natural capital assessment tools available for project developers to use, there is no consistent framework to which these tools are required to adhere when assessing and valuing natural capital stocks and associated ecosystem services.

A lack of a framework for natural capital assessment tools means that buyers and investors cannot compare across NFM projects, as benefits may have been calculated using various methods, and certain tools may not be suitable for certain location. Buyers and investors will want to know that what has been valued has been done so to a high standard, and in a way that is appropriate for the geography of the scheme (e.g., blue-green infrastructure in an urban environment vs. a rural NFM scheme).

<sup>78</sup> <https://www.gov.uk/guidance/combining-environmental-payments-biodiversity-net-gain-bng-and-nutrient-mitigation>

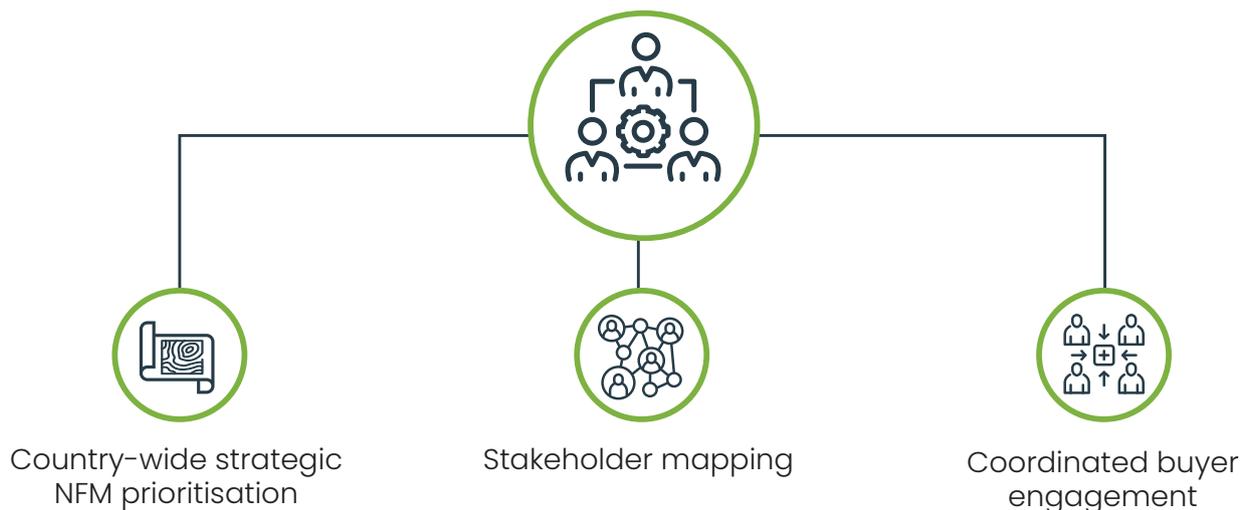
<sup>79</sup> HM Government, March 2023. Nature markets. A framework or scaling up private investment in nature recovery and sustainable farming.

<sup>80</sup> IEMA. Stacking and bundling in the finance of nature markets

<sup>81</sup> HM Government, March 2023. Nature markets. A framework or scaling up private investment in nature recovery and sustainable farming.

# Coordination

Scaling demand for NFM will require multiple beneficiaries, as covered above, thus requiring a coordinated approach. Many buyers of flood risk reduction and other environmental outcomes may be required to contribute to an NFM scheme in order to cover costs or to repay upfront finance (if applicable). Addressing this lack of coordination is imperative for increasing demand for NFM and several key challenges to achieving this were identified through engagement with key stakeholders.



**Figure 7:** Coordination barriers

## 1. Country-wide strategic NFM prioritisation

A lack of strategic oversight of NFM priorities across England reduces the confidence of potential buyers that NFM interventions they co-fund are delivered in areas to deliver the maximum possible benefit. With no strategic prioritisation, there is no baseline foundation set for the future delivery of NFM in the country, and no direction given for potential ecosystem service buyers.

For NFM projects to have an impact on larger flood events, they must be planned strategically, at a large scale, as NFM-only approaches as well as in combination with other more formal engineered solutions. However, there is currently no strategic oversight of NFM delivery across the country to ensure that NFM is delivered where it will create the maximum benefits alongside other competing priorities within a region. With no strategic prioritisation of NFM within a catchment or river system that considers the wider environmental, social and economic priorities, potential buyers and investors lack the confidence that the projects they fund will deliver the maximum benefit for flood risk reduction and wider outcomes.

There are many initiatives aimed at increasing the use of nature-based solutions to reduce flood risk across the landscape. These include Flood Risk Management Plans (FRMPs) drawn up by Lead Local Flood Authorities (LLFAs), Drainage Water Management Plans (DWMPs) and River Basin Management Plans (RBMPs) drawn up by other Risk Management Authorities (RMAs). However, there is currently no strategic link between these plans at a sufficient scale to provide prioritisation of potential NFM sites.

## 2. Stakeholder mapping

A lack of strategic oversight of the commercial drivers for potential buyers of the flood risk reduction and resultant co-benefits within a geography leads to increased time and costs for project developers, potentially leading to missed opportunities.

Mapping and engaging potential buyers can be a time-consuming and resource-heavy process. Establishing relationships between project developers and potential buyers requires considerable effort, particularly if the latter may lack awareness of the flood risk to their businesses or assets. If they are aware, they may not understand the potential risk reduction benefits of NFM or the other co-benefits. This challenge can be especially acute when developing projects in a largely rural location across a large area where there may be many small businesses that would require additional time and resources to engage.

## 3. Coordinated buyer engagement

A lack of a coordinated approach to engaging potential buyers of reduced flood risk within a region, results in increased time and financial costs for project developers, potentially resulting in missed opportunities to build demand.

Currently, project developers must identify flood risk reduction and co-benefits, and create business cases for potential beneficiaries on a bespoke, project-by-project, and buyer-by-buyer basis. Engaging multiple beneficiaries and stakeholders to increase buy-in for the project, is time consuming and costly, often due to the requirements for many face-to-face meetings.<sup>82</sup> This can result in many missed opportunities for funding, a general lack of engagement from the private sector, and a continued lack of awareness of the benefits of NFM to business within the private sector. This is especially true for rural catchments, where potential buyers of flood risk reduction outcomes could be spread across a large area and may consist of many small individual businesses.



<sup>82</sup> Environment Agency, 2019. Natural Flood Management Programme: Interim Lessons Learned.

# Key Enabling Solutions

# Key Enabling Solutions

Through stakeholder interviews, workshops and roundtable, the Working Group has identified several key enablers that could address the barriers identified to building private sector demand for NFM. This section sets out the Key Enablers providing further information on each and the barrier(s) that each Key Enabler is addressing.

1. Strategic prioritisation of NFM
2. NFM asset database
3. Natural capital assessment tool framework
4. Funding for buyer facilitation and partnership development
5. NFM design standards and guidance
6. Clarity on ecosystem service stacking
7. Update to FCERM grant-in-aid partnership funding processes



**Figure 8:** Key Enabling Solutions

# Enabling Solution 1:



## Strategic prioritisation of NFM

A UK Government endorsed, free and open-access mapping application identifying priority locations for NFM delivery for flood risk reduction, and where NFM can deliver wider co-benefits and to what level.

### Overview:

A single, openly accessible, unified representation of the NFM opportunities within England could allow project developers to easily identify NFM opportunities where maximum flood risk reduction and co-benefit generation can be achieved. This would allow project developers to engage with private sector beneficiaries more easily on NFM. Delivering to a coordinated plan potentially helps multiple smaller projects, including community-led NFM projects, deliver small, incremental improvements that combine over time to drive a greater cumulative impact on resilience.

A central government mandated NFM opportunity and prioritisation map is likely to give potential buyers and investors the confidence that funding NFM projects aligns with the overall FRM strategy for England, ensuring delivery of optimum flood risk benefits and environmental co-benefits through these projects. As flood risk reduction benefits are generated within priority areas, it may also be easier to monitor any increase in resiliency delivered by NFM.

This NFM prioritisation exercise could feed into the development of Local Nature Recovery Strategies (LNRs) by highlighting areas where actions such as wetland creation, peatland restoration and tree planting can be achieved through the delivery of natural flood management projects – delivering both flood risk reduction and wider environmental benefits in line with the LNRs guidance published by Defra. Prioritisation could be done in conjunction with stakeholder mapping undertaken by Responsible Authorities for the development of LNRs, that may highlight key counterparties with an interest in reducing flood risk and restoring nature.

Consideration should be given by Defra to mandating on-site monitoring of all government-funded NFM projects over the lifetime of payments, to ensure widespread evidence capture across the country. As the evidence base for NFM is developed further, the NFM prioritisation map can be regularly updated to ensure that the information given is as accurate as possible.

The EA is working to develop a Natural Flood Management benefits tool aimed providing a nationally consistent way of assessing flood risk and wider benefits of NFM projects. This will help the EA to focus on developing NFM projects in locations where they can have the greatest flood risk benefits. A prototype tool has been piloted and the EA are currently scoping out further development work to improve its functionality, with the ambition of making it available more widely to support the development of NFM projects. The high-level method and assumptions on which the tool is based are planned to be published in the near future.

It is important that alongside the development and trialling of this tool, private sector stakeholders are engaged in these processes, to further the understanding of how NFM may provide benefits for different organisations.

Prioritisation should be able to highlight opportunities for NFM to increase the longevity of traditional flood infrastructure. Making these opportunities known could further the use and delivery of NFM across catchments and would increase widespread confidence in NFM as part of a holistic approach to flood risk management.

There are examples of NFM mapping tools already in use, that could be built upon to develop an overall strategic prioritisation of NFM across the country. Some of these are highlighted below.

| <b>NFM Opportunity Maps</b>   | <b>Developer</b>                    | <b>Details</b>  |
|---|-------------------------------------|---|
| <b>Working With Natural Processes Evidence Directory Potential Maps</b> <sup>83</sup> | Environment Agency                  | A selection of interactive maps to show where different types of river and catchment management approaches have the potential to reduce flood risk by working with natural processes.   |
| <b>SCIMAP Flood</b> <sup>84</sup>   | SCIMAP                              | An online tool that aims to prioritise NFM interventions within a catchment to increase their effectiveness.  |
| <b>NFM Studio</b> <sup>85</sup>   | Environment Agency, Atkins          | A strategic tool that quantifies NFM effectiveness relative to runoff reductions at the field scale. It also values the potential natural capital benefits of interventions in Devon, Cornwall, and the Isles of Scilly areas. It is based on open-source data, industry standards and methods. |
| <b>Flood and Drought Research Infrastructure</b> <sup>86</sup>                        | UK Centre for Ecology and Hydrology | The FDRI will create digital infrastructure to make flood and drought information freely available, to inform management plans to reduce flood risk.  |
| <b>SD-TOPMODEL</b> <sup>87</sup>  | University of Leeds                 | A digital model to show the flow of water from hillslopes to river. Existing landscape features and changes to land management practices can be assessed for their ability to reduce flood risk, to help prioritise the siting of future NFM projects in Calder Valley.                         |

**Table 11:** Examples of NFM mapping applications currently in use

<sup>83</sup> Environment Agency: Mapping the potential for Working with Natural Processes – user guide.

<sup>84</sup> <https://scimap.org.uk/scimap-flood/>

<sup>85</sup> <https://storymaps.arcgis.com/stories/3065971ddb42079f63b950eed58f1e>

<sup>86</sup> <https://www.ceh.ac.uk/our-science/projects/floods-and-droughts-research-infrastructure-fdri>

<sup>87</sup> <https://icasp.org.uk/projects-2-2/calderdale-nfm-2/>

It is important to note that the EA will be publishing an update to the Working with Natural Processes Evidence Directory in the summer of 2024. This directory will provide policy makers and practitioners with access to information that explains the benefits of NFM measures and is a vital step in improving confidence in NFM's ability to deliver flood risk reduction.

**Barriers addressed:**

- Confidence
- Coordination

## Enabling Solution 2:

# Natural flood management asset database



An NFM asset database that records all natural flood management assets, projects, and projects within a geography with minimum asset and maintenance data collection requirements. Information held should include NFM asset and intervention type, location and condition, purpose of natural flood management asset and maintenance/adaptive management schedules and history.

**Overview:**

Providing an NFM asset database, similar to that which is provided for traditional flood risk infrastructure and held by the EA, Internal Drainage Boards, Councils and Defra, could give the private sector confidence that the NFM assets they have invested in, or are purchasing outcomes from, are accounted for and that there is a maintenance regime built in and recorded in a central location. It would also ensure that management actions that need to be repeated regularly or implemented as standard across farms, such as improved soil and land management techniques, are done so in accordance with agreements.

NFM assets could include for example: off-line ponds, leaky debris dams, riparian corridors, field parcels with improved management techniques, and areas of wet woodland (among others).

Having this database will allow buyers and investors to examine funded sites and to monitor at a site and portfolio level whether interventions have been implemented to specification as per any agreements, and that these sites are following a suitable maintenance regime to ensure continued ecosystem service delivery. This will give confidence that the NFM assets they have funded are being delivered, recorded accurately, and that regular maintenance records are being kept ensuring the assets continue to deliver the benefits that investors/buyers require. It would provide a constantly updated baseline of what NFM assets are within a region, removing the need to begin this assessment at the start of every project stage.

A single location where all natural flood management assets are registered could allow government to track the delivery of flood risk reduction more accurately and compare outcomes with the budget spent on those natural assets. It will allow RMAs to quickly react after a flood event and investigate how the natural flood assets reduced or exacerbated the flooding, encouraging adaptive management approaches.

There are already examples of natural asset databases and registers to build on, including the Biodiversity Net Gain register managed by Natural England. This register allows off-site units providers to list their sites and obligations centrally. Other examples include The NFM Hub as described in **Box 6** below.

### The NFM Hub

Developed by the Rivers Trust, the NFM Hub allows any civil society group to register an NFM asset and quantify the flood risk reduction through NFM, and the associated co-benefits that the asset delivers. The hub also allows the user to record how the asset is being adapted and maintained.

On the Hub, every 'asset' that is delivered can be assessed for its benefits to biodiversity, water quality, water resources etc. The Rivers Trust have designed the Hub so that it can underpin integrated catchment scale delivery of NFM for any of the multiple benefits that it will deliver. There are three main layers to the information held on the hub:

1. Project level. The user can estimate the marketable benefits of a collection of NbS assets. For example, BNG, Replenish, Carbon, and/or Nutrient Credits. They use published tools to quantify these benefits, which can then be sold. These benefits are then recorded in the Hub. Users are able to record the non-market estimates of multiple benefits from the B£ST tool. This quantifies benefits such as Health and Wellbeing and Education. The benefits can't be sold as there is no market for them currently, but they can be recorded as co-benefits of investment.
2. Asset level information: This is where information about the specific assets is stored, including what assets have been delivered, and where. Physical benefits are evaluated for water quality improvement, flood risk reduction, water resources, and habitat improvement, among others.
3. Maintenance & Adaptation: Information about the condition of the asset is stored here, alongside maintenance records to inform any adaptive management or maintenance that needs to occur.

**Box 7:** The Rivers Trust NFM Hub

### Considerations:

As good soil management, healthy terrestrial habitats and landscape features deliver a significant proportion of flood risk reduction, it is important that these features are recorded and captured on the database. This will require linking up with agri-environment projects which are the largest provider of flood risk reduction through nature-based processes via soil and land management grants.

Data protection considerations need to be made if farm-level information is being held and can be accessed by external parties. For example, having data widely available on leaky dams on specific farms and the maintenance requirements may lead to concern from private landowners and farmers.

For a central NFM asset database to be successful, it would need to be able to easily link up with flood risk asset registers that are currently set up for traditional infrastructure. It will also need to be able to reflect nature-based projects whose primary driver may not be flood risk reduction through NFM, but that deliver some flood risk reduction due to certain interventions. Otherwise, the complete flood risk impact of all natural assets cannot be assessed.

For the private sector to have increased confidence, it will need to be able to see any assets it has funded/co-funded. This will help build confidence within the private sector and will also help with reporting on progress to any environmental targets.

We recommend that an underlying data model and database be assessed for suitability by the EA, and if applicable, be rolled out nationally so that all stakeholders are recording information in a standardised format. This will ensure consistency when comparing NFM projects across geographies. Further considerations should be made on the ability for the private sector to view data within the NFM Hub (or similar) and if there are any data sharing implications.

### **Barriers addressed:**

- Confidence
- Coordination



## Enabling Solution 3:

# Natural capital assessment tool framework



We recommend that an assessment be undertaken of the natural capital valuation tools available for NFM projects, and the results of this assessment to be made publicly available. This assessment should be used to inform the creation of a natural capital assessment tool framework, and that framework to be mandated for every FCERM scheme application.

### Overview:

Highlighting the co-benefits generated by NFM projects is crucial for attracting a wide range of private sector buyers. By using natural capital assessment tools accredited under a high-integrity, government backed framework, opportunities can be highlighted to potential buyers in a standardised manner. This would increase the confidence of buyers that the appraisals of co-benefits have been done to a high standard and would ensure comparability across multiple NFM projects in different geographies.



There are many examples of natural capital assessment tools currently in circulation. Some examples of these tools are highlighted below.

| Natural Capital Assessment Tool   | Developer                                       | Description   |
|---|---|---|
| <b>BEST (Benefits Estimation Tool) (CIRIA, 2019)</b>  | CIRIA   | Estimates impacts and benefits of SuDS and NFM.<br>Assess and monetise many financial, social, and environmental benefits.<br>Identifies stakeholders and support investment decision making.   |
| <b>Green Infrastructure Valuation Toolkit (GI-Val) (Mersey Forest, 2011)</b>                              | The Mersey Forest                               | A set of calculator tools to assess the value of a green asset or a proposed green investment.<br>Benefits given an economic value alongside other quantitative contributions.  |
| <b>Environment Agency's Partnership Funding Calculator (Environment Agency, 2020). Outcome Measure 4.</b> | Environment Agency                              | A standardised and generalised method for appraising the multiple environmental benefits of a proposed FRM scheme.  |
| <b>Co\$ting Nature</b>  | King's College London, AmbioTEK, and UNE PWC MC | Web-based policy-support tool for natural capital accounting and analysis of the ecosystem services provided by nature.<br>Identifies opportunity costs to of protecting nature to produce ecosystem services vs land use alternatives.         |
| <b>Integrated Valuation of Ecosystem Services and Trade-offs (INVEST) software.</b>                       | Natural Capital Project                         | Software to map and value ecosystem services provided by land and seascapes.<br>Assesses how changes in ecosystems are likely to affect the flow of ecosystem services to beneficiaries, to inform decisions about natural resource management. |
| <b>HyrdoloGIS</b>   | Viridian Logic Ltd                              | Identifies, ranks, and prioritises the best interventions to create and where to locate them, to maximise the provision of NbS to local problems.   |

**Table 12:** A selection of natural capital assessment tools currently in circulation.<sup>88, 89</sup>

As can be seen from the above, these tools all assess natural capital differently, and may be more useful in certain geographies when compared to others.

<sup>88</sup> Mott Macdonald, September 2020. Integrating natural capital into flood risk management appraisal.

<sup>89</sup> Ecosystem Knowledge Network – Tool Assessor

A review should be undertaken to assess the extent to which commonly-used natural capital assessment tools diverge in their estimates of the value of natural capital and/or ecosystem service provision and identify sources of discrepancy between tools.

We recommend that the review follow a similar approach to that undertaken by the Harmonisation of Carbon Accounting Tools for Agriculture project undertaken by RSK ADAS on behalf of Defra (see Box 7).<sup>90</sup> Similar areas to be covered in the review of natural capital assessment tools could include:

1. Identifying the key differences between inputs and outputs for an appropriate number of natural capital assessment tools.
2. Identify key drivers that result in the differences in outputs.
3. Map out benefits and limitations of various methodologies used.
4. Assess tools for their applicability to flood risk management specifically.



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<sup>90</sup> Defra and RSK ADAS, June 2023. Harmonisation of Carbon Accounting Tools for Agriculture. Evidence Project Final Report.

### Harmonisation of Carbon Accounting Tools or Agriculture Project

Over eighty tools have been developed to quantify farm emissions, and there is considerable variation in the outputs of these tools. The aim of the Project was to identify how to ensure the quantification tools were robust in their calculations and consistent in their results. Six of the most commonly used tools in circulation, were included in this assessment.

Twenty model farms were created for the assessment, with two of each of the nine Defra farm types covering cereals, general cropping, horticulture, mixed, pigs, poultry, dairy, grazing livestock (less favoured area) and grazing livestock (lowland), plus two additional farms testing functionality around anaerobic digestion and agroforestry (silvopasture) in dairy systems. Each of these tools were applied to each of these farms, and the results analysed to assess discrepancies.

The results uncovered discrepancies between results produced from different types of farms. For example, for seven of the twenty farms, the highest emissions were more than twice as high as the lowest emissions reported. In some instances, the highest emission outputs were 3.5x higher than the lowest. These discrepancies highlight the importance of conducting such a review.

The report also made a number of recommendations to support this harmonisation:

1. Industry and government to define what a farm level assessment is, how it is going to be used, and what parts of the farm business should or should not be included.
2. Calculators should align with the requirements of the latest standards and guidance.
3. Calculator providers should regularly review and update their tools to account for changes in scientific knowledge, carbon accounting methodologies, and new emission factors.
4. Calculators should use emission factors from an agreed set of robust databases for embedded emissions in fertilisers, feeds and fuels.
5. Calculators ought to present outputs consistently and in compliance with the latest standards to help facilitate understanding of emission sources.
6. Calculator providers need to build user confidence through transparency and use third-party verification to ensure calculators align to minimum standards.

**Box 8:** Summary of the Harmonisation of Farm Carbon Accounting Tools project.<sup>91, 92</sup>

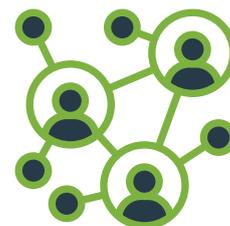
#### Barriers addressed:

- Confidence
- Co-Benefits

<sup>91</sup> Defra and RSK ADAS, June 2023. Harmonisation of Carbon Accounting Tools for Agriculture. Evidence Project Final Report.

<sup>92</sup> <https://adas.co.uk/news/harmonisation-of-carbon-accounting-tools-for-agriculture-report-published/>

## Enabling Solution 4:



# Funding for buyer facilitation & partnership development

Funding made available for the effective facilitation of buyer engagement to stimulate demand for flood risk outcomes and associated co-benefits generated by NFM projects.

### Overview:

Providing funding for NFM projects to focus on engaging potential buyers could increase demand for NFM from the private sector and therefore increase the likelihood of these projects securing sufficient revenue streams.

Currently, proactive engagement with the private sector outside of a few targeted industries, such as property developers and the water sector, is not happening at the scale required to increase demand sufficiently for NFM. Providing facilitatory funding for NFM projects to specifically highlight asset-level and operational interests (for example supply chain exposure to flood risk, or under TCFD & TNFD disclosures) could increase the number of private sector buyers willing to pay for reduced flood risk reduction and/or associated co-benefits generated by NFM projects. There are already examples of government funding projects, that could be used to help stimulate this proactive engagement with the wider private sector.

As highlighted previously, the Natural Environment Investment Readiness Fund (NEIRF) provides grant funding of up to £100,000 to multi-stakeholder projects to help them develop financial and operational models for nature projects in England to a point where private investment can be attracted.<sup>93</sup> So far, the NEIRF project is supporting 86 projects across England over two funding rounds. In December 2023, a third funding round was announced that focussed on supporting farmers in accessing nature markets and other means of accessing private finance for nature.<sup>94</sup> As previously mentioned, of the projects currently funded through NEIRF, more than half are looking to develop revenue streams from the sale of reduced flood risk outcomes and other ecosystem services delivered through NFM.

Providing funding to NFM projects as part of the NEIRF programme to increase buyer engagement would add an additional enabling layer to this existing mechanism and would remove a significant blocker to stimulating demand for NFM from the private sector. Funding could also be used for initial high-level modelling to outline the potential business case for private sector entities. This would allow project developers to calculate expected flood risk reduction outcomes of their projects more easily, and to begin to develop possible business cases for co-investment.

### Barriers addressed:

- Confidence
- Coordination

<sup>93</sup> <https://www.greenfinanceinstitute.com/gfihive/neirf/>

<sup>94</sup> ibid

# Enabling Solution 5:



## NFM standards or guidance

The Group recommends the development of a government-backed NFM design guidance that NFM projects can follow when implementing NFM techniques and maintaining NFM assets. Emphasis should be given to ensuring NFM projects are delivered to a high-level of integrity and, that benefits, dis-benefits and risks inherent in NFM projects, are assessed and mitigated against.

### Overview:

Providing a government-backed standard or set of design, monitoring and maintenance principles will instil confidence in the private sector that NFM projects have been delivered to a high standard, and that risks have been mitigated for. This will increase confidence for potential private sector buyers of flood risk reduction generated by NFM, as buyers will want to ensure that the ecosystem services paid for, will continue to be delivered into the future.

Ensuring NFM is designed and implemented to deliver value for money, with the lowest associated risks, and least ongoing liability and management requirements, will ensure NFM outcomes are implemented to a high standard, reducing any reputational risk that may occur in the event of a failure of the NFM interventions, or for those interventions to potentially increase flood risk to people and properties downstream. For example, while hedgerow creation may on its own reduce flood risk, if land management practices in part enabled by the NFM funded hedge change, such as an increase in grazing levels, this can lead to an increase in flood risk compared to the risk before the hedgerows were created.

The development of a set of government backed NFM principles and undertakings, will help inform the development of an NFM ecosystem market Standard or Code. The British Standards Institution (BSI) is currently undertaking a work programme to develop a set of overarching investment standards for nature markets, with the aim of driving the application of consistent principles and approaches to the quantification of ecosystem services,<sup>95</sup> including NFM.

As mentioned previously, there are multiple examples of best practice guidance for the delivery of NFM. A selection of guidance documents are included in the table below.

<sup>95</sup> <https://assets.publishing.service.gov.uk/media/642542ae60a35e000c0cb148/nature-markets.pdf>

| Best Practice Guide  | Publisher   | Details  |
|--|---|--|
| <b>CIRIA Natural Flood Management Manual</b> <sup>96</sup>   | CIRIA, Mott Macdonald, River Restoration Centre, Yorkshire Dales Rivers Trust, and The Rivers Trust | Overview of NFM, how to set up a project for success and choose appropriate NFM sites and measures.<br><br>Applies to inland NFM measures only.  |
| <b>UK Forestry Standard Practice Guide – Designing and managing forests and woodlands to reduce flood risk</b> <sup>97</sup> | Forestry Commission, Scottish Forestry, Natural Resources Wales, and Forest Service                 | Describes how to comply with the UKFS Good Forestry Practice Requirement to consider how forestry activities can reduce flood risk.<br><br>The Guide comprises five main sections covering: flood risk management; designing new forests and woodlands; forest and woodland management; interventions to slow run-off, and monitoring. |
| <b>International Guidelines on Natural and Nature-Based Features for Flood Risk Management</b> <sup>98</sup>                 | U.S. Army Corps of Engineers  | A practical guide to help inform the process of conceptualisation, planning, designing, engineering, and operating flood risk management systems that include natural and nature-based features (NNBF) to reduce flood risk.<br><br>Covers coastal, estuarine, and fluvial applications of NNBF for flood risk reduction.              |
| <b>Natural Flood Management Handbook</b> <sup>99</sup>   | Scottish Environment Protection Agency  | A practical guide to the delivery of NFM to reduce flood risk and deliver wider environmental co-benefits.<br><br>Includes NFM for river and coastal flooding  |
| <b>The SuDS Manual</b> <sup>100</sup>  | Ciria   | A guide to assist with the planning, design, construction, management and maintenance of SuDS in a way that meets the UK Government’s non-statutory technical standards and on how to deliver cost-effective delivery of multiple benefits.  |
| <b>NFM Guidance for Devon</b> <sup>101</sup>   | Devon County Council  | A region-specific introductory guidance document aimed at landowners, land managers, agricultural and land management advisors, and communities. It is to support individuals in resolving flood issues and managing land in a more productive way.  |

**Table 13:** Examples of NFM design guidelines currently in use

<sup>96</sup> Wren, E et al, May 2022. The natural flood management manual (C802F)

<sup>97</sup> <https://cdn.forestresearch.gov.uk/2022/10/UKFSPG027.pdf>

<sup>98</sup> Bridges, T. S., J. K. King, J. D. Simm, M. W. Beck, G. Collins, Q. Lodder, and R. K. Mohan, eds. 2021. International Guidelines on Natural and Nature-Based Features for Flood Risk Management. Vicksburg, MS: U.S. Army Engineer Research and Development Center.

<sup>99</sup> Scottish Environment Protection Agency, 2015. Natural Flood Management Handbook

<sup>100</sup> <https://www.ciria.org/itemDetail?iProductCode=C753F&Category=FREEPUBS>

<sup>101</sup> <https://www.devon.gov.uk/floodriskmanagement/document/nfm-guidance-for-devon/>

## Scope

Within these guiding principles for NFM design, the wider context of land use management within a catchment should be highlighted, including how this may be causing or exacerbating flood risk, and if measures can be put in place to address this, before considering 'in-channel' interventions, or large capital works such as river restoration [see Connecting the Culm case study]. If current land management practices promote an elevated degree of flood risk, implementing in-channel interventions alone are less likely to produce sustained flood risk benefits, and investments are less likely to produce additionality. This underperformance will negatively impact the ecosystem service provision paid for by private sector buyers and will erode confidence further.

Guidance should also look to articulate the parties responsible for the ongoing maintenance of NFM assets, or the ongoing implementation of on-farm land management techniques. It should also aim to provide clarity on who owns the risk of failure of these assets and who is required to repair and maintain these assets in the event of any damage caused.

## Design guidance

While the market for flood risk reduction through NFM is still immature, more mature ecosystem service markets contain guidance on the delivery of interventions to achieve high integrity outcomes. For example, the Woodland Carbon Code (WCC)<sup>102</sup> mandates that projects must conform with the UK Forestry Standard (including the elements of sustainable forest management (Climate Change, Soil, Water, Biodiversity, Landscape, Historic Environment and People))<sup>103</sup>, and BNG projects must conform to national guidance throughout their 30-year lifespan. The standard or guidance should highlight the need for a whole business protocol including a suite of intervention options for those farms or businesses in receipt of funding to implement NFM measures to reduce flood risk. This will ensure that other non-funded measures implemented on farm will not add to the overall flood risk generated by the business.

## Monitoring, reporting and verification

Monitoring, reporting, and verification (MRV) is crucial to ensuring the NFM interventions are delivered appropriately, and that any adaptive management measures can be undertaken swiftly in response to changing conditions. Any standards or guidelines should include guidance on the minimum level of MRV that is required for NFM projects, and on how that monitoring should be undertaken. In regulated ecosystem service markets, there are already examples of this in place.

In the case of using constructed wetlands to improve water quality for Nutrient Neutrality, Natural England has created the Wetland Mitigation Framework. This was developed in response to the increased use of constructed wetlands in the delivery of Nutrient Neutrality and is designed to enable Natural England staff to adequately and appropriately comment on wetland proposals and designs which are focused on Nutrient Neutrality mitigation.<sup>104</sup> The framework includes detailed guidance on baseline monitoring of constructed wetlands to inform design, performance monitoring to understand the efficacy of the wetland in nutrient reduction, and longer-term monitoring to support maintenance and adaptive management of the wetland once fully operational.

Providing guidelines on MRV could allow for comparable monitoring of NFM across landscapes, and this would therefore help develop the evidence base for NFM going forward. It is important that as this evidence base changes, any standards and guidelines are updated accordingly. This should also feed into the NFM prioritisation map outlined in Key Enabler 1.

## Barriers addressed:

- Confidence

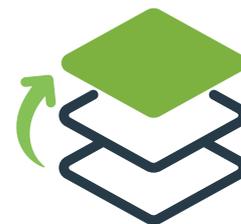
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<sup>102</sup> <https://woodlandcarboncode.org.uk/standard-and-guidance/1-eligibility/1-5-conformance-with-uk-forestry-standard>

<sup>103</sup> <https://cdn.forestresearch.gov.uk/2023/10/The-UK-Forestry-Standard.pdf>

<sup>104</sup> Constructed Wetland Hub, The Rivers Trust, Natural England: Designing for Nutrient Neutrality.

## Enabling Solution 6:



### Clarity on ecosystem service stacking

Allow the stacking of ecosystem service co-benefits, such as BNG, carbon credits, and Nutrient Neutrality individually, to be sold alongside NFM outcomes.

#### Overview:

Permitting the stacking of ecosystem services could increase private sector demand by attracting a broader pool of potential ecosystem service buyers to NFM projects. These buyers may wish to pay for one or more outcome, including flood risk reduction, biodiversity uplift, carbon sequestration, social impact, or water quality improvements (among other ecosystem services). Increased demand from private sector buyers for co-benefits alongside flood risk reduction is likely to increase the chances of projects securing sufficient revenue streams to make the project financially viable, and lower entry costs for buyers with less tangible links to the project.

A wider pool of potential buyers will mean that an individual buyer's financial contribution to the project could be limited to whatever ecosystem service is required by that business, potentially leading to reduced costs. Marketing specific ecosystem services of interest to certain organisations will make it easier to build the business case to that business and may reduce time.

Allowing the stacking of environmental and social outcomes may reduce the risk of potential 'free riding', whereby entities who do not contribute receive benefits they have not paid for. Being able to identify buyers for each ecosystem service would help reduce the risk of free riding by ensuring all monetisable benefits delivered by the project have been purchased by the relevant buyer or purchased by government.

Sourcing funding for NFM projects from a broader array of private sector buyers could potentially reduce the burden on the public purse of delivering flood risk reduction and increase the number of projects delivered.

As discussed previously, the Woodland Carbon Code and Peatland Code do not currently allow the stacking of other ecosystem services alongside carbon, due to the implicit bundling of these other services within the price of the unit. However, both projects have signalled that it may be possible to stack voluntary credits or units generated from a carbon project provided a credible voluntary standard or methodology for the valuation of each ecosystem service.<sup>105</sup> This is a welcome first step, and there are multiple different valuation metrics currently employed by NFM projects in the landscape. Examples of these are included in **Table 14** below.

Consideration needs to be made, however, on the possible negative impact of stacking multiple benefits together, and how this could lead to a reduction in potential beneficial change for flood risk. For example, a BNG site may require a permanent pond for biodiversity, but a reduction in flood risk would require a temporary pond. This permanent pond could in some instances promote quicker run off rates and greater flood risk than if there was no pond.

<sup>105</sup> IUCN Peatland Programme, March 2023. Peatland Code. Guidance. Version 2.0.

| Metric                            | Unit(s) of measurement                                   | Description  |
|-----------------------------------|--|--|
| Increased hydrological lag time   | Hours  | Time between rainfall events, and the peak of the following hydrograph. As water is held in the catchment, lag time increases. |
| Reduction in peak flood flow.     | m <sup>3</sup> /s<br>litres/s                            | The maximum rate of water discharge during a period of run off caused by a storm event.  |
| Reduced volume of flood run off   | m <sup>3</sup>   | The total quantity of water flowing from a catchment during the period of a flood. <sup>106</sup>                              |
| Reduced duration of flood run off | Minutes  | Total duration of water flowing above baseline levels from a catchment during the period of a flood.                           |
| Volume of water storage           | M <sup>3</sup> of water per km <sup>2</sup> of catchment |  |

**Table 14:** Examples of flood risk metrics employed by FRM projects

Other workstreams are also underway, looking to develop standards or codes for water related ecosystem services including flood risk reduction through NFM. In Scotland, work led by Forest Research is developing a Woodland Water Code which will look to quantify the water-related benefits of new woodland planting. This work aims to incentivise greater private investment into woodland creation to help tackle key water pressures including diffuse pollution, flooding, and rising water temperatures. The development of this code is expected to help achieve the target of trebling tree planting rates in England by the end of the current Parliament. Forest Research and Nature Scot are also working on an initiative to explore the possible development of a wider Water Code covering water-related benefits provided by other habitat types in addition to woodland.<sup>107</sup>

As work continues on the BSI's Nature Investment Standards Programme, the Group recommend the development of an NFM Standard and guidance on stacking and bundling be prioritised. We also recommend that the BSI guidance is free to access, and equally useful at both the portfolio and project level.

#### Barriers addressed:

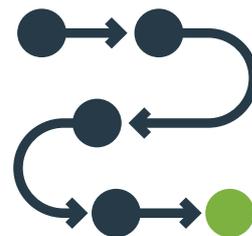
- Confidence
- Co-Benefits

<sup>106</sup> European Environment Information and Observation Network

<sup>107</sup> Forest Research. Research highlights 2022 - 2023

## Enabling Solution 7:

# Update to FCERM grant-in-aid partnership funding processes



We recommend that the wider environmental co-benefits identified through Outcome Measure 4, are valued in the form of ecosystem credits and can be apportioned appropriately between the public, private and third sector organisations sector partnerships.

### Overview:

The wider co-benefits generated in FCERM partnership funding schemes under OM4 need to be 'un-bundled' from within the scheme and made available to the private sector in the form of verified ecosystem units or credits, such as BNG or Carbon.

All benefits generated through OM4 are currently retained within the scheme and held by the EA and Lead Local Flood Authorities. By recording outcomes generated by these schemes as recognisable and verified credits or units, these outcomes could provide the private sector with an opportunity to share in these benefits in a way that fits with their organisational goals. For example, a property development company in need of BNG units could secure agreement from public sector partners to purchase some or all of the units created through an FCERM scheme.

Having outcomes of FCERM schemes as verified credits or units, could increase the amount of private sector capital deployed into FCERM schemes, as these outcomes are now valued in a way that could meet their organisational requirements or legal obligations – such as through BNG requirements.

### Barriers addressed:

- Coordination
- Co-Benefits



# Testing of key enablers

The Group recommends that the above Key Enablers be tested in the short-term using the existing FCERM and NFM programmes. A possible body to oversee testing of these key enablers could be a Regional Flood and Coastal Committee (RFCC). RFCCs (See **Box 8**) are a structure that already exists within the current FRM framework, and that already include multiple stakeholders across the water environment and the local economy.

## Regional Flood and Coastal Committees (RFCCs)

RFCCs are committees established by the EA under the Flood and Water Management Act 2010. They bring together members appointed by Lead Local Flood Authorities (LLFAs) with independent members with relevant experience. There are 12 RFCCs in England and each has a Chair appointed by Defra.

RFCCs guide FCERM activities within their river catchments and along the coastline. Responsibilities include: ensuring coherent plans are in place for identifying, communicating, and managing flood and coastal erosion risks across catchments and shorelines; for promoting efficient, targeted investment in flood and coastal erosion risk management; and for providing a link between flood risk management authorities and other relevant bodies to develop mutual understanding of flood and coastal erosion risks in their areas.

The EA must consult with RFCCs about FCERM work in their region, taking any comments into consideration. RFCCs approve the annual programme of FCERM work in their region and set the local levy that funds flood risk management activities within the region that are a local priority.

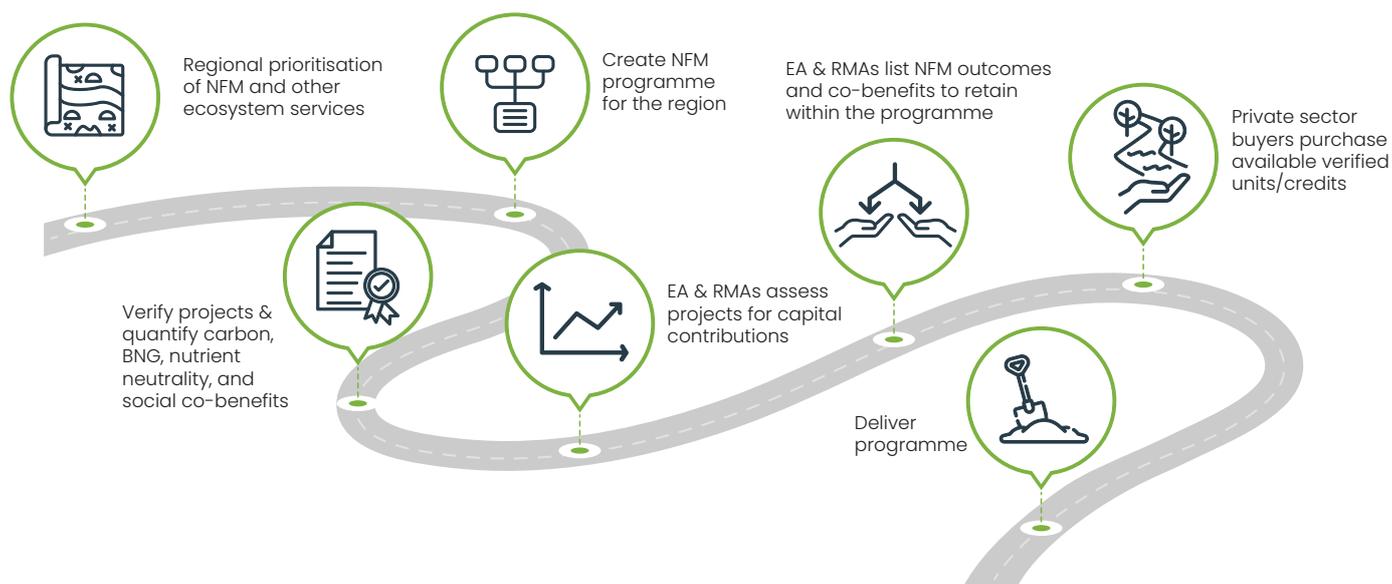
**Box 9:** Regional Flood and Coastal Committees.<sup>108, 109, 110</sup>

<sup>108</sup> <https://www.ada.org.uk/our-members/regional-flood-coastal-committees/>

<sup>109</sup> <https://www.gov.uk/government/collections/regional-flood-and-coastal-committees-rfccs>

<sup>110</sup> [https://consult.environment-agency.gov.uk/fcrm/changes-to-regional-flood-and-coastal-committees/#:-:text=Regional%20Flood%20and%20Coastal%20Committees%20\(RFCCs\)%20are%20Committees%20established%20by,independent%20members%20with%20relevant%20experience.](https://consult.environment-agency.gov.uk/fcrm/changes-to-regional-flood-and-coastal-committees/#:-:text=Regional%20Flood%20and%20Coastal%20Committees%20(RFCCs)%20are%20Committees%20established%20by,independent%20members%20with%20relevant%20experience.)

RFCCs have business plans, many of which include plans and ability to explore innovative financing to deliver flood risk outcomes within their regions. The above recommendations are an opportunity for RFCCs to further that goal. Below outlines a process through which the above could be tested in the short-term. A process for raising funding for FCERM NFM projects through the sale of verified environmental credits/units, is outlined below in **Figure 7**.



**Figure 9:** Proposed Key Enabler testing process for raising funding for FCERM NFM projects through the sale of verified environmental credits.

# Further Work & Further Recommendations

# Further work

## Industry deep dives

As discussed, building private sector demand for NFM projects, and understanding what drives different sectors act as buyers of ecosystem services of NFM projects, is critical to scaling private sector capital into NFM.

Throughout this report we have mentioned a number of different potential ecosystem service buyers, but there are some key sectors that are impacted by flooding who may have an interest in acting as buyers of reduced flood risk reduction from NFM projects. We recommend that deep dive reviews be undertaken into the insurance sector, the water sector and the mortgage sector to assess their specific barriers and identify solutions.

### The insurance sector

Over the course of this project, the potential role(s) of the insurance sector in scaling the delivery of NFM as either buyers of NFM outcomes, or as investors in NFM projects, were explored. While the sector is seen as a potential key stakeholder, there are challenges that are preventing these roles from being fully realised. For example, if a single insurer commits funding to an NFM project, due to the competitive nature of the insurance market, the reduction in risk generated would allow other insurers to price premiums more competitively having not committed funding to the project. This is often referred to as the free rider effect.

The GFI will be exploring this, other challenges, and potential solutions in more detail in a follow up report.

### The mortgage sector

As discussed in this report, the increased risk of flooding is likely to result in higher damage costs to properties and businesses across the country. This will therefore likely have an impact on mortgage affordability due to the increased costs of damages and flood insurance born of higher flood risks. Therefore, as a major lender to properties and households in the UK, it will be key for the mortgage sector to develop a detailed understanding of how the increased risk of flooding will impact their front and back books, and how the sector can build resilience for their portfolios.

Knowledge around NFM, its impacts on risk, and the role it can play in building resilience, is still relatively low within the financial services sector. More work needs to be done to build the knowledge and evidence base of NFM within the mortgage sector, to understand the commercial impacts NFM can have before the business case for investment can be made. The TCFD, TNFD, and Bank of England's Climate Biennial Scenarios exercise have all established processes for the financial sector to assess its climate risks, including flood risk. NFM provides a possible option for financial actors to manage their risks as part of a package of nature-based solutions.

As the mortgage sector is fragmented and borrowers can remortgage frequently, moving between lenders, investing in NFM to derisk a portfolio now may provide no benefit in two-years' time if properties within the portfolio have remortgaged elsewhere. A coordinated approach across the sector may be required to further the understanding of how NFM may impact the mortgage business and lending portfolios.

Launched in 2019, the Climate Financial Risk Forum is an industry-led forum jointly convened by the Prudential Regulatory Authority and the Financial Conduct Authority, that looks to build capacity and share best practice across industry and financial regulators to advance understanding of and response to the financial risks from climate change.<sup>111</sup> A pillar within the Forum is focussed on innovation and looks to set recommendations on how financial services can deliver a step change in aligning private sector financial flows with climate goals, including increasing resilience to physical climate change.<sup>112</sup>

The financial services sector has a key role to play in building the evidence base for NFM and in building resilience going forward. It is therefore key that within the CFRF, the role of NFM in reducing flood risk and building resilience, must be a priority areas of focus.

## **The water sector**

As a major stakeholder in river catchments and flood risk management, the water sector is well-positioned to act as a buyer of ecosystem services in NFM projects. Regulatory drivers to invest more in nature-based solutions have been put forward by the Water Services Regulation Authority (Ofwat), but challenges remain that are preventing the water sector from fully embracing NbS to reduce flood risk and deliver wider co-benefits.

An example of such a challenge relates to the way in which the wider environmental and social benefits of nature-based solutions, including NFM, are valued. Current valuation frameworks do not incentivise NFM as an option of choice for water companies to employ. The current recommended assessment frameworks used by water companies to assess and value wider environmental outcomes as part of their regulatory submissions, overly penalise nature-based solutions as options to reduce flooding.

The water sector is driven by the Water Services Regulation Authority (Ofwat) to deliver environmental improvements in the most cost-effective way to deliver best value for money for bill payers. The Water Industry National Environment Programme (WINEP) defines what water companies must include in their business plans to meet the environmental legislative requirements that apply to water companies in England.<sup>113</sup> Companies have flexibility in how these plans are delivered, so long as regulatory requirements are met, and companies can demonstrate to Ofwat that this is done in the most cost-efficient way for bill payers.

The EA also requires water companies to upscale the use of nature-based solutions in reducing flooding to combined sewer overflows and has provided a value framework to assess the wider environmental outcomes of implementing nature-based solutions to be included in cost-benefit analysis for options appraisal. Projects will either be accepted through having a higher benefit, or by having a lower cost.

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<sup>111</sup> <https://www.bankofengland.co.uk/climate-change/climate-financial-risk-forum>

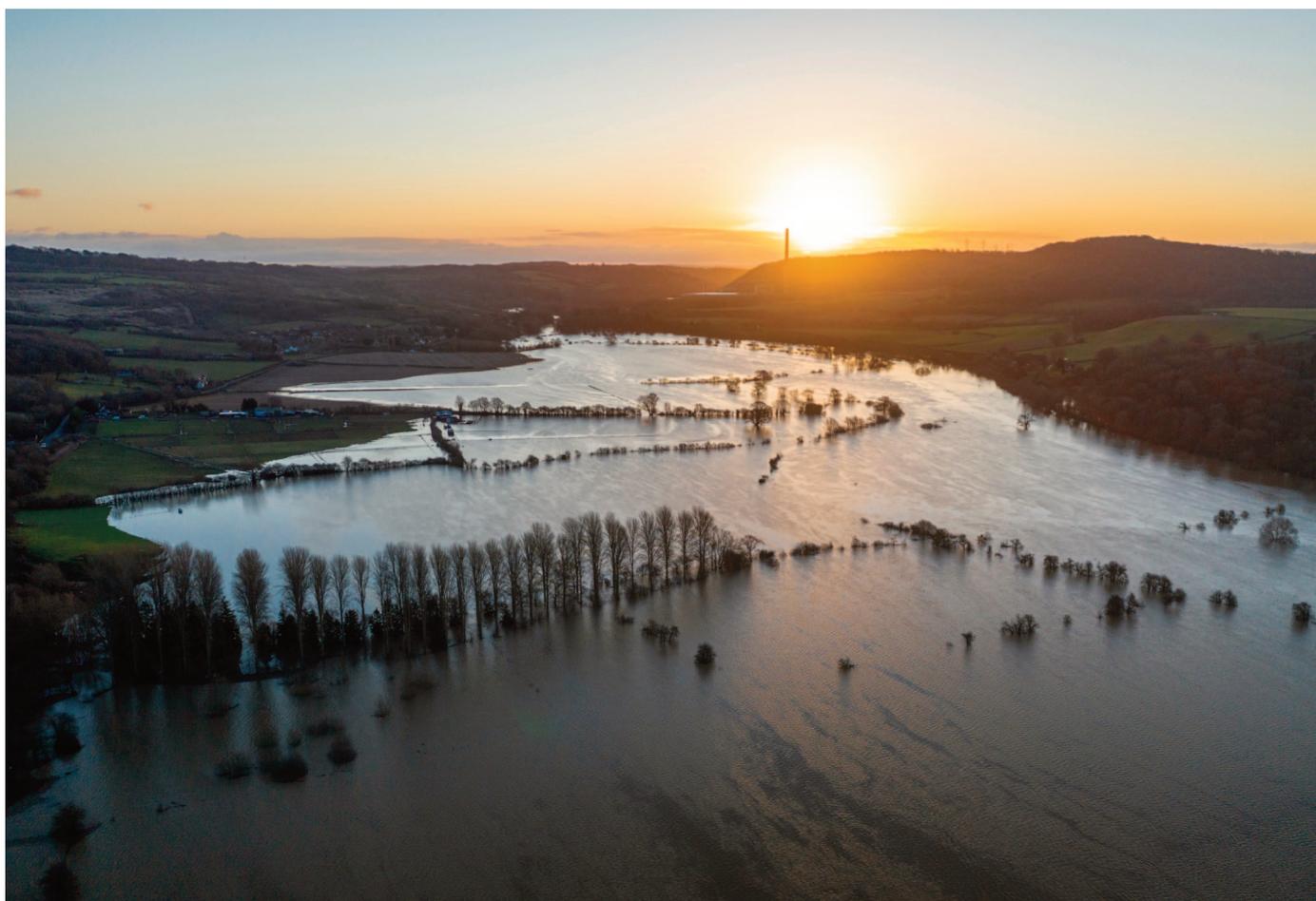
<sup>112</sup> <https://www.fca.org.uk/publication/corporate/climate-financial-risk-forum-guide-2020-innovation-chapter.pdf>

<sup>113</sup> Defra. Water industry national environment programme (WINEP) methodology.

However, the WINEP framework currently ascribes low values to nature-based solutions that do not give a realistic assessment of the broader value delivered by these interventions, resulting in minimal benefit for the water company. Therefore, most options to deliver flood risk reduction for combined sewer overflows (CSOs) are decided purely on lowest cost, where nature-based solutions proposals often fail and are dropped from the decision-making process. This therefore means that water companies are restricted in their use of nature-based solutions to meet regulatory targets, due to the solutions not meeting cost-benefit requirements.

An assessment of the current WINEP value framework to identify short comings could lead to the development of a wider, water-sector wide common value framework for the industry that considers the total value delivered by nature-based solutions. Funded through the Ofwat Innovation Fund, the Mainstreaming Nature-based Solutions Project jointly led by The Rivers Trust, United Utilities, Jacobs and Mott Macdonald provides an opportunity to make this assessment and develop such a framework. The Project looks to scale adoption and delivery of NbS at a catchment scale, and an underlying pillar of this work will be to work with policymakers and regulators to test regulatory requirements that drive greater value.<sup>114</sup>

Improving the business case for NFM for the water sector will allow water companies to act as buyers of reduced flood risk in NFM projects, helping to increase delivery of NFM projects across the country.



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<sup>114</sup> <https://theriverstrust.org/about-us/news/multi-million-pound-project-aims-to-transform-national-approach-to-nature-based-solutions>

# Further Recommendations

## Development of evidence for NFM

Developing the evidence base for the efficacy of NFM is important if NFM is to become an intervention of choice alongside traditional flood risk infrastructure. There have been a number of large research projects in recent years that look to test NFM at different scales. It is important that further research is done in partnership with the private sector, to build a common language around NFM and to develop an understanding of the benefits of NFM within the private sector.<sup>115</sup>

Work undertaken by the University of Oxford to assess the evidence base for NFM in the UK, made several recommendations for further research areas including the below:

- Further research into the causal links between catchment based NFM actions and downstream effects.
- Importance of long-term monitoring as major flood events are rare.
- Increased baseline monitoring and experimental controls for local initiatives to incorporate into the wider monitoring of authority-led schemes.
- Better research and data sharing within the water management industry to add to the evidence base.
- Systematic comparisons of performance, longevity, operation, and maintenance need to be made between NFM interventions and traditional flood risk infrastructure.
- Further research into the extent that NFM interventions add resilience to the impacts of climate change.
- Development of a practitioner toolkit including best practices and where NFM would be best suited.

It is important that this research is conducted at a sufficient scale across landscapes, and that it includes multiple NFM interventions alongside each other. Consideration should also be given to mandating evidence capture across all NFM projects that receive government funding.

## The need for coordination and suitable institutional structures

As mentioned previously, the use of natural measures to reduce flood risk can often involve multiple stakeholders across a large geographical area, from many different sectors including the public, private and third sectors, alongside community groups. However, flooding is only one pressure that can be addressed using nature-based solutions. Within a region there may be multiple pressures on the environment, including on water quality, water resources and biodiversity as well as economic and social benefits that well designed and implemented action can deliver.

There is a need for both public, private, and philanthropic funding to ensure the widespread delivery of NFM across the landscape. NFM has a huge opportunity to deliver flood risk reduction alongside wider co-benefits that may be a priority for a region. As can be seen from this report, there are multiple public funding streams available for NFM and for nature-based solutions to address environmental pressures.

<sup>115</sup> Dadson SJ et al. 2017 A restatement of the natural science evidence concerning catchment-based 'natural' flood management in the UK. Proc. R. Soc. A 473: 20160706.

These include those public schemes aimed at flood risk reduction, but also agri-environment schemes, and programmes such as the Water industry national environment programme (WINEP).

If private finance is to help scale nature-based solutions across the landscape alongside public money, a more coordinated and systems thinking approach to the delivery and financing of NbS will be required, alongside appropriate governance and institutional structures that include representatives from multiple stakeholders.

This echoes calls from the Chartered Institution of Water and Environmental Management (CIWEM) in their A Fresh Water Future report which recommends the implementation of a catchment or regional system management approach to investment and delivery of water-environmental outcomes. This approach would bring together stakeholders from across the public, private, and third sectors to develop overarching plans for local and regional water management priorities at an appropriate spatial scale.<sup>116</sup>

Approaches such as this could be enabled by a defined governance or institutional structure that is able to bring together funding streams for nature-based solutions that deliver multiple environmental outcomes, at scale. Revenue streams from various environmental markets could be brought together with public grant funding and/or philanthropic funding, and may also be used to attract upfront repayable private finance. A more coordinated approach alongside an appropriate governance or institutional structure could also help to build confidence in the efficacy of NbS in addressing various environmental challenges, through the implementation and monitoring of landscape scale interventions.

Examples of these regional approaches to the governance, delivery and financing of NbS that are currently being trialled across England include the Integrated Water Management Plan, a partnership between the EA, the Greater Manchester Combined Authority, and United Utilities, and, the Norfolk Water Fund, in development by Water Resources East, Norfolk County Council, Anglian Water, and The Nature Conservancy.



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<sup>116</sup> CIWEM, 2024. A Fresh Water Future. An Independent Review of Water Sector Performance and Governance and a Co-created Expert, Stakeholder and Public Vision for Future Water Management in the UK.

# Targets and guidance for delivery of NFM

Flood risk management has historically been thought of as a public sector responsibility. Defra has principal responsibility for flood risk policy and the EA works with other organisations to manage the risk of flooding and coastal erosion in England. If this is to change, there are still a number of important signals, drivers and targets that are lacking for the private sector, to stimulate demand for NFM. These are resulting in a lack of urgency and direction within the private sector, slowing engagement and therefore delivery of NFM via private capital.

1. No explicit targets or government signals that set out the potential future funding gap due to increased flood risk from climate change.
2. No level has been set of the flood risk reduction that the private sector can expect the public purse to achieve.
3. No target on the proportion of that gap that will need to be delivered through NFM, and through private investment.
4. No definition of or targets for infrastructure resilience for the country, and how NFM could contribute to those targets.

The above echoes recommendations made by the Climate Change Committee for a refresh of the Green Finance Strategy along with the Third National Adaptation Programme (NAP 3), both of which should clarify where the UK Government expects adaptation actions to be funded through public sources and where private investment is expected.<sup>117</sup>

Addressing the above challenges, by providing clear targets and signals, will allow the private sector to understand how much they would need to invest to receive better flood risk mitigation performance, above and beyond that which can be delivered by the public purse.

## Land Use Framework

As discussed in this report, delivering NFM at a landscape scale is not without its challenges. And as NFM will be needed to be delivered across large areas and at a certain intensity, this will come up against a number of competing priorities for land. Therefore, we strongly recommend that the creation of a Land Use Framework be prioritised, as recommended by the House of Lords Land Use Committee.<sup>118</sup> Examples of such a framework include a Multifunctional Land Use Framework, as suggested by the Food, Farming and Countryside Commission.<sup>119</sup>

## Community Engagement

It is imperative that communities are engaged and empowered during the process of scaling delivery of NFM across the landscape. Communities are a key stakeholder and the ultimate beneficiaries of a reduction in flood risk, but NFM is relatively new for communities and presents as an unfamiliar option to prevent the flooding of their homes. There are numerous groups that can be engaged such as Local Flood Action Groups, the National Flood Forum, and Climate Action Groups.

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<sup>117</sup> Climate Change Committee, March 2023. Progress in adapting to climate change. 2023 Report to Parliament

<sup>118</sup> House of Lords, December 2022. Land Use in England Committee. Report of Session 2022-23. Making the most out of England's land.

<sup>119</sup> Food, Farming & Countryside Commission. The Multifunctional Land Use Framework. The key to better land use decisions.

# Conclusion

The challenges posed by climate change are significant and will require a greater degree of involvement from the private sector than has historically been the case. There is an urgent need to implement NFM at a catchment-wide scale if we are to build resilience for communities and businesses while simultaneously delivering wider social and environmental benefits.

Roundtables, workshops, and numerous stakeholder interviews have revealed that the key overarching barrier to scaling private sector capital into NFM projects, is a lack of buyers of reduced flood risk and other ecosystem services for NFM projects. This report has highlighted numerous barriers that are suppressing demand from the private sector and reducing the potential number of ecosystem service buyers. The solutions have identified how these barriers can be overcome, and implementing these measures is a key part of the next stage of this project. We have provided a potential process for testing these solutions to begin unlocking barriers to demand for NFM from the private sector.

Natural flood management provides a huge opportunity to meet many environmental, financial, and societal demands, but it will require a coordinated effort across many different stakeholders and the breaking down of traditional silos both within and between organisations. We look forward to working with many of these organisations going forward to implement the suggestions contained within this report.



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|----------------------|-----------------------|---|
| <b>3Keel</b>         | Tom Curtis            | Partner                                     |
| <b>ABI</b>           | Ben Howarth           | Chief Sustainability Officer                |
|                      | Louise Clarke         | Policy Advisor                              |
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| RSA Insurance Limited    | Ruth Poulton           | Social Impact and ESG Manager                             |
|                          | Laura Spiers           | Head of Social Impact and ESG                             |
| Scottish Forestry        | Pat Snowden            | Head of Economics and Woodland Carbon Code                |
| Severn Trent             | Richard Smith          | Regulation Manager  |
|                          | Georgina Key           | Principal Catchment Scientist                             |
| Skipton Building Society | Aiden Walker           | Aiden Walker Head of Credit Risk                          |
|                          | Annie Heaton           | Group Head of Sustainability (Interim)                    |
| Sniffer                  | Jonny Casey            | Head of Climate Ready Leadership                          |
| South West Water         | Nick Paling            | Stakeholder Engagement Manager                            |
|                          | David Smith            | Natural Resources Manager                                 |
|                          | Carolyn Cadman         | Director of Natural Resources                             |
| Stroud District Council  | Chris Uttley           | Stroud Valleys Natural Flood Management Officer           |
| Surrey County Council    | Adam Brown             | Surrey Local Nature Recovery Strategy Lead                |
| Swiss Re                 | Cherie Gray            | Global Lead, Sustainability & Market Development          |
| Tandem Bank              | Roger Morris           | Director of Mortgage Division Sales & Distribution        |

| Organisation  | Organisation Name    | Role   |
|---|----------------------|--|
| Thames Water  | Craig Boorman        | DWMP Delivery Manager  |
| The Wildlife Trusts                                       | Kathryn Brown        | Director of Climate Change and Evidence  |
|   | Phoebe Cox           | Green Finance Manager  |
| TNC   | Rob Cunningham       | Europe Resilient Watersheds Programme Director   |
| Trees AI  | Chloe Treger         | Natural Capital Innovation   |
| Trent Rivers Trust  | Ruth Needham         | Head of Landscapes and Partnerships  |
| U.S. Army Engineer Research and Development Center (ERDC) | Margaret Kurth       | Research Environmental Engineer  |
| UK Green Building Council                                 | Kai Liebetanz        | Senior Sustainability Advisor  |
| University of California, Santa Cruz                      | Megan Kelso          | Postdoctoral Scientist in Coastal Conservation and Disaster Risk Reduction                                     |
| University of California, Santa Cruz                      | Matthew Smith, Ph.D. | Biological Scientist   |
| University of California, Santa Cruz                      | Mike Beck            | Director, Center for Coastal Climate Resilience  |
| University of Exeter                                      | Ben Balmford         | Postdoctoral Research Fellow   |
|   | Brett Day            | Professor of Environmental Economics, Director of the Land, Environment, Economics and Policy Institute (LEEP) |
|   | Luke Lindsay         | Senior Lecturer  |
| University of the West of England                         | Mark Everard         | Associate Professor of Ecosystem Services, FET   |
| US Army Corps of Engineers                                | Jeff King            | National Lead and Program Manager - Engineering with Nature (EWN) Program                                      |
|   | Amanda Tritinger     | Research Hydraulic Engineer and Deputy Program Manager for the Engineering With Nature Program                 |
| Water UK  | Dr Lucinda Gilfoyle  | Head of Environment Strategy   |

| Organisation                       | Organisation Name    | Role  |
|------------------------------------|----------------------|---|
| West Cumbria Rivers Trust          | Clair Payne          | Glenderamackin Project Officer                              |
| West of England Combined Authority | Roger Hoare          | Head of Environment   |
|                                    | Lucy Vilarkin        | Climate Resilience Manager                                  |
|                                    | Michael Guthrie      | Head of Climate and Nature Delivery                         |
| Westcountry Rivers Trust           | Laurence Couldrick   | Chief Executive Officer                                     |
|                                    | Iorwerth Watkins     | Senior Farm Advisor   |
| Wildlife Trust                     | Emma Price-Thomas    | Head of Corporate Partnerships                              |
| WTW                                | Neil Gunn            | Lead Associate in the Climate & Resilience Hub              |
| WWF                                | Jane Crabb           | UK Landscapes Project Manager                               |
|                                    | Lucy Lee             | UK Chief Advisor  |
|                                    | David Donnelly       | Senior Advisor - Finance for Nature-based Solutions         |
| Wye & Usk Foundation               | Simon Evans          | Chief Executive   |
| Wyre Rivers Trust                  | Thomas Myerscough    | General Manager   |
| Yorkshire Building Society         | Chris Arthur-McGuire | Senior Credit Risk Manager - Retail Lending & Property Risk |
| Yorkshire Water                    | Phillip Blaen        | Manager of Sustainable Business                             |

**Table 15:** Acknowledgements

# Appendices



# Risk Management Authorities

| Risk Management Authorities                 | Responsibilities   |
|---|--|
| <b>Lead Local Flood Authorities (LLFAs)</b> | LLFAs are county councils and unitary authorities responsible for developing, maintaining and applying a strategy for local flood risk management in their areas and for maintaining a register of flood risk assets. They also have lead responsibility for managing the risk of flooding from surface water, groundwater and ordinary watercourses.  |
| <b>District Councils</b>                    | District Councils are key partners in planning local flood risk management and can carry out flood risk management works on minor watercourses, working with Lead Local Flood Authorities and others, including through taking decisions on development in their area which ensure that risks are effectively managed. District and unitary councils in coastal areas also act as coastal erosion risk management authorities. |
| <b>Internal Drainage Boards (IDBs)</b>      | Independent public bodies responsible for water level management in low lying areas. IDBs work with other authorities and undertake works to reduce flood risk to people and property, and to manage water levels for agricultural and environmental needs within their district.  |
| <b>Highways Authorities</b>                 | Highways Authorities are responsible for providing and managing highway drainage and roadside ditches and must ensure that road projects do not increase flood risk.   |
| <b>Water and Sewerage Companies</b>         | Water and Sewerage Companies are responsible for managing the risks of flooding from water and foul or combined sewer systems providing drainage from buildings and yards.   |

**Table 16:** Risk Management Authorities (RMAs)

# Key Barriers

| Category   | Barrier                                 | Description  |
|------------|---|--|
| Confidence | Insufficient data and evidence          | Within the private sector, there is limited understanding of how NFM can benefit businesses, preventing them from fully understanding their own risks and the possible opportunities provided by NFM.  |
|            |   | Developing this understanding and data can be expensive, preventing potential demand opportunities from being identified at project outset.  |
|            |   | There is an insufficient track record of investable propositions for potential investors. It is therefore difficult for investors to assess NFM projects for risk return purposes.   |
|            | No nationally accepted design standards | There are no widely adopted set of design standards to which NFM projects can adhere to ensure high integrity. This results in a lack of confidence in the private sector when considering co-funding NFM delivery.  |
|            |   | Lack of country-wide natural asset register to record interventions and maintenance records. This leads to the private sector not having easy access to important information regarding assets they may have funded, to ensure they are working appropriately. |
|            | Lack of clear government guidance       | There is currently no government-endorsed, strategic, country-wide prioritisation of NFM potential that considers the wider environmental, social, and economic priorities in a region.  |
|            |   | No clear guidance on how NFM can form part of an integrated FCERM approach.  |
|            |   | A land use framework has not been developed for England, to guide competing priorities for the use of land.  |
|            |   | Explicit guidance from the UK Government on resilience targets is lacking, hindering the flow of private sector capital into NFM.  |

| Category            | Barrier  | Description  |
|---------------------|--|--|
| <b>Co-Benefits</b>  | <b>Co-Benefits Limitations of Partnership Funding system</b> | Environmental co-benefits of all FCERM schemes (including NFM) are not available in a tradeable commodity for the private sector to purchase. This reduces possible demand from the private sector who may be willing to pay for credits or units such as carbon or BNG generated by NFM projects.   |
|                     | <b>Ecosystem service stacking clarity</b>                    | A lack of clarity around the ability to stack ecosystem services alongside NFM is reducing the potential number of buyers of NFM and its co-benefits.  |
|                     | <b>Natural capital assessment tool framework.</b>            | There is no consistent framework for the application of natural capital assessment tools to quantify ecosystem services benefits, leading to a lack of understanding from the private sector as to which tool is suitable for specific NFM projects based on geography, scale or delivery mechanism. |
| <b>Coordination</b> | <b>Lack of country wide NFM prioritisation</b>               | As mentioned regarding confidence, a lack of prioritisation for NFM delivery creates a lack of confidence from potential buyers, that their contributions will align with where NFM has been prioritised to deliver maximum flood risk and wider environmental benefits.                             |
|                     | <b>Lack of stakeholder mapping</b>                           | A lack of a centrally coordinated stakeholder mapping exercise within a region results in additional time and expense for project developers looking to create revenue streams for NFM projects.   |
|                     | <b>Lack of coordinated buyer engagement</b>                  | A large number of potential buyers may be required to make NFM projects viable. Engaging with multiple, individual businesses to develop an NFM project can be a considerable challenge for project developers.  |

**Table 16:** Risk Management Authorities (RMAs)

# Natural Flood Management interventions

For the purpose of this report, the NFM interventions considered are based on the EA's Working with Natural Processes Evidence Directory, as set out below.<sup>120</sup> The scope of this project will look to cover fluvial (river) flooding, pluvial (rainfall flooding including surface water flooding), and groundwater flooding in England.

## River and Floodplain Management

Managing rivers and floodplains aims to recreate or reinstate the natural processes of rivers, reducing water velocities, slowing the flow of water and encouraging more regular floodplain inundation and flood water storage. In doing so, the objective is to reduce flood peaks and reduce downstream flood depths.

| Intervention                                      | Description   |
|---|---|
| <b>River Restoration</b>                          | Reinstatement of the natural physical processes and features that are characteristic of a river. Includes restoring meanders to straightened rivers, enhancing historic river features, improving river sinuosity, green bank protection, improving channel morphology, utilising spoil excavated from rivers, river diversions and removing or bypassing barriers. |
| <b>Floodplain Reconnection &amp; Restoration</b>  | Floodplain restoration aims to restore the hydrological connection between rivers and floodplains so that floodwaters inundate the floodplains and store water during times of high flows.  |
|   | Processes Include removing, setting back or lowering existing embankments, paleochannel reconnection, In-channel features and floodplain wetland restoration.   |
| <b>Leaky/Woody Barriers including beaver dams</b> | Leaky barriers usually consist of pieces of wood, occasionally combined with some living vegetation, that accumulate in river channels as well as on river banks and floodplains.   |
|   | May form naturally along rivers as a result of trees falling locally into watercourses through snagging of natural wood, or through natural processes such as beaver activity. Similar structures can also be engineered by humans to restore rivers and floodplains to slow and store flood water.   |
| <b>Offline Storage Areas</b>                      | Floodplain areas that have been adapted to retain and attenuate floodwater in a managed way with the aim reducing the flood peak further downstream.  |
|   | Positioned next to watercourses, these interventions can temporarily store additional water in the floodplain. Adjacent to run off pathways, interventions such as ponds or earth bunds can have runoff diverted into them.   |

<sup>120</sup> Environment Agency, 2016. Working with Natural Processes – Evidence Directory

# Woodland Management

Different woodland types can reduce flood risk through a variety of processes. These include intercepting and slowing overland flow through increased hydraulic roughness, thereby slowing the rate at which water is delivered to rivers and encouraging infiltration and soil water storage through the root network of trees.

There are three types of woodland based on scale and location type: Catchment Woodland; Cross-Slope Woodland; Floodplain Woodland; and Riparian Woodland.

| Intervention                | Description  |
|-----------------------------|--|
| <b>Catchment Woodland</b>   | Total area of all woodland within a catchment. It combines general woodland cover of all types and species, including plantations, plus specific forms where present, such as cross-slope, riparian and floodplain woodland.   |
| <b>Cross-slope Woodland</b> | Placement of smaller areas or typically belts of woodland across hill slopes. It can comprise all woodland types and species, and can be managed as either productive or unproductive woodland.  |
| <b>Floodplain Woodland</b>  | All woodland lying within the fluvial floodplain that is subject to an intermittent, regular planned or natural flooding regime  |
| <b>Riparian Woodland</b>    | Woodland located within the riparian zone, defined here as the land immediately adjoining a watercourse or standing water. Usually relatively narrow, often extending <5m on either side of watercourses. It typically comprises native broadleaved woodland and is often unmanaged. |

# Run-off Management

Restoring natural processes across the rural landscape can provide a wide range of benefits for the environment and people. From an FCRM perspective, these types of measures can intercept overland flow, restore soils to help store water, encourage infiltration and increase the hydraulic roughness and morphological complexity of rivers and floodplains, which in turn slows floodwaters and reconnects rivers to floodplains to store water.

**Run-off Management includes:** Soil and Land Management; Run-Off Pathway Management; and Peat Restoration

## Soil and Land Management

| Intervention   | Description  |
|--|--|
| <b>Soil Aeration &amp; Subsoiling</b>                                  | Soil aeration is a process that breaks up topsoil compaction and is believed to increase soil infiltration and water retention capacity and, increase the travel time for incident rainfall to reach the arterial drainage system. Subsoiling is also a type of soil aeration and involves loosening the subsoil to break it up to improve drainage and encourage better plant growth.   |
| <b>Changes in Arable Practices</b>                                     | Agricultural practices that use larger machinery to produce uniformly fine seedbeds for autumn sown crops and for late harvesting of crops can compact subsoils and exacerbate flooding. Changing these practices can reduce compaction and therefore risk of flooding.  |
| <b>Changes in Management of Grassland Systems</b>                      | Grassland systems can contribute to an increase in flood risk in places where soil has become compacted, leading to a reduction in infiltration and an increase in surface water run-off.  |
| <b>Use of Agricultural Landscape Features</b>                          | The planting, conservation and management of hedges to intercept overland flow across slopes in erosion-vulnerable areas; reducing the concentration of animal or machinery operations; and the creation of buffer strips to reduce sedimentation in rivers.   |
| <b>Agricultural Headwater Management</b>                               | Measures used that hold back and store water by obstructing and slowing the flow of water across flow paths in fields, tracks, paths and roads, and ditches.   |
| <b>Improving Soil Organic Matter and Improving Soil Organic Carbon</b> | Soils act as 'natural flood management infrastructure'. Poorly managed, compacted soils don't allow drainage, increasing surface runoff and watercourse pollution. Whereas well managed soil can slow the flow of water off agricultural land. The effectiveness of soil water storage depends on the soil texture and on the pore space between soil particles, which is determined by factors such as soil organic matter. The pore size distribution affects aeration, water holding capacity, and drainage capacity of soil. |

## Run-off Pathway Management

| Intervention          | Description  |
|-----------------------|--|
| <b>Bunds</b>          | Long earth bunds may be constructed across grassland slopes (particularly where there are depressions) to hold flows in extreme rainfall events. They are designed to emulate natural features of undulating terrain. They are typically designed to permit livestock grazing, and may be enhancements of features of the traditional farming landscape eg stone walls, wooden walls or hedge-banks. |
| <b>Farm Ponds</b>     | A type of water retention structure that add flood retention capacity as either a permanent wet pond, or a temporary pond that is designed to dry out over time. Small ponds which store overland flow temporarily at the bottom of a field can be effective in reducing overland flow following storm events.   |
| <b>Swales</b>         | Also known as grassed waterways – are a linear, dry, grass channel laid with a shallow fall on its base. They are designed to collect and transfer run-off.  |
| <b>Sediment Traps</b> | Usually an excavated area located on a surface run-off pathway where sediment is trapped and settled before being discharged via an outlet. Effectiveness of sediment traps on flood risk is not well known. No peer-reviewed evidence which suggests they can attenuate peak flows.   |



## Peat Restoration

The UK uplands are dominated by blanket bog with variable peat depth (c. 0.5 m –10 m), a globally rare habitat that is only found in exceptionally wet and oceanic places around the globe. Lowland peat has a wider range of peatland types: fens; lowland raised bogs and blanket bog. Restoration of peat includes a focus on re-wetting peat – restoring the water table to allow a functional ecosystem to accumulate peat and carbon. This is achieved through grip and gully blocking as well as the reintroduction of appropriate peat-forming vegetation – such as Sphagnum spp.

| Intervention                 | Description   |
|------------------------------|---|
| <b>Grip Blocking</b>         | Grips are channels that were cut into peatlands in an attempt to drain them for agriculture. Blocking these grips restores natural drainage patterns, encourages revegetation, reduces erosion and minimises the effect of hydrological change downstream.  |
| <b>Gully Blocking</b>        | Gullies occur in peat when bare peat is exposed to the elements, and moving water can form channels (gullies). Blocking gullies and encouraging vegetative cover within them may increase travel time and cause other flow paths to develop during rainfall events. Gullies occur in peat when bare peat is exposed to the elements, and moving water can form channels (gullies). Blocking gullies and encouraging vegetative cover within them may increase travel time and cause other flow paths to develop during rainfall events. |
| <b>Vegetation Management</b> | Replacing bare peat with appropriate vegetation can stabilise peat and can reduce run-off rates through increased hydraulic roughness.  |

## Estuary Management

For this project, we will be focusing on intertidal saltmarsh management and restoration as natural flood management interventions. Saltmarsh and mudflats Saltmarshes represent accumulations of sediment in the intertidal zone that act to dissipate wave and tidal energy in front of flood defences, and are also important as natural habitats with a range of other ecosystem services.

| Intervention   | Description  |
|--|--|
| <b>Intertidal Saltmarsh Management and Restoration</b> | Restoration of saltmarshes has historically been achieved through management realignment and regulated tidal exchange. Managed realignment involves setting back the line of actively maintained defences to a new line, inland of original defences. The aim of this is to create saltmarsh habitat between the old and new defences. Regulated Tidal Exchange (RTE) is the process of letting flood through behind sea defences through engineered structures such as sluices, pipes or tide gates, to create saline or brackish habitats. |

## Sustainable Drainage Systems (SuDS)

Sustainable drainage systems (SuDS) are designed to control surface water close to where it falls and mimic natural drainage as closely as possible.

| Intervention               | Description   |
|----------------------------|---|
| <b>Bioretention Strips</b> | Bioretention strips are vegetated areas with sand and gravel beneath. They are designed to channel, filter, and cleanse runoff vertically. The runoff can either infiltrate into the ground below or drain into a pipe which carries the water elsewhere. The storage of runoff and rainwater can reduce peak runoff rates which reduces the overall flood risk. Bioretention strips also filter runoff and remove pollutants, nutrients, metals, suspended solids, and bacteria, which has a positive effect on the overall water quality of the stored water. |
| <b>Swales</b>              | Swales are shallow and broad vegetated channels, that provide temporary storage, infiltration, and conveyance of storm water runoff to reduce peak flows in watercourses and drainage systems. Swales can be 'wet' and store water above ground in the channel, or 'dry' where water collects in a pipe or gravel layer beneath. In wet weather, rainwater flows down the sloped sides of the swale, along its length and infiltrates through the vegetation, which acts as a filter, trapping sediment and pollutants.   |
| <b>Rain Gardens</b>        | Rain gardens are small, shallow depressions that receive runoff from roofs and hard surfaces and are made up of vegetation that can withstand being inundated with water for up to 48 hours. They are an infiltration method that allows runoff to accumulate in the shallow depression, increase the amount of water entering the soil whilst filtering out sediment and pollutants, and reduce rates of runoff and volumes of surface water. Downpipes from roof guttering are often disconnected from sewers and redirected into these gardens.              |
| <b>Detention Basins</b>    | Detention basins are storage basins on open, usually flat areas of grass that are normally dry, except during a storm event. They store rainwater and surface water runoff then allow it to slowly soak into the ground, reducing the risk of flooding to the local area. They also filtrate the water to remove sediment and pollutants. When wet, they can be used as a pond for wildlife which will increase the biodiversity of the area and may be useful as an educational resource. When dry, the area is a safe space for leisure activities.           |
| <b>Retention Ponds</b>     | Retention ponds are areas of open and shallow water designed to store rainwater and attenuate runoff at a controlled rate during and after a rainfall event. They differ from detention basins as they are intended to hold water permanently, with the water level rising temporarily during heavy rainfall to accommodate for more water.   |
| <b>Wetlands</b>            | Wetlands are similar to retention ponds and are shallow, marshy areas filled mostly with aquatic vegetation. Wetlands attenuate and slow the flow of rainwater runoff, whilst filtering the water and improving its quality before it enters local watercourses. They remove fine sediments, dissolved nutrients, metals and particulates from the water by filtration through the vegetation and aerobic decomposition.  |

# Co-benefits of NFM projects

| Co-benefits  | Landowners   | Buyers   | Investors                                  | Government  | Community   |
|--|--|--|--|---|---|
| <b>Flood Mitigation</b>  | Additional revenue stream  | Decreased flood risk (downstream businesses); Decreased insurance costs            | Investing in building resilience.          | Avoided costs of flood response; decreased infrastructure costs; carbon savings | Increased resilience to flooding.                                 |
| <b>Water resources</b>   |  | Improved water availability for the water sector, reduced risk of over abstraction | Investing in water security measures       | Improved water security   |   |
| <b>Biodiversity Uplift through creation of habitats/connectivity</b> | Increased pollinator numbers; Potential additional income stream (BNG) | Source of BNG units for purchase   | Additional revenue stream                  | Contribute to 30x30 biodiversity targets etc.                                   | Improved ecosystems; Contribute to Local Nature Recovery Strategy |
| <b>Carbon Sequestration</b>  | Potential additional income stream (carbon)                            | Potential source of carbon credits   | Potential source of carbon credits         |   |   |
| <b>Improved soil quality</b>   | Improved soil fertility, supply chain resilience                       |  |  |   |   |
| <b>Decreased nutrient runoff (improved water quality)</b>            |  | Water Companies: decreased treatment costs   |  | Contribute to water quality targets in EIP                                      | Improved water quality  |
| <b>Eco-tourism</b>   | Potential additional income stream                                     |  | Additional revenue stream to lend against. | Additional tax revenue.   | Added revenue; recreation opportunities                           |
| <b>Recreation (improved attractiveness/access to green space)</b>    | Potential additional income stream                                     | ESG and CSR benefits   | ESG and CSR benefits                       |   | Improved mental health; increased community engagement            |

# Case Studies

# Aire Resilience Company

## Background

The Boxing Day 2015 floods in Leeds caused by Storm Eva flooded over 4,000 homes and 2,000 residential properties, causing in excess of £500 million of damage. In response to this, the Leeds Flood Alleviation Scheme (LFAS) was designed to protect Leeds city centre in the event of another storm of similar magnitude to Storm Eva, and is nearing completion.

However, due to climate change there is a limit to how much additional water these defences can manage before they are at risk themselves of being overwhelmed. Alongside the hard infrastructure, LFAS is implementing NFM interventions such as tree planting and soil and land management in the upper Aire catchment to lower the peak flow of water passing through Leeds during a storm event. However, sufficient funding is not available to LFAS to complete the infrastructure work, and to ensure the ongoing maintenance and management of the NFM interventions – putting the efficacy of these interventions in reducing the peak flood flow in doubt.

In response to the 2015 floods and building on the success of the Wyre Natural Flood Management Project, the Aire Resilience Company (ARC) has been set up as a not-for-profit Community Interest Company (CIC). Supported by the Environment Agency, Leeds City Council, the local RFCC, Rivers Trust and Nature Finance, ARC will look to raise finance through a blend of public and private monies, enabling the delivery of NFM interventions in the landscape and the long-term maintenance of the assets.

Alongside contributing to the long-term flood risk protection to Leeds city centre, ARC looks to provide a blueprint as to how multi-stakeholder NFM projects can be developed, funded and delivered at scale to combat future flood risk, exacerbated by climate change, across the UK.

ARC will secure public sector grant funding and will distribute this funding to delivery partners to implement NFM interventions in the landscape. The project will seek to attract funding from private sector buyers that will be distributed to land managers to cover the maintenance costs of the NFM assets. Maintenance and adaptive management are vital in ensuring the ongoing delivery of flood risk reduction into the future.

## The process

Contracts will be agreed with farmers and landowners in the catchment to host and maintain a range of long-term, targeted NFM measures on their land in return for an annual payment.

Contracts for the delivery of NFM measures are agreed with a range of parties, including environmental NGOs active in the catchment, local businesses, and the farmers and landowners themselves.

To project will then look to agree an ecosystem services contract with a consortium of buyers made up of organisations in and around Leeds. This contract will bring multiple parties together to contribute towards the maintenance and upkeep of the NFM measures to ensure that they remain in place when we need them.

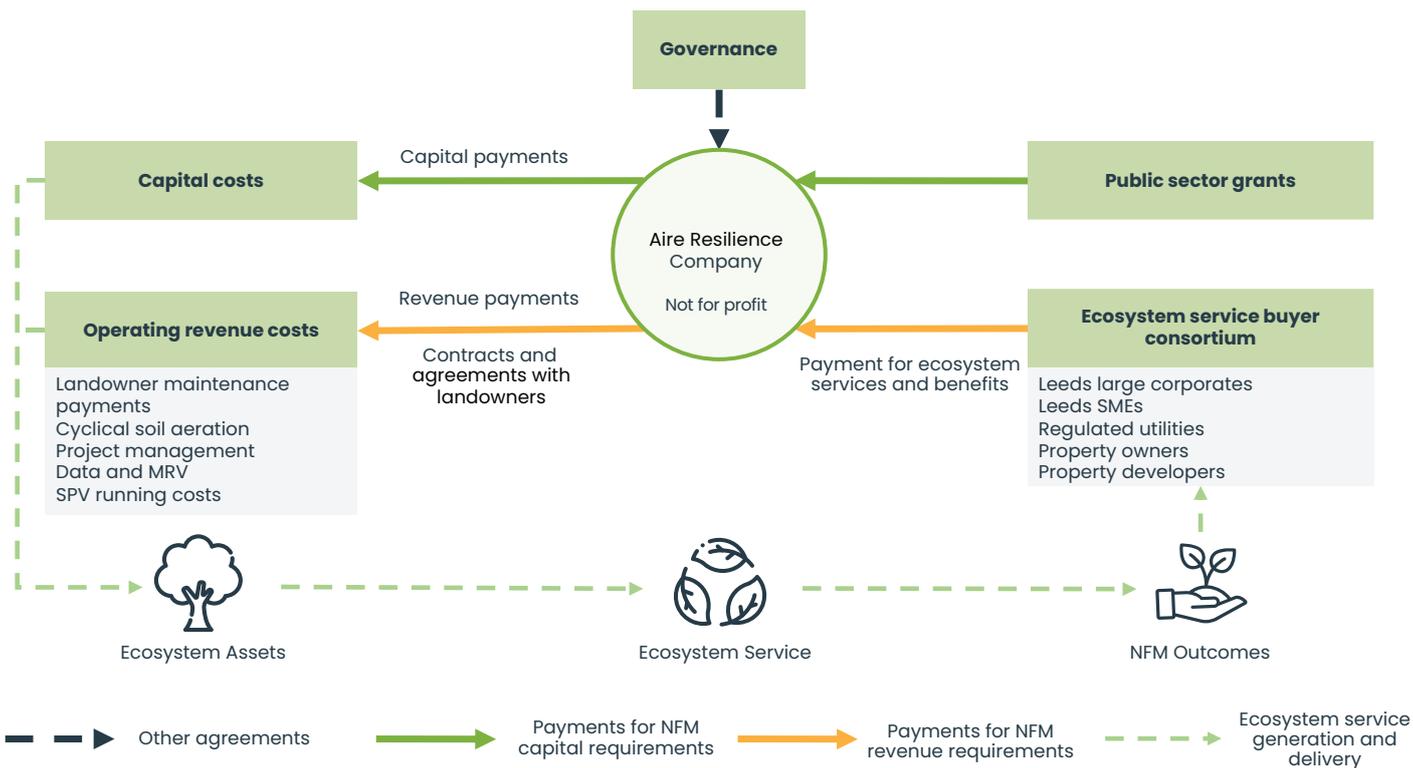


Figure 10: Aire Resilience Company proposed financial model.

### Approach to buyers

Through funding secured by the local RFCC, the project team has dedicated resource to bring together potential private sector buyers of NFM, and to assess the potential business case for funding with each of the potential buyers. To attract as wide an array of beneficiaries as possible, the project team engaged with already existing private sector networks. These included the Chamber of Commerce, large legal firms in the region, and the Leeds Business Improvement District. Other potential networks to leverage could include Economic Development Units and Local Enterprise Partnerships.

This has helped the project reach a large number of potential buyers, without having to engage with multiple, individual SME businesses which would have been prohibitively time consuming and costly.

### Key project details:

The project is led by a team from Leeds City Council, EA and Rivers Trust supported by a Steering Group of wider public, private and third sector partners.

ARC intends to deliver an NFM intervention at scale in the upper Aire catchment aimed at delivering a 5% peak flow reduction where the Aire enters Leeds at Kirkstall in a Storm Eva (1 in 200 year) type flood event by 2069 incorporating climate change predictions.

Hydrological modelling has been undertaken and funded by the EA and Leeds City Council to identify optimal NFM interventions and sub-catchment locations.



The modelled NFM interventions include a combination of tree planting (535ha funded through public sector grants), soil aeration (1,240 ha costing £150k p.a. on a 3 yearly cycle) and other targeted NFM measures design to slow the flow of water (£2m capital and delivery cost). The project requires a capital investment of £2 million and has an associated revenue requirement of £450,000 per annum.

Public sector grant funding will be used to cover the capital costs of tree planting. The revenue requirement is intended to come from (largely) a private sector consortium in and around Leeds whose operations are or could be affected by flooding.

The initial contract with buyers and landowners will be 5 years as this was seen as acceptable by the landowners who were reticent at signing into something more long term that may restrict their future business.

A programme management and MRV plan has been designed and the model is both extendable beyond 5 years and scalable. The initial limit of 5 years is a pragmatic one based on feedback from both businesses and landowners. Should all parties have confidence in the interventions functionality, an extension may be arranged.

# Connecting the Culm



## Background

The Connecting the Culm (CtC) project is a long-term, catchment-wide environmental recovery project for the 100 square mile Culm catchment in Devon, UK. The project is managed by the Blackdown Hills National Landscape and was initiated through an EU Interreg 2 Seas funded project (Co-Adapt 2019-23) with the Environment Agency, Devon County Council and Mid-Devon District Council, all providing additional funding. These UK partners and other agencies continue to support the project as it develops to achieve its long-term goals.

Over recent decades, the Culm catchment has suffered from increased frequency and scale of flooding, decreasing water quality, decreasing biodiversity, and increasing incidences of drought exacerbated by climate change.<sup>121</sup> The main driver for these problems is climate change, but this is exacerbated by soil compaction in the catchment. This is often as a result of certain land management practices that reduce the soils ability to let rain water infiltrate into the soil, increasing surface run off and therefore the risk of flooding. This also causes soil to be washed into the river, taking any pollutants with it, having a negative impact on water quality. To address these issues, the Project group has developed a 25-year **Blueprint for the Culm**. There are seven key principles of this Blueprint, and these are summarised below.

<sup>121</sup> Devon County Council – Introduction to the River Culm. How the catchment works.

| Principle            | Description  |
|----------------------|--|
| <b>Flooding</b>      | Improve resilience to flooding so floodwaters don't threaten communities or damage homes, businesses, and critical transport infrastructure.   |
| <b>Drought</b>       | Improve resilience to drought so water levels sustain wildlife and are sufficient for farming and business even during periods of drought.   |
| <b>Water Quality</b> | Reduce pollution entering the river from all sources so that the Culm's water quality is rated as High, it supports thriving habitats and wildlife populations and is a pleasure for people to enjoy.  |
| <b>Wildlife</b>      | Rebuild a landscape that is rich in wildlife by improving the management of existing wildlife sites and connecting them together by creating new and improved habitats.  |
| <b>Carbon</b>        | Whilst delivering actions to improve resilience, restore as much carbon as possible in soils and woody vegetation to help reduce greenhouse gases in the atmosphere.   |
| <b>Access</b>        | Encourage and enable people of all backgrounds, ages, and abilities to connect with the river so that they can enjoy it to the full. Provide evidence and information to support wider improvements to transport and access issues that relate to the river. |
| <b>Heritage</b>      | Use an understanding of heritage to explore how people have lived with water in this valley through time and inform our actions for a resilient future.  |

**Table 18:** Connecting the Culm project's 25-year Blueprint for the Culm principles.<sup>122</sup>

In 2022, the project received funding from Round Two of the UK Government's Natural Environment Investment Readiness Fund (NEIRF), to explore the potential use of green finance to enable delivery of nature-based solutions (NbS) in the catchment.

To address increased flood risk in the catchment, the Project has mapped out possible NbS interventions and modelled the potential resilience benefits these could have on 'tipping points' (infrastructure) in the system. These have been termed 'Potential Areas of Improved Resilience' (PAIRS). Proposed multi-benefit NbS interventions include:

- Improvements to soil management
- Tree planting and riparian tree planting
- Leaky barriers linked to floodplain reconnection
- Remeandering of the river and expanding temporary water storage
- Ponds and sediment traps

<sup>122</sup> <https://map.devon.gov.uk/portal/apps/storymaps/collections/42f84b515cd64c46ac338649d76d6aa7?item=5>

Through these NbS interventions the project is looking to make: 200 properties and businesses currently at risk of flooding, more resilient; reduce peak flood flows at a major rail crossing by up to 21%; provide 850,000 tonnes of carbon sequestration over a 50-year time span; establish ~790 ha of new woodland and tree cover; restore function to 6,000 hectares of vulnerable and compacted soils; and restore ecological and hydrological function to ~3,000 hectares of existing priority habitat.

These interventions will be implemented on land holdings across the catchment, starting with 30 pioneer holdings (already delivering £200k of NbS), with more expected to join in 2024 and beyond – with a long-term goal of interventions influencing 10,000 hectares (one third of the catchment).

## **The finances**

Initial projections of the capital costs of installing the nature-based solutions as part of the 25-year programme is £20 million. Further costs of £3.9 million per year for replacements, maintenance and adaptive management processes have also been identified.

We have used a natural capital valuation tool (developed with partners through NEIRF) to calculate the 'funding gap' and have made various assumptions, including that 75% of the NbS (upfront and revenue) costs will be covered by Environmental Land Management schemes. The funding gap to secure through green finance is therefore:

- £5m upfront capital
- £2.2m/ year for 25 years for on-going revenue payments

To implement the NbS interventions and to maintain these assets over the 25-year period, the project is investigating the feasibility of raising funding from a variety of sources. These may include one or a blend of the following options.

### **Upfront funding:**

1. Public sector grant funding
2. Private sector loan and/or equity
3. Concessional public sector loans

### **Operational and revenue funding:**

1. Payments for NbS outcomes – including performance management payments from critical infrastructure providers
2. Payments for carbon credits and/or Biodiversity Net Gain units
3. Agri-Environment schemes
4. Corporate stakeholder partnerships (e.g. South West Water)

The project is also investigating the potential for corporate Environmental, Social & Governance (ESG) funding, both for upfront and operational funding. We are collaborating with neighbouring projects/ catchments across farmer clusters, to work with potential ESG buyers to establish what scale of delivery is needed to attract this market.

The primary ecosystem service delivered in this project is the reduction in peak flood flow, achieved by NbS interventions that slow and store water (approximately 250,000 cubic metres) in the catchment. Through these NFM interventions, wider environmental co-benefits will be generated including boosting biodiversity, increased carbon storage, and improved water quality.

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### Potential buyers

To secure sufficient revenue streams, the project is investigating the role of ecosystem service buyers who would be willing to pay for reduced flood risk and/or the other environmental co-benefits generated. The project estimates that up to 85,000 Biodiversity Net Gain (BNG) units and 680,000 Woodland Carbon Units could be generated from this Project, presenting the possibility of securing future investment opportunities. Some potential buyers and their potential drivers for paying for ecosystem services have been outlined below:

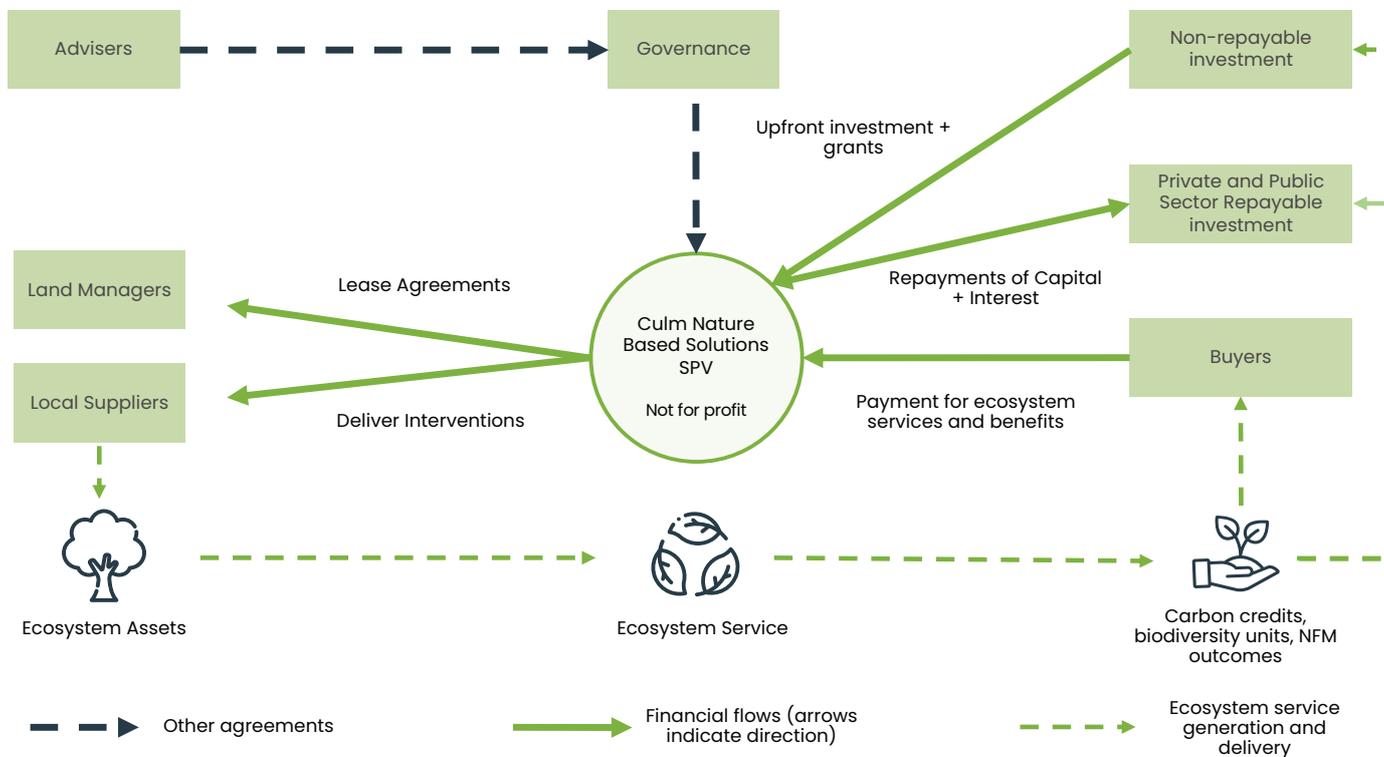
| Potential buyers     | Ecosystem service                            | Drivers   |
|----------------------|--|---|
| National Highways    | Improved water quality                       | The M5 motorway has a negative impact on water quality in the Culm. Addressing this through NFM interventions could be a cost-beneficial method to achieve this for National Highways.  |
| Network Rail         | Reduced flood risk                           | The Great Western Railway Bristol to Exeter line floods at approximately at a 2-year exceedance probability, with 13 events since 2008. Network Rail bears the cost of repairs to the network and is required to reimburse network operators for any delays caused. |
| South West Water     | Improved water quality<br>Reduced flood risk | Requirement to reduce the impact of flooding on sewer networks, that leads to overflows and deterioration of water quality in the catchment. Reducing the load on the sewer network could be a cost-beneficial approach for South West Water to take.               |
| Devon County Council | Reduced flood risk                           | Devon County Council are the lead local flood risk authority for surface water  |

**Table 19:** Potential buyers of ecosystem services in the Connecting the Culm project

### Proposed structure

The project is investigating the potential need to establish a Special Purpose Vehicle (SPV) to manage contracts with buyers, investors and land managers, and capital flows between investors, buyers, land managers and farmers. The SPV will look to enter into long-term lease agreements with land managers to implement and maintain NbS assets to ensure ecosystem service delivery in the long term.

An adaptive management approach will be taken by the project (see also **Wyre Natural Flood Management Project case study**) to allow for intended outcomes and/or interventions to be adjusted over time. An outline of the potential model is included below.



**Figure 11:** Connecting the culm proposed financial model

A potentially alternative model is being developed with the Environmental Farmers Group (EFG), that may shortcut the need for the Connecting the Culm lead partners to establish an SPV themselves..

### Challenges

The lack of a common metric for measuring the performance of NbS is a major barrier. The Project has created a number of ways in which performance of flood related NbS can be measured. These are cubic metres of water stored, and soil water infiltration potential. but a nationally recognised standard is required to make real progress in securing expressions of interest from buyers and investors.

There is a mindset in many major utility/ infrastructure organisations that tends to favour the certainty that arises from applying hard engineered ‘grey’ solutions at the point of environmental impact. The project has developed long-term relationships with asset managers in these organisations because it had access to a well-evidenced hydrological model that provided a convincing demonstration of the likely effects of climate change in the long term.

A significant barrier has been the capacity and appetite amongst the farming community for exploring the novel territory that green finance represents, and for implementing some NbS on farm. Through co-designing NbS that best fits small pastoral farm businesses (typically found in the area) and delivers flood risk outcomes, the project is increasing uptake within the farming community.

# The Eddleston Water Project

## Background

The Eddleston Water Project<sup>123</sup> is a flood resilience and habitat restoration project near Peebles, Scotland. The catchment has undergone extensive changes over the last 500 years, with clearing of native woodland, land drainage, river straightening and afforestation with non-native conifers all contributing to alter how the land drains. Much of the 12 km long main river stem from Waterheads to Peebles was straightened, channelised and embanked in the 19th century to enable the building of a road and a railway, such that connections with its floodplain have been lost. The river was classified by SEPA as at 'bad' ecological status in 2009 (using EU Water Framework Directive (WFD) criteria). In 2010, SEPA's 1 in 200-year flood risk map showed 589 properties to be at risk of surface water flooding (521 of these being in Peebles).

The project was started in 2010 primarily to reduce flood risk and restore habitats at a catchment scale, and ultimately to gather an evidence base on the effectiveness of Natural Flood Management (NFM) for wider use. At the time, Scotland's Flood Risk Management Act (2009) was being developed and the Scottish Government recognised the need for a stronger evidence base for NFM. The Act (Section 20) now requires that for any flood scheme being developed, one must assess to what extent and how the 'natural characteristics' of a catchment can also help reduce flood risk.

The project has been managed by Tweed Forum and directed by a small Project Board chaired by the Scottish Government and the Scottish Environment Protection Agency (SEPA). The Board was subsequently expanded to include Scottish Borders Council (SBC), and is supported by the two main science providers – British Geological Survey (BGS) and the University of Dundee. Further advice is available from a Steering Group of key stakeholders, including Scottish Natural Heritage (SNH), Forest and Land Scotland (FLS), Forest Research (FR), Tweed Foundation, National Farmers Union (Scotland), Scottish Land and Estates, and the Environment Agency. The participation and support of local farmers and landowners in the Eddleston valley is entirely voluntary.

The project began in 2010, when the University of Dundee as the Project's main research provider and cbec ecoengineering produced a scoping study that identified potential NFM measures. The team gathered two years of baseline data before undertaking any capital works, including one year which saw the highest recent river levels on record.

In 2011 the project team set up a comprehensive hydrological and ecological monitoring network to measure the effects of the NFM interventions. This includes an array of instruments across the whole catchment measuring rain and other weather parameters, river levels and flows, groundwater and soil moisture to identify how and where flood runoff is initiated and how floods then move downstream.

## Funding project development

The initial phase took around two years, and costs totalled £355,000, including the feasibility study, the monitoring network, baselining, and engagement with farmers. This first phase was predominantly funded by the Scottish Government. Further costs over the following 15 years included the full monitoring, evaluation, and modelling of the project (£1,157,342), and the design and capital works of the

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<sup>123</sup> Tweed Forum: Eddleston Water Project Database

NFM interventions (£1,251,265). Total costs were ~£2,800,000, though 'help in kind' was a significant component of the project's resources. Notably, this included time from SEPA, which undertook all the extensive hydromorphological and ecological monitoring, and the University of Dundee.

The majority of funding came from the Scottish Government and the EU Interreg Programme (for ongoing monitoring). However, the project also secured grants from a variety of sources, including SEPA, the Forestry Grant Scheme, the Nature Restoration Fund (NatureScot), Scottish Power, CEMEX, Scottish Natural Heritage (SNH), Scottish Borders Council (SBC), Forest and Land Scotland (FLS), Forest Research (FR), CEMEX, Forest Carbon, the Woodland Trust and some carbon finance, with the land owners and managers themselves being important funders and supporters.

While the primary focus of the project was NFM, the team also emphasised the other ecosystem service gains, such as biodiversity, amenity value, carbon sequestration and water quality. The project team also sold a small number of carbon credits from its native woodland creation through the Woodland Carbon Code.

## **Flood Risk Alleviation Outcomes**

The Tweed forum had a key role in engaging with farmers. Working with 20 farmers across the catchment, since 2012 Tweed Forum and partners have been able to install a wide range of NFM measures. The project has recreated 'lost' hydrological and ecological processes at both the river reach and landscape level. Measures implemented across the 69km<sup>2</sup> catchment include the creation of 38 new ponds, the re-meandering of 3.5km of once-straightened river channels, more than 100 engineered log structures to slow excess water, and the planting of over 330,000 native trees.

As a result, strong empirical evidence demonstrates that engineered log structures and associated ponds and riparian planting significantly increased 'lag time' by 2.6 hours or more in each of the NFM headwater sites.<sup>124</sup> In the upper catchment, the two-year return period flood peak has reduced by ~30% post NFM measures and by ~8% in the lower catchment. Interestingly, the project's model of landscape-scale tree planting has shown almost a 20% reduction in peak flood flows as a result of woodland planting, with infiltration of rainfall under mature broadleaf woodland being five to eight times that under grazed pasture or conifers. The creation of a larger pond on the Kidston Mill floodplain saw peak flow at Peebles being reduced by 21%.

NFM measures already implemented show a positive net present value (NPV) of £950k from flood damages avoided. For a hypothetical maximum use of NFM in the catchment this could increase to £2,850k (NPV taken over 100yrs). Looking at additional benefits, re-meandering added between 8% and 46% more channel length, thus significantly improving wildlife habitats, and creating flood storage ponds also improved their surrounding biodiversity. Using best practice methods, the total value of all other benefits (ecosystem services) delivered by the current NFM measures is estimated at £4.2 million (NPV).

Using the BEST valuation tool – which Mott MacDonald identified as the most efficient tool to integrate multiple benefits arising in addition to NFM into decision-making processes<sup>125</sup> – it was found that the total value of other benefits delivered by the NFM measures is four times higher than the flood damages avoided alone. The economic value of the multiple benefits of restoration measures can therefore be demonstrated. One of the takeaways of the project was the importance of gathering supportive information on such co-benefits to improve the chances of securing funding. Other emerging lessons include that appreciable flood reduction will only occur through a wide array of NFM interventions throughout the whole catchment, and that NFM works best at small spatial scales and at low levels of flood risk. One of the main factors having contributed to the project success, was that the Tweed Forum acted as a trusted intermediary to interact with farmers and landowners. This significantly increased the voluntary uptake of NFM measures.

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<sup>124</sup> Tweed Forum (2021): Eddleston Water 2021 Report

<sup>125</sup> Mott Macdonald (2020): Integrating natural capital into flood risk management appraisal

# IGNITION Project

## Background

The IGNITION project was a EUR 5 million project that was 80% funded by the European Union's (EU) Urban Innovation Action Fund. Led by Greater Manchester Combined Authority, the project looked to address increasing climate-related risks that the city faces, including increased surface water and sewer flooding, by developing a retrofitting programme for Sustainable Drainage Systems (SuDS) in the city region. Part of the project investigated the potential for attracting repayable private finance to fund part of the retrofit programme.

To finance the retrofitting of SuDS in the area, the IGNITION project looked to identify potential revenue streams that could be created in order to repay initial upfront investment. A possible revenue stream was identified as coming from forecast potential reductions in site owners' drainage charges, that could be shared with the project over a period of time. This came from an incentive scheme run by United Utilities.

The scheme focusses on non-domestic customers, whose surface water drainage charges are based on the area of a customers' site which drains into the public sewer network. This gives the customer a 'charging band' that defines how much the site is charged.

The incentivisation scheme removes the area of SuDS implemented on a site, from the calculation for the user's chargeable area. This is a 100% reduction for disconnection SuDS, and an 80% discount for attenuation SuDS including green roofs, detention basins, and ponds and wetlands (among others).<sup>126</sup> Therefore, the installation of SuDS by a site owner, will result in a reduction in drainage charges going forward.

The project investigated the possibility of capturing the potential future savings derived from implementing SuDS on a site, to generate a revenue stream over time, to repay upfront capital investment used to fund the retrofitting of the SuDS. Savings would need to be captured across a sufficient number of beneficiaries to cover both the upfront costs of SuDS retrofitting and to repay initial investment.

## Challenges in developing revenue streams

The Project experienced a number of challenges when trying to secure revenue streams to attract upfront investment:<sup>127</sup>

1. Savings from SuDS implementation, even when aggregated over a number of sites, would be small compared with the cost of design and construction.
2. Saving generated by SuDS retrofit could take as long as 50-100 years to repay initial investment – much longer than traditional impact investment timeframes of 3-7 years.
3. Charging bands are reviewed annually by United Utilities leading to uncertainty about the projects ability to generate revenue streams in the long-term.
4. Some organisations may be unwilling to pass on savings to the project.

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<sup>126</sup> <https://www.unitedutilities.com/Business-services/business-customers/sustainable-drainage-systems/>

<sup>127</sup> <https://www.greatermanchester-ca.gov.uk/what-we-do/environment/natural-environment/ignition/the-ignition-project-interim-report-april-2021/>

5. Some benefits of SuDS, such as health and wellbeing, are not monetisable.
6. Potential revenue from future increased site value from improvements to green space cannot be monetised until property is sold.
7. Capital and operational cost uncertainty of SuDS.

Due to uncertainty in generating revenue streams, the Project investigated a ‘blended finance’ approach, whereby upfront investment would be sought alongside non-repayable sources of funding to implement the design and construction of SuDS. Other potential funders could be government sources, philanthropic funders, and or the Regional Flood and Coastal Committee. This would mean that the drainage savings would need to repay a smaller percentage of the total capital outlay to design and implement the retrofit of SuDS.

### Outline blended finance approach

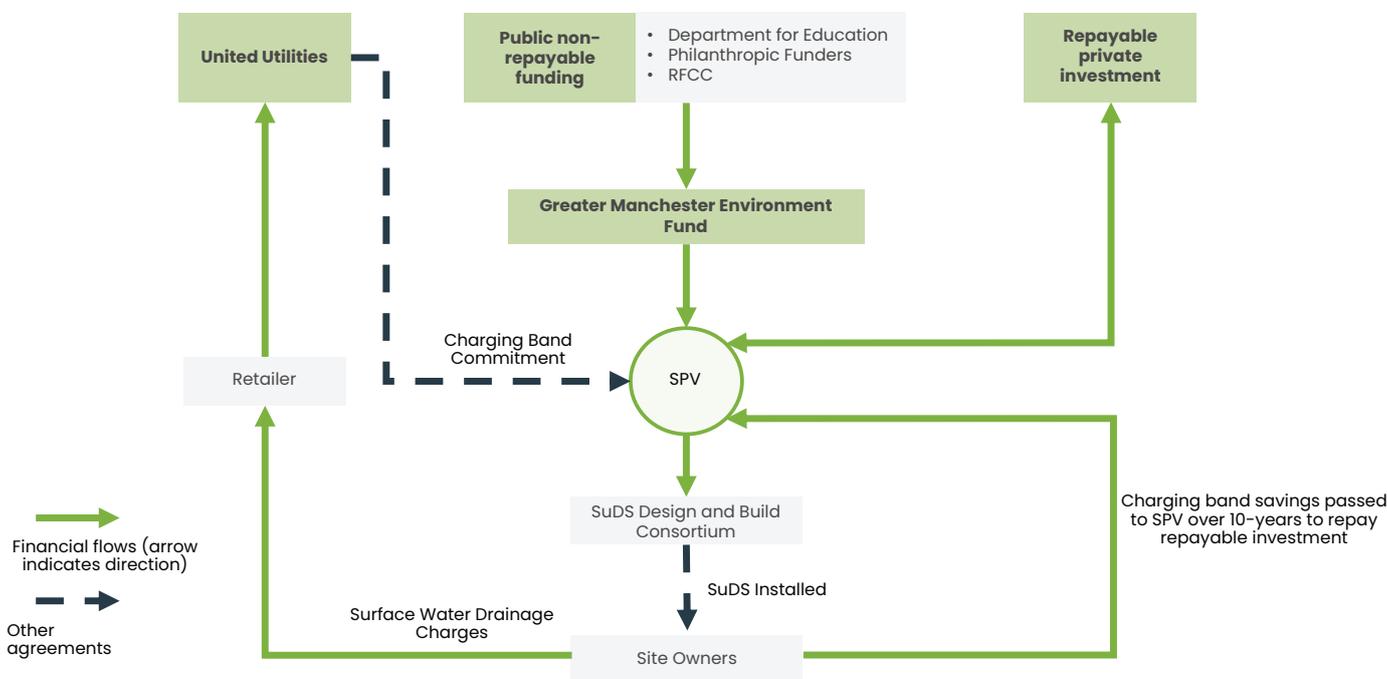


Figure 12: IGNITION Project proposed financial model

### Next steps

To attract a broader range of beneficiaries, the project has recommended several next steps, including:

1. Develop the evidence base for the wider co-benefits of SuDS beyond water quality and flood risk management, for the economic benefits to local businesses, and the value of health and wellbeing improvements.
2. Development of urban co-investment ‘Hot Spots’ – areas where co-investment could deliver benefits to multiple stakeholders.

Create a pipeline of ‘pathfinder’ projects to build the evidence base for securing revenue streams from multiple potential buyers to repay initial

# Landscape Enterprise Networks

Landscape Enterprise Networks (LENs) is an initiative launched through a collaboration between Nestlé Purina and 3keel and supported by Diageo, Nestlé and PepsiCo. It promotes sustainable agriculture and helps mitigate material risks in value chains, ultimately aiming to regenerate landscapes on which businesses, communities and nature depend.

LENs brings together beneficiaries of landscape scale environmental change together with farmers in an aggregation model to achieve long-term, positive impacts.

The programme provides training and technical assistance to farmers to help them adopt more sustainable practices, such as agroforestry, soil conservation, and water management. LENs then brokers negotiations and transactions between buyers of nature-based solutions and groups of land managers who deliver them.

The program also involves collaboration with local governments, non-governmental organisations, and other stakeholders, such as water companies, to support the development of sustainable agriculture policies and the creation of ecosystem services markets. Currently, there are LENs groups in Yorkshire, East of England, Hungary, Poland, and Italy, with others being developed in Scotland and Romania.

The first step in the LENs process is 'identifying organisations that have a shared interest in the performance of a landscape and its assets. Landscape assets include soils, rivers and streams and provide services such as resilient crop production, mitigating flood risk, improving water quality, reducing GHG emissions, or increased biodiversity. The next step is to define a common specification for the needs shared by these demand-side partners. Businesses invest jointly in measures and often finance a variety of environmental outcomes across the same landscape.

The supply side is engaged to define what can be delivered. LENs will then work to broker a deal between the two groups.

Results and impacts of the initiatives are monitored, reported and verified by external experts. The medium- and long-term aim is to create a self-financing programme, with a small percentage of each trade funding an independent, local delivery organisation, which convenes the demand and supply sides, facilitates transactions and builds the pipeline of trades. Regional LENs are supported by the LENs Company Ltd, which provides the standard and governance for the program.

In the East of England, a LENs transaction was completed in 2021 through identifying Nestlé Purina, Cereal Partners UK, West Northamptonshire Council and Anglian Water as stakeholders with overlapping interests in the performance of the landscape. The transaction was valued at £888,000 with the aim of using nature-based solutions to achieve outcomes including resilient agricultural supply chains, flood risk mitigation, water quality improvements, GHG emissions reduction, carbon sequestration and increase in agricultural land managed in a more 'regenerative way'.

Active stakeholders in the East of England LENs model now include Affinity Water, Anglian Water, Cargill, Cereal Partners UK, Nestlé Purina and West Northamptonshire Council and this consortium is now looking to engage farmers to co-procure ecosystem service outcomes to help meet their various needs. The value of the next trade is expected to be £3.78 million, and the number of farmers engaged has now more than doubled.<sup>128</sup>

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<sup>128</sup> <https://landscapeenterprisenetworks.com/how-lens-works/>

# The role of ecosystem engineers in natural flood management

Beavers build dams across small watercourses which slow the flow of water and create diverse wetland habitats. Hydrological research conducted at multiple sites across England has shown that beaver dams reduce downstream peak flows by an average of 30%, even in wet conditions when downstream flood risk is highest.<sup>129</sup> These findings are supported by evidence from mainland Europe<sup>130</sup> and North America.<sup>131</sup>

Beavers and the wetlands they create are associated with a range of co-benefits in addition to increased flood resilience. The storage and gradual release of water from beaver wetlands can help sustain streamflow during drought conditions.<sup>132</sup> Beaver wetlands also filter sediments and other pollutants from the water, improving downstream water quality.<sup>133</sup> The diverse mosaic of habitats within a beaver wetland are associated with high plant diversity<sup>134</sup> and increased wildlife abundance, including protected mammals such as otter and water vole.<sup>135</sup> As a charismatic animal which creates nature-rich wetlands, beavers can also provide significant well-being benefits for people who spend time in their habitats.<sup>136</sup>

One of the challenges of using beavers as a natural flood management (NFM) strategy is the uncertainty associated with their movements in the landscape and the longevity of hydrological benefits they will deliver in a particular location. The likelihood of beavers relocating can be minimised by ensuring that a continuous supply of food – particularly willow (*Salix* spp.) – is available close to watercourses.<sup>137</sup> The resilience of beaver dams and other NFM interventions can also be enhanced by combining different NFM approaches – including beavers – within a catchment. The Devon Resilience Innovation Project is piloting this approach.<sup>138</sup> [See also [Spains Hall Estate Case Study](#)]

One of the barriers to expansion of NFM projects with beavers is that traditional flood mitigation funds are designed for projects which require large upfront capital payments with limited and relatively restricted options for providing revenue payments to landowners. For projects involving wetland creation and/or expansion using wild beavers, the upfront capital costs are typically small but the opportunity costs to landowners can be significant. The downstream flow attenuation benefits of beaver wetlands are likely to remain restricted in scale unless positive financial incentives can be provided for landowners to deliver wetland expansion in priority areas of a catchment.

<sup>129</sup> Puttock, A., Graham, H.A., Ashe, J., Luscombe, D.J. and Brazier, R.E., 2021. Beaver dams attenuate flow: A multi-site study. *Hydrological processes*, 35(2), p.e14017.

<sup>130</sup> Nyssen, J., Pontzele, J. and Billi, P., 2011. Effect of beaver dams on the hydrology of small mountain streams: example from the Chevral in the Ourthe Orientale basin, Ardennes, Belgium. *Journal of Hydrology*, 402(1-2), pp.92-102.

<sup>131</sup> Westbrook, C.J., Ronnquist, A. and Bedard-Haughn, A., 2020. Hydrological functioning of a beaver dam sequence and regional dam persistence during an extreme rainstorm. *Hydrological Processes*, 34(18), pp.3726-3737.

<sup>132</sup> Larsen, A., Larsen, J.R. and Lane, S.N., 2021. Dam builders and their works: Beaver influences on the structure and function of river corridor hydrology, geomorphology, biogeochemistry and ecosystems. *Earth-Science Reviews*, 218, p.103623.

<sup>133</sup> Puttock, A., Graham, H.A., Cunliffe, A.M., Elliott, M. and Brazier, R.E., 2017. Eurasian beaver activity increases water storage, attenuates flow and mitigates diffuse pollution from intensively-managed grasslands. *Science of the Total Environment*, 576, pp.430-443.

<sup>134</sup> Willby, N.J., Law, A., Levanoni, O., Foster, G. and Ecke, F., 2018. Rewilding wetlands: beaver as agents of within-habitat heterogeneity and the responses of contrasting biota. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 373(1761), p.20170444.

<sup>135</sup> Brazier, R.E., Puttock, A., Graham, H.A., Auster, R.E., Davies, K.H. and Brown, C.M., 2021. Beaver: Nature's ecosystem engineers. *Wiley Interdisciplinary Reviews: Water*, 8(1), p.e1494.

<sup>136</sup> Gandy, S. and Watts, R., 2021. Potential psychological benefits of nature enrichment through the reintroduction of the Eurasian beaver (*Castor fiber*) to Britain: A narrative literature review. *European Journal of Ecopsychology*, 7, pp.41-74.

<sup>137</sup> Rosell, F. and Campbell-Palmer, R., 2022. *Beavers: ecology, behaviour, conservation, and management*. Oxford University Press.

<sup>138</sup> <https://www.devon.gov.uk/drip/>



## Spains Hall Estate

Spains Hall Estate, a privately owned estate immediately upstream of the historic village of Finchingfield in north Essex, England, delivered a pilot NFM project with the Environment Agency (EA) in 2019, using man-made leaky dams and the first beavers to return to Essex.<sup>139</sup> The project tested the effectiveness of nature-led NFM in reducing flood risk to 18 properties on the EA's flood receptor database, four of which were, at the time, ceded to Flood Re. The pilot saw the estate, the EA, Anglian Eastern Regional Flood and Coastal Committee (AERFCC) and Coca-Cola Replenish (via the Rivers Trust) come together to pay for £40,000 of capital works. Timber leaky dams were constructed on the largest channel, and beavers were introduced to a four hectare, fenced, woodland tributary to create a wetland. Monitoring by the EA and Kings College London over 5 years suggested that the project was having a beneficial impact, so plans were drawn up to extend the work.

In 2022 the Estate devised a business plan to deliver over £1.2m of investment including creating two new beaver enclosures totalling 40 hectares (100 acres) on the main Finchingfield Brook, complementing the now deteriorating leaky dams. Capital grants of almost £400,000 to construct the beaver fence and associated infrastructure were secured from two private sector water companies; Essex and Suffolk Water's WINEP programme, and Anglian Water's Flood Partnerships Programme. Private sector funding was bundled with public sector capital grants from the Environment Agency WEIF programme, Anglian Eastern RFCC NFM programme and Lead Local Flood Authority Essex County Council capital programme.

The estate also voluntarily separately allocated land area within and outside the new beaver enclosures for additional, non-grant funded habitat works (including grassland and scrub establishment) designed to complement the NFM capital works whilst delivering extra outcomes linked to nature recovery, water quality, water resources and carbon. Biodiversity units (and voluntary biodiversity credits) are generated and sold by the estate from the land. Other ecosystem service outcomes are currently bundled within biodiversity deals.

This approach provides the long-term revenue security to maintain an extensive land use system that enhances the effectiveness and longevity of NFM capital works, delivers a greater range of outcomes, and contributes towards maintenance of NFM capital items. The BNG legal obligation means that the habitats established alongside the NFM works will remain in place for at least 30 years, providing a level of permanence for the voluntarily created NFM outcomes.

<sup>139</sup> [https://www.spainshallestate.co.uk/nfm\\_beavers](https://www.spainshallestate.co.uk/nfm_beavers)

# The Wyre River Natural Flood Management Project

The Wyre Catchment Natural Flood Management Project (Wyre NFM Project) aims to use nature-based solutions to reduce flood risk in the Wyre River catchment, using a blend of public and private finance. The Project is being led by the Rivers Trust, the Wyre Rivers Trust, Triodos Bank UK, the Environment Agency, United Utilities, Flood Re, Co-Op Insurance and the Esmée Fairbairn Foundation.

The project was started in 2016 after Storm Desmond flooded hundreds of properties in the Wyre catchment. It is one of four pilots initially funded by Defra, the Environment Agency, and the Esmée Fairbairn Foundation as part of the Natural Environment Investment Readiness Fund to trial the possibility of generating revenue streams from ecosystem services.

## Land Managers and Interventions

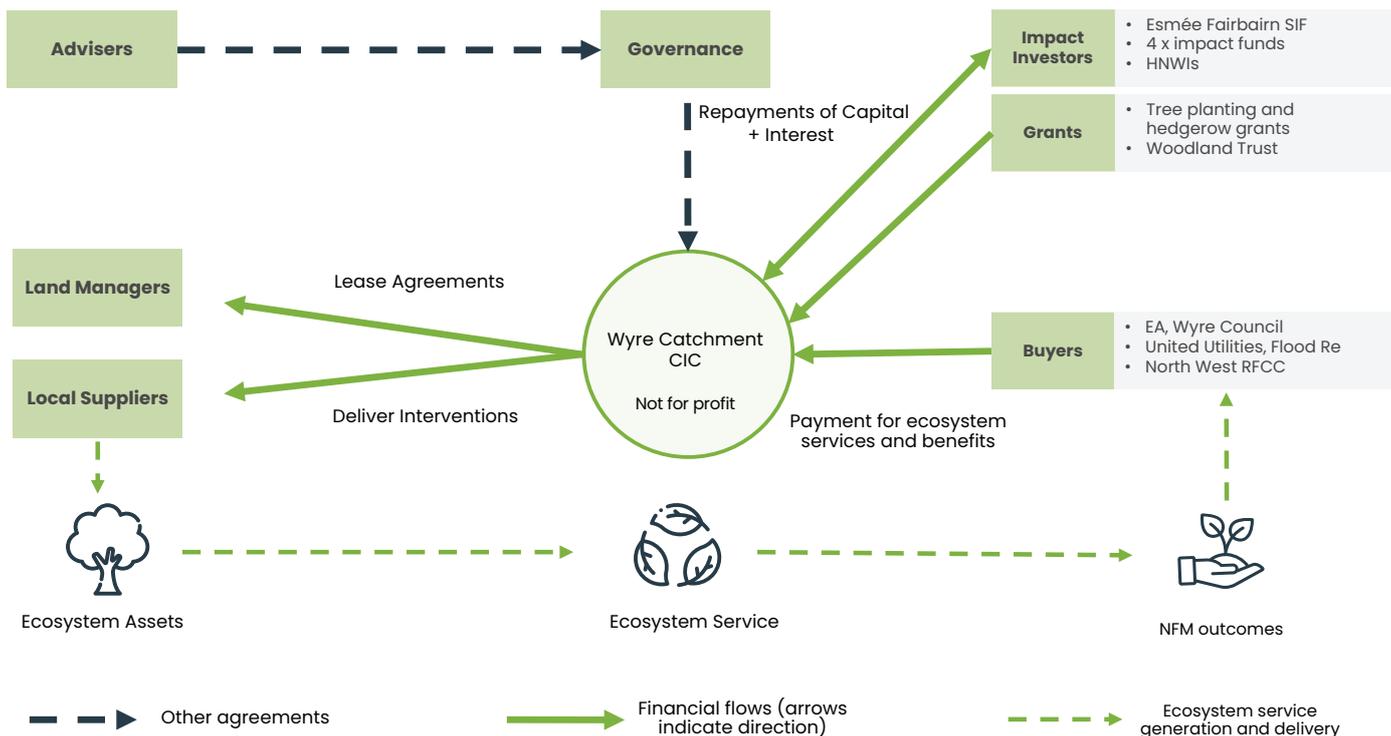
Firstly, the land managers – predominantly farmers – are responsible for hosting and maintaining the nature-based interventions that help to reduce flood risk. The obligation is in place over a nine-year period, with the potential to extend up to 50 years. The landowners or land managers receive an annual payment for hosting and maintaining the interventions, with the potential for additional payments if certain biodiversity targets are achieved. The Project has developed a delivery plan of these interventions over 70 hectares, spread across more than 10 land holdings. The interventions include 39 hectares of woodland creation, 1710 leaky dams, 42 ponds and scrapes, and 10km of new bunded hedgerows.



**Figure 13:** A riparian buffer strip. The increased surface roughness within the buffer helps to slow surface flows of water. The removal of stock from the area also reduces soil compaction allowing for increased percolation of water into the soil. (©Sam Hope, Wyre Rivers Trust)

To make sure these interventions are performing, the Project has set up an ‘adaptive management phase’, with an initial five-year period that allows the interventions to be altered according to their performance data. This phase precedes the start of outcomes-based payments from the beneficiaries in Year Six, giving the Project a period for altering the interventions to optimise performance during peak flow events.

The interventions themselves are installed by the Wyre Rivers Trust and its volunteers. The estimated costs of the Project comprise £1.5 million of capital expenditure, and £50,000 a year in running costs, including the land manager payments and maintenance costs of the interventions.



**Figure 14:** Transaction structure of the Wyre NFM Project including multiple stakeholders involved

### Investors

To cover the £1.5m of up-front costs, a mix of public and private funding was used. Grants of £627,500 were issued over the first three years of the project for tree planting and hedgerow creation from the Woodland Trust. Private investment for the remaining £850,000 was agreed in the form of a nine-year loan, split into two complementary facilities that bring nine investors together, with the funds drawn down over three years and repayments due in years four to nine. The interest rate is set at 6%, and the impact investors have agreed to an ‘incentive reduction’ in the interest rate of 1% if the interventions deliver certain biodiversity targets, with part of these savings passed onto the land managers.

### Approach to buyers

To cover these costs, the Project identified beneficiaries to pay for the ecosystem services that these interventions generate. The five buyers identified were Flood Re, United Utilities, the Environment Agency, Wyre Council and the Northwest Regional Flood and Coastal Committee (RFCC). The buyers pay an annual project fee from Year One to cover the lease payments to land managers. This is conditional on the implementation and maintenance of the interventions. The outcomes-based payments start in Year Six when the performance data, gathered by the Wyre Rivers Trust, verifies the delivery of the ecosystem services.

The Project modelled the value of NFM benefits. Some 30 sites and assets were predicted to be impacted by the interventions within the area, including drinking and wastewater treatment works, and network pumping stations. It is estimated that the interventions will deliver a 5–15% reduction in flood impact, with a middle figure of 10% taken for the subsequent modelling. Some interventions are predicted to reduce peak flow by up to 20%. The Project team expects these interventions to last around 120 years. Taking this into account with the expected frequency of flooding over the 120-year period and historic costs from past flooding, the Project team modelled the financial savings from the reduced flood impact. United Utilities then agreed an annualised payment schedule that captured the value of the NFM benefits over this 120-year period.

## Co-benefits

Though the main ecosystem service that this project focused on is flood risk reduction, other benefits include up to 40 hectares of woodland creation and peatland restoration which will be submitted as separate projects under the Woodland Carbon Code and the Peatland Code. It also includes water stewardship measures captured under Replenish, a methodology of volumetric water-based accounting the Rivers Trust is using to approach corporates in the local area seeking to offset water usage. For biodiversity uplift the Project will use a custom-built biodiversity measurement framework that was co-developed with Defra. The latter is linked to an 'impact adjusted' finance mechanism with the institutional investors, whereupon if a biodiversity metric is met, the investors will receive a reduced interest rate.



**Figure 15:** An excavator creating a large pond at the base of a slope, on which a woodland has been created. (©Sam Hope, Wyre Rivers Trust)

It was estimated that the aggregated value of the ecosystem services being delivered outweighs the cost of creating and maintaining these interventions several times over. A total of £2m in ecosystem service payments is scheduled over the nine-year period.

To create a legal structure that had independence and removed risk from the Rivers Trust and Wyre Rivers Trust, the Project team established a not-for-profit Special Purpose Vehicle (SPV), The Wyre Catchment Community Interest Company (CIC). It acts as the legal entity through which capital flows for the Wyre NFM Project – including the aggregation of payments across buyers. Once the ecosystem services were modelled and the buyers and sellers were engaged, the Wyre Catchment CIC sourced external investment to provide the upfront capital and manage risk.

## **Risk sharing**

The external investment provides key risk-sharing features for the four stakeholder groups of the Project: the buyers, landowners, investors, and the charities (Rivers Trust and Wyre Rivers Trust). Financial risk primarily rests with the investors. At Year Six, if the performance data gathered on the interventions reveals that the ecosystem services have not been delivered as expected, the buyers then pay a reduced fee, and investors would face a loss of capital from this. Moreover, 80% of the interventions must be delivered by the end of Year Three, and if these are not delivered, the buyers have the option of reviewing contracts in Year Four, leaving the investors with no capital or interest repayments. Buyers carry less financial risk as they pay an annual project fee, meaning they would have paid fees for the first three years if they decided to exit on Year Four.

Some challenges needed to be overcome for the Project. One such challenge was that farmers wanted assurance they would not be excluded from future payments of Environmental Land Management schemes (ELMs). There were also existing agreements in place – Countryside Stewardship (CS) agreements – that posed the threat of penalties to farmers who hosted interventions on sites under these agreements. Defra and the Rural Payments Agency therefore provided a written statement to say that project participation wouldn't exclude farmers from ELMs participation or result in penalties from existing CS agreements.

The Wyre NFM Project team is now applying the learnings from this model to develop projects in other locations. The team notes however that each catchment is unique and will have its own requirements in implementing and financing natural flood management interventions.

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