

# Case Study 30. Sussex Flow Initiative

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**Main driver: Flood mitigation, Water Framework Directive**

**Project stage: In progress**



**Photo 1: Newly planted trees Sussex flow initiative project**

## **Project summary:**

Sussex Flow Initiative is an innovative partnership project between the Sussex Wildlife Trust, the Environment Agency and the Woodland Trust, based in the River Ouse catchment in East Sussex. The project aims to promote and deliver Natural Flood Management (NFM) approaches helping to create a landscape that is more resilient to flooding, drought and climate change, and which delivers enhanced biodiversity and natural services. The project team has been working with local landowners, community groups, volunteers, the Adur and Ouse Catchment Partnership and many other stakeholders since 2012.

Following extreme flooding in the town of Uckfield, East Sussex, in 2000, Durham University was commissioned to produce a model of the River Uck (a subcatchment of the River Ouse). This indicated that the addition of NFM measures along specific river reaches could, in combination, reduce the flood peak in Uckfield by up to  $12\text{m}^3\text{s}^{-1}$  (cumecs). In 2012, a pilot project – Trees on the River Uck (TrUck) – was formed with the aim of establishing whether it was possible to deliver multiple (flood) benefits as well as Water Framework Directive objectives. Through the work on TrUck it became clear that engagement with landowners and subsequent delivery would take time, particularly as Countryside Stewardship and Forestry grants were largely suspended or in transition during this period. It also became clear that putting the original Durham University model outputs into action on the ground was a great deal more complex than the model suggested. This forced the project to develop its own flooding models linking detailed local information to national datasets and drivers (for example, the Water Framework Directive).

## Project summary (continued):

After 5 years, the Sussex Flow Initiative had established sufficient momentum to start implementing NFM measures on a meaningful scale. The project has highlighted the multiple benefits possible with an NFM approach, and how these benefits can be targeted and applied across large landscapes. In 2014, it was time to move beyond the Uck subcatchment and TrUck became the Sussex Flow Initiative, expanding the work to look at the fluvial reaches of the upper Ouse along with the original River Uck boundary.

Since then the project team has been working closely with the Ouse and Adur Rivers Trust to create subcatchment plans. These plans highlight whole suites of measures which can be applied to improve landscape and environmental quality, as well as natural services and NFM. The following NFM measures are the main focus of the demonstration work:

- natural woody flow deflectors and diverters
- washland meadows
- woodlands
- hedgerows
- shelter belts
- temporary natural water retention features
- land drainage modification
- seasonal and permanent open water features such as ponds and scrapes
- promoting positive soil stewardship and land management

It is also hoped to increase floodplain woodland coverage in the upper headwaters of the River Ouse to 40% of the total floodplain (based on the extent of Environment Agency Flood Zone 2) within the next 10 years (depending on funding).

The Sussex Flow Initiative specifically aims to influence others to consider NFM approaches through:

- **Demonstration.** This involves: promoting measures and providing evidence through local trail sites; gradually adding small low risk measures; and assessing opportunities for larger future projects and interventions.
- **Advocacy.** This involves inspiring and influencing others to incorporate NFM approaches (for example, statutory bodies, Lead Local Flood Authorities, community groups, landowners and utility operators)
- **Signposting.** This involves: sharing knowledge and experience; producing evidence and guidance to help others implement NFM; providing practical advice and support to others starting other projects in the area; and highlighting other resources and evidence available to support and facilitate work.

One of the most important outcomes of the project has been to influence the flooding agenda both locally and nationally to promote lowland NFM. There are now websites, a Facebook page and a range of interpretative materials on NFM from blogs to booklets. The targeting of NFM by the Environment Agency has been directed through the assessment of opportunities linked to:

- the estates of stakeholders and partners
- priority Water Framework Directive water bodies
- Forestry Commission/Countryside Stewardship target areas for water quality and flood risk management
- small unprotected communities at risk of flooding
- low risk sites highlighted by the Sussex Flow Initiative targeting models
- sites identified by other local projects as being relevant or suited to NFM
- ecosystem service provision (an ecosystem services model for the whole catchment to use alongside NFM models is currently being developed)

## Key facts:

The Sussex Flow Initiative (and previously TrUck) has:

- created a range models and data to aid targeting and reduce risks including the Floodplain Woodland Habitat Potential model, Backwater Buffers (to buffer infrastructure from impoundment effects), Compound Topographic Wetness model and Woodland Water Storage assessment
- assessed and incorporated other data and models produced by others including River Habitat Survey data (Ouse and Adur Rivers Trust), Habitat Potential Models (Sussex Wildlife Trust), EcoServ-GIS and Catchment Based Approach (CaBA) data
- engaged and advised landowners covering 5,000ha of the Ouse (10% of the non-tidal catchment), including 70km of riparian land
- completed detailed surveys of the river and riparian corridor for 50km of main river in partnership with the Ouse and Adur Rivers Trust
- made a detailed assessment of two subcatchment areas (50km<sup>2</sup>), providing maps of potential and priority NFM measures, incorporating biodiversity and Water Framework Directive elements and listing multiple benefits received for each measure
- planted over 30,000 trees incorporating 8ha of new woodland and over 3km of new hedgerows, all designed to slow the passage of water and increasing river shade along 5km of river
- produced NFM guidance leaflets to help guide and inform landowners and other practitioners (2 more are planned by 2018)
- engaged with, presented to, and advised multiple stakeholders including the European Commission, WWF, Environment Agency Flood and Coastal Risk Management (FCRM) teams, Transition Town groups, Flood Forums, the Southern Regional Flood and Coastal Committee, Rivers Trusts and local councils
- secured funding from Lewes District Council to support a range of NFM work and trial measures across the Ouse catchment by 2018
- held a wide range of events such as landowner workshops, water fairs, local resident flood forums and drop-in surgeries
- promoted NFM at conferences, in the local media and via a presence at a variety of local events such as wood fairs



**Map 1: Sussex Flow Initiative project area, Upper River Ouse, East Sussex (source: Sussex Flow Initiative, Ordnance Survey)**

## 1. Contact details

### Contact details

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## 2. Location and catchment description

### Catchment summary

<b>National Grid Reference:</b>	Central grid ref: TQ434203
<b>Town, County, Country:</b>	East Sussex, UK
<b>Regional Flood and Coastal</b>	South East

<b>Committee (RFCC) region:</b>	
<b>Catchment name(s) and size (km<sup>2</sup>):</b>	River Ouse catchment (fluvial extent), 510km <sup>2</sup>
<b>River name(s) and typology:</b>	Multiple tributary streams and main river sections showing multiple river types including bedrock channels, ditch/small drains and modified urban watercourses
<b>Water Framework Directive water body reference:</b>	Including the non-tidal Ouse and all of its tributaries, there are 22 Water Framework Directive water bodies within the project area.
<b>Land use, soil type, geology, mean annual rainfall:</b>	Land use: pasture, arable, urban Soils: Wealden clay, Tunbridge greensand series Geology: mudstones, sandstones, Gault clay, chalk Average annual rainfall: 830mm

### 3. Background summary of the catchment

#### Socioeconomic/historic context

Historically, the River Ouse has been extensively dredged and straightened for navigation and to increase channel capacity. This means many river reaches are overdeepened, disconnected from their floodplain, and lack much of the internal (woody), marginal and riparian habitats synonymous with a healthy river system.

The feeder streams of the Ouse are small and shallow wooded gill streams, which are locally unique. Large areas of the catchment become flashy in times of heavy rainfall, particularly on the clay. Some of the middle Ouse tributaries are similar, while others are characteristic of slow-flowing lowland streams, attributable in places to historic navigational weirs. The lower reaches of the Ouse are typical lowland channels of uniform depth and flow. The river flows predominantly through soft sandstones, alluvium and clays, though the Bevern and Northend streams are notable in that they are derived from chalk springs (both winterbourne and perennial). A number of these chalk streams have associated mills and mill leat diversions.

At Lewes, the river becomes tidal and significantly modified (canalised and embanked, with tidal defences at Barcombe) to provide flood defences to the town of Lewes and the conurbations and infrastructure downstream. Floodwaters are often trapped behind these flood embankments for prolonged periods. The Ouse estuary joins the sea at Newhaven, which again is heavily modified for flood risk management, industrial use and navigation purposes.

Much of the Ouse landscape has been heavily modified over time for agriculture and for housing. Despite Sussex being the second most wooded county in England, there are still significant areas with limited woodland and hedgerow cover, and large areas of floodplain that – through historic dredging and drainage – have become hydrologically disconnected from the river. Intensive land uses such as arable farming and intensive dairy farming have also reduced the floodplain's capillary capacity through the degradation of soils.

#### Flood risk problem(s)

The Ouse catchment is subject to fluvial, tidal, groundwater and surface water flooding. In terms of fluvial flooding, the towns of Uckfield and Lewes have been subject of a number of large-scale historic floods, most significantly in 1916, 1925, 1960, 1974 and 2000. The event in 2000 was the worst recorded, causing extensive damage across the catchment at an estimated cost of £130 million. Groundwater flooding is localised to extreme events in the chalk and greensand (for example, in 2012 to 2013), while surface water flooding is increasing in both rural and urban areas.

There has been a noticeable change in the frequency, intensity and seasonal range of large rainfall

events. The catchment has seen a number of weather precedents set over the past 15 years, including winter droughts, summer floods and numerous occurrences of large volumes of geographically isolated rain falling over short spaces of time.

Increased urbanisation in the catchment has exacerbated the flashiness of some parts of the river. Many other more rural areas flood badly, but do not have sufficient housing to put them on the Environment Agency priority flood risk register. Large amounts of flash flooding are now occurring in urban areas due to surface water run-off, while rural areas suffer more from having transport routes and farming resources submerged by flooding.

### **Other environmental problems**

The water quality of the River Ouse is compromised by a range of pressures from isolated sources of pollution through to the combined effects of multiple diffuse sources (both rural and urban). Evidence for the ecological status of the river system shows that nutrient enrichment, particularly phosphates in freshwaters (from agricultural diffuse pollution, sewage treatment works and rural septic tanks), is a primary reason for poor water quality. Other factors affecting surface water quality include increased demand for water abstraction (domestic and industrial), combined sewer outfalls, a growing (urban) population, changing land use and land management practices, and the uncertainty of climate change factors.

The river has also been significantly modified over the centuries resulting in canalisation, culverting, subsurface drainage, embanking and other hard engineering which have served the purpose of draining land for agriculture. River flow and fluvial flooding has also been affected by the installation or removal of in-channel weirs and structures. These interventions have had an impact on the course and flow of the river, and are contributing to a reduction in the ecological status of the system. As a result, fish passage is also an important issue in the catchment. In many cases, bridges across the river are too small for the volumes of water they are expected to carry and they now serve as throttles to floodwaters when these pass through.

Overall, the habitat quality of River Ouse catchment wetlands is very limited. There are small and isolated patches of priority habitat in floodplains such as fen and reedbed, but very few of any notable size. Riparian and in-stream habitats are often homogenous and heavily affected by surrounding land use. Ponds are on the whole degraded and nutrient-rich. Natural topographic variations in floodplains have been largely 'smoothed out' over the decades, leaving limited seasonal wetland habitat.

## **4. Defining the problem(s) and developing the solution**

### **What evidence is there to define the flood risk problem(s) and solution(s)**

The initial project, TrUck, was based on a model created by Durham University called Overflow (developed by Professors Nick Odoni and Stuart Lane), which highlighted a number of river reaches where addition of NFM measures in combination could lead to a reduction in flood peak.

Groundtruthing and landowner engagement highlighted the difficulties in installing NFM measures; some areas already had natural NFM measures in place (such as floodplain woodland) and others were not suitable due to land use (such as fisheries) or lack of landowner support. With limited funds to re-run the model, the focus switched to ways of maximising the data and expertise gained to target beneficial but low risk locations, while gradually adding measures to key sites indicated by the Uck Overflow model. It was also clear that not all NFM measures are suited to all locations, and working at a large scale, the focus was on simple models that could help refine targeting. These models included:

- Compound Topographic Index of Wetness – a geographical information system (GIS) model that highlights which areas get wet first and drain last, thus indicating areas where water storage could be increased or maximised, or where surface water problems are likely
- Ouse Back Water Buffers – to highlight areas where large blocks of woodland could increase local flooding to roads or other infrastructure due to the backing up of water, buffers were created downstream of roads or other pertinent features (such as Scheduled Ancient Monuments) using GIS

- Floodplain Woodland Model – a GIS based model which incorporates a range of data (including back water buffers and inundation regimes), providing a heat map to highlight areas of the floodplain that would most benefit from woodland planting to slow the flow
- Habitat Potential Models – the Sussex Biodiversity Record Centre has created a range of opportunity maps for 9 priority habitats including wet woodland and lowland meadows
- EcoServ-GIS – an ecosystem services model for 9 priority ecosystem services including water purification run for the Ouse by the Sussex Biodiversity Record Centre

Additional evidence was gathered via the following routes.

- **Subcatchment walkover surveys and mapping.** Working with the Ouse and Adur Rivers Trust, and recognising the need to combine and analyse existing data, a methodology was developed to assess opportunities of NFM with multiple benefits. This approach incorporates River Habitat Surveys, water quality testing, land use, historic land use, habitat connectivity and EcoServ-GIS. This provides an opportunity map of all possible measures and highlighted which would be most beneficial in terms of, for example, reducing flooding, improving water quality or providing ecosystem services. As each subcatchment is completed, workshops for landowners in the area are organised to promote these outcomes.
- **Rural unprotected properties.** Work with Environment Agency flood risk managers is examining how NFM could help increase protection to rural properties at risk of flooding that do not have or cannot benefit from traditional flood protection.
- **Academic partnerships.** The project has worked with, and is building on a number of local and national projects with academia, to exchange data, build knowledge and expertise.
- **National datasets.** National targeting of water protection areas and flood areas, as well as Water Framework Directive, Keeping Rivers Cool and other target mapping have all informed the work.
- **Local datasets.** Species and habitat evidence as well as local knowledge have been used to highlight issues and to develop solutions.
- **Uckfield Flood Forum:** Momentum for the pilot project, TrUck, was generated by members of the Uckfield Flood Forum following the engagement of the community in ways to reduce flood risk by the Knowledge of Environmental Controversies group. This work highlighted the impracticalities of more hard engineered solutions (such as creation of a reservoir), and led members of the Flood Forum to look at other solutions.
- **Environment Agency Catchment Flood Management Plans.** The majority of the upper Ouse catchment is designated as an Environment Agency 'Policy 6' area: 'Areas of low to moderate flood risk where we will take action with others to store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits', which supports the use of NFM.
- **Landowner liaison.** Significant pieces of work have often come about opportunistically through work with landowners.
- **Sussex Ouse Meadows Project.** This is an ongoing project to survey and map floodplain meadows and woodlands in the Ouse.'

Progress has been reviewed at various stages of the project via discussion and engagement with expert panels, teams within the Environment Agency, important academics in the field, and representatives of other national and European NFM projects.

The project team believes local people and other stakeholders have become convinced that NFM is a viable option through:

- local engagement – people 'seeing with their own eyes', getting involved in River Habitat Workshops and so on
- the presentation of common sense facts, backed up by evidence
- visual presentation of maps and evidence
- the demystification of how water and flooding works locally, and what the potential solutions are
- seeing that localised engineering solutions work to a point, but that greater benefits can be derived in the long term by using multiple methods of flood risk management across the landscape
- seeing there is no 'one size fits all' solution, and that each location and case is unique in its sources

and solutions

- realising they are able to contribute to doing something about the issue
- seeing that NFM can have multiple benefits for the community and the environment
- people's desire to plant hedgerows – the most popular NFM measure, though difficult to fund
- the accessibility of low cost, simple solutions to flooding

Urban sustainable urban drainage (SUDS) measures are slightly more problematic and much more costly. The project does not currently have the resources (staff or money) to go through the necessary planning applications and iterations to install SUDS. However, the project does advise on their location and provides as much support as possible.

### What was the design rationale?

Due to the scale of the project (whole river catchment), time was spent understanding the landscape and the hydrology of its different constituent parts. This included a range of modelling and mapping exercises.

The initial rationale was to produce outputs from the River Uck Overflow model. Once the difficulties with not only delivering these outcomes but also in commissioning a new model (particularly the cost) were realised, the focus shifted to other ways in which flood risks could be reduced and in other locations. The aim was to install and test a range of NFM measures, across a range of different landscapes, to see if NFM could work at a catchment scale. A further aim was to enhance the multiple benefits accrued from NFM, which would meet the broader agendas of the project's partners.

Working with the Woodland Trust, one of the focus areas has been tree planting. Much of this new woodland has been small in size (~1ha patches) and therefore requires less planning than larger sites. Hedgerows have also been a core activity and, where possible, are restored on historic hedge lines and across slopes or floodplain fields.

So far woody dam designs have been trialled in low risk locations, using local and natural materials; the design of these small dams was influenced by the work of the Slowing the Flow project at Pickering in North Yorkshire. A range of different dam designs has now been developed to suit different project locations and to maintain environmental flow. Experimental and 'case study' NFM measures were installed initially at the properties of the project partners where they could be showcased to others.

Other trial sites are being developed for different measures such as flood storage ponds and washland meadows for delivery by 2018.

Various landowners have been advised on the reduction of surface water flows and run-off.

The subcatchment plans will be presented to the catchment partnership and will be used to support the creation of a wide range of NFM and Water framework Directive measures across each subcatchment.

### Project summary

<b>Area of catchment (km<sup>2</sup>) or length of river benefitting from the project:</b>	Upper (fluvial) River Ouse catchment: 510km <sup>2</sup> Length of Detailed River Network: 1,100km
<b>Types of measures/interventions used (Working with Natural Processes and traditional):</b>	Floodplain woodland Hedgerows Shelter belts Flood storage ponds Woody dams Washland meadow.
<b>Numbers of measures/interventions used (Working with Natural</b>	As of 2016: 8ha woodland, 3km hedgerows, 10 woody dams



<b>Processes and traditional):</b>	
<b>Standard of protection for project as a whole:</b>	Not yet known
<b>Estimated number of properties protected:</b>	Not yet known

## How effective has the project been?

### *Demonstration*

- It has not yet been possible to quantify the impact on flood peak in the River Uck or wide Ouse, partly because of the time it will take for NFM measures such as woodlands and hedgerows to become fully functional. In addition, further measures will be put in place over the next few years and beyond (funding dependant). However, the project team is confident that all the NFM measures that have been installed have had no negative impact on flooding and the majority are thought to have had a positive impact on flooding (that is, through surface water interception). Unfortunately, the limited hydrological monitoring across the catchment means it is unlikely that exact figures on the extent to which these NFM measures will reduce flooding could be obtained.
- The detailed assessments of 2 water bodies have highlighted opportunities for multiple benefits measures and funding has been obtained for a further 5 subcatchment areas.
- Trials have been carried out to better understand the use of woody dams and their impacts on geomorphology. The rapid and extensive sediment accretion means that there are implications from this type of work that need to be assessed. Plans are in place for more extensive woody dam trials, along with flood storage ponds and washland meadows. A suite of case study examples of these and other measures such as land drainage reduction is being built up.
- The project team also promotes multiple benefits work such as ecosystem service provision and climate change mitigation.

### *Advocacy*

- The project team has been extremely effective in influencing local (and national) use and understanding of NFM, engaging with well over 30,000 people over the course of the project and influencing others through the media and the internet.
- The team has consulted and advised others to use NFM in 2 other Sussex catchments.
- Local community groups have been induced to look at SUDS solutions and NFM measures to reduce local flooding issues.
- The project has contributed to work at a European level and worked in partnership with a range of key organisations including catchment partnerships and rivers trusts.

### *Signposting*

- Guidance notes on how to deliver NFM have been produced on woody material in rivers (The Woodland Trust 2016) and floodplain washlands.
- The project team is continuing to work with academic institutions to develop research into the efficacy of different NFM measures.
- The project's active and popular websites host a range of information and useful links on flooding and NFM.
- The project's modelling and mapping work at a landscape scale is being to help local people to effectively target NFM and multiple benefits measures to appropriate areas of the landscape.
- The project is regularly used as a point of reference for guidance on NFM.

## 5. Project construction

### How were individual measures constructed?

- Small woody dams constructed in the woodland ditch/stream network used volunteers and materials from the site. Dams were designed to allow some water passage underneath the dam.
- Other measures (for example, flood storage ponds and washland meadows) are being planned for installation in 2017 to 2018.
- Trees and hedgerows were all planted with help from local volunteers, with planting guidance provided via the National Forestry Standard. Deer guards are necessary for all sites in the Ouse catchment and mesh guards were used for all floodplain sites.

### How long were measures designed to last?

- Monitoring of decay of trial woodland dams is ongoing. After 4 years, the dams remain in place and the wood used (alder and hazel) remains intact.
- Advice is given on long-term maintenance of trees and hedgerows. Agreements are in place to prevent their removal in the next 12 years.

### Were there any landowner or legal requirements which needed consideration?

- Flood defence consents were obtained for floodplain and river bank planting. Applications will be made for the creation of wader scrapes and other temporary flood storage features.
- Full planning consent is being sought for the flood storage ponds.
- A full assessment of local designated sites and other important habitats/features was made for every site to ensure no damage to existing biodiversity or ecosystem services.
- Botanical surveys were undertaken at key sites to ensure net gain in terms of habitat provision.
- Landowners whose property was next to a trial site were consulted where required.
- Landowners were advised on streamlining NFM work with existing grant schemes such as Countryside Stewardship and Forestry Commission grants.
- Reassurance was given to landowners that they can remove NFM measures if they can be shown to have exacerbated flooding (this has not been necessary yet).'
- Data agreements have been made to ensure the legal restrictions on the use of mapped data are adhered to.
- Health and safety protocols and insurance are provided for volunteers and staff.

## 6. Funding

### Funding summary for Working with Natural Processes (WWNP)/Natural Flood Management (NFM) measures

<b>Year project was undertaken/completed:</b>	Started 2012 Funded until 2019
<b>How was the project funded:</b>	Funding from multiple sources, covering different time periods and focus  Fundors (listed by contribution with largest first): Environment Agency, Woodland Trust, Sussex Wildlife Trust, Lewes District Council, Royal Bank of Canada, private charitable donations, Adur and Ouse Catchment Partnership

<b>Total cash cost of project (£):</b>	Funding 2012 to 2017 Funds received: £235,000 In-kind contributions: £105,000
<b>Overall cost and cost breakdown for WWNP/NFM measures (£):</b>	Woody dams: staff and volunteer time only Woodland: ~£30,000 over 5 years Hedgerows: ~£15,000 over 5 years
<b>WWNP/NFM costs as a % of overall project costs:</b>	20–30% of costs up to 2017 Estimated 30–40% for 2018 to 2019
<b>Unit breakdown of costs for WWNP/NFM measures:</b>	Not yet known
<b>Cost–benefit ratio (and timescale in years over which it has been estimated):</b>	Not yet known

## 7. Wider benefits

### What wider benefits has the project achieved?

- All the woodland and hedgerow sites have been planned to enhance river health, ecosystem services provision and ecological networks, and to contribute towards Water Framework Directive targets. This has been achieved using GIS mapping and data, including historic maps. These sites will also contribute to water quality enhancement, air quality enhancement, noise pollution reduction, climate change mitigation, green space provision and so on.
- Information from the project has been used in 2 new NFM projects in other Sussex catchments.
- Ecosystem services mapping can now help to articulate the multiple benefits of NFM sites using the EcoServ-GIS model. NFM planting has been achieved in areas identified as high risk in the Keeping Rivers Cool for climate change mapping.
- NFM measures have been installed in national target areas for water quality and flood reduction.
- Local communities have been influenced to reduce flood risk through NFM and SUDS measures.
- NFM measures have been targeted across failing Water Framework Directive catchments to maximise water quality benefits.
- Hedgerows and other habitats have been targeted at areas where they will increase biodiversity benefit and landscape connectivity for target species such as bats.
- Tree planting has been used as source protection for spring heads.

### How much habitat has been created, improved or restored?

- Engagement with, and advice given to, landowners covering nearly 70km of the river network
- Increased river shade and reduced bank erosion on 5km of river
- 3km of hedgerows and ~8ha of new woodland incorporating over 30,000 trees planted

## 8. Maintenance, monitoring and adaptive management

### Are maintenance activities planned?

- All the hedgerows and trees are supplied with specific guidance for future maintenance and an agreement to maintain NFM features must be signed by the landowner prior to planting.

- For other measures, such as flood storage ponds, maintenance agreements will be made with the landowner, with help provided by project partners where possible. It is hoped to train landowners to understand how to spot when measures are no longer functional.

### **Is the project being monitored?**

- Fixed point photography is used on a number of planting and woody dam sites.
- Support has been given to a range of student projects, including MSc and PhD level research. There are plans to support more in the future.
- Hydrological impacts will be assessed using extensive and historic gauges. However, timescales and funding mean there is no capacity at present to plan this far ahead. This will be factored in as the project develops.
- Different models relevant to NFM are being investigated to see if some specific questions can be answered such as how much storage or delay could be increased in existing Ouse woodlands.
- Mapped (habitat and other) data are being gathered for use in monitoring long-term landscape change.
- Records are kept of the landowners advised and contact is maintained with them where possible.

### **Has adaptive management been needed?**

- The trials of woody dams in woodland ditches have informed further work to retain low flows and to encourage the creation of more natural flow channels where sediment has accumulated rapidly in ditches.
- A small number of dams were moved by floodwater during a recent summer flash flood, which produced flows well in excess of expectations. There are plans to increase the size and reduce the mobility of these dams to reduce the potential for future washout.
- It is envisaged that individual landowners will be responsible overall for the monitoring and maintenance of NFM measures. Where possible they will be provided with guidance on adaptive management.

## **9. Lessons learnt**

### **What was learnt and how could it be applied elsewhere?**

- One of the greatest boons has been the support of the project partners (Sussex Wildlife Trust, Environment Agency and The Woodland Trust), which all share an underlying belief in NFM and the need to start this work now, without seeing immediate benefits. Partnership work with other organisations, projects and groups, along with volunteer and community support from local people, has also helped progress to be made.
- Consulting with local at risk communities, landowners and local groups should begin as soon as possible. This helps garner local support, but also provides a great deal of pertinent local information that can be otherwise difficult to find.
- When local people feel educated and empowered to do something positive to reduce flooding, with the support of non-governmental organisations and statutory organisations, they are very keen to participate.
- Having a project officer, who is a trained and trusted advocate of NFM is a priority as they provide an accessible point of contact for advice, funding and support.
- Long-term funding is an issue. Funding for staff time and for NFM delivery is both limited and difficult to acquire.
- Opportunities for NFM are often small in size (though cumulatively large across a landscape).
- Lowland NFM is not a 'one size fits all' approach. However, the range of techniques available offers options at most sites.

- At this stage of the project, it is much easier to quantify the other benefits accrued from the NFM measures such as watercourse protection or habitat creation. Further funding has been gained based on these benefits.
- Current, comprehensive and continuous river survey data are vital.

#### *Gaining support from landowners*

- It takes time to build relationships of trust with landowners and stakeholders. It is clear from the work in the Ouse that voluntary take-up of NFM measures, particularly those that change land use or have implications on hydrology, is not overly forthcoming and it takes time to encourage landowners to participate.
- It helps to articulate clear and multiple benefits to landowners, such as wildlife enhancement, better water and soil management and wood fuel benefits.
- Landowner support often radiates out from one landowner to neighbouring properties over following years, and often leads to larger schemes and opportunities.
- Because the majority of landowners are only willing to undertake small-scale measures, an even greater number of participants is required to evoke a significant reduction in downstream flood peak. This has cost and benefit implications as each site takes time to plan regardless of size.
- Landowners generally support NFM measures based on other benefits accrued, such as wood fuel or water protection, as opposed to helping to reduce flooding for downstream communities.

#### *Catchment scale*

- Working at the catchment scale in a lowland and heavily populated area with complex land ownership, it is important to develop a detailed understanding of the characteristics of different areas and the mechanisms influencing local or wider flooding. This involves a great deal of work and time, and demands understanding of a range of different disciplines such as ecology, hydrology, geomorphology, weather patterns and geology.
- In order to target, plan and instigate NFM measures it is vital have a detailed understanding of the subject area. At the catchment scale it is not possible to measure the gradual addition of small-scale NFM measures. It is therefore essential that the catchment is broken down into smaller areas. Although some areas are better suited to particular NFM measures than others (for example, woody dams in very steep headwaters may not be as effective as those at less steep gradients), it is possible to use catchment data and knowledge to help effectively target individual measures.

#### *Floodplain woodland*

- The majority of Ouse landowners only want small areas of planting (<1ha). As such these are likely to carry little risk, but a large number of these need to be planted in order to obtain a reduction in flood peak.
- Where roads or other infrastructure may be negatively affected by water impoundment caused by large blocks of woodland, downstream buffers can be easily applied using GIS. Stakeholders concerned about increasing flood risk through the addition of NFM found this work particularly persuasive in supporting NFM.

#### *Woody dams*

- Woody structures situated within the stream or in-channel rapidly accrete sediments, losing profile. During times of low flow in summer months in smaller streams or ditches, a step change created behind dams can lead to pooling and potentially increased eutrophication. To avoid this problem, a range of different designs for different locations have been developed, some of which only interact with the watercourse during times of high flow.
- The term 'woody debris dam' causes a bad reaction in some due to entrenched beliefs in the importance of removal of in-channel wood.

## **10. Bibliography**

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### **Project background**

This case study relates to project SC150005 'Working with Natural Flood Management: Evidence Directory'. It was commissioned by Defra and the Environment Agency's [Joint Flood and Coastal Erosion Risk Management Research and Development Programme](#).