The **Eddleston Water** Project

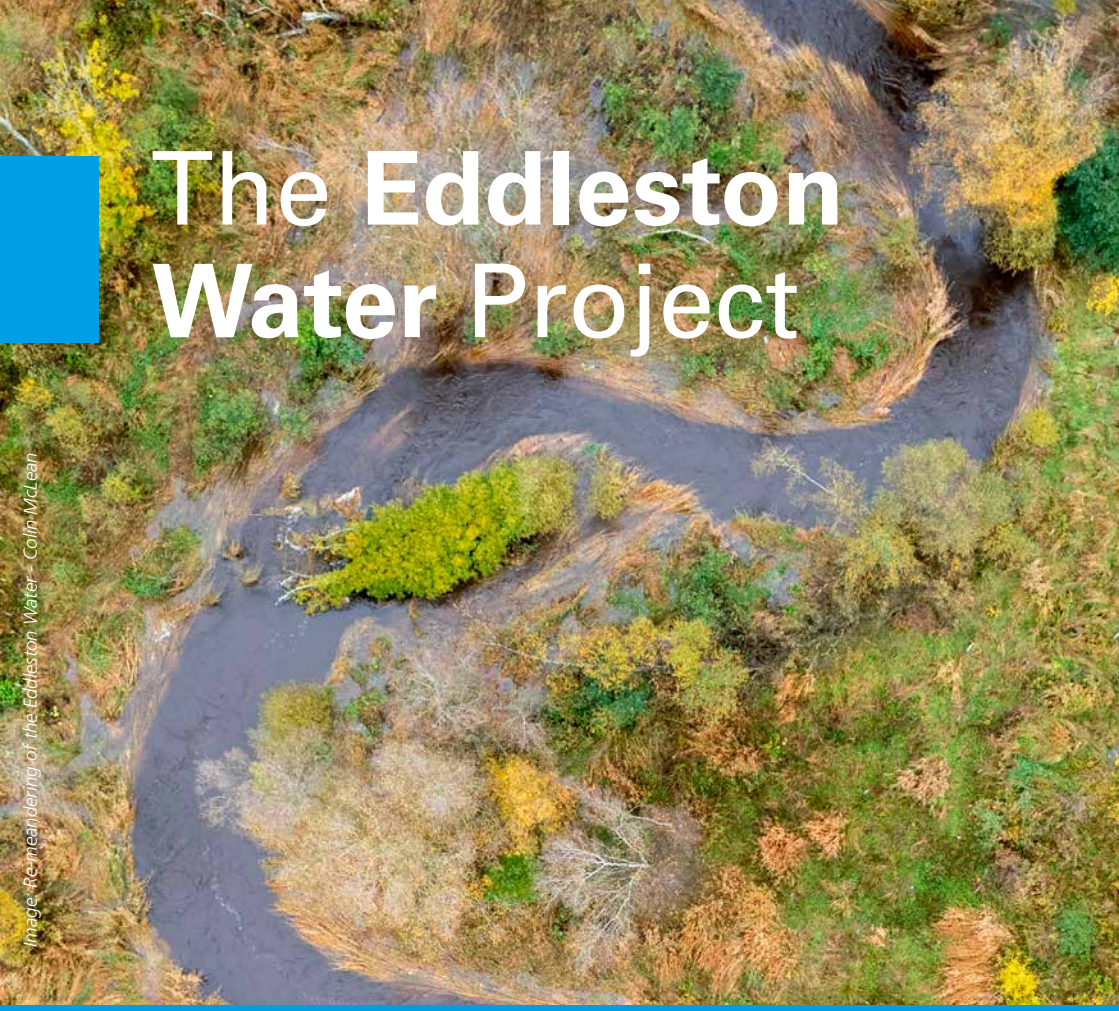

Image: Re-meandering of the Eddleston Water - Colin McLean

The Eddleston Water project is Scottish Government's long-term study of the effectiveness of natural flood management (NFM) techniques to reduce flood risk to downstream communities and improve wetland habitats for wildlife. NFM is just one part of a whole catchment approach to improving flood resilience. It works alongside other measures such as flood walls, flood forecasting and warning schemes, planning control and behavioural responses. Together with NFM, this can provide a plan-led approach to reducing flood risk and tackling climate change. The project looks to provide the evidence base to assess the value, costs and benefits of NFM by restoring some of the natural characteristics of what is a typical Scottish river system through changes to land management practices delivered across the whole catchment.

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Project aims

The project has three main objectives:

1 To assess the effectiveness of natural flood management (NFM) measures to reduce the risk of flooding to downstream communities;

2 To assess the impact of NFM restoration on wetland habitats and species, and its potential to improve the overall ecological status of the river; and

3 To work with landowners and farmers in the local community to maximise the benefits of the work, whilst sustaining farming livelihoods and practices.

In seeking to deliver these objectives, the project aims to generate robust evidence of the impact, cost and benefits of working with natural processes at a catchment scale.

The Eddleston Water

The Eddleston Water is a tributary of the River Tweed in the Scottish Borders, with a catchment of 69 km^2 draining south to join the main river at Peebles. It is a typical small Scottish catchment, with a mix of forestry, rough grazing and improved grassland. It has distinct sources and pathways in terms of flood generation and water movement down the valley, making it ideal for study.

Historical perspective

Over time, the course of the river has been extensively altered. Long sections were straightened in the early 19th century to enable the building of a toll road from Peebles to Edinburgh. This, along with the later building of a railway line and embankment, and land drainage to improve agricultural production, this has altered how the valley drains and cut off the river from its floodplain. As a result, flood waters travel quickly and directly from the hill slopes and along the river channels towards the downstream communities. This has increased flood risk, and caused habitat loss and damage to the river and other wetlands across the catchment.

Current environment

Scottish Environment Protection Agency (SEPA)'s flood risk assessment shows over 500 properties are at risk of flooding in Eddleston and Peebles under a 1:200 year scenario. The river was classified by SEPA as 'bad' ecological status in 2009 (using EU Water Framework Directive criteria), largely due to the historical works that straightened and altered the physical structure of the channel and its banks. Subsequent recovery of the physical and ecological condition of the river has been limited due to the low energy and high impact of past engineering on the channel. Water quality is generally good, and the river is designated an EU Special Area of Conservation for its salmon, lampreys, otters and aquatic plants.

Who is involved?

Tweed Forum leads the partnership of Scottish Government, SEPA and Scottish Borders Council, with University of Dundee as the main science provider. Key research partners include British Geological Survey, along with Heriot-Watt, Edinburgh Napier and other universities. Support and advice come from NatureScot, Scottish Forestry, National Farmers Union (Scotland), Tweed Foundation and the Environment Agency. The most important partners are the landowners and local community with whom Tweed Forum works closely, so that everyone can contribute ideas and follow the project's progress.

Project development:

The project has three phases:

1 **2010:** ***Scoping study*** – led by Dundee University, with cbec eco-engineering Ltd, this identified a wide range of potential NFM and habitat restoration measures that theoretically could be implemented in the headwaters and floodplain of the Eddleston. It also developed the project monitoring strategy.

2 **2011/12:** ***Installation of the monitoring network and baseline measurement*** – a detailed surface hydrological monitoring network was installed, along with meteorological, ecological and ground water measurement systems prior to any NFM work beginning.

3 **2012- ongoing:** ***Implementation of measures and monitoring*** – with further project development, supported by EU North Sea Region Interreg Building with Nature programme (2016-2020).

Implementation of measures on the ground:

Tweed Forum as a trusted 'intermediary' visited key farmers and landowners, seeking opportunities for creation or 'improvement' of existing habitats - to deliver NFM and restore the physical structure of the river channel and adjacent wetlands. With no payments or obligations to change land use, this is a voluntary arrangement, such that some potential sites for NFM remain unavailable due to their importance to ongoing farming operations. Working with 22 farmers so far, we have delivered the following measures:

Upland (Source) areas:

- **Woodland planting** - 215 hectares with c.350,000 native trees (some also on the floodplain). Tree planting is well supported through the Scottish Rural Development Programme and can help increase flood attenuation, infiltration and evapotranspiration.
- **Large wood structures** - 116 high-flow log structures installed in small upland river channels, These temporarily hold back water in high flows, diverting it on to the floodplain, lowering and delaying the arrival of the flood peak in communities downstream.
- **Upstream ponds** – 41 ponds have been created of varying sizes, each with a designed 'free board' above low water level . This enables them to store flood water during intense rainfall events before becoming full, whilst also being important new wildlife habitats.

Valley/Floodplain (Pathway) areas:

- *Remeandering the river channel* - 3.5km of river re-meandered and 2900m of flood bank removed. This increases river length, reduces the slope and speed of water flow and creates more diverse in-stream habitat. Through reconnecting the river with its floodplain, it creates more space for water.
- *Floodplain pond* – created a large pond at Kidston to temporarily store flood water.
- *Contour hedges* - planted 1km of contour hedges to slow overland flow.

Monitoring

The monitoring strategy is designed to provide the evidence to answer the aims and policy questions posed, by assessing:

a) **the effectiveness of specific types of NFM measures to reduce flood risk and improve ecological status** – using detailed comparative studies of individual interventions, including re-meandering the river; woodland planting, log-structures and the benefits of flood storage ponds;

b) **the impact of restoration on flood risk and habitats at a whole catchment scale** - using flood hydrograph comparisons, and monitoring of rainfall, river flow and groundwater levels, and by routine measurements of ecological status downstream.

A network of rain gauges, groundwater and river level gauges have been installed throughout the valley to collect data on river flows and flood frequencies. This has also enabled the development of a detailed hydrological and hydraulic catchment model.

Hydrological Monitoring includes:

- Rainfall and weather stations
- River flow and flood gauges
- Flood pond levels and storage
- Ground water surveys and boreholes

Ecological Monitoring includes:

- River habitats, hydro-morphology and channel sediments
- River biology – invertebrates, fish, plants
- Aquatic invertebrates of Flood storage ponds

We have also investigated landowner & community engagement with NFM.

Costs and Benefits: we are assessing the value of NFM interventions by assessing flood damages avoided and benefits provided, including improvements in biodiversity, carbon management, water quality, access, recreation and other ecosystem services.

Emerging Results

- **Different NFM measures can reduce flood risk** by slowing the flow, temporarily storing surface waters and delaying the peak floods.
- **Appreciable flood risk reduction through NFM** is likely only to be achieved by the widespread application of many NFM measures throughout the entire catchment.
- **NFM measures work best in smaller catchments and in response to lower-level flood events**. They will not stop flooding in major events.
- **NFM and habitat enhancement measures provide a wide range of additional benefits.**
- **The economic value of the flood damages avoided,** and multiple benefits of restoration measures can be demonstrated.

And specifically:

Impact of high-flow log structures in headwater streams:

- 'Lag time' between rainfall and peak river flow has increased by up to 7 hours in headwater catchments up to 25km^2 with high-flow restrictors.
- In the upper catchment, the 2-year return period flood peak has reduced by c.30% post NFM measures.

Re-meandering:

- remeandering and reconnecting the channel to the floodplain can locally improve flood storage by up to 6%.
- meandering alone, staying within flood banks without temporary storage on the adjacent floodplain is less effective.
- new meanders add 8-47% channel length, with increase in extent of potential spawning sites for salmon.
- New meander channels have an increased diversity of habitats and are rapidly recolonized by plants and invertebrates.

Temporary flood storage ponds:

- Ponds in the upper catchment can readily store water, but this is only effective in small sub-catchments.
- Modelling the potential impact of large floodplain ponds suggests that they could locally reduce the discharge peak by up to 20% and delay it by up to 6 hours, but such ponds occupy prime farmland.
- Creating temporary flood storage ponds leads to significant enhancement of catchment biodiversity, including newts and dragonflies.

Woodland Planting:

- Infiltration of rainfall under mature broadleaf woodland is 5-8 x that under adjacent grazed pasture, with rough grazing also good for infiltration.
- Modelled impacts of planting trees at a landscape-scale show up to 40% reduction in high flows and flood peaks delayed by 45 minutes under different climate scenarios.
- Recent and ongoing research shows the importance of soil type and location on the effectiveness of woodland planting.

Costs and Benefits of NFM

- **NFM measures already implemented show a positive present value** of £950k from flood damages avoided. For a hypothetical maximum scenario this increases to £2,850k (PV) over 100yrs.
- **The total value of other benefits delivered by NFM across the catchment (£4.2m PV) are 4x larger than flood damages avoided alone**. Biodiversity, carbon, water quality, access and recreation are key added NFM benefits.

Future Plans

The Eddleston project has developed to be an important research platform, attracting researchers from Scottish, UK and overseas institutions. Currently we are:

- looking to share and test our learning in other catchments;
- working with farmers to implement further NFM measures;
- examining the potential to raise significant funds for catchment restoration through private finance.

Eddleston Water – Project Sites

Installing woody debris flow restrictors, mimicking fallen trees, to hold back high flows

Key

- Eddleston Watershed Boundary

Completed Projects

- **Flow Restrictors/Engineered Log Jams:** 116 installed on upper tributary streams
- **Native Tree Planting:** 211 hectares planted, over 340,000 trees
- **Pond Creation:** 39 ponds excavated
- **Re-Meandering Works:** 3.5km of river remeandered
- **Peatland Restoration:** Over 15ha of peatland restored
- **Transverse Hedges:** 2.8km hedgerows created
- **Tree Planting** - outwith project
- **Productive Conifer**
- **Leadburn Community Woodland**
- **Pond** - outwith project

Extensive riparian planting in the headwaters

Monitoring site - stream stage recorder

Re-meandering completed on the Eddleston Water at Nether Kidston

Flood retention pond at Kidston Mill

Spreading the word about River Restoration and Natural Flood Management

The project will continue to work with local schools, colleges, scientists, policy makers, advisory services and farmers by hosting field trips and study tours to show what can be achieved on the ground to reduce the effects of flooding and achieve multiple benefits from NFM in a working landscape.

Full details of the project are available at:

http://tweedforum.org/the-eddleston-water-project

This includes a database of available reports and material.

The project wishes to thank the farmers and landowners in the Eddleston Water catchment for their help and enthusiasm in taking this initiative forward.

Support for the work has been received from a wide range of public and private sources, including:

Scottish Government, EU Interreg North Sea Programme, SEPA Water Environment Fund, NatureScot, Scottish Power, Forest Carbon, the Woodland Trust, Scottish Borders Council, CEMEX, Scottish Forestry, the Environment Agency.

We would welcome your comments and ideas. Please contact:

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