The Eddleston Water Project - measuring the effectiveness of restoring a sub-catchment of the Tweed

14:00 **The Eddleston Water Project: aims & policy context -** Chris Spray (University of Dundee)

14:15 **Designing practical restoration works on the Eddleston Water and making them happen** Hugh Chalmers (Tweed Forum) and Carolyn Mills (cbec)

14:40 **Surface Water Monitoring -** Tom Ball & Andrew Black (University of Dundee)

15:00 **Measuring the contribution of groundwater and soil water to flooding -** Alan McDonald (BGS)

15:20 **Geomorphology and ecology monitoring -** Chris Bromley (SEPA)

15:40 **Discussion and summing up -** Chris Spray (Chair)

BGS 1835

University of Dundee

Cbec Ltd

TWEED FORUM

The Eddleston Water Project: aims & policy context

Pilot Catchment Study
Science underpinning
National policy

- **Flood risk management** - Flood Risk Management (Scotland) Act 2009
- **River habitat restoration** Water Environment & Water Services (Scotland) Act 2003

Both look to reconnect damaged rivers to their catchments

Chris Spray **Scottish Freshwater Group 30 Oct 2014**

University of Dundee

Landscape scale conservation of river systems - wider view

- River catchments offer ***major opportunities for restoring delivery of a range of benefits (ecosystem services***) to local communities and wider society at the landscape scale

- This is exemplified by ***both 'top down' government initiatives*** (such as those to improve the ecological status of water bodies under the Water Framework Directive) and ***'bottom up' voluntary initiatives***, as exemplified by the work of Tweed Forum with local land managers

- The Eddleston Water project is a key component of the **Scottish Government's commitment to promoting a sustainable approach to water and land management** and to restoring habitats and promoting 'natural flood management'

- The scientific challenges are (a) ***restoring functionality*** (b) ***monitoring and proof of impact and (c) community buy-in***

The Eddleston Water Project

Partnership Approach

Phase I: Scoping study - 2009/10

Phase II: Base line monitoring & planning 2010 - 2012

Phase III: Implementation & Monitoring 2013 - 2015……

University of Dundee

The Scottish Government

SEPA Scottish Environment Protection Agency

TWEED FORUM

Scottish Borders COUNCIL

Environment Agency

Scottish Natural Heritage

Tweed Foundation

Forest Research

Cbec Ltd

The Land owners and Community

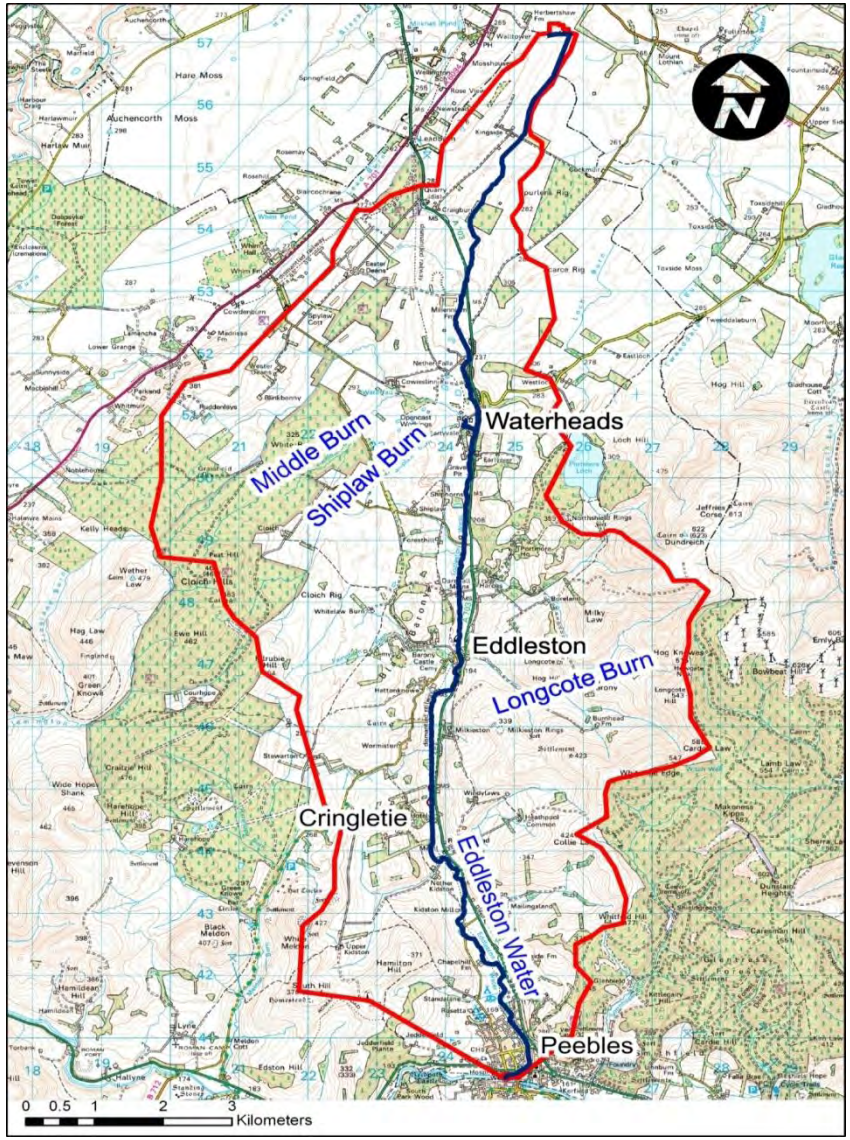
Eddleston Water – subcatchment of Tweed 69 sq kms

- Tweed length: 156 kms
- Catchment: 5,000 sq kms
- Scotland 84%; England 16%
- Mainly agricultural & valley towns
- 130,000 population, tourism, farming (sheep & cereals), Salmon, Rugby, Tweed woollens

TWEED FORUM

Natural Flood Management projects in the Tweed catchment

Eddleston Water – historically suffered major changes



- **Eddleston** a typical Scottish catchment, with long history of agricultural land management
- Fractured greywackes mantled with highly variable covers of till, fluvio-glacial outwash and peat
- Annual precipitation: 850 mm (valley floor)-1500 mm (summits)
- Simple river system - steep slopes on either side of main stem, with distinct sub-catchments.

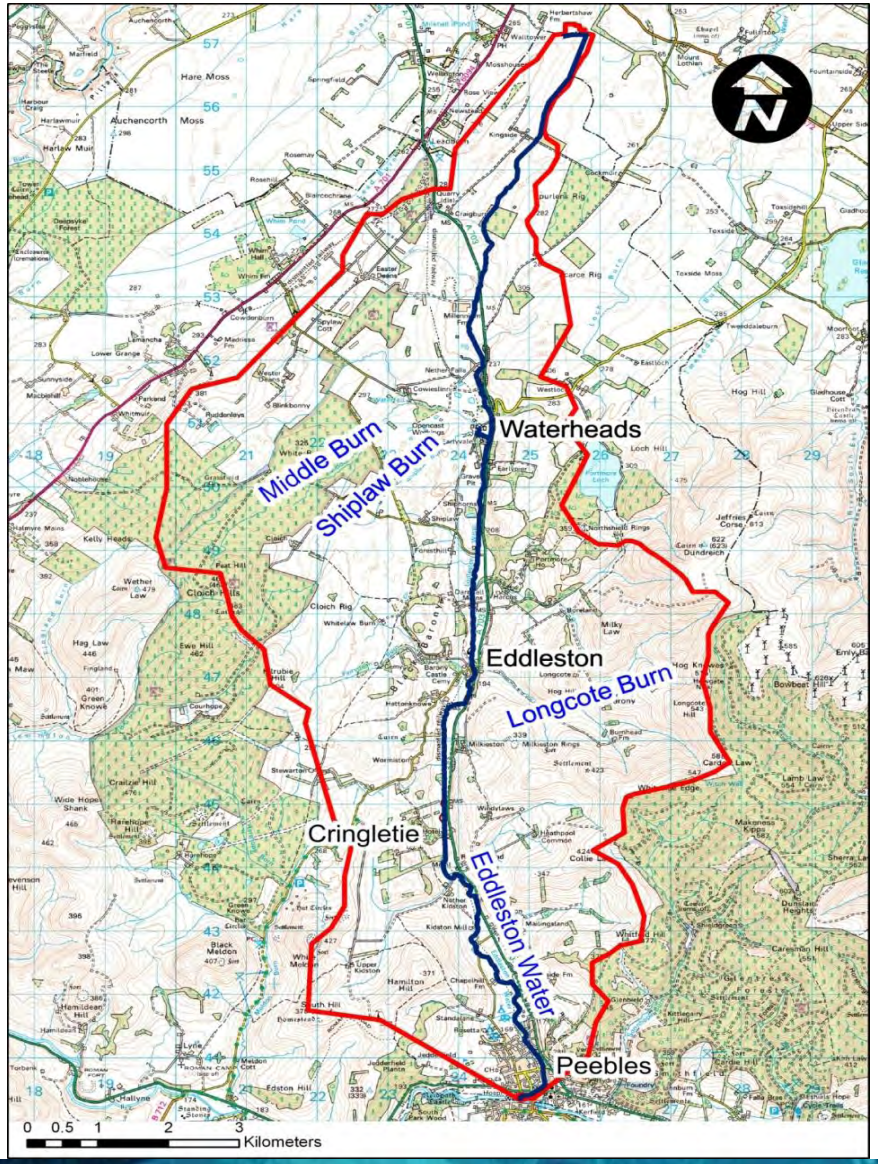
Distinct character of the current landscape

Sources

Pathways

Receptor (Peebles)

Eddleston Water – water management challenges



Long history of **river and flood plain management** – for agriculture mainly – and of **flooding** (1723, 1777, 1792, 1831, 1846, 1865, 1881, 1891, 1897, 1908, 1914, 1926, 1948, 1956, 1977, 1986, 1988, 1991, 1997, 2000, 2005, **2012)**

EU Conservation status as a 'Special Area for Conservation' - as a 'Ranunculus type' river,

- Atlantic Salmon
- Lampreys
- Otters.

Classed as 'bad' ecological status under the EU Water Framework Directive:

- channel morphology
- aquatic plants (medium)

Characterisation and current status: flood risk

Peebles – March Street, June 2012.

Linfall Bridge, 2012

Overall Aims of Eddleston Water project

... "**to restore river and its whole catchment whilst at the same time promoting livelihoods of those who derive income from the sustainable management of farms, forests and fishery**":

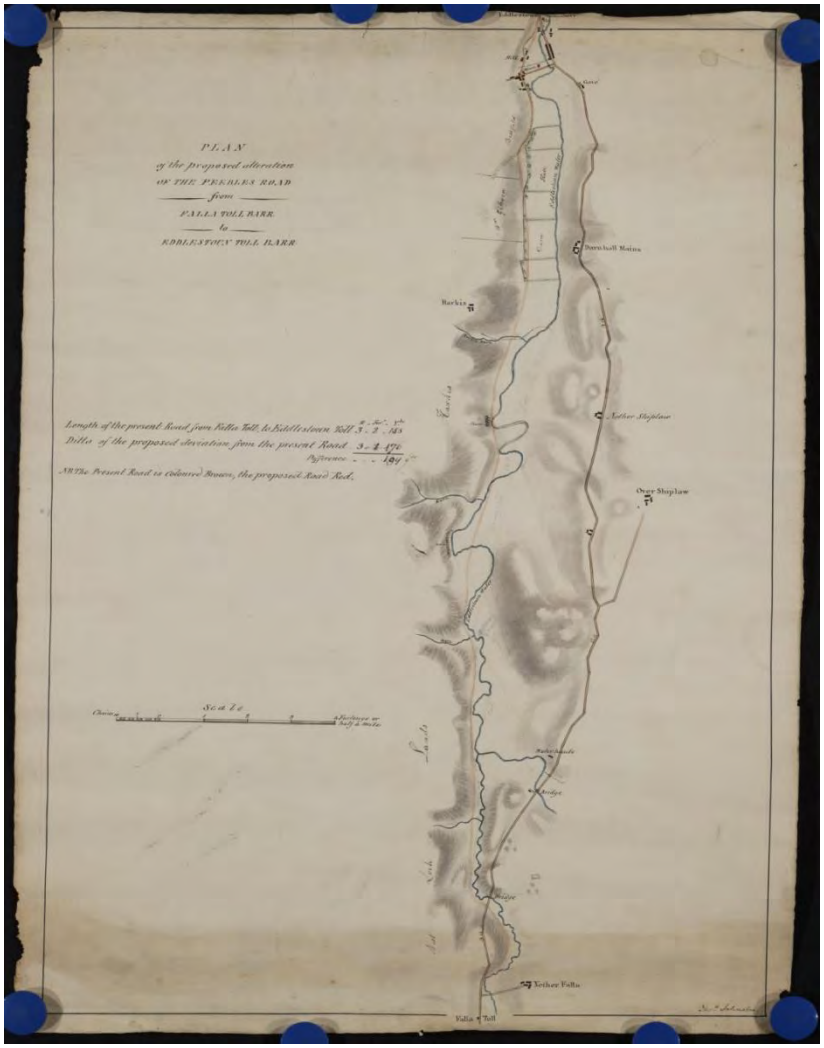
- **improved physical habitat**
- **reduction in flood risk**

……whilst ***promoting sustainable management*** of the local farms, fisheries and forestry interests,

……and ***enhancing biodiversity and recreational*** opportunities for residents and tourists.

Currently fails Water Framework Directive status: - BAD
Historical channelisation and loss of floodplain connectivity

Toll road map: - old course 1790's



Roy Map

Main stem sinuous *c*.1750: but extensively channelised by 1811 or earlier

WFD Status currently failing due to:

Hydro-morphology = Bad status

Macrophytes = Moderate status

Key Policy Objectives

Aim: to answer key national policy questions concerning the costs and benefits of 'restoring' our rivers and their catchments for people and for wildlife

- **Can we reduce the risks of flooding to local communities by changing the way we manage our land and rivers? – and if so, by how much?**
- **Can we improve habitats and meet the requirements for 'good ecological status' under the Water Framework Directive?**
- **What techniques and ideas work best? – and where?**
- **What other benefits can be delivered alongside these – for landscape, water quality, climate change resilience, recreation, fishing, tourism, etc?**
- **What are the costs of restoration?**
- **How do we do so, whilst also maintaining a prosperous and sustainable farming community and local businesses?**

Eddleston Water Restoration Scoping study (July 2010)

(a) Detailed characterisation of the catchment

(b) Output Recommendations:

- Plans for physical restoration of channel and floodplain
- Proposals for interventions to achieve flood risk reductions
- Value for money and priorities for action
- Stakeholder engagement

(c) Monitoring Plans

Werritty, Ball, Spray, Bonell, Rouillard & Archer (Dundee university)

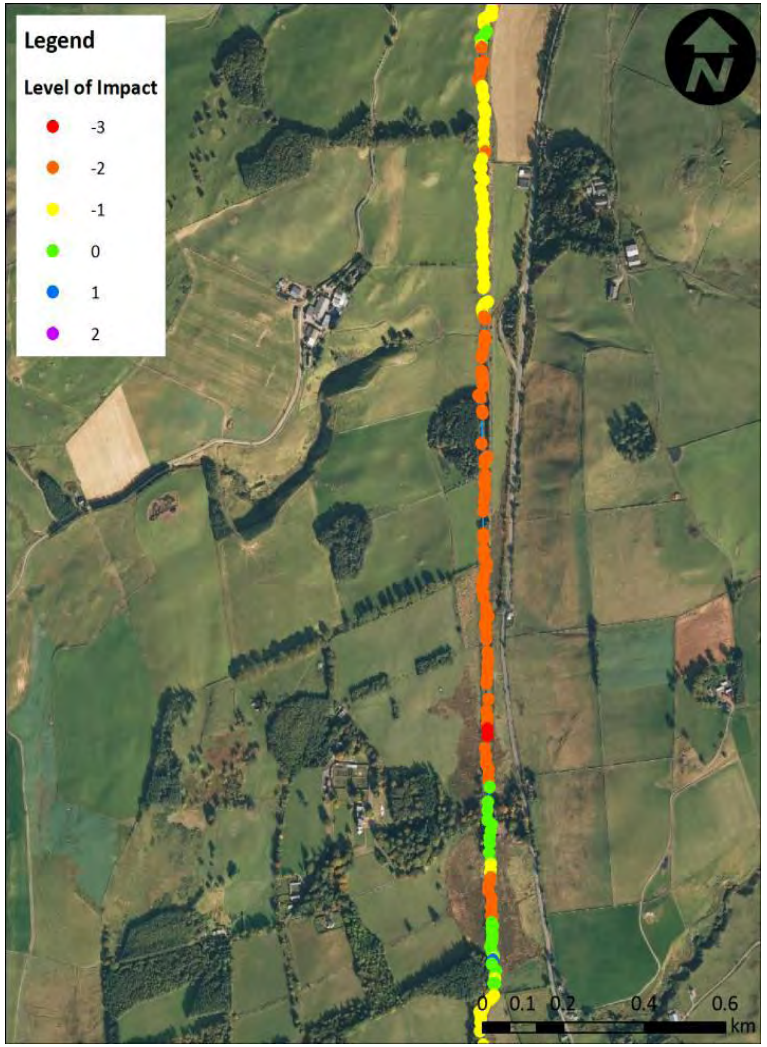
and Bowles & Moir (cbec)

Detailed Hydro-morphology of the whole river length

Cringeltie and Lake Wood

Detailed survey (MImAS) - Bad ecological status

- **High impact channel realignment 37%**
- **Low impact channel realignment 15%**
- **Embankments and floodwalls 26%**
- **Loss of bankside riparian vegetation 14%**



Implications for restoration:

- **Enables targeting of interventions**
- **u/s good value, inexpensive meanders**
- **d/s selected re-meandering & embankments**
- **Can improve to moderate & potentially good**

Contribution to achieving NWRM objectives - including EU directives – and benefits the measures deliver (1)

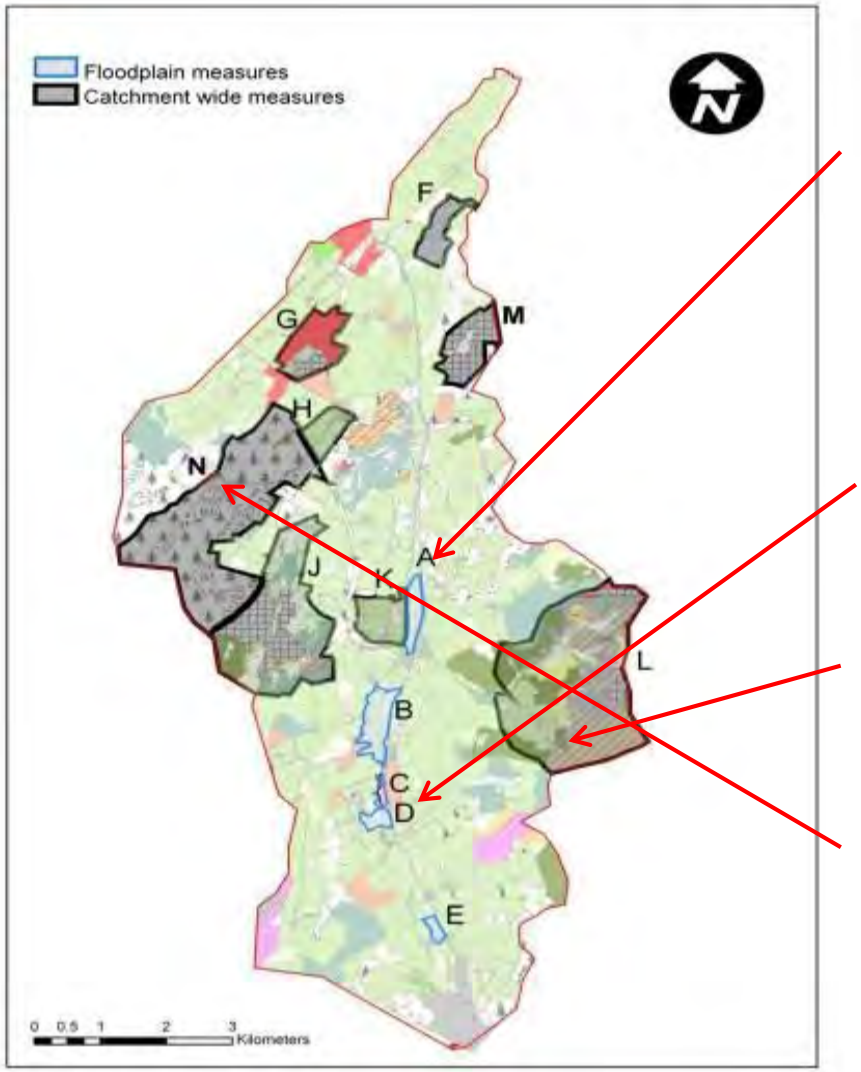
WFD Status Change:

- **Bad** status now improved to **Poor** status – due to re-meandering and tree planting

Original loss of system capacity due to numerous pressures:

Zone	Activity	Activity Impact (%)	Total Impact (%)
Channel	High Impact Channel Realignment	30.12	78.87
Channel	Embankments and Floodwalls no Bank Reinforcement	22.19	78.87
Channel	Low Impact Channel Realignment	13	78.87
Channel	Riparian Vegetation	7.11	78.87
Channel	Grey Bank Reinforcement	1.7	78.87
Channel	Pipe and Box Culverts	1.44	78.87
Channel	Green Bank Reinforcement and Bank Reprofiling	1.2	78.87
Channel	Impoundments	1.06	78.87
Channel	Bridges	0.62	78.87
Channel	Set Back Embankments and Floodwalls	0.33	78.87
Channel	Intakes + Outfalls	0.07	78.87

Identified different options to restore functionality, reduce flood risk and improve habitats – in sources and pathways



Selected options/measures:

A: breach/set back embankments, new fence margins, riparian woodland, wet woodland,

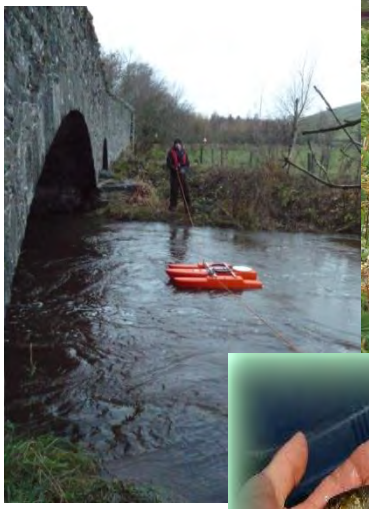
C: **re-meander channel** - **Cringeltie**

L: Reduced stocking density, **tributary woodland, floodplain forest – Longcote burn**

N: create ponds, wetlands, riparian woodland block ditches, **engineered log jams – Middle burn**

Monitoring Programme developed focussed at multiple benefits

Catchment wide and at scale of Individual Interventions

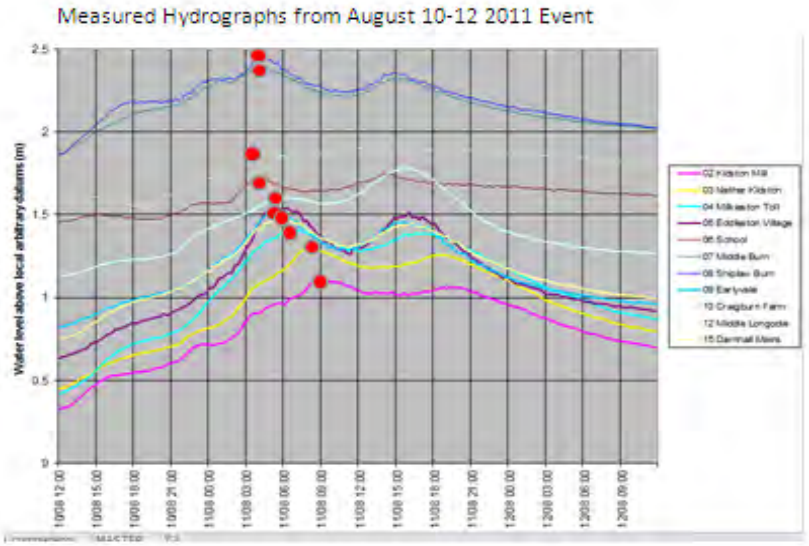


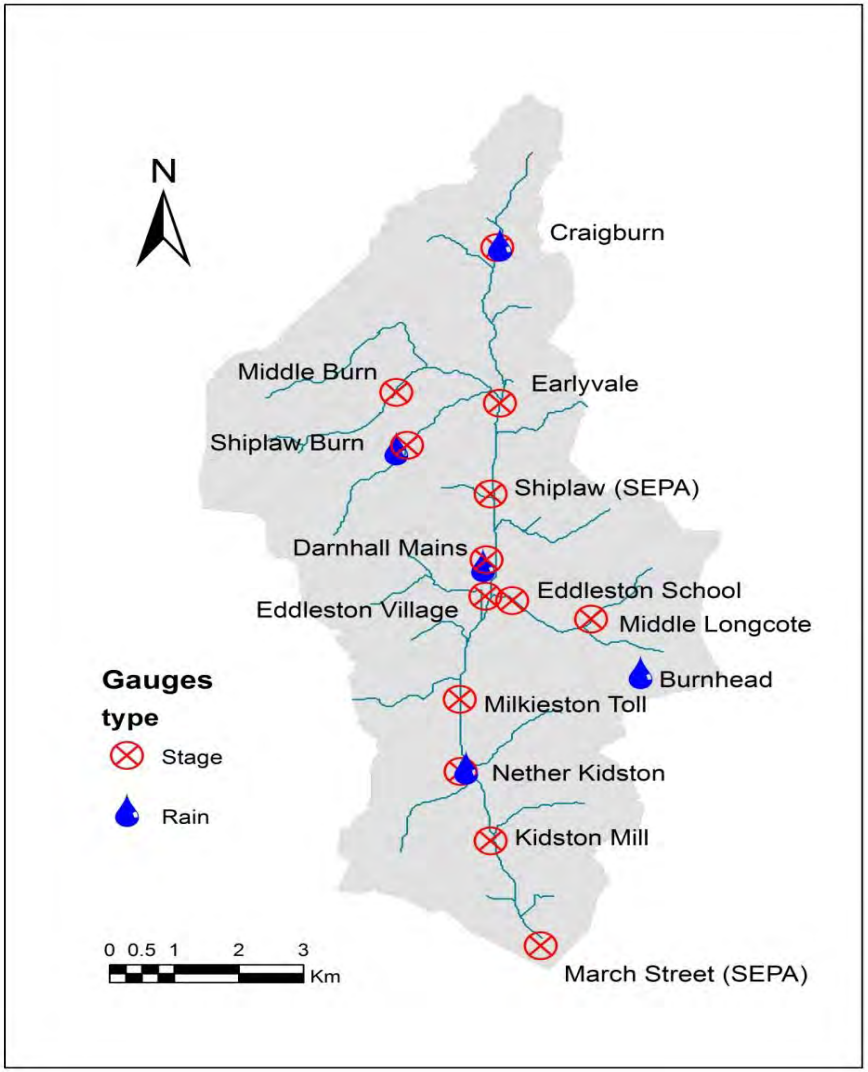
Measuring:

- Precipitation and weather
- Flows and river Levels
- Groundwater
- Physical stream habitats and hydro-geomorphology
- Ecology – plants, fish, invertebrates
- Acceptability to local farmers

New Monitoring network for Catchment flood flows

- **Installed a new detailed Hydrometric Network to record river levels and flood flows. Also Weather stations**
- **Identification of how and where flood runoff is initiated and its conveyance downstream, causing flooding**





Monitoring the impact of re-meandering the river – detailed ecology

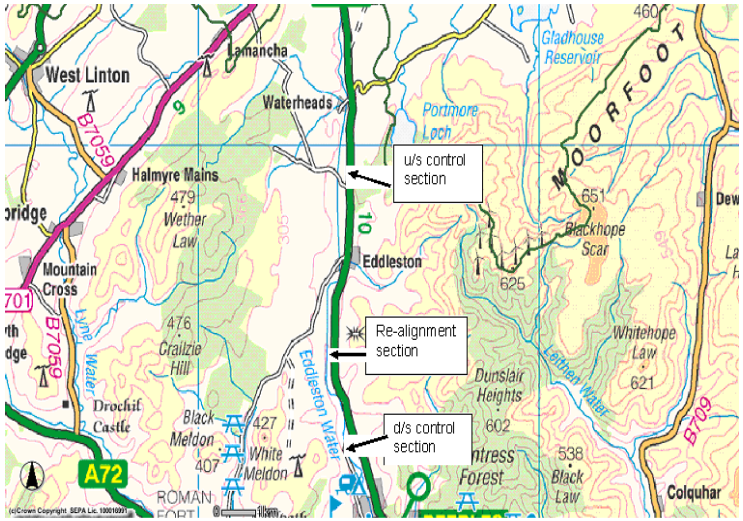
Ecology surveys of re-meanders 2011/13

- **Experimental sites** - Cringeltie & Lake Wood
- **Control sites** (upstream & downstream)

Aquatic invertebrates surveyed 2012 and 2013

Macrophytes surveyed 100m sections at Cringeltie, Lake Wood and control sections

Channel hydro-morphology surveys in 2013



Implications for restoration:

Establishes a very detailed base-line for analysis of the impact of abiotic changes in the physical features of the river channel on the biotic communities – links geomorphology & ecology

Impact of changes on catchment land use: -tree planting costs

2012 Completed Practical Works

Costs

Darnhall: fencing, planting, pond creation.
£7,688

Burnhead: riparian fencing/planting
£10,598

Portmore: riparian fencing/planting
£24,799

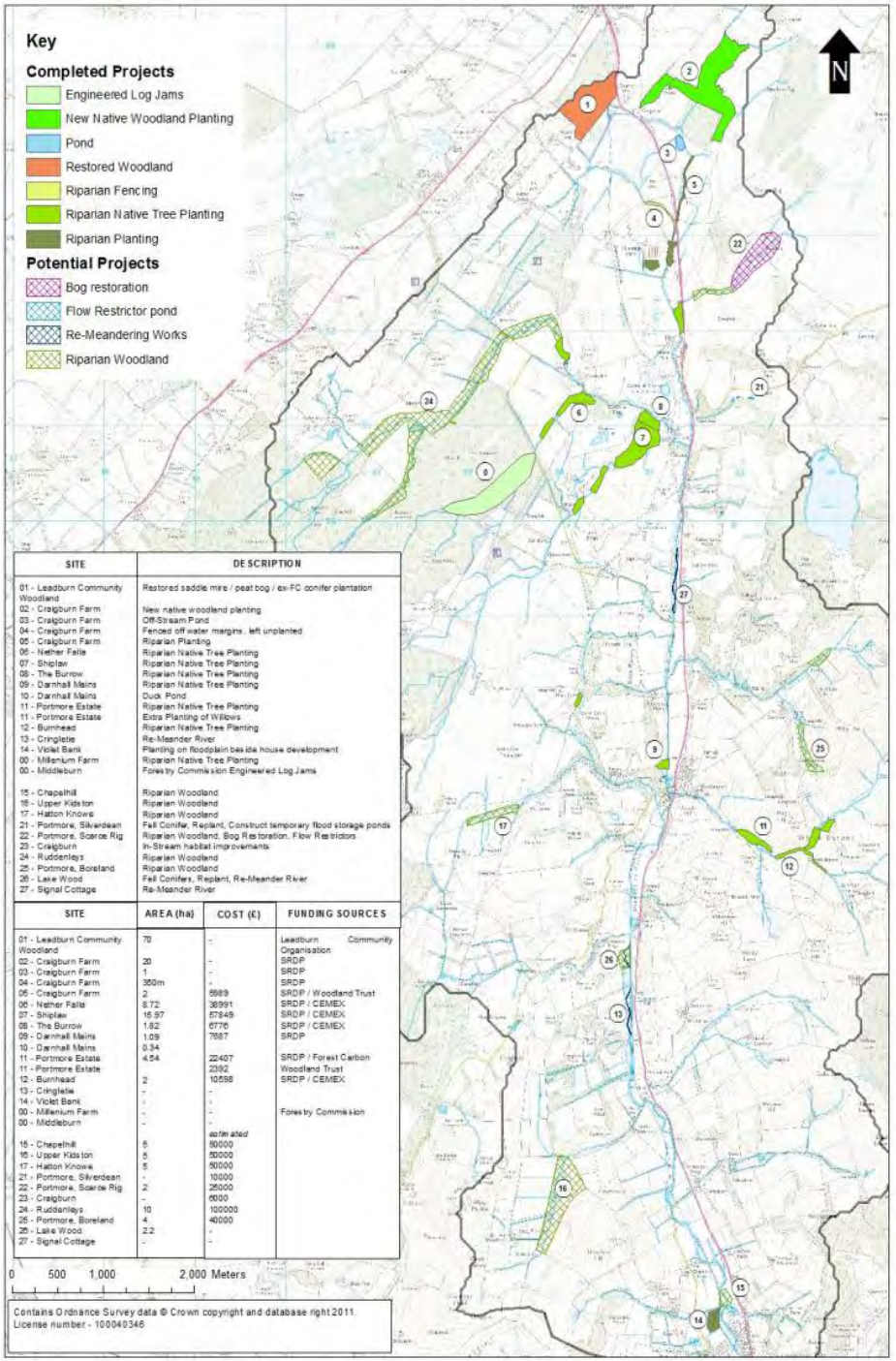
Shiplaw Burn: Fencing/planting
£62,405

Nether Falla: fencing/planting
£38,990

The Burrow
£7,412

Craigburn farm: planting water margins.
£5,989

Total Costs catchment planting (2012)
£157,881



Physical works on the ground - new meanders Autumn 2013

Physical works on the ground - new meanders Autumn 2013

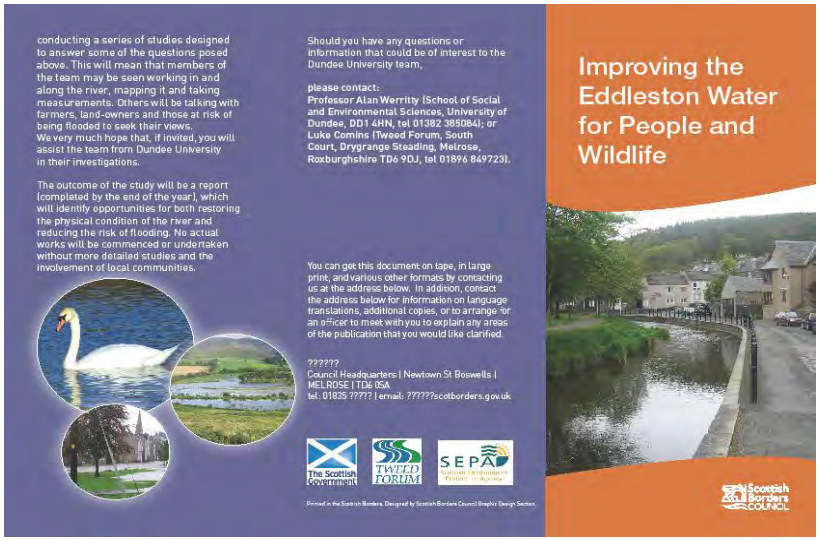
Physical works on the ground - new meanders Autumn 2013

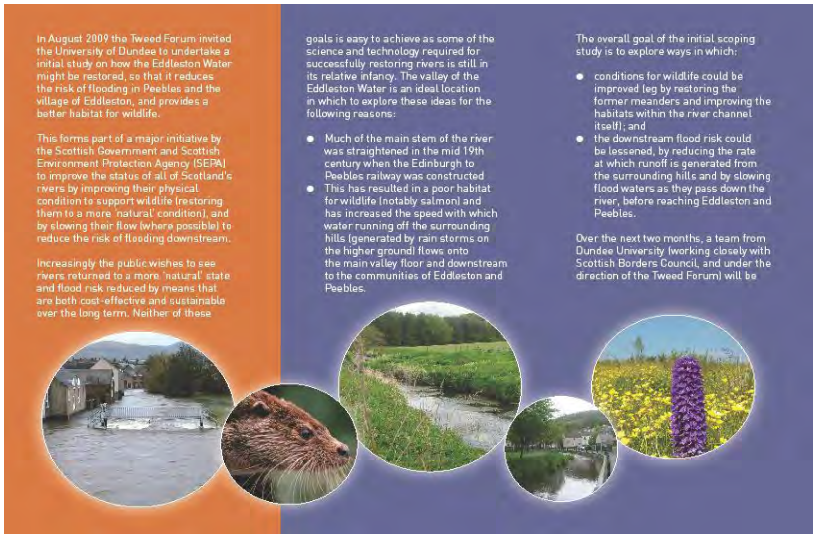
Trabajo físico sobre el terreno- meandros September 2014

Monitoring the impact of re-meandering the river – detailed hydro-morphology measurements

- **Detailed sediment sampling** and assessment of channel structure and form at Cringeltie, Lake Wood and 2 control sites
- **Matching ecological surveys** of species abundance and diversity at all sites

Social challenges – Opportunities and Barriers to restoration





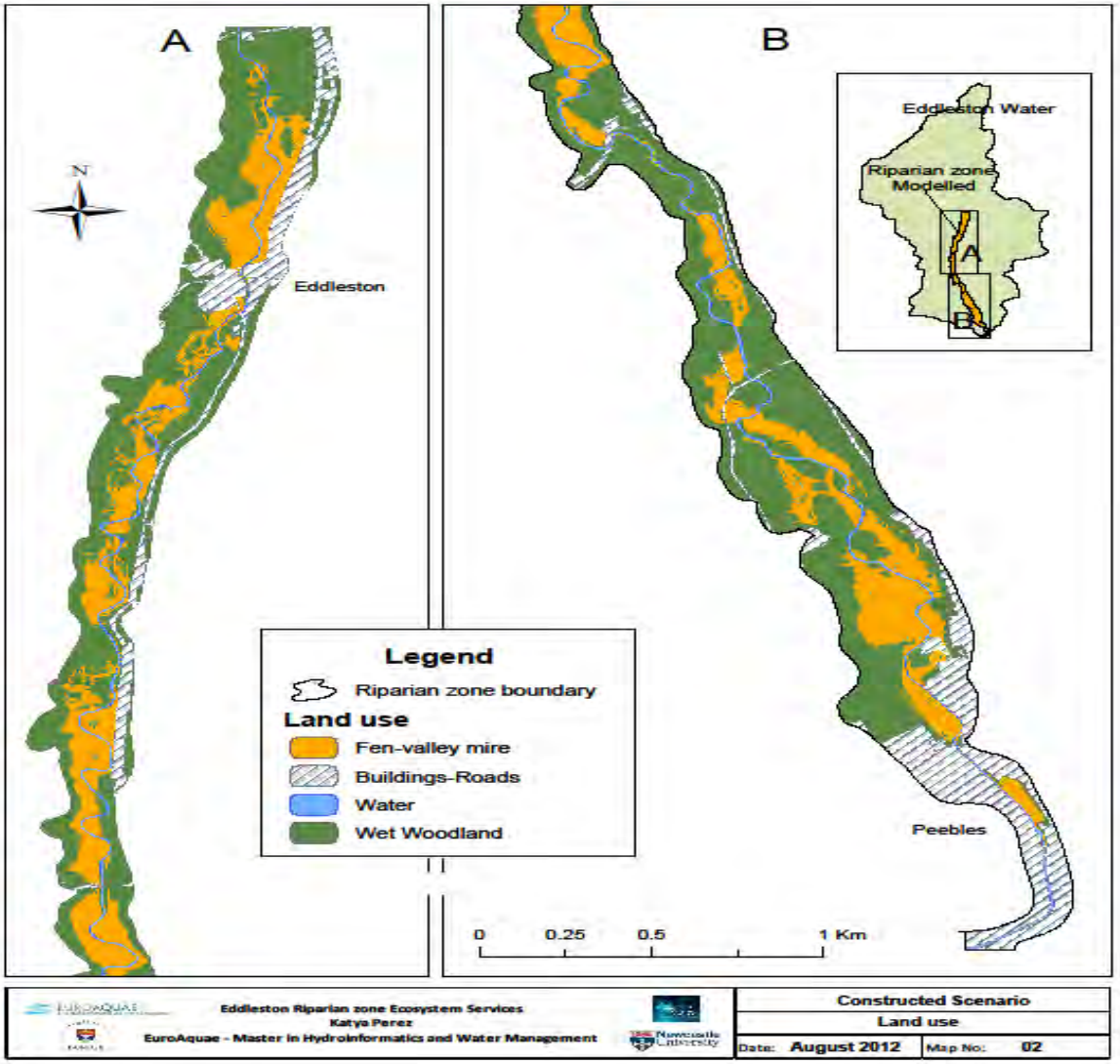
- **Interviews with key stakeholders**: Scottish Govt, SEPA, Tweed Forum, Scottish Borders Council, SNH, Tweed Foundation, Scottish Water, NFU(Scotland), Scottish Wildlife Trust, RSPB, Country Landowners Business Association.
- **Interviews with landowners** (three floodplain and two upland famers) middle-aged, male, long-term landowners in the valley (>30 years) with several sources of income.
- **Literature review**
- **On-going study on Farm businesses and NFM measures across Tweed**

A potential projected (modelled) flood regulation land use scenario

Flood risk regulation scenario, using NFM techniques:

Farming in the floodplain is replaced by Wet Valley Woodland - max flood retention & high Mannings 'n'

River course has now been "re-meandered", based on course of the old river and embankments "removed"



Multiple benefits? - Ecosystem Services selection

Flood regulation prioritised, other services chosen as most relevant for this scenario:

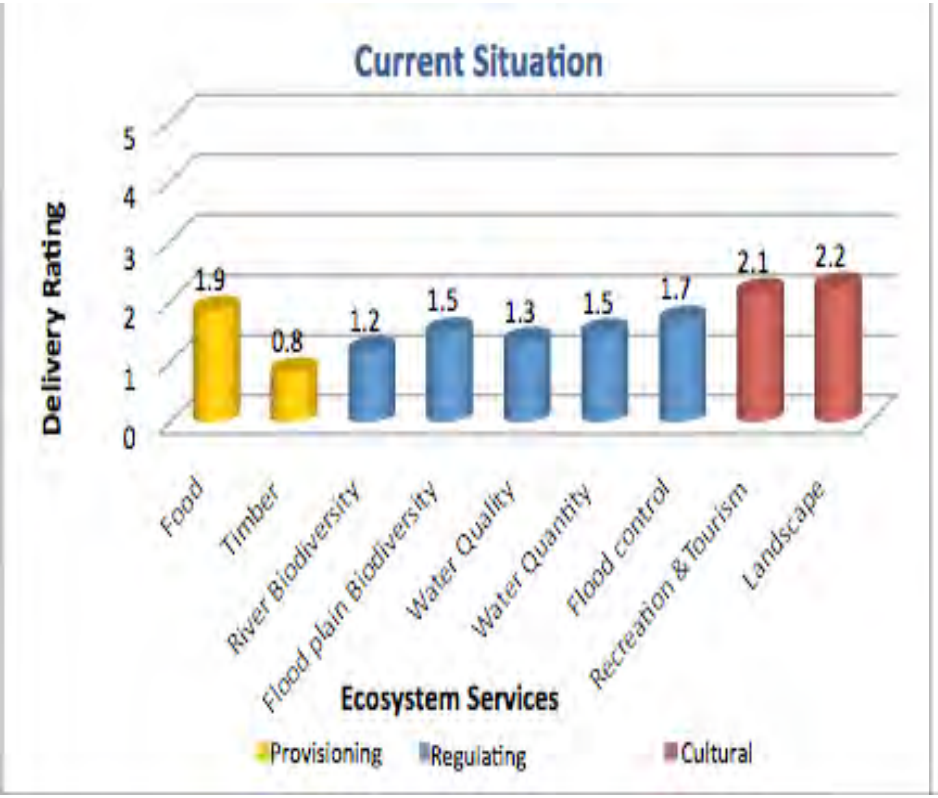
Provisioning	Regulating	Cultural
Food	Water Quality	Recreation & Tourism
Timber	Water Quantity	Landscape
	Flood control	
	Flood plain biodiversity	
	River biodiversity	

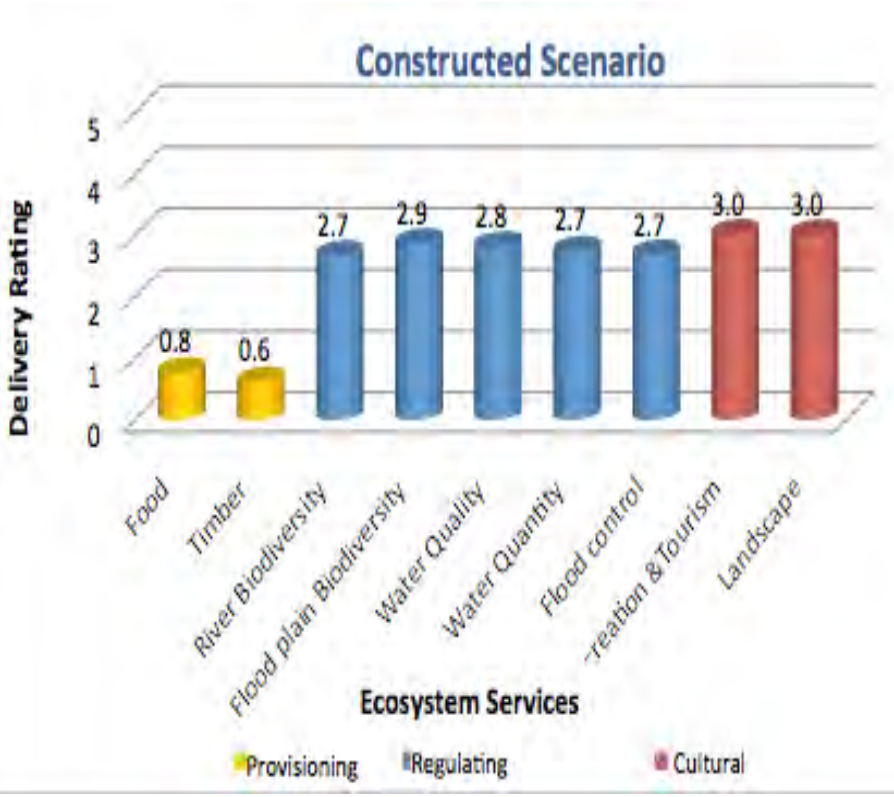
Ecosystem service scores – but is it worth it?

Changing land use to promote NFM gives enhanced flood regulation….
→ But other services also impacted positively/negatively in new scenario

But what are costs and benefits – what restoration is 'worth' doing?

2014 – assessing Cost-Benefits & costs avoided in flooded communities





Eddleston Water - unique monitored pilot catchment for 'proving' the value, costs and benefits of restoring functionality and processes at a catchment scale

Integrating Science and Policy at the catchment scale

River flow and flood gauges

Ground water surveys and boreholes

Rainfall and weather stations

River habitats and hydro-morphology

River biology – fish, plants, invertebrates

Land-owner & community engagement

Ecosystem service initiative

Long-term funding and a successful Partnership Approach

Long term Value