

Latest headline evidence from the Defra Multi-objective Flood Management Demonstration Projects:

Land use and management can make a significant contribution to reducing flood risk

Primary aims

In 2009 Defra funded three Multi-objective Flood Management Demonstration Projects with the primary aims of:

- Demonstrating and promoting the contribution that land management can make to managing flood risk;
- Producing other benefits for the environment and communities, such as conserving biodiversity, enhancing the landscape, promoting carbon sequestration and improving water quality.
- Achieving these aims by working with natural processes

The three projects

1. Making Space for Water Project (Dark Peak, Derbyshire) - Moors for the Future/
Environment Agency
Effect of restoration of severely eroding peat on headwater catchments
2. Source to Sea Project (Holnicote, Somerset) - National Trust
Effect of a range of natural flood management measures at a catchment scale
3. Slowing the Flow Project (Pickering, North Yorkshire) - Forest Research
Effect of a range of natural flood management measures at a catchment scale

Background

Starting in 2009, these projects have now been running for five years. Each has been collecting robust evidence to clearly demonstrate the effectiveness of land-use measures to manage flood risk at a catchment scale and deliver multiple other benefits.

Headline Reporting

A symposium held in the University of Manchester on 14th and 15th May 2014 provided a platform for discussions focussing on the most recent developments and outcomes from the three projects. This is of particular relevance to policy makers responding to last winter's floods and their need for a better evidence-base to guide a more sustainable approach to flood risk management. The following is a set of concise headlines for this purpose.

Headlines

From Source to Sea project - based on the Holnicote Estate in Somerset

1. The targeted implementation of a range of natural flood management measures at a catchment scale has been shown at Holnicote to reduce downstream flood risk
2. During last winter's unprecedented rainfall in Somerset, there was no flooding in the vulnerable villages that have experienced regular flooding in the past
3. There was a 12% reduction in flood peak in late December 2013 on an already saturated catchment containing 90 properties at risk with an insurance value of £30M; the associated NFM measures had a capital value of £138,000
4. Management of soils and the continuance of agricultural support mechanisms hold the key to creating sustainable and resilient rural landscapes

All three projects

5. The development of a robust evidence base to demonstrate the effectiveness of NFM measures at a catchment scale is likely to take several years to a number of decades, depending on the type of measure and scale of implementation
6. The involvement of the local community and the cooperation of all stakeholders within a partnership approach provide a vital platform on which to deliver optimum flood risk management on a whole-catchment scale
7. Assessments of Ecosystem Services reveal that the financial value of a wide range of benefits delivered by NFM measures greatly outweigh the cost of their implementation; however the opposite may often be the case for individual private landowners

Expanded Headlines

From Source to Sea project - based on the Holnicote Estate in Somerset

Hydrologic and hydraulic modelling

The Holnicote project has:

- Explored the use of appropriate hydrologic and hydraulic models to represent the baseline catchment conditions, validated against the 15 minute time series flow record. These outputs are being compared to those derived from models representing both actual conditions based on the known land management changes that have been implemented in the catchments and more theoretical future conditions implemented without constraints across parts of the study area.
- Used GIS spatial analysis tools and hydraulic modelling methods to assess surface water flow pathways and flow accumulation areas in the Horner Water moorland headwaters and the middle Aller floodplain to identify target areas for the most effective implementation of natural flood management measures.
- Used the well-known rainfall-runoff model, the Probability Distributed Model (PDM), to explore how land management practices (on improved grassland and arable land) can affect soil condition, surface runoff, soil water storage and ultimately the total outflow from sub-catchments of the Aller and Horner Water.

- Developed hydraulic models of the Aller and Horner Water (using the ISIS 1D software) based on channel and structure survey datasets of all the main watercourses in the catchments, a DTM, the representation of hydraulic roughness of the channel and the floodplain, and the meandering nature of the watercourses.
- Explored how inflows to the hydraulic models, generated by standard hydrological methods or imported from PDM outputs, are routed downstream where the combined effects of hydraulic capacity, conveyance, connectivity and constrictions can lead to out-of-bank spilling of water onto floodplain areas, which are then mapped spatially using a linked 1D-2D ISIS-TUFLOW floodplain model.

Empirical Evidence for Hydrological Change

The Holnicote project has:

- Developed and explored the use of appropriate statistical analyses and models for assessing changes in catchment hydrological response to land management interventions.
- Three principal methods have been developed. 1) Flow variability analysis examines the entire flow record in order to determine whether there have been changes in the frequency and intensity of runoff events in the pre and post intervention periods. 2) Hydrograph analysis looks for changes in the hydrograph response during any particular runoff event, with the intention of detecting changes in peak runoff and response time between pre and post intervention monitoring periods. 3) Climate analysis aims to interpret any significant changes in catchment hydrological response in light of climate (principally rainfall) variability.
- Interim results obtained so far, although not definitive, indicate changes in hydrological response to land management interventions, which will have positive effects on reducing flood risk downstream
- These effects include reductions in peak flow, and increases in hydrograph response (lag time and time to peak).
- These changes, although positive, have to be assessed in the context of the entire catchment flow response in order to avoid the issue of flow synchronicity and amplification, which could have the opposite effect of increasing flood risk, rather than reducing it.
- with the Aller catchment being in single ownership under the National Trust, there is an almost unique opportunity to implement wider-scale, agricultural and land management interventions, such as soil and ploughing management, crop management and the creation of buffer strips and woodland, which will serve to reduce flood risk and provide, once and for all, the hard evidence that catchment scale land management interventions can have a significant effect on reducing flood risk. This critical observation has so far only been demonstrated with a high degree of certainty on smaller catchments and field scale experiments.

Demonstration of Multiple Benefits through an Assessment of Ecosystem Services

- The natural environment has a value to society that can be difficult to express in terms of direct cost and so is often overlooked e.g. the ability of a well-managed natural environment to slow down the flow and temporarily store flood waters, to reduce flooding downstream.
- Already, this winter (2013/14) during the extremely high rainfall events across southern England, land management changes in the River Aller catchment reduced the flood peak by 12%. The capital cost of the associated land management changes amounted to some £138,000; the 90 properties protected have an insurance value of £30M.
- Working with the tenant farmers means that the land can still be used for agriculture. The flood reduction measures also prevented potentially damaging impacts on tourism in the

village of Allerford and are helping to address soil erosion problems for tenant farmers and creating habitats for wildlife.

- We recognise that the concepts and language of ecosystem services are complex and we need to find ways of making it easily understood.
- The Source to the Sea project at Holnicote Estate is developing a Payment for Ecosystem Services (PES) approach to develop real, sustainable markets around the sale of ecosystem services. Some of the challenges and issues we will tackle are:
 1. Simplifying the language used to make the concept accessible to a wide audience;
 2. Demonstrating the financial value of goods and services provided by the Holnicote Estate;
 3. Developing tools to engage different sectors of society to recognise the value of the natural environment and to 'buy' the goods and services on offer.
- Around 1.2M visitors come to Holnicote each year. If just 10% of the visitors can be engaged in spending £1, this would generate revenue of £100,000 p.a. to invest in on-going land management initiatives. It will be important to demonstrate the tangible benefits of this work - we will report on and share the results widely with others.