Case study 34. River Ray Rural Flooding

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Main driver: Coordinating farming community engagement in rural flood risk management

Project stage: Consultation phase

Photo 1: Construction work on the River Ray (source: NFU)

Project summary:

In light of the winter 2013 to 2014 flooding, farmers asked the National Farmers Union (NFU) for assistance in developing pragmatic options to help reduce flood damages to agricultural businesses and rural communities. In an attempt to build consensus on developing community driven approaches to flood and coastal risk management (FCRM), a 2-part investigation based on the River Ray catchment in Oxfordshire was made by NFU South East.

- A survey of the attitudes of farmers in the catchment to conventional and novel approaches to flood risk management received responses from approximately 47% of all catchment landowners.
- A hydrological modelling study considered the relative impacts of various land use and land management scenarios on the severity of flooding events. Scenarios included comparisons between watercourse maintenance, pond creation/enhanced flood storage, soil compaction, urbanisation effects and climate change predictions.

Key facts:

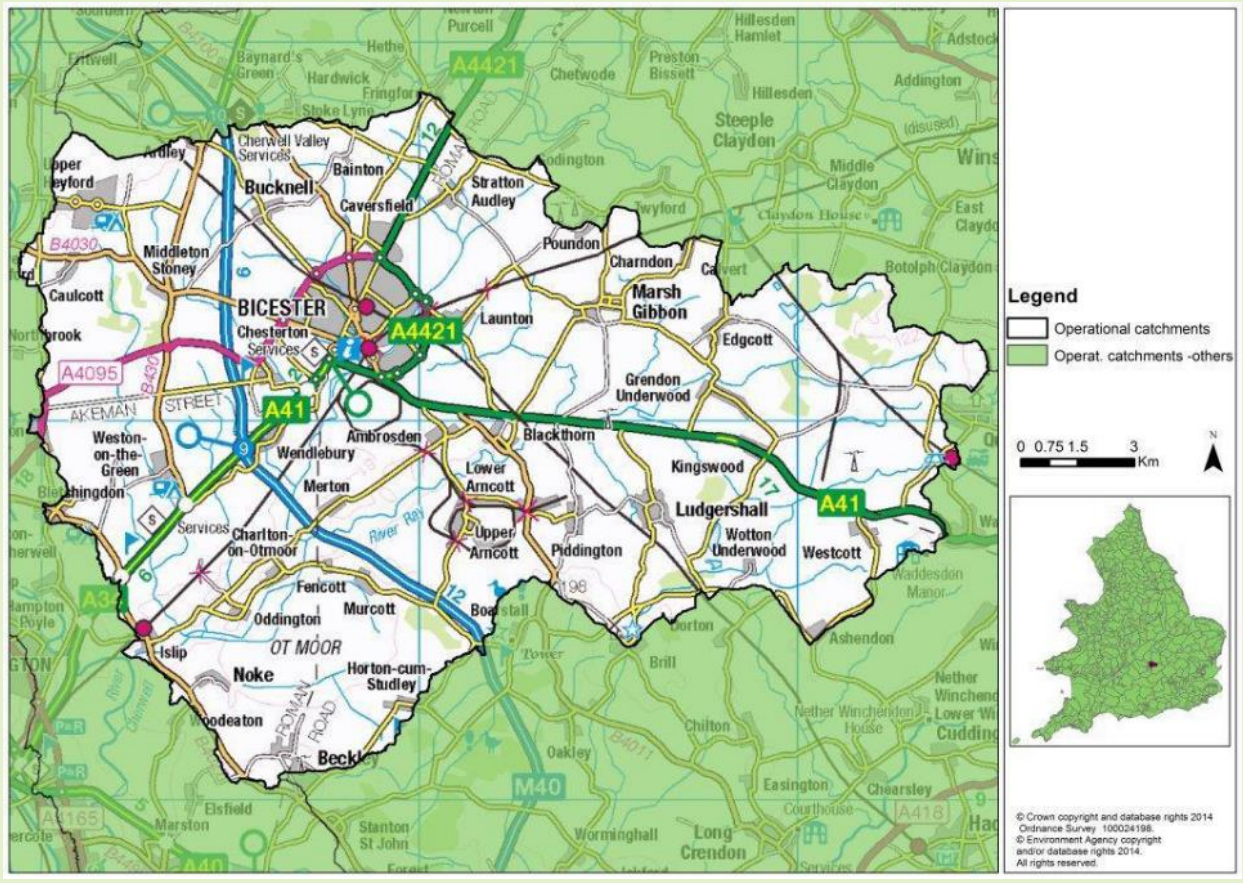
Rural landowners have a clear preference towards conventional watercourse maintenance and the NFU estimates a cumulative spend in the region of £221,000 per year on catchment drainage. This translates to approximately £9.20 per hectare spent by farmers to enhance storage in farm ditches. The modelling study predicted that unconstrained channel maintenance could achieve agricultural damage reductions equivalent to between £10 and £57 per ha per year, roughly commensurate with the private spending reported by survey participants. In contrast, unconstrained soil compaction has a potential influence on flood damages of £75–£100 per hectare per year depending on land use and position within the catchment.

Survey participants showed preference towards working collaboratively. Among larger landowners, 67% were in favour of a local management group and 58% would pay be willing to pay towards an Internal Drainage Board. A relatively high 49% also considered it important to build small and numerous water storage facilities for times of flooding, with a further 35% neutral on the issue, indicating some commitment to consider a 'whole catchment' flood risk approach.

The unconstrained modelling scenarios predicted:

- damage reductions of 61% (agricultural) and 64% (property) from watercourse maintenance
- 31–37% reduction in agricultural damages from additional pond storage
- ±34% (agriculture) and ±166% (urban) damage sensitivity from unconstrained soil compaction
- 15% damage increase from climate change

These are not 'real world' predictions but indicate the relative gains possible from a combination of approaches where consensus can be reached.



Map 1: River Ray Catchment (source: Ordnance Survey and Environment Agency)

1. Contact details

Contact details	
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2. Location and catchment description

Catchment summary	
National Grid Reference:	SP585174
Town, County, Country:	Oxfordshire and Buckinghamshire, UK
Regional Flood and Coastal Committee (RFCC) region:	Thames
Catchment name(s) and size (km^2):	River Ray, 287km^2
River name(s) and typology:	Modified watercourse
Water Framework Directive water body reference:	
Land use, soil type, geology, mean annual rainfall:	The catchment forms part of the Upper Thames Clay Vales National Character Area 'Low-lying clay-based flood plains coursed by the River Thames and its dense network of tributaries and ditches, often lined by willow and reed'. Land use statistics from the Centre for Ecology and Hydrology (CEH) indicate that the Ray catchment area is made up of 11.3% woodland, 42.6% arable/horticulture, 40.1% grassland and 2.1% urban. The only major conurbation is Bicester, with numerous villages scattered across the area. Mean annual rainfall 700mm.

3. Background summary of the catchment

Socioeconomic/historic context

The Upper Thames National Character Area is ranked eighth nationally in terms of its share of development outside urban or urban fringe areas. Bicester has been identified as a growth town that will play an important role in the economic growth of Oxfordshire.

Flood risk problem(s)

Drainage characteristics are influenced by the impermeable Oxford clay geology, which predominates throughout much of the area. The gradient of the Ray is also among the lowest in the UK, which combined with the clay, makes the Ray particularly vulnerable to flooding. The river is also strongly affected by the impounding effects of the River Cherwell downstream.

Approximately 67% of the soils are Agricultural Land Classification (ALC) Grade 4 (Poor) 'slowly permeable, seasonally wet, slightly acidic but base-rich loamy and clayey soils' and given over largely to livestock grazing. The flashy nature of the catchment, combined with the relatively impermeable nature of the soils, has historically prompted much land drainage improvement work. While the floodplain still floods readily, watercourses have been historically deepened to allow for the quicker evacuation of floodwaters. There are approximately 35 flood defence structures, 5 raised defences and 4 flood storage areas within the catchment.

Other environmental factors

Parts of the catchment have very high nature conservation value. There are approximately 15 Sites of Special Scientific Interest (SSSIs) within the catchment, central to which is Otmoor SSSI. These contain predominantly areas of neutral floodplain grasslands, consisting of both herb-rich meadows and wet grasslands important for waders. The area has been targeted for ecological protection and restoration, with both the RSPB and the Berkshire, Bucks and Oxon Wildlife Trust (BBOWT) having reserves within the catchment.

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

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

It is estimated that 37km^2 of the catchment is within Flood Zone 3 and 44km^2 within Flood Zone 2, so that approximately 28% of the catchment is at risk of flooding. There are localised issues around Islip and nearby villages.

Respondents to the questionnaire reported up to 2,541 acres of flooding (10.3km^2) in winter 2013 to 2014, approximately 4% of the total farmland area or up to 13% of all flood affected land within the catchment. Some 65% considered that the character of flood events had changed in living memory in terms of duration, extent and frequency.

A total of 48 respondents reported approximately £109,322 of flood damage during the winter 2013 to 2014 event, much of which was uninsured. This has been calculated as a broad cost of between £71 and £165 per hectare averaged across all land use types in all parts of the catchment. Considered in the context of indicative net incomes from farming (for example, -£249 per hectare for winter wheat and -£309 per hectare for lowland suckler herds during 2015), the flood damages experienced were severe.

What was the design rationale?

Current priorities on river maintenance are set out in the Environment Agency's 'Maintenance Protocol', which states:

'In the past, many flood defence schemes primarily provided drainage and other support for farming. Our need to prioritise investment of public money in FCRM has led to a shift of focus to locations where the probability of flooding, economic damage and risk to life are greatest. The shift means that we are no longer able to justify maintaining assets which predominantly drain land and provide little flood risk benefit. In some areas it is no longer possible for the Environment Agency to provide some or all of the funds for the long-term management of those assets.'

In this context, the design rational behind the project is to try and identify ways of continuing to manage flooding on productive farmland and to explore possible ways of providing flood risk management services on behalf of the catchment.

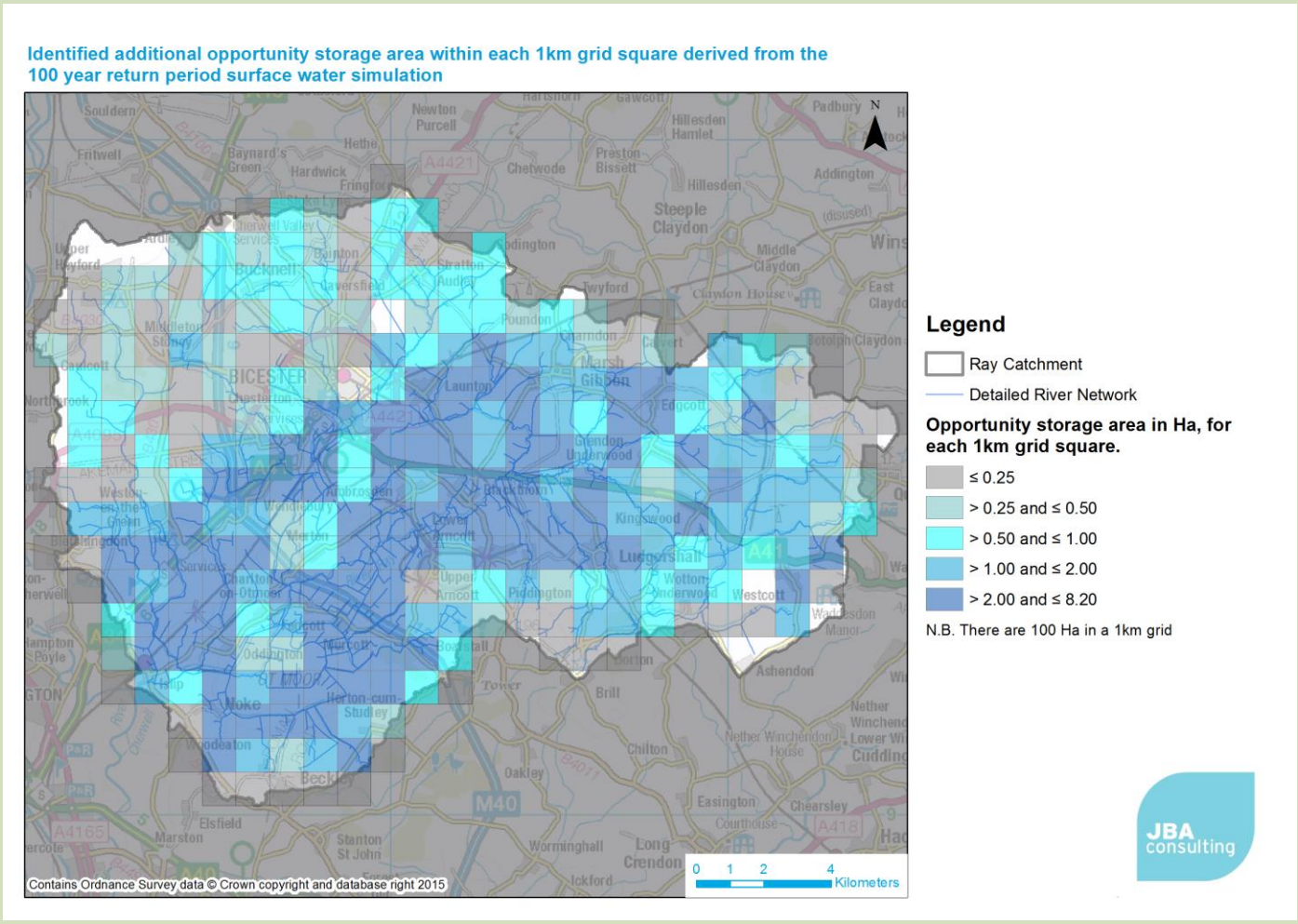
Project summary	
Area of catchment (km^2) or length of river benefitting from the project:	–
Types of measures/interventions used (Working with Natural Processes and traditional):	Explored through modelling: • effectiveness of drainage and conveyance maintenance operations in rural areas • influence of land use/management change and urban/infrastructure development, focusing on the changes between the 1885 urban extent of Bicester and the present day • influence of soil structural properties and condition • influence of climate change • potential for run-off attenuation opportunities, such as enhanced storage to reduce agricultural and property damages
Numbers of measures/interventions used (Working with Natural Processes and traditional):	Not applicable
Standard of protection for project as a whole:	Not applicable
Estimated number of properties protected:	Not applicable

How effective has the project been?

The project has explored the interface between farming attitudes and possible low cost catchment interventions to reduce flood risk. The project has assembled an extensive database and has been able to develop a high level of engagement with the major catchment stakeholders (Photo 2).

The modelling survey generated a number of stakeholder engagement maps (see Map 2), which show the areas with greatest sensitivity to flooding intervention measures. Alongside a further series of maps showing potential locations for run-off attenuation measures, this evidence base can be used to continue working with stakeholders to develop a works programme for delivering community-based flood attenuation. This is intended as the next phase of the project, depending on resource availability.

Photo 2: Local stakeholder Natural Flood Management (NFM) events on the River Ray (source: NFU)



Map 2: Map showing opportunity for storage areas across the Ray catchment (source: JBA Consulting)

The run-off attenuation modelling enhanced flood storage in approximately 2–10% of the land area by increasing the depth of flood storage by 1m in areas already subject to flooding. Using JBA's JRAFF software, this attenuation is predicted to deliver a 31–37% reduction in flood damages to agriculture.

A rough estimate of the costs involved in constructing additional pond storage over 2% of the catchment is significantly greater than £1 million. This far exceeds the value of the agricultural flood damage reduction achieved through modelling, which would be ~£500,000 during a 1 in 100 year design event. The cost of enhancing pond storage is therefore unlikely to be justified for agricultural purposes alone. It is recognised that there could be further potential reductions in property damage, but the scope of this study was insufficient to consider these effects.

To achieve the modelled flood damage reductions, it is likely that outside sources of funding would be needed, albeit the study has identified a possible source of partnership funding from the local community. Further work is needed to try and develop this opportunity.

In the absence of outside funding there may be scope to put in place opportunistic interventions where local communities prioritise these.

5. Project construction

How were individual measures constructed?

The project has not reached implementation; however, it may be possible to identify a preferred works programme in consultation with local landowners.

How long were measures designed to last?

Design lifespan is extended through ongoing maintenance. The ideal outcome would be to identify a collaborative mechanism for generating revenue funding in perpetuity to achieve low cost interventions.

Where there any land owner or legal requirements which needed consideration?

Not applicable

6. Funding

Funding summary for Working with Natural Processes (WWNP)/Natural Flood Management (NFM) measures	
Year project was undertaken/completed:	2014 to 2015
How was the project funded:	NFU
Total cash cost of project (£):	£33,500 excluding time input from NFU staff
Overall cost and cost breakdown for WWNP/NFM measures (£):	Cost of consultant: £32,000. Cost of questionnaires: £500 Cost of local meetings: £1,000. Staff hours not included: ~12 months full-time equivalent
WWNP/NFM costs as a % of overall project costs:	Not applicable
Unit breakdown of costs for WWNP/NFM measures:	Not applicable
Cost–benefit ratio (and timescale in years over which it has been estimated):	Not applicable

7. Wider benefits

What wider benefits has the project achieved?

No physical interventions have been made. The model scenarios explored relationships between soil compaction, enhanced pond storage, impacts on farming and urban areas, climate change and watercourse management. In considering all of these variables as part of a focused consultation, there is potential to generate multiple benefits in delivering habitat enhancements alongside enhanced flood protection and improved farm productivity should there be an opportunity to move forward into a delivery stage.

How much habitat has been created, improved or restored?

Not applicable

8. Maintenance, monitoring and adaptive management

Are maintenance activities planned?

Not applicable

Is the project being monitored?

Not applicable

Has adaptive management been needed?

Not applicable

9. Lessons learnt

What was learnt and how could it be applied elsewhere?

The results from the modelling survey demonstrate that no single management technique can feasibly mitigate the costs of flooding alone. However where a combination of interventions might be delivered in sufficient number, this may technically be able to reduce overall damage costs within the catchment. Channel maintenance and soil structural changes appear to exert the most influence on agricultural and property damages, while pond creation seemed less influential.

While the real world impact of soil compaction was not investigated in this study, the model results indicated a high degree of sensitivity around soil compaction and flood damages. This is perhaps unsurprising given that the model intervention encompassed every square metre of the catchment. Nonetheless this has possible implications for other projects in exploring general soil management and how the enhancement of infiltration capacity might improve flood risk as well as enhance farm productivity.

Stakeholder engagement and consensus building are evidently crucial factors in delivering measureable outcomes at a catchment scale. This project identified enthusiasm among stakeholders and even a willingness to contribute financially; however, building consensus requires a high degree of time, effort, consistency and funding to enable delivery. The full cost of building consensus may be somewhat undervalued in most project costings, but it should be the primary consideration for projects looking to achieve measurable flood risk reductions.

This project attempted to 'engage through research', which enabled all stakeholders to approach the issues with an open mind in the understanding that there was no right or wrong answer. This approach is recommended to others. However, the project's major shortcoming lies in:

- not having put in place physical examples to aid further interest
- not being able to sustain an ongoing presence with landowners in the catchment long term
- not having yet found a 'champion' in the catchment to take this forward under their own enthusiasm

These points are worth considering for those looking to develop projects in other catchments.

10. Bibliography

ORMESCHER, T., KEEN, T. AND CLIFFORD, D., 2015. *Coordinating new approaches to watercourse management in rural catchments. Is there a case for a new Internal Drainage Board in Oxfordshire.* Stage 1 report. Petersfield, Hampshire: Farmers Union South East.

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.