

FLOOD MANAGEMENT IN BORDERLANDS

Final Research Report (April 2012)

Contents

EXECUTIVE SUMMARY.....	2
1. Background.....	2
2. Objectives.....	3
3. Methods.....	3
3.1 WP1.1 and 1.2.....	4
3.2 WP2.....	5
3.3 Community mapping P-GIS 1.....	5
3.4 Validation P-GIS 2.....	6
3.5 WP3.....	6
3.6 WP4.....	6
4. Results.....	7
4.1 Sharing Flood knowledge in borderlands.....	7
4.2 Exploring options for adaptive management practices.....	9
4.3 Participatory GIS.....	11
4.4 Learning together.....	13
4.5 Capacity building and training.....	14
4.6 Knowledge transfer.....	14
4.7 User engagement.....	15
4.8 Future research priorities.....	16

EXECUTIVE SUMMARY

This study looked at two sub-catchments of the cross-border River Tweed (the Eddleston and Wooler Water catchments) to help identify principles for developing cooperation in land management strategies to build resilience in respect of the impacts of climate change on flooding in borderlands.

The aim of the study was not to generate new data on the mechanisms of flood alleviation or adaptation but instead to understand and contribute to the *exchange of knowledge* between organisations and individuals concerned with flood risk management in rural areas. In doing this, the study looked at incorporating local knowledge into land management strategies; facilitating knowledge exchange between groups and across the national border; using an integrated set of qualitative and quantitative research methods to explore options for adaptive management practices and examining existing social and natural science data sets to see how they may be used more effectively to support management strategies. Local networks, including land managers, members of statutory agencies, and local government, businesses and the wider public, were accessed via partnerships with Tweed Forum and the Northern Rural Network.

Methods such as literature review, interview, Q methodology and participatory GIS were used to elicit information from the individuals participating in the study. The study gained an insight into how natural and traditional flood management issues are perceived by the general public and a flavour of what organisations view as key issues in the arena of natural and traditional flood management issues. Knowledge exchange across the border was facilitated by the wide range of individuals involved in the study, dissemination of information via the Tweed Forum constituency and a project website and the relationships between individuals and agencies were shown to be complex and dynamic. Networks to support the use and transfer of documents, noticeably around physical science, were already found to be in place with six key flood groups meeting regularly. It was found that stakeholders felt connected and understood each other's roles and responsibilities well. However, there was still confusion about the practice of flood risk management, especially who was doing what where and how different organisations interpreted both regulation and uncertainty in knowledge and evidence. Our findings suggested that there is not much cross over between academic and non-academic documents.

Several issues surrounding natural flood management were elicited, including issues of uncertainty, and the importance of networks and trusted expertise were repeatedly highlighted. Also the role of scale was a common theme, the need for site-specific management interventions conflicting with the need for large-scale generic flood prevention schemes. Q Methodology was used to get a sense of the range of views on the nature of the problem of flooding locally and it was found that there were no common determinants for those views. The value of Q in making people to think carefully about their point of view was particularly felt by agency representatives who saw opportunities for bridging gaps or moving discussions in new directions. The participatory GIS elements of the study showed that that local, grounded, stakeholders with a knowledge of the local area can contribute usefully to problem definition and to option generation with respect to flood management. A number of future research priorities have also been identified which will be of use to various stakeholders.

1. Background

This study has been funded as a knowledge exchange project to identify principles for developing cooperation in land management strategies to build resilience in respect of the impacts of climate change to flooding in borderlands. Borderlands are complex and indeterminate spaces that exist at the interface of different territories and present a complex and messy arena. In this case the borderlands concerned are those between professional and lay knowledge, between responsible agencies, and between one nation and another. Flooding in rural areas affects both land based businesses and residents but low population density and a shift in policy from flood defence to flood risk management, has meant that little resource is directed towards protecting rural areas. Sustainable flood risk management (SFRM) encompasses practices of natural flood management (NFM) and includes multipurpose land management schemes.

In this study we looked at two sub-catchments of the River Tweed, which crosses the border between Scotland and England. There is a strong need to increase the flood resilience of the region in response to expected climate change which was underlined by severe flooding in the region in 2008 and 2009. The Tweed catchment is designated with the Solway as an international border area requiring a unified River Basin Management Plan (RBMP) under the Water Framework Directive. Scottish devolution has led to an increasing divergence in policy within the Tweed catchment with differences of approach to particularly complex regimes of rural development and protective environmental designations administered by many different agencies on both sides of the national border. The Tweed catchment provides an excellent case to illustrate the rapidly changing institutional environment that followed the floods of 2007, 2008 and 2009 in England, the Pitt Review and consequent recommendations, the introduction of the Flood Risk Management (Scotland) Act 2009 and the England Water Management Act 2010.

2. Objectives

This project was designed *to understand and contribute to knowledge exchange between organisations and individuals concerned with flood risk management in rural areas*. It was not intended to generate new substantive data about the mechanisms of flood alleviation or adaptation.

Aim: To identify principles for developing cooperation in land management strategies for borderlands with particular respect to building flood resilience in the face of the uncertain effects of climate change

The objectives of the project were:

- to incorporate local knowledge into land management strategies
- to facilitate knowledge exchange between local groups, local and national agencies and across the national border
- to use an integrated set of qualitative and quantitative research methods to explore options for adaptive management practices
- to examine existing social and natural science data sets to see how they may be used more effectively to support management strategies
- to evaluate how people learn together in the course of the project

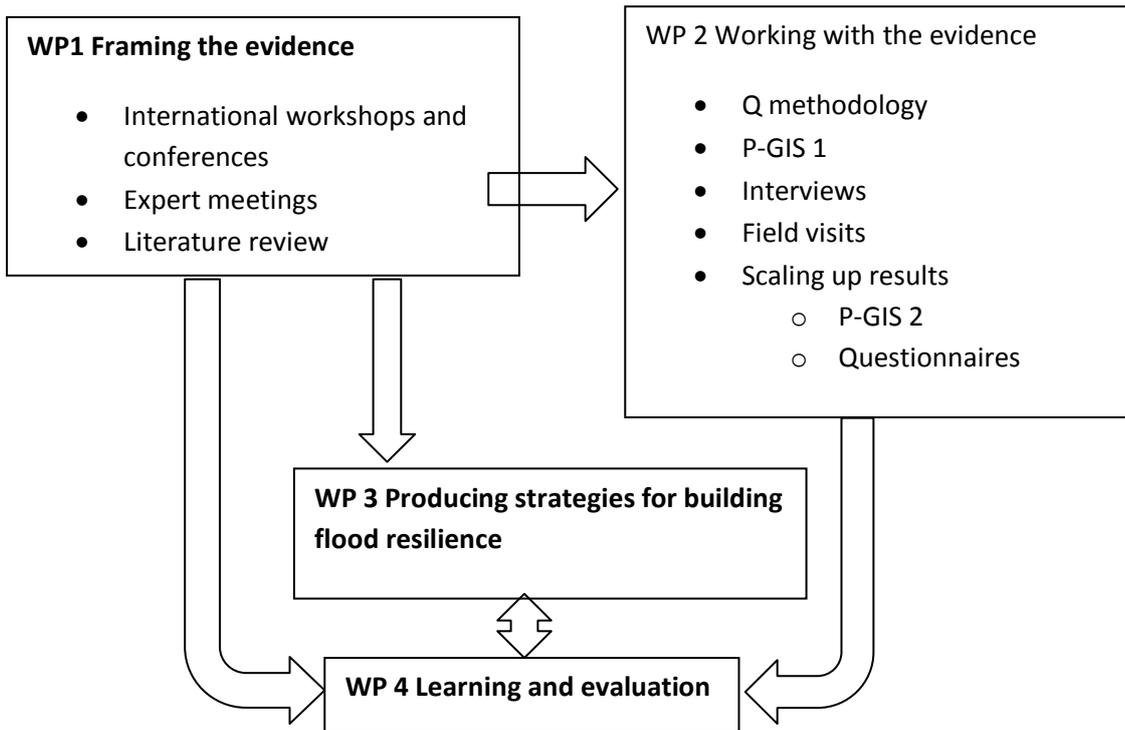
Academic input to the research was supported by partnership with Tweed Forum and the Northern Rural Network (NRN). Tweed Forum (TF), established in 1998, acts across the border to establish a network between a number of Scottish and English stakeholders (<http://www.tweedforum.com/>). Its objective is to promote the sustainable use of the catchment through holistic and integrated management and planning. Cheviot Futures (CF) works closely with TF on the ground and brings together 11 organisations concerned with helping rural communities build resilience to climate change. NRN has over 1300 members including rural businesses and organisations across northern England and southern Scotland.

The original work plan was focused upon the Rivers Bowmont and Glen in the Tweed catchment. In the interim between applying for and winning the funding for this project considerable work was carried out on these catchments leading to the risk of stakeholder fatigue. Acting on the advice of TF the sites for the project were changed to Wooler Water in England and Eddleston Water in Scotland. These rivers are both subject to sudden flooding events and offered a good comparison for the work. In addition, this brought in partners from the Centre for Water Law, Policy and Science at the University of Dundee, who were already working on the Eddleston Water, and who were able to obtain additional funding of £25K from The Scottish Government for the support of Professor Christopher Spray to contribute to the Borderlands project.

3. Methods

The methods for the study were developed through the Work Packages (WPs) that structured the work, shown diagrammatically below. Both qualitative and quantitative methods were used in the study.

Figure 1: Project design



3.1 WP1.1 and 1.2 The first stage of the project coincided with two key meetings: The New Civil Engineer two day Flood and Water Management Conference and Workshop and the RELU funded Catchment Management for Protection of Water Resources, both held in London in November 2010. These meetings brought together key individuals involved in flood management research and implementation in the UK and beyond. Two further ‘expert’ meetings were arranged. The first in January 2011 was at the Flood Hazard Research Centre at Middlesex involving 2 senior flood researchers; and the second in March at the James Hutton Institute with 6 flood researchers. The interviews were semi-structured, followed a planned schedule and were recorded and transcribed. Data from the interviews were analysed and used in the development of the interview schedules for WP1.2. Statements gathered from the interviews and transcriptions were contributed to the statement bank for the Q method.

Extensive searches of the literature on natural flood management included academic papers, consultants’ reports, reports from statutory agencies, regulations, and government reports. All yielded statements for the Q methodology. The purpose of WP1.1 was to scrutinize existing data and research outputs covering the study area to determine ‘moments of connection’, where the data and knowledge created have been used as evidence in decision making, and ‘sink holes’, where data and knowledge have apparently been disconnected from the decision making process. The analysis for WP1.1 focused on the Tweed catchment and in addition to the literature review involved:

- Developing a map of organisational linkages highlighting different pathways data travel and how they are taken up and used as evidence. Organisational maps were developed from a range of sources; ethnographic reflection on the research and discussion with project partners.
- Interviews with selected representatives from the organisations involved in flood management in the Borderlands (n = 9).

At the same time, an extensive search was made of the historical record of floods in both sub-catchments, and across the wider Tweed, to inform analysis of the changes in perception of flood risk management over time, including the scales and drivers for management intervention.

3.4 Validation P-GIS 2

The maps were validated with a wider constituency using Rapid Appraisal GIS (RAP-GIS). It was agreed with TF and NRN that this was likely to yield more useful feedback than the proposed web-based questionnaire. The digitised map for Eddleston Water was presented at the agricultural show in Peebles on August 13th, and for Wooler Water at the Glendale show on August 29th. Attendees were invited to comment on the maps and to make additional suggestions, using flags to mark locations and information. The participants were asked to choose one of the positions generated from the Q sort with which they most identified. In addition basic socio-economic data and post codes were collected from each participant in the exercise in order to determine whether buy-in came only from particular groups. Sixty completed questionnaires and mappings were collected in Peebles and 55 at Glendale. In this way both qualitative and quantitative data were used to generate understandings of the issues around flooding and flood management in each catchment.

Data from the Q sort and P-GIS work were combined and analysed to provide a robust analysis of understanding of the problem of flooding and natural flood management.

3.5 WP3

The results from the analysis of data flows, Q-sort, participatory maps and questionnaires from the wider community were presented to invited policy, regulatory and implementing stakeholders from across the catchment at a meeting in Newcastle in early January 2012. Based upon the findings the participants were invited to identify key tools to aid communication and understanding of flood risk management in rural areas. The discussants were then asked three key questions:

- i. If you had £10K to spend NOW what would you spend it on?
- ii. If you had no constraints on the spending what would you do?
- iii. If there was to be one policy briefing as an output from this project what would you like its substance to be?

The results of the discussion generated the substantive outputs of the project.

3.6 WP4

WP4 was designed to elucidate and record expert stakeholder learning and also to record the social learning which takes place within the Managing Borderlands project itself. It was intended that passive evaluation tools would be used to avoid stakeholder 'consultation fatigue'. The discussion from the meeting of the expert stakeholders Q group were recorded and transcribed. This observation was supplemented by two semi-structured interviews with significant stakeholder actors who were in a particular position to drive cross-sector learning and cross-border learning. These interviews, along with those of WP1, threw light on the causes of 'double loop learning' in specific actors. These were largely due to personal situation and background. The findings were contextualized within, and compared with other outputs from the other WPs. An analysis was also performed on the recording of the final (WP3) meeting to link in with the output of the other WPs.

Finally, to reflect upon learning within the Managing Borderlands project itself, researchers and practitioner participants (Tweed Forum) were encouraged to keep researcher diaries/workbooks. The diaries were not analysed individually but used to facilitate conversation with WP4 workers and others. The project was simply too short to identify changes in behaviour between actors. However, this experience itself illustrates the pitfalls of interdisciplinary research amongst personalities caught within paradigms, and this is being followed up in a publication from project researchers.

4. Results

4.1 Sharing Flood knowledge in borderlands

Data drawn from the literature reviews, meeting notes and analyses of semi-structured interviews at the Flood Hazards Research Group and James Hutton Centres revealed significant issues that were explored further in WP2 including:

- The changing political context of flood risk management in rural areas: emphasis has moved from agricultural production to an urban politics that views the countryside as an area of multiple uses including recreation, landscape, and land management
- NFM is not widely understood, nor is it visible to urban eyes, so it is unlikely that urban populations will feel responsibility for compensating farmers
- Different scientific practices call up differing degrees of trust among different groups
- The responses of the Agencies associated with flood resilience and mitigation are often by the general public
- What may appear as an identifiable group of stakeholders (e.g. farmers, small rural businesses etc.) may cover a very heterogeneous group of interests
- Similarly 'communities' are heterogeneous and in particular there is a significant difference in understanding and response to floods from 'locals' and 'newcomers'
- There was felt to be a move among Agencies from concern with the 1:200 or 1:100 year flood in rural areas to managing the smaller, more frequent floods that had high economic and social costs; NFM was recognising as having a significant role to play here
- Sharing data had costs that arose not just from licensing, data protection etc. but also from the time involved and uncertainty about data produced by others.

We adopted a reflexive approach to labels such as 'local knowledge' and 'stakeholder' in this project, and have not drawn clear boundaries between categories of knowledge. Local knowledge contains not only the knowledge of local residents, but also that of scientists, academics, public servants and NGO workers who have a specialist interest in a particular locality. Here, the idea contrasts not with 'scientific' or 'expert' knowledge *per se*, but with top-down or 'off the peg' solutions. The sharing of 'local knowledge' is a key element of the second objective to facilitating knowledge exchange across the national border. This objective was met through networking over the course of the project and the maintenance of key communications channels. Two members of the project team brought with them a wealth of local contacts in land management, governance and third sector bodies in the study areas. Through these contacts a wide range of interested individuals were enrolled into the project (see user engagement). These people were brought in initially to engage in the Q Methodology study and contacts were maintained throughout the project. Regular progress reports were made to Tweed Forum for dissemination to a wider constituency. Tweed Forum also set up and maintained the project website. A workshop was held which brought together policymakers/ regulators / practitioners (those who could put ideas into practice) involved in flood risk management in both of the case study localities to discuss findings in a cross border context and to advise on how to take forward the research findings in practice.

Mapping of the organisational linkages between actors and agencies showed them to be complex and dynamic. Key individuals are common to many groups involved in managing flooding and so act as both knowledge brokers and intermediaries. There is more than one perspective on how the groups and organisations come together to make decisions around flooding. This was illustrated by the creation of two different diagrams of the organisations and individuals involved.

Through examination of key documents providing flood knowledge to flood risk managers in the borders, we found that there are networks that support the use and transfer of documents, noticeably around physical science, which can be crucial to the uptake and influence of documents. This is also one of the reasons why we did not find evidence of social learning *as a result of* our project: it was already perceived by stakeholders to be happening and they had no particular need of a new learning 'space'. There are six

key groups that met regularly whose remit covers flooding. These groups are composed of representatives from 17 organisations. Some people are common to all groups. Hence the stakeholders themselves feel well connected and know each other's roles and responsibilities well. A full list of participants is shown in section 2B of the report form. Yet, during interviews it emerged that whilst the communication and routes for knowledge exchange between professionals are well developed there was still confusion about the practice of flood risk management, especially who was doing what where and how different organisations interpreted both regulation and uncertainty in knowledge and evidence. Our findings suggested that there is not much cross over between the academic and non-academic documents. Where this does occur it is not through flood management organisations seeking out academic material and incorporating it into their reports, but rather when work by academics is commissioned by organisations responsible for flood management. So, while this does provide a narrow route for knowledge exchange, even commissioned work with a very applied and practical focus is not necessarily picked up and used widely, depending on the socio-political context surrounding a document. Interviews with key actors support the findings of the review of documents and the organizational mapping exercise and elaborate four further themes.

4.1.1 Sustainable flood management.

Those responsible for regulation and implementation are caught between incompatible expectations rooted in changing approaches to flood risk management (hard engineering versus NFM). In addition, they face a mixture of external and internal pressures. On one side are external factors such as new policies, research and public opinion, which are calling for a sustainable paradigm; on the other side are internal factors such as their training, assumptions, methods, timescales and protocols, which support existing knowledge and have validated their expertise and behaviour. The prevailing interpretation of NFM is that it is a good but contested idea. A critical aspect of the 'challenge of NFM' is that it does not correspond with expectations amongst the flood management community. While there are flood engineers and hydrologists developing tests to determine the effectiveness of NFM measures, the respondents each state or allude to distortions rooted in the social and political nature of support for NFM. They characterise NFM as a socio-political manifestation of the public's desire for a more natural system of flood management and associate NFM with 'popular' initiatives like river restoration. Support for NFM is thought to be somewhat idealistic due to its disconnection from an understanding of traditional flood management, meaning the physical nature and interactions between rivers and floodplains.

4.1.2 Uncertainty of evidence to support management approaches.

The respondents alluded to the uncertainty that surrounds NFM and its unlikely ability to control river behaviour. This uncertainty is rooted in a need for evidence and consistently forms the basis for scepticism. The required evidence needs to correspond with what is expected and what has traditionally fulfilled expectations. For example, despite having sufficient confidence to apply NFM, one respondent notes that he is also working with hydrologists to develop a more traditional evidence base for what he feels is viable flood management. This view alludes to the dominance of a scientific framing in the context of flood management and to the need for tangible evidence to determine 'what is effective'. The uncertainty with which the respondents characterise NFM is always explained with reference to either science or to scientific method.

4.1.3 Role of expertise.

The importance of networks and using trusted expertise was repeated in many interviews. Expertise was very much considered to be experiential. Respondents highlighted the importance of taking ideas from others within the regional network, more widely across the UK, and even recruiting individuals with certain experience to join organisations to strengthen local expertise. Yet they are also aware of the regulatory and governance structures within which they then develop and implement catchment interventions. Separation between academics and environmental managers was reinforced by time pressures, following usual professional ways of working, and not having access to the same resources, such as databases of scholarly articles. One respondent also noted that just as documents can become buried and sinks of information, so too can experiential knowledge and expertise. Organisations may buy in and develop individual and group expertise, but this is not always communicated well, especially if the knowledge does not get picked up and

transferred or used by the networks. Increasingly, this is compounded by the practice of outsourcing work and using consultants to undertake flood risk planning within Agencies responsible for this.

4.1.4 The importance of specific sites of intervention.

The role of scale was repeatedly mentioned in interviews. Some comment was focused around the need for site-specificity when designing management interventions, which in turn leads to problems in trying to develop large-scale, generic flood prevention schemes. Designing small scale interventions to protect against flooding was also simpler in that it provides a focus for the many and varied perspectives and expertise that exist in the decision making networks around flooding in the Borderlands. There is also a lack of clarity about where the jurisdiction of one organisation starts and ends in terms on managing flooding compared to another organisation (for instance main river versus tributaries), especially in England. Hence partnership working at one particular location is an efficient way of bringing the full range of knowledge and expertise together to: find out what other organisations are doing, be strategic about meeting multiple objectives, be strategic about developing match funding and securing support for a proposed intervention.

Analysis of the role and importance of particular sites led us to develop an understanding about how data and evidence tends to be used at individual sites in Borderlands when making and designing flood risk management interventions. The primary data (both physical and social) is collected and compiled by a range of actors from a range of sources. This is then used by the organisations involved to make decisions and is used within different sections of particular organisations, for instance highways or flood management, or civil contingencies. The primary data is also used to produce a number of composite sources of information, such as the flood risk map, which is then used by multiple organisations in many different ways. Depending on the interpretation of regulation, the management objective in question and the funding available, the primary and composite data is brought to bear on a certain location. Around all the decisions there are issues of quality and robustness of data, information and knowledge, and professionals tend to act on ‘what is good enough’ in terms of determining an intervention at a particular site. Thus the data, knowledge evidence, governance, practice and socio-political culture are entwined in managing flood interventions and can be cross cut at a particular location.

4.2 Exploring options for adaptive management practices

Q Methodology was used to get a sense of the range of views on the nature of the problem of flooding locally and to see if there were any common determinants for those views (i.e. the geographical or institutional position of the participants). We found two main factors (which represent discursive positions) on the problem of flooding among all participants.

The four most significant statements that differentiate the factors are listed in Table 1.

Statement	Factor 1 rank	Factor 2 rank
Traditional engineered flood defences are neither sustainable nor cost effective	+5	-5
Some lands need to be sacrificed in the national interest	+4	-5
No homes should be built on floodplains	+2	-3
Improved agricultural drainage leads to greater flood risk downstream	+3	-2

Table 1: Significant statements that emerged from the Q methodology

Factor 1 recognises a problem with traditional flood management, whereas factor 2 does not. Factor 1 considers the loss of land for flood protection to be justified, whereas factor 2 thinks this unimportant (might not necessarily disagree). Factor 1 is more sympathetic to preventing floodplain building than factor 2. Factor 1 recognises the downstream risks posed by draining farmland, whereas factor 2 is less concerned. We found no particular determining characteristics for why individuals ended up clustered on one view or the other. Perspectives on the issue are not being driven by differing policy or experience of

flooding either side of the border. The flipside of this, fed back to participants, is that an individual cannot know in advance whether a person will agree with their position on flooding just by knowing what their job/role is or where they live

The study also suggests that there is more agreement than we might have thought. Indeed there are three statements on which the factors are in agreement.

Statement	Factor 1 rank	Factor 2 rank
Existing and new developments in flood risk areas should be made flood resilient	+2	+2
Flooding is only a problem because land use has changed	-3	-3
Sustainable flood management includes making good use of a catchment's natural capacity to store water and reduce peak flows	+5	+5

Table 2: Statements suggesting agreement

Both are in agreement that natural storage is an important component of flood management. This agreement is slightly misleading. The statement *ranks* the same in both ideal sorts, but its absolute value is considerably more important in defining factor 1 than factor 2.

These findings provided a more 'socially robust' basis for asking a wider constituency about the problem of flooding and potential solutions (i.e. it was not just the team's view being tested, but positions drawn from a range of different stakeholders). The general findings informed the team members who performed the initial P-GIS work in the two localities. We also constructed paragraphs representing the two factors found in the Q exercise to use as a short questionnaire at two further events (see below). Ambiguities in the language of one of the factors suggested there could be two quite different perspectives within it and we broke this point down for consultation with the wider publics. We generated questions to ask that we would never have come up with without the Q and the involvement of the Q participants. The Q prioritised what was most important to ask about. Alongside the P-GIS work carried out at the agricultural shows, three options were put to all respondents and they were asked to note which they most agreed with. Option 2 is derived from factor 1 of the Q Methodology study; Options 1 and 3 are the two differing interpretations of factor 2. Option 1 focuses on continuing to use engineering solutions; Option 3 is more concerned with building (social) resilience.

Option 1	Option 2	Option 3
Floods are such a big problem for individuals and communities – they leave emotional scars – that we need to defend people and properties with major engineering works. No land should have to be sacrificed to prevent flooding elsewhere but we can make use of a catchment's natural capacity to store water.	We need to look for alternatives to traditional heavily engineered flood defences – they aren't sustainable economically or environmentally. We should make use of a landscape's natural ability to store water. The attitudes of farmers and other land managers are a key part of flood management. Improving land drainage upstream can lead to greater flood risk downstream, so some lands might have to be sacrificed for flood protection.	Floods are really frightening and leave emotional scars; recovering from them can take years. I don't really think about flood defences (they might never be enough); we need to focus on people, helping them prepare for floods.

Table 3: Options used for wider consultation

The results show an overwhelming preference for Option 2 across all respondents

Location	Option 1	Option 2	Option 3
Wooler	4	39	5
Peebles	9	38	4

Table 4: Preference of options outlined in Table 3

The capacity of Q Methodology to throw up surprising new points of view rests on the way in which perspectives raised by Q will not necessarily correspond to any individual participant’s point of view. The Q outputs represent the viewpoint of an ‘idealised’ person who stands at the centre of a group of participants who all roughly agree on certain issues. All those who cluster around that idealised person have some common points of agreement that bring them together. The surprises can come from who your views align with or the other ideas that your opinions lie alongside. Also important is that engaging in an actual Q sort can really force people to think hard about their point of view and prioritise their concerns. It can be a personally useful experience and can generate collective interest simply by virtue of being something different (although this can also turn people off). There was considerable interest in the future use of Q from agency representatives during the project feedback workshops, perhaps in bridging gaps or moving discussions in new directions. However, the method is time consuming in its initial phases and whether this investment of time is considered worthwhile will depend on the resources available and the commitment of the agencies to constructing a better understanding of the various manifestations of complex problems across different constituencies.

4.3 Participatory GIS

The general findings from the use of participatory mapping is that local grounded stakeholders with a knowledge of the local area can contribute usefully to problem definition and to option generation with respect to flood management. Figure 3 shows one of the maps drawn by participants (at the Peebles stakeholder mapping meeting – there are equivalent maps for Eddleston and Wooler). It shows their ideas of where there were particular problems with flooding in the town. Using a map allowed stakeholders to agree amongst themselves to a high degree of accuracy where particular problems occur. This makes it useful to explain to technical experts what the local ‘lay’ knowledge actually is. The stakeholder-drawn map of Figure 1 was then digitised (using specialist software) to give a digitised version which the stakeholders verified and ‘owned’. This digitised version, Figure 4, was used to communicate town-level problems with flooding.



Figure 3: Stakeholder drawn map of flooding issues in Peebles

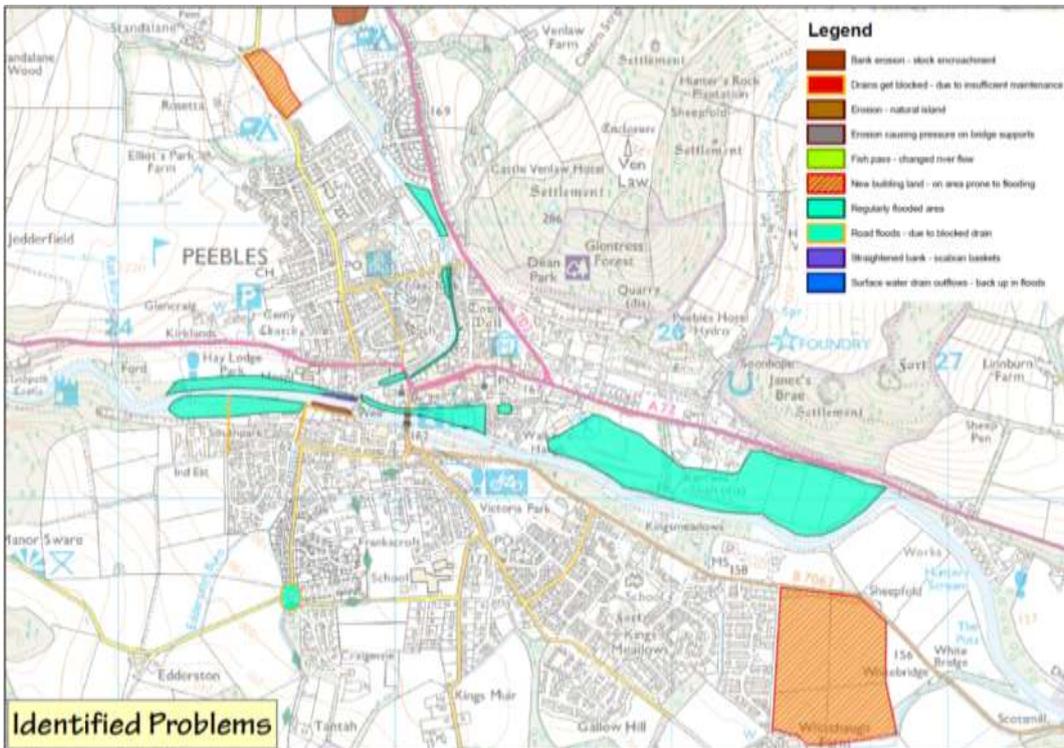


Figure 4: Digitised version of Figure 3 More importantly, Figure 3 was used within the local groups to focus discussion on potential solutions: these were both (more natural) management measures upstream and more engineering-led solutions within the town itself as is shown in Figure 5.

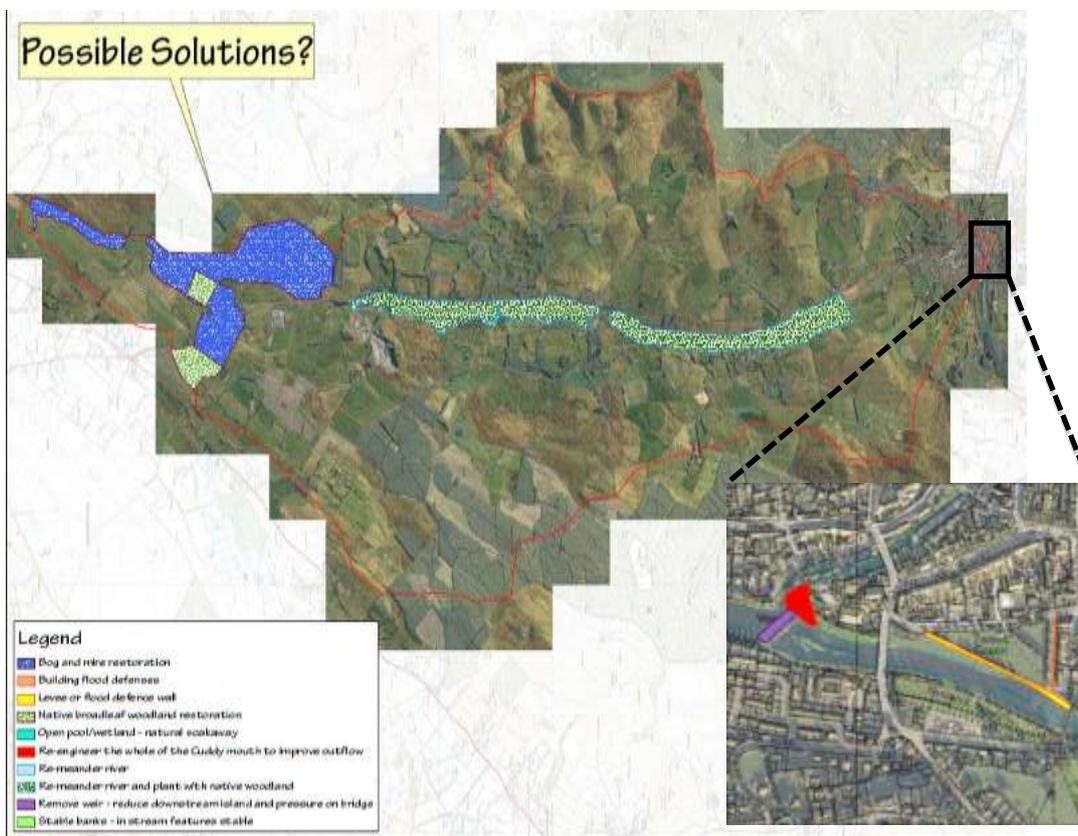


Figure 5 Map of possible solutions to reduce flooding in Peebles

This dichotomy between NFM as being perceived as something of the countryside and uplands which more conventional engineering solutions are for the towns is highlighted in most of the maps. (This is not surprising the definition of NFM tends to apply to upstream and rural areas whereas SUDS (Sustainable Urban Drainage) is most commonly used in towns.) For example the Wooler participants mostly suggested NFM measures in upland areas but suggested – or offered for consideration – re-engineering the bridge in the town.

By using the maps and the Q-outputs together in the RAP-GIS at the two shows, it was possible to get a wider feeling for the community uptake of the two ‘paradigms’ of flood management and relate these to the scheme plans outlined on the maps. The findings were remarkably similar in Scotland (Peebles show) and in England (Glendale Show). The former had approximately 66% in favour of NFM-type solutions with 17% in favour of traditional ‘engineering’ solutions while another 17% either chose both or a mixture. In England (Glendale Show, Wooler) the figures were 70% in favour of NFM, only 4% choosing engineering solutions alone, and 26% choosing a mixed approach. This shows that the scheme preferences are closely linked to norms and values.

4.4 Learning together

Social learning did not occur among the research team in that nobody substantially changed their perspective on the problem as a result of working in the team. The key reason we see for this is the short time scale of the project (particularly lacking the longer start-up phase that interdisciplinary endeavours can require to promote social learning – c.f. Donaldson et al, 2010). A further hindrance was that the academics from Dundee were not in the original partnership and had not been party to the design of the project. The changing make-up of the project team and its working parameters (see above) changed relationships for the delivery of project. However, it was agreed by all that they had learnt from the experience of academics working closely with the Agencies and other stakeholders on problems, and through the framing the research and working in a cross-disciplinary manner. From the interviews and observations conducted we can detect opportunities for social learning around the issue of flooding in existing networks and a strong willingness to engage in co-learning and decision making among many agency representatives.

4.5 Capacity building and training

The project team brought together researchers who had worked together in various combinations in the past but who had not all previously worked together. They brought together and shared insights from both previous and current RELU projects as well as other large interdisciplinary projects. This built capacity for future interdisciplinary work on complex environmental problems.

The Q methodology was taken up and used in another sub-catchment of the Tweed by a PhD student from Dundee who attended sessions with the project team before developing his own study.

Experience in the application of PGIS and Q Methodology was gained within the team.

Outputs and impact

Following discussions with Tweed Forum, Cheviot Futures, an external academic facilitator and representatives from three agencies associated with governance and development of NFM in the Borders three significant outputs were identified for development:

- A physical model of a river catchment to demonstrate the effects of NFM on rainwater flow and flooding. This model will be used by Tweed Forum to take to agricultural shows throughout the catchment to explain and discuss NFM and SFM with the general public. The model will act as an educational tool but will also facilitate engagement with the public on flood risk management and climate change. In addition to the Borderlands contribution, the Scottish government has contributed £6K for a purpose built trailer. (This will be completed by May 30th. 2012)
- A short manual on conducting and analysing a Q sort is to be provided, along with the materials developed by the project (the statements and sorting grid), so that interested agencies can conduct further comparative Q studies.
- A handbook of P-GIS practices has been made available on the Tweed Forum website which offers a straightforward introduction to the techniques and can be used by government bodies, planning or regulatory agencies or local groups concerned with environmental management.
- A video has been made outlining the process and significant findings of the project. This will be made available on the Tweed Forum web-site all the participants in the project including academic groups will be notified.
- 4 academic journal articles are in preparation:

Forrester, J. et al (in submission) 'Why multi-level, multi-method, participatory understandings are necessary for managing complex environmental problems' *Journal of Environmental Planning and Management*.

Bracken, L.J. et al (in prep) Adaptive flood management: practices in Borderlands

Cooke, B. et al (in prep) Paradigms of Flood Management in the Borderlands: grappling with a sustainable alternative

Passmore, D. et al, (in prep) 'Historical perspectives on flood risk management and community adaptation in the Tweed Basin, Anglo-Scottish Borders', *Journal of Flood Risk Management*

4.6 Knowledge transfer

The aim of the project was to facilitate knowledge transfer within and between stakeholder groups concerned with flood management. In addition to the activities described in the methods section above the following were undertaken:

- Web site linked to Tweed Forum web site
- Regular reporting to members of Tweed Forum management meetings
- Work shadowing of the project by a member of Tweed Forum dedicated to the Borderlands project ensured continual exchange between the stakeholder representatives and the research team
- Field visits to flood sites throughout the Borders including farm visits and to NFM projects currently undertaken by Cheviot Futures

Knowledge transfer beyond the catchment (achieved and forthcoming):

- Northern Rural Network Short course, February 1st. 2011 *Catchment Management and Public Engagement*
- *Interactive workshop NFM in Borderlands*, RELU conference: Who Should Run the Countryside? Gateshead November 2011.
- SAC/SEPA Biennial Conference - Agriculture and the Environment IX - Valuing Ecosystems: Policy, Economic and Management Interactions 3-4 April 2012, Edinburgh - paper on "*Trends and Issues in Delivery of Multiple Ecosystem Services at the Catchment Scale: Priorities for River Restoration*"
- NERC WSKEP workshop, Linking Natural networks and communities across rural and urban systems, 3 May, Edinburgh - paper on "*Challenges for Water Security Science, Governance, the Ecosystems Approach and Integrating knowledge, policy and practice*"
- Wetlands International Conference - Wetlands Matter: Valuing Wetland Ecosystems in a Changing Climate 24 February 2011, Edinburgh – presentation; *UK Overview – Wetland ecosystem services and biodiversity in a changing climate*
- Scottish Government/SNIFFER Flood Risk Management Conference 2011, Edinburgh – presentation *Cross Boundary Partnerships – managing borderlands: engaging stakeholder communities in decisions concerning sustainable flood management*
- Scottish Universities Insight Institute Workshop, May 2011 - *Water Management at the Interface of Government and Society - The Role of Participatory Catchment Organisations*
- Workshop on Participatory approaches to river catchment management. Durham University. 2011. *Participatory approaches to understanding the practice of flood management in Borderlands*.
- Durham International workshop 'The social-nature of water in disciplinary research'. Durham University.2011. *What to do with too much water: the practice of flood management*. In on
- Response to Colin Filer 'Interdisciplinary perspectives on historical ecology and environmental policy in Papua New Guinea'. 6th International Conference on Environmental Future 2011., Newcastle.
- *Participatory approaches to understanding practices of flood management across borders*. EGU General Assembly, Vienna. April 2012.
- *The role of experiential knowledge in flood management: practices in the Scottish-English Borderlands*. IBG-RGS Annual Conference, Edinburgh, July 2012.
- Donaldson, A Session on 'co-producing flood knowledge' for 'Stakeholders and participation' module for Postgraduate planning students, School of Architecture, Planning and Landscape Newcastle University (Borderlands case study).
- *Participatory Adaptive Flood Management* UK/Ireland Planning research conference 12-14 Sept 2011 - University of Birmingham - Presentation to academics and planners
- PGIS training course to Challenge Programme on Water and Food Limpopo Basin project team (academics) - Borderlands used as a case study 2011 Johannesburg, South Africa
- - PGIS training course to Challenge Programme on Water and Food Volta Basin project team (academics) - Borderlands used as a case study (Nov 2011) Tamale, Ghana
- Enabling citizen choices about land use and the natural environment , Natural Capital Initiatives, Feb 2011 London (Invited participant)
- NERC Knowledge Exchange Good Practice Event, Royal Institution, July 2011(Invited participant)
- Catchment Change Network one-day workshop at Lancaster University 'Guidelines for good practice in involving stakeholders when coping with uncertainty in managing catchment change' May 23rd 2012(Invited participant)

4.7 User engagement

The whole project was based around user engagement. Each Q and PGIS workshop attracted 5-10 people who were potential end users of the knowledge, relationships and tools generated throughout the project; at every stage key stakeholders helped develop both the knowledge and the format of the final outputs, as described.

Apart from the 4 partner universities and Tweed Forum, the project involved representatives from: Northumberland County Council (officers and Councillors); Northumberland Community Flood Partnership; Northumberland National Park; Borders Council; Environment Agency; Natural England; SEPA; Scottish Government; NFU Scotland; Eddleston Flood protection co-ordination group; Eddleston Parish councillors; Northumbria Constabulary; Northumberland Fire and rescue service; Glendale Gateway trust; Glendale Agricultural Society; Local land and business owners and local land managers; 5 other UK universities.

4.8 Future research priorities

- The practice of flood management is dynamic and messy. It would be helpful to have some stability in terms of evolving legislation to enable professionals to develop and sustain practice to work out who is doing what where and when.
- Professional networks for managing floods in the Borders are well established and work well in terms of generating personal connections and trust. However, there should be more connections made and sustained with local communities.
- PGIS and RAPGIS are effective ways to capture local knowledge and could be embraced more by professional organisations.
- There needs to be a push for more scientific evidence for the effectiveness of natural and sustainable flood management at the whole catchment scale.
- Professional environmental managers are highly skilled at making quick, efficient decisions based on limited evidence and with limited resources. Academics work in very different ways. To encourage more transfer of knowledge and evidence between the two groups new mechanisms to develop communication and ensure useful and relevant academic research need to be developed.
- Research is needed on the possible financial incentives for land managers/owners to work together to establish NFM at the catchment scale
- Open debate needs to be encouraged on the value of NFM to all households and businesses in rural catchments and to identify the distribution and magnitude of costs and benefits
- Follow up research is needed to evaluate the effectiveness of NFM and changing attitudes of households and communities