

MAKING SPACE FOR PEOPLE:

INVOLVING LOCAL KNOWLEDGE IN FLOOD RISK RESEARCH AND MANAGEMENT IN RYEDALE, YORKSHIRE

Report of the Ryedale Flood Research Group

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EXECUTIVE SUMMARY

Introduction

- Flooding has become an increasing concern for government, public authorities and businesses in the UK over recent years, as well as for the individual people and communities affected by flooding events or by the risk of flooding. This is because of a sense that severe flood events in the UK have become relatively more frequent, disruptive and costly. The Association of British Insurers estimated that the summer floods of June and July 2007, which affected 55,000 properties and led to 13 deaths, cost over £3billion to the insurance industry alone. Understanding what causes flooding and how best to introduce measures to reduce the risk to people, property and infrastructure has been the focus of increasing efforts among scientists in the UK.
- This report presents an account of a 12-month project to explore new ways of conducting scientific research into local flood risk management. The project focussed on the district of Ryedale in North Yorkshire and, more specifically, on flood risk problems in and around the town of Pickering associated with Pickering Beck and the River Seven. The work is part of a larger research project, entitled *Understanding Environmental Knowledge Controversies*, which is managed by Professor Sarah Whatmore at the Oxford University Centre for the Environment, Professor Stuart Lane at the Department of Geography, Durham University, and Professor Neil Ward at the Faculty of Social Sciences, University of East Anglia.
- The project was originally conceived in 2003, long before the high profile flooding in Ryedale in 2007, and it is examining flooding as just one example of a wider set of environmental controversies. The project is analysing the public controversies generated by the risk management strategies and forecasting technologies associated with diffuse environmental problems such as flooding and pollution. It is focussing on flooding as an example of an urgent rural land management problem that is controversial among scientists and the public alike, especially those members of the public directly affected. The research is examining the science and politics of flood risk modelling. It is also looking at how to improve the way in which the public are involved in decisions about managing flood risk.
- The project is funded by the Economic and Social Research Council and the Natural Environment Research Council as part of the UK Research Councils' Rural Economy and Land Use (RELU) Programme. This interdisciplinary research programme involves over 500 scientists working in teams across more than 50 different universities and research institutes in the UK. All RELU projects are independent academic research and are subject to the usual protocols of scientific peer review.

Flood Risk Management: The Conventional Approach to Science and Policy

- Flooding is not a new phenomenon, but recent episodes of flooding in the UK have raised concerns that flooding is becoming more frequent and more damaging. There is an emerging scientific consensus that flooding is likely to become an increasing problem in the future. The Environment Agency estimates that over five million people and two million homes and businesses are currently at risk of flooding in England and Wales, with assets valued at £250billion.

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- Traditional approaches to flood risk emphasise protecting people and property by building flood defences, often close to locations at risk. Such defences can be prohibitively expensive, and so recent policies have sought to explore other measures. For instance, Defra's *Making Space for Water* approach recognises the natural function of floodplains as stores of water, and suggests that this function should be factored into schemes that aim to reduce flood risk. This might mean allowing some floodplains that are currently defended to flood, with the result that towns and cities downstream are protected. While such solutions may be cheaper and deliver additional biodiversity benefits, they are potentially controversial for two reasons. First, they are less visible and hence often less reassuring, than conventional flood defences such as embankments. Second, while this solution may reduce flood risk for some, it will increase it for others, notably those living in less densely populated flood-plain areas.
- Since 1996, flood risk management has been the responsibility of the Environment Agency. Policy is set nationally by the Department for the Environment, Food and Rural Affairs (Defra). Following the floods of June and July 2007, the Government asked Sir Michael Pitt to carry out a review of the lessons to be learned. The Pitt Review published an interim report in December 2007 and its full report in June 2008. These argued that the law relating to water management and drainage systems is complex and involves numerous bodies. The Review pointed to scope for greater inter-agency co-operation and recommended that the Environment Agency take a stronger strategic role in managing inland flood risks. At the same time, the Environment Agency is undergoing internal restructuring with increasing emphasis on the national and strategic level. Overall, the current approach to flood management policy is leading towards a strengthening of national and 'higher-level' institutions and a weakening of more locally-grounded institutions such as Internal Drainage Boards.
- Flood science has to use computer models to predict the risk and impact of future flooding events, and to understand how these may be affected by changes such as housing development. These models are generic in that they are designed to work anywhere, provided they are driven by appropriate local information, such as river flows and catchment topography. In many cases, they incorporate local knowledge, such as where water reached in an historical flood event. However, this conventional approach only makes partial use of the local knowledge that can improve our understanding of a flood problem. Local people are rarely involved in identifying possible solutions, as these are determined by the ready-made model.
- Overall, flood risk management is becoming more complex, but it is also becoming more remote from the people most directly affected by flooding and flood risk. Strong feelings of frustration and disempowerment emerged in the public debate that followed the 2007 floods. This was linked to a sense that the agencies responsible for managing flood risk operate at a distance from those affected by their policies.

Experimenting in Participatory Science

- The *Understanding Environmental Knowledge Controversies* project starts from a different perspective in addressing flood risk management science and policy. One of its key elements is an experiment in finding new ways of working, not just between academic researchers from different traditions (the natural and social sciences), but also between these academics and people who live in an area directly affected by flooding. This makes the approach doubly experimental — it involves working across different scientific disciplines, and working in partnership between university-based researchers and local people.

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- This approach to conducting participatory science is informed by philosophers and sociologists of science, notably Isabelle Stengers at the Free University of Brussels. They emphasise the importance of science as a process of knowledge ‘in-the-making’ rather than as knowledge ‘ready-made’. Their focus on process directs attention to the laborious business of how scientific knowledge claims are produced, and how they gain (or lose) credibility within scientific communities and get built into public policy decisions. The project’s local work centres on an experimental methodology called *Competency Groups*, that seeks to translate these philosophical principles into research practice. The Ryedale Flood Research Group is such a group.
- As a way of doing science differently, Competency Groups are distinctive from other approaches to participatory science in four ways: they focus on the **practice** of knowledge-production as well as the nature of the knowledge produced; they treat research as a collaborative process in which the people and things involved make a difference; they bring academic and local people together over a sustained period to generate new collective knowledge and skills (competencies); they do not try to include representatives of pre-existing stakeholder groups, but to create new communities of knowledge.
- Flooding is controversial not only because the underlying causes of flooding are not always clear, but also because there is often a lack of agreement about the best way to reduce flood risk. In the approach in this project, we have not tried to ‘settle’ the controversy once and for all, but to work with it constructively, through a process of discussion, research and enquiry that draws on the different experiences and understandings of group members.
- The local work in Ryedale has centred on the flood risk problems in and around Pickering. It forms the first of two local experimental case studies, with the second running in Sussex in 2008-2009. The *Understanding Environmental Knowledge Controversies* project is due to be completed in the summer of 2010 by which time the experiences of the local work in the two case study areas will inform the overall project conclusions. At the end of the project, the experiences from the two local case studies will be presented at an international conference on *Understanding Environmental Knowledge Controversies: Democratising Science* to be held at Oxford University in December 2009.

Flooding in Ryedale: The Local Controversy

- The district of Ryedale in North Yorkshire has been prominent among those affected by flooding in recent years. There have been several serious incidences of flooding in the Yorkshire Derwent catchment since the 1990s. Pickering was among those places seriously affected in June 2007, and other parts of Ryedale flooded more recently in September 2008.
- The district has a long history of flood problems. The catchment has been particularly badly affected by flooding in 1927, 1930, 1931, 1932, 1960 and in more recent times, during March 1999, summer and autumn 2000, August 2002 and June 2005. Notably, there were relatively fewer flood events during the 1950s and 1960s than has been the case over the last decade.
- Dealing with the flooding problem affecting Pickering and its surrounding area has proved a heated and controversial issue locally. The strength of feeling is reflected in

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the tone of the debate conducted, for example, in the letters pages of the local newspapers and at public meetings. While there is a strong local sense that 'something must be done' to reduce flood risk, the question of what should be done is a controversial one. In particular, there is strong disagreement about the value and effectiveness of building a large flood defence in the centre of Pickering.

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- As part of the research project, the researchers advertised their intention to work in Ryedale and invited local people who might be interested in being involved to get in touch. As a result, eight local people from in and around Pickering were recruited to what we together decided to call the 'Ryedale Flood Research Group'. We worked together over a 12-month period to investigate the science of flood risk management in the local area. Seven meetings took place between September 2007 and September 2008, interspersed with a wide range of additional research activities. Group members brought items such as photographs, maps, documents, and other artefacts to the meetings to make historical comparisons and to show how and why flooding was a matter of concern, including a video film specifically made by a group member. Drawing on these, and resources developed by the academic researchers, the group collectively produced graphs and charts to map the flooding problem.
- Specialists in hydrological modelling developed a state-of-the-art computer model of the hydrology of key parts of the catchment. This research was supplemented by local archival work, an analysis of local scientific studies and policy reports, personal interviews with key local officials, and oral history work.
- The Group's work involved experimentation, developing collective competencies, and coming to a shared understanding of the scientific and policy issues, though not necessarily a consensus on the causes of, and solutions to, flooding in Ryedale. At the start of the Ryedale work, it was explicitly stated that the project was not promising, nor specifically aiming, to solve Ryedale's flood problems. Nevertheless, as the work progressed, it became increasingly clear that the research was yielding new insights and lessons that may be of use for those interested in reducing flood risks in the catchment. The Group agreed to produce this report to share these lessons, and they are set out in the conclusions and recommendations that follow.
- The Group's modelling explored the potential role of upstream storage using bunds. (These are relatively small dam-like structures which allow rivers and streams to continue to flow, but 'hold back' excess flow in temporary storage). The analysis involved a distributed hydrological routing model, able to work with digital topographic and rainfall data. The model focused upon routing of surface overland flow under conditions of soil saturation in response to rainfall depths typical of the June 25th 2007 event. On the basis of the modelling, the Group agreed that upstream storage might be used to reduce flood risk for both Pickering Beck and the River Seven at relatively low cost.
- A second theme of vegetation, sedimentation and river roughness was pursued using a model (HEC-RAS), developed by the US Army Corps of Engineers. This modelling showed that vegetation and sediment accumulation in the rivers in the Vale of Pickering could be contributing quite significantly to local flood risk. This accorded with recent and renewed concern nationally over the effects of vegetation and sediment upon flood risk.

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- The work also generated important lessons for the practice of flood risk science.
 - *First*, our approach was to simplify the model so that it included the features deemed to be important in this particular place. This meant that instead of having to devote efforts to making an off-the-shelf model fit the place we wanted to model (*i.e.* Ryedale), we could concentrate on developing a model tailor-made to the place. We believe that this is a more cost-effective approach to flood science.
 - *Second*, we brought key elements of the decision-making process in at the start, together with types of knowledge that are usually either excluded from the modelling process altogether, or not taken into account until the end. This knowledge included specific understandings about suitable (and unsuitable) locations for trying out solutions. It increases the potential for solutions not just to make a difference, but also to be practicable.
 - *Third*, overcoming the conventional divide between ‘lay’ and ‘expert’ knowledge was a crucial step in developing ‘collective competence’ across the group, as was the growing confidence of local members in their knowledge.

Conclusions

- To reduce flood risk in Ryedale, upstream storage holds promise as a cost-effective option and is therefore worthy of further exploration by the relevant authorities. Our modelling indicates that the construction of a few small bunds, appropriately sited upstream, could significantly reduce flood risk downstream at sites such as Pickering.
- Our modelling suggests that vegetation growth in rivers and on riverbanks can be a contributory factor in accentuating local flood risk. In some situations, the same may be said for accumulation of sediment. Existing policies are seeking to reduce levels of river maintenance in rural areas. Our findings highlight the fact that while this may benefit the many downstream, it brings increased flood-risk for the few who live upstream, usually in more sparsely populated rural areas.
- The project in Ryedale has been an experiment in involving local people in a sustained way over a 12-month period in a process of collaborative knowledge production. Involving local knowledge (or what we call ‘vernacular knowledge’) helps reframe research questions in beneficial ways and changes the ways that science gets done. In particular, our approach enabled the group to ‘try things out’ and experiment. We argue that this approach produces more useful and socially robust knowledge.
- Close engagement between local people and academic researchers over a sustained period of time changed the nature of the environmental modelling we conducted in important ways. The modelling was used to open up new thinking, rather than to produce definitive solutions. The divide between so-called ‘experts’ and ‘local people’ also dissolves as expertise is distributed among the group and beyond.
- We conclude that this kind of participatory science not only produces more socially robust knowledge, but can also be a more cost effective means of exploring how to reduce flood risk. According to local press reports, more than £750,000 has been spent exploring options for flood risk management in and around Pickering over recent years. We calculate that our research in Ryedale has cost less than £110,000,

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which has come through the use of an academic research grant funded by research councils.

- We decided to call the report of our research in Ryedale *Making Space for People*. This is purposefully in contrast to the Government's strategic framework for flood risk management, which is called *Making Space for Water*. Reports of official inquiries into the 2007 summer floods emphasise the need for flood managers to work more closely and effectively with local people, although their recommendations are primarily focussed on the efficacy of flood warning systems and raising awareness about flood resilience measures for homes and businesses. We argue that there is a risk that the national strategic framework for flood risk management and the agencies responsible for implementing it are becoming increasingly remote from the concerns and interests of people in flood risk areas.
- This remoteness is likely to be increased as the Environment Agency Areas merge and Internal Drainage Boards may be forced to amalgamate. There is a pressing need to 'make space for people' in the process of deciding the best way to deal with local flooding and to involve the public in the conduct of flood risk science.

Recommendations for Ryedale

- We recommend that strategies for upstream flood storage are explored for the southward draining becks of the North York Moors by the Environment Agency. This should include assessment of the effects of intervening in any one sub-catchment in isolation upon the relative timing of sub-catchment peaks and hence downstream flood-risk.
- We recommend that the process of developing upstream storage schemes in Ryedale is undertaken using models appropriate to the type of scheme that we have suggested. This may mean that conventional, 'off-the-shelf' models are not suitable.
- We recommend that the progressive withdrawal of maintenance should be regarded as an active intervention in the river system. This requires that the impact of withdrawing maintenance should be assessed in the same way as other flood risk management schemes.
- We recommend that the concerns of those who could be affected by decisions to withdraw river maintenance are taken seriously, and that those who are concerned are fully and actively involved in the assessment processes.

Interim Recommendations for Strategic Flood Risk Management

- Our project is at its half-way point and we are now beginning our local work in the catchment of the River Uck in East Sussex. We intend to generate a set of lessons from our work in both Yorkshire and Sussex in the latter part of 2009. This means that our wider recommendations for strategic flood risk management in England can only be interim at this stage. Nevertheless, on the basis of our work in Ryedale, we invite flood scientists and civic groups to consider the implications of our method of collective working in Ryedale for their own efforts to solve flood problems.

1. INTRODUCTION

This report presents an account of a 12-month piece of work to explore new ways of conducting scientific research into local flood risk management centred on the district of Ryedale in North Yorkshire. The study is part of a larger research project, entitled *Understanding Environmental Knowledge Controversies*, managed by academics at the Universities of Oxford, Durham and East Anglia.

The controversies around genetically modified crops and foods in Britain since the 1990s have shown the difficulties generated by the ways in which scientific knowledge is variously used and understood by policy-makers and non-scientists (see Horlicks-Jones *et al.*, 2007). Scientific activities that were once confined to laboratories and journals have become more open to public scrutiny through technologies like the internet. This means that scientists, and those who use their work, have to think again about how science should inform democratic decision-making.

The *Understanding Environmental Knowledge Controversies* project was conceived in order to address the public controversies generated by the management strategies and forecasting technologies associated with diffuse environmental problems such as flooding and pollution. The project studies flooding as a pressing rural land management problem that is controversial among scientists and the public alike, especially those members of the public directly affected. The project is focused on the science and politics of flood risk modelling and how to improve public involvement in determining the role of rural land management in the amelioration of flood risk. In order to explore such controversies, the Project Team has had to develop new tools and approaches identify the effects of particular practices, and to account for how environmental science is produced, used, and disputed.

1.1 Background to the Study

The project is an experiment in finding ways of ‘doing science differently’ that involves academic researchers collaborating in new ways across their disciplinary boundaries, and working in close partnership with local people affected by flooding. The project was more than three years in the planning, and it was decided in 2005 that the Yorkshire Derwent catchment would be one of the two local case study areas. The project was not, therefore, specifically designed as a response to the recent spates of flooding in 2007 and 2008.

1.2 Flooding

The Environment Agency estimates that over five million people and two million homes and businesses are currently at risk of flooding in England and Wales, with assets valued at £250billion. It is generally accepted that flooding poses an increasing problem. The 2004 Flood Foresight study by the Office of Science and Technology (OST) warned that annual damage from flooding can be expected to increase in the future (OST, 2004). The Government’s overall approach to flood risk management is encapsulated in the *Making Space for Water* programme led by the Department for the Environment, Food and Rural Affairs (Defra). The extensive flooding in England in June and July 2007 also prompted a national review of preparedness for flooding, and of the policies and institutions responsible for flood risk management — the Pitt Review (2007; 2008).

The causes of increased flooding are complex. The UK's weather patterns are heavily influenced by the position of the North Atlantic jet stream which influences the tracks of North Atlantic storms. The position of this storm track, and the intensity of the storms that follow it, are primary drivers of the UK's flood risk. Flood records show that, after a period of relative quiescence between the 1960s and 1990s, the last decade has been relatively flood rich, for reasons that are not yet fully understood.

Flooding can take different forms. River (or fluvial) flooding is direct flooding when water in a river breaches its banks. Surface water (or pluvial) flooding occurs through direct run-off from land. Groundwater flooding occurs when the water-table underground rises up and emerges through the natural surface. There is considerable scientific uncertainty about the relationship between rural land management and the risk of flooding in river catchments. The role of land management in producing increased and more-rapid run-off is well-established. However, we know much less about these effects on a scale larger than a few square kilometres squared. We do not know where and the extent to which rural land management might reduce downstream flood risk.

1.3 The Rural Economy and Land Use Programme

The *Understanding Environmental Knowledge Controversies* research project is one of approximately 50 projects funded under the UK Research Councils' Rural Economy and Land Use (RELU) Programme. The RELU Programme aims to advance understanding of the challenges caused by changes in rural economies and land use today and in the future. Interdisciplinary research is being funded between 2004 and 2010 in order to inform policy and practice with choices on how to manage the countryside and rural economies. The Programme is an unprecedented collaboration between the Economic and Social Research Council (ESRC), the Biotechnology and Biological Sciences Research Council (BBSRC) and the Natural Environment Research Council (NERC). It has a budget of £24 million, with additional funding provided by the Scottish Government and the Department for Environment, Food and Rural Affairs. The Programme is funding research under a series of themes: public trust in food chains; tackling animal and plant disease; sustainable land and water management. The Programme is also innovative in its involvement of a wide range of stakeholders not only in shaping the programme as a whole, but also through involvement in the delivery of individual research projects.

1.4 The Understanding Environmental Knowledge Controversies Project

The research project team for *Understanding Environmental Knowledge Controversies* is led by Professor Sarah Whatmore at Oxford University Centre for the Environment, Professor Stuart Lane at the Department of Geography at Durham University and Professor Neil Ward at the Faculty of Social Sciences, University of East Anglia.

This three-year project, funded by the RELU Programme, looks at the relationship between science and policy, and in particular explores how to engage the public with scientific research. The aim is to develop a new approach to interdisciplinary environmental science, involving academic scientists, social scientists and local people working together throughout the research process. The key to the project's approach is interdisciplinarity, which involves natural and social scientists working closely together and, throughout the life of the project, re-evaluating their respective practices and assumptions.

Two areas prone to flooding were selected for the fieldwork. The first, in Ryedale in Yorkshire, centres on Pickering, and the second, the Ouse system in Sussex, centres on Uckfield. In each of these areas the Project Team has established Competency Groups,

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which offer an opportunity to experiment in democratising science. The Competency Groups are composed of researchers and local people for whom flooding is a matter of particular concern. The groups work together to share different perspectives: on why flooding is a problem; on the role of science in addressing the problem; and on new ways of doing science together.

Environmental issues play an increasingly prominent role in our daily lives. However, questions of the causes, effects and solutions to environmental problems are often surrounded by controversy. Such controversies are often between the realms of science and policy-making institutions, on the one hand, and social groups and individuals directly affected by an issue. The controversy surrounding many environmental issues, and confusion around the way in which they are reported, mean that there is a risk that the public will become increasingly disengaged. People living with flooding often feel their experience and knowledge is ignored by those responsible for flood policy and flood science. To try to reverse this trend, and to regain public trust and engage local experience in knowledge about flood events, the project sets out to try a new way of doing science. It aims to make four substantive contributions to knowledge:

- To analyse how the knowledge claims and modelling technologies of hydrological science are developed and put into practice by policy makers and commercial organisations (such as insurance companies) in flood risk management. The analysis will focus on how and why flood models become subject to scientific dispute and public controversy, and with what consequences for public engagement and trust.
- To develop an integrated model for forecasting the in-river and floodplain effects of rural land management practices. This model will be used to test hypotheses about the impact of land management in both lowland and upland environments on downstream flood risk.
- To experiment with a new approach to public engagement in the production of interdisciplinary environmental science, involving the use of Competency Groups. These groups bring together diverse kinds of scientific and local knowledge about flood risk modelling and management in particular localities over a sustained period.
- To evaluate this new approach to doing public science differently and to identify lessons learnt that can be exported to other fields of knowledge controversy (e.g. nanotechnology, biotechnology and climate science).

The project work is divided into four Work Packages. Work Package 1 examines environmental knowledge production and controversy and is led by Sarah Whatmore and Catharina Landström at the Oxford University Centre for the Environment. Work Package 2 examines Minimum Information Requirement science and modelling in relation to the hydrology and hydraulics of rural catchment management and is led by Stuart Lane and Nick Odoni at Durham University's Department of Geography. Work Package 3 examines new forms of interdisciplinary working in environmental science through the Competency Group approach and is led by Neil Ward at the University of East Anglia's Faculty of Social Sciences and Sue Bradley at Newcastle University's Centre for Rural Economy. Finally, Work Package 4 explores how lessons and skills developed through the project on flooding might be transferred to other diffuse land management issues such as diffuse pollution. Details of the objectives of each Work Package are contained in Appendix II.

2. FLOOD RISK MANAGEMENT: THE CONVENTIONAL APPROACH TO SCIENCE AND POLICY

2.1 The Evolution of Flood Risk Management

Flooding is not a new phenomenon, but recent episodes in the UK have raised concerns that flooding is becoming more frequent and more damaging. There is a general scientific consensus that flooding is likely to become an increasing problem in future. The Environment Agency estimates that over five million people and two million homes and businesses are currently at risk of flooding in England and Wales, with assets valued at £250 billion.

Traditional approaches to flood risk emphasise protecting people and property by building flood defences, often close to locations at risk. Such defences can be prohibitively expensive, and so recent policies have sought to explore other measures. For instance, Defra's *Making Space for Water* approach recognises the natural function of floodplains as stores of water, and proposes that this function should be factored into flood risk reduction schemes. This might mean allowing some currently defended floodplains to flood, with the result that towns and cities downstream are protected. While such solutions may be cheaper, and deliver additional biodiversity benefits, they are potentially controversial for two reasons. First, they are less visible than conventional flood defences such as embankments. Second, although flood risk may be reduced for some, this solution may increase it for others, notably those living in less densely populated floodplains.

Other rural land management measures can help reduce flood risk. For example, changing the partitioning of precipitation between overland (fast) and subsurface (slow) flow can *encourage infiltration*. Increasing retention of run-off within the catchment or reducing the speed of conveyance of run-off within can *encourage storage*. Reducing conveyance *upstream* of sites needing protection can *encourage a slower flow*. However, outstanding questions remain. For example, rural land management measures may work in some geographical contexts but not in others, or in some rainfall and flood risk conditions but not others. Much research has tended to focus on the plot and small catchment scale, leaving important questions about the 'up-scaling' of some of the processes identified. There also remains a tendency to search for a generic answer to the question *Does Rural Land Management Impact Flood Risk?* when the only possible answer depends upon the relationship between the type of management adopted and the particular characteristics of a catchment.

Since 1996, flood risk management has been the responsibility of the Environment Agency. Policy is set nationally by the Department for the Environment, Food and Rural Affairs (Defra); before 2001 it was set by the Ministry of Agriculture, Fisheries and Food. Following the extensive floods of June and July 2007, the Government asked Sir Michael Pitt to carry out a review of the lessons to be learned. The Pitt Review published an interim report in December 2007 which argued that the law relating to water management and drainage systems is complex and involves numerous bodies. The report pointed to scope for greater inter-agency co-operation and for the Environment Agency to take a stronger strategic role in managing inland flood risks. At the same time, the Environment Agency is undergoing internal restructuring with increasing emphasis on the national and strategic level. Overall, the conventional approach to flood management policy is one which, over time, is seeing a strengthening of national and 'higher-level' institutions and a weakening of more locally-grounded institutions such as Internal Drainage Boards.

Flood science has to use computer models in order to predict the impact of future flooding events, and to understand how these may be affected by changes such as housing development. These models are usually developed as generic — that is they are designed

to work anywhere for a particular type of flooding, provided they are driven by appropriate local information, such as river flows and catchment topography. In many cases, they incorporate local knowledge of the problem, such as where water reached in an historical event. This information is used to make the model work. It allows the model's parameters to be changed so that the model can incorporate this local information. However, this approach represents a particular view of the way that local knowledge that can be brought to a flood problem. In order to make the model work, local knowledge is transferred to the generic model, but the model itself is left intact. As a result, it is the model that frames the type of solution that can be tried out. The framing itself cannot be questioned. This severely limits the extent to which issues of local circumstance, difference and contingency are included in the flood risk management process, especially given the multitude of different forms of rural land management that could be tried in any one place.

Overall, flood risk management needs to explore a much wider range of possible interventions. The rural landscape is one area where interventions are being suggested. Scientific uncertainty over the potential role of the landscape is combining with social uncertainty over what could be tried where. This is at a time when people feel that the institutions responsible for flood risk are increasingly distanced from the people most directly affected by flooding and flood risk. A strong theme in the public debate and coverage of the 2007 floods was the remoteness of the institutions responsible for flooding and strong feelings of frustration and helplessness and disempowerment among those affected.

2.2 Institutions in Flood Risk Science and Management

Defra has lead responsibility for policy on flooding and flood risk management. (Defra also has responsibilities for environmental protection more widely, the food and farming industries and rural affairs). Defra explains its role in flooding and flood risk management as follows.

Flooding: Defra's Role

Defra has overall *policy* responsibility for flood risk in England. Defra funds most of the Environment Agency's flood management activities in England and provides grant aid on a project by project basis to the other flood and coastal defence operating authorities (local authorities and internal drainage boards) to support their investment in capital improvement projects to manage flood risk. Defra does not build defences, nor direct the authorities on which specific projects to undertake. The works programme to manage risk is driven by the operating authorities. We regard this arrangement as a partnership, try to ensure that risk is managed effectively by the authorities and provide guidance to help ensure this. Traditionally, *flooding* in this context has meant from watercourses or the sea rather than from other sources. However, Defra's new strategy (*Making space for water*) is taking a holistic approach to management of risk from all forms of flooding (river, coastal, groundwater, surface run-off and sewer) and coastal erosion, and seeking to ensure the programme helps deliver sustainable development.

Managing the Risk

Defra's policy is to reduce risks to people, property and the environment from flooding through the provision of defences, flood forecasting and warning systems, increased flood resilience of property, beneficial land management changes and discouragement of inappropriate development in areas at risk of flooding. There is much more to be done to reduce the overall level of risk. Unfortunately, large numbers of people will remain at risk from particularly severe exceptional events beyond the design standards of defences and planning for emergencies is an important part of our work with the Environment Agency and other partners. The Government invests significant sums of money each year to reduce risk.

Defra's programme includes encouragement of Shoreline Management Plans and Coastal Groups, our joint research and development programme with the Environment Agency and funding of the Agency's flood risk maps, Catchment Flood Management Plans, Public Awareness Campaigns and the National Flood and Coastal Defence Database and associated risk assessment methodology.

Defra is committed to an achievement target to cover the period of the 2004 Spending Review (April 2005 to March 2008). We are developing a new Strategy for Flood and Coastal Erosion Risk Management - *Making space for water*. A Stakeholder Forum contributes to policy development as do public consultations. Given the importance to the public of flood insurance, the Government works closely with the Association of British Insurers on flood risk.¹

The Environment Agency was established in 1996 through a merger of the functions of the former National Rivers Authority, Her Majesty's Inspectorate of Pollution and some of the waste management function of local authorities. (The National Rivers Authority had been established as a new body in 1989 at the time of the privatisation of the former Regional Water Authorities. The Agency employs around 11,000 staff and has a wide-ranging remit that includes:

- preventing flooding and pollution incidents;
- reducing industry's impacts on the environment;
- ensuring waste produced is correctly disposed of;
- advising on land use planning, including advice on regional planning, development plans and planning applications;
- cleaning up rivers, coastal waters and managing water resources;
- improvement of contaminated land;
- improving wildlife habitats;
- improving and enhancing inland waterways and ensuring sustainable inland fisheries.

Local communities and businesses tend to experience flood risk management issues principally through contact with the Environment Agency. A review of the Agency's work and functions by the House of Commons Environment, Food and Rural Affairs Committee in 2006 drew conclusions in relation to the Agency's work on flooding. The Committee was concerned that: the Agency faced difficulties in managing its wide range of responsibilities (p.11); it struggled in recruiting and retaining staff in specialist areas including flood risk engineering; (p.19); stakeholders reported problems arising from the lack of distinction between the Agency and Defra's role in policy-making (p.25); that its advice on development in areas of flood risk was sometimes over-ruled (p.31); that Government should aim to increase the Agency's funding in this area to £1 billion per year in the long term (p.34); and that Defra should review how effectively the Agency was spending its money on flood risk management (p.34). Finally, on communicating with the public about flood risk, it recommended that:

The Agency should also consider other innovative ways to reach out to the general public in these areas of work, bearing in mind that not everybody uses the internet as their main source of information (p.35).

Other organisations also have roles to play in the management of flood risk, but responsibilities are divided between drainage systems, land drainage, highways and so on. In its interim report, the Pitt Review (2007, p.61) pointed out how responsibilities for flood risk

¹ <http://www.defra.gov.uk/enviro/fcd/default.htm> [accessed 2.4.08]

management are complex and there is often a lack of clarity of responsibilities. For example, local government and the Department for Communities and Local Government have responsibilities for land use planning, which can be an important factor affecting flood risk. Responsibility for surface water drainage includes the Highways Agency, water companies, and British Waterways. In rural land management, private landowners have a role to play in managing flood risk, and may have interests as riparian owners (of fishing rights on rivers).

In parts of England, drainage is managed by Internal Drainage Boards (see Association of Drainage Boards, 2008). Although these statutory bodies have long histories that often date back centuries, they currently principally operate under the Land Drainage Act 1991. They have permissive powers to undertake work on drainage and water level management and are involved in the maintenance of rivers, drainage channels and pumping stations on 'ordinary watercourses' (*i.e.* water courses other than 'main rivers') in their areas. (The Environment Agency is responsible for main rivers).

2.3 National Policy for Flood Risk Management

In 2004, Defra launched the Government's *Making Space for Water* (MSW) initiative. MSW is a cross-Government programme taking forward the development of a new strategy for flood and coastal erosion risk management in England. (A previous *Strategy for Flood and Coastal Defence* had been published in 1993). The Government held a three-month consultation exercise in autumn 2004, and reported on responses to the consultation exercise in March 2005. The Government's response to this consultation² set out the strategic direction of travel on a number of key issues and outlined the programme of work required to resolve policy issues, and set the policy direction for the next 20 years and beyond. The aim of the new strategy, taken from the First Response document, is:

"To manage the risks from flooding and coastal erosion by employing an integrated portfolio of approaches which reflect both national and local priorities, so as:

- to reduce the threat to people and their property;
- to deliver the greatest environmental, social and economic benefit, consistent with the Government's sustainable development principles; and
- to secure efficient and reliable funding mechanisms that deliver the levels of investment required to achieve the vision of this strategy."

The MSW programme consists of 25 separate projects, divided into 4 themes: a holistic approach to managing flood and coastal erosion risk; achieving sustainable development; increasing resilience to flooding; and funding. The Government has set out its vision as follows (Defra, 2005, pp.14-15):

The concept of sustainable development will be firmly rooted in all flood risk management and coastal erosion decisions and operations. Full account will be taken of the social, environmental and economic pillars of sustainable development, and our arrangements will be transparent enough to allow our customers and stakeholders to perceive that this is the case. Account will also continue to be taken of long-term drivers such as climate change. Decisions will reflect the uncertainty surrounding a number of key drivers and will where appropriate take a precautionary approach. Decisions will be based on the best available evidence and science.

Flood and coastal erosion risk management will be clearly embedded across a range of Government policies, including planning, urban and rural development, agriculture,

² <http://www.defra.gov.uk/enviro/fcd/policy/strategy/1stres.pdf>

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transport, and nature conservation and conservation of the historic environment. Other relevant Government policies will also be reflected in the policies and operations of flood and coastal erosion risk management. There will be a mix of policies designed to minimise the creation of new risks (by the way development policy is implemented in areas of flood risk), to manage risk and to increase resistance and resilience. There will be a clear understanding and acceptance of the respective roles of the state, central and local government, other organisations and agencies, and of individuals. The public will be more aware of flood and coastal erosion risks and empowered to take suitable action themselves where appropriate.

There will be increased use of co-funding with other bodies and other schemes so as to secure sustainable and cost-effective management of flood and coastal erosion while at the same time securing a greater overall contribution to sustainable development than would have been possible without co-operation. The true costs of providing, and not providing, flood and coastal defences and other measures will be reflected to a greater extent than at present in individual and commercial decision-making. Expenditure will be focused so as to achieve value for money, and will be prioritised to deliver maximum benefits in line with this strategy.

There will be local participation in decision-making, in particular through the preparation of Catchment Flood Management Plans and Shoreline Management Plans, within a context of national standards and nationwide information on flood risks and prioritisation.

There will be a holistic approach to the assessment of options through a strong and continuing commitment to Catchment Flood Management Plans and Shoreline Management Plans, within a broader planning matrix which will include River Basin Management Plans prepared under the Water Framework Directive and Integrated Coastal Zone Management.

There will be transparent and measurable targets and performance indicators, in terms of managing risks to people, property and the environment, to ensure those responsible for delivering the strategy can be held to account. These measures will drive performance forward and enable the identification and dissemination of good practice solutions.

The results of the strategy will be seen on the ground in the form of more flood and coastal erosion solutions working with natural processes. This will be achieved by making more space for water in the environment through, for example, appropriate use of realignment to widen river corridors and areas of inter-tidal habitat, and of multi-functional wetlands that provide wildlife and recreational resource and reduce coastal squeeze on habitats like saltmarsh.

The Strategy also explains (p.20):

The Government recognises that, even within the improved risk management framework to be introduced under this strategy, there will be cases where investment in capital schemes (on 'hard' or 'soft' flood management/coastal erosion solutions) will not be justified. In such cases and in line with its policies on social justice, the Government recognises that there is a need to consider extending the risk management tools available, in particular to take account of the needs of smaller rural or dispersed communities.

The Strategy sets out the Government's approach to rural land management with respect to flood risk as follows (p.25):

In the light of responses to the consultation, the Government will continue with its policy of providing funding for the maintenance of existing defences only where the costs are justified by the full range of benefits provided by the defences. Costs and benefits will, however, be measured in a more holistic way that takes better account of environmental and social, as well as economic, considerations. We will put in place clear exit strategies to ensure that withdrawal of funding is well planned and takes account of all the consequences.

Where land and property is needed for works associated with managed realignment under a flood management scheme, the Government will continue to provide the finance for this. We envisage that the number of such realignment schemes, and therefore their share of the risk management budget, will increase as part of our increasing use of the portfolio approach ... The Government will continue to use land-purchase where compensation habitat is required under the Habitats Regulations. We will also continue to make maximum use of economic incentives to landowners through agri-environment schemes.

2.4 Concerns About Flood Risk Management Following the 2007 Floods

Following the extensive floods of June and July 2007, two major enquiries were undertaken into flooding in England. First, the House of Commons Environment, Food and Rural Affairs Select Committee ('the EFRA Select Committee') established a formal Select Committee inquiry into the issue. Second, the Government appointed Sir Michael Pitt to head up a review of the flooding in order to learn lessons from what had happened.

The EFRA Select Committee inquiry took written evidence in the autumn of 2007 and sat for its oral hearings between October 2007 and February 2008. Key ministers, senior civil servants and representatives of the main statutory and stakeholder bodies appeared before the Committee to give evidence. The Committee's inquiry attracted unprecedented levels of public interest, with 187 written memoranda being submitted by various interested parties, 80 of which came from members of the public. The comments most frequently made by members of the public were:

- poor maintenance of drains had contributed to local flooding;
- poor watercourse maintenance and lack of river dredging had contributed to local flooding;
- "riparian" owners, such as farmers and other landowners, were unaware of their responsibilities for watercourse maintenance;
- development on the flood plain should be stopped;
- houses built on the flood plain had to be properly flood resilient and resistant.³

The Committee published its report on 7th May 2008 and made 41 specific recommendations. (These are listed in Appendix III of this report).

³ House of Commons Environment, Food & Rural Affairs Committee (2008, p.7).

Headline findings from the Commons Select Committee Inquiry (May 2008)

[The Committee] found flood defence measures focussed almost exclusively on river and coastal flooding and that the infrastructure to deal with floods caused by heavy rainfall was in an “unclear and chaotic state”.

No organisation currently has responsibility for surface water flooding at either the national or local level. For example, during their inquiry MPs heard how in Hull and parts of Sheffield, when heavy rainfall was predicted, local authorities lacked the information to know which areas were vulnerable to flooding. When the heavy rains started no body was responsible for issuing flood warnings to those people whose properties may be affected. When drains began to overflow it was difficult to determine who was responsible for which drains.

MPs want the Environment Agency to have an over-arching role to provide advice and guidance but local authorities should have a statutory duty for surface water drainage to ensure its area remains effectively drained. However, a local authority could sub-contract part of this responsibility where ownership of the drainage system lies with another body.⁴

Following the floods of June and July 2007, the Government asked Sir Michael Pitt to carry out a review of the lessons to be learned. The Pitt Review published an interim report in December 2007 and its full report in June 2008. The Interim report made 72 recommendations, including 15 that it considered most urgent. The Final Report contained 92 recommendations. (We list these in Appendix IV). Interestingly, one recommendation in the interim report on rural land management was shelved in the final report. The Interim Report had recommended that “the Environment Agency should provide an analysis of the effect that land management practices had or would have had on the impact of flooding during the summer 2007 floods” (Interim Conclusion No. 32). By the Final Report, it was explained that this recommendation was “not carried over: technically too difficult and of limited value” (p.45, Implementation and delivery plan annex).

Note that in these two major inquiries, relatively little attention was given to the ways that knowledge about flooding is generated. The Pitt Review did have recommendations to make about new science to be done and about new work for flood modellers to carry out. However, there was little questioning of the processes of producing flood science. Furthermore, while emphasis was given to the need for greater public engagement in flood issues, this primarily focussed on early warning systems and improving resilience. Little mention was made of the role of local people in the production of flood science.

It is here that our research has some distinctive messages which have not featured sufficiently in the national discussions to date. The next sections explain our approach to participatory environmental science and what we found from our experiment.

⁴ House of Commons Environment, Food & Rural Affairs Committee Press release 7 May 2008
http://www.parliament.uk/parliamentary_committees/environment_food_and_rural_affairs/efra_pn34_080507.cfm

3. EXPERIMENTING IN PARTICIPATORY SCIENCE

3.1 Doing Science Differently

The *Understanding Environmental Knowledge Controversies* project starts from an unusual perspective in addressing flood risk science and policy. One of its key elements is an experiment in finding new ways of working, not just between academic researchers from different traditions (the natural and social sciences), but also between these academics and people who live in an area directly affected by flooding. This makes the approach doubly experimental — it involves working across different scientific disciplines⁵, and between university-based researchers and local people working in partnership.

This approach to participatory science is informed by philosophers and sociologists of science, notably Isabelle Stengers at the Free University of Brussels. They emphasise the importance of science as a process of knowledge ‘in-the-making’ rather than as knowledge ‘ready-made’. Their focus on process directs attention to the laborious business of how scientific knowledge claims are produced, gain (or lose) credibility within scientific communities and get built into public policy decisions. Our project’s local work is also influenced by attempts to operationalise these ideas among Belgian sociologists, Pierre Stassart and colleagues, who have examined food, farming and environmental issues at the University of Liege (Stassart *et al.*, 2007; Stassart, 2008). Our local work in Ryedale uses an experimental methodology called *Competency Groups* that seeks to translate these philosophical principles into research practice.

As a way of doing science differently, Competency Groups are distinctive from other approaches to participatory science in four ways:

- they focus on the **practice** of knowledge-production as well as the nature of the knowledge produced;
- they treat research as a collaborative process in which the people and things involved make a difference;
- they bring academic and local people together over a sustained period to generate new collective knowledge and skills (competencies);
- they do not try to include representatives of pre-existing stakeholder groups, but to create new communities of knowledge.

3.2 Working with Controversy

For people who are not usually directly affected by flooding, the problem becomes controversial during and immediately after flood events. The perceived institutional failures that emerge often hide a deeper and more pervasive sense of controversy held by those who have to live with flood risk about why, still, nothing has been done. Here, reasons for

⁵ There is now a burgeoning literature of the need for, and practical issues arising from, research that spans different academic disciplines. Some of this literature addresses the changing nature of universities in the modern world (Gibbons *et al.*, 1994; Nowtny *et al.*, 2001) and the perceived need to change the way that science is funded (House of Lords Select Committee on Science & Technology, 2000; HM Treasury, 2004; National Academy of Sciences *et al.*, 2005) to make it more applicable to ‘real world problems’ which do not respect disciplinary boundaries. Elsewhere, researchers who have worked across disciplinary boundaries are producing accounts of the experience and drawing out lessons (see, for example, Lowe and Phillipson, 2006; Maasen *et al.*, 2006).

inaction are played out through debates about national level frameworks for making decisions, such as those associated with cost-benefit analyses. Knowledge becomes a clear dynamic of the controversy because of the dependence of such analyses upon estimation of the magnitude and frequency of future flood events. Knowledge claims are therefore intricately bound up in the nature and dynamics of the controversy. From the philosophical approach in our project, ***rather than seeing the resolution of the controversy as a challenge to be addressed, we see the controversy as a source of energy to be harnessed***, not necessarily to settle the controversy, but as a means of enabling new forms of collective competence as part of flood risk management.

3.3 Democratising Science

The local work in Ryedale centred on the flood risk problems in and around Pickering. It forms the first of two local experimental case studies, the second running in Sussex in 2008-2009. The *Understanding Environmental Knowledge Controversies* project is due to be completed in the spring of 2010 when the experiences of the local work in the two case study areas will inform the overall project conclusions. At the end of the project, the experiences from the two local case studies will inform an international conference on *Understanding Environmental Knowledge Controversies: Democratising Science* to be held at Oxford University in December 2009.

4. FLOODING IN RYEDALE: THE LOCAL CONTROVERSY

The research project selected Ryedale as a case study area for local research in 2004 when preparing the initial proposal for funding for the research. It is important to note that the project was not conceived as a response to the flooding that took place in the district in June 2007. This section sets out the recent history of flooding in Ryedale and explains the recent controversy about how best to reduce flood risk.

4.1 The History of Flooding in Ryedale

The district of Ryedale in North Yorkshire has been prominent among those in recent years affected by flooding. There have been several serious incidences of flooding in the district since the 1990s. The town of Pickering was seriously affected by flooding in June 2007, and there has been further flooding in the district as recently as September 2008.

The catchment of the Derwent and its tributaries is predominantly rural, extending south from the North York Moors and flowing into the River Ouse at Barmby south of Selby. The largest towns in the catchment are the market towns of Malton and Norton. Most towns, including Pickering and Helmsley, and many of the low-lying villages, have a long history of flooding.

The tributaries in the upper catchment respond rapidly to heavy rainfall and, though the slopes are gentler downstream, the river levels can remain high for many days. The history of flooding in the catchment is detailed in the Catchment Flood Management Plan (CFMP), produced for the Environment Agency in 2007.

The History of Flooding in the Derwent

The Derwent catchment has a long history of flooding with evidence dating back to 1892. Prior to the flooding in 1999, the previously highest recorded flood was in 1947. The catchment has been particularly badly affected by flooding in 1927, 1930, 1931, 1932, 1960 and in more recent times, during March 1999, summer and autumn 2000, August 2002, June 2005 and June 2007.⁶

The autumn 2000 flood event was the worst flood recorded. It was estimated to have been an event with a two per cent chance of happening in any year. The impacts of this flood were severe on communities and many properties within the catchment suffered significant flooding. ... Smaller, more frequent events can still cause significant damage to those affected. As a result of the autumn 2000 event, over 200 properties in the Derwent catchment were affected by flooding. Pickering, Stamford Bridge, Old Malton, Malton and Norton, Sinnington, Elvington and Thorganby were subject to significant flooding.

Environment Agency (2007) *Yorkshire Derwent Catchment Management Plan* p.10

The two main reasons for flooding in the catchment are, first, prolonged and heavy rainfall across the North York Moors, sometimes combined with snow melt, which causes flooding across the whole of the catchment and, second, intense local rainfall events during summer months. Existing flood risk management measures include: floodplains and flood-banks; maintenance; and flood alleviation schemes.

The Derwent Catchment Flood Management Plan modelled different land management scenarios for the catchment. These scenarios included:

⁶ The most recent floods in Ryedale were in September 2008.

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- blocking land drains, reducing flood peak levels by 10 per cent;
- using buffer strips adjacent to watercourses, delaying the flood peak by two hours;
- widescale afforestation, a combination of scenario one and two;
- increasing land drainage, speeding up the flood peak by 2 hours;
- floodplain storage;
- increase channel conveyance (flow);
- climate change.

The Agency argued that the results from the modelling suggested that land use management could help reduce flood risk. Their suggestions for changes included:

- modifying land drains to slow the flow from reaching watercourses;
- encouraging afforestation where appropriate;
- improving channel conveyance (flow), and identifying opportunities for restoration of meanders where appropriate and to increase water storage within the river channel;
- identifying suitable flood storage locations.

The CFMP argued that the possibility of storing water should be investigated further. The overall policy for the Derwent catchment was summarised as follows:

- Improve catchment information – rainfall, run-off, river level/flow and flood risk;
- Prevent inappropriate development in the floodplain;
- Make space for water – improve land management practice, restore natural use of floodplain;
- Improve communication – professional partners, landowners, those directly at risk from flooding;
- Promote sustainable urban drainage systems;
- Climate change – monitor the effects of climate change – to Derwent catchment policy

(Environment Agency, 2007, p.19)

4.2 Recent Developments in Flood Risk Management in Ryedale

The flooding in 1999, 2000 and 2002 increased the public and political pressure to act to reduce flood risk in the catchment. A local Flood Forum Group was established in Malton and work began on a new flood defence scheme for the town. This involved erecting raised walls along the banks of the River Derwent through the town at a cost of £7.5million.

In August 2001, the Environment Agency submitted an application to Ryedale District Council for planning consent to construct a series of flood defences along Pickering Beck to reduce flood risk for the town of Pickering. However, there were local objections. These included: that some properties would suffer increased flood risk as a result; that the proposed defences would be detrimental to the appearance of the town; and that there had been only limited consultation. The Agency withdrew the proposed scheme and appointed consultants to examine alternative options and develop a proposed scheme with a positive benefit/cost ratio that would cover as much of the community at Pickering as possible.

The project, carried out by Babbie Brown and Root (see Babbie Ltd, 2003), involved a hydrological review and hydraulic modelling and a description of the area to be protected. It then set out eight main options, describing the basic components of each. The options considered were:

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- Do nothing - which would be likely to lead to an increase in the frequency of flooding
- Do minimum – which would leave flood risk at its existing levels and involve current levels of maintenance work
- Improved maintenance and flood warning - which could reduce flood levels by improving the capacity of the river channel through improved maintenance
- Upstream storage – through the construction upstream of a flood retention dam for holding flows during a flood event
- Widening the existing channel – which could reduce flood levels by increasing the capacity of the river channel through river widening
- Channel re-grading - which could reduce flood levels by increasing the capacity of the river channel through deepening the river bed and removing the weirs
- Local flood defences – the erection of brick and stone flood walls through the town
- Flood diversion tunnel – a flood diversion tunnel could convey flood water from Pickering Beck to Costa Beck so reducing flood risk in the town of Pickering

4.3 The Problem of Flooding in Pickering and its Surrounding Area

The Pickering Flood Alleviation Scheme Options Report was produced in August 2003, but no further flood defence work was undertaken. The risk faced by the town's people and businesses became politicised locally once again following the flood event of 25th June 2007.

In the aftermath of the 2007 flooding, Shadow Floods Minister Anne McIntosh (the Prospective Parliamentary Candidate for Thirsk and Malton) was quoted as saying

"Pickering lays claim to being the most forgotten area substantially hit by the recent floods, and the people of Pickering feel very neglected. No warnings were given before the floods hit, and sandbags were not available for every vulnerable home and business.

"It is highly surprising and disappointing that the Government have so far failed to award any recovery monies whatsoever to the town, utterly devastated by these floods."

She went on to say:

"I shall argue that the Pickering Flood Alleviation Scheme, like the Thirsk scheme, would bring huge and direct benefits and immediate relief from further flooding to the town."⁷

Some of the recent local press coverage of the aftermath of the 2007 floods is contained in Appendix V.

⁷ Quoted in the Malton & Pickering Mercury, 18th July 2007.
<http://www.maltonmercury.co.uk/2393/39Forgotten-town39.3036558.jp>

5. THE RYEDALE FLOOD RESEARCH GROUP

In this section, we briefly explain the process by which the Ryedale Flood Research Group was established and conducted its work. The Project Team had been preparing for establishing and running the Group between March and June 2007, and the Group was established in July 2007, meeting regularly between then and September 2008. (A more detailed account of the Group's activities is contained in Appendix VI).

5.1 The Establishment and Work of the Group

The Project Team recruited eight local residents. The project was advertised in two local newspapers, both of which published news features on the project. Before these pieces appeared, Sue Bradley (based at the Centre for Rural Economy at Newcastle University), who acted as co-ordinator for the Group, placed notices in shop windows, community notice boards (including in a supermarket and a doctor's surgery) and arranged for them to be distributed through local library and museum networks. The notices, which were posted up just two weeks before the June 2007 Pickering Floods, were set out as follows:

Interested in what causes flooding, or how flood risk is managed?

We are a team of researchers from Oxford, Durham and Newcastle Universities conducting a one-year research project on flooding in the Derwent. We would like 5 local people to work with us. For further information about the project, and to express an interest in being involved, please write, including your contact details, to Sue Bradley, Centre for Rural Economy, Newcastle University, Newcastle upon Tyne, NE1 7RU (E-mail susan.bradley@ncl.ac.uk or telephone 0191-222-8506) by 30th June 2007.

Sue led on recruitment, steered by the policy of the Project Team. A one-page introduction to the project, explained the Project Team's ambitions for the Group. It offered Group members the following:

- The opportunity to 'make something together' – though we don't know what.
- The opportunity to be part of, and help shape, a national project about how scientists and local residents can work together more effectively and can better understand flood risk management.
- Some intellectual engagement in a collective endeavour, learning about different experiences and understandings of the local water environment
- The opportunity to produce some oral testimony (through life history recordings) of people living in Ryedale at the time of the 2007 floods.

Once the eight local members were recruited, six meetings of the Group took place between September 2007 and July 2008. Communications between meetings included letters, e-mails, phone-calls and exchanges via a password-protected website set up for the Ryedale group. Contact with Ryedale-based members varied from occasional e-mails and phone-calls to working together to produce written resources for the Ryedale Flood Research Group's website. This contact was important in terms of building the personal relationships needed for a continuing exchange – and development – of ideas, not just about flood risk management, but also about the practice of Competency Groups – an important part of the shared research, whose findings would inform approaches taken by other projects.

The project website and password-protected web-based discussion forum were set up and run by Gillian Willis, project administrator, following a suggestion from a Ryedale member at

the first meeting. This provided a space to store and access resources (e.g. photographs and documents) produced by Group members, and as a way of sharing news and ideas, and of asking questions. Whether by choice or circumstance, the website was not accessible to everyone, so Sue copied and posted paper versions of the blogs to members at intervals.

It was envisaged that locally-based members might collect data to inform the flood modelling. This took a number of forms. First, field visits with local members allowed us to reformulate our ideas about the modelling, about where to try things, what to try, how to reformulate the model to represent other processes. Second, local members were able to work with the Project Team to develop a shared understanding of flow gauge data. Third, local members spontaneously produced a wide range of data including photographs, historical records and a video illustrating the views of members about lack of maintenance of local watercourses, which have both informed the modelling and generated further discussion in the group. The widespread concern in the group about the lack of maintenance made it critical to undertake modelling of floodplain flow. Systematic photographs were taken by a local member and these were then used with a scientific manual to identify possible numerical (Manning's N) values for river roughness for use in the hydraulic model.

In the period between main meetings, Sue met each member individually to hear how they had found the previous meeting and note suggestions and requests for next time (e.g. for how meetings might be organised differently). These individual meetings also served the purpose of maintaining a space where views might be expressed without the collective pressures associated with a group event. Feedback reports based on these meetings informed the Project Team's approach to the subsequent main meeting.

In the initial meetings with respondents, Neil and Sue had explained that the meetings would be recorded. Permission to film was sought in the first meeting. There were no objections from Ryedale members, and video recording of the first meeting began after the tea break. All subsequent meetings were videoed, with Gillian Willis (project administrator) taking the role of film-maker.

All Group meetings were held on Tuesday evenings in Pickering Memorial Hall. They were originally scheduled to be between 7 and 9pm. In response to feedback following the first, subsequent meetings were extended so they started at 6.30 and ended at 9.30. In practice, people arrived earlier and the agendas were so packed that meetings overran. All the university-based members attended every meeting, as did all Ryedale members except two, who had work or family commitments on particular evenings. Membership remained constant throughout the 11-month period of the six meetings. An account of the content of the six group meetings is contained in Appendix VI.

5.2 Collective Knowledge Production

The vehicle for generating knowledge was not simply Group members talking amongst themselves, although dialogue was important. Rather, there was also an important emphasis on bringing objects, or things, as the stimuli around which the group was able to establish its collective competence in general and the necessary content of the model in particular. In preparation for the first meeting, everybody had been asked to bring an object that was evocative of their experience of flooding. A wide range of things — photographs, flood-damaged carpet, press cuttings etc — became the focus for discussions in small groups about the variety of experiences of flooding.

At the second meeting the main objects were large Ordnance Survey 1:25,000 maps of the catchment, also showing the Environment Agency outlines of places liable to flood. Again we divided into smaller groups which took on the task of correcting the flood outlines

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generated through Environment Agency computer modelling. We also imagined and mapped measures that could be tried to reduce flood risk, both in the local towns and villages (e.g. Sinnington, Pickering) and also in the wider catchment. We were encouraged to be speculative and make suggestions without any considerations of technical feasibility or costing. Two themes emerged from this: the possibility of using upstream flood storage measures such as low impact, low cost, bunds; and the question of how much flood risk reduction could be achieved through river maintenance.

The activities during the first two meetings enabled two members to encode a computer model in which we could try out different upstream storage options. In the third meeting this model, running on lap-top computers, became an object that made it possible for the group to see how much flood reduction we could achieve by upstream storage. In trying the model out we were able to think through where we knew there might be opportunities for storage as well as possible constraints (such as the importance of the North Yorkshire Moors Railway). This activity also, and crucially, involved thinking critically about what we had done. Indeed, all Group members contributed to raising concerns and questions about the results, such as what would happen to the timing of flood peaks from Pickering Beck and Seven Beck, in relation to catchments like the Rye further upstream; the risks associated with upstream bund failure; and the acceptability of bunds in relation to required changes in land use, necessary compensation, etc. These concerns aside, we decided that upstream storage might be used to reduce flood risk for both Pickering and Seven Becks at relatively low cost.

In the fourth meeting we watched a video made by a member to show the extent of vegetation in the river and on the banks. This prompted a long discussion about flood risk management and policy on local and national scale. The video was one of the items produced to inform the modelling and generate further discussion in the group. In fact, so much material was collected that it proved impossible to give it adequate attention within the main meetings, where it had to compete with other items on the agenda. In response to this, one member suggested an extra meeting to be devoted to sharing the material gathered and offered to host it at his home, which was held between the fourth and fifth main meetings.

Between the fourth and fifth main meeting, an additional 'reading group' was held with the aim of making official flood-related documents more accessible. This focussed on two recent reports into flooding in Ryedale: The Pickering Flood Alleviation Scheme Options Report (2003) produced for the Environment Agency by the Babbie consultancy group; and the Environment Agency's Derwent Catchment Flood Management Plan (2007). The meeting focussed on how members could bring their knowledge of flooding to the interpretation of these reports and then use these understandings to be in a better position to engage with statutory officials.

The discussion in the Group's fourth meeting also prompted the trying out of an extant model (HEC-RAS) developed by the US Army Corps of Engineers, to pursue the issue of vegetation and maintenance. For the fifth meeting, one member of the Group set the model up for a river-floodplain reach typical of what we had seen in the video and in the photographic records collected by group members. Our findings showed that both vegetation and sediment accumulation in the rivers characteristic of the Vale of Pickering could be contributing quite significantly to local flood risk. This accorded with recent and renewed concern nationally over the effects of vegetation and sediment upon flood risk.

In the sixth meeting, the discussion returned to the issue of the group making something for others to use, which had been touched on in previous meetings. One suggestion was to put material on a CD for wider distribution, including a version of the computer model that the Group generated which would enable other interested people to try out this tool.

5.3 Hydrological Modelling

5.3.1 The modelling philosophy

The Group had to approach the modelling in a different way to that which is normal for a hydrological analysis. This way of working reflected the wider goals of the project and was underpinned by a particular philosophy.

When models are used to inform decision-making in hydrology, such as part of a consultancy process, what informs the choice of model is normally the models available ‘off-the-shelf’. All models comprise a conceptualisation of what it is about the real world that needs to be modelled. By using off-the-shelf models, we take for granted the existing conceptualisation that has been written into them. Our modelling philosophy is different in that it is ‘knowledge-theoretic’. Rather than starting the modelling process according to models we have, or focussing on what we know from hydrological theory or what we can infer from available datasets, we began by conceptualising the model by explicitly restricting the model in the light of available knowledge, including the uncertainty associated with that knowledge. This is neither only theoretical knowledge, nor only data-based knowledge, but involves opening up the definition of **what is admissible knowledge** to include the collective knowledge, or competence, of the Ryedale Flood Research Group. The models were framed by the Group for Pickering Beck. This does not preclude use of existing models. It only uses them if this process of conceptualisation identifies such a model as being a suitable way forward.

5.3.2 Imagining what needed to be in the model

In the first two meetings, we focussed upon what needed to be in the model. The vehicle for doing this was bringing and discussing objects such as photographs, press cuttings and so on. Maps of the catchment, showing also the Environment Agency flood outlines were the focus of small group discussions, where we imagined and mapped what could be tried to reduce flood risk both in particular settlements and in the wider catchment. In developing what needed to be included in the model, the focus was not only upon what had to be solved, but also on the processes that needed to be represented and the problems and possibilities provided by extant data needed to run the model.

5.3.3 Model 1: upstream storage

One member, Nick Odoni, wrote a model to allow the Group to try out upstream storage using bunds. This involved a distributed hydrological routing model, able to work with extant digital topographic (Figure 1) and rainfall (Figure 2) data. Informed by what the Group knew about the catchment, the model focused upon routing of surface overland flow under conditions of soil saturation in response to rainfall depths typical of the June 25th 2007 event. Some of the model development required coding standard hydrological functions (e.g. calculation of drainage networks, Figure 3). Some development required special tools to be written to allow all Group members to run the model (e.g. Figure 4). We dedicated much of the third Group meeting to working with the storage model, trying to see how much flood reduction we could achieve. In trying the model out, we were able to think through where we knew there might be opportunities for storage as well as possible constraints (such as the importance of the North Yorkshire Moors Railway). This activity also, and crucially, involved thinking critically about what we had done. Indeed, all Group members raised concerns and questions about the results, such as what would happen to the timing of flood peaks from Pickering Beck and the River Seven, in relation to catchments like the Rye further upstream; the risks associated with upstream bund failure; and the acceptability of bunds in relation to required changes in land use, necessary compensation and so on. These concerns aside, we developed a majority consensus that upstream storage might be used to reduce flood risk for both Pickering Beck and the River Seven at relatively low cost.

Figure 1 - Digital Topographic Data for Pickering Beck

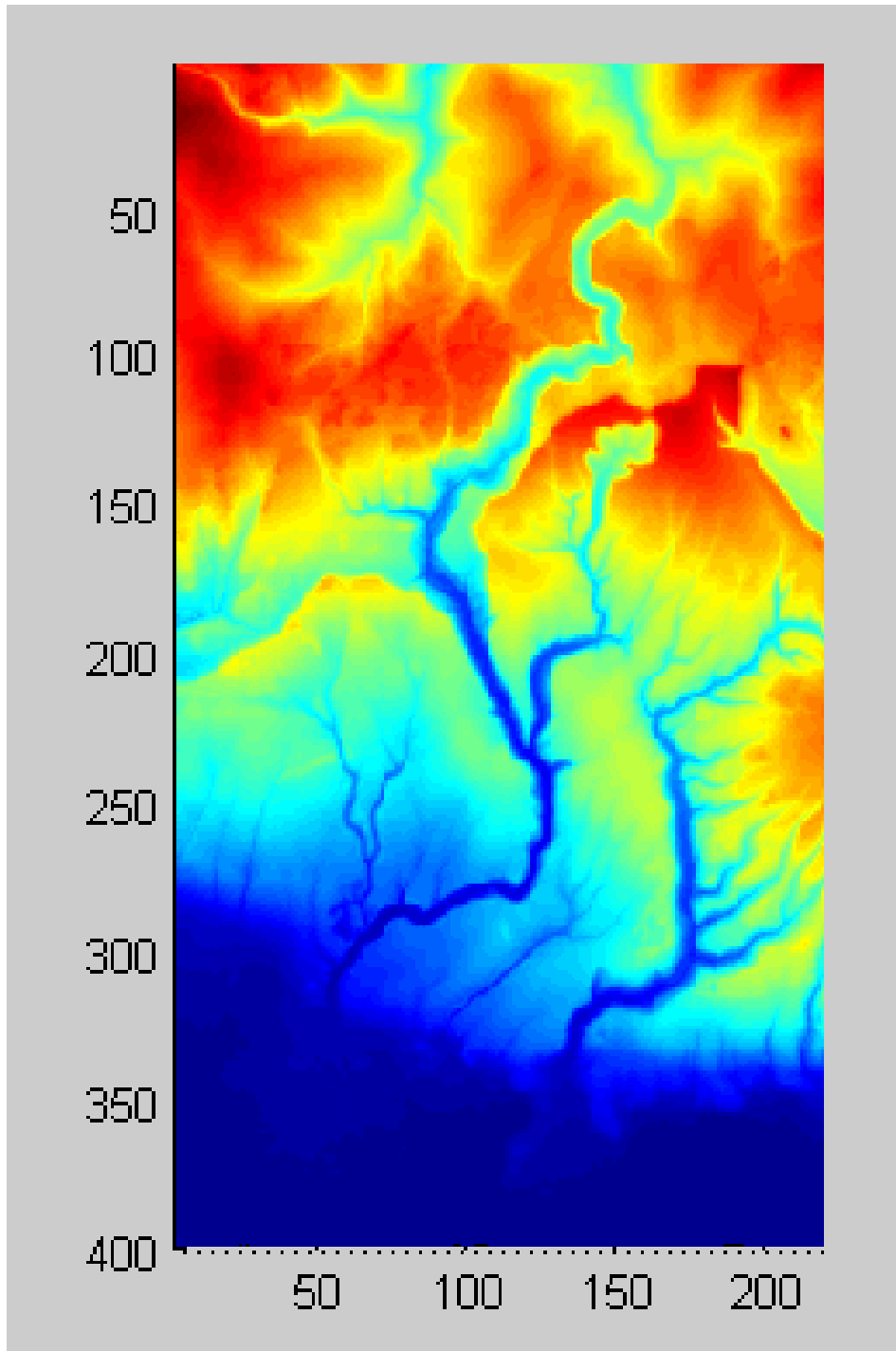
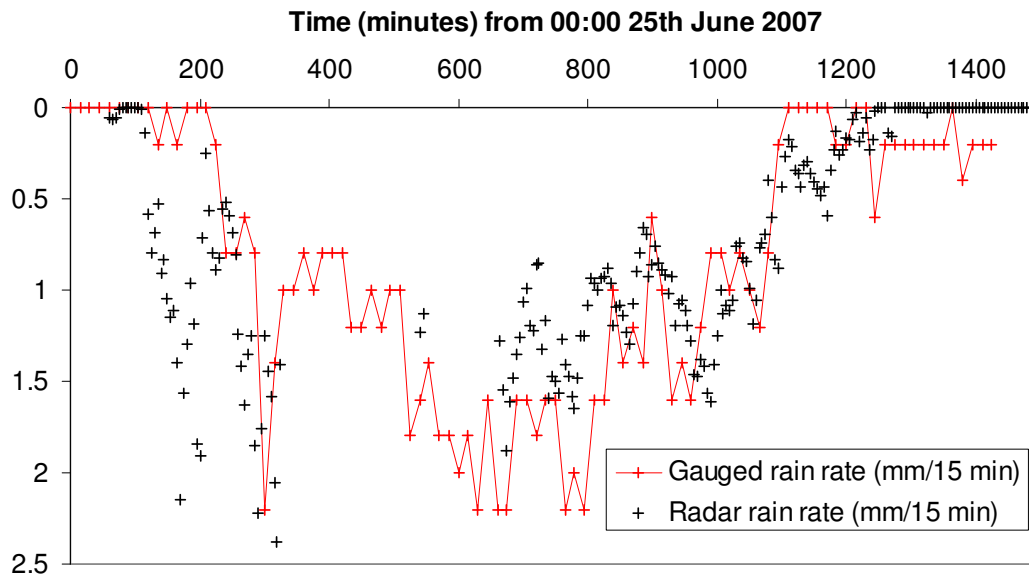


Figure 2 - Measured rainfall data for four stations during the June 25th 2007 event



[N. B. Data are shown for the rain gauge at Brown Howe and extracted from the rainfall radar data for comparison. The radar did not function continuously throughout the storm event.]

Figure 3 - Calculated Drainage Network for the Pickering Beck Catchment

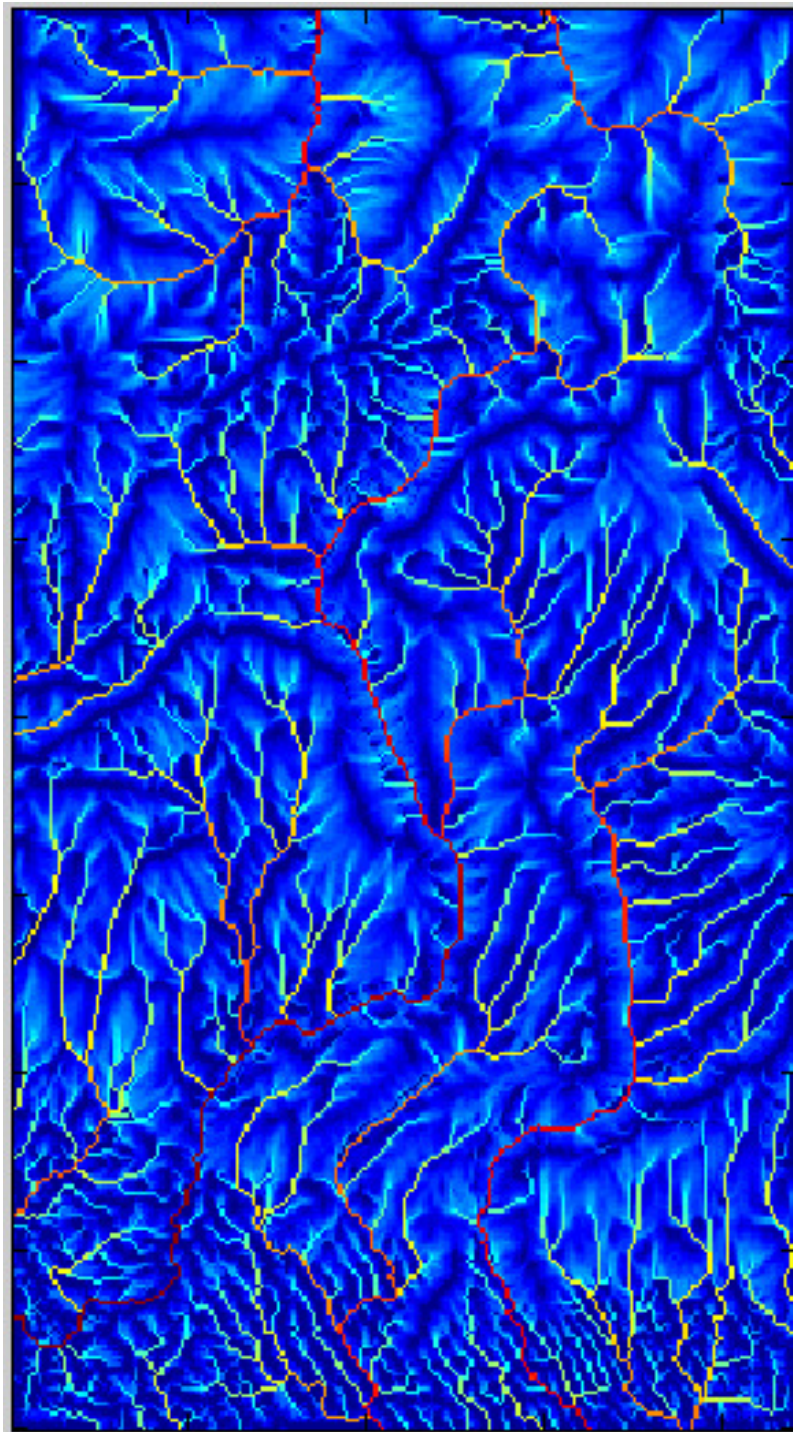
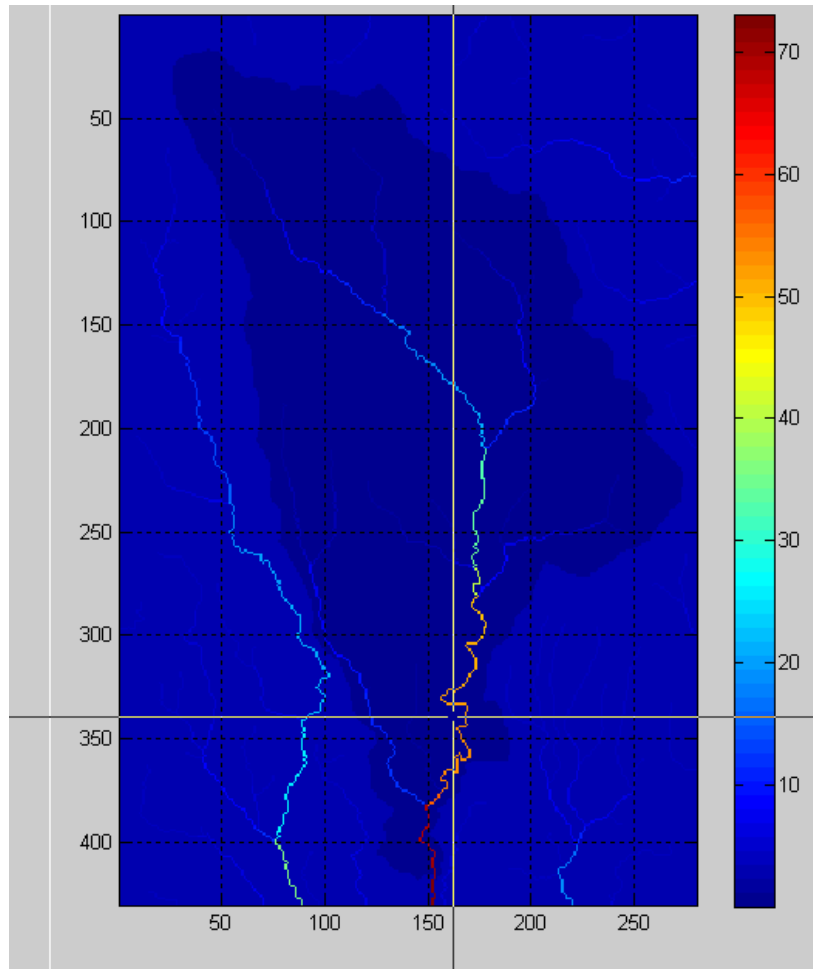


Figure 4 - The Bund Tool



The white cross was used by Group members to identify where to try a bund out. Once all bunds were positioned, Group members could try different bund heights out for each bund, including a rough estimate of the cost of bund construction.

5.3.4 Model 2: river maintenance

The second theme was pursued using an extant mode (HEC-RAS), developed by the US Army Corps of Engineers. As we had identified the effects of river maintenance, both vegetation and sediment, as being important, and as one-dimensional hydraulic modelling has benefited from a significant body of research into how to parameterise vegetation and sediment effects, we felt that an off-the-shelf model was appropriate. Again, one member of the group set the model up for a river-floodplain reach typical of what we had seen in a second member's video and photographic records. In the fifth Group meeting, in break out groups, we ran the model, exploring how changing bed levels and changing roughness impacted upon model predictions. Roughness was informed by photographic surveys undertaken by local group members, which we translated as a Group as a whole into estimates of river roughness using a picture book (a standard component of much flood risk consultancy). We simulated the effects of roughness changes, using the book as a guide, and river dredging, for river discharges with different return periods. Our findings showed that both vegetation and sediment accumulation in the rivers characteristic of the Vale of Pickering could be contributing quite significantly to local flood risk. This accorded with recent and renewed concern nationally over the effects of vegetation and sediment upon flood risk.

5.4 The Group's Findings

5.4.1 Flood Risk Management in Ryedale

In relation to the challenge of reducing flood risk at Pickering and Sinnington, the Group concluded that upstream storage might be a means of reducing flood risk. This was a majority view and it was held simultaneously with residual concerns over its feasibility. However, there was a consensus that this option should be explored further. There was also a majority view that the changes in maintenance regime of rivers in the area were contributing to increases in local flood risk. It was also noted that this removal of maintenance appeared to reflect the aims of *Making Space for Water* rather than the view, held as incorrect by the Group, that vegetation and sediment do not impact local flood risk.

5.4.2 Lessons for the Practice of Modelling

We have reflected upon the wider implications of our way of modelling for the more general practice of modelling in flood risk management. Here we explain some of our key findings for the practice of flood risk science.

Lesson 1. What makes a general model?

One of the criticisms of our model is that it has been developed for a geographically specific place. Traditionally, models are developed as generic tools that can be applied across different places. In an attempt to deliver generic capability, models have processes added to them. Our way of working mitigates this and indeed challenges the very nature of much assumed modelling activity: to develop generic models. However, we would note the following. As a model becomes more complex it often becomes less usable, especially in relation to data demands and computational limits on establishing model uncertainty. Moreover, even the most complex model requires tuning, through parameterisation, to particular local conditions. Once calibrated, an exercise that can take a lot of time, the model no longer travels. With our modelling approach, by simplifying a model to what is deemed to matter to the place being modelled, we produce simpler models, ones that are more

parsimonious, with reduced uncertainty in model predictions, and where, with a simpler model, much more time can be spent establishing that uncertainty, something that is commonly resisted in modelling activities. The burden of effort shifts from making an off-the-shelf model work in a particular place to developing a model directly suited to that place. We believe that our way of modelling may actually be more cost effective than tuning an off-the-shelf model.

Lesson 2: Moving what matters to decision-making upstream

When a decision is made about how to reduce flood risk, it is not just the modelled knowledge that is needed. It is also the other factors that might determine whether or not a scheme can go ahead. This is normally done at the end of a study. This raises the question as to the point of trying out scenarios in a model when it is quite clear that they are likely to be unsuitable, for other reasons. In our approach, we bring these constraints to the process of deciding what to model, we move critical influences in decision-making upstream. In Pickering Beck, flood risk reduction through catchment storage had been rejected in previous studies as they had used models that could only represent the effects of a large structure (effectively a reservoir) on flood risk reduction and which had been sited on a tributary that was a relatively unimportant contributor to Pickering flood risk. Our way of working brought a range of knowledges normally either excluded or deemed inadmissible to the flood modelling process until its very end, right to the fore. This included: (1) where to try things out in terms of where to make a difference; *'This is a very insignificant bit. It is this one that is the one. The one that goes up to Lockton is where all the water comes from. This ... [tributary]... doesn't matter ...'* (22.1.08); (2) where to try things in terms of the feasibility of land management change; *'Once you get right up into Farndale ... it's still agricultural, but it tends to be the sort of sheep farming ... if it is going to get flooded up there and it is only on a temporary basis for say 2/3 days, it is not going to affect the silage anyway.'* (22.1.08); (3) how the proposals might be made more acceptable through an agri-environmental scheme; *'they would go for it straight away because the moor fellas aren't earning a lot of money.'* (22.1.08); and (4) the institutional context within which the model was being developed; *'I think we have to be concerned about the visual aspects. Also the wildlife...'* (22.1.08) and *'It is all in a national park'* (22.1.08).

Lesson 3: Establishing faith in knowledge

Although much of our way of working emphasised the co-production of a new collective competence, across the Group, a critical precursor to this was moving beyond the conventional divide between expert knowledge and lay knowledge, and growing amongst local members a faith in the role of their own knowledge. Analysis of our meeting records showed a rich seam of knowledge about how flooding worked, one expressed in vernacular terms, but also an initial hesitation to bring that knowledge to the Group. Using things like maps of predicted flood extent and the objects Group members brought, and – critically – the experience of trying out flood reduction strategies using the models, knowledge that had previously tended to be left as inadmissible by those who possessed it became not only admissible but also useful as part of the collective competence established by the Group.

6. CONCLUSIONS

Flooding in Ryedale

To reduce flood risk in Ryedale, upstream storage holds promise as a cost-effective option and is therefore worthy of further exploration by the relevant authorities. ***Our modelling indicates that the construction of a few small bunds, appropriately sited upstream, could significantly reduce flood risk downstream at sites such as Pickering.***

Our modelling suggests ***that the role of vegetation growth in rivers and on riverbanks can be a contributory factor in accentuating local flood risk. In some situations, the same may be said for accumulation of sediment.*** Existing policies are seeking to reduce levels of river maintenance in rural areas. Our work emphasises that while this may benefit the many downstream, it brings increased flood-risk for the few who live upstream, usually in more sparsely populated rural areas.

Doing Science Differently

The work also generated important lessons for the practice of flood risk science.

First, our approach was to simplify the model so that it included the features deemed to be important in this particular place. This meant that instead of having to devote efforts to making an off-the-shelf model fit the place we wanted to model (*i.e.* Ryedale) we could concentrate on developing a model tailor-made to the place. We believe that this is a more cost-effective approach to flood science.

Second, we brought key elements of the decision-making process in at the start, together with types of knowledge that are usually either excluded from the modelling process altogether, or not taken into account until the end. This knowledge included specific understandings about suitable (and unsuitable) locations for trying out solutions. It increases the potential for solutions not just to make a difference, but also to be practicable.

Third, overcoming the conventional divide between ‘lay’ and ‘expert’ knowledge was a crucial step in developing ‘collective competence’ across the group, as was the growing confidence of local members in their knowledge.

The project in Ryedale has been an experiment in involving local people in a sustained way over a 12-month period in a process of collaborative knowledge production. Involving local knowledge (or what we call ‘vernacular knowledge’) helps reframe research questions and changes the ways that science gets done. In particular, our approach enabled the group to ‘try things out’ and experiment. We argue that this approach produces more useful and socially robust knowledge.

Close engagement between local people and academic researchers, over a sustained period of time, changed the nature of the environmental modelling we conducted in important ways. The modelling was used to open up new thinking, rather than produce definitive solutions. The divide between so-called ‘experts’ and ‘local people’ also dissolves as expertise is distributed among the group and beyond. In essence, ***expertise is a property of the collective.***

We conclude that truly participatory science not only produces more socially robust knowledge, but is also a more cost effective means of exploring how to reduce flood risk than conventional approaches. According to local press reports, more than £750,000 has been spent exploring options for flood risk management in and around Pickering over recent years.

We calculate that our research in Ryedale has cost less than £110,000 through the use of an academic research grant funded by research councils.

We decided to call the report of our research in Ryedale '*Making Space for People*'. This is purposefully in contrast to the Government's strategic framework for flood risk management, which is called '*Making Space for Water*'. Official enquiries into the 2007 summer floods have emphasised the need for flood managers to work more closely and effectively with local people, although this is primarily focussed on the efficacy of flood warning systems and raising awareness about flood resilience measures for homes and businesses. We argue that there is a risk that the national strategic framework and the agencies responsible for implementing it are becoming increasingly remote from the concerns and interests of people in flood risk areas.

The increasing remoteness of flood management decision-making from local people is accentuated as Environment Agency Areas merge and Internal Drainage Boards may be forced to amalgamate. There is, therefore, a need to 'make space for people' in the process of deciding what best to do about flooding locally, including public involvement in the conduct of flood risk science.

7. RECOMMENDATIONS

7.1 Recommendations for Ryedale

- We recommend that strategies for upstream flood storage are explored for the southward draining becks of the North York Moors by the Environment Agency. This should include assessment of the effects of intervening in any one sub-catchment in isolation upon the relative timing of sub-catchment peaks and hence downstream flood-risk.
- We recommend that the process of developing upstream storage schemes in Ryedale is undertaken using models appropriate to the type of scheme that we have suggested. This may mean that conventional, 'off-the-shelf' models are not suitable.
- We recommend that the impacts on flood-risk of the progressive withdrawal of maintenance are treated as an active intervention in the river system. This would require them to be actively assessed in the way that any other flood risk management scheme is.
- We recommend that the concerns of those who could be directly affected by decisions to withdraw river maintenance are taken seriously through their full engagement with these processes of assessment.

7.2 Interim Recommendations for Strategic Flood Risk Management

- Our project is at its half-way point and we are now beginning our local work in the catchment of the River Uck in East Sussex, and we intend to generate a set of lessons from our work in both Yorkshire and Sussex in the latter part of 2009. This means that our wider recommendations for strategic flood risk management in England can only be interim at this stage. Nevertheless, on the basis of our work in Ryedale, we invite flood scientists and civic groups working on local flood problems consider the implications of our way of collective working in Ryedale for their own efforts to solve flood problems in an era of increasing concern about flooding and its effects.

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APPENDIX I - THE RESEARCH PROJECT TEAM

Professor Sarah Whatmore (Principal Investigator)

Sarah is a Professor of Environment and Public Policy at the Oxford University Centre for the Environment (OUCE). She is also a Fellow of Linacre College. Sarah's research interests focus on relations between people and the material world, particularly the living world, and the spatial technologies that inform the ways in which these relations are imagined and practiced in the conduct of science, governance and everyday life. She has published widely on the theoretical and political implications of those questions in the fields of agriculture and food, land rights and land-use planning, biodiversity and biotechnology.

Professor Stuart Lane (Co-Investigator)

Stuart is Director of the Institute of Hazard and Risk Research at Durham University. Stuart's background is a mixture of physical geography and civil engineering, which has enabled him to develop a strongly quantitative approach to the understanding of hydraulic and hydrological processes, grounded strongly in a geographical approach. Stuart's main research interests are in the quantification of hydrological and hydraulic flows, and the associated impacts upon solute and sediment transfer, geomorphology and ecology.

Professor Neil Ward (Co-Investigator)

Neil took up the post of Dean of Social Sciences at the University of East Anglia in July 2008 and was previously Director of the Centre for Rural Economy and Professor of Rural and Regional Development at Newcastle University. His research interests are in the study and practice of rural development, especially in the UK and Europe. He has also worked on agricultural, environmental and regional politics and policy.

Ms Sue Bradley (Research Associate)

Based at Newcastle University, Sue has a degree in English and Drama from Bristol University and a Certificate in Life History Work from Sussex University. Since 1992 Sue has worked with oral history, firstly on regional community arts projects, then as the field worker responsible for Book Trade Lives, a oral history programme run by the British Library's National Life Stories unit. She is interested in ways in which personal experience can be related, heard and understood, and how oral history can be used in participatory research.

Dr Catharina Landström (Research Associate)

Catharina is a project research associate, based at the OUCE. Her PhD was awarded within the field of science and technology studies and her work in the project focuses on investigating the scientific knowledge claims and technologies concerned with flood risk. Prior to this Catharina has conducted social and cultural research on biological control of exotic pests in Australia and on gender and technology in Sweden.

Dr Nicholas Odoni (Research Associate)

Based at Durham, Nick is a geomorphologist interested in the application of models to explore geomorphological and environmental problems. Aspects of his PhD and previous master's research will be applied in a novel way to understanding flood behaviour and exploring flood management options. In addition, his first degree (Rural Resource Management, University of Plymouth) helps to provide an appreciation of the issues affecting rural communities and driving rural land use.

Ms Gillian Willis (Project Administrator)

Based at OUCE, Gillian is the Project Administrator and Web Manager. Her background lies originally in marketing communications, and she has considerable experience in project management within the National Health Service and within education.

APPENDIX II - THE PROJECT WORK PACKAGES

The project is divided into four work packages.

Work Package 1 - Environmental Knowledge Production and Controversy

The aim of this work package is to understand the production of scientific knowledge claims and technologies concerned with flood risk, the way in which they are built into the working procedures of organisations, and how and why they become subject to scientific dispute and public controversy. Its objectives are:

- To develop the project's theoretical foundation in relation to environmental knowledge practices, technologies and controversies;
 - To produce an empirical analysis of catchment management practices in the case study localities addressing: a) how environmental science knowledge is produced and circulated; b) the processes by which this knowledge is 'hard-wired' into scientific and policy practice; and c) the nature of local public controversies associated with these processes and methodologies;
 - To investigate the specific knowledge technology of hydrological modelling and the knowledge practices and practitioners involved in the production and circulation of competing models and their public and commercial users (e.g. insurance companies);
 - To interrogate and analyse the project team's own modelling practices, including the generation of the secondary data used, in the production of Minimum Information Requirement (MIR) Science and the effects of the Competency Group methodology on these practices; and
 - To investigate the role of visualisation in the production, circulation and contestation of hydrological/hydraulic models (e.g. the Environment Agency's on-line Flood Risk maps; the Office of Science and Technology's Floodranger 'game') and their potential as public engagement tools that enable users to recognise and negotiate knowledge controversies.
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Work Package 2 - Minimum Information Requirement Science and Modelling

This package will develop and validate an integrated Minimum Information Requirement (MIR) model for understanding the effects of land management on flood risk, and evaluate this by comparison with other approaches. The MIR model will be structured in an open-ended modular way to allow addition of modules for other types of diffuse land management activities to be incorporated. Its objectives are:

- To develop a MIR model for flood risk associated with diffuse land management activities, primarily using secondary data sets and new data where necessary;
 - To modify the tool that originated under a previous NERC Grant to include upscaling to large catchment areas (>100km²) for predicting the effects of rural land management upon flood risk;
 - To explore model parameterisation in terms of sensitivity and propagation of uncertainty and to undertake model assessment, including "measurement" activities involved in generating secondary data;
 - To undertake simulation analyses to specifically address whether diffuse land management activities impact upon flood risk; and the extent to which diffuse land management activities can be used to mitigate against flood risk; and
 - To undertake appropriate comparative scientific assessment of alternative modelling approaches for this type of problem.
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Work Package 3 - New Forms of Interdisciplinary Working in Environmental Science

The aim of this package is to develop and evaluate the ‘Competency Groups’ approach to interdisciplinary working, and to draw out lessons for the production of interdisciplinary knowledge in environmental science, but also lessons that are exportable to other research areas (including other diffuse environmental problems, such as pollution). Its objectives are:

- To review recent efforts to develop interdisciplinary research projects involving social and natural scientists to inform the conceptual framework for the project and field approach to Competency Groups;
 - To establish, facilitate and monitor two Competency Groups in the case study areas to help plan, guide and review the scientific approach to studying rural land management and its environmental implications;
 - To investigate the experiences of working in Competency Groups by group members through life history recordings;
 - To monitor the experience of interdisciplinary working among the team using Q methodology; and
 - To identify lessons for future research, both with RELU and beyond.
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Work Package 4 - Transferring Lessons and Skills to Other Diffuse Land Management Issues

The aim of this package is to assess the extent to which the scientific characteristics that make knowledge controversies integral to the specific case of flooding can be extended to other diffuse land management issues more generally. Its objectives are:

- To review the current natural science base of a wide range of land management activities that impact upon the water environment (*i.e.* diffuse pollution, including coarse sediment, soil erosion, nutrient, microbiological and pesticide risks);
 - To support the literature review through a series of meetings with key UK and overseas scientists to confirm and develop the natural science base and to identify where our proposed methodologies are likely to be most appropriate;
 - To undertake a series of small group meetings with natural scientists; policy makers and land managers to test the knowledge assumptions behind the project and disseminate key findings in order to encourage new ways of working; and
 - To use additional interviews with scientists to assess the nature of response and perceived barriers to implementing project results in their areas of science.
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Appendix III - The Recommendations of the House of Commons Environment, Food and Rural Affairs Select Committee Inquiry into Flooding (May 2008)

1. It is right that the Environment Agency continue to devote the majority of its resources into river and coastal flood risk management, and the building and maintaining of river and coastal flood defences. However, management of surface water flood risk can not remain in its current unclear and chaotic state. A key first step for Government must be to determine organisational responsibility for surface water flooding. We reject the idea of a dedicated Flood Agency.
2. We agree that the Agency is the best-placed organisation to take a strategic role at the national level in relation to surface water (and other inland) flooding.
3. The Agency's overview role needs careful specification. The Government must not add further responsibilities and functions to the Agency at a rate greater than it can absorb through recruitment, training and other preparatory measures. Increased responsibilities must be adequately funded. The Government must also not place unrealistic expectations on the Agency in relation to the modelling and mapping of surface water flood risk, as this will raise public expectations unrealistically.
4. In determining an overview role, the future relationship between the Agency and local authorities must be carefully articulated and defined in order to produce lines of accountability. This relationship is key to the future management of surface water flood risk. We believe the main purpose of the Agency's overview role should be to provide guidance and advice to local authorities on managing surface water flood risk, to provide quality-assurance of local authorities' plans to manage surface water flood risk, and to ensure consistency in practice between local authorities.
5. The model for Surface Water Management Plans (SWMP) currently advocated by Government lacks clarity about how co-ordination will be achieved between organisations responsible for surface water drainage in a particular area. In particular, the model does not explain how organisations can be persuaded to fulfil their responsibilities under such plans. In its response to our Report, the Government should set out clearly how the benefits of co-operation will be turned into action. It should also explain how it intends the enhanced SWMPs to fit alongside the existing system of Catchment Flood Management Plans and River Basin Management Plans.
6. Local authorities should have a statutory duty for surface water drainage. It should be the duty of a local authority to ensure its area is, and continues to be, effectively drained of precipitation to an agreed national standard of service.
7. Where the local wastewater utility and/or Internal Drainage Board has ownership of, or responsibility for, parts of the drainage system, local authorities should have the power to sub-contract part of their responsibility for ensuring effective drainage to those organisations, and to require their co-operation in managing surface water drainage on an area basis.
8. The Government should accept the Pitt Review's interim conclusion that local authorities be required to compile a register of all the main flood risk management and drainage assets (overland and underground), including an assessment of their condition and details of the responsible owners. The register should also determine physically where one organisation's responsibility ends and another one's begins. It should be available to the public as a web-based resource. Local authorities could also provide information to members of the public through a one-stop shop telephone number. Local authorities should receive co-operation from other organisations in compiling this register. Upper-tier local authorities should take the lead and, where they exist and where they wish to, parish and town councils should be involved.
9. Following its consultation, the Government must provide a clear steer about which local authority, in two-tier authorities, should take the lead in co-ordinating the management of surface water flooding and drainage at the local level.

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10. We recommend that the Department for Innovation, Universities and Skills and the Environment Agency develop, and publish, a strategy to address the national shortage in flood risk engineers. If the national shortage in this profession is not addressed, much of the Pitt Review may be impossible to implement.
11. We believe local authorities should be responsible for the ultimate ownership and maintenance of sustainable drainage systems (SUDs), as happens elsewhere in Europe. The Government needs to resolve ownership and maintenance issues as a matter of urgency to enable the current house-building and eco-towns programmes to incorporate maximum use of SUDs.
12. A presumption in favour of SUDs should be included in the Planning Bill, to add weight to Planning Policy Statement 25 (PPS25).
13. We welcome the Government's decision to consider, as part of its Water Strategy, changing surface water charging to reflect the "polluter pays" principle. Ofwat should insist that water and wastewater companies state the proportions of customers' bills that are made up of foul water drainage, surface water drainage and highways drainage. Property owners who have, or retro-fit, SUDs should receive a rebate on the surface water component of their water company bill.
14. We welcome the Government's Water Strategy policies to change householders' rights to allow them to pave over their front garden, without planning permission, only if the surface is porous and to review the automatic right to connect surface water drains and sewers to the public sewerage systems. We recommend that any new discharge of surface water by drain or sewer to a watercourse should require the consent of the Environment Agency.
15. Ministers have repeatedly used the £800 million allocation in 2010–11 in an attempt to convey the impression that this large amount of money will enable Government, and others, to respond effectively to the challenges posed by the summer's floods. When broken down, however, the Comprehensive Spending Review 2007 (CSR07) settlement is far less impressive, and looks inadequate to cope with both the traditional and new risks the country faces. In light of the upcoming final Pitt report, and the resources that both local authorities and the Agency will inevitably require to address surface water flood risk, we recommend that the Government reappraise the adequacy of its CSR 07 settlement to combat all types of flood risk.
16. Sir Michael Pitt should publish the full costs of his final recommendations as soon as possible. The Department should make clear in its response how it intends to fund the Pitt Review if the cost of its final recommendations exceeds £34.5 million. It should also say what options it is exploring as to how local authorities will be funded to carry out their responsibilities as a result of the Pitt Review.
17. We welcome the Government and the Agency's work to develop a long-term investment strategy for flood risk management. This strategy should provide some answers about the level of flood risk protection that the public should expect, the research and organisation involved (particularly for surface water flooding), the number of flood prevention and alleviation schemes required nationally, and how much this would cost. The strategy should also take account of the effect of climate change on the frequency and intensity of rainfall and storm surges. The strategy should be subject to a public consultation process, and published.
18. We support the Pitt Review's interim conclusions related to development in the flood plain, to ensure new buildings in the flood plain are properly flood resilient and resistant.. We welcome the Government's announcement to provide a Practice Guide Companion to ensure local authorities properly implement PPS25, particularly in respect of the impact of development on those downstream. We recommend that Government departments, working with the Local Government Association, carry out a survey to establish the present ability of local authorities to implement PPS25 and, should a skills deficit be identified, put forward policies to address this issue.

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19. The Department and the Agency should explore the possibility of ring-fencing a minimum proportion of the Agency's capital expenditure over a three-year CSR period for new capital schemes in rural areas.
20. We recommend that the Government consider the possibility of ring-fencing Grant-in-aid directly to Regional Flood Defence Committees.
21. The Agency should develop a clear strategy for expenditure on new capital works versus maintenance of existing systems. It should ensure that any proposed new scheme should have an estimated maintenance schedule in the same way that it is accompanied by a construction bill of quantities. The Agency should also ensure its maintenance budget for the CSR 07 period includes the additional maintenance work necessary on the new capital schemes it will build during the period.
22. Given the enormous level of interest, we believe it is appropriate that local people have to be involved, and consulted, in the formulation of decisions about watercourse and river maintenance. The Agency, and local authorities, must open up dialogue with members of the public, through appropriate local fora, to ensure that they are part of this process.
23. Once decisions have been made, the Agency should make clear, via its website or other means, the maintenance programme for all its watercourses—even if this, in some cases, is minimal—including the risk assessment which the Agency has made in deciding its approach to maintenance of a particular watercourse. The future schedule of maintenance should be announced whenever possible.
24. The Government should ask the Environment Agency and Natural England to agree on how to resolve any conflict between effective drainage for flood defence purposes and the preservation of watercourses as important wildlife habitats, and publish the results.
25. The Government should re-examine the money available for the maintenance of watercourses and produce a clear analysis, by the end of 2008, of the balance between maintenance and capital spend, bearing in mind the National Audit Office's conclusions, the scepticism of the public that not enough maintenance is being done, and the views of the Environment Agency.
26. Either the existing system of riparian duties needs to be made to work more effectively or it needs to be replaced. The Government should explore the practicality, costs and benefits of pursuing both courses of action. Work should begin as soon as possible to examine whether riparian ownership is fit for purpose.
27. We previously endorsed the Pitt Review's interim conclusion that local authorities be required to compile a register of all the main flood risk management and drainage assets, including details of the responsible owners. This register should include the owners of all watercourses, and be publicly available.
28. Defra should work with its partners and bodies to decide, by the end of 2008, how natural process flood risk schemes with multiple benefits can be best funded and developed. We strongly support the creative use of the Single Farm Payment to reward land owners if their land is used for the purpose of natural flooding to protect people and buildings elsewhere.
29. The Government should re-examine the current statutory duties on utilities in relation to emergency planning. A specific duty should be placed on utilities to ensure their critical assets are protected from the effects of flooding and that they have adequate business continuity plans in the event of a flood. This should include ensuring supply system resilience so that the failure of a key asset can be substituted by other means with a minimum interruption of service. The Agency should advise on plausible scenarios, taking into account climate change impacts.
30. We believe a proper sharing of financial responsibility is necessary between utilities' shareholders and customers in improving the resilience of utilities' infrastructure. Ofwat must ensure that the 2009 price review takes full account of the need for water companies to

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improve the resilience of critical assets, and of the costs this implies. But in doing so, it should also resist attempts by water companies to raise water bills, in order to pay to bring the infrastructure to the level of resilience it should have had in the first place. Consumers should not pay for companies' past inadequacies.

31. We agree with the Agency that reservoir and dam safety management should shift from being based on size to a risk-based approach. We endorse the Government's plans to introduce a requirement for emergency plans for reservoir and dams. We recommend an immediate review of the existing legislation in this area.
32. We recommend that Network Rail work with the Environment Agency, local authorities and others to design solutions that will minimise flood risk to themselves and other land owners close by.
33. Local authorities and other relevant local organisations need to rehearse emergency response exercises on a more regular basis. This would help to improve preparedness and also ensure people in various organisations know each other. The scale of the rehearsed emergency events should take account of the extreme weather events predicted as a result of climate change. The Government and the Environment Agency should be centrally involved in the formulation of such exercises to ensure that they are demanding enough.
34. The Government must ensure that the voluntary sector is included as part of civil contingency planning to maximise the effective use of the sector.
35. Emergency response in two-tier local authorities can add complications to an already difficult situation. We support the Pitt Review's interim conclusion that "upper-tier" local authorities should be the lead organisation in relation to multi-agency planning for severe weather emergencies at the local level, and for triggering multi-agency arrangements in response to severe weather warnings.
36. The Government should revise upwards both the planning contingency whereby the water industry is required to prepare for 200,000 people without water for 7 days, and the minimum per capita amount of water to be provided in an emergency. It should then ensure that water companies are able to demonstrate that they have the ability to meet these minimum standards, through the provision of sufficient materials such as bowsers and/or bottled water.
37. The Environment Agency should undertake to provide copies of its three flood guides to local authorities, to be circulated for free to those houses in areas of highest risk.
38. The Government should include an assessment of flood risk within the information to be included in Home Information Packs. The Environment Agency's guides should also be included in the packs for those properties deemed at risk.
39. There should ideally be an opt-out for receiving flood warnings from the Environment Agency in areas of high risk, rather than the current opt-in system. The Agency should publish, by the end of 2008, any results from its pilot scheme to register automatically eligible households and premises for flood warnings unless they opt out. It should also set out any concerns that have arisen from the pilot.
40. We understand that insurance companies will want to produce their own detailed flood risk maps for commercial reasons. The current situation, however, is a recipe for conflict. The Government should set out its policy on how it intends to resolve this potential confusion. We recognise the production of flood maps is a dynamic process and is dependent on the best data available, but it is in everyone's interest to have the best available validated map. The Environment Agency should take the lead in pulling partners together to achieve this. The Agency should set up a standing committee that annually reviews all the available data on flood mapping, so insurance companies and the Met Office can share experience, and this committee should publish an annual report about the dynamics of the process.

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41. Following the publication of the Pitt Review's final report, the Department must publish a costed and prioritised action plan to set out the timetable for implementing Sir Michael Pitt's findings. We recommend that the Government request that Sir Michael Pitt be given a role within the Environment Agency to ensure the implementation of his findings.

Appendix IV - The Final Recommendations of the Pitt Review

1. Given the predicted increase in the range of future extremes of weather, the Government should give priority to both adaptation and mitigation in its programmes to help society cope with climate change.
2. The Environment Agency should progressively take on a national overview of all flood risk, including surface water and groundwater flood risk, with immediate effect.
3. The Met Office should continue to improve its forecasting and predicting methods to a level which meets the needs of emergency responders.
4. The Environment Agency should further develop its tools and techniques for predicting and modelling river flooding, taking account of extreme and multiple events and depths and velocities of water.
5. The Environment Agency should work with partners to urgently take forward work to develop tools and techniques to model surface water flooding.
6. The Environment Agency and the Met Office should work together, through a joint centre, to improve their technical capability to forecast, model and warn against all sources of flooding.
7. There should be a presumption against building in high flood risk areas, in accordance with PPS25, including giving consideration to all sources of flood risk, and ensuring that developers make a full contribution to the costs both of building and maintaining any necessary defences.
8. The operation and effectiveness of PPS25 and the Environment Agency's powers to challenge development should be kept under review and strengthened if and when necessary.
9. Householders should no longer be able to lay impermeable surfaces as of right on front gardens and the Government should consult on extending this to back gardens and business premises.
10. The automatic right to connect surface water drainage of new developments to the sewerage system should be removed.
11. Building Regulations should be revised to ensure that all new or refurbished buildings in high flood-risk areas are flood-resistant or resilient.
12. All local authorities should extend eligibility for home improvement grants and loans to include flood resistance and resilience products for properties in high flood-risk areas.
13. Local authorities, in discharging their responsibilities under the Civil Contingencies Act 2004 to promote business continuity, should encourage the take-up of property flood resistance and resilience by businesses.
14. Local authorities should lead on the management of local flood risk, with the support of the relevant organisations.
15. Local authorities should positively tackle local problems of flooding by working with all relevant parties, establishing ownership and legal responsibility.
16. Local authorities should collate and map the main flood risk management and drainage assets (over and underground), including a record of their ownership and condition.
17. All relevant organisations should have a duty to share information and cooperate with local authorities and the Environment Agency to facilitate the management of flood risk.

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18. Local Surface Water Management Plans, as set out under PPS25 and coordinated by local authorities, should provide the basis for managing all local flood risk.
19. Local authorities should assess and, if appropriate, enhance their technical capabilities to deliver a wide range of responsibilities in relation to local flood risk management.
20. The Government should resolve the issue of which organisations should be responsible for the ownership and maintenance of sustainable drainage systems.
21. Defra should work with Ofwat and the water industry to explore how appropriate risk-based standards for public sewerage systems can be achieved.
22. As part of the forthcoming and subsequent water industry pricing reviews, Ofwat should give appropriate priority to proposals for investment in the existing sewerage network to deal with increasing flood risk.
23. The Government should commit to strategic long-term approach to its investment in flood risk management, planning up to 25 years ahead.
24. The Government should develop a scheme which allows and encourages local communities to invest in flood risk management measures.
25. The Environment Agency should maintain its existing risk-based approach to levels of maintenance and this should be supported by published schedules of works for each local authority area.
26. The Government should develop a single set of guidance for local authorities and the public on the use and usefulness of sandbags and other alternatives, rather than leaving the matter wholly to local discretion.
27. Defra, the Environment Agency and Natural England should work with partners to establish a programme through Catchment Flood Management Plans and Shoreline Management Plans to achieve greater working with natural processes.
28. The forthcoming flooding legislation should be a single unifying Act that addresses all sources of flooding, clarifies responsibilities and facilitates flood risk management.
29. The Government and the insurance industry should work together to deliver a public education programme setting out the benefits of insurance in the context of flooding.
30. The Government should review and update the guidance Insurance for all: A good practice guide for providers of social housing and disseminate it effectively to support the creation of insurance with rent schemes for low income households.
31. In flood risk areas, insurance notices should include information on flood risk and the simple steps that can be taken to mitigate the effects.
32. The insurance industry should develop and implement industry guidance for flooding events, covering reasonable expectations of the performance of insurers and reasonable actions by customers.
33. The Environment Agency should provide a specialised site-specific flood warning service for infrastructure operators, offering longer lead times and greater levels of detail about the velocity and depth of flooding.
34. The Met Office and the Environment Agency should issue warnings against a lower threshold of probability to increase preparation lead times for emergency responders.

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35. The Met Office and the Environment Agency should issue joint warnings and impact information on severe weather and flooding emergencies to responder organisations and the public.
36. The Environment Agency should make relevant flood visualisation data, held in electronic map format, available online to Gold and Silver Commands.
37. The Environment Agency should work with its partners to progressively develop and bring into use flood visualisation tools that are designed to meet the needs of flood-risk managers, emergency planners and responders.
38. Local authorities should establish mutual aid agreements in accordance with the guidance currently being prepared by the Local Government Association and the Cabinet Office.
39. The Government should urgently put in place a fully funded national capability for flood rescue, with Fire and Rescue Authorities playing a leading role, underpinned as necessary by a statutory duty.
40. Defra should amend emergency regulations to increase the minimum amount of water to be provided in an emergency, in order to reflect reasonable needs during a longer-term loss of mains supply.
41. Upper tier local authorities should be the lead responders in relation to multiagency planning for severe weather emergencies at the local level and for triggering multi-agency arrangements in response to severe weather warnings and local impact assessments.
42. Where a Gold Command is established for severe weather events, the police, unless agreed otherwise locally, should convene and lead the multi-agency response.
43. Gold Commands should be established at an early stage on a precautionary basis where there is a risk of serious flooding.
44. Category 1 and 2 responders should assess the effectiveness of their emergency response facilities, including flexible accommodation, IT and communications systems, and undertake any necessary improvement works.
45. The Highways Agency, working through Local Resilience Forums, should further consider the vulnerability of motorways and trunk roads to flooding, the potential for better warnings, strategic road clearance to avoid people becoming stranded and plans to support people who become stranded.
46. The rail industry, working through Local Resilience Forums, should develop plans to provide emergency welfare support to passengers stranded on the rail network.
47. The Ministry of Defence should identify a small number of trained Armed Forces personnel who can be deployed to advise Gold Commands on logistics during wide-area civil emergencies and, working with Cabinet Office, identify a suitable mechanism for deployment.
48. Central government crisis machinery should always be activated if significant wide-area and high-impact flooding is expected or occurs.
49. A national flooding exercise should take place at the earliest opportunity in order to test the new arrangements which central government departments are putting into place to deal with flooding and infrastructure emergencies.
50. The Government should urgently begin its systematic programme to reduce the disruption of essential services resulting from natural hazards by publishing a national framework and policy statement setting out the process, timescales and expectations.

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51. Relevant government departments and the Environment Agency should work with infrastructure operators to identify the vulnerability and risk of assets to flooding and a summary of the analysis should be published in Sector Resilience Plans.
52. In the short-term, the Government and infrastructure operators should work together to build a level of resilience into critical infrastructure assets that ensures continuity during a worst-case flood event.
53. A specific duty should be placed on economic regulators to build resilience in the critical Infrastructure.
54. The Government should extend the duty to undertake business continuity planning to infrastructure operating Category 2 responders to a standard equivalent to BS 25999, and that accountability is ensured through an annual benchmarking exercise within each sector.
55. The Government should strengthen and enforce the duty on Category 2 responders to share information on assets, enabling more effective emergency planning within Local Resilience Forums.
56. The Government should issue clear guidance on expected levels of Category 2 responders' engagement in planning, exercising and response and consider the case for strengthening enforcement arrangements.
57. The Government should provide Local Resilience Forums with the inundation maps for both large and small reservoirs to enable them to assess risks and plan for contingency, warning and evacuation and the outline maps be made available to the public online as part of wider flood risk information.
58. The Government should implement the legislative changes proposed in the Environment Agency biennial report on dam and reservoir safety through the forthcoming flooding legislation.
59. The Risk and Regulation Advisory Council should explore how the public can improve their understanding of community risks, including those associated with flooding, and that the Government should then implement the findings as appropriate.
60. The Government should implement a public information campaign which draws on a single definitive set of flood prevention and mitigation advice for householders and businesses, and which can be used by media and the authorities locally and nationally.
61. The Environment Agency should work with local responders to raise awareness in flood risk areas and identify a range of mechanisms to warn the public, particularly the vulnerable, in response to flooding.
62. The Environment Agency should work urgently with telecommunications companies to facilitate the roll-out of opt-out telephone flood warning schemes to all homes and businesses liable to flooding, including those with ex-directory numbers.
63. Flood risk should be made part of the mandatory search requirements when people buy property, and should form part of Home Information Packs.
64. Local Resilience Forums should continue to develop plans for door-knocking, coordinated by local authorities, to enhance flood warnings before flooding and to provide information and assess welfare needs once flooding has receded.
65. The Met Office and the Environment Agency should urgently complete the production of a sliding scale of options for greater personalisation of public warning information, including costs, benefits and feasibility.

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66. Local authority contact centres should take the lead in dealing with general enquiries from the public during and after major flooding, redirecting calls to other organisations when appropriate.
67. The Cabinet Office should provide advice to ensure that all Local Resilience Forums have effective and linked websites providing public information before, during and after an emergency.
68. Council leaders and chief executives should play a prominent role in public reassurance and advice through the local media during a flooding emergency, as part of a coordinated effort overseen by Gold Commanders.
69. The public should make up a flood kit – including personal documents, insurance policy, emergency contact numbers (including local council, emergency services and FLOODline), torch, battery or wind-up radio, mobile phone, rubber gloves, wet wipes or antibacterial hand gel, first aid kit and blankets.
70. The Government should establish a programme to support and encourage individuals and communities to be better prepared and more self-reliant during emergencies, allowing the authorities to focus on those areas and people in greatest need.
71. The Department of Health and relevant bodies should develop a single set of flood-related health advice for householders and businesses which should be used by all organisations nationally and locally and made available through a wide range of sources.
72. Local response and recovery coordinating groups should ensure that health and wellbeing support is readily available to those affected by flooding based on the advice developed by the Department of Health.
73. The Government, the Association of British Insurers and other relevant organisations should work together to explore any technological or process improvements that can be made to speed up the drying out and stabilising process of building recovery after a flood.
74. The monitoring of the impact of flooding on the health and wellbeing of people, and actions to mitigate and manage the effects, should form a systematic part of the work of Recovery Coordinating Groups.
75. For emergencies spanning more than a single local authority area, Government Offices should ensure coherence and coordination, if necessary, between recovery operations.
76. Local authorities should coordinate a systematic programme of community engagement in their area during the recovery phase.
77. National and local Recovery Coordinating Groups should be established from the outset of major emergencies and in due course there should be formal handover from the crisis machinery.
78. Aims and objectives for the recovery phase should be agreed at the outset by Recovery Coordinating Groups to provide focus and enable orderly transition into mainstream programmes when multi-agency coordination of recovery is no longer required.
79. Government Offices, in conjunction with the Local Government Association, should develop arrangements to provide advice and support from experienced organisations to areas dealing with recovery from severe flooding emergencies.
80. All central government guidance should be updated to reflect the new arrangements for recovery and Local Resilience Forums should plan, train and exercise on this basis.
81. There should be an agreed framework, including definitions and timescales, for local-central recovery reporting.

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82. Following major flooding events, the Government should publish monthly summaries of the progress of the recovery phase, including the numbers of households still displaced from all or part of their homes.
83. Local authorities should continue to make arrangements to bear the cost of recovery for all but the most exceptional emergencies, and should revisit their reserves and insurance arrangements in light of last summer's floods.
84. Central government should have pre-planned rather than ad-hoc arrangements to contribute towards the financial burden of recovery from the most exceptional emergencies, on a formula basis.
85. Local Recovery Coordination Groups should make early recommendations to elected local authority members about longer-term regeneration and economic development opportunities.
86. The Government should publish an action plan to implement the recommendations of this Review, with a Director in Defra overseeing the programme of delivery and issuing regular progress updates.
87. The Government should establish a Cabinet Committee with a remit to improve the country's ability to deal with flooding and implement the recommendations of this Review.
88. The Government should establish a National Resilience Forum to facilitate national level multi-agency planning for flooding and other emergencies.
89. The EFRA Select Committee should review the country's readiness for dealing with flooding emergencies and produce an assessment of progress in implementation of the Review's recommendations after 12 months.
90. All upper tier local authorities should establish Oversight and Scrutiny Committees to review work by public sector bodies and essential service providers in order to manage flood risk underpinned by a legal requirement to cooperate and share information.
91. Each Oversight and Scrutiny Committee should prepare an annual summary of actions taken locally to manage flood risk and implement this Review, and these reports should be public and reviewed by Government Offices and the Environment Agency.
92. Local Resilience Forums should evaluate and share lessons from both the response and recovery phases to inform their planning for future emergencies.

APPENDIX V – Examples of Local Press Coverage of the 2007 Floods

The Yorkshire Post, 28th June 2007⁸

Flood defences pass first real test for communities swamped in the past

By Mark Branagan

North Yorkshire: Malton and Norton escaped further flooding misery when the River Derwent peaked at just five feet below the defences installed by the Environment Agency after the community was swamped twice in 18 months.

It was the first real test of the scheme as water levels continued to rise during Tuesday evening because of the torrential rain. But the Agency said the flow had peaked 5ft below the surface of the barriers at midnight.

Flood warnings remained in place for riverside paths in York and Tadcaster but the roads were returning to normal in Pickering, where homes, businesses, and shops were hit on Tuesday.

But questions are already being asked about cuts to flood-defence funding, which led to a scheme planned for Pickering after the 2000 floods being scrapped three years ago to save money.

Vale of York Tory MP Anne McIntosh said: "I have today written to David Miliband MP, Secretary of State for Environment Food and Rural Affairs, asking him to justify the cuts in flood defence spending.

"My heart goes out to all those in parts of the Vale of York and North Yorkshire such as parts of the Thirsk and Easingwold area, Pickering and also other parts of Yorkshire, who have been severely affected by the recent flooding."

Flood campaigner and Ryedale Council Liberal Democrat leader Howard Keal said: "Hundreds of thousands of pounds damage and appalling distress have been caused by short-sightedness and utter neglect."

Ryedale MP John Greenway said: "The message to the Environment Agency and the Government is quite clear – enough is enough. We must have the defences built now.

"People's lives have once again been made a misery, businesses have lost thousands of pounds and the whole economy of Pickering will suffer, especially as these floods have happened in the peak holiday months."

Clean-up packs and information leaflets are being issued to residents of areas hit by flooding by Environmental Health Officers from Ryedale Council as the clean-up started in Pickering.

Council chief executive Janet Waggott said: "As well as providing help and support for residents who have been flooded we are keeping a watching brief on the situation in the Ryedale area. We will be closely monitoring the situation in partnership with the emergency services."

North Yorkshire County Council said all schools had now reopened, including Lady Lumley's in Pickering which had been used as an emergency shelter for flood victims.

North Yorkshire fire service said two fire engines were still out – one pumping out water at the Station Hotel in Pickering and another dealing with problems in Brotherton, Selby.

⁸ <http://www.yorkshirepost.co.uk/floods/Flood-defences-pass-first-real.2988671.jp>

Malton & Pickering Mercury 18th July 2007 ⁹

New plea on flood defences

Ryedale Council is on the warpath in the battle to bring long-mooted flood defences to Pickering. It is to lobby Government ministers and agencies – alongside Ryedale MP John Greenway – in order to get the £6.4 million defences built.

“Preventable measures” to clear debris and silt from rivers, drains, gutters and dykes will also be looked at by council officers.

Cllr Howard Keal, described the Pickering floods as “predictable, preventable and shameful” at the full council meeting on Thursday.

He said: “It’s shameful that £700,000 has been invested in a viable scheme for Pickering. That was more than five years ago and they could have and should have been built. If that had happened we would not have had flood water rampaging through the town.

“The Government gambled. It gambled with people’s livelihoods and people’s homes and the people that lost were the people of Pickering.”

Cllr Keal said the defences were a “quick win” and deliverable as opposed to the years it would take to help other affected areas across the country.

“We need action. We need it now. We don’t need excuses,” he added.

Cllr Keith Knaggs called for a “co-ordinated follow-up” to complement the “indignation solution” of a petition launched by Cllr Keal.

He suggested the council writes to the Environment Agency and Yorkshire Forward and speaks to floods minister John Healey, who was educated at Lady Lumley’s School.

It was also revealed that flood defences would be on the agenda as part of a wider meeting with the head of Yorkshire Forward as well as in discussions with Mr Greenway and Vale of York MP Anne McIntosh, the shadow floods minister.

Cllr Knaggs suggested council officers look at preventable measures by cleaning drains, gulleys and sewers which, he believes, aided flood water in Normanby, Pickering and Thornton-le-Clay.

But Cllr John Clark said the council should pursue a clean-up before trying to secure flood defences.

He said: “If that doesn’t work then we start spending millions on flood defences. But to spend millions on flood defences when Pickering Beck has nowhere to go – there’s no logic to it.”

The majority of the council supported the proposals of Cllrs Keal and Knaggs to urge the Government to pay for flood defences in Pickering and to look at a clean-up.

Cllr Clark voted against the motion and Cllr Tommy Woodward abstained.

⁹ <http://www.maltonmercury.co.uk/2393/New-pleaon-flooddefences.3036490.jp>

The Yorkshire Post, 1st August 2007 ¹⁰

Flooding anger boils over at meeting

By Robert Sutcliffe

ANGRY flood protesters "ambushed" up to a dozen Environment Agency officials yesterday to demand immediate action to safeguard their town. The residents are upset that in spite of £750,000 being spent on drawing up a scheme for flood protection in the North Yorkshire market town of Pickering five years ago nothing has been done. Members of the Pickering Flood Defence Group briefly sandbagged the entrance to the memorial hall where officials were due to hold a surgery for residents. Floods defence campaigner Howard Keal said it was an outrage that Pickering had been flooded six times since 1999 but no action had been taken. Last year the Yorkshire Post revealed that the Environment Agency had been forced to abandon many flood prevention projects because of a lack of funds. As well as a £6.7m scheme to protect 50 properties in Pickering, an £11.7m project for Ripon which was designed to protect 600 homes and businesses was also shelved. Mr Keal said: "We have taken the opportunity today to bring home the message that it is not enough to come here and have a chat.

"While it's welcome that they are looking at improving things, it doesn't stop the flooding.

"When it came this time it was in the middle of the night on June 25 and caused damage upwards of £2m to 70 properties. People are absolutely desperate to see an end to the fear that has come into their lives. This scheme has been on the cards for five years and yet nothing has been done and that's a scandal. I am absolutely sick of hearing platitudes from the Government about how much is being spent on anti-flooding measures. They knew it was going to happen and have failed to protect people and that's unacceptable."

Peter Croot, whose home on Beck Isle was affected by the recent flooding, said: "There were about 30 or 40 protesters. "We were chanting away but had to stop while a funeral cortege turned up from the chapel across the road so it was a bit awkward. "I think the Environment Agency officials were quite scared because there was going to be this protest." He added that Ryedale Council had pledged £1m towards the cost of the scheme but said Pickering scored only five points on the flood scale and 31 were needed.

Tory Shadow floods minister Anne McIntosh, MP for the Vale of York, has called for an independent inquiry into the causes of flooding and said it was not fair that Pickering had received nothing.

A spokeswoman for the Environment Agency said: "Officers have been here today to hear about residents' experiences of the flooding which we hope to combine with our own records and that will give us a better insight into what needs to be done in the future. "We have had quite a good turnout today. It started at lunchtime and people are still coming in and asking questions this evening. "We have done one in Ripon already and this is the second one with a number planned for South Yorkshire." She confirmed that until the Government came up with the necessary funding there could be no go-ahead for the Pickering scheme.

The operation to restore mains water to thousands of homes across Gloucestershire following flooding was in full swing last night. More than 140,000 homes were left without water after flood waters forced a water treatment centre in Tewkesbury to shut. Some 70,000 homes had been reconnected so far. Severn Trent director of customer services Martin Kane said: "We are aiming to have 80 per cent of homes back on supply within 24 hours." But the water is still not safe enough to drink. Teams are carrying out water quality tests across the network.

¹⁰ <http://www.yorkshirepost.co.uk/flooding/Flooding-anger-boils-over-at.3075269.jp>

Environment Agency's web-site about on the 2007 Pickering Floods ¹¹

Pickering

Why did the floods happen?

Pickering flooded on 25 June from surface waters and from Pickering Beck.

Where did the floods take place?

Properties in the Hungate, Beck Isle, Undercliffe and Market Place areas were severely affected by flooding. The Pickering Antiques Centre and adjacent houses were flooded. The main A170 road through Pickering was flooded which caused restrictions to parts of the town.

What did we do during the floods?

Throughout the floods we used a number of different ways to warn people of the risk of flooding from rivers. We use a combination of these methods depending on the information and systems that are available in that area. Examples of these are:

- Regular updates via the media on TV, radio and the internet.
- Floodline - information was available 24 hours a day, 7 days by calling 0845 988 1188
- Live warnings in force were detailed on our website.
- Floodline Warnings Direct - sent warnings 24 hours a day by telephone, text message, email, fax or pager. Register by calling 0845 988 1188.
- Police and others knocked on the doors.

What did we do to forecast where flooding would happen? We use the latest technology 24 hours a day to monitor rainfall, river levels and sea conditions. We can provide local area forecasts on the possibility of flooding and its likely severity. We use this information to know when to issue flood warnings.

How did we warn the public? We issued a flood warning to the Hungate and Beck Isle areas and we warned 93 people. In the whole of Pickering, 141 properties are registered to receive flood warnings this represents 43 per cent of properties in the flood warning areas.

What impact did the floods have?

How many properties were flooded? Approximately 48 properties in Pickering were flooded.

What did we communicate during and after the floods?

We had staff out and about talking to people who were affected by the floods, giving them advice about what was happening. We took part in seven media interviews to provide advice to the public. Since then we have met members of the public at two town council meetings and at a flood surgery in Pickering. We have listened to people's concerns and answered a large number of questions.

What are we doing in the future?

Following floods in 2000 and 2002 a proposals for a flood alleviation scheme for the town of Pickering were developed and put to residents in July 2003. A package of local defences defending 51 homes and 13 businesses was agreed. Unfortunately, since then the scheme has failed to win the necessary £6.7 million funding. The scheme has not ranked highly enough in Defras priority scoring system. Since the June 2007 flooding we have been working closely with Ryedale District Council and Pickering Town Council to review what other options are available to us.

The Yorkshire Regional Flood Defence Committee has allocated £50,000 of local levy money and Ryedale District Council has secured £1 million. We are now working with Ryedale District Council to investigate possible partnership/external funding initiatives and to determine the best ways to spend this money for the benefit of the Pickering community. We are in the process of reviewing and improving the flood warning service provided to Pickering. We are also working closely with the Town Council who intend to set up a flood warden scheme and develop an emergency flood plan for the town. We are also investigating the possibility of doing some minor works in the form of a relief channel in the Mill Lane area of Pickering. Details of this work are still in the development stage.

Into the future

The 2007 summer floods provided us with valuable information about areas of England and Wales at risk from flooding. Find out how we will use this new information.

¹¹ <http://www.environment-agency.gov.uk/subjects/flood/1867303/1882997/1867390/1891227/?lang= e>

APPENDIX VI - THE WORK OF THE RYEDALE FOOD RESEARCH GROUP

Membership

Ms Susan Bryant, Sinnington; Prof Stuart Lane, Durham University; Mrs Betty Grave, Pickering; Mrs Betty Hood, Pickering; Dr Catharina Landström, Oxford University; Dr Nick Odoni, Durham University; Mr Mike Potter, Pickering; Mr David Quinn, Pickering; Prof Neil Ward, University of East Anglia; Prof Sarah Whatmore, Oxford University; Mr Geoff Wright, Great Barugh; Mrs Sheila Wright, Great Barugh; One resident who prefers not to be named here.

The Group Meetings were facilitated by Sue Bradley (Newcastle University), with administrative and technical support from Gillian Willis (Oxford University). The Group met formally on 6 occasions over a twelve-month period at the Pickering Memorial Hall, complemented by several additional meetings and field visits. The formal meetings took place on the following dates: 11th September 2007; 6th November 2007; 22nd January 2008; 18th March 2008; 20th May 2008; and 8th July 2008.

The Methodology for Establishing the Group

The Project Team initially aimed to recruit five local residents, but eight residents were eventually recruited. The project was advertised in two local newspapers. Both editors proposed, and eventually published, news features on the project. Before these pieces appeared, notices were placed in shop windows, community notice boards (including in a supermarket and a doctor's surgery) and distributed through local library and museum networks. The notices, which were posted up just two weeks before the July 2007 floods, were set out as follows: *Interested in what causes flooding, or how flood risk is managed? We are a team of researchers from Oxford, Durham and Newcastle Universities conducting a one-year research project on flooding in the Derwent. We would like 5 local people to work with us. For further information about the project, and to express an interest in being involved, please write, including your contact details, to Sue Bradley, Centre for Rural Economy, Newcastle University, Newcastle upon Tyne, NE1 7RU (E-mail susan.bradley@ncl.ac.uk or telephone 0191-222-8506) by 30th June 2007.*

Sue Bradley led on recruitment, steered by the policy of the Project Team. While distributing the information she developed a network of local contacts through personal recommendations and by contacting representatives of local churches, the University of the 3rd Age, local sixth form colleges and other individuals identified via community websites.

The purpose of this 'snowballing' was two-fold. First, it helped the Project Team to disseminate information more widely (including by word of mouth) and, second, in accordance with the ethos of the project, it allowed the work to benefit from local expertise at an early stage. This initial exploration led to some lengthy conversations with individuals who gave advice on local resources, and insights into the local issues of flooding in Ryedale.

Press releases were sent to the *Gazette & Herald* and the *Malton & Pickering Mercury*. On Monday 25th June the town of Pickering and surrounding area were affected by severe flooding from Pickering Beck and the River Seven. The *Gazette & Herald* posted news of the research project on its website on the day of the flood, and printed a piece in association with a flood report the following week (4th July). The *Mercury* printed a piece about the project alongside an extensive photo montage of the flooding two days after the event (in its issue of 27th June), when it also posted a piece on its website.

Nineteen people responded to the newspaper pieces, notices and leaflets. Only two of these responded before the flooding of 25th June (and before news of the project was published in

The Ryedale Flood Research Group – *Making Space for People*

the papers). Thirteen of them expressed an interest in working with the research team. Of the rest: one sent a copy of a DVD they had made about the 1999/2000 floods in Malton and Norton; one wished to nominate members on behalf of the organisation he worked for; two wrote to let the research team have their views and concerns about flooding but clearly stated that they did not wish to participate; one responded after the closing date (when the Group had already been constituted); and another sent brief details of personal experiences of flooding without specifying whether or not they were interested in attending the meetings.

Every response was acknowledged and all who had expressed an interest in participating were contacted by telephone, except for one person who proved impossible to contact. The point of the phone-calls was to explain more about the project and to hear about each person's reasons for responding.

Thirteen respondents were met in person in Ryedale during July 2007. Each meeting lasted for at least an hour and a half, and several were longer. The aims were:

- to explain more about the aims of the university-based Project Team;
- to emphasise that participation should be in an individual rather than in a representative capacity;
- to learn about respondents' personal interests and concerns in relation to flooding;
- to understand more about local controversy surrounding flood risk management;
- to help the team come to a decision about the geographical focus of the project.

It had initially been anticipated that the geographical focus would be in and around Malton. However, in the light of these meetings, it was decided to focus on a location encompassing Pickering Beck and the River Seven, where eight respondents lived, and which had been affected by the severe flooding on 25th June. It was clear that the management of flood risk here was the subject of both concern and controversy, with urgent calls for a flood defence to be built in Pickering (a measure held to be too expensive by the Environment Agency) countered by alternative, smaller-scale suggestions from other residents and local groups.

The Work of the Group

Once the eight local members were recruited, six meetings of the Group took place between September 2007 and July 2008. Communications between meetings included letters, e-mails, phone-calls and exchanges via a password-protected website set up for the Ryedale group. Contact with Ryedale-based members varied from occasional e-mails and phone-calls to working together to produce written resources for the Ryedale Flood Research Group's website. This contact was important in terms of building the personal relationships needed for a continuing exchange – and development – of ideas.

The project website and password-protected web discussion forum were set up and run by the Project Administrator, following a suggestion from a Ryedale member at the first meeting. This provided a space to store and access resources (*e.g.* photographs and documents) produced by Group members, and as a way of sharing news and ideas, and of asking questions. Paper versions of the blogs were also posted to members at intervals.

It was envisaged that locally-based members might collect data to inform the flood modelling. This took a number of forms. First, field visits with local members allowed the Project Team to reformulate its ideas about the modelling, about where to try things, what to try, how to adapt the model to represent other processes. Second, local members were able to help the Group develop a shared understanding of flow gauge data. Third, local members spontaneously produced a wide range of data including photographs, historical records and a video illustrating the views of members about lack of maintenance of local watercourses, which both informed the modelling and generated further discussion in the Group. The

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widespread concern in the Group about the lack of maintenance made it critical to undertake modelling of floodplain flow. Systematic photographs were taken by a local member and these were then used with a “Manning’s N” picture book to identify the possible roughness values for stretches of river for the hydraulic model. In fact, so much material was collected that it proved impossible to give it adequate attention within the main meetings. In response, one member suggested an extra meeting to be devoted to sharing the data gathered by Ryedale members, and hosted it at his home.

Between the fourth and fifth main meeting an additional ‘reading group’ meeting was held with the aim of making official flood-related documents more accessible. This focussed on two recent reports into flooding in Ryedale: The Pickering Flood Alleviation Scheme Options Report (2003) produced for the Environment Agency by the Babbie consultancy group; and the Environment Agency’s Derwent Catchment Management Plan (2007). A key point in the discussion was how local members could bring their knowledge of flooding to the interpretation of these reports and then use their understandings to be in a better position to engage with statutory officials.

In the period between main meetings, Sue met each member individually to hear how they had found the previous meeting and note suggestions for next time (*e.g.* suggestions for how meetings might be organised differently). These individual meetings also served the purpose of maintaining a space where views might be expressed without the collective pressures associated with a group event. Feedback reports based on these meetings informed the Project Team’s approach to the subsequent main meeting.

All meetings were held on Tuesday evenings in Pickering Memorial Hall. They were originally scheduled to be between 7.00pm and 9.00pm. In response to feedback following the first, subsequent meetings were extended so they started at 6.30pm and ended at 9.30pm. In practice, people arrived earlier and the agendas were so packed that meetings over-ran. All the university-based members attended every meeting, as did all Ryedale members except two, who had work or family commitments on particular evenings. Membership remained constant throughout the 12-month period of the six main meetings and ancillary meetings. The contents of the meetings are set out below.

First Meeting (11th September 2007)

- Welcome and introductions
- Discussions in pairs for people to talk about their personal interest in flooding
- Introduction to project work-packages
- The arrangements for recording the meetings
- Working in small groups with brought objects
- Round-table discussion of the history of flooding in Ryedale
- Ideas for future working

Second Meeting (6th November 2007)

- Feedback
- Naming the group
- Working with maps
- Flooding and modeling
- Brought materials
- Data-gathering

Third Meeting (22nd January 2008)

- Feedback
- Modelling flooding
- Data-gathering
- Trying things out in the landscape
- What to produce?

Fourth Meeting (18th March 2008)

- Newsround and brought materials
- Institutional and policy developments
- Video presentation on river maintenance
- Planning future work (reading group; examining materials)

Fifth Meeting (20th May 2008)

- Newsround and brought materials
- Planning the group's outputs
- Computer modeling and applying Manning's N
- Planning future work

Sixth Meeting (8th July 2008)

- Newsround and brought materials
- Reflecting on the group's way of working
- Going public
- Drafting *Making Space for People*
- Planning the October event

APPENDIX VII - ACKNOWLEDGEMENTS

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... and all those people in Ryedale who gave of their time to be interviewed for the project.