Flood Hazard Management in England and Wales: From Land Drainage to Flood Risk Management

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Synopsis

Flooding is a major natural hazard in the UK. Government policies towards flood hazard management have changed radically over the last 50 years both as a result of reactive responses to major flood events and incrementally in response to influences external to the flood defence policy field.

INTRODUCTION

Flooding is a major natural hazard in the UK. Currently about 1.85 million homes, 185,000 commercial properties and approximately 5 million people are estimated to be at risk from flooding in England and Wales (Environment Agency, 2001). Five per cent of England's population lives in the 2,200km² of land most at risk from flooding by the sea, while 10,000 km² is threatened by flooding from rivers. In all, about 10 to 15 per cent of urban areas and about half the best agricultural land is at risk.

Flooding in the UK is mild by global standards. Major lowland rivers such as the Severn and Thames rise relatively slowly and recede quickly, allowing time for both warning and response. There are, however, urban and upland rivers that respond more quickly and coastal flooding presents a special threat to lives and property. With the exception of flooding in Lynmouth, Devon, in 1952 and the east coasts floods of 1953, floods have directly claimed few lives in the UK since the turn of the century. There is, however, growing evidence that UK floods have long-term effects on the psychological health of their victims and, as elsewhere, cause much distress and disruption to lives and livelihoods.

Since 1945, successive UK governments, and the responsible agencies, have developed and implemented policies and programmes of investment to mitigate against the effects of flooding. Our research focuses on the way in which UK policy towards flood hazard management has changed over the past 50 years. This, as we argue in full elsewhere (Johnson et al, 2003), has resulted from two important processes: incremental and catalytic change. Firstly, we show the gradual evolution of policy over the last half-century as a process of incremental change. Secondly, we demonstrate how policy changes have partly been the result of reactive responses to major flood events, which have acted as catalysts for accelerating the rate of policy change, or for fundamental changes in policy. Thus, the gradual evolution of policy has been punctuated by events that have offered a 'window of opportunity' for policy change.

INCREMENTAL CHANGE

Policies for the management of rivers, coasts and flood plains in the post war period have evolved as a result of gradual changes in factors such as social and economic conditions, organisations, institutions, political context, technology, information and knowledge. At the same time, slowly developing changes in the underlying values, beliefs, attitudes and behavioural norms of key actors in the policy field exert a significant influence on this incremental change. In the flood hazard context, three phases of change, each characterised by terms commonly used at the time to describe the main policy approach, can be identified over the last 50 years: 'land drainage', 'flood defence' and most recently 'flood risk management'. Characteristically, each of these phases can then be associated with the

differential emphasis placed on, attitudes towards and beliefs in:

- structural flood defences;
- flood warning systems and public awareness raising;
- land use planning and development control for flood risk areas.

Land drainage

In the decades following the second world war, through to the late 1970s, the focus of river and coastal management was on rural land drainage and flood defence. The aim of which was to increase agricultural productivity and self-sufficiency in food production and to protect farm profitability, as much as it was on flood defence to protect urban assets. The economic and social context was influenced by the experience of war. Domestic food production and self-sufficiency had been crucial to the survival of the country during the war, and remained major policy objectives well into the post-war period. As late as 1977, the policy of the Ministry of Agriculture supported land drainage to increase the availability of productive land and the Ministry estimated that 2.6 million hectares (6.4 million acres) of agricultural land in England and Wales remained in need of drainage. In 1980-81, the ratio of expenditure on agricultural and urban drainage improvement was still approximately 40:60 for England and Wales. In keeping with the societal values and engineering orthodoxy of the time, structural solutions and 'hard engineering' schemes dominated with little regard for the environmental impact. Rivers were dredged, straightened and channelised, and coastal and riverine wetlands were drained in land drainage and 'river improvement' schemes designed to take water away as fast as possible. Flood and drainage problems were addressed on a piecemeal site-by-site basis rather than in a strategic and holistic way.

Flood forecasting and flood warning systems were, at the beginning and through much of the period, rudimentary. Systems for the dissemination of warnings to the public were very variable across the country and highly localised. Following serious flooding in 1968, a conference was convened by the Ministry of Agriculture and the first moves were made towards a national flood warning system. However, the science and technology to support more sophisticated forecasting and warning systems were lacking at the beginning of the period and developed only gradually over time. Warning dissemination was the responsibility of the police and local authorities and generally depended upon the police knocking on doors or alerting people with loudhailers, local flood wardens, and devices such as wartime warning sirens. At the beginning of the period, there were only three national radio programmes and no use was made of the broadcast media to disseminate warnings.

From the inception of the current planning system in the Town and Country Planning Act 1947, the need to address the issue of development in flood risk areas has been recognised in central government circulars issued in 1947, 1962, 1969 and 1982, providing evidence of gradual incremental change towards firmer guidance on development and flood risk over the years. However, land use planning and development control as initiated under the 1947 Act, have remained a zealously guarded local authority responsibility and these authorities have varied greatly in the attention that they have paid to the issue of flood risk. As a result, much development has taken place in riverine and coastal flood plains even in areas where flooding has occurred since 1945, building up the damage potential and threat to life posed by floods.

Flood defence

The 1980s into the 1990s was a period of transition in which there was a gradual shift away from agricultural land drainage towards urban flood defence. This reflected the decline in the importance attached to the agricultural sector in the British economy. The UK had joined the EEC in 1972 and the

overproduction of food in Europe under the Common Agricultural Policy became a major concern. Furthermore, the country increasingly had access to a global market, importing food from across the world. In the winter of 1984-5, the Government announced a cut in the annual grant for land drainage and stipulated that the emphasis should in future be on urban flood protection rather than improvement for agriculture. This process culminated in the strategy set out by the Government in 1993 in which rural drainage and flood defence schemes were accorded the lowest priority for grant aid.

From the 1980s, increased access to computing facilities, and developments in mathematical modelling and mapping created powerful new tools for flood management, greatly enhancing knowledge and understanding of flood problems. At the same time, changing societal values, growing public awareness of environmental issues and concern about habitat and wildlife loss, particularly that associated with land drainage and flood defence, lead to increasing recognition of the need to take these matters into account in the design of flood alleviation schemes and to growing interest in 'soft engineering' approaches. This was reflected in the Land Drainage Improvement Works (Assessment of Environmental Effects) Regulations 1988 which placed an obligation on drainage bodies in England and Wales to decide whether proposed works were likely to have significant environmental effects. When a new national body with flood defence responsibilities, the National Rivers Authority, was created in 1989, it was given enhanced conservation duties. Clear government guidance on integrating environmental and engineering aspects of flood defence works was published in 1992. Throughout the period, structural flood defences continued to be the main focus of activity and expenditure and little attention was paid to the development of flood warning systems and to land use planning and development control issues.

Flood risk management

From the mid-1990s onwards, there has been a gradual transition towards a more strategic, multi-method, and integrated approach to land and water management: a flood risk management approach. This moves away from the traditional focus on defending against floods to a focus on managing the flood risks in terms of both probabilities and consequences. Under this approach, to manage flood risks, decision-makers must account for changes and trends, in both the short and long-term, across catchments, functions and institutional boundaries. Flood risk management is then the decision-making process which seeks to manage the reaction of the system to external perturbations, recognising in particular that not all floods can be prevented, thus the focus broadens from one focused on flood defence to one focused on the combination of:

- Flood abatement: the prevention of flood waves, e.g. through reforestation;
- Flood control: the prevention of floods, e.g. through embankments; and
- Flood alleviation: the reduction of flood impacts, e.g. through land use regulation (de Bruijn et al, 2003).

Thus, there is less emphasis on structural flood defences designed to prevent floods and more emphasis on measures to reduce flood waves and improve flood alleviation. This is evident in the increased attention afforded to flood warnings, which were accorded the highest priority by MAFF in 1993, and the priority placed on flood warnings by the Environment Agency in recent years. In addition, as illustrated recently, there is an increased emphasis on public flood awareness raising, self-help, land-use planning and development control, exemplified by Government guidance on development and flood risk: Planning Policy Guidance 25.

During this period, the Government's adoption of sustainable development as a

guiding principle for policy meant that social, economic and, particularly, environmental issues had to be taken into account in river, coastal and land management. European Union legislation, for example, the EC Habitats Directive 1992, also was influential. At the same time, changes in knowledge and understanding, for example, of climate change, and the development of 'soft' and bio-engineering techniques encouraged approaches to flood defence that sought to work 'with' nature rather than 'against' it, including beach nourishment, river and flood plain restoration and managed realignment on rivers and coasts.

This shift towards a strategic and holistic approach to catchment management based on an ecosystems perspective is now central to policy. This 'new' thinking is demonstrated in the Environment Agency's (2003) 'new strategy for flood risk management' 2003-2008 which, whilst, in part a 'rebranding' exercise, will have a very profound impact on policy, in fundamentally altering the focus of government investment towards a more risk-based approach.

CATALYTIC CHANGE

In addition to these incremental changes, national flood events, that is flood events of more than regional significance that are recognised by the government as such, create a 'window of opportunity' for catalytic policy change: accelerated changes or changes that take policy in new directions. We have identified the flood events of 1947, 1953, 1998 and 2000 as events that acted as such catalysts for policy change.

The 1947 riverine floods

The 1947 flood occurred at a time of rapid political, social and economic change. Most significant of which was the emergence of the nation from the Second World War, the global economic recession, world food shortages and the dollar crisis. The national economy was under significant economic stress, was dependent on domestic agricultural production for food consumption and was facing a serious fuel and power crisis as a result, in part, of the harsh winter which immediately preceded the flood.

The cause of the 1947 flood can be attributed to three main factors: snow, ice and rain. Heavy snowfalls were followed by a deep depression bringing with it rain and increased temperatures. This lead to rapid snow-melt which, in combination with the frozen ground, resulted in the flooding of 690,000 acres of agricultural land and thousands of homes, businesses and industries. This flood has long been seen as a benchmark, unique in its extent, volume, persistence and impacts, probably the worst flood the country had ever experienced and certainly the worst for many centuries (Barker, 1948).

It was, however, on domestic food production that the impact was most severely felt which naturally translated into a primary focus on agriculture-related policy outcomes, at a time when the land drainage orthodoxy was dominant. In addition, the war context meant that the Catchment Boards, whose responsibility it was under the 1930 Land Drainage Act to implement flood prevention measures, had been prevented from doing so due to shortages in labour, material and financial resources. Therefore, at the time of the flood, many Catchment Boards had been unable to carry out anything other than the most urgent repairs to defence structures and assets.

In addition, the reliance by the government on the information provided by the chief engineers of the various Catchment Boards, as the mechanism for formulating long-term policy, fundamentally influenced the structural and engineered nature of the policy changes which the 1947 catalysed. It also influenced the relationship between the government and these Boards by providing the government with the necessary platform to encourage the Boards to increase their investment in flood protection measures.

For their part, the government was keen to see that many of the river 'improvement' schemes put forward by the Catchment Boards were pressed forward as a matter of urgency. It was, therefore, towards the increased investment in, and construction of, flood prevention measures along many of the main rivers in England and Wales to which policy was focused. Here, the River Great Ouse Flood Prevention Scheme, which required a special Act of Parliament to initiate, is illustrative of the scale of investment considered, with this capital intensive scheme (£6.5m in 1947) attracting a special government grant of 90 per cent of the cost, 15 per cent above normal.

In short, therefore, the land drainage orthodoxy of the time meant that the primary policy impact of the 1947 flood, the expediency of structural flood prevention measures, was primarily focused on the protection of agricultural land with urban defence accorded secondary priority. This naturally resulted in limited attention to development control issues and flood warning procedures in areas other than a small number of urban areas, most notably along the river's Thames and Lee.

The 1953 East Coast Floods

The 1953 flood was a unique flood event in recent history in its nature, severity and impact. Its fundamental cause was meteorological with an exceptional and widespread northerly gale, which developed in the North Sea and spread southwards down the eastern coast of Scotland and England towards the Dutch coast. This gale resulted in significant rises in sea levels coinciding with spring tides. The storm surge caused overtopping and breaching throughout the eastern seaboard from the Humber in the North to the Thames estuary in the South on the 31st January and 1st February 1953. Whilst not the greatest surge on record, this was, and remains, the greatest flood in recent British history.

The impact of the flood was immense by UK standards. Along the 1,370 miles of defences, there were 1,200 breaches, more than 300 people lost their lives, 160,000 acres of farmland was inundated, 24,000 houses were flooded and 32,000 people were evacuated from their homes.

A departmental committee was set up, under the chairmanship of Lord Waverley, to examine:

- the causes of the flood;
- the possibilities of recurrence;
- the margin of safety for sea defences;
- the measures necessary for improvements in flood warnings; and,
- to review the institutional and financial arrangements of the various bodies concerned with coastal defence (Waverley, 1954).

As a result of their investigations, the Waverley committee proposed certain policy changes as a direct result of the 1953 flood. First, and foremost of which was the recognition of the need to implement both an emergency and longer-term flood warning system. This lead to the development of an emergency system between April and September of the same year, a significant investment in research, the greater involvement of the Meteorological Office and, ultimately, to the development of the Storm Tide Warning System. These were not policy issues regarded as important before the flood.

Secondly, whilst the report was unable to determine the probability of flood recurrence, it did recommend that flood defence standards should be raised to the level of the 1953 flood in areas of high property value and agricultural importance. As a result, the flood lead to an increase in the rate of policy change directed towards the raising and strengthening of flood defences throughout the eastern seaboard. This margin of safety was to become the predetermined standard of protection for coastal defence structures, where economically justifiable.

Finally, the 1953 flood lead to particular attention being focused on the flood defence

structures operating in the London estuary. Given the importance of this region, and the potential risk to which it was exposed, there was deemed to be a narrow margin of protection offered. This resulted in the implementation of the Thames Barrier some 30 years later.

The 1998 Easter flood

The widespread riverine flooding of Easter 1998, affecting locations in a 5,000km² band across the middle of England and into Wales, occurred after a long period in which no major flood events had taken place. The public, and to some degree, the authorities, had become complacent about flooding and were taken by surprise by the event caused by unusually intense and prolonged rainfall on already saturated catchments (Bye and Horner, 1998).

A new government had come to power in 1997 and the newly created Environment Agency was preoccupied with its new responsibilities for waste management and pollution control. Although the Agency had assumed responsibility for flood warning dissemination in September 1996, it had had little time to make an impact on the fragmented warning arrangements it inherited. Few of those flooded received any warning and the performance of the Agency was severely criticised by the public and M.P.s who called for a Judicial Inquiry. In response, the Environment Agency set up an independent review of their performance lead by two respected individuals, Peter Bye, a former local authority chief executive, and Michael Horner, the director of an engineering constancy.

The flood event highlighted the need to plan for, and manage, all flood events including extreme events, which may become more common in the UK with climate change. It also demonstrated that it would not be possible to deal with all potential flood risks through structural flood defences. It, thus, gave added impetus to the transition towards a risk management approach to flooding. The Independent Review Team's report, the Bye report (Bye and Horner, 1998), emphasised the human impacts of flooding and the need to give greater attention to the human and social aspects of warning systems and messages. This, it can be argued, had a significant and broad effect on the balance between technical and social issues in research, staffing, policy and its implementation within the Environment Agency with greater emphasis given to social issues.

The flood event had a specific policy outcome in terms of the flood warning system and public awareness raising through the Bye Report, its acceptance by central government and the Environment Agency and its implementation by the Agency through its Action Plan. The Bye report called for consistent national standards in the flood warning system and for an extension of some form of warning arrangements to cover areas not at high risk. It lead directly to the development of a new, national, and clearly defined four level system of flood warning codes with associated behavioural advice. A telephone message service, FloodLine, providing regularly updated information on flooding and flood warnings was established. The codes and the FloodLine number are now used by the broadcast media in their weather reports. The Bye report also contributed to the initiation in 1999 of annual autumn flood warning campaigns, using national media advertising, as well as local information campaigns. These have, generally, had the effect, over the past five years, of raising and maintaining awareness of flooding and flood risk, of the Agency as the body for flood defence, of the flood warning system and of the appropriate response to floods.

A further outcome of the flood event and the Bye report was a review of the Automatic Voice Messaging (AVM) system, which the Agency had seen in 1996 as its main means of delivering warnings directly to the public. The flood demonstrated that the capacity of this locally based telephone message system would be inadequate to cope with a major

flood event such as that of 1998. The Agency, therefore, initiated a project to develop and implement a Multi Media Warning Dissemination Service, which would have the capacity to deliver a much larger number of warning messages using a wider range of communication channels including the telephone, internet, e-mail and mobile phone and text messages. This project is due to deliver in 2004. Reliance upon technological solutions for warning dissemination does raise questions as to the access to, and acceptability of, new technologies particularly for disadvantaged groups and those with disabilities. These are being explored in Agency research.

The autumn 2000 floods

The events of 1998 and 2000 had a cumulative effect on policy. The more widespread flooding of autumn 2000, which affected over 700 locations in all regions in England and Wales and a total of 10,000 properties, was the cumulative result of rainfall unprecedented during the previous 270 years. It served to reinforce the view that it was essential to plan for extreme events which might occur as a result of climate change. The Deputy Prime Minister characterised the event as a 'Wake up call' to Britain. The much-improved performance in 2000 of the newly enhanced flood warning system reassured government that this issue in flood risk management was being addressed. The issue of new buildings in flood plains, themselves at risk from flooding or giving rise to risks elsewhere had been raised after the 1998 flood event. The government agreed to review its existing advice to local planning authorities on development and flood risk. It had had no plans to do this prior to the 1998 flood.

When the serious floods occurred in autumn 2000, the government decided to look again at the guidance it was in the process of producing in the light of the floods and to strengthen and toughen the message it contained. The government, when it issued the newly revised guidance for consultation, indicated that it was looking for a 'step change' in the responsiveness of the land-use planning system to the issue of flood risk management.

The final guidance, Planning Policy Guidance 25, issued in July 2001 (DLTR, 2001), was a direct outcome of the autumn 2000 floods and introduced a different and much more rigorous risk-based approach towards development and flood risk. It embodied the precautionary principle and required an appropriate flood risk assessment for all development plans and proposals, where there was any flood risk on site or that might be generated elsewhere. It proposed a sequential test that should be applied, giving priority to those areas that presented little or no risk over those with low to medium or higher risk. It also differentiated between developed and undeveloped, defended and undefended high risk areas, and indicated that the standard of protection and life of flood defences and the type of development proposed should be taken into account in decisions on development. It also stated that development in 'functional flood plains should be wholly exceptional'. The government indicated its intention to monitor implementation and to review the policy in 2004 to encourage compliance by local planning authorities. Thus, the guidance reflected the recognition of the importance of the land-use planning system to the flood risk management approach. This is indicated in the advice to the land-use planning authorities to guide development away from areas of flood risk and thus avoid the need for structural flood defences. Likewise, the document recognises how flood plains could be maintained and indeed restored through washland creation and managed realignment to fulfil their natural functions.

CONCLUSIONS

Throughout this paper we have sought to demonstrate the transition of flood policy over time as a process of incremental and catalytic change. We argue that it is the underlying contextual factors in combination with the values, norms, beliefs and attitudes in society generally, and in the policy field in

particular, which determines incremental changes in the orthodoxy towards flood hazard management. In the UK, we illustrated three such periods in the post-war era.

Superimposed on this, we argue that flood events of national significance offer important 'windows of opportunity' to change the rate, and even the direction, of policy towards flood hazard management. However, it is recognised that these policy options are dictated as much by the context and orthodoxy in-situ at the time of the flood, as it is by the nature of the crisis itself. Here, for example, the only new idea to emerge as a direct result of the floods presented was the Storm Tide Warning System after the 1953 flood. In the other case studies, the flood provided the opportunity to expedite the rate of policy change from ideas already in circulation.

By documenting this change, it is possible that countries other than the UK can learn from this case study of policy change and avoid many of the mistakes made. Taking this argument further, the UK case study demonstrates the importance of implementing mechanisms that address all aspects of flood risk management, rather than taking a flood defence or land drainage approach. Fundamental to the former is the recognition of the importance of the human impacts of flooding, the need for public awareness, good warning systems and the importance of individual and community response as well as the more traditional focus on flood defences.

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REFERENCES

Barker, D. 1948 *Harvest Home: The official story of the great floods of 1947 and their sequel*. HMSO, London.

de Bruijn, K., Green, C., Johnson, C. and McFadden, L. 2003 Evolving concepts in flood risk management: searching for a common language. Paper submitted to *Natural Hazards*.

Bye, P. and Horner, M. 1998 ***Easter Floods 1998: Volume 1.*** Report by the independent team to the Board of the Environment Agency. Environment Agency, Bristol.

DTLR 2001 *Planning policy guidance note 25, development and flood risk* DTLR, London.

Environment Agency 2001 *Lessons Learned: the autumn 2000 floods,* Environment Agency, Bristol.

Environment Agency 2003 *Strategy for flood risk management (2003/4 - 2007/8), version 1.2* Environment Agency, Bristol.

Johnson, C.L. Tunstall, S.M.and Penning-Rowsell, E.C. 2003 A model of incremental and catalytic policy change: from land drainage to flood risk management. Paper submitted to the *Transactions of the Institute of British Geographers*.

MAFF/Welsh Office 1993 *Strategy for flood and coastal defence* MAFF, London.

Penning-Rowsell E C and Tunstall S M 1996 Risks and resources: defining and managing the floodplain in **Anderson M G Walling D E and Bates P D** eds. *Floodplain processes* John Wiley and Sons, Chichester 494-533.

Waverley, J.V. 1954 *Report of the Departmental Committee on Coastal Floodin*g. HMSO, London.