Select Committee on Environment, Food and Rural Affairs Written Evidence

Memorandum submitted by Professor Donald Knight (FL 85)

Comments on the recent floods (Summer, 2007)

1. INTRODUCTION

We have been here before—Thames (1947), Lynmouth (1952), Severn (1990), Leamington (1988), UK wide (2000), Boscastle (2004), Carlisle (2005) and today (2007). And that ignores all the coastal flooding events in the UK and numerous events overseas. So it's not new. I offer here a few comments on issues that you will not often hear about via the media, but which are drawn from my personal experience of working on certain aspects floods for many years. I will avoid detailed technical issues, which of course I can explain, but references are provided for those interested in such matters.

I would remind you that however distressing the consequences of flooding are here in the UK, our problems are mild compared with those in other countries (e.g. Bangladesh, China, USA, Mozambique, etc.). Of all the natural catastrophes that can occur (earthquakes, storm, flood, etc.), floods are still the biggest killer in the world, especially so in Asia. However, even in the developed world, and notably in Europe, we have seen devastating floods in the last decade, some in part due to climate change. The articles on "*Floods—are we prepared*" (Knight *et al*., 2006) and "*Examples of recent floods in Europe*" (Knight & Samuels, 2007) illustrate this. The journal in which these two papers appear (see references) indicates how much more prepared the Japanese are in their forward thinking about policy and practice for all types of disaster, in funding R&D institutes and in public awareness campaigns.

So as far as the UK is concerned I suggest you look back at the ICE presidential commission report "*Learning to live with rivers*" (November, 2001), which reviewed the technical aspects of flood risk management in England and Wales, following the widespread flooding in Autumn 2000, the wettest Autumn period in the UK for 270 years. The report was later published as a book, under the title of "*Flood risk management*" (Fleming, 2001). More recently, I had the opportunity to bring together many European experts and researchers to run an Advanced Study Courses for the European Commission of flooding issues. The series of lectures were later published as a 607 page book in 2006, under the title "*River basin modelling for flood risk mitigation*" (Knight & Shamseldin, 2006). So, as I say, it's not new, and is familiar territory for river engineers like myself and other professional colleagues. If you read our conclusions in the ICE 2001 report you will find many aspects that are as relevant today as they were then, and indeed, many recommendations that have still not been addressed. Having said that, the recent rainfall in June and July this year has been exceptionally severe.

2. GOVERNMENT

I do not wish to be unduly critical, but as an academic it is my job to offer advice and comment, especially on technical issues within my province. I leave it to the politicians to act or not—it is their prerogative. So I begin with two comments on the role of government and the part played by the Department for Environment, Food and Rural Affairs (defra), as that government department controls the Environment Agency (EA), sets policy and is therefore important.

(i) It is inexcusable that a few years ago defra abolished the post of Chief Engineer. We have a very able chief scientist to the government, Sir David King, who led the Foresight programme (2003) on flooding. But however good that programme was, it was looking at long-term issues and hence not particularly focused on the "here and now" practical issues. I suggest we must have engineers in charge of technical issues related to engineering. The last chief engineer at Defra, Reg Purnell, was an outstanding leader whose expertise and political acumen we miss. We see how inter-related many flood issues are—affecting infrastructure, water supply, power generation and transport. Floods are pre-eminently about the built environment, which Civil Engineers have all the necessary expertise to deal with. Engineers use the best science available, but add to that their own experience of what has been done in the past and the art of the possible. Within Government, it is astonishing that we have chief scientists for food safety, veterinary practice, pharmacy, science, etc. but not one for "engineering". Perhaps this is why successive UK governments have been so timid and lacklustre about major engineering projects—high speed rail links, nuclear energy, tidal barrage on Severn estuary, etc., to name but a few.

(ii) The lack of adequate funding to do the job properly in a changing environment is another clear failure of government. Having been an advisor on fluvial processes to defra for 6 years (1999-2005), one always expects to see some proposals ignored, advice not taken and written reports collect dust, but to have the majority suffer that fate is frustrating. At the final plenary meeting of all the Theme Advisory Group (TAG) members in July 2005, there was considerable disquiet at the lack of investment in both R&D on flood risk management and at the projected expenditure levels on the constructions and maintenance of capital flood defences. A figure of at least £1 billion was suggested for the latter. Although expenditure on capital works has increased from around £300 million to £500 million over a decade, and Hilary Benn has this week announced a further increase to maybe around £700 million, it is still not enough. These large sums need to be set in the context of the £2.5 billion cost to insurers in these last two months alone, and the value of national infrastructure assets at risk from flooding in the UK, estimated to be of the order of £300 billion. It was deplorable that in 2006 defra actually reduced expenditure by £15 million on the vital modelling work done by engineering framework consultants on flood risk planning, in order to meet a shortfall of cash arising from the needs of the farming community, due to defra's own poor administration and lack of foresight. The lack of funding, both for the maintenance of capital works, R&D and strategic consultancy work must be laid at the government, not the EA, but this is not to say that the EA has no shortcomings.

3. THE ENVIRONMENT AGENCY (EA)

(i) I suggest the EA has some serious strategic weaknesses in its management and policy. Despite perpetual re-organization, the EA is a top-heavy organization with a poor science base, especially to do with the hydrodynamics of rivers and floodplain processes.

(ii) Furthermore, it made a major error in the late 1990s by out-sourcing all its hydrodynamic modelling expertise to consulting engineers, referred to as the "framework consultants". Although it is sensible to have a team of experts outside the agency, tied in for the long-term rather than for ad-hoc consultancies for particular schemes, never-the-less it is inappropriate for the EA to have no effective internal expertise left at all. In 2001 we debated about whether the management of flooding within the UK should be taken away from the EA and given instead to the Met Office, mainly on the grounds that the latter has a better science base and also on the grounds that this might bring meteorological, hydrological and

hydrodynamic modelling together, which in some cases is desirable. We decided not to recommend this, but it is noticeable that the EA is hardly visible at scientific meetings or via publications in learned society journals. It is hardly ever present at international conferences presenting the results of hydrodynamic model results, which are at the heart of flood risk mapping and management. It has disbanded all its modelling teams and lost most, if not all, of its expertise in this strategic area.

(iii) This brings me to a third comment about the EA. It is water level that is of crucial significance in flooding, albeit driven by discharge via precipitation. The prediction of the stage-discharge relationship is not necessarily as straightforward as most people expect (see references). Some theoretical aspects related to estimating the H v Q relationships for overbank flows and extreme flood events are complex. Consequently much of the data collected by the EA for high flows at gauging stations that are outflanked or inadequately designed is surprisingly high. Consequently, the Flood Estimation Handbook (FEH), and later revised derivatives, contains spurious data on which return periods are estimated. In addition, most mathematical models require good quality data (not just HvQ) for calibration purposes. Nearly every single project I have ever been involved with for the framework consultants over many years indicated some sort of errors in gauging station data. Unless the EA uses models intimately, it never understands fully the poor quality of much of their own data, the poor spatial and temporal coverage, and the inadequacy of it for really developing mathematical models to a higher level. Too many flood risk maps, derived from such models, are inadequately calibrated and are of poor quality. For the last two Summers, supervising MSc students working separately for Halcrow and Peter Brett Associates (pba) problems with data became glaringly obvious yet again.

The FEH was sponsored by one particular Research Council (NERC), without any reference to other Research Councils, such as EPSRC, and regrettably it is therefore completely biased towards hydrology and omits any consideration of hydraulics or hydrodynamics. These did at least get a brief mention in the original Flood Studies Report in the 1970s, a forerunner of the FEH. This bias in the FEH has had the effect that in flood analysis, there is an undue focus on only one half of the problem, discharge and not water level. It is now time that the EA/defra put all its hydrometric water level data onto a single CD, so that for any UK river in any catchment the water level data is systematically given to Ordnance datum along a river course. Explanatory notes should be given for every gauging station, together with complete hydraulic equations, allowing sensible extrapolation to be undertaken where necessary. Historic flood data could also be added, as well as flood outlines for particular frequencies of precipitation or run-off. This would mirror perhaps how catchment descriptors are available for all UK catchments within FEH. The idea of a Flood Plain Handbook (FPH), as a companion to the FEH, is one close to my heart. Further work is also desirable on the UK Roughness Advisor (RA) within the Conveyance Estimation System (CES), as it is crucial for accurate hydrodynamic modelling. Indeed I have proposed these things several times, and again more recently, as highlighted next.

(iv) Fourthly, the EA is under statutory control to develop and operate a hydrometric scheme for rivers in England and Wales. This largely consists of rainfall and river flow (or water level) gauges at various points in a catchment. Long term records are kept and used for frequency analysis, producing key statistics, flow duration curves, etc. Although the EA does some excellent work in this respect, it is starved of funds, does not treat its hydrometric division with the status it deserves, and has divorced many of its monitoring teams from the end-users, thus denying them the opportunity of seeing how their data are crucial in flood risk

management. For example, if the EA possessed more capability in modelling, the inadequacies of simply regressing equations through data, without any real understanding of the physical processes that produce that data would become apparent. Weir formulae are seemingly disregarded, inbank and overbank rating curves are often established with no hydraulic vision, so cannot be safely extrapolated, etc. Imaginative ways of measuring new kinds of data are also not encouraged enough. A fundamental reform of our hydrometric scheme and the use to which data are put is long overdue. More imaginative ideas on measuring water surface slope, resistance coefficients, surface velocities, video cameras at many more stations might help. I have recently put such a proposal up to the EA, but have had no response. Is this because "management" is devoid of technically perceptive enough engineers to see the significance and adequate funding for this type of work? I wrote the section in the ICE report (2001) on "the intelligent client", ie the EA, which should be re-read, as well as helping to get the EA "skills shortage" working group (2004-06) off the ground. I am also currently involved in a 3 year EPSRC sponsored research project titled, "*New approaches to estimating flood flows via surface videography and 2D & 3D modelling*", run jointly between Birmingham and Loughborough Universities, the Centre for Ecology & Hydrology at Wallingford and a Japanese University.

(v) Fifthly climate change. Defra and the EA have suggested the adoption of a precautionary rule that adds 20% to river flood flows to account for climate change up to 2115. Two recent studies by MSc students at the University of Birmingham (Bearne, 2006 and Green 2007) have shown that the basis of this rule is intellectually flawed and in practice is an underestimate, especially for urban or impermeable catchments. See Table B2, page 16, of PPS25. Comparisons were made on three UK catchments, sponsored by two leading framework consultants (Halcrow and pba) who were sceptical of the EA's advice and wanted to see for themselves how it applied in practice. One has to ask why it is that the question of the validity of this rule is first raised by two students writing their MSc dissertations. Why is the science group in the EA not engaged in such work? Again it points to lack of strategic thinking, modelling capability and awareness.

(vi) Building on floodplains. In reports like "Making space for water", in planning guidance notes (PG25) and in planning policy statements (PPS25), consideration is given to development on floodplains. Water needs to be either stored of conveyed down a river course and in times of flood it soon becomes apparent how buildings and infrastructure on floodplains limit the flow and heighten water levels. Compound channels are a useful way of maintaining ecological status and also providing extra discharge capacity when needed in times of flood. These types of channel are popular in Japan, and have been researched in the UK (eg Flood Channel Facility work at HRWallingford. See www.flowdata.bham.ac.uk). Never allowing any construction on some existing floodplains is not tenable (eg London), but serious consideration needs to be given to controlling developers better, as well as government house building programmes (eg Thames gateway). Various examples exist in the UK of how the EA's advice has been overridden by central government with regard to allowing unsuitable development of buildings. If strict power regarding planning approval is to be devolved to the EA with regard to flooding, then their modelling expertise will have to be taken to the highest level in order to produce flood risk maps that are demonstrably accurate and will not be disputed by other hydrodynamic experts in a court of law. This reinforces the points previously made about improving river and floodplain modelling within the EA.

(vii) My last comment on the EA is one that possibly illustrates the lack of hydraulics knowledge. In my last letter to Reg Purnell (27/07/05), I set out 5 issues that I thought were important concerning the new R&D arrangements. Regarding one issue I said "As you are aware, I am still somewhat concerned about the capability of some of the senior management within the Environment Agency in this respect, particularly when dealing with technical fluid flow issues. You have to look no further than the Jubilee channel as a monument to the "skills shortage" within the EA. A new £90 million channel takes only 2/3 of its design flow—how basic can you get? Especially when the EA has a new "Conveyance Estimation System", developed through a £0.5 million R&D managed programme, and then "launched" in June 2004. But it gets even worse, as, in another criticism of the EA, I have to say that the CES software is still not available to anybody within the Agency or by consultants who want it, due to EA "procedures"'.

And in a postscript, I have to add that it is still not available today, even in July 2007! This just reinforces my view that dealing with the EA is a bureaucratic nightmare. You just have to talk to any consultant and they will say the same thing. Baroness Young and Sir John Harman are both culpable in this respect and need to seriously consider their functional capabilities. The group may wish to see the whole of my letter of 27/07/05, and Reg Purnell's response, since they both deal with the important issue of R&D within defra and the ERA. I was co-author of the 2005 report "A vision concerning the hydraulics knowledge base required in river engineering and associated research needs" (Knight & Ramsbottom, 2005), for the Defra/Environment Agency Flood and Coastal Defence R&D programme.

4. PRIVATE AND PUBLIC UTILITIES

It is now widely recognized that flooding is not just pluvial or fluvial, but may be caused by poor drainage and infrastructure in inappropriate places. Thus the private sector needs to be involved, as do local government. Consideration needs to be urgently given to policy and planning regulations regarding the various parties (water and sewerage companies, like Severn-Trent), as well as the difficult technical issues related to combined surface and sub-surface modelling of water flows. Many planners and developers seem to have lost sight of certain simple principles regarding water. Some aspects of drainage are not rocket science, even though complex modelling via Infoworks and other software packages is. On this issue, the UK is in danger of not supporting software development enough at centres like HRWallingford, or in consultants and universities, where much work is done, but not at a commercial level. The private sector alone cannot support continual development of software for river engineering as it is not cost-effective in their terms. An example of this is the well respected ISIS software, now used extensively throughout the UK for flood risk mapping by the framework consultants for the EA. It was mainly developed in the private sector on a very limited budget, eked out of profits from commercial consultancies, and with little support from central government or the EA. We could be a world leader in such software, but our position is weakening, with other countries developing their own systems. The excellent work done by UK engineers, especially at HRWallingford, is shown by their leadership of the largest European collaborative R&D project known as Floodsite (website below). Our research establishments, and particularly our university laboratories, need more funding from central government, otherwise the UK will lose out further in terms of world markets and influence in this important area.

5. HOME OWNERS

The EA is not an emergency service, and the fire service and police are not paid to solve flooding problems. Home owners must not expect the government to do everything. Home owners need to take responsibility themselves, consult flood risk maps and when exchanging property ensure that solicitors understand the significance of these maps. They should consider basic drainage concepts in relation to their property, as well as PPS25, as insurance companies certainly will. The tacit "gentleman's agreement" between the UK government and the insurance companies is just about at breaking point. The UK is the only country in Europe where flood insurance is still possible to obtain. The insurance companies only agree to insure properties in the UK on the assumption that the central government puts in sufficient resources to protect against flooding. Hence the importance of the £500 million highlighted in Section 2(ii) and defra's need to increase this to where the TAG groups think it should be. Developers building on floodplains need strict control, without trivializing planning as is the danger in some of the requirements in PPS25. Projects involving the Thames Gateway scheme and the future of the Thames barrier involve some complex and politically difficult issues.

6. The Media

The media love floods, but regrettably for most of the wrong reasons. They like dramatic pictures, disaster video footage but give little analysis. The UK has some excellent research scientists and engineers, and has done some sterling work. Sadly, the scientists get more coverage than the engineers. This is one reason why a Chief Engineer should be at the heart of government to give authoritative leadership on major engineering issues. The media rarely comment on the EU Water Framework Directive, (2000) and the more recent EU Flooding Directive (2007), both of which will impinge on legal and policy issues for many years to come. Instead the media seem to like climate change issues more, which happily does at least relate to floods. As a result, the public has improved its understanding of climate issues, even if governments have been more cautious in their actions. The media needs to understand the concept of a return period in a non-stationary time series and the concept of adaptive flood risk management. In the same way, defra and the EA need to work to higher levels of flood defence, possibly taking 1 in 200 return periods and beyond as the norm, as well as contemplating and designing for those situations when flood defences are overwhelmed.

In Summary

1. Government—no Chief Engineer; lack of funding for R&D, capital works, maintenance & operational activity regarding flood schemes; policies on floodplain development are re-active rather than pro-active with respect to floods; research needed on the 20% rule in PPS25; needs to develop adaptive flood risk management policies and consider worst case scenarios; avoid the "complacency" cycle.
2. Environment Agency—lack of strategic management at technical level; poor science base with regard to river hydrodynamics; should not necessarily stop out-sourcing of modelling, but should develop internal modelling capability as well; should improve hydrometry and application of new technology, including remote sensing; consider worst case scenarios; should develop a Flood Plain Handbook (FPH) on water level data for the UK, somewhat akin to the Flood Estimation Handbook (FEH) and CDrom; develop the Roughness Advisor with suitable water surface slope data.
3. Private & public utilities—better co-ordination of flood risk management policies with defra and EAa is needed; financial penalties and inducements are needed.

4. Home owners—consult flood risk maps; use flood proofing if necessary, it is their responsibility; think about the unthinkable and how floods might affect their property.
5. The media—not very reliable and always focusing on the dramatic, visual material; media needs to be more informative and highlight the complex engineering issues involved; engineers maybe need to learn to be more media savvy.
6. Final comments—"learning to live with rivers"—are we? Perhaps we are not learning fast enough and making sufficient "space for water"? There are many websites related to flooding issues (try a few key words in Google) and the Floodsite and Peseta websites listed in Knight & Samuels (2007) are worth perusing. Three websites that I have been particularly concerned with in recent years are: www.flowdata.bham.ac.uk, www.river-conveyance.net and www.europa.eu.int/comm/environment/water/flood_risk/index.htm.