

**The Growing risks of climate change on households in England.
By David Crichton**

David Crichton is a graduate in Economics from St Andrews University and has 30 years of underwriting and claims experience in the British insurance industry, latterly at senior management level. He is the author of several books and many research papers and has advised the OECD, UN, NATO, and insurers and governments in four continents on climate change issues.

Affiliations

Please note that this paper reflects the author's personal views.

- Visiting Professor, Benfield Hazard Research Centre, University College London. This is the leading hazard research centre in Europe, specialising in natural disasters and insurance. <http://www.benfieldhrc.org/>
- Visiting Professor, Middlesex University Flood Hazard Research Centre, London, <http://www.fhrc.mdx.ac.uk/>
- Honorary Research Fellow, University of Dundee, the home of the first UNESCO water research centre in Europe and the British Flood Insurance Claims Database. <http://www.dundee.ac.uk/>
- Fellow of the Chartered Insurance Institute. <http://www.cii.co.uk/cii.aspx>

Abstract

This paper considers the problems of vulnerability to subsidence and storm damage and exposure to flooding hazards in England and identifies the roles and responsibilities of the main players. While the whole of the UK will suffer climate change impacts, this paper applies primarily to England where the impacts will be greatest due to lack of adaptation. For example, England is the only country in the UK where planning guidelines still allow new building in flood plains. Not only that but developers are still permitted to connect foul and surface water drainage to existing drainage systems even if they do not have sufficient capacity, and sustainable drainage development is still in its infancy with no robust arrangements for maintenance. As such, England makes an interesting case study for its continued failure to introduce sustainable approaches to water management, or to learn from other countries.

Key words: Climate change, Flood, Natural flood management, Sustainable development, Insurers, Insurance template, architects, land use planning, agriculture, legal developments.

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Introduction

Subsidence, flood and storm is a growing problem in England. The devastating floods of 2000 caused damage to 10,000 properties and the total cost to insurers was nearly £1billion. Climate change scientists are predicting significant changes in rainfall patterns, rapid sea level rise, higher storm surges and changes in storm tracks all of which will make some areas of the country much more exposed to hazards. The Thames Barrier will protect London against the 1,000 year flood until 2030, but it will have to be raised more often. In its first 18 years of operation it was raised twice a year on average. In the last seven years it has been raised nine times a year on average. Between its opening in 1982 and May 2007 it has been raised 103 times not including routine engineering work. Most of these events have been in recent years: in winter 2002/3 it was used on a record 14 consecutive tides to help to alleviate fluvial flooding in the Thames catchment, when flows in the Thames reached their third-highest value, a more-severe event than in Autumn 2000. By 2030, due to sea level rise and other factors, it has been estimated that it will need to be raised 30 times a year on average.

Who are the people best placed to help society to adapt to climate change impacts?

Architects

Architects will become very important players; there is much talk about sustainable building which often seems to just boil down to throwing in extra insulation and a few solar panels. For true sustainability, architects will need to learn about how to make their buildings more resilient against subsidence, storm and flood. In some areas they will need to design floating buildings as in Holland, or buildings on stilts. They will need to learn about resilient reinstatement of existing buildings after flood or storm damage. In short they will need to learn how to adapt our buildings and cities to climate change and in particular to make buildings in flood hazard areas flood proof. If they want to save energy, they need to lower the use of materials with high embedded energy content such as concrete, steel, glass or bricks. Timber is an ideal solution; it sequesters a tonne of carbon per cubic metre and is a renewable resource¹.

These subjects are not taught in architecture schools and there is only one architectural text book on the subject in the world². At the same time, building regulations do not reflect the changes in storm tracks which are predicted: the standards are much lower in the South of England for example than in the North, because historic records show most storms cross the North of the country³. Climate change may cause storm tracks to move south⁴ and even if they do not become more severe (which they may do) such storms will certainly be much more damaging as buildings in the south are less resilient and population densities are higher. When not particularly severe storms crossed the south of England in 1990 they produced 3 million insurance claims.

Planners

Planners will have an important role to play, and should start to take climate change into account. For example, subsidence will become an increasing problem in some areas⁵ and incredibly, new building is still allowed in England without proper geological risk assessments⁶. As insurers gain access to new sources of high resolution subsidence data such as PS InSAR⁷ from satellites such as ERS2, ENVISAT and RADARSAT, these areas will become increasingly blighted⁸.

Drainage is a huge problem in England. Planners allow new developments to be connected to existing sewers even if they are overloaded⁹. In one city where 10,000 houses were recently

¹ "Food for thought" pp56-62. Architecture Today Issue 174, January 2007. ISSN 0958 6407

² Roaf, S. Crichton, D., and Nicol, F., 2005 "Adapting Buildings and Cities for Climate Change" Architectural Press, Oxford. ISBN 0 75065 9114.

³ In Scotland, building standards are much higher and storm damage is relatively rare. In 1993, Shetland suffered the worst wind storm on record in Europe, but property damage on land was negligible.

⁴ Dronia, H., 1991. "Zum vermehrten Auftreten extremer Tiefdruckgebiete über dem Nord-atlantik." Die Witterung in Übersee, 39(3), 27.

⁵ Brignall, A P., Gawith, M J. Orr, J L., and Harrison, P.A, 1998 "Assessing the Potential Effects of Climate Change on Clay Shrinkage – induced Land Subsidence". In Thomas E Downing, Alexander J Olsthoorn and Richard S J Tol (editors) 1998. "Climate, Change and Risk" (ISBN 0 415 1703 1) Routledge, London.

⁶ Such assessments are required by planners as a matter of course in Scotland when subsidence risk is suspected.

⁷ Permanent Scatterer Synthetic Aperture RADAR Interferometry

⁸ Crichton, D., 2002 "Weather Warning" Ground Engineering Journal, November 2002.

⁹ Under the Water Industry Act 1991. This is not permitted in Scotland where adequate drainage capacity must be in place before a development will be considered

flooded with raw sewage, there are allegedly 37,000 houses connected to the sewage system in excess of its design capacity. The problem is worst in London where there are now plans to build the "Tideway Tunnel" just to take overflows from London's sewers. This tunnel will be 32.2km long and more than seven metres wide, and will run up to 80 metres deep from Hammersmith in West London, to Beckton, in East London, with an additional spur tunnel (5.5km long) from Abbey Mills in Stratford to Beckton.

In the writer's experience there is still a great deal of misunderstanding about sustainable drainage systems (SUDS) amongst local authorities in England and maintenance arrangements are not satisfactory¹⁰. A 2005 survey of insurance companies¹¹ showed great concern over the haphazard way in which SUDS are being implemented in England and many insurers indicated they would not accept risks in proximity to badly designed SUDS schemes¹².

Above all there is also the issue of the flooding risk which is now well mapped thanks to a £5m investment by one insurer. It is appreciated that there are pressures on local authorities to allow many more new houses to be built to satisfy growing demand due to greater longevity, the break up of the family unit, and immigration¹³. Such demand seems set to increase, especially as climate change leads to more migration from countries ravaged by flood, drought, famine, and war.

According to the Environment Agency, at present some 5 million people, 2.3 million homes and 185,000 businesses are at risk of flooding in England and Wales, representing property, land and assets to the value of £200 billion.

This means that around 10% of houses in England are at risk of flooding¹⁴. Between 2000 and 2006, the proportion of new houses being built in such areas averaged 11%¹⁵. Planners could reduce the risk by ensuring that the architects of buildings in flood hazard areas design their buildings to be flood proof. Better still, they could refuse planning permission altogether in such areas, although the power of the developer is often hard to resist without support. England still allows development in the floodplain, even under their 2006 planning policy statement¹⁶. Scotland stopped in 1995¹⁷, Wales in 2004¹⁸, and N. Ireland in 2006¹⁹. Building in the floodplain not only puts lives at risk, it makes the flooding hazard worse downstream.

In England and Wales, in 2003, at least 21% of planning applications to which the Environment Agency issued formal objections on the grounds of flood hazard were overruled²⁰. This understates the problem because the Environment Agency was only consulted in about half of all planning applications. In 2002, some 27% by value of all new domestic residential properties in England were built in flood plain land²¹. Hopefully the growing public and media pressure on planners to act more responsibly will help to balance the influence of the developers, but planners still seem to

¹⁰ The water industry in Scotland has not been privatised and Scottish Water has a statutory duty to adopt and maintain SUDS provided they reach specified design standards.

¹¹ Crichton, D., 2005. *"Perspectives from the insurance industry"* Proceedings of the Third National Conference on Sustainable Drainage, Incorporating 27th Meeting of Standing Conference on Stormwater Source Control. 20th - 21st June 2005, at Coventry University, England.

¹² In Scotland there has been close liaison between planners and insurers on the design of SUDS through the FLAGs network.

¹³ Barker, K., 5th December 2006. *"Review of Land Use Planning"*. HM Treasury and Dept of Communities and Local Government.

¹⁴ This is a rough estimate for England only, based on Environment Agency figures and applies to the 100 year return period flood.

In Wales it is 12% for the 100 year flood (Source; Welsh Assembly).

In Scotland the figure is 3.8% for the 200 year return period flood excluding the effects of flood defences (Source; Scottish Executive).

¹⁵ House of Commons Communities and Local Government Committee November 2006. *"Planning Gain Supplement"*. The Stationery Office, London HC 1024.

¹⁶ DCLG 7 December 2006. *"Planning Policy Statement 25: Development and Flood Risk"* ISBN: 978 0 11 753974 7 Dept of Communities and Local Government, London.

¹⁷ Scottish Office, 1995. *"National Planning Policy Guidelines; 7 - Flood"* (NPPG 7), Scottish Office, Edinburgh.

¹⁸ Welsh Assembly Government, 2004. *"Technical Advice Note 15. Development and Flood Risk"*.

¹⁹ Dept of Environment N. Ireland, June 2006 PPS 15 'Planning and Flood Risk'

²⁰ The corresponding figure in Scotland from 2003 to 2006 is zero. (Scottish Parliament written answer 32242)

²¹ Lord Renton of Mount Harry, House of Lords Debate, Hansard, 18 Dec 2001 : Column 215

take insurance availability for granted, and to ignore the potential for blight if insurance is no longer available at affordable prices. A survey²² published in 2007, asked parents to name the ideal features of a good place to bring up a family. High on their list was “low risk of flooding”. (Scottish towns came first and second in the top ten.)

A recent research report²³ has highlighted some of the problems of planning in England:

- Lack of involvement by the local community and key stakeholders when forming local planning policy.
- Tendency for flood risk to be assessed and mitigated on a site by site basis, inhibiting the potential for strategic mitigation solutions.
- Difficulties balancing socio-economic and environmental priorities against flood risk concerns.
- Local planning policy on flood risk is often generic and fails to tailor national policy with local circumstances.

These problems could be addressed by establishing Scottish style “Flood Liaison and Advice Groups” (FLAGS) as recommended²⁴ by ODPM in 2004. Such groups are often set up on a catchment basis and enable planners to develop strategies in partnership with planners in adjoining councils on a catchment wide basis. They also enable discussions to take place informally with key stakeholders such as insurers, property developer representatives, environment agency staff, emergency planners, building control, land owners, academics, NGOs, British Waterways, Network Rail, and community representatives. As a result, almost all local authorities in Scotland have adopted some or all of the “insurance template”²⁵ in their planning strategies. This template sets out what levels of flood risk are insurable at normal terms and is based on the 200 year return period for housing and a 1,000 year return period for hospitals, old people’s homes and homes for the disabled etc.²⁶. FLAGS have been operating since 1993 in Scotland where they cover 94% of the population²⁷.

At no cost to the local taxpayer, they provide advice and spread best practice and the latest research findings on SUDs, flood defences, Water Framework Directive, insurance availability, flood warning dissemination, emergency planning and community relations etc. It is interesting that not a single planning authority in England and Wales has yet established a Flood Liaison and Advice Group.

Insurers

Flooding causes so much misery and trauma that it is hard to understand why local authorities in England do not show more concern. Perhaps this is because in the past, cheap insurance has been available from the private sector. For many years, the insurance industry has tried not to discriminate against people and businesses in flood hazard areas, but increasingly this means cross subsidies from the premiums paid by those in safe areas. Partly this approach was due to government pressure, and partly because insurers recognise that providing home insurance gives opportunities for cross selling other products such as life and motor insurance. 60% of customers hold multiple insurance products from the same insurer²⁸.

Mainly it was due to the fact that flood mapping was not very accurate. The result of course was that people could obtain insurance and therefore mortgages to buy houses in hazardous areas.

²² Readers Digest Poll, May 2007.

²³ White, I., Richards, J., and Carter, J., March 2007. “Flood Risk Management Policy Issues - Volume 2 – Urban” FRMRC Research Report UR8, 78pp, Manchester University

²⁴ ODPM, 2004. “The Planning Response to Climate Change” October 2004.

²⁵ Tavendale A and Black A R (2003) *Planning Practice under NPPG7: Planning and Flooding*, Scottish Planning and Environmental Law, 95, 11-13.

²⁶ Crichton, D., March 2005 “Flood risk and insurance in England and Wales: are there lessons to be learnt from Scotland?” Technical Paper Number 1, Benfield Hazard Research Centre, University College London.

²⁷ A survey of insurers by the author in 2005 with the assistance of the ABI, found that several insurers now discriminate in favour of areas covered by FLAGS so that flood insurance in such areas is becoming easier and cheaper to obtain.

²⁸ “World Insurance Report 2007” Capgemini and the European Financial Management and Marketing Association.

Many insurers now realise that these subsidies are no longer sustainable, for several reasons:

1. Much better flood maps are now available, thanks to insurance investment in airborne SAR data which forms the basis of the flood maps produced by the Environment Agency in England and Wales²⁹.
2. Competition between insurers means that they can no longer afford to subsidise high risk flood areas. If they do, they know they will lose business in the lower risk areas as more insurers use geographic information systems and more sophisticated underwriting techniques.
3. The EU Solvency II Directive will force insurers to reduce their exposures in flood risk areas.
4. The number of properties at risk of flooding is growing (at least in England) due to new house building in flood risk areas³⁰.
5. Projected scenarios detailed in the Foresight reports³¹, using modelling data from the Government, show that the cost of flooding is likely to rise in the order of 30 or 40 times by 2080. This would mean that flooding could cost the UK economy up to £42 billion on average every year, in today's prices.

At present, insurers are prepared to maintain cover for existing customers in flood hazard areas at increased, but still subsidised, prices although they are often reluctant to quote for new customers in such areas. The question must be where is the "tipping point" that will cause the major insurers to charge the full risk premium in such areas or refuse to renew cover altogether? A recent court decision may be just such a tipping point.

Tate Gallery v Duffy, 2007.

Until now, insurers have been unwilling to issue policies subject to the exclusion of flood damage because they knew this could result in costly legal arguments. Between 1976 and 2007, case law in England seemed contradictory. First it defined "flood" as water "not naturally there"³² but later it was held that at the same time it had to be "caused by a natural event"³³. However in *Tate Gallery v Duffy, 2007*, it was held that if the insured peril is "flood" what matters is the accumulation of water itself and not how it got there³⁴. This anticipates the definition due to appear in the new EU Flood Directive, which is:

- "'flood" means the temporary covering by water of land not normally covered by water".

A new clearer legal definition of flood opens the way for insurers to start to exclude flood cover, and this could be a valuable tool for underwriting new build properties. It is not always easy to tell whether new properties are in a flood risk area. There is a time lag between the sale of the new property, the allocation of a new postcode, and the appearance of that postcode in insurers' quotation systems.

This court case would enable insurers to simply apply a general exclusion of flood damage to new build properties. This would mean that anyone wishing to have flood cover (for example to satisfy their mortgage lender) would have to provide additional information about the risk, such as a copy of the Environment Agency's flood risk assessment, and pay extra premium where warranted. Of course in high risk areas such cover could become very expensive if available at all and this could provide an opportunity for a niche market insurer or broker specialising in high risk flood cover.

²⁹ These maps are still not as good as those published on the internet by the Scottish Environment Protection Agency, with the assistance of insurers and FLAGs. Even more detailed maps are available to local planners and FLAG members in Scotland.

³⁰ Research by Professor Handley at the University of Manchester shows that 56% of local planning authorities in England have defied Environment Agency advice not to build in a flood hazard area. (Personal Communication)

³¹ Evans, E., Ashley, R., Hall, J., Penning-Rowse, E., Saul, A., Sayers, P., Thorne, C. and Watkinson, A. 2004. *"Foresight. Future Flooding. Scientific Summary: Volume 1 Future risks and their drivers."* Office of Science and Technology, London. And Evans, E., and Hall, J., December 2004. *"A new climate for flood planning"* *Ingenia*, the Journal of the Royal Academy of Engineering, December 2004.

³² *Young v Sun Alliance* [1977] 1 WLR 104; [1976] 3 All ER 561; [1976] 2 Lloyd's Rep 189; 120 SJ 469, CA (Civ Div).

³³ *Computer & Systems Engineering Plc v John Lelliott (Ilford) Ltd* (1989) 54 BLR 1, CA (Civ Div).

³⁴ *Board of the Trustees of the Tate Gallery v Duffy Construction Ltd.* (2007) EWHC 361 (TCC)

Already flood excesses up to £20,000 or higher are becoming common. After the floods of 2000, 45% of respondents to a survey of residents and businesses in Lewes reported substantial changes in their insurance premium and a further 18%, mainly residents, reported that flood insurance had been refused³⁵. In a survey of the insurance industry published in Insurance Times in November 2006, 70% of respondents said they intended taking a much firmer line in the future.

By contrast, a survey by ISL Ltd (a company which administers quotation systems for household insurance) published in "Scotland on Sunday" on 12 November 2006 found that householders in flood-risk areas in Aberdeen, Glasgow, Edinburgh and Perth could significantly reduce their annual building insurance premium by switching to an insurer which recognises that flood risks are being well managed in Scotland³⁶. Specifically, homeowners in flood-risk areas of Perth could save £117.20, in Glasgow £143.46, in Aberdeen £75.11, and in Edinburgh's Stockbridge, which flooded in 2000, £92.36.

Insurance Brokers

Insurance brokers will find new opportunities, especially in helping small businesses. Many small businesses are under insured. Many do not have Business Interruption cover and focus groups show that the main reason for this is that they do not understand BI and do not have a professional broker to help them³⁷.

Property Developers

The boom in house building and house prices in England is leading to a steep rise in profits for property developers. The big problem is finding suitable land. In many parts of SE England, the only safe undeveloped land is designated as Green Belt, Site of Special Scientific Interest, heritage site, or prime agricultural land, each zealously guarded by special interest groups with statutory backup. In some counties such as Arundel, the only land left is flood plain or coastal wetlands and there are no guardians for floodplains except concerned members of the public. Property developers have developed huge "land banks" in such areas in the expectation that continued pressure from government on planners to allow more houses will persuade planners to give permission to build. If the planners refuse, the developer can appeal. If the planners consent, concerned citizens can not appeal. It will be hard to persuade property developers to give up these land banks³⁸ without government intervention.

Environmental Interests

Environmental interests could insist on more sustainable planning and flood management policies. Houses in flood hazard areas will inevitably be flooded and the fitting of extra insulation in such areas simply means more demolition work by the insurers to remove it so that the building can dry out properly, not to mention more debris to go to landfill, adding to premium costs in such areas.

Land owners

After the War, farmers were encouraged to increase arable production. Many hill farmers did this by introducing land drains and building flood banks along rivers even if this meant a greater flood risk downstream. A major four year research project by WWF in Scotland with funding from HSBC Bank has demonstrated that land owners could significantly reduce downstream flood risks by blocking land drains, removing flood banks and planting trees and hedges, thus slowing down rainfall run off³⁹. In Japan, legislation in 2000 has shifted the strategy from structural flood defences to natural flood management because they have discovered it is much more cost

³⁵ Lewes Flood Action group survey.

See <http://www.lewes-flood-action.org.uk/insurance/surveyresults.html>

³⁶ <http://scotlandonsunday.scotsman.com/business.cfm?id=1671912006> downloaded on 6 May 2007.

³⁷ Crichton, D. 2006 "Climate Change and its Effects on Small Businesses in the UK" AXA Insurance. ISBN 978 0 9554108 0 2. (condensed version available from http://www.axa.co.uk/aboutus/corporate_publications/climate_change.html)

³⁸ Property developer representatives have attended FLAGS in Scotland for 14 years and over this time they have realised the need to alter their land bank policy to avoid taking options on flood risk areas because they realise that they will never get planning permission. They have been prepared to co-operate because they realise there is a "level playing field" and a consistent approach across all local authorities.

³⁹ WWF Scotland, 27 February 2007. "Slowing the Flow" 16pp. WWF Scotland, Dunkeld.

effective⁴⁰. In Germany, the Rhine and Meuse floodplains are being restored with EU grants to reduce the flooding risk downstream⁴¹, and Germany and Scotland are working together on the EU funded "SAFER" project to test new methods of natural flood management. Such projects are good for wildlife as well as people.

That does not mean that such solutions would work in England of course, but it has been suggested that the post war activities of land owners upstream in building land drains and river bank barriers contributed to the severity of the flooding in Carlisle in 2005, where a 180 year return period rainfall event produced a 1,000 year return period flood.

Farming is set for an upheaval:

- Many farmers are reaching retirement age and many more farms are likely to come up for sale within the next ten years.
- Working farms are exempt from death duties and currently 29% of sales of farms are to absentee landlords who want to avoid inheritance tax. This has pushed up land values.
- The demand for bio energy crops like rapeseed cannot be satisfied with existing production, so arable land values will inevitably increase even more.
- Climate change will extend growing seasons, but prolonged droughts will bring problems. The "dust bowl" effect is already being seen in some places where soil is being blown away. If this is followed by heavy rainfall the dust can turn into muddy floods which can damage surrounding property⁴².

It may be hard to persuade farmers to "farm water" under the current Common Agricultural Policy⁴³. The managers of National Parks could show a lead in this area but have so far failed to do very much.

Emergency Planning Officers

Under the Civil Contingencies Act 2004, emergency planners have new powers and duties to reduce the impacts of flood and other disasters, for example:

- "to generate a resilience culture at local level by extending the civil protection duty beyond emergency planning to address risks to businesses in the local business and the voluntary sector." And
- "assessing the likelihood of an event or situation which presents a serious threat to human welfare, the environment, political administrative or economic stability or security in the local area; collaborating with partner agencies and the local community; production of a community risk register which is to be maintained, reviewed and published⁴⁴".

As insurance becomes harder to obtain in flood hazard areas, there is evidence that in England these areas are increasingly being used for social housing⁴⁵ and old people's homes. In other words the most vulnerable members of society are being forced to live in the most hazardous areas. For example in one area in the south of England which prides itself on its "green" credentials there is a major new housing development in a floodplain. Insurers refuse to cover these houses so mortgages are not available and they will be sold for social housing. Local

⁴⁰ Takeuchi, K., 2002. "Flood Management in Japan – From Rivers to Basins." Water International Vol 27, No 1 pp 20-26, Illinois, USA

⁴¹ INTERREG Rhine Meuse Activities Programme (IRMA). see European Commission Press Release Reference: IP/01/1822 Date: 13/12/2001 Brussels.

⁴² This is less of a problem in Scotland where farmers have to take precautions to stop this happening because Section 99 of the Roads (Scotland) Act 1984 allows property owners to be prosecuted for allowing water to run off onto roads.

⁴³ The Scottish Executive is currently under pressure from the insurance industry and NGOs to change legislation to enable grants to be made to farmers to do this in Scotland. There are grounds for optimism that this may happen soon.

⁴⁴ For flood issues, much of this is already done in Scotland which has Flood Liaison and Advice Groups for stakeholder consultation especially with insurers and where local authorities are obliged to publish biennial reports on flood risks and action taken.

⁴⁵ While the numbers of owner-occupiers with contents insurance is growing (from 89% in 1995 to 93% in 2004), only 39% of tenants in the social rented sector in England and Wales had contents insurance in 2004. (In Scotland, the figure is 57%.) Three million low income households in England are uninsured for contents.

residents are concerned because they know that the land floods regularly but they have no rights of appeal over the planning decision.

Recent research⁴⁶ has shown that

- Intangible flood impacts (relating to non-material and/or emotional losses) were more severe than tangible flood impacts (relating to material losses) and immediate impacts were more severe than lasting impacts.
- The trauma of being flooded and its immediate aftermath was the most significant intangible impact, disproportionately felt by the elderly and most vulnerable. Loss of cherished family memorabilia was felt most acutely by the elderly.
- Vulnerable households on low incomes reported higher immediate and lasting intangible impacts, pointing to lower social resilience.

In England, government research shows that 18.2% of the population have a limiting illness or disability, and 7.6% are 75 or over⁴⁷. Warnings can reduce the impact of flooding, and emergency planners could do much more to become involved in ensuring that the most vulnerable people receive warnings and assistance.

Nowhere are warnings more important than the issue of potential dam break. Local authorities have a duty under the Civil Contingencies Act 2004 to carry out risk assessments and plan for emergencies accordingly. Reservoirs can have a positive effect in reducing flooding by storing rainfall run off to avoid peak flows⁴⁸, but what if the reservoir collapses or a landslide into the reservoir causes catastrophic overtopping⁴⁹? Risk management is particularly important for reservoirs⁵⁰.

There has been a spate of dam failures in the USA and around the world since 2000, often due to climate change impacts⁵¹. As structures age, become unsafe or too costly to repair a number are now being demolished before they collapse. In the USA the rate of dam removal has exceeded the rate of construction for the last ten years with 80 dams removed in the last two years⁵². Australia, France and Japan are also removing dams for safety reasons. This is not happening on a large scale in the UK, although one dam in Yorkshire has recently been modified to take it out of the Reservoirs Act after it burst in 2005 due to heavy rainfall. Meanwhile the biggest reservoir to be built for 25 years is planned by Thames Water at Abington near Oxford to provide water for London. Construction is planned to start in 2011.

Most of the 5,000 British dams are over 100 years old and many were constructed during the severe dry spells (1850s, 1880s, and 1890s) at the start of the Industrial Revolution⁵³ in order to provide water for power and textile processing. They are becoming more vulnerable to failure due to climate change⁵⁴. Climate change will bring unprecedented spells of very heavy rain which will

⁴⁶ Werritty, A., Houston, D., Ball, T., Tavendale, A., and Black, A., 3 April 2007. "Exploring The Social Impacts Of Flood Risk and Flooding In Scotland" Scottish Executive Environment Group Research Findings No.32/2007

⁴⁷ Defra and Environment Agency, 2006. "Flood Risks to People (Phase 2)" R&D Research report FD2321

⁴⁸ McInally, G A, Anderson, J L and Lee, D (1995) *Positive operation of hydro-electric schemes to aid flood control: experiences in the Tay catchment*. In: Reservoirs in River Basin Development. Eds – Santbergen & Van Westen. Balkema, Rotterdam, The Netherlands.

⁴⁹ In 1959 when the Malpasset dam in France failed, 421 people died, and in 1963, overtopping of the Vaiont dam in Italy caused by a landslide resulted in 1,189 deaths, even though the dam itself remained intact. In 1972, a dam in West Virginia, USA failed causing 125 deaths. In 1976, the Teton dam in Idaho, USA, failed during its initial filling, killing at least 11 people.

⁵⁰ Hughes, A; Hewlett, H W M; Samuels, P G; Morris, M; Sayers, P; Moffat, I; Harding, A; and Tedd, P. 2000 "Risk Management for UK Reservoirs." Construction Industry Research and Information Association (CIRIA) Research project report C542. London. (Insurance interests in the project represented by Crichton, D.).

⁵¹ Bosshard, P., and Switkes, G., 2004. "Rash of Dam Failures Raise Safety Concerns" World Rivers Review Vol. 19 No. 4, p7. August 2004. International Rivers Network, Berkeley, California, USA.

⁵² Marks, J. March 2007. "Down go the Dams" Scientific American, March 2007.

⁵³ Barker, P A, Wilby, R L, & Borrows, J., 2004. "A 200-year precipitation index for the central English Lake District" Pp 769-785 Hydrological Sciences–Journal–des Sciences Hydrologiques, 49(5) October 2004.

⁵⁴ Babbie Group and the Centre for Ecology and Hydrology, 2002. "Climate Change Impacts on the Safety of British Reservoirs" Report commissioned by the Department of the Environment, Transport and the Regions (DETR) now DEFRA, through their reservoir safety research programme

challenge the original design standards. For example a long drought⁵⁵ followed by heavy rainfall puts great stress on the earth embankments of reservoirs, most of which were built before heavy earth compaction equipment was available, and chemical grouting techniques to stabilise sub soil foundations and prevent underground seepage were not available until relatively recently⁵⁶. Embankments can suffer from weakening due to burrowing animals and minor earth tremors could cause the earth to liquefy. Many reservoirs are in valleys where a landslide into the reservoir could cause disastrous overtopping. High winds could create waves which could overtop, leading to erosion and possible collapse. Satellite technology called "PS InSAR" is an inexpensive and valuable tool for monitoring sub millimetre ground movement but is so far only being used on one reservoir in the UK.

Larger reservoirs holding more than 25,000 cubic metres of water above ground level have to be registered and inspected every ten years under the Reservoirs Act 1975 which is intended to prevent escapes of water. The Environment Agency is responsible for the enforcement of the Reservoirs Act 1975 for the 2,010 large raised reservoirs in England and Wales⁵⁷, and has established a reservoir safety unit in Exeter. Until the Environment Agency took over safety matters in England and Wales⁵⁸, reservoir risks were clouded in secrecy. In 2005, a new database was created by the Environment Agency using data from the Building Research Establishment database and accessible to the public under the Freedom of Information Acts and a new post incident reporting system was set up on a UK wide basis⁵⁹.

On average three reservoirs each year in England need to have emergency draw downs to prevent failure but sluice gates can become jammed because of age and sediment. Pumps then have to be used. There have been 24 "near misses", 12 on large raised reservoirs and 12 on dams not covered by the Act, and over 100 notices served⁶⁰ since the Environment Agency started keeping records after they took over safety enforcement in October 2004. The new more open approach in England and Wales is to be welcomed and liability insurers of reservoir undertakings should take the opportunity to apply their risk management skills to assist the authorities.

The Environment Agency is not only the safety enforcement authority in England and Wales, the Reservoirs Act (as amended) recognises that it has a conflict of interest as the biggest operator of reservoirs itself with 169 reservoirs owned or adopted, the majority in connection with flood prevention schemes. For safety reasons the Environment Agency has the power to give permissions for annual opening of scour valves to clear sediment from sluice gates to ensure they work when needed. The Environment Agency has emergency powers to order a draw down under the supervision of an Inspecting Engineer for any reservoir as a precaution if lives are at risk, but it has to balance this against the possible pollution and environmental damage caused by the release of sediment.

There were dam break disasters with hundreds of lives lost in Britain in 1852, 1864 and twice in 1925⁶¹. Yet planners have been quite happy to allow houses to be built in the direct path of a potential dam break and the Environment Agency say that 69% of dams pose a potential risk to

⁵⁵ Over much of England and Wales, 18 of the 23 months from November 2004 had rainfall totals less than the long term average. The resultant (2005-2006) drought was the first long-duration drought event to hit the UK for a decade, and the most severe since 1975-1976, and it provided a severe test of the sufficiency of the nation's water resources supply systems.

⁵⁶ The first dam to use this technique in the UK was the Backwater dam opened in 1969.

⁵⁷ There are 680 reservoirs in Scotland. Safety enforcement in Scotland is carried out by the 32 local authorities. They do not need to have specialist dam engineers but they are democratically accountable if there is a failure. There are 70 reservoirs in N. Ireland where there is currently a safety review under way. New regulations⁵⁷ came into effect on 1st February 2007. They do not deal with dam safety, but require all reservoirs to be licensed.

⁵⁸ The Environment Agency is not responsible for the safety of small reservoirs, reservoirs in mines and quarries, or for canals or tidal barrages. These come under the Health and Safety Executive.

⁵⁹ Environment Agency, 2007. *"Learning from experience; post incident reporting for UK dams."* Environment Agency, Exeter.

⁶⁰ Ian Hope, Technical Manger, Reservoirs Safety, Environment Agency. Personal communication May 2007.

⁶¹ In 1852 the Bilberry Dam failed at Holmfirth (the location for filming the TV series "Last of the Summer Wine"), leading to 81 deaths and the destruction of 244 properties. During the War, the RAF used the rebuilt dam for training for the "dambusters" raid.

life⁶². Emergency planners do not yet have the sort of emergency warning and evacuation procedures used in other countries such as France⁶³ although "Flood Plans" are promised for England and Wales for 2009. It is not known how many people live in the danger zones because the security services have insisted that the maps showing the areas which would be flooded in a dam break are kept secret even from emergency planners, the police, insurers and the people living there, due to fears of terrorist attack. This was relaxed in 2007, and work is in progress to release existing maps. When they are released, insurers will be able to take the risks into account more accurately.

Engineers

Some may argue that the flood risk can be addressed by spending more on structural flood defences in England and Wales even at the cost of spending less on schools and hospitals. After all, some other countries are spending more⁶⁴. But spending money on flood defences while still building in floodplains is a Sisyphean task, especially when there are over 600 bodies or committees dealing with flood defences in England.

Scotland with its strict planning controls has been able to set a target of defending every property against the 100 year flood by 2008 and unlike England is actively using natural flood management techniques with assistance from the financial sector and the EU. These are proving to be ten times more cost effective than structural solutions such as walls, tunnels and reservoirs⁶⁵. Insurers are unlikely to help to fund structural solutions when they do not offer best value for money.

Government

In the longer term, climate change will make many of our cities uninhabitable due to sea level rise⁶⁶. This will mean that people in these cities will have to relocate to higher ground.

Government could help this process to start now by encouraging businesses to move to safer areas⁶⁷. If the Government really takes climate change seriously it should consider moving its Parliament to Birmingham rather than spending the £40bn needed to defend the centre of London. This would demonstrate to the public just how important the problem is.

As a matter of urgency, building standards should be reviewed in the light of climate change, particularly to make buildings more resilient to storm and subsidence damage. Insurance data⁶⁸ shows that newer buildings are much more vulnerable to storm damage than older ones because of lightweight construction methods introduced in 1971.

Government in England wish to continue to allow increased house building in flood hazard areas on economic grounds, but the economic arguments do not stand up to scrutiny very well:

- Their methods of estimating tangible flood costs are restricted and do not reflect the true financial costs of a flood as measured by the National Flood Insurance Claims Database for example. This is the largest flood damages database⁶⁹ in the world, and is widely used by the insurance industry, but ignored by Government.
- They do not fully take into account the intangible costs of the human physical and mental health damage which are increasingly recognised to be very significant.
- They do not fully take into account the financial losses caused by disruption, loss of business and increased cost of working. One insurer's figures⁷⁰ show that the average cost

⁶² Environment Agency, 2007. "A better place to live; Working together for the safety of our reservoirs."

Environment Agency, Exeter.

⁶³ Emergency planners always attend FLAGS in Scotland so that these concerns can be discussed informally.

⁶⁴ Scotland spends £556 on flood management per property at risk compared with £131 per property at risk in England.

⁶⁵ WWF Scotland, 27 February 2007. "Slowing the Flow" 16pp. WWF Scotland, Dunkeld.

⁶⁶ Benfield Hazard Research Centre, UCL, 2006. "Dangerous Climate Change: rising sea levels and ocean circulation changes." Technical Report 05. UCL London.

⁶⁷ The Scottish Government has been relocating government departments out of Edinburgh for several years now. However the HQ of SEPA, the Scottish equivalent of the Environment Agency, has been located next to a pond in the middle of a floodplain. This provides a constant reminder to their staff about flood risks.

⁶⁸ Mootosamy, V.K.S, and Baker, M.J., 1998 "Wind Damage to Buildings in the United Kingdom" University of Aberdeen, Department of Engineering. Published by the Loss Prevention Council, Paper LPR 8: 1998 Watford. (ISBN 0 902167 49-9).

⁶⁹ Black, A., Werritty, A., and Paine, J., October 2006. "Financial costs of property damages due to flooding; the Halifax Dundee Flood Loss Tables 2005." University of Dundee, sponsored by Halifax General Insurance Services.

⁷⁰ Source AXA Insurance.

of business interruption claims from small businesses after a flood event have increased dramatically in the last 4 years.

The Government should at least consider the measures used in the rest of the UK to prevent the use of flood hazard areas for the construction of old people's homes, emergency services control centres, hospitals, schools⁷¹, homes for the disabled⁷², electricity sub stations, mobile phone transmitters, drinking water treatment plants, or evacuation routes where the flood hazard exceeds the 1,000 year return period.

Conclusions

The latest planning guidelines in England still allow development in flood hazard areas. Government appears to be more interested in satisfying the demands of property developers to help them to increase their already substantial profits⁷³ rather than protecting the public. Insurers are nimble and sure footed; they can withdraw from such risks very easily. After all why should their customers subsidise property developers? As insurers withdraw from such areas, they will increasingly be blighted and occupied by the poor, the old, the disabled and the sick who cannot afford to live in safe areas. This is surely going to build up problems of social division in the future⁷⁴. Insurers are already seeing the symptoms in the huge growth in looting and fraud after a flood event. Something that was very unusual prior to 1998.

"One thief... protested that the iron and microwave oven he had stolen were his by right. In his view, the goods were compensation for his ground-floor flat being inundated, he was sure he would get no other."

Ruth Rendell "The Babes in the Wood". (Reprinted with the kind permission of the publishers.)

In Carlisle in January 2005 there were two deaths. These were elderly ladies who refused to be evacuated because of fears of looting. They stayed in their flooded home without heating or light and died from the cold. Is this what we should expect in a civilised developed country? Is it perhaps a taste of things to come?

Further Reading

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⁷¹ Insurance research shows that 15% of fire and ambulance stations, and 12% of hospitals and schools in England are in flood hazard areas. In total, England has 89 hospitals and 2,374 schools on floodplains. Over 70% have no flood defences.

⁷² Including waiving the Disability Discrimination Act for houses in flood hazard areas. Measures such as ground floor toilets and lowering floor levels to avoid doorsteps make such properties much more vulnerable to flooding.

⁷³ The top four housing property developers in England made combined profits of £1,688m in 2006.

⁷⁴ Crichton, D. 2006 *"Climate Change and its Effects on Small Businesses in the UK"* AXA Insurance. ISBN 978 0 9554108 0 2

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