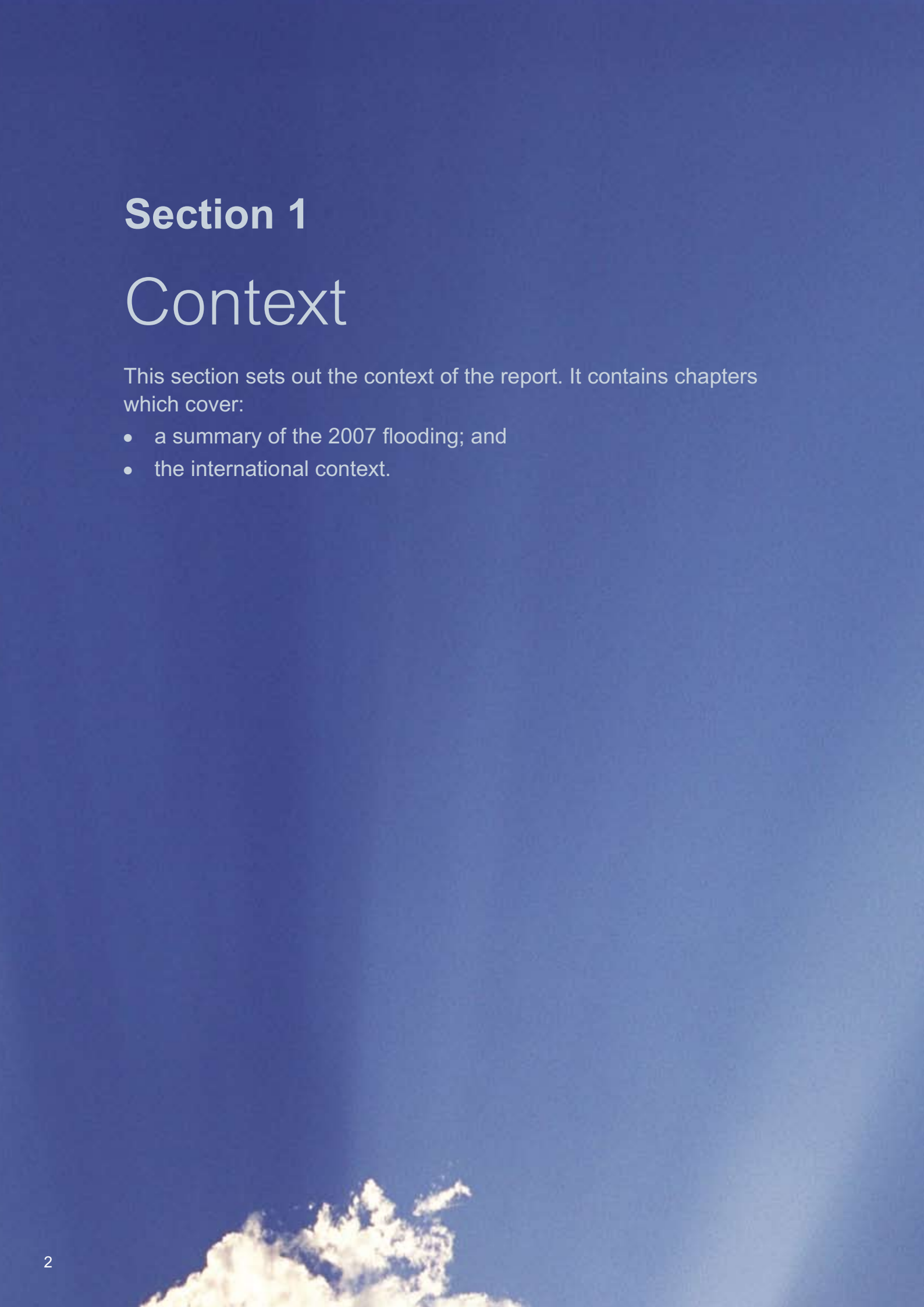
Section 1

Context

This section sets out the context of the report. It contains chapters which cover:

- a summary of the 2007 flooding; and
- the international context.



A summary of the 2007 flooding

This chapter describes the exceptional events that took place during summer 2007. It contains sections on:

- the weather situation;
- the UK weather forecast;
- flood defences;
- the flooding;
- the effects of the floods on people, businesses, agriculture and heritage sites;
- the UK situation in June 2008; and
- key dates.

Introduction

1.1 The floods that struck much of the country during June and July 2007 were extreme, affecting hundreds of thousands of people in England and Wales. It was the most serious inland flood since 1947.

1.2 In the exceptional events that took place, 13 people lost their lives, approximately 48,000 households and nearly 7,300 businesses were flooded and billions of pounds of damage was caused. In Yorkshire and Humberside, the Fire and Rescue Service launched the "biggest rescue effort in peacetime Britain".[1] Across Gloucestershire, 350,000 people were left without mains water supply – this was the most significant loss of essential services since the Second World War. Other critical infrastructure was damaged and essential services including power supplies, transport links and telecommunications were disrupted.

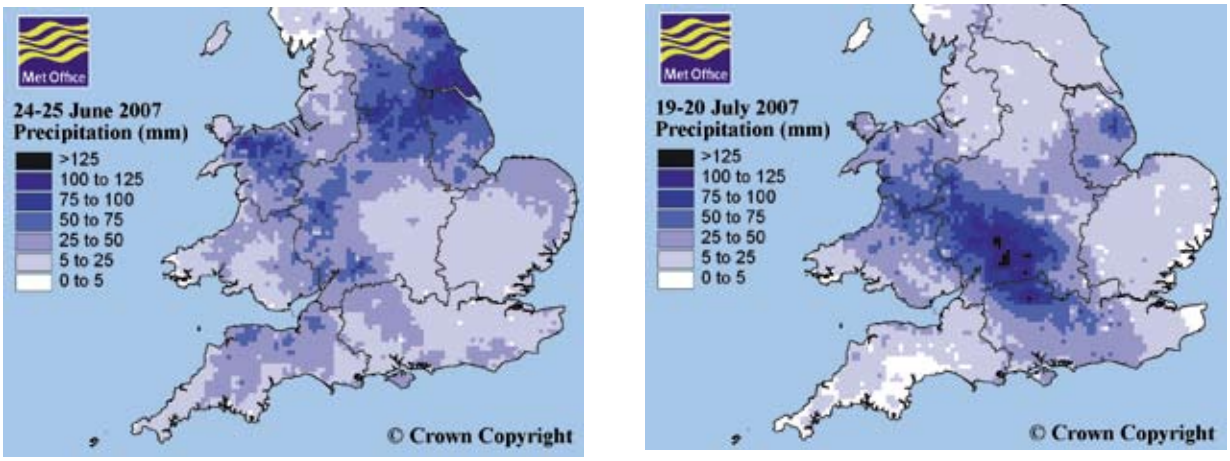
The weather situation

1.3 The rainfall during June and July 2007 was unprecedented. The severe flooding which followed came after the wettest ever May to July period since national records began in 1766. Met Office records show that the total cumulative rainfall in May, June and July 2007 averaged 395.1mm across England and Wales – well over double usual levels.

1.4 The exceptionally heavy rain resulted in two severe and disruptive flooding events; the first during the week of 20 June and the second during the week of 18 July. A clear indication of where the heavy rain fell can be seen in the maps of precipitation levels for England and Wales during 24–25 June and 19–20 July 2007, (Figure 1.) This heavy rainfall was the result of an unusual pattern of weather that can be attributed to two major causes: the position of the Polar Front Jet Stream and high North Atlantic sea surface temperatures.

[1] General Secretary Matt Wrack, Fire Brigades Union Press Release 28 June 2007

Figure 1 – Precipitation Levels for England and Wales during 24–25 June and 19–20 July 2007



The Polar Front Jet Stream

1.5 The Polar Front Jet Stream is a key factor in the UK's weather. Found at around 35,000 feet and reaching speeds of 300 miles per hour, this ribbon of wind is formed by temperature differences in the upper atmosphere between cold polar air to the north and warm tropical air to the south. At this boundary, weather fronts develop which bring heavy rain and strong winds. For much of summer 2007, the Jet Stream was stronger and further south than normal resulting in many heavy rain-producing weather systems crossing southern and central areas of the UK. Figure 2 shows the relative positions of the Jet Stream in July 2006 and July 2007 for comparison.

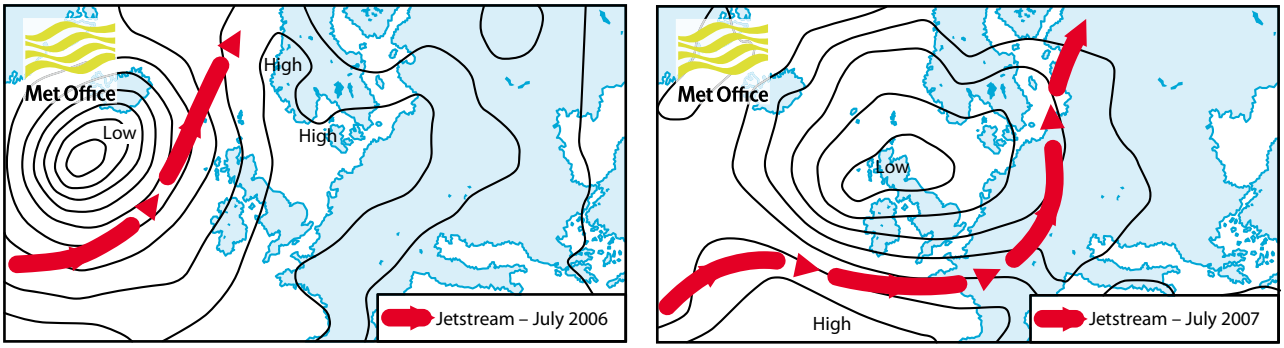
North Atlantic sea surface temperatures

1.6 The temperatures of the North West Atlantic Ocean waters were above normal for much of spring and early summer 2007. Consequently the air mass above the ocean was warmer and held more moisture. When this air mass was forced to rise as a result of frontal activity, more rain formed. This rain fell throughout the spring and culminated in the main events of 24–25 June and 19–20 July, as the weather fronts in the slow-moving depressions passed over the country.

The UK weather forecast

1.7 The Met Office is responsible for forecasting the weather and issuing National Severe Weather Warnings, through the National Severe Weather Warning Service (NSWWS) to customers when hazardous or severe weather has the potential to cause danger to life, or widespread disruption to communications or transport. The Met Office works with the Environment Agency to provide weather forecast and tide warnings and it is the Environment Agency's responsibility to issue river and coastal flood warnings to partners and the public.

Figure 2 – Relative positions of the Jet Stream in July 2006 and July 2007



The Met Office forecast

1.8 The levels of rainfall in summer 2007 were generally well predicted by the Met Office – in particular, the weather forecasts preceding the major July flooding were the most detailed and accurate to date for a major flooding event in the UK. Nonetheless submissions to the Review suggest responders found the weather forecast updates from the Met Office confusing at times.

1.9 Early warnings giving three days notice of severe weather were issued to both NSWWS customers and the public before the two major flooding events. The early severe weather warnings were distributed direct to emergency response organisations via email and fax, and Met Office Public Weather Service Advisors around the country worked with responders to deal with the impact. There was sufficient lead time for some mitigation plans to be put in place. Subsequent focused warnings about the areas at greatest risk of disruption were provided as confidence in the forecasts grew.

The Environment Agency forecast

1.10 The Environment Agency forecast flood levels and issued warnings relatively accurately. However, problems arose in four of eight Environment Agency regions across England and Wales affected by the floods.

The Thames region

1.11 In the Thames region, the Environment Agency's rainfall runoff forecasting model for the Thames and its tributaries worked well and the magnitude (but not the timing) of the event was well forecast. However, on the mornings of 21 and 25 July the Regional Telemetry System partially failed, thus providing no data to the National Flood Forecasting System (NFFS). A total of 24 telemetry outstations out of 632 (4 per cent) experienced some kind of failure during the event, while in other cases poorly configured outstations caused unnecessary alarm errors. On one site, due to a river alarm that failed, a flood warning was issued two hours after flooding had commenced. In total, 448 out of 1,925 (23 per cent) properties in the region affected by main river flooding were in areas that did not receive a warning in time.

The Midlands region

1.12 In the Midlands, a small number of the Environment Agency's river level gauges reached their recordable limit, were inundated by flood waters or lost power, while others were inaccessible due to the extreme flood conditions and could not therefore be read. The rapid water level rise on some watercourses meant that it was not possible to give warnings two hours in advance. On two occasions, flood warnings were issued after flooding had already occurred.

The North-East region

1.13 In a number of locations in the North East, warnings were received after surface water flooding had already affected properties. The absence of high-resolution rainfall radar coverage across the whole of the North-East region limited the potential to predict rainfall and forecast flooding.

The Anglian region

1.14 In the Anglian region, a number of flood warnings and severe flood warnings were issued in areas that did not experience any significant flooding, which suggests that some warning thresholds were set too low. The NFFS was not operational in the Anglian region at the time, and this limited the warning service available. Existing forecasting models and tools had generally been calibrated against winter flood events, presenting challenges in predicting flood peak travel times during the summer floods.

Flood defences

1.15 The majority of flood defences, both those on rivers and those against coastal surges, are maintained by the Environment Agency. Others are maintained by local authorities, internal drainage boards, businesses and individuals. These defences are typically designed to withstand an event with an annual 1 in 100 chance of occurring.

1.16 In England and Wales, during the floods of June and July 2007, 9 per cent (1,016 km) of man-made raised flood defences were put to the test. However, due to the scale of the event approximately 50 per cent (525 km) of the raised flood defences were overtopped by the sheer volume of water.[2]

1.17 Overall, the defences held up well with less than 0.2 per cent of the total defences failing physically, breaking down or failing to operate as expected. The failure of these defences did not significantly affect the overall level of flooding due to overtopping and the magnitude of the event.

The flooding

1.18 Flooding occurs from a number of sources. **River (fluvial) flooding** occurs as a result of water overflowing from river channels, **surface water (pluvial) flooding** when natural and man-made drainage systems have insufficient capacity to deal with the volume of rainfall, **groundwater flooding** when the level of water underground rises above its natural surface and **coastal flooding** when the sea level rises above the level of coastal land.

1.19 The events of the summer were characterised by fluvial and pluvial flooding: rivers flooded surrounding areas and, following the exceptionally high rainfall, there was direct flooding of areas with insufficient drainage capacity.

Fluvial flooding

1.20 The two key factors in fluvial or river flooding are:

- the volume of rainfall; and
- the capacity of the ground and rivers to absorb and transport the water.

1.21 In a typical summer, river, groundwater and soil moisture levels are usually low, providing capacity to absorb heavy rainfall and reducing the likelihood of flooding. However, in May and early June 2007, the weather was particularly wet, so river, groundwater and soil moisture levels were already high when the intense rain fell in June and July, exacerbating the flooding.

Pluvial flooding

1.22 The critical factors for pluvial or surface water flooding are:

- the volume of rainfall;
- where it falls; and
- its intensity.

1.23 In urban areas, sudden and intense rainfall cannot drain away as quickly as it can in rural areas where the soil is exposed. Due to its nature, surface water flooding is hard to predict and the scope for providing warnings is limited. Significant flooding occurred in areas that had not previously flooded because of this.

The Environment Agency figures

1.24 In our interim report we attributed a third of the flooding to main river flooding or a combination of main river and surface water and two thirds of the flooding to inadequacies in surface water drainage systems. These figures were obtained from the Environment Agency but have since been questioned.

1.25 The Environment Agency figure was calculated by subtracting the number of properties definitively flooded, in whole or in part, from main rivers from the total number of properties flooded. The number of properties therefore quoted as flooded from surface water included flooding from a wide range of sources that were not main rivers, for example ditches and groundwater. More importantly, this figure included properties flooded by sewers and drains which could not discharge properly because many urban river channels ran close to full (without overtopping). Integrated modelling has shown that where river channels run close to full, the capacity of surface water sewerage outfalls and potentially other drainage outfalls is significantly affected.

[2] Environment Agency update on failed assets May 2008

1.26 Many of the properties included by the Environment Agency in their 'surface water flooding' category actually flooded from a combination of factors. Unfortunately, due to the way that the data was collected, the two-thirds figure quoted cannot be further clarified. Nevertheless, surface water flooding was a major issue in the events of last summer and will remain a significant problem in the future.

The June event

1.27 Heavy rainfall from severe thunderstorms affected much of northern England on 14–15 June. Whilst this caused comparatively little flooding itself, it did saturate the ground. This amplified the impact of heavy rain on 24–25 June, after which the weather remained unsettled and wet until the end of the month.

1.28 The heaviest rain in June occurred in Yorkshire, Humberside, Lincolnshire, Derbyshire and Worcestershire. Four times the average June rainfall fell in places on the North York Moors and in the South Pennines. In Hull, 8,600 homes (20,000 people) and 1,300 businesses were flooded as a result of the city's drainage network being overwhelmed by heavy and prolonged rain. In Sheffield, the Neepsend electricity substation was shut down with the loss of power to 40,000 people. Over 1,000 people were evacuated from villages near the Ulley reservoir dam near Rotherham after a torrent of water caused significant structural damage to the dam. This led to the M1 being closed for 40 hours as a precaution.

The July event

1.29 The second main flooding event was due to exceptionally heavy rainfall on 19–20 July, with a slow moving depression centred over south-east England moving northwards during the day. The flooding was exacerbated once again because the ground was still saturated from the previous month's rain.

1.30 The heaviest rain in July occurred in Warwickshire, Worcestershire, Gloucestershire, Herefordshire, Shropshire and Oxfordshire. There was nearly four times the July average rainfall in the Malverns and the Cotswolds. Tewkesbury was particularly hard-hit with Severn Trent Water's Mythe water treatment works flooding. This left 350,000 people without mains water supply for over two weeks. Around 10,000 people were left stranded on the M5 and surrounding roads as drivers were forced to abandon cars, and 500 people were stranded at Gloucester railway station as the railway network failed.

1.31 The Fire and Rescue Service, the Armed Forces, the Environment Agency and the National Grid erected temporary defences at Walham electricity substation, which saved it from flooding and helped protect the power supply to 500,000 people in Gloucestershire and South Wales. However the Castle Meads electricity substation was shut down whilst temporary defences were put in place, which left 42,000 people without power in Gloucester for up to 24 hours.

The effects of the floods

The effects on people

1.32 The Review commissioned qualitative research, carried out in October 2007, to look into the effects of the floods on individuals. The Review also commissioned qualitative research, carried out in April 2008, to look at the health impacts of the floods and the performance of the insurance industry. Both pieces of research were carried out by the independent research agency GfK NOP Social Research and the full reports are available for download from the Review website: www.cabinetoffice.gov.uk/thepittreview.

1.33 The scale and speed of the floods in summer 2007 came as a shock. Even if people were aware that heavy rain was forecast, they did not expect it to affect them, and certainly not so seriously. Most people had never experienced flooding like this before and did not know how to react – what preventative steps to take or who to call for help.

1.34 Some did take steps to protect their property, moving their possessions upstairs or attempting to prevent water ingress. Many people were forced to evacuate their homes, either staying with friends or relatives or being transferred to rest centres or temporary accommodation. This caused fear and distress as people worried that their homes would be damaged further by the flooding or targetted by opportunist thieves in their absence.

1.35 After the flood, many people were unable to return home and disrupted living patterns led to family and personal stress. Some families who did return home were confined to using only the upper floors, while others moved into caravans located on their driveways.

1.36 The loss of water and power supplies caused feelings of fear and helplessness. Where water supplies were lost, bowsers and bottled water were made available in various locations. But it was difficult for vulnerable people and those without transport or enough physical strength to collect the water and take it back to their homes. Scarcity of water caused arguments and tension in local communities. In addition, the loss of power meant people could not get information from television, mains radio and the internet. It also prevented people from communicating with others, as many modern landlines and mobile telephones require power to charge batteries.

1.37 Walls and floors were soaked, and the mud, silt and sewage carried by the flood waters caused considerable damage to people's homes. In addition, there were reports that contamination resulted in a continuous bad odour as well as infestations of rats, mosquitoes and flies. People also reported physical health problems, including diarrhoea, asthma, sore throats, cold sores and bad chests, all of which may have resulted from the damp living conditions and overall contamination of their homes.

1.38 Presented with one of their biggest ever challenges, insurers responded quickly to the events, implementing major crisis measures to respond to the overwhelming demand. In the majority of cases people were dealt with quickly and efficiently by their insurer and loss adjustor. There were incidents, however, where it took several days for customers to be able to make contact with their insurer and even longer for their loss adjustor to contact them. Loss adjustors are a crucial first step in the claims process and in some cases initial lack of availability delayed the clean-up process. Many people were uninsured and for them, after the flooding, advice on where to start and what to do was less easily available. They did however receive a limited amount of money for repairs and support through public funds including grants from local authorities and the Department of Work and Pensions (DWP), as well as support from the voluntary and community sector.

The effects on businesses

1.39 Many businesses suffered flooded sales premises, together with damage to stock and equipment. In addition, the loss of power and communications led to missed orders and enquiries. It took considerable time for many businesses to get back to normal, as there were delays caused by paperwork that had been lost in the flooding, which led to problems making insurance claims, tracing orders or filling in tax returns. Businesses in the tourism and leisure sector suffered with fewer customers and lost revenue. Some hotels benefited from people displaced by the floods, demand for takeaways increased with people unable to cook and building firms were inundated as the recovery process began.

1.40 All the Regional Development Agencies (RDAs) affected by the flooding of June and July put in place specific flood recovery schemes for small to medium enterprises. These schemes have usually taken the form of a grant of up to £2,500. In total RDAs have currently committed over £11 million in support for businesses affected by the floods.

1.41 Months after the summer floods, many thousands were still experiencing inconvenient disruption to their everyday lives. Many families were forced to spend the Christmas holidays in temporary accommodation; hundreds of school children in some of the worst affected regions were still being taught in temporary classrooms; and businesses were still far from fully recovered and trading at pre-flood levels.

The effects on agriculture

1.42 The most significant impact on the farming sector was in respect of crop losses. In some cases, agricultural land floods either by design or as a result of a typical winter weather event. However, as the flooding occurred in the summer months, the impact was magnified as growing crops are more vulnerable. Approximately 42,000 hectares of agricultural land across England flooded last summer, slightly over 0.5 per cent of the total area. Of this, 15,600 hectares were grassland

(including grazing, hay and silage fields) and arable and fodder crops made up the remaining 26,300 hectares.[3] Due to the relatively small area affected, there was no noticeable effect on UK food prices.

1.43 It is estimated that the number of farms affected was between 2,600 and 5,000. Taking into account that some crops from flooded fields were lost entirely, whereas others could be salvaged, albeit with a potential reduced yield and quality, total losses are estimated at £11.2 million. This equates to average losses of between £2,670 and £6,675 per farm although the Review has heard of large variations, from minimal losses to over £500,000. Typically damage to growing crops is uninsurable and with average farm incomes per head in 2007 at £13,349,[4] some farms are likely to have been severely affected.

1.44 Dairy and livestock farmers also faced a number of problems during and after the flooding. In some cases they had to save their animals from drowning or prevent them from drinking contaminated water. Livestock was lost: a reported 1,000 sheep were killed in Staffordshire and several thousand chickens drowned in Lincolnshire. Dairy and livestock farms suffered from loss of grazing and forage crops, creating additional expenditure on animal feed as well as affecting growth rates and milk production.

1.45 To date, there is no accurate assessment of the overall economic impact of the floods on agriculture but with indirect costs such as land reinstatement, the effect of interrupted crop rotations, additional management time and cashflow/finance issues factored in, it is likely to be in the region of tens of millions of pounds, and well beyond the support available through government funds and insurance.

The effects on heritage sites

1.46 English Heritage and National Trust visitor attractions were significantly affected by the floods of last summer, as well as numerous World Heritage Sites, suffering both physical damage and lost revenue. World Heritage Sites affected included Birdoswald Roman Fort (part of the Hadrian's Wall Site), Fountains Abbey, Ironbridge Gorge, Derwent Valley Mills and Blenheim Palace. Many listed properties were also affected.

The UK situation in June 2008

1.47 One year on from the 2007 summer floods, communities are still recovering and are not likely to be back to normal for many months to come. Figures from the Association of British Insurers (ABI) show that there were at least 180,000 claims (130,000 home, 30,000 business and 20,000 motor) following last summer's floods. By the beginning of June 2008, the ABI estimated that over 90 per cent of all claimants had received at least an interim payment.

1.48 The percentage of domestic claims that have been settled is steadily increasing, up from 42 per cent in mid-December 2007 to 60 per cent in mid-February 2008. At the end of March 2008, the ABI estimated that 71 per cent of domestic claims and 40 per cent of business claims had been settled in full.

1.49 Approximately 14,500 households were provided with alternative accommodation by insurers. At the end of May 2008, local authorities estimated that 4,750 households were still not back in their homes. The ABI predict that 96 per cent of policyholders who moved to alternative accomodation will have moved back in by the summer of 2008.

1.50 Funding of up to £87 million has been made available by various government departments and agencies to assist the affected regions and help those in greatest need. This includes funding for schools, transport and businesses.

1.51 In addition to this, the European Commission has granted European Union Solidarity Fund aid to the UK with a net value of £31 million to help deal with the damage caused by the floods. The new fund will be made available to local authorities, police authorities and fire and rescue services to offset costs incurred in dealing with the 2007 floods and their knock-on effects.

[3] Impact of 2007 summer floods on agriculture, ADAS (FINAL) Food and Farming Group, Defra January 2008
[4] www.defra.gov.uk/news/2008/080131d.htm

1.52 One year on, many people continue to suffer the long-term disruption that the summer floods of 2007 caused. Some areas are still recovering from the floods and as recent flood events in Oxfordshire and Somerset show the threat of flooding remains an ever-present danger to individuals and communities in the UK. It is recognised that, although many aspects of the response to last summer's floods were positive, there are lessons to be learnt to improve the way we deal with flooding in the future.

Key Dates

- 14 – 19 June: Met office issues Flash Warnings of Severe Weather (heavy rain) associated with thunderstorms, severe thunderstorms strike and flooding is reported in Northamptonshire, West Midlands, Staffordshire, Herefordshire, Worcestershire and Yorkshire.
  One man dies after being swept away by a bursting river in North Yorkshire.
  Evacuations take place in all areas from homes and schools but blocked roads and disrupted rail services leave people stranded and hamper rescue efforts.
- 21 June: Overnight rain causes floods in Boscastle, three years after record floods hit the village.
- 22 June: Met Office issues Early Warning of Severe Weather.
- 23 June: Ingham rainfall radar station in Lincolnshire is hit by lightning and put out of action. Ingham provides rainfall information for eastern and north eastern England.
- 24 – 28 June: Flooding is reported in East Anglia, Staffordshire, Lincolnshire, Nottinghamshire, Shropshire, Worcestershire and Yorkshire. Torrential rain causes surface water flooding in Hull, a result of the city's drainage network being totally overwhelmed, leaving 30,000 people homeless. In Yorkshire and Humberside the fire brigade launch the "biggest rescue effort in peacetime Britain". Neepsend electricity substation is inundated and shut down with a loss of power to around 40,000 people around Sheffield. One man dies while attempting to clear debris from a manhole in Hessle. Elsewhere there are another three flood-related fatalities. Around 1,000 people are evacuated from villages near the Ulley reservoir dam, after a torrent of water caused significant structural damage. This led to the M1 being closed for 40 hours as a precaution.
- 28 June: Home Office figures show that 3,500 people have been rescued from flooded homes and a further 4,000 call-outs were made by the fire, ambulance and police services.
- 2 July: The Department for Environment Food and Rural Affairs (Defra) announces an increase in funds for flood protection to £800 million by 2010/11.
- 3 July: Forecasters warn of treacherous weather for the rest of July.
- 7 July: Gordon Brown visits flood victims in Yorkshire. He announces a £14 million support package for the areas affected by the recent floods as well as changes to the Bellwin scheme to make it easier for local councils to claim back additional costs from the government. In the support package, £10 million will go to local authorities in flood hit areas to support the work that they and other organisations are already doing to help recovery, £3 million from the Department for Transport to help with the cost of repairing roads and bridges; and a contingency reserve of £1 million that may be drawn upon as needed by the Department for Work and Pensions. ABI estimates the damage from the floods at £1.5 billion.
- 12 July: Secretary of State for Environment Food and Rural Affairs in a statement to the House of Commons announces there will be an independent review into the floods.
- 13 July: Communities and Local Government (CLG) release initial payments of £8 million as part of the Government's support package.
- 14 July: Met Office issues a Severe Weather Warning of 50mm rain in some parts of the country for the day.
- 16 July: Met Office predicts heavy rain, thunderstorms and even tornadoes, as strong winds and low pressure sweeps across England. The Environment Agency issues severe weather warnings in the north-east. Much of Yorkshire and parts of north-east England are already saturated from the previous rain in June.

- 17 – 19 July: The Met Office issues an Early Warning of Severe Weather, tropical storms, mini tornadoes and torrential rain hit parts of England causing flooding and leave hundreds of people stranded.
- 20 – 22 July: Flooding reported across Gloucestershire, Buckinghamshire, Oxfordshire, Worcestershire, West Midlands and Warwickshire. Overnight on the 20/21 up to 10,000 people are left stranded on the M5 as drivers are forced to abandon cars. 500 people are stranded at Gloucester railway station as the railway network fails. Rest centres are set up for 2000 people unable to get home. In total 6,000 people stay in 10 rest centres overnight. A further £2 million of the Flood Recovery Grant is allocated.
- 22 – 23 July: Further flooding is reported in Herefordshire. Oxfordshire. Gloucestershire and in particular Tewkesbury, Gloucester and Oxford. Severn Trent Water's Mythe water treatment works in Tewkesbury is flooded leaving 350,000 without water for over two weeks. The fire and rescue service, the Armed Forces, the Environment Agency and the National Grid erect temporary defences at Walham electricity substation saving it from flooding and protecting 500,000 people from losing power. Central Networks' Castle Meads electricity substation is shut down; this leaves 42,000 people without power.
- 24 July: CLG announces a further £10 million to supplement the existing flood recovery grant made available to local authorities. Over 1 million litres of water have been distributed in Gloucestershire. A further 700 bowsers are also placed in priority areas in the county. The Red Cross launches its National Floods Appeal.
- 25 July: Flooding hits the Thames region and evacuations take place in Oxford. The Chancellor of the Exchequer announces a package of measures for individuals and businesses affected by severe flooding bringing forward legislation that will allow the Commissioners of HM Revenue and Customs (HMRC) to waive interest and surcharges on tax paid late due to the floods.
- 26 – 27 July: A heavy downpour of rain falls across England, causing localised flooding in Gloucestershire. A father and son are found dead at Tewkesbury Rugby club. They were attempting to pump water out of the premises, but were overcome by fumes from the pump. A further 2.5 million litres of bottled water are distributed, with over 1,000 bowsers now put out across Gloucestershire.
- 27 July: Department for Children Schools and Families (DCSF) announce they are providing £10 million funding designed to cover short term costs incurred in getting children back into schools by the start of term.
- 7 August: Water supply fully restored in Gloucestershire.
- 8 August: Sir Michael Pitt is appointed by the Secretary of State for the Environment, Food and Rural Affairs to chair an independent review into the floods of June and July 2007.
- 10 August: DCSF announce a £4 million funding package for schools and children's services in areas affected by the July floods.
- 14 August: Department for Culture Media and Sport (DCMS) announce a £1 million cash injection to promote tourism, rural destinations and visitor attractions.
- 16 August: £6.2 million was allocated under new flood recovery scheme announced from the July floods.
- 20 August: The Government submitted an application to the European Union Solidarity Fund (EUSF), requesting help in meeting the uninsurable costs of the floods.
- 24 August: a further £1.2 million was allocated from the flood recovery scheme.
- 5 October: The Red Cross begin making grants to local authorities and charities from its National Floods Appeal to support people affected by the floods.
- 10 October: The first EFRA select committee hearing.

- 10 December: CLG announce that the EU propose to grant EUSF aid totalling €162.388 million to help deal with damage caused by floods in England, Northern Ireland and Wales in June and July. The exchange rate was fixed at the rate at the time of application, so it is expected to equate to around £110 million (with a net value of £31 million).
- 17 December: The Pitt Review launch an interim report of initial findings on the lessons to be learnt from last summers floods.
- 31 January: A further £1 million was released to the 9 Local Authorities with a large number of households still displaced from the flood recovery scheme.
- 4 March: An additional chapter to the Interim Report, covering the recovery phase, is published.
- 17 March: Sir Ken Knight, the Government's Chief Fire and Rescue Adviser, publishes the final report on his review of the operational response and role of the Fire and Rescue Service during national flooding incidents.
- 6 May: The Government announces it is able to set up a Restoration Fund of almost £31 million for English local authorities affected by the floods to support their continued efforts to rebuild their communities because of the success of the UK in bidding for the EUSF.
- 7 May: Environment, Food and Rural Affairs Committee publish report on Flooding.
- 25 June: Pitt Review published.

The international context

Alongside evidence from the events of the summer and discussion of the wider UK context, the Review has also considered international best practice. This chapter explores how selected countries deal with the risk and impact of flooding. It contains sections on:

- managing flood risk;
- raising public awareness of flooding; and
- reducing the disruption on critical infrastructure.

Introduction

2.1 The summer floods of 2007 were a dramatic reminder of just how vulnerable the country is to major flooding. But our experience was by no means unique. To put the events into context, during 2007 there were over 200 major floods worldwide, affecting over 180 million people. The human cost of all the floods in 2007 was more than 8,000 deaths and over $23 billion worth of damage.[1] But even against that dramatic back-drop, the floods that devastated England last year ranked as the most costly flood in the world in 2007.

2.2 Flooding affects countries in different ways depending on climate, governmental structures and socio-economic conditions. The causes and types of flooding may differ for each country – for example, Canada and the United States face flooding from ice thaws, while countries such as Burma or Bangladesh face seasonal monsoon winds which bring massive rainfall. The Review has found that all countries face similar issues and problems, such as raising risk awareness, adaptation to climate change and the use of flood defences.

2.3 Countries are also reaching similar conclusions on how to deal with flooding, such as moving towards risk-based approaches to flood management, the need for better information sharing, and better warning and forecasting procedures. Seeing these approaches being taken internationally is an indication that countries can often learn from one another.

2.4 Since the interim report we have considered how other countries are dealing with the issues addressed by the Review. This has taken the form of a series of visits to the Netherlands, France, Sweden and the United States, as well as desk-based research. This international evidence forms an important part of our evidence base.

[1] Figures from the Centre for Research on the Epidemiology of Disasters, Université Catholique de Louvain, at www.cred.be

Managing flood risk

Climate change: a global challenge

2.5 The Review has found strong evidence that concerns about climate change are driving significant reform in flood risk management and related areas. Evidence of how seriously the international community is taking this includes the formation of the United Nations Intergovernmental Panel on Climate Change (IPCC) to evaluate the impact of climate change and provide advice to governments.

2.6 In the UK, both the *Foresight Future Flooding* report (2004) and the Stern Review (2006) have been internationally recognised as credible studies looking into climate change. Other countries such as Sweden, Iceland and Germany are taking similar steps in researching the effects and consequences of climate change on their own population and economy.[2] The Review recognises the importance of informing everyone – from the government to the general public – of the seriousness of climate change and its impact on everyday life. Some governments are still hesitant because the nature and pace of climate change is uncertain but, as the Swedish government report *Sweden Facing Climate Change* (2007) states, there is sufficiently robust information for governments to start adapting to climate change at once.

Sweden Facing Climate Change report, 2007

The Swedish Government's report *Sweden Facing Climate Change* (2007) evaluated the implications of possible climate change scenarios at the regional and local level, including an estimation of the costs. It addressed how the government should plan for the impact that climate change will have on Sweden, considered roles and responsibilities for government and authorities, as well as the impact climate change will bring in terms of economic development, agriculture, national infrastructure, communication, transport, tourism, the environment and human health.

The Swedish report reinforced the key message that climate change will have a dramatic impact on the country unless there is swift action from the government to adapt. The report stated that climate change will mean rising temperatures, causing dramatic changes in the weather, with more serious seasonal precipitation and more intensive torrential rain. This will increase flooding of lakes and watercourses, and threaten coastal settlements as well as towns and cities in low-lying areas. The increased frequency of flooding will have a considerable impact on buildings and critical infrastructure, such as dams; put a greater strain on existing drainage systems; and increase the chances of landslides. Small changes in seasonal differences will have a considerable impact on ecosystems and the biodiversity of natural habitats. The quality of Sweden's drinking water will be affected by increased flooding; there will be greater chances of chemical and microbial pollution; the increased frequency of flooding will threaten lives, particularly the vulnerable; and there will be an increased risk of water-borne diseases. Any predicted benefits from climate change will be heavily outweighed by the serious consequences from it.

While the scenarios in the report do not necessarily apply to countries other than Sweden, it does show the impact climate change could have on daily lives. For governments, it shows the need to adapt to climate change soon, the need for greater research into the effects of climate change on their country, and the need to improve current infrastructure to cope. For individuals, the report highlights the risks they will face from more frequent flooding, the individual costs involved from energy consumption and the impact on human health.

[2] The Swedish Government's *Sweden Facing Climate Change* report, 2007; the Icelandic Government's *Climate Change Strategy*, 2007; and the German Government report *Taking Action Against Global Warming*, 2007

Flood insurance

2.7 In the UK, flood insurance is usually provided as part of business and household insurance. Generally, this is not the case internationally. Other countries approach flood insurance differently and, while they may not necessarily apply directly to the UK-context, there are some issues which are of interest.

2.8 The immense economic losses following recent major flooding across the world have highlighted the need for proper financial arrangements to insure against losses. For example, damage from the central European floods in 2002 is estimated to have cost €18 billion,[3] of which only €3 billion was borne by private insurers. This resulted in the governments of the countries affected, such as Germany and Austria, bearing the majority of the costs. The European Union Solidarity Fund was in part created to address the burden EU member states were carrying in the event of a major natural disaster.

2.9 The insurance industry is best placed to cope and deal with flooding when flood cover is included in basic insurance policies. In many countries around the world, the failure to adopt this approach has led to low uptake. Flood insurance is widely available, but is usually offered as an extension of an existing policy, such as fire policy. Low penetration of flood insurance can be explained by the fact that customers deem the extra cover to be too expensive, as is the case in Canada, or that there simply is no need for extra flood coverage because there is an expectation that the state will provide financial assistance, as in Italy or Germany.[4]

2.10 A common strategy for increasing uptake of flood insurance is through outreach programmes and media campaigns, including campaigns targeting younger generations, which help raise awareness and encourage people to become more resilient and better prepared for flooding. The Review has found that countries such as the Netherlands and the United States are addressing the need to ensure more people are aware of the risks they are facing from flooding. Outreach programmes such as FloodSmart[5] in the United States form an important tool to change behaviour and encourage personal responsibility. Through leafleting, poster and radio campaigns, FloodSmart highlights the risk people face, and the economic and emotional impact of flooding. It has helped gradually to increase the number purchasing flood insurance in the US.

2.11 Other countries also recognise the importance of proper schemes to provide insurance coverage for low-income sections of society. In France, where flood insurance take-up is high, anyone who purchases car, home or business insurance is automatically covered for all natural disasters through a uniform surcharge. This has made insurance more affordable for the poorest living in areas at risk of flooding, who might otherwise have been excluded from flood insurance schemes simply because the premiums would have been too great a burden.

2.12 Considering flooding as one among many natural disasters provides a potential solution to some of the problems countries face in providing flood insurance cover for the vulnerable and poor, and in spreading the risk among policy-holders. However, setting the right premium to make the insurance programme sustainable has been one of the problems the French system has faced. Since its creation in 1982, it has had to be raised several times. Originally the premium was set at 9 per cent but has subsequently risen to 12 per cent, reflecting the increasing costs associated with some of the major disasters that have affected the country, such as the 2001 floods in north-west and central France. The French government has also had to make several injections of funds to make up shortfalls.

[3] Munich Re, *Annual Review: Natural Catastrophes 2002*, 2003
[4] Swiss Re, *Floods – An Insurable Risk? A Market Survey*, 1998
[5] The FloodSmart scheme is sponsored by the National Flood Insurance Program (NFIP).

Flood defence

2.13 Evidence from overseas shows that flood risk management needs to move on from hard defences to softer approaches. Hard defence structures have proven successful abroad, but questions are being raised about escalating costs in a changing climate. In the Netherlands, which has a strong tradition of investing in vast engineering flood defences such as the Deltaworks project, the concern is whether expensive flood defences are sustainable in the face of the challenge posed by climate change. The maintenance costs of the existing defences are increasing and the construction of new defences will also have to be funded.

Deltaworks project, the Netherlands

The Deltaworks project is a series of large dams, sluices and storm barriers, built to protect the Netherlands from flooding. After the devastating North Sea floods in 1953, which killed 1,835 people in the Netherlands alone, it has successfully protected the country from major flooding since the first storm barrier was completed in 1958. It is an example of the great lengths the Dutch government goes to defend the country from one of its biggest natural threats.

To understand why the Dutch government puts such massive investment into flood defences, we have to understand the scale of the risk that the Netherlands has always faced. Over two-thirds of the country is below sea level and some 90 per cent of its economic assets are under threat from flooding. The main rivers, the Rhine and Meuse, are far larger than those found in the UK, and the Netherlands effectively acts as the drainage basin for much of the water flowing from Germany, France, Belgium and Switzerland. In response to the scale of the problem, the Dutch government has invested heavily in flood defences to a very high standard – up to 1 in 10,000 year events for the central regions of the country. Whilst primarily built to defend the country from flooding, the Deltaworks project has also resulted in other benefits such as improved freshwater supply for agriculture, better transport links for business and thriving nature reserves.

The Dutch are realising the extent to which huge investment is required to maintain the Deltaworks project, particularly in light of future climate change predictions. Under current thinking, it is predicted that the dykes will have to be raised to mitigate the effects of rising sea levels and the dams will have to be closed more often in the future. This will result in a greater cost burden for maintaining the existing flood defence projects, which in turn will also have a knock-on effect on the costs of new defences. Dutch officials have told the Review that there is a concern as to how sustainable such projects are, and that the government is looking at risk-based measures to protect the country that will include use of flood mitigation techniques other than hard flood defences and raising public awareness and preparedness for flooding.

2.14 Alternatives to hard flood defence structures include approaches such as expanding river capacity in the Room for the River[6] project in the Netherlands. The Dutch are recognising that greater consideration should be given to moving away from simply raising dykes and hard defences, and towards increasing the capacity of rivers to cope with greater volumes of water. Although many of these alternative approaches are highly engineered and the Room for the River project still requires investment of over €2 billion, the Dutch government hope that the project will be sustainable and that working with natural processes will bring benefits including improving the quality of the environment of the river basin and building better capacity to cope with predicted climate changes.

Housing, land use and planning

2.15 Other countries have recognised that the problems caused by flooding and climate change are exacerbated by changes in land use. Increasing populations and expanding urbanisation have led to the hardening over of natural surfaces through paving and construction. The central European floods in 2002, which affected parts of Germany, Austria and the Czech Republic, have been partly attributed to urbanisation and the resulting increase in direct surface runoff into rivers.[7] The European Union recognises that building on flood plains has reduced natural absorption rates and increasing flooding incidences,[8] but European countries are by no means the only ones to acknowledge this. In fact, many studies across the world have found a direct correlation between urbanisation and increased river flows.[9]

2.16 Local and national governments play a central role in flood risk management. Legislative frameworks on building and planning are decided by the national government, but most planning decisions are exercised by local authorities on a case-by-case basis. In countries with low population density like the United States or Canada, flooding is less of a problem compared to countries with higher population densities like the UK. There have been instances in the United States where the authorities have relocated entire villages away from a flood risk area. However, in countries such as the Netherlands where land is at a greater premium, there is a recognition that better land use decisions have to be taken.[10] More attention is being paid to planning policy and a more stringent control of land use and development planning is being established, similar to the Planning Policy Statement 25 (PPS25) in the UK.

2.17 Increasingly, countries are turning to sustainable urban drainage systems (SUDS) to reduce the impact of development on flooding. As will be discussed in Chapter 7, SUDS are a range of sustainable methods of managing surface water runoff, such as swales, detention basins or permeable surfaces. In the German state of North Rhine-Westphalia, a programme of financial incentives has been used to encourage the development of new or retrofitted green roofs, a technique that can be used to reduce and control storm runoff. It has been a great success in encouraging homeowners to install SUDS[11] and shows that financial incentives can be effective.

Raising public awareness of flooding

2.18 Informing the public of the risks they face before, during and after a flood event is now commonplace, and most governments issue guidance on how to act in the event of a flood.[12]

6 The Dutch Cabinet Spatial Planning Key Decision, *Ruimte voor de Rivier*, 2006
7 Risk Management Solutions, *Central Europe Flooding, August 2002: Event Report*, 2003
8 EU Research: *Floods: Managing the risks of flooding in Europe*, at http://ec.europa.eu/research/environment/newsanddoc/article_3249_en.htm
9 A study of the Upper Thames Region watershed in Ontario, Canada, by N. Nirupama and S. P. Simonovic, *Is Urbanization Increasing Flood Risk?*, 2004
10 The Dutch government, *Policy Change for Flood Defence in the 21st Century*, 2006
11 G. Lawlor *et al, Green Roofs: A Resource Manual for Municipal Policy Makers*, 2006
12 Many countries researched have government-backed websites dedicated to giving public information on how to act in event of a flood. A selection of these include: *Public Safety Canada* (Canada) at www.publicsafety.gc.ca; Department of Civil Protection (Italy) at www.protezionecivile.it/cms/attach/vademecum_xi_1_19.pdf; or the *New South Wales State Emergency Service* (Australia) at www.ses.nsw.gov.au/topics/2227.html

They follow some key principles including use of clear and simple language, use of real-time data and explanations of any technical terms that might be used such as descriptions of risk levels.[13] A wide range of media are used, including television, radio and increasingly the internet, but also other sources such as mobile telephone or teletext services, as is the case in Germany, to cater for different audiences.

2.19 All the countries the Review has looked at recognise the central importance of raising the public's awareness of flooding. In the Netherlands, the Dutch population has grown accustomed to government intervention which has resulted in high levels of confidence that the government can stop flooding from occurring. We have been told that the success of engineering projects to keep water out for over 50 years, such as the Deltaworks project, has resulted in public complacency. People just do not believe that flooding will happen to them. In the Netherlands, a survey conducted for the Ministry of the Interior found that only 3 per cent of the population had made some preparations for flooding; 60 per cent were not aware of the risks they face; and 80 per cent felt safe in their environment.[14] The Taskforce Flood Management Organisation[15] (TMO) was created in 2006 to consider the country's state of readiness and re-educate the population as to the risks they face.

2.20 The ability of individuals and organisations to respond to flooding events is based on the accuracy and timeliness of information, including flood risk maps, weather forecasting and real-time data. The effective delivery of such information requires good cooperation between meteorological forecasters and hydrological centres, as well as the emergency services and the media. Both the Bayern Flood News Service[16] and the French central flood forecasting service (SCHAPI)[17] have developed similar visualisation tools that successfully convert all the flood data from real-time river monitoring systems into simple online maps. The colour-coded warning system corresponds to the flood threat level colour-coded systems, ensuring consistency. This visualisation allows the user to see easily whether rivers and localities are at risk from flooding.

2.21 Close cooperation between meteorological and hydrological forecasters enables more consistent, timely and accurate information to be delivered to the public. In Sweden, meteorology and hydrology services sit within a single organisation, the Swedish Meteorological and Hydrological Institute (SMHI), and this structure has facilitated consistent single-source information for public services such as emergency responders. France has also recently moved towards this model, with the creation of SCHAPI to ensure better collaboration with the French meteorological service, Météo-France. As will be discussed in more depth in Chapter 4, SCHAPI benefits from co-location with Météo-France. Closer cooperation has modernised flood forecasting in France, and has helped to ensure that warnings are accurate, timely and consistent. The re-organisation of SCHAPI has helped generate a high level of understanding among the public of flood warnings and what to do in event of a flood.

[13] European Exchange Circle on Flood Forecasting (EXCIFF), *Good Practice for Delivering Flood-Related Information to the General Public*, 2007

[14] The Ministry of the Interior and Kingdom Relations (BZK), *PerceptionAudit campaign*, 2008

[15] Taskforce Management Overstromingen (TMO)

[16] Bayern Hochwassernachrichtendienst, at www.hnd.bayern.de

[17] Central Service for Hydrometeorology and Flood Forecasting (SCHAPI) Flood Vigilance Maps, at www.vigicrues.ecologie.gouv.fr

Communicating risk to the public effectively

2.22 Greater public awareness of risk can help reduce the impact of floods on individuals. Communication strategies are an important component of any policy to manage the risks of flooding, as the Dutch government is recognising.[18] The provision of better information on the risk of floods and its consequences results in increased awareness and preparedness among citizens and businesses alike. The *Denk Vooruit* (Think Ahead) campaign has been central to the latest approach by the Dutch government in re-educating the public about the risks they still face. Its aims are simple: to raise awareness of existing risks; to clarify individual roles and responsibilities; and to outline action plans for members of the public. Its key message, 'Emergencies cannot be planned. Preparations can', encourages people to realise that they have the power to influence something that could happen to them. Television and radio advertising campaigns help emphasise the core messages, and websites have been set up which allow individuals to see what risks they face in their area, the probability of a disaster and the consequences for human health and well-being.[19]

2.23 Increasingly, awareness of flood risk also begins in the classroom. According to the International Strategy for Disaster Reduction report by the United Nations, initiatives aimed at teaching risk reduction to school children, help them "fulfil a role … to serve as agents of disaster risk reduction".[20] In countries as far afield as Bangladesh,[21] the Netherlands[22] and the United States,[23] learning kits have been developed to engage children through games, stories and rhymes, and then to teach concepts such as 'risk reduction' or 'hazards'. In France, risk education has been successfully integrated into the national curriculum to sensitise school children to risk reduction.[24] The joint initiative by the ministries of National Education, Health and the Interior has meant that risk education is part of the national curriculum for around 12 million students from primary to tertiary levels. Teachers are given training and are able to inform children of risks, preventive measures, survival techniques, emergency drills and their responsibilities in a disaster. Early indications in France suggest that the initiative has been successful in getting schools to develop specific risk reduction plans and carry out exercises.

Reducing the disruption to critical infrastructure

2.24 Countries are recognising that emergencies can and do cause severe and widespread damage to the functioning of society. Major terrorist attacks such as these on September 11, 2001 in the United States, the bombings in Madrid in 2004 and London in 2005, as well as serious flooding, have brought home to governments the need to put in place contingency plans to identify the threat to critical infrastructure and minimise disruption. The Review has found that countries are beginning to plan on an all-hazards approach, that tackles both security threats and natural hazards such as flooding.

2.25 Other countries are far more willing to share information about critical infrastructure than the UK. In France, there is a general openness about risk information. Local city mayors, responsible for public safety in their communes, have access to potentially sensitive information on critical infrastructure in order

[18] The Dutch government, *Policy Change for Flood Defence in the 21st Century*, 2006
[19] *Denk Vooruit* campaign at www.crisis.nl and the Risk Maps website at www.risicokaart.nl
[20] International Strategy for Disaster Reduction, *Towards a Culture of Prevention: Disaster Risk Reduction Begins at School*, 2007
[21] The 'Know Risk = No Risk' campaign in Bangladesh has been developed in the local language Bangla, and has been gradually introduced into primary and secondary schools in Bangladesh
[22] *Droppie Water* interactive website for children, at www.droppiewater.nl
[23] The Masters of Disaster education pack developed by the American Red Cross helps teachers to teach students about disaster safety by integrating core lessons into the regular curriculum, such as art, maths, science and social studies
[24] Article 5 of Law 2004–811, which was rephrased in the Education Code Article L.312-13.1
See www.assemblee-nationale.fr/12/proposition/pion2775.asp (in French)

to develop suitable local emergency plans in which utility operators are also involved. Even countries which were previously reluctant to disclose information on critical infrastructure and the impact of its failure from flooding are beginning to see the counter-argument for putting information in the public domain. The United States Army Corps of Engineers (USACE), the federal body whose responsibilities include engineering projects to mitigate flooding, has recently overcome its previous reluctance to publish inundation maps of dams. Maps are now published because this enables the USACE to warn the public to take the risk of dam failure seriously and prepare themselves accordingly.

2.26 The Review has also found that other countries have taken a more systematic approach to assessing the risks to critical infrastructure. As outlined in Chapter 15, plans such as the National Infrastructure Protection Plan (NIPP) in the United States and the Protection of Vital Infrastructure project in the Netherlands, show how some countries have developed strategies to analyse the vulnerability of critical infrastructure; to ensure the effective distribution of funding and resources to protect critical infrastructure; and to set out clear actions for operators to minimise the disruption and consequences of failure of critical infrastructure. These plans help to manage risks, threats and vulnerabilities of critical infrastructure more systematically and effectively.

Continuity of essential services

2.27 Businesses are becoming more aware of the need for business continuity planning to form an integral part of good business practice. Recent global events such as the central European floods in 2002 have highlighted the consequences of major losses to business and critical infrastructure. A survey of European business continuity management (Marsh, 2008)[25] has shown that there is greater business continuity awareness among European firms, and that firms are starting to see business continuity as good practice in the management of their overall operational risks. Businesses are moving away from seeing business continuity management as merely a compliance or insurance-related measure. But the Review has found that although business continuity is still in its infancy, governments can take a lead in promoting business continuity, as is the case in France.

2.28 The French government has recently passed a law on the security of critical infrastructure,[26] which includes a business continuity plan requirement. Set up in response to the recent influenza outbreak, the law applies more generally to the wider context of increased threats such as terrorism or flooding. The law requires individual operators to draft classified Operator Security Plans[27] which are known only by the operator and the government. Each plan is individual and is drawn up based on individual circumstances and the needs of the operator, but may include elements such as improving defences and setting out evacuation arrangements.

[25] Marsh, *The Upside to business continuity*, 2008

[26] Details from the French Republic's Decree No. 2006-212 on the security of important vital activities, *La Sécurité des activités d'importance vitale*, 2006

[27] Plan de Sécurité d'Opérateur (PSO)