Environment Agency

Flooding in England:

A National Assessment of Flood Risk

omes that are at threat from damage. Critical infrastructure such as water treatment works and power stations are often close to
ure. It is neither technically feasible nor economically affordable to prevent all properties from flooding. We therefore take a risk
cations for new building or development in flood and coastal risk areas. Our interventions help control development and preven
pact of flooding can reduce if we continue to invest in flood warnings and public information campaigns. They help householder

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Published by:

Environment Agency
Rio House
Waterside Drive, Aztec West
Almondsbury, Bristol BS32 4UD
Tel: 08708 506 506
Email: enquiries@environment-agency.gov.uk
www.environment-agency.gov.uk

Foreword

I'm very pleased to introduce the Environment Agency's first national assessment of flood risk for England. This is a major piece of work that brings together our latest scientific and engineering knowledge to describe clearly the risks of flooding from rivers and the sea. It underpins our future plans for investment in flood risk management as well as helping us to work together with our partners to protect the public and property from floods more effectively.

The events of the summer of 2007 demonstrated the major impacts floods can have. They also showed the importance of understanding the flood risks we face nationally so that we can be better prepared to face future risks. In all, around 5.2 million properties in England, or one in six properties, are at risk of flooding. More than 5 million people live and work in 2.4 million properties that are at risk of flooding from rivers or the sea, one million of which are also at risk of surface water flooding. A further 2.8 million properties are susceptible to surface water flooding alone.

The scale of the challenge we face in managing these risks may be daunting, but this report means that the Environment Agency and the organisations and people we work with can meet it more effectively. We must also make sure we build a better relationship between those at risk and those who manage this risk. Much more can be achieved by bringing all the interested parties together through the Environment Agency's strategic overview of all sources of flooding with a shared understanding of the risks.

While celebrating the advances that this report provides, it is important to remember that the technology and skills available to map and measure risk are still developing. Rising sea levels and increasingly severe and frequent rainstorms caused by climate change mean that the risk of flooding will increase. This assessment is one step in an ongoing journey that we must take to ensure that our understanding of the risks keeps pace with these changes. It will be regularly updated, improved and published to keep you informed and to help us work together to manage floods.

Paul Leinster
Chief Executive of The Environment Agency

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Summary – National assessment of flood risk

Introduction

The Environment Agency plays a central role in managing flood risk from rivers and the sea. We have the strategic overview role for flood risk management from all causes of flooding, including rivers, the sea, groundwater, reservoirs and surface water. This report explains how we tackle the risk of flooding in England, looking mainly at flooding from rivers and the sea.

Flooding is a part of nature. It is neither technically feasible nor economically affordable to prevent all properties from flooding. The Envrionment Agency's aim is to reduce flood risk and minimise the harm caused by flooding. We take a risk-based approach to achieve the best results possible using the budget and resources available. We are working to reduce both the likelihood of flooding and the impacts of a flood when it happens.

Managing the risks of flooding

Investment

Government recognises that it is important to invest in flood risk and coastal management and has committed to increase public spending on it from £600 million in 2007-2008 to £800 million in 2010-2011.[X]

A main part of the Environment Agency's role is to improve and keep in good order over 25,400 miles of flood defences that help to reduce flood risk from rivers and the sea in England. In 2008-2009 we spent approximately two thirds of our flood risk management budget, £427 million, on building, improving and keeping flood defences such as managed river channels, walls and raised embankments, flood barriers and pumps in good condition.

This investment provides tangible benefits. Between 2003-2004 and 2007-2008, improvements by the Environment Agency, local authorities and Internal Drainage Boards reduced the risk of flooding to over 176,000 households, and of these, 156,000 are attributable to the Environment Agency's flood defence improvements.

Investment in flood risk management represents good value for money. Most new flood defence schemes now built reduce expected damage by at least £8 for every £1 spent, significantly above the 5 to 1 target set by central government.

Development control

Locating property outside the floodplain is a prime way to reduce flood risk. If this is not practical, siting new buildings in areas of lowest risk is the next choice. Local planning authorities must now consult the Environment Agency on planning applications where the proposed development is at risk from flooding or is likely to increase the risk of flooding elsewhere.

The latest figures for 2007-2008 show that the Environment Agency's advice is, in the main, accepted. In cases where we objected on flood risk grounds, and where local planning authorities have advised us of the final decision, fewer than four per cent of these applications have gone ahead against our advice.

Warning and prepardness

Ensuring the emergency services and the public know where and when it will flood, and how serious the flooding is likely to be, is a complex task. The Environment Agency has increased the number of households and businesses offered a flood warning service. We have also launched a new National Flood Forecasting Centre with the Met Office that will allow us to better predict the scale and timing of flooding events and monitor them as they happen. This will ensure that the emergency services and other local responders focus their efforts where the imminent risks are greatest – a difference that could save lives.

[X] (£20m of investment originally budgeted for 2010-2011 was bought forward into 2009-2010 to provide an early start to projects that will benefit 27,000 homes when completed)

In 2008-2009, 55 per cent of people living in flood risk areas knew they were at risk and, of these, three out of five had taken some action to prepare for a flood. This may have involved checking their insurance, signing up to the Environment Agency's flood warning service, or installing flood resistance and resilience measures.

Who remains at risk of flooding

The Environment Agency's 2008 National Flood Risk Assessment shows there are 2.4 million properties at risk of flooding from rivers and the sea in England. Our preliminary assessment of surface water flood risk also suggests that one million of these are also susceptible to surface water flooding with a further 2.8 million properties susceptible to surface water flooding alone. In all, around 5.2 million properties in England, or one in six properties, are at risk of flooding. The expected annual damages to residential and non-residential properties in England at risk of flooding from rivers and the sea is estimated at more than £1 billion.

Floods can cause serious indirect impacts, including damage to important energy, water, communications and transport infrastructure. They can also interfere with basic public services such as schools and hospitals.

The National Flood Risk Assessment shows that a sizeable part of our important infrastructure and public services are in flood risk areas. This is especially so for water-related infrastructure that needs to be near rivers. For example, over 55 per cent of water and sewage pumping stations/treatment works are in flood risk areas, with 34 per cent at significant risk.

Protecting communities at risk

In consultation with many local organisations and groups the Environment Agency has produced Catchment Flood Management Plans (CFMPs) covering the main 68 catchments in England. These documents set out the strategic context for managing flood risk in a catchment, helping decision makers by identifying the policy options being adopted to manage flood risks. They also help form the position we take in our work to manage assets, watercourses, flood forecasting, and to help land use planning and development.

The CFMPs aim to promote the most effective approaches to managing flood risk, investing time and money to best effect. Even where it is not affordable or sustainable to maintain defence structures CFMPs should set out other ways of managing risk. Where possible we also aim to work with nature in reducing flood risk, allowing floodplains and river corridors to return to their natural condition. This improves habitat for wildlife, increasing, conserving and protecting areas like wetlands and salt marshes.

Investing for the future

It is likely that with climate change (which could lead to increased rainfall, river flows, and higher coastal storm surges) and development pressures, flood risk in England is going to increase in the future, with potentially the most significant changes likely to happen in the latter half of the century.

The Environment Agency has prepared a *Long-term investment strategy* that will allow us to understand future levels of risk and what investment may be needed to manage it over the next 25 years and beyond. The intention is that it will inform a public debate on how society should manage flood and coastal risk.

1. Introduction

The Environment Agency is the lead organisation for providing flood and coastal risk management and warnings of flooding from main rivers and on the coast. We are responsible for the strategic overview for all sources of flooding. This means we will advise and bring together the planning and management of flood risk from rivers, the sea, groundwater, reservoirs and surface water. Many different public and private bodies are involved in managing flood and coastal erosion risk, each accountable for different aspects of risk management. The Environment Agency's challenge is to help bodies such as local authorities, internal drainage boards, the Highways Agency and utility companies work together with us to achieve the Government's 'outcome measures' (see Table one on page 10).

This report sets out the main findings of the 2008 National Flood Risk Assessment and places particular emphasis on the role played by the Environment Agency in tackling the risk of flooding from **rivers and the sea** in **England**.

1.1. The causes of flooding

In England, the most common forms of floods are:

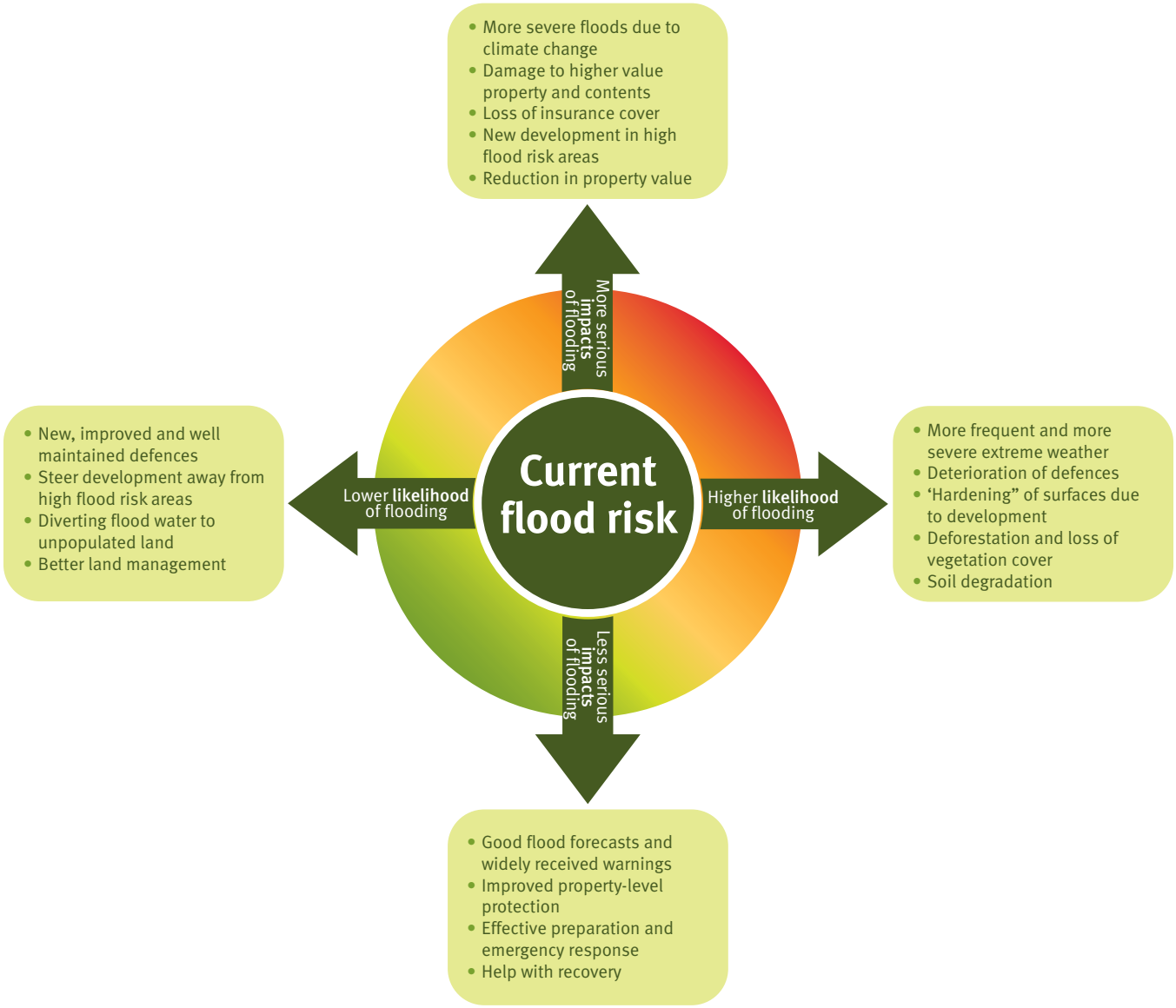
- **River flooding** that occurs when a watercourse cannot cope with the water draining into it from the surrounding land. This can happen, for example, when heavy rain falls on an already waterlogged catchment.
- **Coastal flooding** that results from a combination of high tides and stormy conditions. If low atmospheric pressure coincides with a high tide, a tidal surge may happen which can cause serious flooding.
- **Surface water flooding** which occurs when heavy rainfall overwhelms the drainage capacity of the local area. It is difficult to predict and pinpoint, much more so than river or coastal flooding.
- **Sewer flooding** that occurs when sewers are overwhelmed by heavy rainfall or when they become blocked. The likelihood of flooding depends on the capacity of the local sewerage system. Land and property can be flooded with water contaminated with raw sewage as a result. Rivers can also become polluted by sewer overflows.
- **Groundwater flooding** that occurs when water levels in the ground rise above surface levels. It is most likely to occur in areas underlain by permeable rocks, called aquifers. These can be extensive, regional aquifers, such as chalk or sandstone, or may be more local sand or river gravels in valley bottoms underlain by less permeable rocks.

1.2. A risk-based approach to managing floods

Floods are part of nature. It is not technically feasible nor economically affordable to prevent all properties from flooding. Therefore a risk-based approach is taken to achieve the best results possible using the budget and resources available. As almost all of the Environment Agency's funding has historically come from the taxpayer, we have a responsibility to ensure we achieve as much benefit as possible from the funds provided. These include benefits for people, the economy and the environment and all are valued when we identify the need for investment in flood risk management. The balance of priorities within the programme is determined by the 'outcome measures' announced by Defra in 2008 (see Table one below).

Our aim is to minimise the harm caused by flooding. This involves **reducing the likelihood** of flooding and **reducing the impacts when flooding occurs**. At the same time there are underlying **pressures** that are increasing risk, such as climate change, housing development or changes in land use. Sometimes we can affect these drivers, for example by influencing planning and land development. There are, however, other drivers that are beyond our direct influence, such as climate change impacts on the weather and sea level rise. Figure one shows some of the things that can change the risk of flooding.

Figure one: Managing flood risk – addressing likelihood and impacts



2. Managing the risks of flooding

The risk of flooding is a product of both the flood event itself and the vulnerability of the person, property or environment exposed to the event. The Environment Agency want to reduce the likelihood and the effects of flooding and our 2009-2015 strategy for managing flood risk is currently under development and will include:

- A policy framework that sets principles, objectives and responsibilities.
- Flood risk assessment and flood mapping to understand which places are most at risk and in what circumstances.
- Development control through the planning system to prevent and reduce the risk to new developments and to ensure development in one place does not cause problems in another.
- Constructing and maintaining flood defences and other techniques for controlling or containing the flow of water from entering an area.
- Protective measures at individual properties to keep water from entering them, and to reduce the damage if water does enter.
- Protecting of important infrastructure to avoid any secondary impacts associated with flooding including loss of energy, water, telecoms, transport and other public services.
- An early warning system that forecasts floods and provides personalised warning information in the best way, for example, using the internet, telephones, and television and radio broadcasts.
- A well-prepared emergency response to help people in danger and protect as many properties as possible from flooding.
- Strong and reliable insurance to spread risks and ensure coverage to as many properties as possible, so householders and business owners can recover quickly.
- Help with clean-up and recovery.
- Funding to support the flood risk management strategy.

Following the Pitt Review of the 2007 floods, the Government has given the Environment Agency a strategic overview role:[1]

The Environment Agency will have a new strategic overview role for all forms of flood risk, including groundwater and surface water for which no body has previously been clearly responsible. The Environment Agency will lead and co-ordinate the planning and management of all sources of flood risk while retaining operational responsibility for main rivers and coastal flooding. The Environment Agency will work closely with local authorities on their on-the-ground management of surface water flooding so comprehensive assessments of local flood risk will be possible for the first time.

The rest of Section two gives an overview of the approach to flood risk management outlined above.

2.1 Strategy and policy framework

There is a hierarchy of strategic documents, varying in detail and geographical scale, which define the overall response to flooding. We describe these briefly in the following paragraphs.

2.1.1 Strategy and policy

Government strategy

Making space for water (2005) sets out the cross-government, overarching strategy for flood and coastal erosion risk management in England.

The Government's strategy has continued to evolve and broaden. For example:

- *The Climate Change Act (2008)* requires a UK-wide climate change risk assessment every five years accompanied by a national adaptation programme that is also reviewed every five years. The Act has given the Government new powers to require public bodies and statutory organisations such as water companies to report on how they are adapting to climate change.
- *Future Water (2008)* The Government's overall strategy for water looks mainly at water supply and provision. It reaffirms *Making space for water* as the basis for managing river and coastal flooding. However, it also sets out a vision for better management of surface water to address the dual pressures of climate change and housing development.
- *The Pitt Review (2008)* following the 2007 floods made 92 recommendations.[2] The Government supports changes that will help achieve them all.[3] In particular, there is now increasing attention paid to surface water flooding, a main cause of damage in the 2007 floods. The new Floods and Water Management Bill, published in April 2008 for public consultation and pre-legislative scrutiny, will provide the legislation needed to carry out further work in this area.

Flood risk management outcome measures

The Government sets outcome measures[4] for the Environment Agency and other operating authorities that work with us to manage flood risk. These form the basis by which we set priorities for investment decisions. The five outcome measures are used to develop new flood and coastal erosion risk management schemes and these appear in table one. The targets show what the capital programme – that is, spending on flood defence upkeep and improvement projects – is expected to contribute to these measures over the period 2008-2009 to 2010-2011. There are a further four outcome measures that have set, or are developing, targets for the Environment Agency on flood warning, contingency planning, preventing inappropriate development and long term policies and action plans.

Table one: Government outcome measures for the Environment Agency and other Operating Authorities

Outcome measures for 2008-2009 to 2010-2011	Definition	Minimum target
Economic benefits	Average benefit cost ratio across the capital programme based on the present value whole life costs and benefits of projects completed in the period 2008-2009 to 2010-2011.	Five to one average with all projects having a benefit cost ratio strongly greater than one.
Households protected	Number of households with increased standard of protection against flooding or coastal erosion risk.	145,000 households of which 45,000 are at significant or greater flood risk.
Deprived households at risk	Number of households in the 20 per cent most deprived areas for which the likelihood of flooding reduces from significant or greater risk.	9,000 of the 45,000 households above.
Nationally important wildlife sites	Hectares of SSSI land where there is a programme of measures in place, agreed with Natural England, to reach target condition by 2010.	24,000 hectares.
UK Biodiversity Action Plan habitats	Hectares of priority Biodiversity Action Plan habitat including intertidal, created by March 2011.	800 hectares of which at least 300 hectares should be intertidal.

European policy

European Union Directives, including the Water Framework Directive (2000/60/EC) and Floods Directive (2007/60/EC), require consolidated river basin management planning, assessment and mapping of hazards and risks, and preparation and use of flood risk management plans. The frameworks set out in the directives closely match those already applied in the UK.

Development control strategy

Planning Policy Statement 25: Development and Flood Risk (2006) sets out the Government's approach to the use of the planning system to reduce flood risk. Under this guidance, Regional Strategies and Local Development Frameworks must include and account for flood risk. These are the core planning documents for regional bodies and local authorities respectively. Local authorities have a duty to carry out, with the Environment Agency, a Strategic Flood Risk Assessment. This forms part of the evidence base that contributes to Local Development Frameworks.

Local flood management strategy

Catchment Flood Management Plans (CFMPs), the Environment Agency will produce CFMPs for 68 main catchments in England during 2009. They are high-level planning tools and set out objectives for flood risk management across each river catchment and estuary. They also identify flood risk management policies that are economically practical, have a potential life of 50 to 100 years, and will help us work with others to put them in place. The CFMPs consider inland flood risk from rivers, surface water, groundwater and tidal flooding but do not cover sewer flooding. However, at present our understanding of river and tidal flooding is stronger than that from other sources.

Shoreline Management Plans (SMP) are mainly produced by coastal groups/local authorities and perform a similar role to CFMPs but examine coastal flooding and erosion risks. SMPs cover the entire coastline. These are under review, with second generation SMPs due for completion by 2010.

2.1.2 Responsibilities

Many bodies and agencies have responsibilities to help tackle the risk of flooding. These are some of the organisations involved:

Table two: organisations responsible for flood risk management

Department for Environment Food and Rural Affairs (Defra)	Defra has national policy responsibility for flood and coastal erosion risk management and provides funding through grants to the Environment Agency.
Environment Agency	The Environment Agency is the principal flood risk management authority in England and Wales. It is responsible for forecasting and mapping flood risk, providing warnings, advising on development in the floodplain, building and keeping defences in good order and taking part in emergency planning and response. The Environment Agency manages central government grants for capital projects carried out by local authorities and internal drainage boards.
Local authorities	Local authorities lead in reducing risks from development in the floodplain and management of drainage and small watercourses. They will play an increasingly important role in helping to manage the risks associated with surface water flooding. They also take the lead in emergency planning for flooding and handling the recovery of areas that have been effected by flooding.
Internal drainage boards (IDBs)	IDBs are independent bodies responsible for land drainage in areas of special drainage need. These are mostly low-lying areas that need active management of water levels.
Regional flood defence committees (RFDCs)	RFDCs have a duty to take an interest in all flood matters in their area. They are responsible for decisions about the annual programmes of improvement and maintenance work carried out by the Environment Agency.
Local resilience forums (LRFs)	These are the local planning forums for all emergencies, including flooding. They bring together the emergency services, Environment Agency, NHS and other bodies like water and energy companies. Together they plan for prevention, control and reducing the impact of floods on the public.
Insurance industry	The Association of British Insurers (ABI) and its members is vital in providing cover and handling claims for damages caused by a flood. Under an agreement with the Government, they have committed to continue insurance coverage for most properties, even some at significant risk, in return for action by government to identify and manage risks.
National Flood Forum	A registered charity providing advice to those at risk and campaigning for better protection from flooding.

Flood risk assessment - understanding the risks

Assessing and mapping flood risk is a complex skill. Over many years the Environment Agency has developed increasing understanding of where and when flooding could happen and how serious it might be. Such assessments are a crucial undertaking on which all the other measures depend. They involve modelling the behaviour of the sea and river basins in different weather and tidal conditions, and matching this to knowledge of land topography to see where floods are likely to arise and how often.

There are two main mapping approaches covering flooding from rivers and the sea:

- **The Flood Map** is for use by property owners and local authorities and shows where floods may occur and how severe they could be. It is a map of natural floodplains showing areas that could flood if no defence structures were in place. It uses the same risk categories as local authorities and its data contributes to local planning authority decisions. It also helps property owners recognise risks and prepare for floods. The Flood Map is available from our web site. Users enter a postcode to see the area of the Flood Map in which they have an interest.
- **The National Flood Risk Assessment** presents risk and vulnerability in greater detail. It differs from the flood map because it considers the impact of flood defence structures and other measures that reduce risk. Its purpose is to contribute to flood risk management policy and investment priorities, and to help insurers in setting risk-based premiums and excesses.

Our approach to flood risk mapping is constantly improving as we develop our knowledge and technical capacities. We have produced initial maps of areas susceptible to surface water flooding and provided this to LRFs. The accuracy of these is being developing and they are not yet suitable for a house by house assessment of risk. These will provide further help to local authorities with emergency planning and in their new local flood risk leadership role, including action to tackle surface water risks.

2.2 Planning and development – living out of harm's way

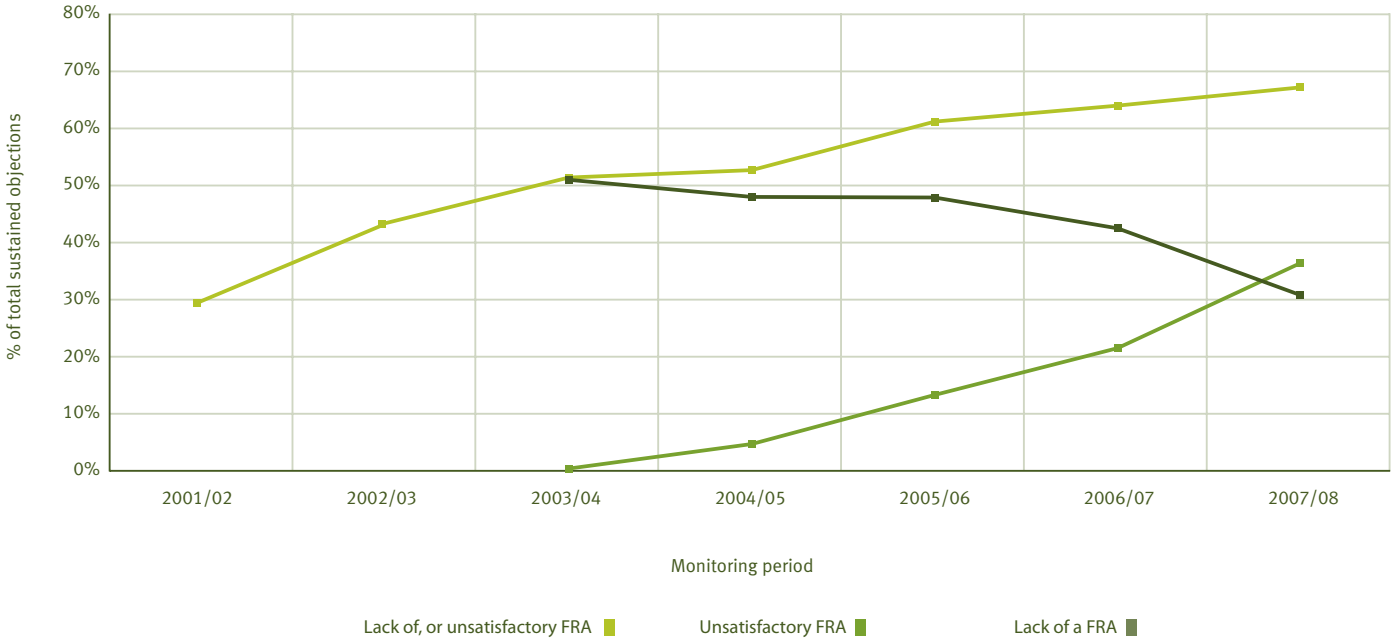
2.2.1 Development

Building property and putting other assets away from the floodplain is the best way to reduce risk. If this is not possible then development should take place in areas of low flood risk. The Government's Planning Policy Statement 25 (PPS 25)[5] requires that flood risk be a consideration at all stages of a planning application. This will help avoid development in areas at risk of flooding, and discourage building in areas of highest risk. In exceptional circumstances, where development is necessary in such areas, the policy aims to ensure that it is safe, to reduce the risk and to avoid displacing flood risk to other areas.

Local planning authorities in England must consult the Environment Agency on planning applications where the property is at any risk from flooding. Developers must also produce a Flood Risk Assessment (FRA) to show their development proposals comply with planning policy on flooding. The Environment Agency provides technical advice to local planning authorities and developers on how best to avoid, manage and reduce the adverse impacts of flooding. We may also object to planning applications that are inconsistent with government policy, where the flood risk assessment is inadequate or if the tests to see if a development is acceptable have not been carried out correctly. Local authorities have to balance many development objectives and pressures, and can sometimes reject Environment Agency advice. In cases where planning authorities choose to grant planning permission for big developments against our recommendations, the Secretary of State will have notice of this and may 'call-in' the decision. The Association of British Insurers has said that its members will not necessarily offer to insure new properties sited in areas of flood risk.

Figure two shows that around two-thirds of our objections to planning applications arise from an inadequate or absent FRA. These are necessary to ensure proper consideration of flood risks before any development takes place in the floodplain. However, if local planning authorities and applicants use the standard planning application form, the checklists and PPS25 Practice Guide, all introduced in 2008, the number of planning applications with good-quality FRAs should increase.

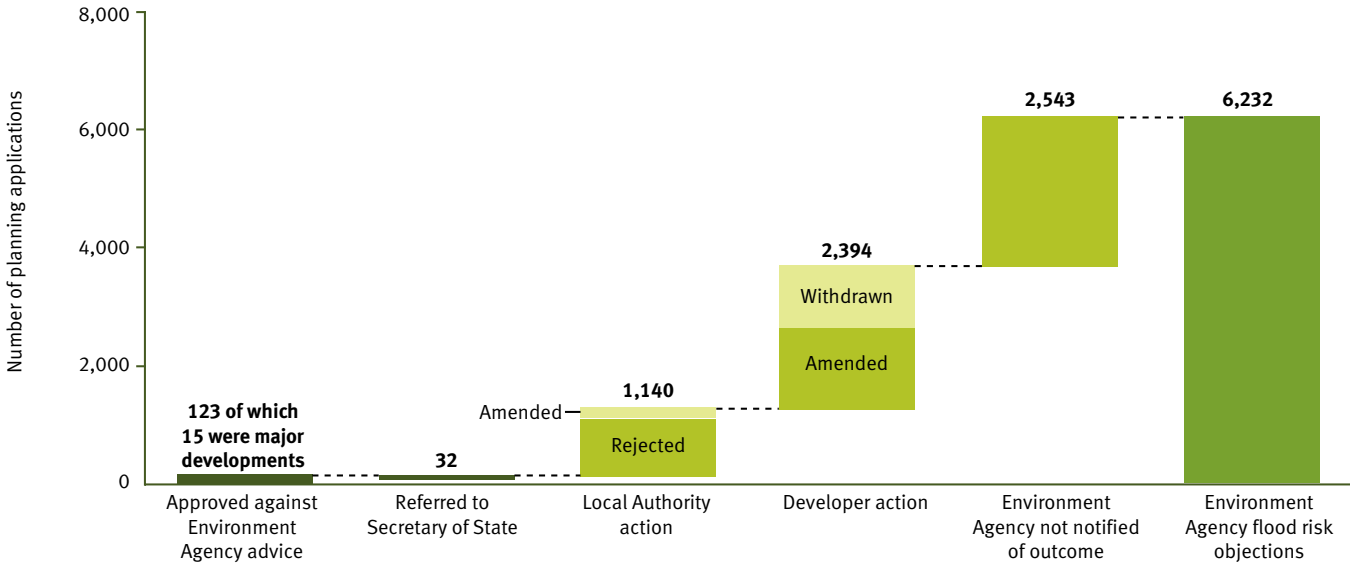
Figure two: Sustained objections to planning applications on the basis of a lack of a satisfactory FRA



If we are to prevent inappropriate development in flood risk areas we must give the highest quality technical advice to local authorities. Our success in this is partially measured through Government's 'High-Level Target 5' which records how many times local planning authorities accept or reject our objections.

The latest figures for 2007-2008 show the impact of our advice. In cases where the Environment Agency objected on flood risk grounds, and where local planning authorities advised us of the result, less than four per cent of applications gained approval. This was usually because developers agreed to changes in their proposals, they withdrew their application, or there was a refusal of planning permission from the local planning authority. Only 15 big developments gained approval against our advice. There are still too many applications where we object but do not receive notice of the eventual decision. However, independent research shows there is no difference in the results of those cases where local planning authorities report their decisions to the Environment Agency, compared with cases where they do not.

Figure three: Resolution of Environment Agency flood risk planning objections in England 2007-2008



2.2.2 Existing communities

Though the Environment Agency can influence the planning process and work to stop developers building inappropriate properties in risk areas in the future, it must be remembered that there are some 2.4 million properties already built in the floodplain.

Sometimes, natural events such as coastal erosion or sea level rise increase the risk of flooding to a point where it is technically impossible or financially impractical to continue a policy of defence. The Environment Agency and local government must then make difficult economic judgements as we both have a duty to achieve the maximum benefit to society and we may achieve more by defending properties elsewhere. These difficult decisions sometimes call for carefully managed realignment of the coast and floodplain to reflect the natural changes that happen over time. The long-term planning framework set out in catchment flood management plans and shoreline management plans will help with this.

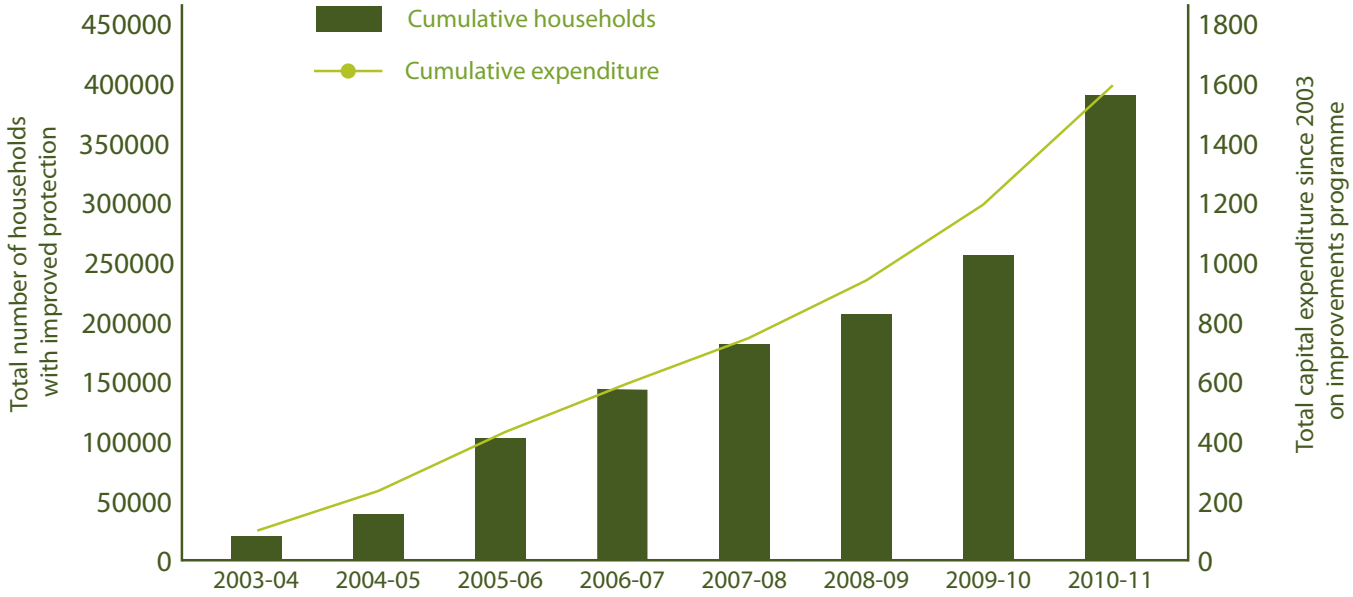
2.3 Protecting communities in the floodplain – flood defences

One of the Environment Agency's main roles is to build, improve and keep flood defences such as maintained river channels, raised embankments, floodwalls and culverts in good order to reduce flood risk from rivers and the sea. This work consumes the largest share of our budget by far. We also build and keep in good order sluices, outfalls, floodgates pumps and barriers, such as the Thames Barrier. These reduce flood risk and manage water levels.

The Environment Agency is responsible for some 25,400 miles of flood defences and about 36,000 sluices, outfalls, floodgates and barriers in England. Using the average cost of building each of the different defences, and applying these to our database of flood defence structures, we estimate replacing all defences that we maintain would cost over £20 billion.

We spend most of our budget on improving flood defences and keeping them in good order. In 2008-2009 we spent £427 million on this. This was 65 per cent of our flood and coastal risk management budget. This investment gives tangible benefits. Between 2003-2004 and 2007-2008, improvements achieved by us, local authorities and Internal Drainage Boards reduced the risk of flooding to more than 176,000 households. Of these, 156,000 are attributable to the Environment Agency's own flood defence improvements.

Figure four: Cumulative number of households benefiting from reduced likelihood of flooding since 2003-2004 (England)



We are planning to increase spending by 20 per cent in real terms by 2010-2011 to improve flood defences and keep them in good working order.[6]

The large base of flood defence assets needs continuous maintenance, and this is the second largest call on our budget after our work to improve assets. We routinely carry out visual inspections of all river and coastal flood defences using a risk-based priority programme, assessing their condition and identifying any causes for concern. We give each asset a grade: very good, good, fair, poor or very poor. Based on what defence it is, and the impact of flooding and the visual condition, we decide if a defence is in a satisfactory state, or if it needs further investigation or improvement.

The Environment Agency's work aims to ensure that 95 per cent of our assets perform as designed during a flood event.

Figure five: Condition of linear defences

Source: Environment Agency, (England and Wales February 2009).

Table three: Flood risk management asset condition (England and Wales, December 2008)

Percentage of assets that perform as designed	Defences such as flood walls and embankments	Structures such as pumping stations, barriers, sluices and outfalls
Upkeep by Environment Agency	95	96.4
Upkeep by third party	87.2	96.5
All assets	92	96.4

Summer 2007 put our flood defences to the test. Despite facing some of the biggest downpours ever recorded in many parts of the country, 99.8 per cent of our flood defences performed as designed. We estimate that they protected more than 100,000 properties from flooding. Our experience is that fewer than one per cent of the impacts from flooding result from failure of flood defences.

Following the 2007 review by the National Audit Office and Public Accounts Committee[7], we are making the following improvements to how we manage flood defences:

- Our asset management planning is helping to set priorities for spending on the highest flood risk areas. This planning will detail the full cost, both now and in the future of the building, running, upkeep and replacement of flood defences. It will also set out the benefits of having the defences and reducing the damage from flooding.
- We have prepared a new *Long-term investment strategy* to make the best use of funds, and to ensure success in meeting the objectives for flood risk management investment.

We are continuously updating and improving our database of flood defences and their condition. This is helping us target investment more precisely to where there is most need.

2.4 Defending individual properties – resistance and resilience

It is impossible and impractical to reduce all flood risk, or to defend against all possible floods in all places. However, it is possible to reduce the impact of a flood at the individual property level through flood resistance and resilience measures. Flood resistance measures, such as door guards, help prevent floodwater getting into a property. Resilience measures are those that minimise the damage when floodwater is in a property. A typical example is water resistant wall plaster.

The cost of damage to property as a result of a flood can be great. According to a report prepared for Defra, repairing a house after a flood can cost between £10,000 and £50,000 depending on the flood depth.[8] Defra also found the costs of applying resistance measures, such as waterproof doors, windows and airbricks, can range between £3,000 and £10,000 for a whole house. While the cost of such measures can appear expensive, some may not cost more than the standard repairs and are likely to pay for themselves after a single flood event.

The Environment Agency provides advice to property owners on how to prepare for a flood and are developing additional guidance about self-help home protection measures for householders, businesses and the building contractors that fit them. The National Flood Forum, a registered charity, provides information on products and techniques for protecting individual properties. The Association of British Insurers also encourages improved property level protection.[9] Some insurers already include flood risk information with renewal notices. This is expected to become increasingly widespread as we continue to refine flood risk mapping, identifying vulnerable properties with greater accuracy.

2.5 Protecting important national infrastructure and keeping essential services running

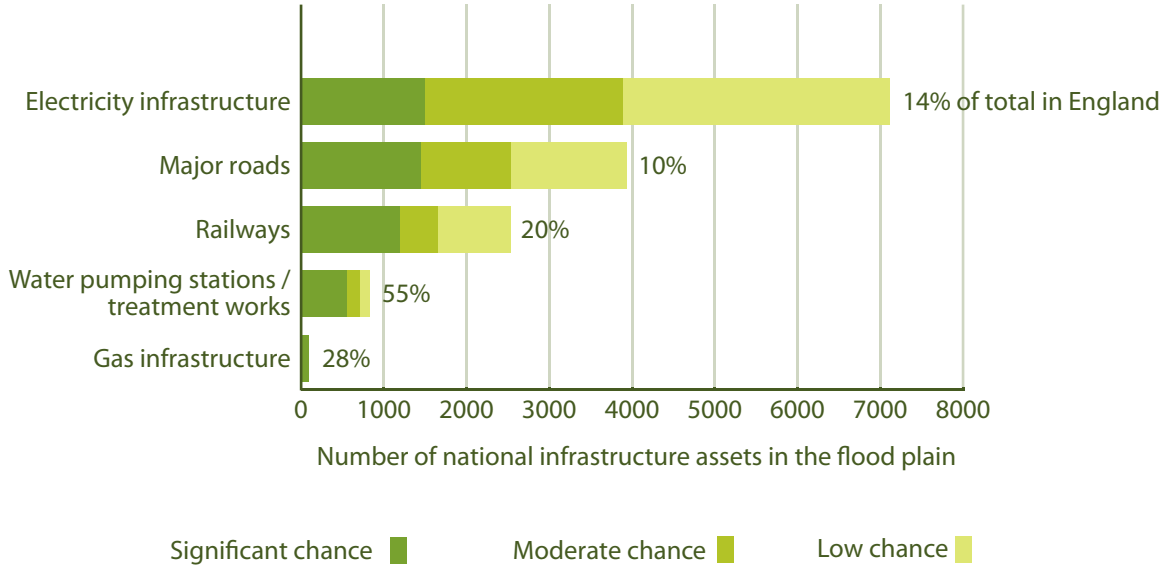
Floods can cause serious indirect impacts, including damage to important energy, water, communication and transport infrastructure. They can also interfere with basic public services such as schools and hospitals. For example, the 2007 floods disabled major infrastructure in Gloucestershire. Flooding at Tewkesbury's Mythe water treatment works left 140,000 homes without clean water for up to 17 days. It was also necessary to shut down Castle Meads electricity sub-station, leaving 42,000 people without power in Gloucester for 24 hours. Flooding on the M5 motorway trapped 10,000 people, with many others stranded on the rail network. A big effort to set up temporary flood defences at Walham electricity substation saved the power supply to 500,000 people in Gloucestershire and South Wales.[10] Other vulnerable infrastructure includes emergency service stations and headquarters, which may also be part of the response, and important public services such as hospitals, schools and care homes.

The 2008 National Flood Risk Assessment which provides the information in this report, identifies the number and types of important infrastructure and public services in flood risk areas. Water-related infrastructure like treatment works need to be close to rivers as their running depends on them. As a result, a high percentage of water company plant is in flood risk areas. For example, more than 900 pumping stations and treatment works, over half of those in England, are in flood risk areas.

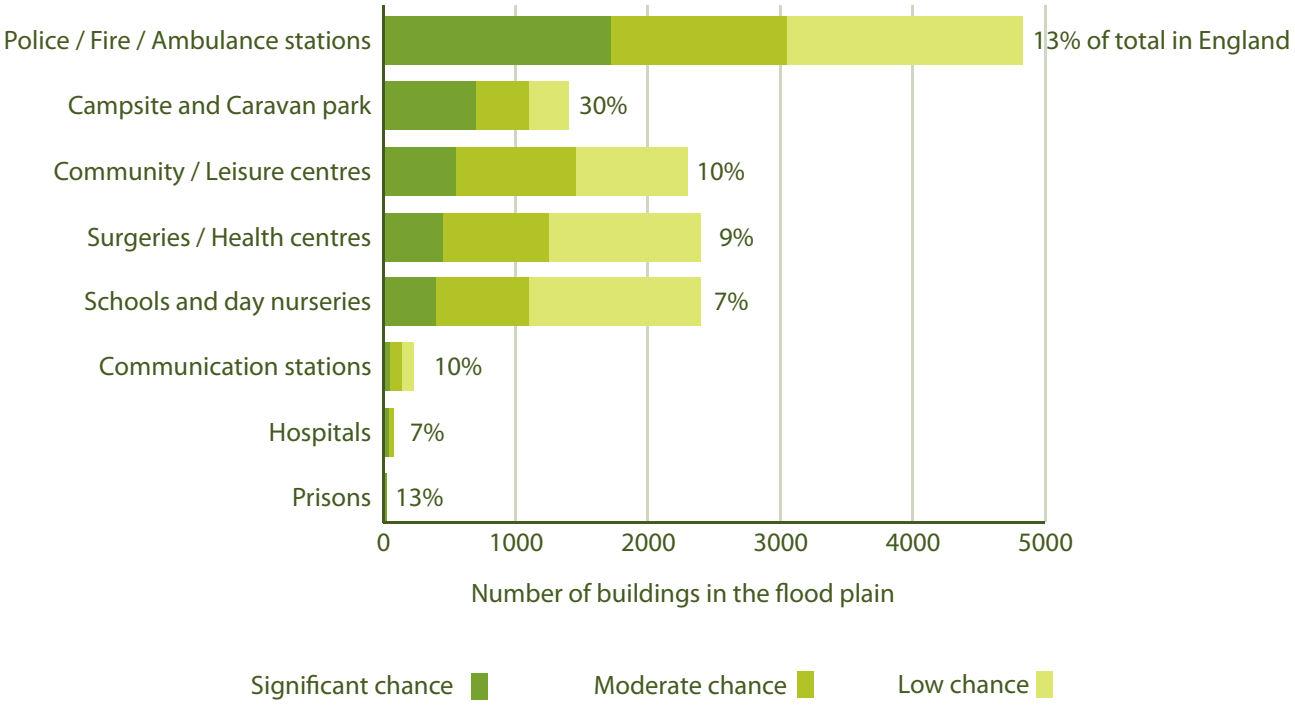
Other types of important national infrastructure are also at risk. About 7,000 electricity infrastructure sites, some 14 per cent of all in England, are at flood risk. In addition, about 10 per cent of main roads and 21 per cent of railways are at risk. It is important to assess the potential impact of flooding on these infrastructure sites. A loss of, or interference in, basic services may affect a wide area where many people also face the clean-up and recovery from a flood.

Figure six: National infrastructure assets in flood risk areas.

Transport and utilities infrastructure



Other services



Local resilience forums (LRFs) perform the basic co-ordinating role at local level for preparing for emergencies, including flooding. The Environment Agency works with LRFs and emergency services to help protect important infrastructure and utility supplies. We are also providing a warning service to infrastructure operators through Floodline Warnings Direct.

Both economic regulators in the water and energy industries, OFWAT and OFGEM, are responding to the problem of defending important infrastructure. They are considering how to finance further investment in protecting this infrastructure through the pricing reviews that allow the recovery of costs through customer bills.

2.6 Flood forecasting and warnings

Ensuring the emergency services and the public know where and when it will flood and how serious the flooding will be is a complicated task. Often the first step is linking a weather forecast to a model of how a river basin or coastal system behaves during flood conditions. This helps set out the scale, timing and location of the anticipated flood risk. We then issue a warning to people at risk with sound, specific information about what they should expect. All this needs to happen quickly and in a way that allows the emergency, utility and essential public services to prepare, and that gives people enough time to protect themselves, their family and their homes. There is a balance to strike between the need to provide advice and warnings in good time, and the risk that false alarms will lead to loss of confidence in the system.

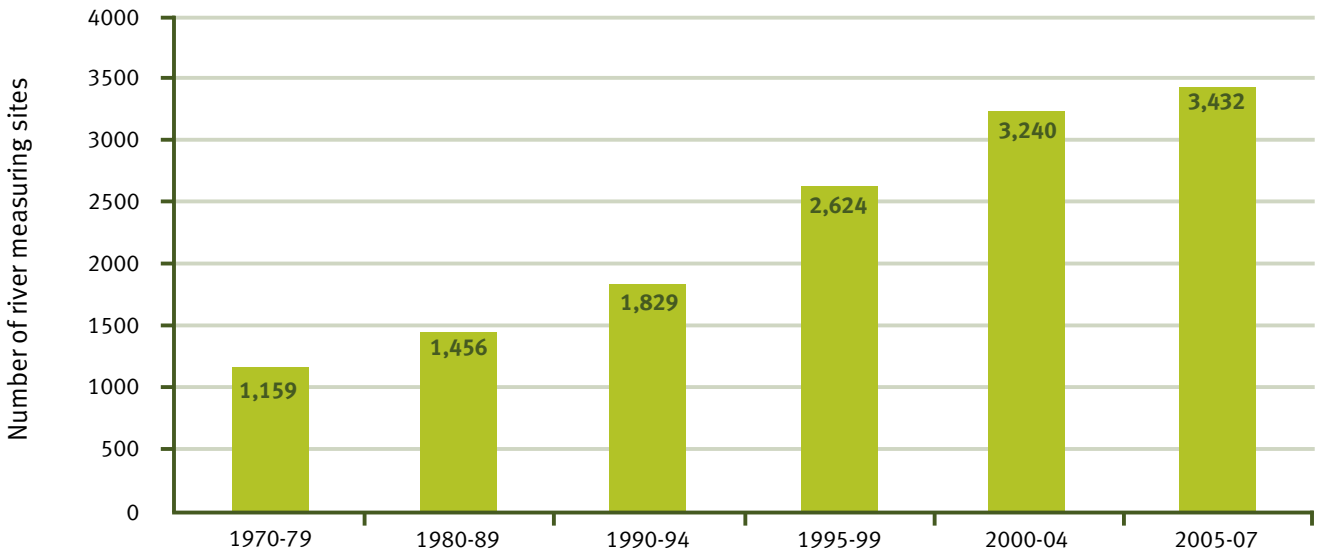
We provide advice to different audiences: to householders, businesses, public services, electricity and water companies, transport operators and to those involved in responding to a flood. Each audience has different needs and our communications must provide the information that will help them take the right actions at the right time.

2.6.1 Detecting and forecasting floods

The Environment Agency is constantly developing tools to make flood forecasting more accurate and detailed. The Met Office uses large and complex computer models of the atmosphere to help predict rainfall amounts and the scale of tidal surges. With the Met Office, we have developed a joint national Flood Forecasting Centre that brings together highly skilled hydrologists and meteorologists into one team that can give much better unified forecasts. Information provided by the Flood Forecasting Centre feeds into our computer models of rivers and coastal areas to predict the scale and timing of flood risks for specific areas.

Getting accurate and timely weather and flood predictions depends on forecasters receiving live data telling them what is happening in the atmosphere, on land and in the sea and rivers. We have increased the number of gauging stations and river level data sites in recent years – see figure seven. This is helping to improve the quality of computer models and the forecasts we can make. More tide level and wave gauges are also contributing to increased accuracy of forecasts for coastal flooding events.

Figure seven: Number of river measuring sites available to help identify flood risk



Source the Environment Agency

We are working with partners to develop new ways of presenting information on flooding. These will help flood-risk managers, and emergency planners and responders, understand what is happening and so do their job with more confidence and knowledge.

2.6.2 Warning and communicating about floods

To be useful, flood warnings need to get to the people who need them in good time. Those who receive them also need to be ready and prepared to take action.

Since 2005-06, we have progressively made our flood warning service available to more households and businesses at risk. In 2007-08, 61 per cent of properties at risk across England and Wales could receive a flood warning if needed. This was ahead of the target agreed with Government. Our present aim is to make our flood warnings available to 72 per cent of households and businesses at risk in England and Wales by April 2010-11 and 80 per cent by April 2013. We are on track to achieve this.

We issue flood warnings when our measurements of river or sea levels reach a threshold or trigger level, or when our forecasts show that high-water levels are imminent. We use forecasts made for 1,163 river level locations and 805 coastal locations to ensure our flood warnings are as accurate as possible for local communities.

Table four: Percentage of properties offered a flood warning

Percentage of properties offered a flood warning	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11
England and Wales achieved	20	51	61	—	—	—
England and Wales target	19	30	57	62	67	71

Our flood warnings service, combines services provided directly to those at risk, and information that is available to anyone by telephone, the web and the media. The service currently covers risk of flooding from rivers and the sea.

Our flood warning services

Floodline Warnings Direct (FWD) service provides flood warnings to the at-risk public by telephone, mobile, e-mail, SMS text message, fax or pager. By April 2009 over 430,000 people in England and Wales were registered on FWD, and numbers have grown every year since we introduced the service in 2004. In February 2009 we warned more than 50,000 people in one day, providing information about the developing flood risk across southern and eastern England.

Floodline (0845 988 1188) our 24-hour telephone helpline gives the public access to up-to-date information about flooding anywhere in England, Wales and Scotland. In 2008 Floodline received more than 290,000 calls. Over the last 10 years people have dialled the Floodline number more than 2,540,000 times.

The Environment Agency's Customer Charter states that. *We will provide flood warnings at least two hours before flooding happens in areas where a service can be provided.* During the 2007 floods four-fifths of our warnings achieved this standard, despite the almost unprecedented intensity of the rainfall.

We regularly carry out public surveys to understand people's awareness of flood risk and the extent to which they have prepared for the eventuality of a flood. By April 2009 the number of people living in flood risk areas that know they are at risk had risen to 55 per cent, up from 46 per cent in 2005-2006. Three out of five of those who are aware of their risk had taken some action to prepare for a flood. This may have involved checking their insurance, signing-up to Floodline Warnings Direct, knowing how to turn the electricity supply off, or installing flood resistance or resilience measures.

Looking ahead, we want to further improve the accuracy, coverage and timeliness of our flood warning service through:

- Providing new forecasting and warning services for surface water and groundwater flooding. The National Flood Forecasting Centre is testing an alert service for surface water flooding.
- Developing the current flood warning alerts and warnings to make them easier to understand and act on.
- Providing more detailed advice to emergency and public services before flooding so they can better prepare for the expected events.
- Working with telecommunications companies to ensure the majority of landline customers at high risk who have not registered for Floodline Warnings Direct, including ex-directory, can receive flood warnings by 2010.
- Engaging directly with communities through our Floodwise campaign to ensure more people take action to prepare themselves for the risk of floods in areas known to be at risk.

2.7 Flood response and recovery

When a flood happens, the emergency services, NHS, local authorities, and the Environment Agency take collective responsibility for minimising the harm to people and property. Working together we manage and involve other agencies, such as water and energy companies, mounting a strong, unified response. These 'responders' prepare their plans for managing flooding in advance and in detail. The 2004 Civil Contingencies Act provides the basis for planning for all types of emergency. It gives the responders a legal duty to work together to assess the risks and then make plans to prevent, reduce, control and mitigate the effects of an emergency.

Recovery from a flood can be a long and distressing experience for individuals and communities. For households, an important contribution to recovery comes from insurance claims that pay for rebuilding and repairs, and may contribute to temporary accommodation costs while a property dries out.

Local authorities take lead responsibility for recovery at community level. The Government provides National Recovery Guidance which provides web-based[11] 'one stop shop' advice on how and where local responders, especially local authorities, can get help from government or other sources during the recovery phase of an emergency.

A new National Flood Emergency Framework will provide the basis for future flood emergency planning, response and recovery. It will define roles, bring together information, guidance and main policies for use by all involved in emergency planning at national, regional and local levels. Over the last year the Environment Agency has been working with emergency responders to plan and produce 'Multi-Agency Flood Plans' to ensure a stronger and more consistent response to flood emergencies. Work on developing these plans will continue, as will emergency exercises to test the collective efficiency and competence of responders. A big national flood emergency exercise will happen in 2011. The last of these, Exercise Triton, took place in 2004.

2.8 Insurance – spreading risk and recovering quickly

The insurance industry plays a major role in managing the recovery from flooding. Through paid premiums, policyholders pool their risks, gaining access to the funds when they need to replace and repair their property after a flood. The Association of British Insurers (ABI) puts the cost of the 2007 floods at £3 billion, with 135,000 claims from householders, 35,000 from businesses and 20,000 for damage to vehicles.[12]

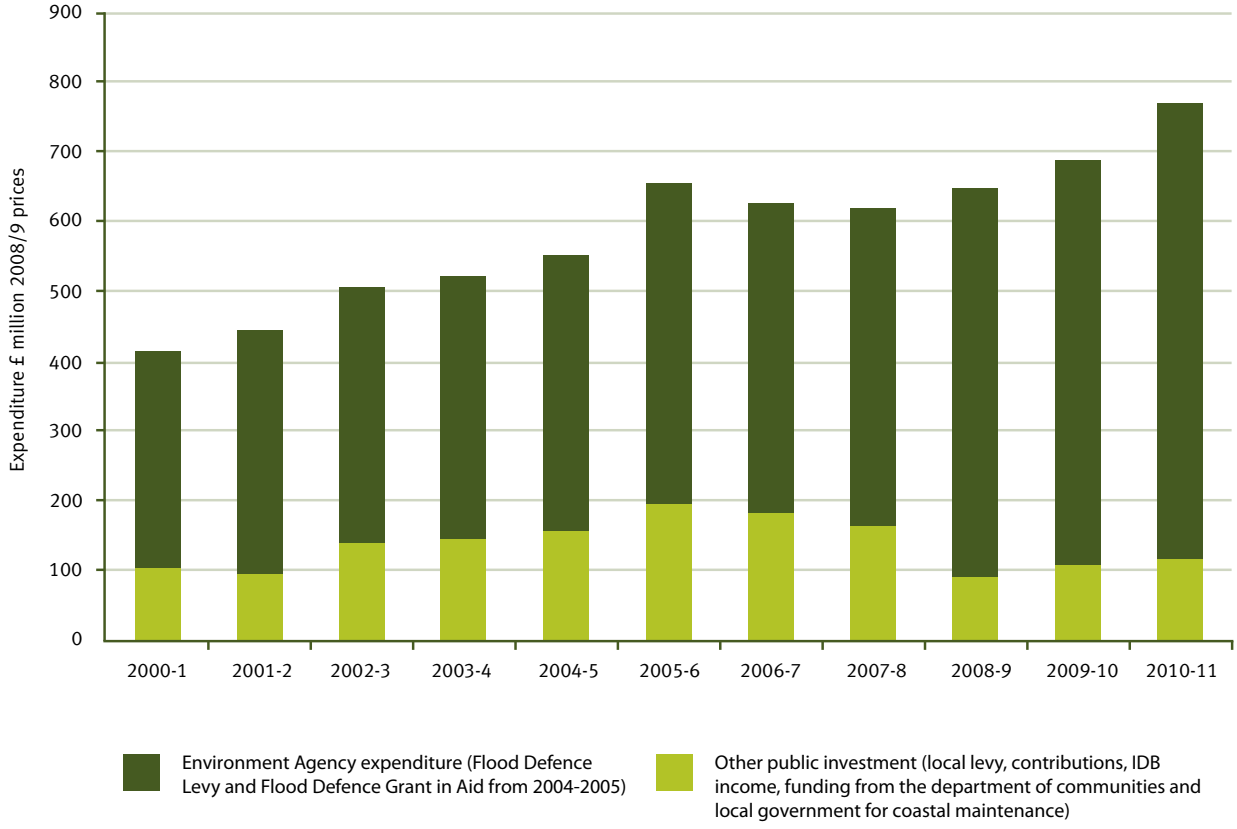
The improvement in risk information from the Environment Agency has implications for the insurance industry and policyholders. As risk information improves, insurance companies may choose to raise premiums or withdraw policies from those most at risk, and to charge lower premiums for those at lower risk. While there is an economic logic to this, it could lead those most at risk facing severe financial losses in a flood, making it more difficult for them to recover from a flood if one happened. The ABI and its members are aware of this, and agreed with Government to continue to provide insurance cover in most cases until at least June 2013.

The agreement, known as the 'statement of principles', has conditions: in return for continuing to offer cover, insurance companies expect action by the Environment Agency to reduce flood risk in the areas of significant risk. The new statement of principles, agreed in July 2008, also supports the objective of avoiding development in places at significant risk. Because of this, the ABI will no longer guarantee affordable insurance against flooding for new developments built against Environment Agency advice from 1 January 2009. Any decision to insure is a matter for the insuring company. This position will extend to all households and businesses from 2013.

2.9 Funding to support flood risk management

Government recognises flood risk management investment is important. It has substantially increased funding in real terms since the floods of 2000.[13]

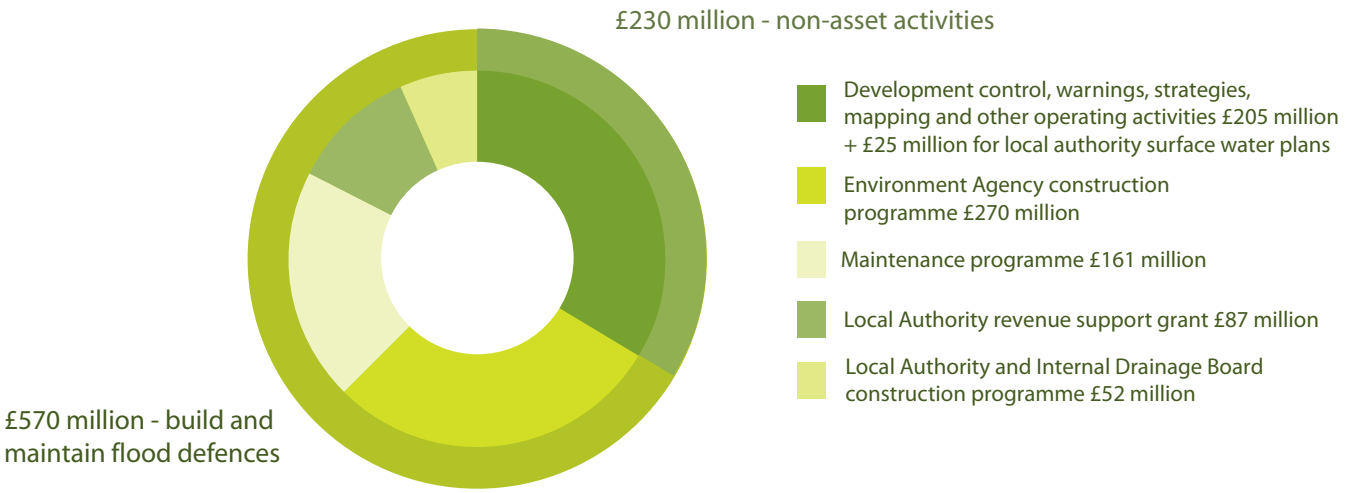
Figure eight: Expenditure on flood risk management (England – values adjusted to 2008-2009 prices)



Source: Defra / Environment Agency

We give funds to other bodies when they are carrying out agreed capital projects. In turn local government also funds us to carry out works that are a locally identified priority. We use the money we get to complete plans that are part of our overall strategy.

Figure nine: Flood and coastal risk management expenditure (England): £800 million in 2010-2011



3 Who remains at risk of flooding?

3.1 The National Flood Risk Assessment

This National Flood Risk Assessment examines where flooding could occur in all 69 river catchments and the coastline around England using 39 weather patterns of varying severity and likelihood. The assessment includes the extent to which flood defence structures reduce the chance of flooding and what might happen if they overtop or fail. This understanding of the likelihood of flooding allows us to map the vulnerability and impacts of floods, including the people, property, infrastructure and land (including farmland) at risk. The national assessment gives a picture of the damage that may arise. This includes costs, and the numbers, types and location of properties affected. The current analysis has not looked at any other impacts of flooding that also contribute to the overall risk. These include measures such as risk to life, damage to crops and livestock, disruption to commerce and transport, long-term changes to habitats, land use and land value.

The national assessment identifies land at risk from flooding using three risk categories. These consider the chances of weather severe enough to cause a flood, and the likelihood this will overwhelm defence structures or lead to their failure.

Table five: Flood risk categories

Risk category for a location	The chance of flooding in any year at that location	
Low	Less than 0.5 per cent	One in 200 chance in any given year
Moderate	0.5-1.3 per cent	One in 200 to 1 in 75 chance in any given year
Significant	More than 1.3 per cent	One in 75 chance in an given year

The risk categories assigned to locations are necessarily estimations because of the complexities of weather prediction and flood estimation. While the results provide the best national assessment of risk, we take great care to make sure we and others use the results correctly to avoid unnecessary blight or impact on property values or flood insurance. The national assessment is a snapshot of current conditions at the time we gather the data. However, the underlying pressures and drivers, and the flood risk management in response to them, are changing all the time. The category of a location may change over time because of more accurate modelling, or better information on the flow of water, or because the risk itself is changing. For example this can happen because of changes in the catchment, or perhaps because of changes in the protection provided by flood risk management assets.

We estimated the 2008 flood in Morpeth had a 0.67 per cent (or 1 in 150) chance of occurring in any year. We recorded 150 mm (6 inches) of rain falling in the River Wansbeck catchment between Friday 5 September and Saturday 6 September. Weather events like those seen in Morpeth will occur somewhere in England relatively frequently, with government estimating 1 in 150 or greater chance events having a 65 per cent chance of happening somewhere in England at least once each year. With climate change, severe conditions will occur more often in future and 1 in 150 chance events will become even more severe.[14]

Figure ten: 2.4 million properties at risk of river and coastal flooding by chance of flooding

Significant chance of flooding: more than 1:75	
Moderate:	1:75 - 1:200
Low:	1:200 - 1:1000

Source: National Flood Risk Assessment, 2008

The maps on the two next pages show two different views of flood risk by local authority area. Firstly figure 11 shows the proportion of the local authority land area at risk of flooding. This information should help local planning authorities in their decision-making. Only 11 per cent of land is at risk from flooding from even a rare extreme flood event of up to a 1 in 1,000 (0.1 per cent) chance in any year. We therefore place great emphasis on controlling flood risk by keeping inappropriate development away from the floodplain. As areas redevelop and regenerate, there must be maximum encouragement for developers to build property outside the floodplain and in those exceptional cases where building does take place in the floodplain, to make it safe.

Secondly, figure 12 shows the number of properties at significant risk – giving the extent to which buildings in the floodplain have more than a 1 in 75 (1.3 per cent) chance of flooding. This combines a measure of likelihood of a flood in an area and the results, which is the number of properties exposed to the flood event. This shows the areas where local authorities and the Environment Agency have the greatest challenges.

Figure 11: Local Authority Boundaries
Percentage of land within the floodplain

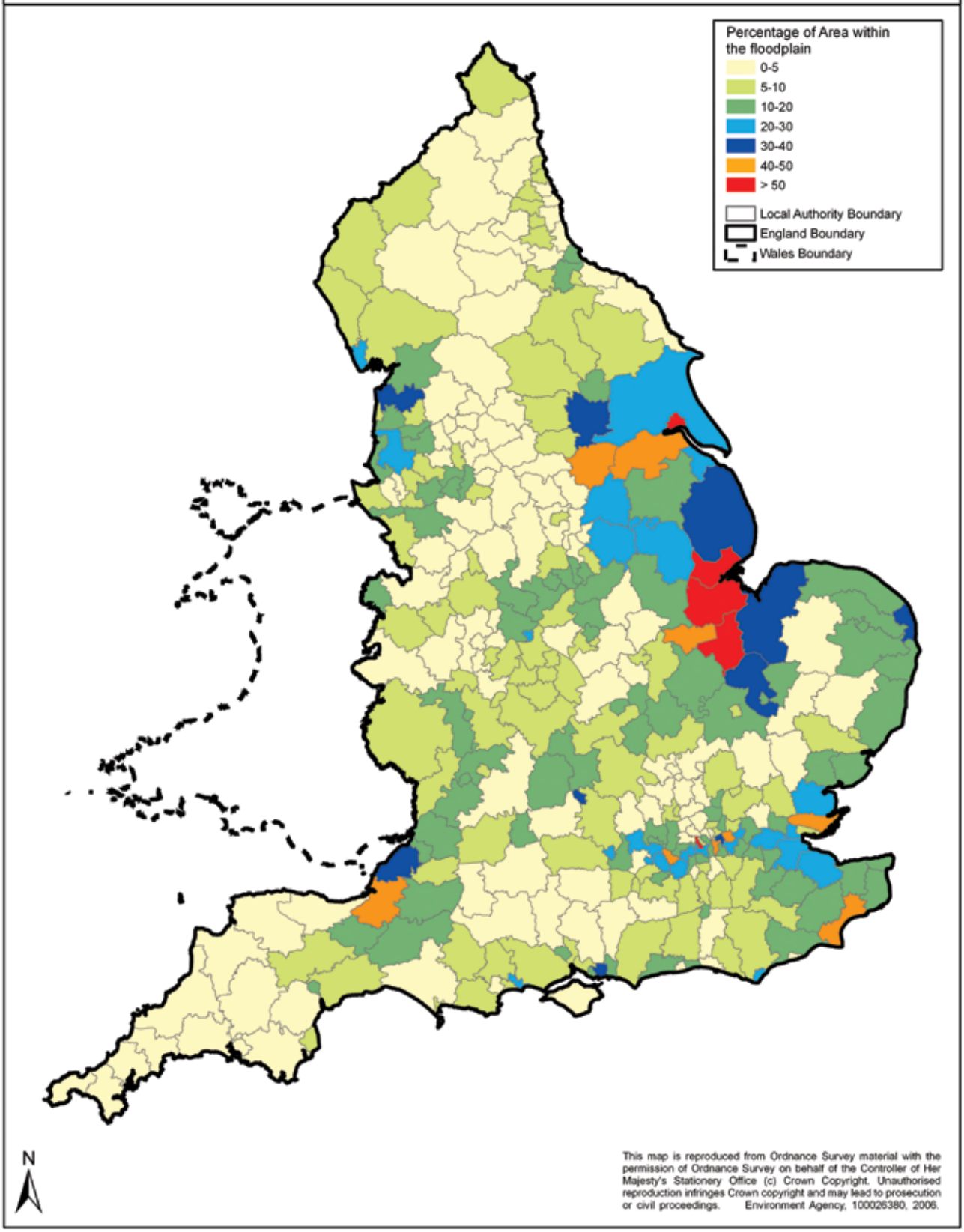
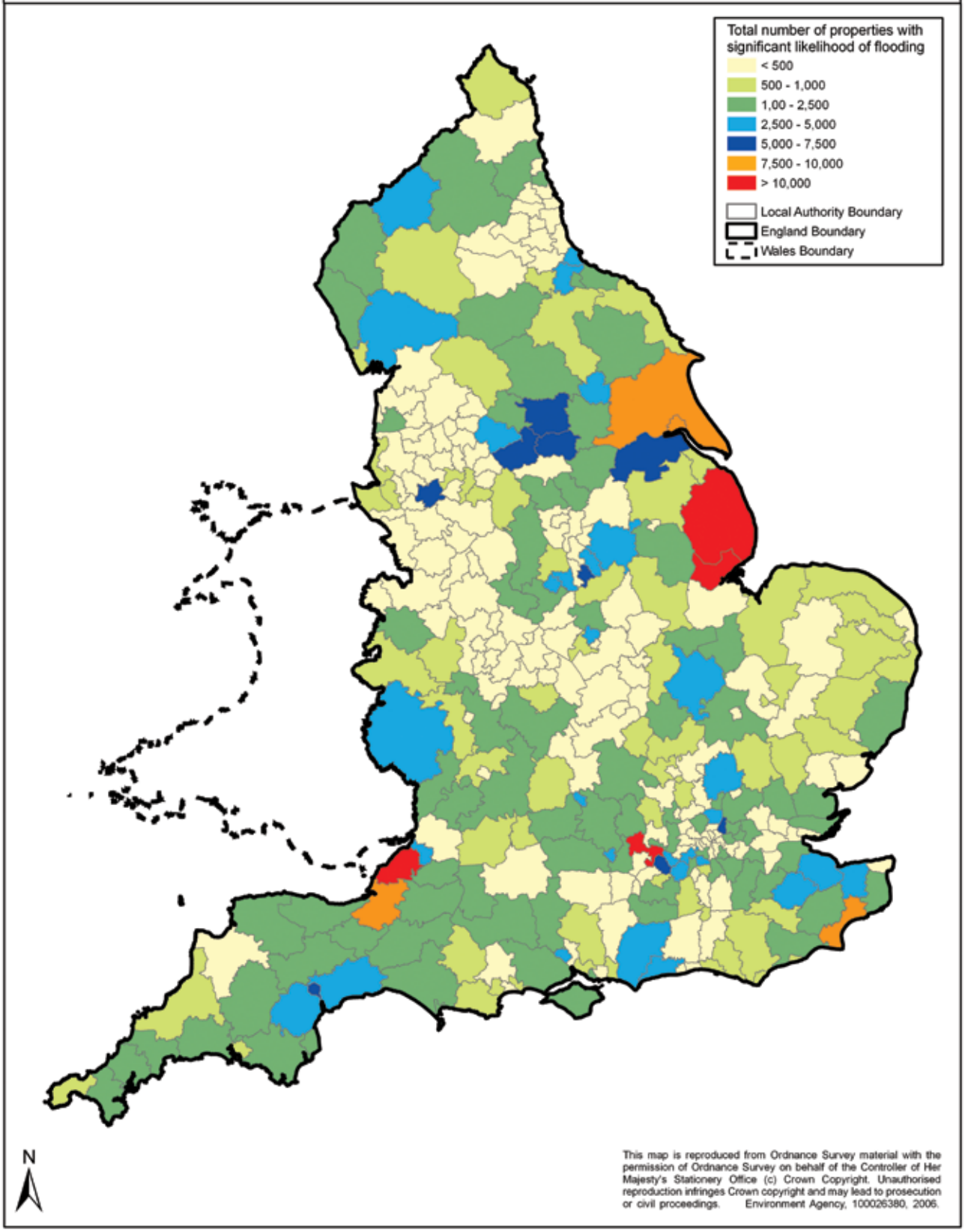


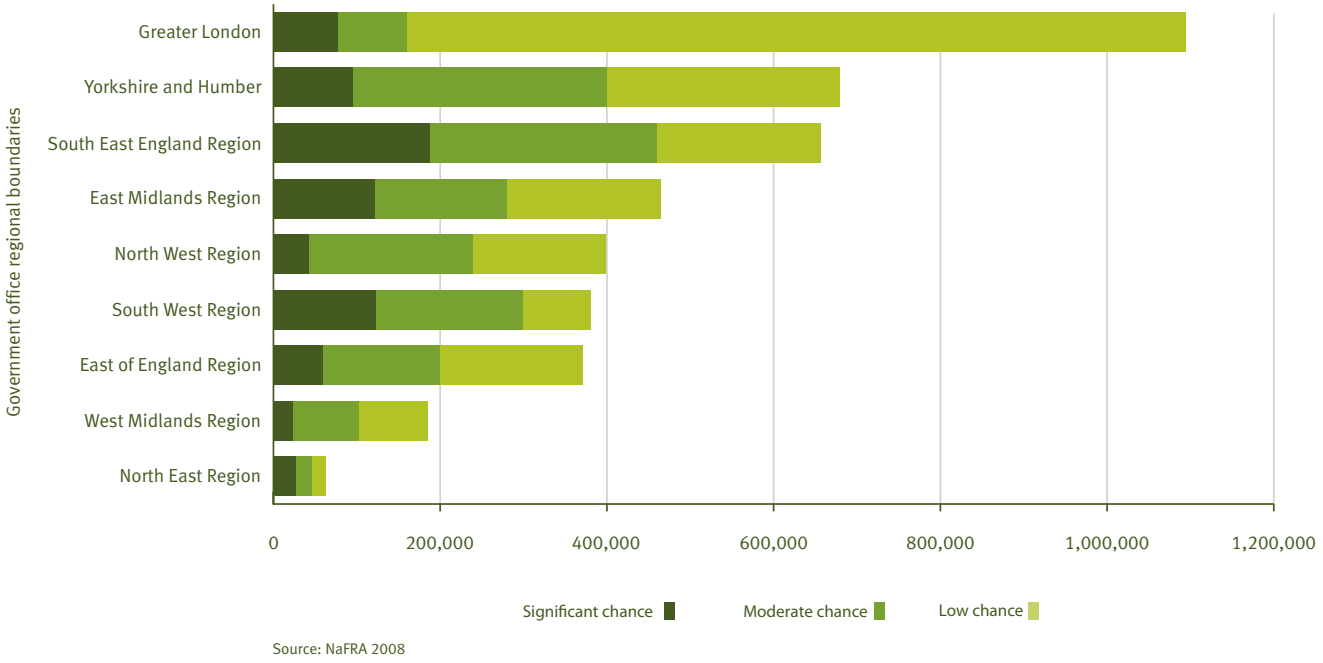
Figure 12: Local Authority Boundaries
Number of properties in areas with significant likeihood of flooding



3.2 Regional and local flood risk

Regionally, London has the highest number of people at risk from flooding. In the Greater London area there are 542,000 properties – around one million people – located in the floodplain

Figure thirteen: Regions ranked by the number of people living in the floodplain



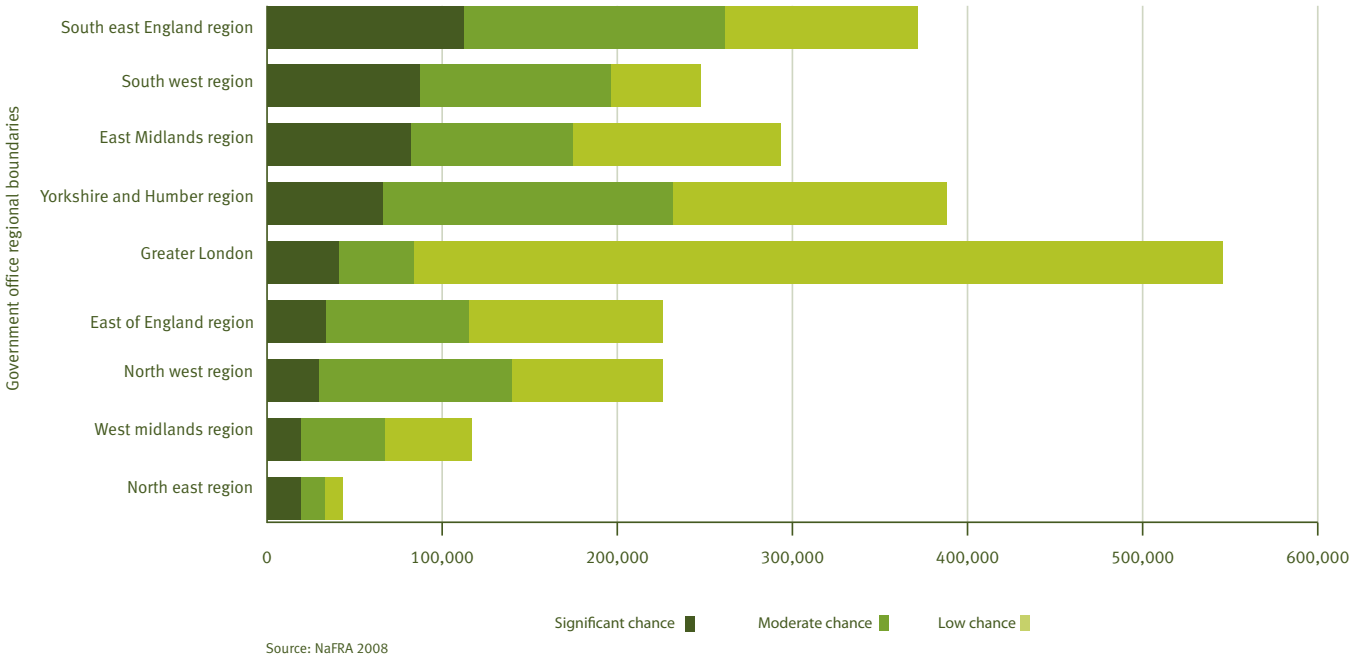
Source: NaFRA 2008

However, although London does have the largest number of people at risk, 458,000 of those properties at risk in London – 84 per cent – are in areas with a low chance of flooding. This is mainly due to the major flood defences and flood defence structures in the Thames Estuary, including the Thames Barrier, reducing the risk of tidal flooding. Replacing the Thames Barrier and related defences may become necessary at some future point. This is because a rise in sea level will reduce the protection provided to those currently at low risk. With our professional partners we are examining the merits of replacing the Thames Barrier and related defences as part of our Thames Estuary 2100 project.

The 84,000 properties - 16 per cent - in London where the risks are significant or moderate are located on the tributaries of the River Thames in north and south London. On these rivers, such as the Lee, Brent and Ravensbourne, the risk is from fluvial, or river flooding, after heavy rainfall. In London there are also risks from surface water flooding, especially as a result of heavy rainstorms. With highly urbanised river catchments, water run-off from paved surfaces and surface water can happen very rapidly. The Drain London partnership which is led by the Greater London Authority and includes the Environment Agency is assessing the risk from surface water flooding in more detail.

The national assessment informs high-level decisions on where investment is most needed by showing where investment will give most benefit. The number of properties in areas with a **significant** chance of flooding are highest in the south east, which has 25,000 more properties – around 64,000 people – in this highest risk category compared with the south west. The south east also has the largest number of properties in areas with a **moderate** or **significant** chance of flooding, with 259,000 properties, or around 460,000 people.

Figure fourteen: Regions ranked by the number of properties at significant risk of flooding



Source: NaFRA 2008

The national assessment is also able to identify those local authorities with the most properties that have a significant chance of flooding from rivers and the sea. The properties in these local authority areas are likely to flood more often, so householders, businesses and local authorities need to plan and prepare for more regular flooding. These are areas where we have to make use of all the techniques available for managing flood risk – not just defence structures. Householders and business need to receive and respond to warnings, undertake property-level protection measures, and be ready for a flood.

Figure fifteen: The ten local authorities with the highest number of properties in areas with a significant chance of flooding

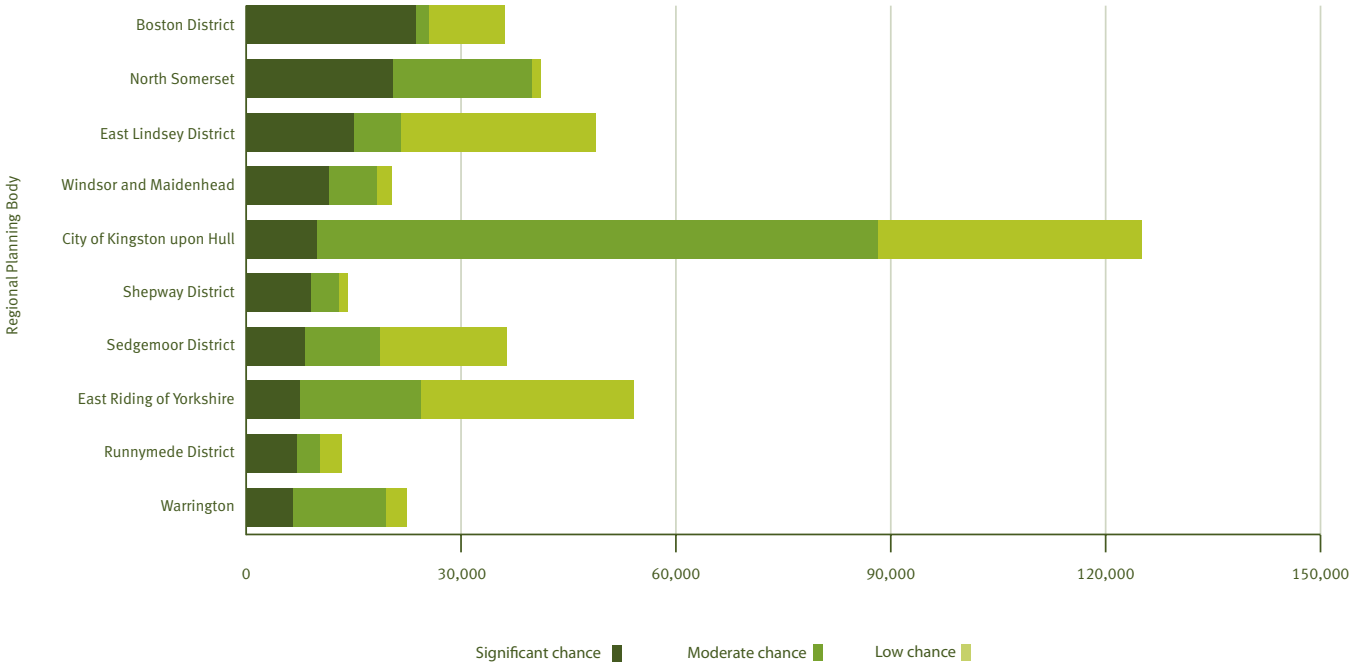


Figure 15 shows that the City of Kingston-upon-Hull and East Riding in Yorkshire are the two local authorities with the highest number of properties with a chance of flooding. However other local authorities, such as Boston and North Somerset, have a higher share of properties in areas of significant flood chance. For instance, Boston has about two-thirds of its properties in areas with a significant chance of flooding.

The national assessment allows us to target staff and funding, and to give priority to those communities that face the greatest risks where risk is a combination of the chance of flooding and the consequences or impacts of flooding.

4 Protecting communities at risk in the longer term

4.1 Catchment flood management plans

The challenge ahead for the Environment Agency is to create the right strategic approach to flood risk management for the longer term, bearing in mind the extent of defence and funding agreed by Government. Working with many local groups and organisations, we have produced or are in the process of producing catchment flood management plans (CFMPs) covering the main 68 river catchments in England. The CFMPs cover all the country, except the Thames estuary. Here, we are preparing a detailed plan (Thames estuary 2100). It will reflect the needs of the Thames Gateway as it develops and changes in the future.

The CFMPs build on the National Flood Risk Assessment by understanding all the mechanisms behind flood risk in a catchment, and how flood risk may change in the future as a result of climate change or different land use. Using this evidence base, the CFMPs set out our policy response to flood risk across each river catchment. They identify local flood risk management policies that are integrated and balance environmental, social and economic needs over the long term (50 to 100 years), and comply with government guidance. In practice, most of the policy actions concentrate on the first 25 years of the plan, recognising that there may be major changes in our priorities and the issues we need to respond to in planning 50 to 100 years into the future. They are locally specific and prepared using a consistent method. They follow national guidance and provide a broad assessment and plan, including:

- Catchment overview – a thorough overview of the hydrology, land use and other characteristics of the catchment.
- Current flood risks and management – a broad account of the existing flood risks and the protective regime already in place to manage them.
- Future flood risk – an assessment of how the risks may evolve, for example through climate change.
- Policy appraisal – an examination of what actions are possible to meet the objectives in each specific area within the catchment.
- Achieving the CFMP – how the policies identified will become action.

5 Investing for the future

The Environment Agency's national flood risk assessment shows there are 2.4 million properties at risk from flooding from rivers and the sea in England, with more exposed to surface water and other forms of flooding. The expected annual damages to residential and non-residential properties in England at risk from flooding from rivers and the sea, including hospitals and schools, is over £1 billion.

The Environment Agency play a central role in managing flood risk at all levels, and now has the strategic overview role for flood risk management from all causes of flooding, including rivers, the sea, groundwater, reservoirs and surface water. The Government has committed to increasing investment in flood risk management from £600 million in 2007-2008 to around £800 million in 2010-2011, a total of more than £2.1 billion over the three years. Government investment in flood risk management represents excellent value for money. Most flood defence schemes built reduce expected damage by at least £8 for every £1 spent.

It is likely that with climate change and development pressures, the flood risk in England is going to increase in the future, with potentially the biggest change likely to happen in the latter half of the century. Our decisions and policy choices will influence and tackle flood risk both now and in the future. We have prepared a *Long-term investment strategy* (LTIS) that allows us to understand the future risk, the costs and benefits of investment to manage it, and the choices available over the next 25 years.

At current levels of funding, the impact on households at risk and expected annual damages are both likely to increase. The 2004 Foresight *Future Flooding* report[15] suggested that a year-on-year increase of between £10 million and £30 million was necessary every year until the 2080s on top of inflation to respond to climate change. The LTIS is updating this analysis to examine different investment scenarios. It will help identify the policy choices open to us, the results of those policy choices, and the investment we need.

Identifying the funding needed to manage increasing flood and coastal risk is a main part of the LTIS. However, we will also need to identify the best ways of working with central and local government, businesses and communities to get the maximum benefit from all flood and coastal risk work. The intent is for the LTIS to inform a public debate on how society manages flood and coastal risk in the future.

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