National Audit Office

Report
by the Comptroller
and Auditor General

Department for Environment, Food & Rural Affairs and Environment Agency

Strategic flood risk management

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National Audit Office

Department for Environment, Food & Rural Affairs
and Environment Agency

Strategic flood risk management

Report by the Comptroller and Auditor General

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Sir Amyas Morse KCB
Comptroller and Auditor General
National Audit Office

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This report examines whether current arrangements for the strategic management of flood risk in England deliver value for money.

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Contents

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Key facts

5m

properties at risk of flooding as of December 2013

£24bn

Environment Agency's estimate of the replacement value of flood defence assets it maintains

£606.2m

total funding for flood risk management in 2013-14

9.5:1	Environment Agency estimate of the ratio of benefits to costs across all projects in the current flood risk management capital investment programme as of March 2014
£140 million	additional funding expected to be sourced through the partnership funding model by March 2015
£270 million	additional funds allocated by government following the 2013-14 winter storms

Summary

1 Autumn and winter 2013 and 2014 saw the wettest period in the south of England for 250 years. The extreme conditions tested the country's resilience to adverse weather and its consequences, causing flooding and widespread disruption.

2 Coastal flooding is one of the highest priority risks on the United Kingdom's National Risk Register of Civil Emergencies. As of March 2014, the Environment Agency (the Agency) estimated that 1 in 6 homes in England is at risk of flooding from coastal, river and surface water. Climate change means that the weather is becoming more unpredictable, leading to increased risk of severe weather events. Effective flood risk management is important so that the country is in the best position to protect against these risks, and to safeguard homes, communities, businesses and infrastructure.

3 The Department for Environment, Food & Rural Affairs (the Department) has national policy responsibility for flood risk management and the Agency has a strategic overview role and is responsible for the management of flood risk from main rivers and the sea. There are many other bodies with responsibilities for flood risk management, including local authorities.

4 This report examines the sustainability of current funding approaches, and how flood risk management activities are managed and delivered. It follows on from our previous report in 2011, which looked at flood risk management and the partnership funding scheme.

Key findings

Risks to future sustainability

5 **The Government's 2012 Climate Change Risk Assessment reported that climate change will significantly increase flood risk in the UK.** This is increasing the load on assets, which may in turn increase operational costs, if current performance is to be maintained (paragraphs 2.16 and 2.17).

6 **The Agency's long-term investment strategy (2009) noted that funding would need to increase by an average of £20 million every year, plus inflation, until 2035 if the current overall level of risk was to be maintained.** However, between 2010 and 2013, capital and revenue funding was reduced by 18% and 10% respectively. The Agency is currently developing a new investment strategy, due to be published in late 2014, which will update the funding assumptions in the 2009 version (paragraphs 2.2 and 2.18).

7 **The government made an extra £270 million available following the winter storms in 2013 which allowed the Department and Agency to respond quickly to events, and to begin restoring the condition of flood defence assets.** This included an additional £35 million for asset maintenance in both 2014-15 and 2015-16. In cash terms, this has restored maintenance funding to 2010-11 levels, although this represents a real-terms decrease of 6% between 2010-11 and 2014-15. The additional money following the winter floods established a new peak for total funding in 2014-15. However, excluding this exceptional contribution, total funding decreased in real terms by 10% between 2010-11 and 2014-15 (paragraph 2.2).

8 **The Agency has made efficiencies, including a saving of £44 million between 2011 and 2014 in respect of capital construction projects.** However, the risk of more severe weather events will put pressure on existing budgets (paragraph 2.3).

9 **The Agency has a robust process in place to prioritise maintenance spend, based on the benefits and risk identified by flood risk model data.** Annually, it undertakes an exercise to allocate funding for asset maintenance, using its national database of maintenance needs. The Agency fully funds the minimum maintenance needs for all assets, and further funding is then allocated according to benefit–cost priority for each asset system (paragraphs 2.4 and 2.5).

10 **The Agency recognises that it needs to make difficult decisions around whether it continues its maintenance of some flood risk assets.** For example, there are a number of 'legacy' assets with lower benefit-cost ratios. The Agency funds maintenance in higher risk areas first, and so may not be able to fund maintenance elsewhere (paragraph 2.8).

Impact of funding levels on assets and flood risk

11 As of August 2014, some 1,356 asset systems with a lower benefit–cost ratio (50% of the total) are being maintained to a minimal level. Assets in the affected systems are likely to deteriorate faster as a result, potentially resulting in a lower standard of protection, as well as increasing capital replacement costs in the long term. This change also suggests that the benefits from the original capital investment in those assets will not be maximised (paragraph 2.11).

12 The Agency has done work to model what the optimum level of capital and maintenance funding split would look like. It has modelled, with appropriate caveats, different scenarios to demonstrate what the impact might be on whole-life cost. Its work did conclude, however, that overall the impact of new assets on maintenance costs is hard to quantify (paragraphs 2.14 and 2.15).

13 The Agency has not communicated to communities the local effect on future flood risk from the de-prioritisation of maintenance in some areas. The Agency holds estimates of the relationship between maintenance expenditure and asset lives for various flood defence types, and it has used this information nationally, but it has not communicated the effect of this change in maintenance regimes in some local areas in future years (paragraph 2.12).

14 The Agency has prioritised funding for maintenance on a national level, primarily based on benefit–cost ratio; this is calculated by, among other factors, the number of homes in an area. **These decisions will have significant effects on individual geographical areas.** In particular, where the Agency deprioritises maintenance in areas where assets have lower benefit–cost ratios, asset failure in these areas will become more likely unless the management of those assets is taken on by another body (paragraph 2.5).

15 The Agency has analysed the relationship between deterioration maintenance for its floods structures and defences and flood risk. The Agency estimates that investment in maintenance of flood defences and structures gives it a benefit–cost ratio return of 7:1 (paragraph 2.13).

Capital and revenue funding

16 From 2015, the capital budget will be approved for a 6-year period, which provides a longer period of certainty about funding allocations and helps medium-term planning. The Department and Agency told us that this has provided a better opportunity to plan and identify future projects against other capital priorities to ensure funding is earmarked at the appropriate time (paragraph 2.4).

17 The allocation of maintenance funding for 2015-16 is for a 1-year period, in line with government policy. This makes it more challenging to plan long term and to make efficiency savings, because of contracting uncertainties and availability of funding (paragraph 2.4).

Partnership funding

18 The Department and Agency have implemented a partnership funding model. The approach aims to increase investment from outside central government and allows the Department to fund a larger number of projects on a part-funded basis (paragraph 2.20).

19 The Department did not set funding targets against which to judge the success of the new model, so it is difficult to evaluate whether it has been a success. However, more partnership funding has been attracted than it initially expected. The Department's policy impact assessment included a 'best-case' assumption of £125 million additional contributions by 2014-15, and between April 2011 and March 2015 it will have attracted an estimated £140 million in funding. Some 75% of contributions have come from other public sector sources, with 25% directly from the private sector. In addition, a Department-commissioned evaluation of the scheme indicated that, on the whole, the approach is progressing well in meeting its policy objectives (paragraph 2.21).

20 The Department does not have sufficient data to measure accurately the current level of success for partnership funding schemes led by other risk management authorities. While the Agency's systems capture its own funding allocations to projects adequately, they do not capture contributions in kind. In addition, partnership funding contributions collected by lead local flood authorities and internal drainage boards are not captured until up to 2 years after schemes are completed. This reduces the accuracy and speed with which the Department can measure whether it is achieving its aim of broadening sources of funding for flood risk management beyond central government. It may also result in missed opportunities to improve outcomes from the new model by influencing partner organisations (paragraph 2.23).

Benefit–cost analysis

21 Benefit–cost assessments for capital flood defence projects are robust and well thought through. The Agency's approach to benefit–cost analysis is consistent with HM Treasury's Green Book. The Agency has produced detailed guidance on identifying the typical benefits and costs of projects, and investment appraisals are clear and thorough (paragraph 2.25).

22 For flood projects, the Agency seeks to secure an acceptable standard of protection while maximising the difference between costs and benefits. It does not always necessarily select or prioritise projects with the highest benefit–cost ratio, as this would mean the entirety of funding would be directed to a smaller number of projects delivering very high standards of protection in the most populated areas. Benefit–cost thresholds set by the Agency ensure that limited funding is not exhausted on a few high-value projects, and can be allocated across a wider range of smaller-value projects (paragraph 2.27).

23 There is a healthy benefit–cost ratio for floods projects. The Agency anticipated it would achieve a programme benefit–cost ratio of at least 8:1 for its flood defence projects funded through grant-in-aid for the current spending review period. As of March 2014, it has achieved 9.5:1 (paragraph 2.25).

Flood modelling and asset management

24 The Agency has improved the way it presents flood modelling data, and has committed to more improvements in both sophistication and ease of use. Since 2011, the Agency has made the likelihood of flooding categories clearer and more consistent with other flood maps and has also improved its understanding of the risks of surface water flooding. The Agency is continuing to improve the data in the National Flood Risk Assessment model. It is publishing information about the reliability of its model data at different scales of risk assessment; undertaking hazard mapping locally to help predict coastal flooding; and examining ways to improve the presentation of flood risk from a combination of sources (paragraphs 3.3, 3.5 and 3.6).

25 The Agency is building its understanding of individual assets to target its resources more effectively and improve its risk management. It is enhancing its asset management approach by increasing the amount of information available on individual assets. This will assist its ability to make decisions on assets. The Agency expects this new approach, to be launched in 2015, will improve risk management through better targeting of investment and delivering efficiencies in the way asset maintenance is managed (paragraphs 3.11 and 3.12).

Communication and working with others

26 The government's aim is to encourage local communities to take steps to manage their own flood risk. This has brought some necessary complexity into the system. However, beyond this, some stakeholders consider that there is an added layer of complexity that could be simplified and that strategies and plans are not always aligned or complementary (paragraph 3.17).

27 The Agency has engaged directly with communities on key changes which affect them, but the expectations of communities could be better managed. The Agency has recognised the importance of engaging communities in areas where flooding regularly occurs and is proactive in its communications with these communities. However, it needs to ensure that its communication around changes to maintenance regimes is relayed to those communities affected, so that their expectations are managed (paragraph 3.19).

28 The Department is working with local authorities to publish their flood risk strategies quickly to ensure they are prepared for future flooding events. As of March 2014, only 16% of lead local flood authorities have published their local strategies despite the requirement being in place since 2011. The Parliamentary Under-Secretary of State for Water, Forestry, Rural Affairs and Resource Management has recently written to all lead local flood authorities, asking that they complete their strategies by 31 December 2014 (paragraph 3.16).

Conclusion on value for money

29 The Department and Agency have limited resources to spend on maintaining and enhancing the standard of flood protection in England. The Agency has responded to these constraints by improving cost-effectiveness, and adopting methods for prioritising service delivery which provide a healthy return on investment. On these criteria, the Agency is achieving value for money.

30 However, current spending is insufficient to meet many of the maintenance needs the Agency has identified for its assets. In the areas where maintenance has been deprioritised – typically, where there are a low number of homes – this will increase the danger of asset conditions degrading, so increasing flood risk. The Agency may be faced with decisions on whether to replace affected assets earlier than would otherwise be the case, or to let them lapse. It is reasonable, based on recent experience, to predict a role for community and political pressure in how these decisions play out. (As a rule, our experience is that ad-hoc emergency spending is less good value than sustained maintenance). The impact of climate change will also continue to increase pressure on defences. We conclude that the achievement of value for money in the long term remains subject to significant uncertainty.

Recommendations

31 The Department should consider how funding for flood risk management can be made more sustainable in the medium to long term. It should:

a **Seek to ensure that its maintenance programme protects long-term value for money.** In particular, the Department needs to:

- seek to balance capital and revenue funding in a way that minimises whole-life asset costs, taking advantage of any flexibility in the split between capital and revenue funding which can be secured;
- work with HM Treasury to understand whether it can lengthen the planning cycle for revenue funding in the same way as it has for capital, in order to further improve value for money in procurement; and
- further analyse the effectiveness of the new partnership funding model, based on more comprehensive and timely data than are currently available. Once reviewed, it should then reflect on whether any changes could be made to improve the effectiveness of this model.

b The Department and Agency should consider whether a more transparent approach to flood risk strategies and data would improve the general understanding of communities about who has responsibility for flood risk. Together, they should:

- **Build on their engagement with the public**, particularly where maintenance work on flood defences has been changed, reduced or rationalised.
- **Collect more robust and timely performance management data** from risk-management authorities to help them fully realise the benefits expected from the move to partnership funding.
- **Continue to monitor the lead local flood authorities' progress with publishing their local flood risk management plans** and take action if these are not produced within a suitable timeframe.
- **Review the range of strategies and plans in place** to see if they can be amalgamated or rationalised in order to reduce the burden on communities and promote public engagement.

c The Department and Agency have made improvements to their flood modelling and asset management since our last report in 2011. To build on this the Department and Agency should:

- **Gather more detailed information on individual asset maintenance costs** to help further optimise the value for money in how they deploy funding for maintaining flood risk assets.
- **Develop their ability to forecast the effect of asset maintenance decisions on future asset conditions**, in order to analyse more fully the long-term effect of maintenance prioritisation decisions.
- **Build on the sophistication of flood modelling data** and ensure that both industry and the public have access, within data protection guidelines, so its value is maximised.

Part One

Context

1.1 Flooding has a devastating impact on communities, environment and infrastructure, with personal disruption and clear-up costs, losses to property and, in extreme cases, loss of life. Flooding can come from rivers, the sea or surface water.[1] In 2013, the risk of flooding from the coast was one of the highest priority risks on the National Risk Register of Civil Emergencies.[2] In England, some 5 million properties – 1 in 6 – are at risk of flooding. Of these, 2.4 million properties are at risk of flooding from rivers or the sea and 3 million are susceptible to surface water flooding.[3] **Figure 1** shows properties at risk of flooding in England as of 2014.

Overall responsibility for managing flood risk

1.2 The government has made the maintenance of England's flood defence capacity a national priority.[4] The Department for Environment, Food & Rural Affairs (the Department) has national policy responsibility for managing flooding and coastal erosion, with responsibility for strategy and operations held by various 'risk-management authorities'. All of these authorities have distinct roles and responsibilities defined by the Flood and Water Management Act 2010 (the Act). Where responsibility lies depends on the source of flooding risk, for example whether it stems from main rivers or surface water. All authorities must prepare strategies or plans describing their objectives for managing flood risk and the measures they propose to achieve these. At a national level, the Environment Agency (the Agency) holds these responsibilities – locally, they fall to lead local flood authorities and other bodies (**Figure 2** on page 14).

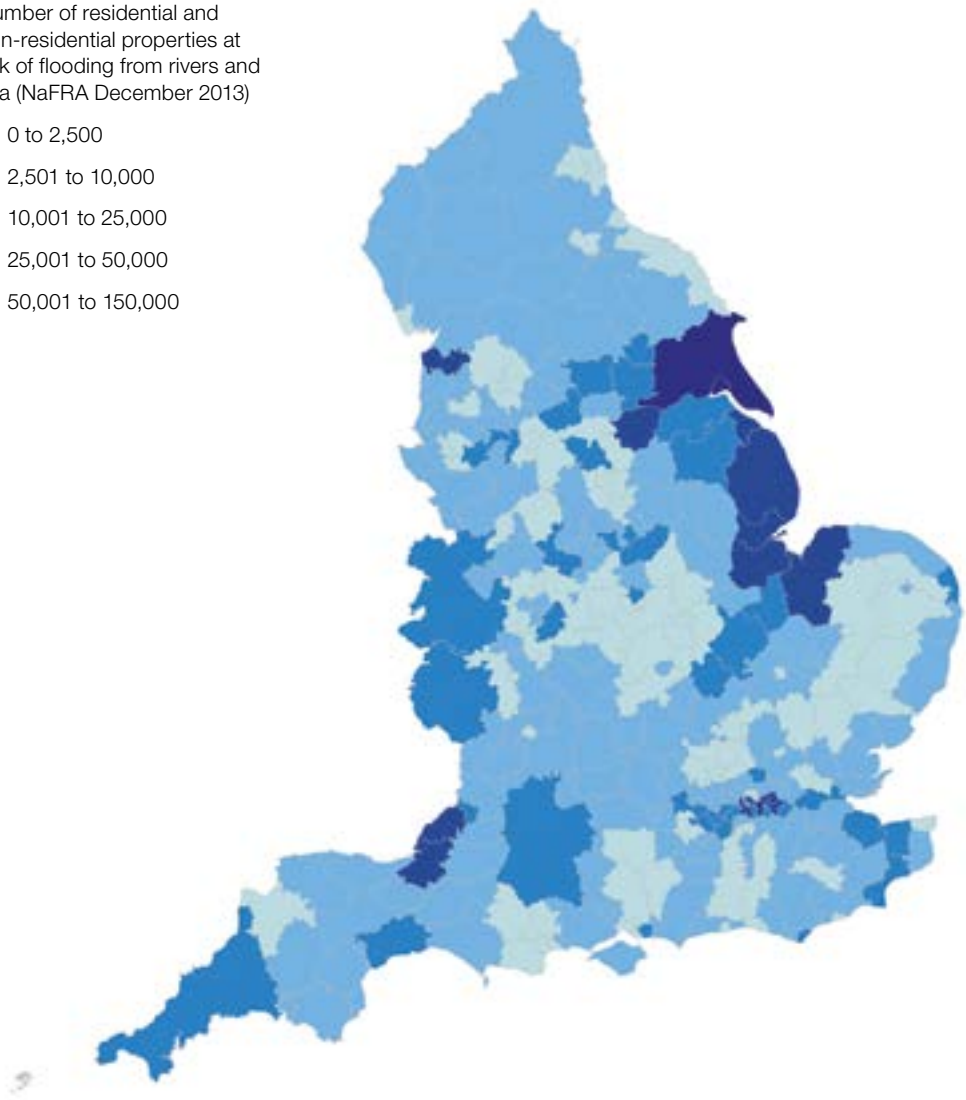
1 Flooding from rainwater (including snow and other precipitation) which is on the surface of the ground (whether or not it is moving), and has not entered a watercourse, drainage system or public sewer.
2 Cabinet Office, *National risk register of civil emergencies 2013 edition*, 2013, available at: www.gov.uk/government/uploads/system/uploads/attachment_data/file/211867/NationalRiskRegister2013_amended.pdf, accessed 8 September 2014.
3 Some properties are at risk of both surface water flooding and flooding from rivers and the sea which is why the total number of properties for both is 5 million.
4 Department for Environment, Food & Rural Affairs, *Business Plan 2011 to 2015*, November 2010.

Figure 1

Properties at risk of flooding in England

Number of residential and non-residential properties at risk of flooding from rivers and sea (NaFRA December 2013)

- 0 to 2,500
- 2,501 to 10,000
- 10,001 to 25,000
- 25,001 to 50,000
- 50,001 to 150,000



Notes

1 Includes both residential and non-residential properties.

2 NaFRA is the National Flood Risk Assessment Model.

Source: Environment Agency

Figure 2
Bodies involved in flood risk management

Department for Environment, Food & Rural Affairs

National policy for flood and coastal protection. Provides funding for flood risk management authorities

Environment Agency

Strategic overview of all sources of flooding. Operational responsibility to manage flooding from main rivers and the sea

Department for Communities and Local Government

Sets out national planning framework for development and flood risk. Ensures flood risk is appropriately factored into planning processes. Coordinates local authorities' recovery

Cabinet Office

Develops cross-sector resilience programmes for civil contingencies, which includes flooding

Regional flood and coastal committees

Ensure plans are in place to identify, communicate and manage flood risks across catchment and shoreline areas. Promote efficient and targeted investment. Provide linkages between flood risk management authorities and other bodies

Lead local flood authorities

Preparing local flood risk management strategies. Maintain registers of flood risk assets. Manage flood risk from surface water, groundwater and ordinary watercourses

Local resilience forums

Multi-agency partnerships that plan and prepare for localised incidents, including those related to flooding

District and borough councils

Through local plans and planning decisions, ensure new development is safe, flood resilient, does not increase flood risk overall and where possible reduces the risk

Internal drainage boards

Independent public bodies covering around 10% of the country. Responsible for water-level management in low-lying areas and regulation of activities on ordinary watercourses within drainage districts

- National
- Regional
- Local

Note

1 County or unitary local authorities have been designated as lead local flood authorities.

Source: Environment Agency

Strategies and plans

1.3 The Act states that the Agency must develop, maintain, apply and monitor a strategy for flood and coastal erosion risk management in England. In cooperation with the Department, the Agency published the National Flood and Coastal Erosion Risk Management Strategy for England in 2011.[5] The Strategy has several guiding principles and objectives, including:

- putting long-term strategic plans in place;
- avoiding inappropriate development in areas at risk from flooding and coastal erosion;
- building, maintaining and improving assets; and
- increasing resilience through raising awareness and improving forecasting and warning.

Beneath this national plan are many other strategies and plans that detail how local risk management authorities will mitigate flood risk within their areas of responsibility (**Figure 3** overleaf).

Funding

1.4 Flood risk management is funded from several sources (**Figure 4** on page 17). During 2013-14, the Department invested £606.2 million on flood risk management activities. Of this, some £315 million (52%) was capital and £291 million was revenue (48%).

The partnership funding model

1.5 The Department introduced flood and coastal erosion resilience partnership funding (partnership funding) in May 2011 as a new approach to funding capital projects addressing flood and coastal erosion risk.[6]

1.6 Instead of meeting the full costs of a limited number of projects, the new approach intended to make government funding available for a larger number of schemes on a part-funded basis. Contributions from outside central government would make up the balance. These contributions can be from any combination of public and private sources.

1.7 The Department's aim in making this change was to increase the number of communities protected, and to "ensure that local ambitions for protection are not dictated by what Government alone can afford".[7] The policy also aims to encourage local participation in decision-making.

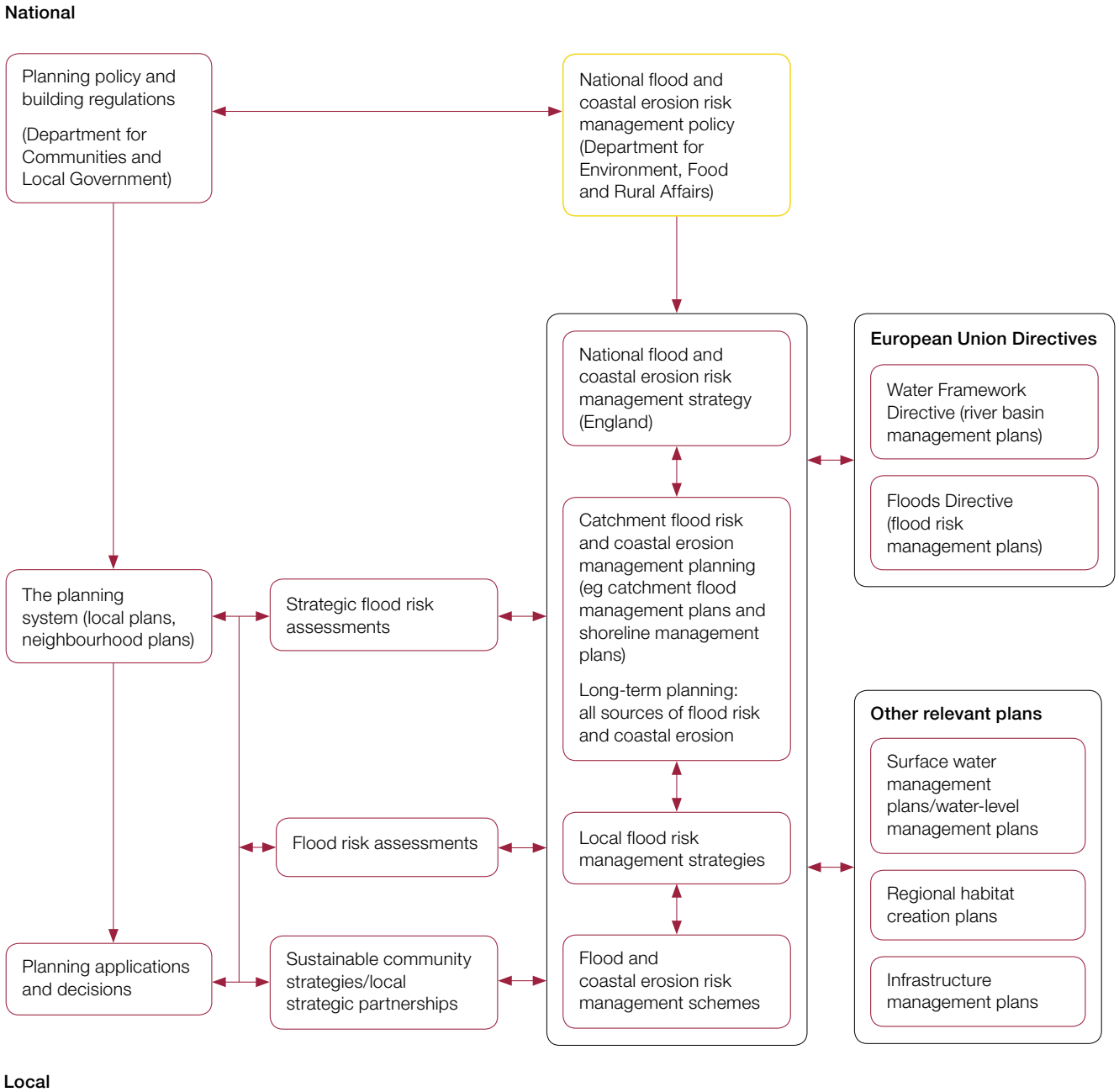
5 Department for Environment, Food & Rural Affairs and Environment Agency, *Understanding the risks, empowering communities, building resilience, the national flood and coastal risk management strategy for England*, May 2011, available at: www.gov.uk/government/publications/national-flood-and-coastal-erosion-risk-management-strategy-for-england, accessed 26 August 2014.

6 Department for Environment, Food & Rural Affairs, *Flood and coastal resilience partnership funding*, May 2011, available at: www.gov.uk/government/uploads/system/uploads/attachment_data/file/221094/pb13896-flood-coastal-resilience-policy.pdf, accessed 26 August 2014.

7 Hansard HC, 23 May 2011, Column 43WS. Available at: www.publications.parliament.uk/pa/cm201011/cmhansrd/cm110523/wmstext/110523m0001.htm, accessed on 22 October 2014.

Figure 3

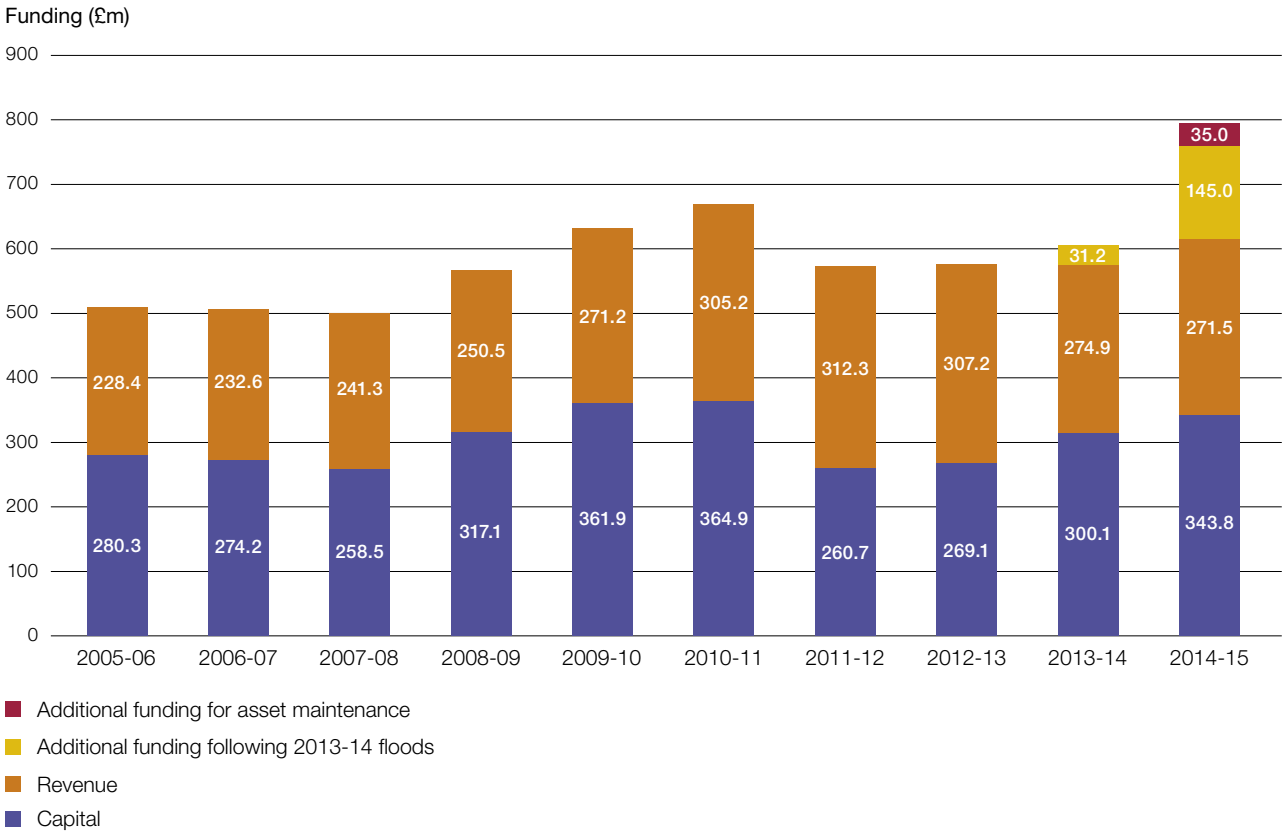
Flood and coastal erosion risk management strategies and plans and their relationship to planning initiatives



Source: Environment Agency

Figure 4

Breakdown of funding between capital and revenue of total government investment in flood risk management in England



Notes

1 Figures for 2014-15 are allocation, not spend.

2 Overall revenue funding for 2013-14 increased as a result of additional funding from government to cover incident response costs and urgent repairs to assets during the winter storms.

3 £30 million of additional funding was allocated for 2013-14, against which £31.2 million was spent. This included both capital and revenue.

4 Additional funding allocated for 2015-16 (not shown) amounts to £60 million.

5 Previous years will also include an element of incident management costs and repairing assets damaged during flooding.

6 Funding for 2015-16 will be announced during 2014-15.

Source: National Audit Office analysis of figures from the Department for Environment, Food & Rural Affairs

How households and infrastructure are protected

Flood modelling

1.8 The Agency has a National Flood Risk Assessment system, which allows it to develop national-scale assessment models of flood risk from rivers and seas.[8] It is the main source of information used to communicate flood risk to the public. The medium- to long-term flood risk assessments help the Agency decide where to focus investment. The model shows how the likelihood of flooding is distributed within an area and also considers the impact of flood-defence structures that reduce risks. In addition, further data from local modelling supplements gaps in knowledge of flood risk that cannot be represented in the National Flood Risk Assessment.

Flood defences

1.9 Flood defences take many forms including temporary barriers, sluices and pumping stations (**Figure 5**). The Agency estimates the replacement value of the flood defence assets it maintains at £24 billion.[9] These include 1,000 km of coastal defence, 2,695 flood systems and 182,928 individual assets. Of the total flood defences in England (more than 40,500 structures with a value of £35 billion), the Agency is responsible for maintaining 45% of these defences. The other 55% are maintained by third parties.

Promoting access to insurance – Flood Re

1.10 The government is also taking steps to ensure households at risk of flooding can access insurance. The Association of British Insurers and the government agreed a memorandum of understanding in 2013 on how a not-for-profit scheme, 'Flood Re', might work. The scheme aims to ensure flood insurance remains affordable for owners of properties at high risk of flooding. The government and the Association of British Insurers expect the insurance industry to manage and fund Flood Re, offering cover at a set price to individuals who might otherwise struggle to get affordable flood insurance.[10]

8 National Flood Risk Assessment includes rivers with a catchment greater than 3 km^2, but does not show risk from other sources such as smaller rivers, drains, roads, sewers, groundwater or surface water.

9 The £2 billion of assets included in the Agency's accounts are only those which are directly owned by the Agency.

10 Insurers will place into the fund those homes at high risk of flooding they feel unable to insure themselves, with the premium to cover the flood risk part of the household premium capped. The cap will be based on council tax bands, and the capped premiums will go into the fund to help pay flood claims.

Figure 5
Different types of flood defences

Note

1 Clockwise from top left: Temporary flood defence barrier; sluice structure; pumping station, and rail embankment acting as a coastal defence.

Source: Environment Agency

How flood schemes are approved, built and maintained

1.11 All risk-management authorities can bid for funding from central government to provide flood defences. Allocations from national funding are calculated using defined payment rates. These are scaled to prioritise households at significant risk, especially in deprived areas and to deliver statutory requirements.[11] The Agency prioritises capital investment in flood defences in accordance with government policy as set out in the Department's policy statement on partnership funding, and is consistent with HM Treasury's Green Book guidance on policy appraisal. Projects are subjected to an initial analysis, which should identify the costs and benefits the project will generate, and this is used to determine whether it is worthwhile to proceed to a more detailed options appraisal (**Figure 6** overleaf).

11 These include meeting obligations under the European Union's Water, Habitats and Birds Directives.

Figure 6
Developing and funding capital projects

Benefit–cost analysis

Key steps	Illustrative example
Identify the issues and shortlist potential options for further appraisal	A town's main river poses an unacceptable level of future flood risk for its residents. After consultation with local stakeholders, the town's local authority identifies the capital construction of an **upland flood storage facility** as a viable option.
Identify the lifetime benefits and costs of each option	All direct and indirect costs are identified and monetised, such as initial survey, design, construction and maintenance costs. For the upland flood storage facility, these costs are estimated at **£15 million** in total. With flood defence projects, benefits usually represent the value of future flood damages avoided to properties, national infrastructure, transport and business impacts. For this project the benefits are estimated at **£120 million**.
Discount to present values and calculate benefit–cost ratios	Benefits and costs are discounted to present values over the lifetime of the project. The project is predicted to have a useful life of **25 years**. Using a standard rate of 3.5% discounted over 25 years the upland flood storage option will generate: • **£6.3 million** of present value costs; and • **£50.8 million** of present value benefits. A benefit–cost ratio is derived by dividing benefits by costs. The higher the benefit–cost ratio, the greater the return the project will generate for its initial investment. This project produces a ratio of **8.06:1**.
Compare results and select the preferred option	The benefit–cost ratio is compared with that generated by other options under consideration.[1]

Funding allocation model

Determine share of central funding project is eligible for	The preferred option is evaluated against the outcome measures of the government's partnership funding model. These measures, in addition to funding contributions already secured, **determine the level of central grant-in-aid the project is eligible for**. The outcome measures (*and how they are valued in the model*) are: • number of households moving to a lower flood risk category (*20% of every pound of damage prevented, or 40% if in a deprived area*); • number of households better protected against coastal erosion (*20% of every pound of damage prevented, or 40% if in a deprived area*); • environmental benefits supporting statutory obligations such as EU Water, Habitats and Birds Directives (*£15,000 or £50,000 per ha, or £80,000 per km of river bed*); and • all other social and economic benefits (*5.5% for every pound of the calculated benefit*).

Note

1 The option with the highest benefit–cost ratio does not necessarily become the preferred option, as increases in levels of protection can offer only marginal benefits compared with the additional costs involved, without increasing the overall benefit–cost ratio. The Agency sets increasing thresholds for marginal benefit–cost ratios to progress to specific levels of protection as the preferred option. This approach seeks to secure an acceptable standard of protection while maximising the difference between benefits and costs. This ensures limited overall funding is not all spent on a few high-value projects.

Source: National Audit Office

1.12 The Agency has a 'long list' of projects from those identified in local strategies. These are considered, prioritised and proposed by the regional flood and coastal committees. The Agency then assesses individual projects. The numbers of projects submitted generally exceeds the available budget, so the Agency prioritises schemes based on their benefits and outcomes to be delivered and availability of partnership funding. Once the Agency has approved a project and the total funding package is in place, including partnership funding, the projects can go ahead. Similarly, the Agency prioritises asset maintenance annually in order to allocate funding. It funds all asset systems to meet their minimum maintenance need. From the remaining budget, it allocates funding to meet identified need for asset systems with a higher benefit–cost ratio, although as of 2014 this is currently being reviewed.

1.13 The Agency considers funding for maintenance of new schemes as a whole-life cost within the initial economic appraisal and approves this as part of the overall scheme. Funding for ongoing maintenance of older schemes is prioritised by the Agency from its grant-in-aid allocation. This is based on the risk and consequence of assets failing and the benefit derived from the scheme.

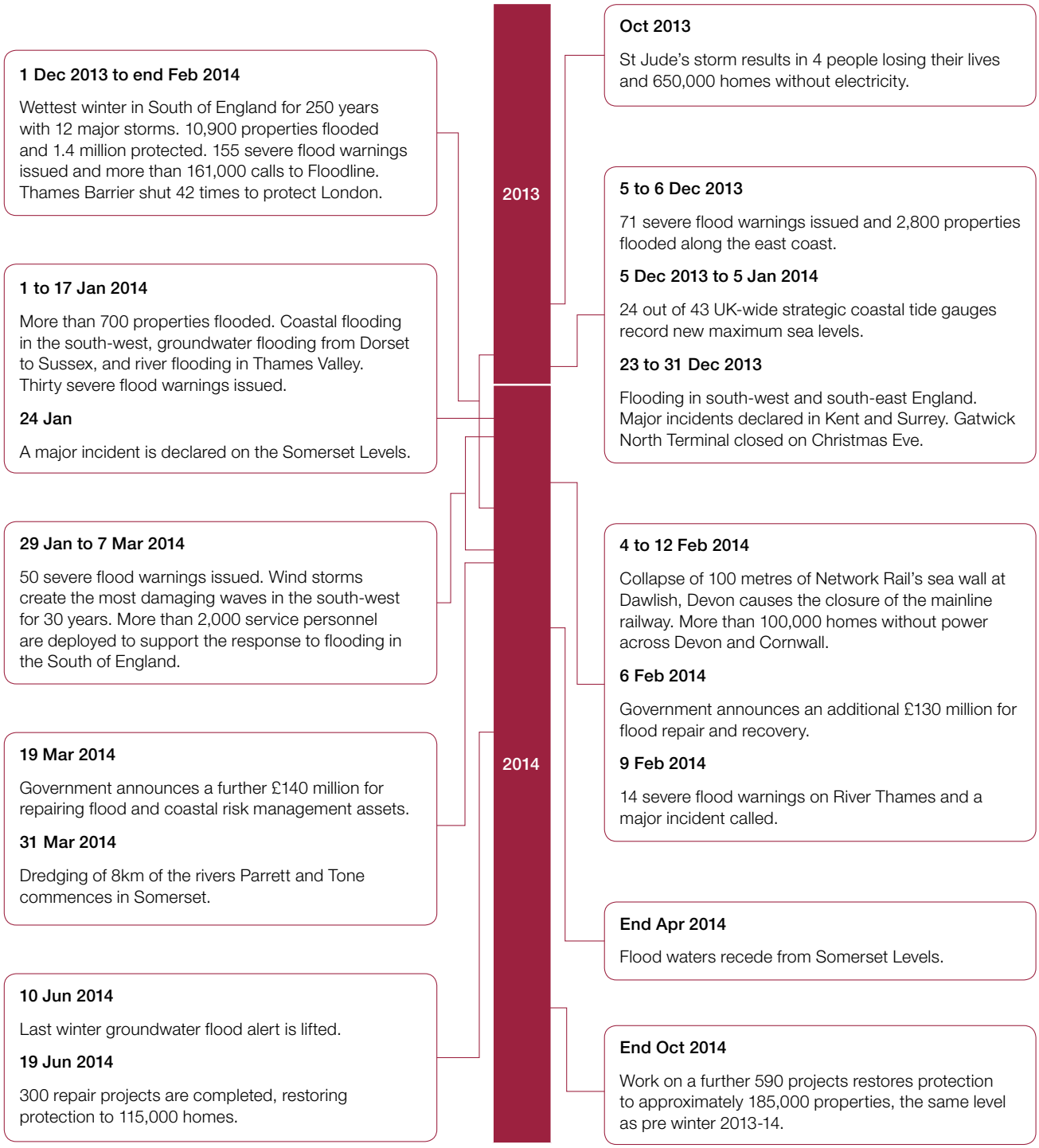
The winter floods

1.14 The winter of 2013 to 2014 saw a series of extreme weather events in many parts of England, and in the South it was the wettest for 250 years. These conditions tested the country's resilience to adverse weather and its consequences, causing flooding and disruption to communities, businesses and infrastructure.

1.15 In early December 2013, a tidal surge hit first the west and then the east coast of England. This was followed by a series of winter storms, causing flooding from rivers, the sea, surface water and groundwater. Around 7,700 homes and 3,200 commercial properties were affected. Some 49,000 hectares of agricultural land were flooded and 50 of England's most important designated wildlife sites affected. The rainfall led to 155 severe flood warnings.[12] The investment in flood and coastal erosion risk management assets and operational response meant that 1.4 million homes and businesses and around 250,000 hectares of farmland were protected. **Figure 7** (overleaf) outlines the timeline of the major events.

12 The 3 categories of flood warnings are: severe flood warning where life may be endangered; flood warning where immediate action is needed; and flood alert where flooding is possible and people should be aware.

Figure 7
2013-14 winter storms and flood warnings and events



Source: National Audit Office analysis of Environment Agency data

Scope

1.16 This report builds on our 2011 report looking at strategic flood risk management, and examines 2 main areas:

- sustainability of funding approaches; and
- how flood risk management activities are managed and delivered.

1.17 We have not evaluated the response to the winter storms. We have included case studies of communities affected by recent flooding events to illustrate aspects of strategic flood risk management:

- Lower Thames area – challenges of funding (Part Two);
- Morpeth – partnership funding (Part Two);
- Somerset Levels – maintenance of assets (Part Three); and
- Lincolnshire – example of good practice in partnership working (Part Three).

1.18 Our audit approach and evidence base are at Appendix One and Appendix Two. We have outlined how the Department and Agency have responded to previous recommendations made by the Committee of Public Accounts at Appendix Three.

Part Two

Funding

2.1 In this part we look at:

- risks to funding sustainability;
- the partnership funding model; and
- the benefit–cost analyses of projects.

Risks to funding sustainability

Funding levels

2.2 Funding levels for flood risk management reached a peak in 2010 and have fluctuated since (Figure 4). Between 2010-11 and 2013-14, central government funding for flood risk management fell, by 18% for capital and by 10% for revenue in cash terms. However, following the winter floods, the Department allocated an extra £270 million to be distributed between 2013-14 and 2015-16.[13] The funding allowed the Department and Agency to respond quickly to emergency situations and to start restoring the condition of flood defence assets. Some £200 million of this additional amount was allocated for repairing the damage caused by the floods, and for incident response. This brought total funding to a new peak in 2014-15, although excluding this exceptional allocation of £200 million, total funding decreased in cash terms by 3% between 2010-11 and 2014-15 (10% in real terms).[14]

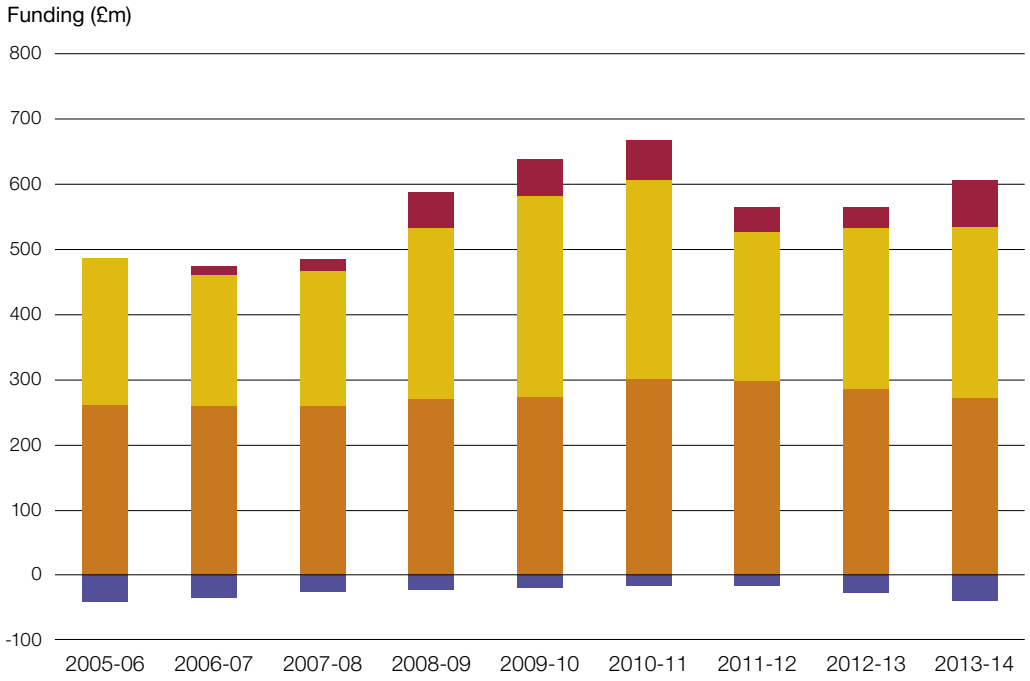
2.3 Likewise, funding for maintenance has fluctuated. Between 2010-11 and 2013-14, within the 10% overall revenue reduction, the Environment Agency's (the Agency's) funding for maintaining flood assets had reduced by 14%.[15] An additional £35 million allocated for 2014-15 and 2015-16 as part of the £270 million has, in cash terms, restored maintenance funding to 2010-11 levels. In real terms, this equates to a 6% decrease between 2010-11 and 2014-15. The Agency has reduced and prioritised its maintenance regime and also made efficiencies, including a £44 million saving on capital construction costs between 2011 and 2014. **Figure 8** shows actual expenditure by flood risk management authorities between 2005-06 and 2013-14, split between capital and revenue.

13 As reflected in Figure 4, £30 million of this was allocated for 2013-14; £180 million for 2014-15; and £60 million for 2015-16.
14 Real term prices were calculated using HM Treasury GDP Deflator Series (June 2014) with 2013-14 as the baseline year.
15 Overall revenue funding for 2013-14 increased as a result of additional funding from government to cover incident response costs and urgent repairs to assets during the winter storms.

Figure 8

Flood and coastal erosion risk management expenditure by Environment Agency and other risk management authorities 2005-06 to 2013-14

Between 2010-11 and 2012-13 funding reduced, then increased again in 2013-14 following the winter floods



	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
Local authority and internal drainage boards	0	13.2	18.0	53.4	55.8	60.5	37.9	30.9	70.9
Capital	224.3	200.4	206.1	264.1	308.3	305.6	229.4	247.1	262.8
Revenue	262.4	260.5	261.1	270.2	274.5	302.6	298.1	286.3	271.6
Flood and coastal erosion risk management income	-41.6	-34.5	-25.8	-22.1	-18.5	-17.1	-16.9	-27.2	-39.4

Note

1 Data refers to flood defence grant-in-aid funding to Environment Agency.

Source: National Audit Office analysis of Environment Agency spend figures

2.4 The Department for Environment, Food & Rural Affairs (the Department) worked with HM Treasury to agree a long-term financial commitment for the capital budget (over a 6-year period), which has allowed both the Department and the Agency to plan effectively. However, the revenue budget which funds the asset maintenance programme is allocated annually, in line with government policy, which makes it difficult to plan long term. A report commissioned by the Department for Transport suggests that funding certainty and financial flexibility is associated with cost savings on highways asset renewals of 10% to 20%.[16] Likewise, the National Audit Office (NAO) report *Maintaining strategic infrastructure: roads* found that changes in funding mix and lack of predictability has practical implications and may cost more in the long term.[17]

The Agency's work to prioritise funding

Direct asset maintenance

2.5 Based on its current funding, the Agency cannot afford to undertake all the maintenance that it has identified on lower priority defences, so it has put in place an approach to prioritise spend on its asset maintenance activities. Each year, it undertakes an exercise to allocate funding for asset maintenance, using its national data on maintenance needs. The Agency commits to funding the 'minimum' maintenance needs for all assets, which it defines as the lowest unavoidable cost of maintaining statutory compliance and operational readiness over a 12-month period, accepting that the standard of service may decline as a result.

2.6 This leaves a set of 'identified needs' for each asset, which the Agency judges are required to safeguard the optimal condition of the asset and preserve its longevity, but cannot be fully met by current funding levels. Assets with these needs are sorted by benefit–cost ratio. Of the balance remaining in the budget, the Agency allocates funds to identified needs of assets using a sliding scale with a benefit–cost ratio of more than 8:1 (which reflects current capital benefit–cost requirements). As of 2014, this approach is being reviewed for the future to further optimise the Agency's maintenance activity.

2.7 In 2014-15, using this approach, all asset systems received minimum needs. Those asset systems with benefit–cost ratios of greater than 8:1 received a proportion of their identified needs.

Preventative operations and conveyance

2.8 In addition to expenditure directly on the preventative maintenance of flood risk management assets, the Agency funds work on other maintenance activities, including inspections and the operation of defences as well as the maintenance of main watercourses ('conveyance'). The Agency told us that, ideally, £60 million a year is needed for preventative operations and a further £45 million per year for conveyance. As a result of the additional funding allocated in 2014-15 and 2015-16, this level of funding has now been provided (**Figure 9**).

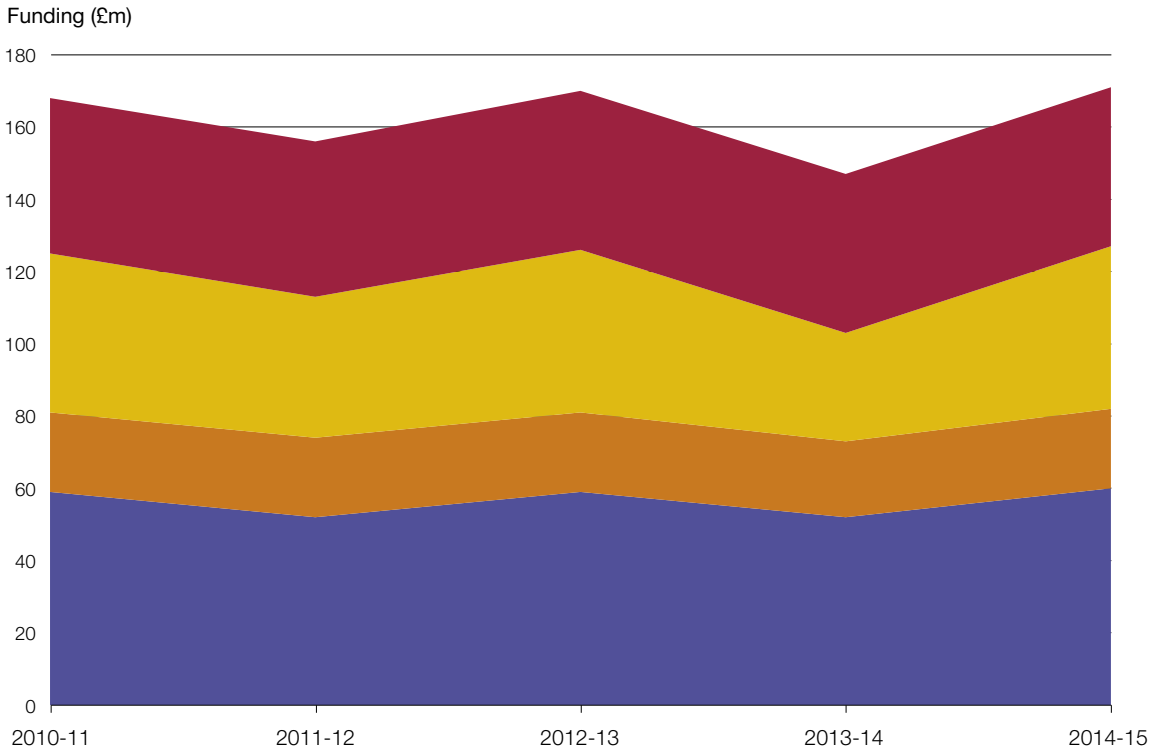
16 Alan Cook, *A fresh start for the Strategic Road Network: Managing our roads better to drive economic growth, boost innovation and give road users more for their money*, 2011, page 38.

17 Comptroller and Auditor General, *Maintaining strategic infrastructure: roads*, Session 2014-15, HC 169, National Audit Office, June 2014.

Figure 9

Distribution of funding for asset maintenance and other preventative work

Funding for asset maintenance and other preventative work dropped then rose following the 2013-14 winter floods



	2010-11	2011-12	2012-13	2013-14	2014-15
OPS	43	43	44	44	44
Conveyance	44	39	45	30	45
MEICA	22	22	22	21	22
Defences	59	52	59	52	60
Total	**168**	**156**	**170**	**147**	**171**

Notes

1 OPS – can refer to inspecting assets, providing utilities, operating flood barriers and pumping stations to reduce flood risk and managing water levels.

2 Conveyance – allowing water to flow more freely along the river channel, eg controlling aquatic weeds, dredging, removing shoals and silt, clearing screens and removing obstructions from river beds.

3 MEICA – Mechanical, Electrical, Instrumentation, Control and Automation, such as carrying out minor repairs or maintenance of pumps and tidal barriers.

4 Defences – repairs and maintenance of existing structures and defences, eg managing grass and trees on flood embankments, controlling animal populations.

Source: Environment Agency

2.9 The Agency has established prioritisation protocols to allocate funding to different types of maintenance activity.[18] In practice, spend on conveyance is most liable to reduce when funding is under pressure, because conveyance works tend to have lower benefit–cost ratios than other activities. Expenditure on asset operation and mechanical and electrical maintenance has a higher priority in light of the need to operate the assets and keep them in safe working order. While the Agency has applied benefit–cost analysis to these prioritisation decisions, a number of stakeholders have expressed specific concerns over the extent of cuts in conveyance work in their areas. The Agency has also looked to reduce spending in these areas by rationalising maintenance regimes to avoid 'gold-plating', for example to clear grass banks less frequently where it estimates that the flood risk benefits achieved will be unchanged.

Effect of funding levels in maintenance regimes

2.10 Flood risk is driven by a number of factors, including: climate change; the extent of flood defences; and the condition of those defences.

2.11 The Agency manages its maintenance regime to meet funding constraints. As of August 2014, this means that in line with its approach outlined in paragraphs 2.5 to 2.7, some 1,356 asset systems with a lower benefit–cost ratio (50% of the total) are being maintained only to a minimal level, meaning that the useful lives of those assets will be reduced. This could in turn lead to increased future flood risk and costs as assets will deteriorate more quickly. As the reliability of assets reduce, operational costs rise and the Agency will need to carry out capital replacement more quickly if it wishes to preserve the level of flood protection in the affected area. It also follows that the benefits from the original investment in these assets will not be maximised. Until 2013-14, the Agency exceeded its target to keep 97% of high-consequence assets in target condition (**Figure 10**). During 2013-14, asset conditions worsened a result of the severe winter weather. As of end of October 2014, 100% of the permanent repairs or temporary repairs with appropriate contingency measures were in place for the 890 priority flood risk management assets that were damaged during the winter storms. This restored protection to over 200,000 properties.

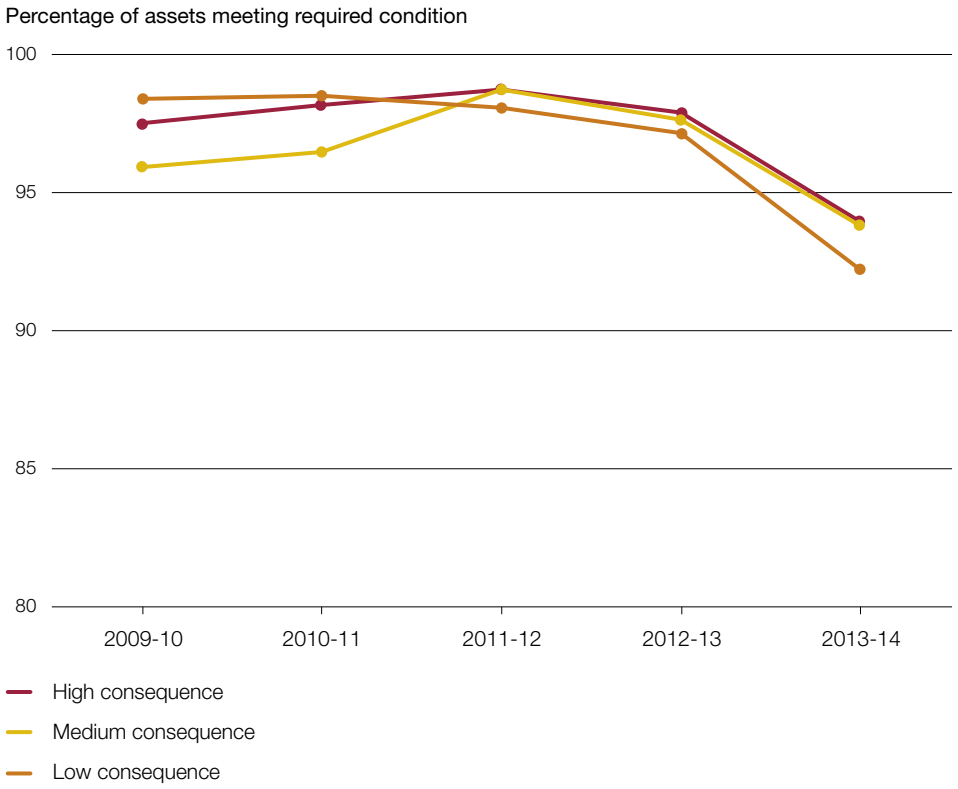
2.12 The Agency holds estimates of the relationship between maintenance expenditure and asset lives for various flood defence types. It has used this information to forecast the national effect of these changes in maintenance regimes on capital replacement and flood risk. It has not, however, communicated to communities the effect at a local level on flood risk in some areas arising from the de-prioritisation of maintenance. However, as maintenance in some areas is further deprioritised, there is likely to be a significant effect in future years. This leads to a risk that some geographical areas will be disproportionally affected by the funding reductions, and also that the risk of asset failure may increase.

18 Environment Agency, *Protocol for the maintaining flood and coastal risk assets*, October 2003, available at: www.gov.uk/government/uploads/system/uploads/attachment_data/file/297893/Protocol_for_AM.pdf, accessed 10 September 2014.

Figure 10

Target condition of Environment Agency assets

Until the winter floods in 2013-14, the Agency has exceeded its target to keep 97% of high-consequence assets in target condition

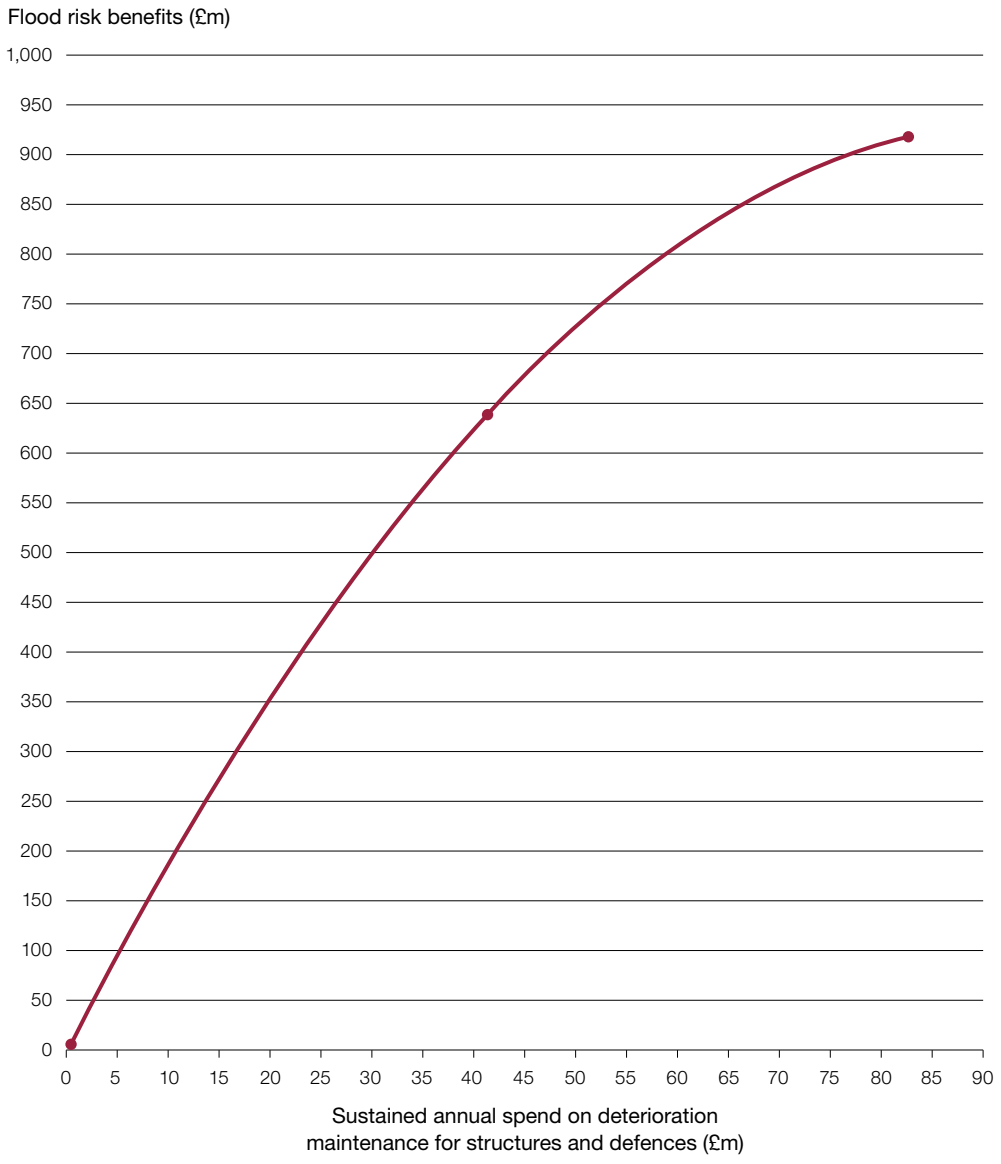


Source: Environment Agency

2.13 The Agency has calculated deterioration rates for its assets, and used this to project the impact on the extent of benefits provided by flood risk measures of increasing or decreasing expenditure on operational maintenance (**Figure 11** overleaf). The Agency estimates that an increase of £4.9 million in maintenance spend would reduce flood risk by £46.7 million. The Agency estimates that investment in preventative maintenance of flood structures and defences gives it a benefit–cost ratio return of 7:1.

Figure 11

Projection of flood risk benefits based on changes to sustained spending levels on preventative maintenance



Note

1 The costs refer to the element of overall maintenance investment that is planned preventative maintenance of structures and defences. It does not include maintenance costs for operation, conveyance or MEICA work.

Source: Environment Agency

Balance between capital and maintenance expenditure

2.14 Considered nationally, flood risk will be positively affected by capital investment and prioritisation of maintenance regimes; but both these activities will have markedly different effects on different areas and systems. While the Agency's basis for making these decisions appears sound, there will be important implications at a local level.

2.15 The Agency has done some work to calculate what the optimum split of capital and maintenance expenditure would look like. It has modelled, with appropriate caveats, different scenarios to demonstrate what the impact might be on whole-life cost. Its work concluded that the impact of new assets on maintenance costs is difficult to quantify overall. However, as the Agency is not able to fund the 'identified' maintenance needs of a significant proportion of its assets there is a need, in its forthcoming long-term investment strategy, to outline a level of funding that maximises the benefits from its ongoing investment in new flood defences. As of September 2014, the Agency is reviewing its approach to identified need.

The projected impact of climate change on flood risk

2.16 The 2012 Climate Change Risk Assessment outlined that rising sea levels and increased rainfall will have a significant impact on flood risk.[19] It noted that Northern Europe has had more frequent spells of very wet weather over the previous 40 years; that future winters will become wetter; and that rainfall will increase across all UK regions. Similarly, sea levels are expected to continue to rise and the rate of this rise is also expected to increase. The impact of climate change is one of 10 top issues the Department's Chief Scientist recently raised concerning research and development issues facing the Department.[20]

2.17 These changes will increase the load on flood protection assets, which in the medium to long term will require an increase in maintenance requirements and may increase operational costs to sustain current performance.

The Agency's new long-term investment strategy

2.18 The Agency's long-term investment strategy (2009) noted that funding would need to increase by an average of £20 million every year, plus inflation, until 2035 if the current standard of protection was to be maintained. As of September 2014, the Agency is updating its strategy for the Autumn Statement. The strategy will reflect new funding and risk baselines; broaden the evidence base to include surface water management, flood incident management and environmental obligations; and identify the long-term optimum level of spend.

2.19 The **Case study** on pages 32 and 33 for the Lower Thames highlights the challenges for funding in the longer-term to allow projects to be able to proceed.

19 *Climate Change Risk Assessment for the Floods and Coastal Erosion Sector*, 2012.
20 Available at: https://ianlboyd.wordpress.com/2014/08/22/a-personal-take-on-the-top-10-rd-issues-for-defra/ (accessed on 26 September 2014).

Case study

2013-14 winter flooding in the Lower Thames

Facts and figures

The River Thames between Datchet and Teddington has the largest area of developed floodplain in England without flood defences, with more than 15,000 homes and businesses within the area at risk from flooding from a 1 in 100-year flood.

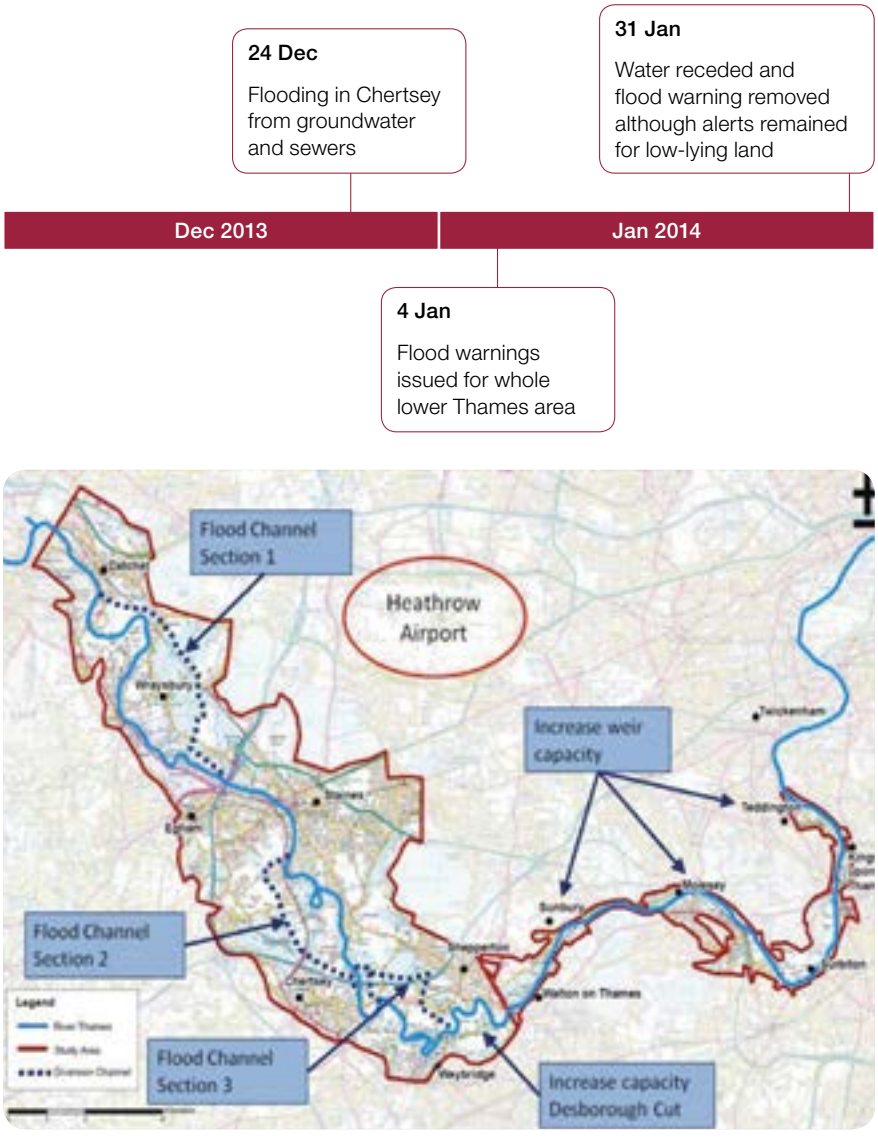
28
properties flooded in January

943
properties flooded in February

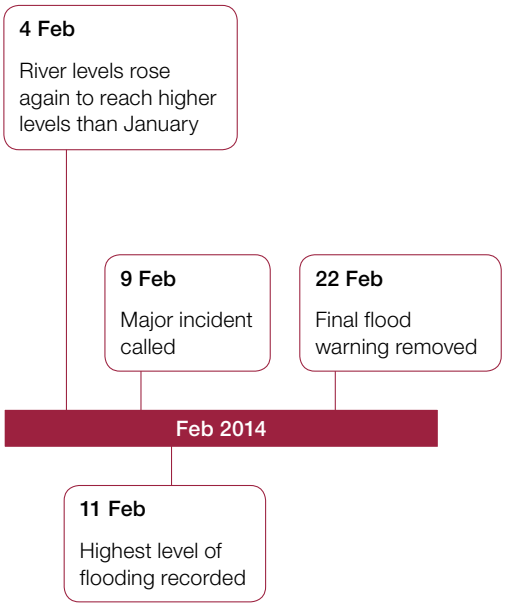
14
severe flood warnings

50 days
flood water lasted

Up to 1.5 metres
of flood water at lowest-lying areas nearest to river



Source: National Audit Office/Environment Agency



The Lower Thames Project

The River Thames Scheme is a proposal to reduce flood risk in communities near Heathrow, including Datchet, Wraysbury, Egham, Staines, Chertsey, Shepperton, Sunbury, Kingston and Teddington. The scheme consists of the construction of flood channel, improvements to 3 of the existing Thames weirs, installation of property-level products for up to 1,200 homes (to make them more resistant to floods) and improved flood incident response plans. The flood channel will be between 30 and 60 metres wide and 17 km long, built in 3 sections.

The scheme will deliver the recommendations set out in the Lower Thames Flood Risk Management Strategy 2010. It was estimated in 2009 that the capital cost of the scheme would be £302 million. The scheme is expected to qualify for a central government grant of 53% of the cost. The remaining funding needs to be secured from other sources, including local council, local enterprise partnerships, businesses and other beneficiaries. Subject to funding, the scheme will be carried out in two phases by 2025. The Thames Regional Flood and Coastal Committee is currently funding the development stages of the scheme. This has established the delivery programme and enabled progress on several projects as part of the scheme. The River Thames Scheme can only be delivered if the full funding is secured.

Key points/lessons learned

- There is considerable support for the scheme from the main risk management agencies.
- The gap in funding is significant. Without the ability to raise funds through local levy, it is unlikely to be achieved as local authority budgets will not be sufficient to cover the shortfall. It is also difficult to budget for something so far in to the future with uncertainty on funding allocations.
- The Agency has a challenge to persuade some communities that this scheme will alleviate flooding downstream of the project. The Agency is engaged with the communities and has appointed specific officers to undertake this role. This is being developed across the Agency to get local people engaged in projects.

Partnership funding model

2.20 The partnership funding model was intended to raise the level of funding available for flood risk management over and above that available from central government funds alone. It has achieved this goal – between April 2011 and March 2015 the Department estimates that some £140 million (£32 million actual, £108 million estimated) will have been raised through this model. This exceeds its 'best-case' assumption of £125 million, which was set out in the Department's impact assessment for the new policy. This model has allowed more schemes to be completed and feedback from partners is generally supportive of the model's aims.

2.21 It is difficult, however, to evaluate whether the model has been a success; as it is relatively new, and the Department did not set a target for the amount of funding it wanted to achieve; however, a Department-commissioned evaluation of the scheme indicated that, on the whole, the approach is progressing well in meeting its policy objectives. In our 2011 report, the Department anticipated that the majority of external funding would come from private sources.[21] However, most of the funding has come from public sources; some 75% funded by local authorities, and 25% directly from private contributions. Some of the 75% from local authorities may be raised indirectly from the private sector, for example through the community infrastructure levy.[22]

2.22 Current partnership funding from third parties is primarily large one-off contributions for a small number of projects, making this a potentially volatile source of income year on year. **Figure 12** highlights that much of the funding is estimated, even in the short term, and therefore not guaranteed. As a condition of the 6-year funding allocation, from 2015 onwards, at least 15% of funding will be raised from non grant-in-aid sources. As of September 2014, the Agency is defining how it will achieve this target.

2.23 The Department does not have all the current data on partnership funding beyond its own boundaries. The key data needed to implement the partnership funding policy has been driven by the need to manage grant-in-aid allocations, evaluate project business cases and meet the Environment Agency's financial accounting needs. However, this means that only estimates of contributions identified by other risk-management authorities are recorded until they submit their final statement of account 2 years after their schemes have completed.[23] In addition, risk-management authorities do not have to specifically provide data on what contributions in-kind they receive that reduce the costs of projects. Without these data, the Department cannot currently accurately track partnership funding given to local authorities until 2 years after schemes are completed, which impacts on its ability to accurately evaluate the success of the model.

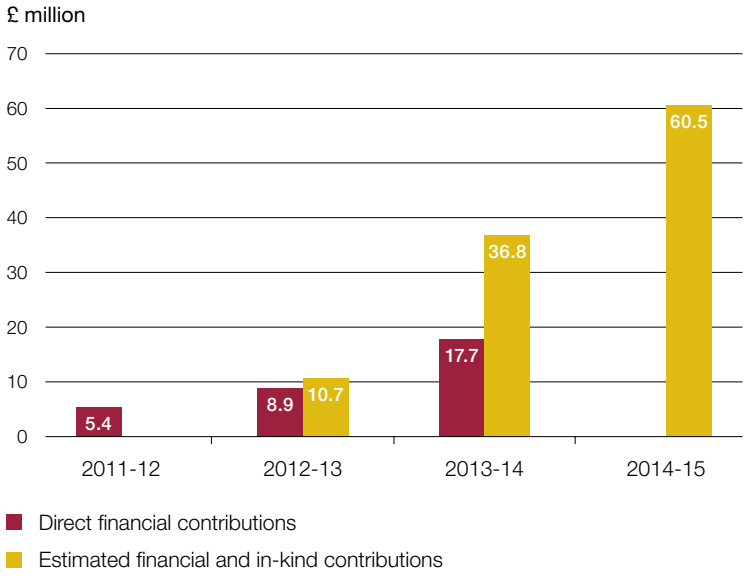
21 Comptroller and Auditor General, *Flood Risk Management in England*, Session 2010–2012, HC 1521, National Audit Office, October 2011.

22 A locally set general charge, which local authorities can choose to implement, levied on developers, per m^2 of most new development across an authority's area.

23 An agreement with the Department for Communities and Local Government to reduce burdens on local authorities by central government.

Figure 12
Partnership funding contributions

The majority of partnership funding is estimated and therefore not guaranteed



Notes

1 Directly measured financial contributions are those passing through the Environment Agency accounts for Agency projects.

2 Estimated financial and in-kind contributions cover all other forms of contribution for Environment Agency, local authority and internal drainage board projects.

Source: National Audit Office analysis of data from the Environment Agency

2.24 Both the Department and the Agency have taken steps to ensure that Agency staff and partnerships are supported and informed about partnership funding. In 2012 the Agency and Department, in association with the Local Government Association, jointly published a guide for lead local flood authorities that included a number of case studies on different partnership approaches and organisations that have provided funding.[24] Since then, it has shared examples of different approaches used and developed further guides on how to identify and communicate the need for contributions. It has provided area Agency staff with an interactive overview of the partnership funding approach. In autumn 2014 the Agency intends to run partnership funding training workshops for lead local flood authorities. The **Case study** on pages 36 and 37 gives an example of what can be achieved with partnership funding, and highlights the Morpeth scheme, one of the first to be approved under the model.

24 Department for Environment Food & Rural Affairs, Environment Agency and Local Government Association, *Partnership Funding and collaborative delivery of local flood risk management: a practical resource for LLFAs*, March 2012, available at: http://randd.defra.gov.uk/Document.aspx?Document=9958_FD2643_Partnershipfundingguide.pdf, accessed 26 August 2014.

Case study
Flooding in Morpeth

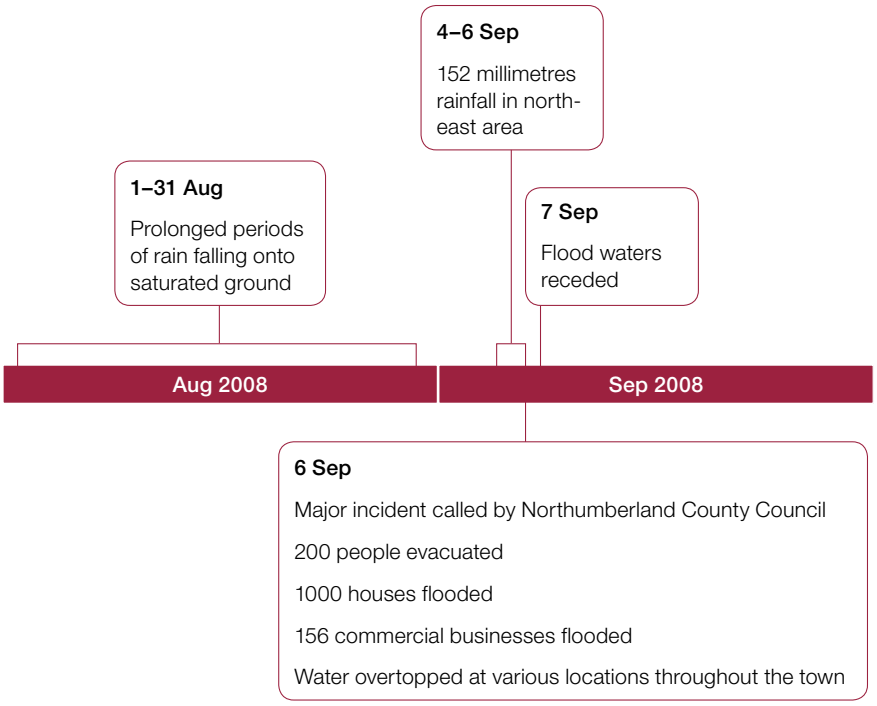
Facts and figures

Morpeth has flooded 21 times in the last 170 years, but 2008 was the most significant. The previous big event in 1963 was a 1 in 100-year event. In 2008 the event was a 1 in 137-year event.

1,000
houses were flooded

156
commercial premises flooded

4
Severe flood warnings issued



Source: National Audit Office/Environment Agency

Morpeth Flood Relief Scheme

One of the first to be approved under partnership funding, the Morpeth scheme (completing autumn 2014) will see the construction upstream of a new dam and reservoir and enhanced flood defences throughout the town.

Led by Northumberland County Council and the Agency, the scheme will provide defences for a 1 in 137-year event. The scheme includes:

- upstream storage (reservoir) on the Mitford Estate;
- new floodwalls where none exist;
- refurbishment of existing floodwalls;
- tree screens;
- improved capacity of Cotting Burn culvert plus upstream storage; and
- improved capacity of Church Burn culvert.

Total costs are estimated at £21 million and Northumberland County Council is funding £12 million of the costs.

Key points/lessons learned

- Strategy developed and agreed with partners to tackle flooding in 2005.
- As a result of the review of the flood event in 2008, the resilience plan has been updated and lessons learned have been shared with main risk management agencies and the community, to improve evacuation in future.
- Project stalled on a few occasions because of the previous funding regime and the benefits being too low to secure full grant-in-aid funding.
- Local partnership funding model has allowed scheme to progress.
- A shop has been used in Morpeth to inform residents of the scheme and progress. More than 1,000 people have visited the shop during the construction phase of the work.
- Regular newsletters are sent out by the project partnership, which includes Northumberland County Council, the Agency and Northumbrian Water.

Costs and benefits of new capital projects

2.25 The Agency's approach to appraising capital flood defence projects is robust and consistent with HM Treasury's Green Book guidance. Investment appraisals for projects are detailed and well thought through. It has produced extensive guidance for applicants to follow, setting out the processes for identifying and monetising the typical costs and benefits of flood and coastal defence projects. The relationship between costs and benefits is expressed as a benefit–cost ratio, which reflects monetised gain relative to the investment.[25]

2.26 Successful flood defence schemes tend to have high benefit–cost ratios. As of March 2014, the ratio for all flood defence projects funded by the Agency during the current 2010 spending review period was 9.5:1, which compares favourably across government. The Agency is confident it can achieve a final ratio of at least 8:1 by the end of the spending review.

2.27 The Agency's investment appraisal method allows it to identify and fund a greater number of smaller-value projects, as opposed to allocating limited funding across a small number of large projects. As the Agency is working within the constraints of its funding, its appraisal policies set a higher benefits threshold for higher-cost projects. This is designed to secure an acceptable standard of protection with a sufficiently high benefit–cost ratio, in cases where the highest net present value[26] might be deemed 'gold-plated'.[27]

2.28 The Agency could, however, do more in its guidance to be clear that there is potential to deliver a scheme with a higher standard of protection, if partnership funding can be secured to meet the increased costs. The Department and Agency recognise this and as of 2014 are reviewing their guidance.

Determining benefits for agricultural land

2.29 Stakeholders have a range of views on whether greater emphasis should be placed on particular benefits when appraising capital schemes and on the grant-in-aid payment rates for their specific interest area. For instance, rural stakeholders we spoke to consider that greater emphasis should be placed on the value of agricultural land. At present, almost 60% of Grade I agricultural land in England is dependent on flood risk management or land drainage activities. However, the Agency estimates that following the 2007 summer floods in England, flooding on farmland accounted for only 2% of total economic losses.

25 Benefit–cost ratio is calculated by dividing the value of expected benefits by the value of expected costs. The higher the ratio, the greater the return on investment will be.

26 Net Present Value is the present value of expected future cash flows minus the cost.

27 In the Agency's experience, increased levels of protection can be marginal when compared to the additional cost involved. Thus, it does not always necessarily choose the option offering the highest benefit–cost ratio, but instead looks to achieve a sufficient level of protection for the costs involved.

2.30 When appraising flood defence projects and allocating funding, the Agency takes account of all economic benefits, including the possible flooding of agricultural land as well as other factors such as damage to property, business or infrastructure. Its appraisals are based on government guidance on the projected impact on national economic output caused by flood events, and do not include any preferential weighting in respect of agricultural land or any other sector.

Part Three

Flood risk management activities

3.1 In this part of the report we look at:

- flood risk modelling;
- asset management;
- communication with communities; and
- working with risk-management partners.

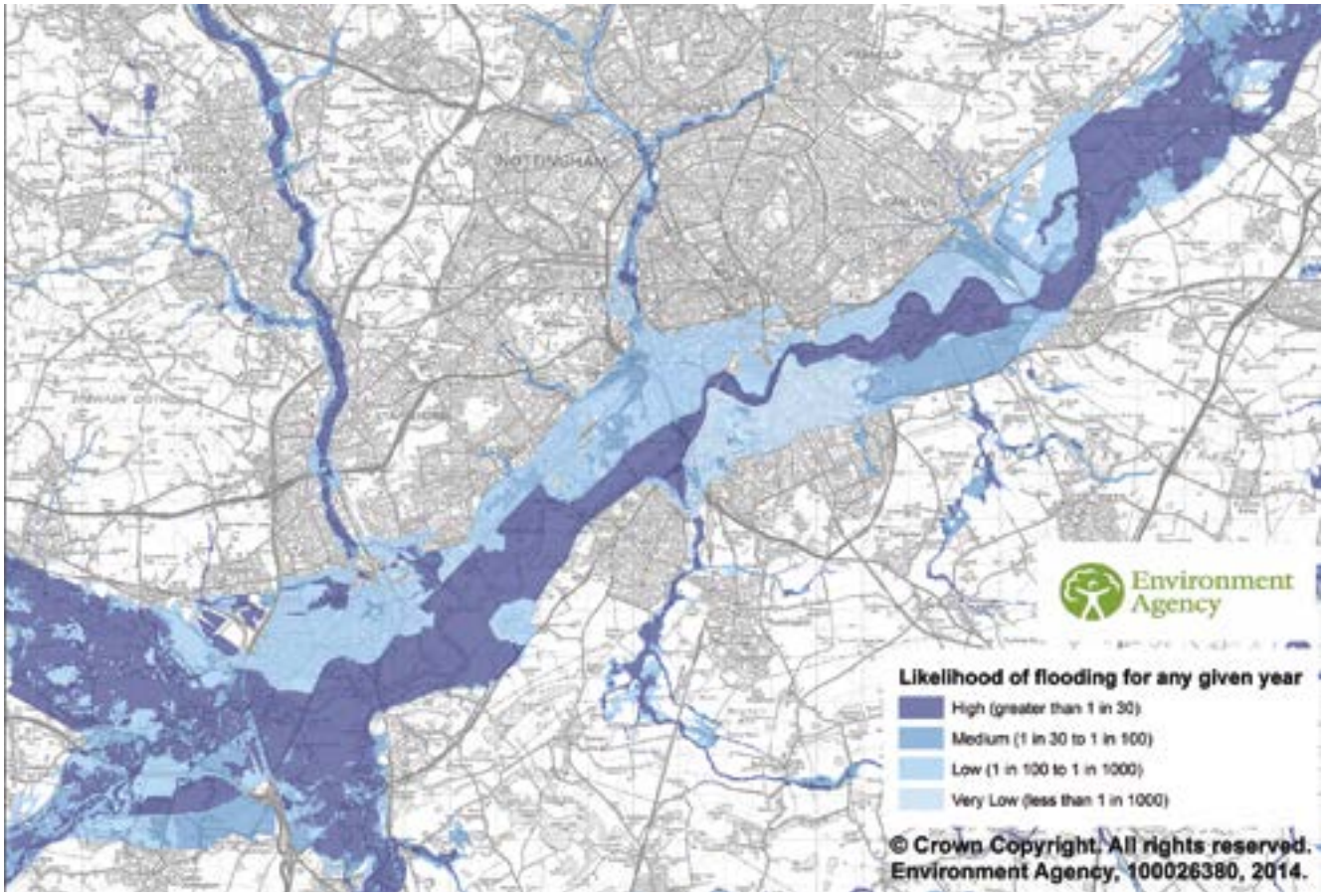
Flood risk modelling

Use and presentation of data

3.2 The Environment Agency (the Agency) takes a risk-based approach to all its flood and coastal risk management activities. Key to this is the accuracy of the models used to predict where flooding will occur. The Agency considers itself to be a leader in main-river and coastal flood risk modelling and hydrological science. Its expertise is often sought at different flood risk events. Most stakeholders responding to our call for evidence felt flood models in England were well developed and supported strategic decision-making.

3.3 The Agency has improved the way it presents data from its models. In 2011 the flood likelihood categories were made clearer and more consistent across the Agency's other flood maps, such as surface and reservoir maps. The Agency has recently published information for the first time about the reliability of its model data at different scales of risk assessment. This is so users can make more informed decisions about how they use the data. The **gov.uk** website makes all flood maps publicly available for householders to check if they are in flood prone areas and what the expected level of risk and range may be during an event. **Figure 13** gives an example of how the Agency's modelling predicts and communicates risk to users.

Figure 13
How flood modelling looks at a local level



Source: Environment Agency

3.4 As of 2015, the Agency will develop a single integrated map that shows the national risk of flooding from all sources. This model will allow all risk-management authorities to use the same data, which will assist when planning flood risk management activities at a local and regional level. As of September 2014, the Agency is working to meet a deadline of December 2015 whereby the latest data will be provided to insurers for their use.

3.5 The Agency has also improved the data within the model; for example it has taken further steps to improve its understanding of the risks of surface water flooding. It produces maps of surface water flooding in partnership with lead local flood authorities, who have the overall responsibility for managing this risk.

3.6 As well as the national-level mapping, area Agency offices can undertake more detailed hazard mapping locally to help predict where flooding will occur. The extra mapping undertaken for the east coast area helped the Agency to work with local flood resilience forums to decide where properties needed to be evacuated for the winter surge. The Agency is currently looking at how hazard mapping principles can be adopted nationally, so that it has a better understanding of flood risk management at all levels, and how and when emergency procedures need to be put in place.

Data-sharing

3.7 The Agency has improved its collaboration and information-sharing with the Met Office. Before 2009, flood forecasts did not make the most effective use of the Met Office's weather forecasts. Since 2009, the Agency has collaborated with the Met Office on the Flood Forecasting Centre. This centre ensures the best possible join up of Agency and Met Office data and expertise, for example by producing 5-day forecasts that deliver longer lead-times for where flood warnings are needed to warn emergency responders and residents about imminent risks.

3.8 The reciprocal sharing of data with other partners, where data protection guidelines allow, should enhance all risk-management authorities' knowledge of flooding. For example, the Association of British Insurers is arranging for aggregated claims data to be provided to the Department for Environment, Food & Rural Affairs (the Department) as part of the Flood Re agreement. This data could be useful for validating the accuracy of the Agency's own models. The information held by the water companies would also help local authorities in developing their sustainable urban drainage system plans.[28]

Asset management

3.9 The Agency needs to continue to engage with other asset owners and ensure they take responsibility for maintaining their assets. It only has direct maintenance responsibility for 45% of flood assets. The other 55% is the responsibility of local authorities, internal drainage boards and private owners. Whereas there is only one risk-management authority responsible for managing a watercourse, there are often many parties (including private individuals) responsible for managing assets on this watercourse, which adds to the complexity of maintenance and replacement arrangements.

3.10 The lack of awareness of who owns assets can have serious consequences. During our fieldwork, we were told of two recent incidents where a flood embankment and an earth bund had been removed to improve properties. This resulted in property flooding. The owners said that they were not aware that the embankment and bund were flood defences.

28 Sustainable urban drainage systems are a sequence of water management practices and facilities designed to drain surface water in a manner that will provide a more sustainable approach than what has been the conventional practice of routing run-off through a pipe to a watercourse.

3.11 The Agency has recognised that there are opportunities to save money if it improves its asset management. From 2006, asset maintenance costs have been assessed at a 'system' level – that is, a group of assets to protect one area. There is less detail about the replacement cost, and costs of maintaining just one element of the system. Each asset system is rated as high, medium or low, depending upon the consequence of the system flooding. Each asset within a system has the consequence rating attributed to the system. This might not provide the optimum level of expenditure for individual components.

3.12 As of 2014, the Agency aims to enhance the systems approach to asset management by incorporating more information from individual asset registers, which record the condition of each of its assets. This will allow it to improve its risk management through better targeting of investment. It will also deliver efficiencies in the way asset maintenance work is managed. This is the approach taken by many lead local flood authorities.

3.13 The **Case study** on pages 44 and 45 looks at the flood event in Somerset and the remedial work that has been undertaken to improve the conveyance of water and the future water management plans that are being put in place.

Working with others

3.14 We observed some good-practice examples of local partnership working to manage flood risk plans and activities. In Lincolnshire, for example, all the risk-management authorities and other main stakeholders meet monthly to manage and mitigate the risk from coastal flooding. The group has a clear and collective understanding and ownership of flood risks, and has produced a local strategy outlining each organisation's roles and responsibilities. It has agreed the projects which will receive either partnership funding, or funding through the use of the local levy, based on priority and benefits to be achieved. The Agency has recognised that this approach is good practice, and the Lincolnshire partners are actively engaging with other areas in England to share their experiences and knowledge (**Case study** of coastal surge in Lincolnshire on pages 46 and 47).

3.15 The Department's capacity-building support for lead local flood authorities has been well received. It has provided funding support to train staff from across all local authorities to improve their knowledge and expertise of flooding. In addition, the Agency has seconded staff to the local authorities to provide additional resource to complete strategies and develop sustainable urban drainage system plans. This is a reciprocal arrangement where some local authority staff have also come into the Agency to improve their understanding of surface water issues.

Case study
2013-14 Winter flooding in Somerset

Facts and figures

Many parts of the area sit below sea level. The flooding of winter 2013-14 was due to prolonged heavy rainfall resulting in record high levels on the rivers Parrett and Tone over an extended period. This combined with high tides in January resulted in record flooding of the moors area.

175
houses were flooded

50,000
properties were protected from tidal and fluvial flooding

8.1 metres
the highest ever tide of 8.1 metres was recorded on 3 January 2014

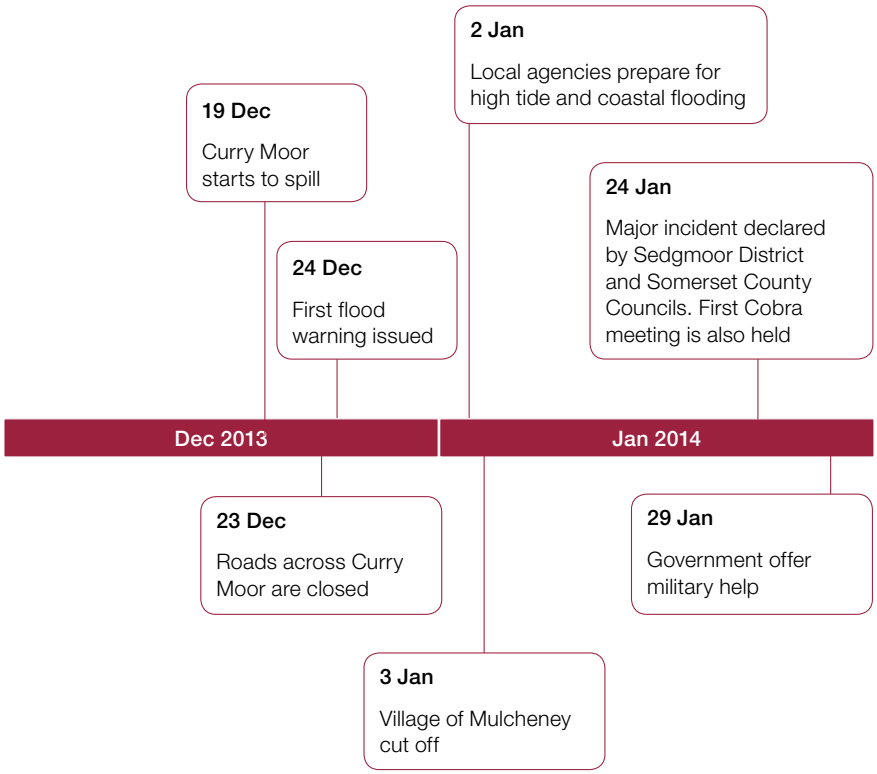
200
Additional Agency staff brought in from across the country to support emergency response

2
severe flood warnings issued

11,000
hectares of land affected (6% of Somerset)

100 million
cubic metres of water on the Levels at the height of the flooding

2 hours
pumping on the Levels was equivalent to emptying Wembley Stadium every 2 hours



Source: National Audit Office/Environment Agency

'The 20-year plan'

Authorities, agencies and community representatives across Somerset were tasked by the Secretary of State to develop a long-term flood action plan for the area.

Developed in just 6 weeks by the risk-management authorities, the Somerset Levels and Moors Flood Action Plan was published in March 2014 with objectives, including reducing the frequency and duration of flooding, maintaining access to communities, increasing resilience and ensuring strategic transport connectivity.

The plan outlines what it intends to deliver over the next 20 years, including:

- dredging the Tone and Parrett rivers;
- increasing the capacity of the Sowy/King Sedgmoor Drain;
- investing in flood management infrastructure;
- construct a barrier or sluice at Bridgwater; and
- establishing a Somerset Rivers Board to coordinate maintenance of all the rivers across the Levels.

Partners recognise that partnership funding opportunities are limited due to the number of properties being protected and there being no major sources of private sector funding.

Key points/lessons learned

- £10 million funding from government given in April to dredge rivers and deal with urgent repairs. This did not include partnership funding.
- Local flood groups are crucial to taking control of event using strategic emergency response plans.
- Local community flood plans are essential to avoiding panic and anxiety and to check that vulnerable people are identified and assisted. Flood wardens are also important to help coordinate response across different agencies.
- Regular communication with communities both before, during and after flood events through a range of channels is important from all risk-management authorities.

Feb 2014

5 Feb

Following 5 flood warnings, 2 severe flood warnings are issued and for Moorland residents to evacuate

7 Feb

Village of Moorland cut off and flooded

11 Feb

Agency continues to pump water and to support efforts. Nineteen high-capacity pumps brought in from Holland

Mar 2014

5 Mar

Somerset delivers its 20-year plan

8 Mar

Last house clear of water

14 Mar

Official end of the emergency response and incident moves to recovery phase

Case study

2013-14 Coastal surge in Lincolnshire

Facts and figures

Many areas have been hit badly by regular storms and coastal surges and in 1953 41 people died and flood water penetrated 9 km inland. The flooding of winter 2013-14 was due to a combination of very high tides, low weather pressure and westerly winds.

1st and 3rd
ranked local authorities in Lincolnshire with the highest number of properties at significant flood risk (Boston and East Lindsey)

40,000+
largest concentration of caravans in Europe

137,000
properties at risk of flooding and

Almost 1,000
properties flooded

136,000
properties protected

11
severe weather flood warning during 2013-14 winter storms

2,300
hectares of land flooded, and

222,000
hectares protected

5 Dec

severe flood warning issued and houses evacuated along the coast

6–12 Dec

325 km defences inspected, 45 Agency staff involved in checking assets, 120 damaged assets

Dec 2013

5 Dec

Boston defences overtopped with 791 properties flooded

198 properties flooded along South Humber bank and Lincolnshire coast

28 Dec

Next high tide and 20 assets to be repaired

Temporary barriers erected where repairs could not be actioned in time

Source: National Audit Office/Environment Agency

Key flood schemes at Lincshore and Boston

Lincshore is a multi-year scheme and has focused on re-nourishing the beaches along the Lincolnshire coast, which are constantly impacted by the waves. This project increases the resilience of the area to surge, and has made year-on-year efficiencies as a result of learning.

Using sand from the seabed, a dredger replenishes the sand on the beach at key sites which have been identified by survey. In 2014, more than 520,000 m^3 of sand will be used.

A long-term strategy is being developed by the partners as climate change will require greater volumes of sand in the future. The coastline may look different in the future as a result of different methods for improving resilience are understood.

Boston – to protect the town from risk of flooding a tidal barrier is being erected just outside the town centre. Part of a larger scheme of works, the town will benefit from increased height of flood walls in the lower part of the town, and improved watercourse management on the canals and higher waterways. There are 5 phases:

- Phase 1 – new navigation link at Black Sluice;
- Phase 2 – refurbish flood defences in town centre;
- Phase 3 – Boston tidal barrier and associated works;
- Phase 4 – new waterfront facilities; and
- Phase 5 – future raising of defences.

Key points/lessons learned

- All risk-management authorities understand the risks and prioritise flood alleviation work. Good level of partnership working and shared ownership of risks and identification of organisation responsibilities.
- An East Coast Action Plan has been developed in conjunction with all partners to mitigate risk.
- All local authorities have completed their strategic flood plans and are working with national groups on sustainable urban drainage systems.
- Local hazard mapping has been developed to identify local critical infrastructure and the most vulnerable people, and to assist with evacuation planning.
- A Lincolnshire coastal campaign has been developed that outlines shared ambition, balanced messages and what communities must do in an event.

Delays in production of local flood risk management strategies

3.16 Lead local flood authorities' progress in producing mandatory flood risk management strategies has been slower than expected. By March 2014 only 16% of lead local flood authorities (24) had produced strategies. A further 34 authorities have plans out for consultation, and 94 are in progress. As part of the Flood and Water Management Act, local authorities were tasked to develop, maintain, apply and monitor a strategy for managing flood risk from surface water, groundwater and ordinary water courses, which took direction from the National Flood Risk Management Strategy (2011). The Department has identified the highest priority areas and has been working with them to complete their strategies. The Parliamentary Under-Secretary of State for Water, Forestry, Rural Affairs and Resource Management has recently written to all lead local flood authorities, asking them to complete their strategies by 31 December 2014.

Communication

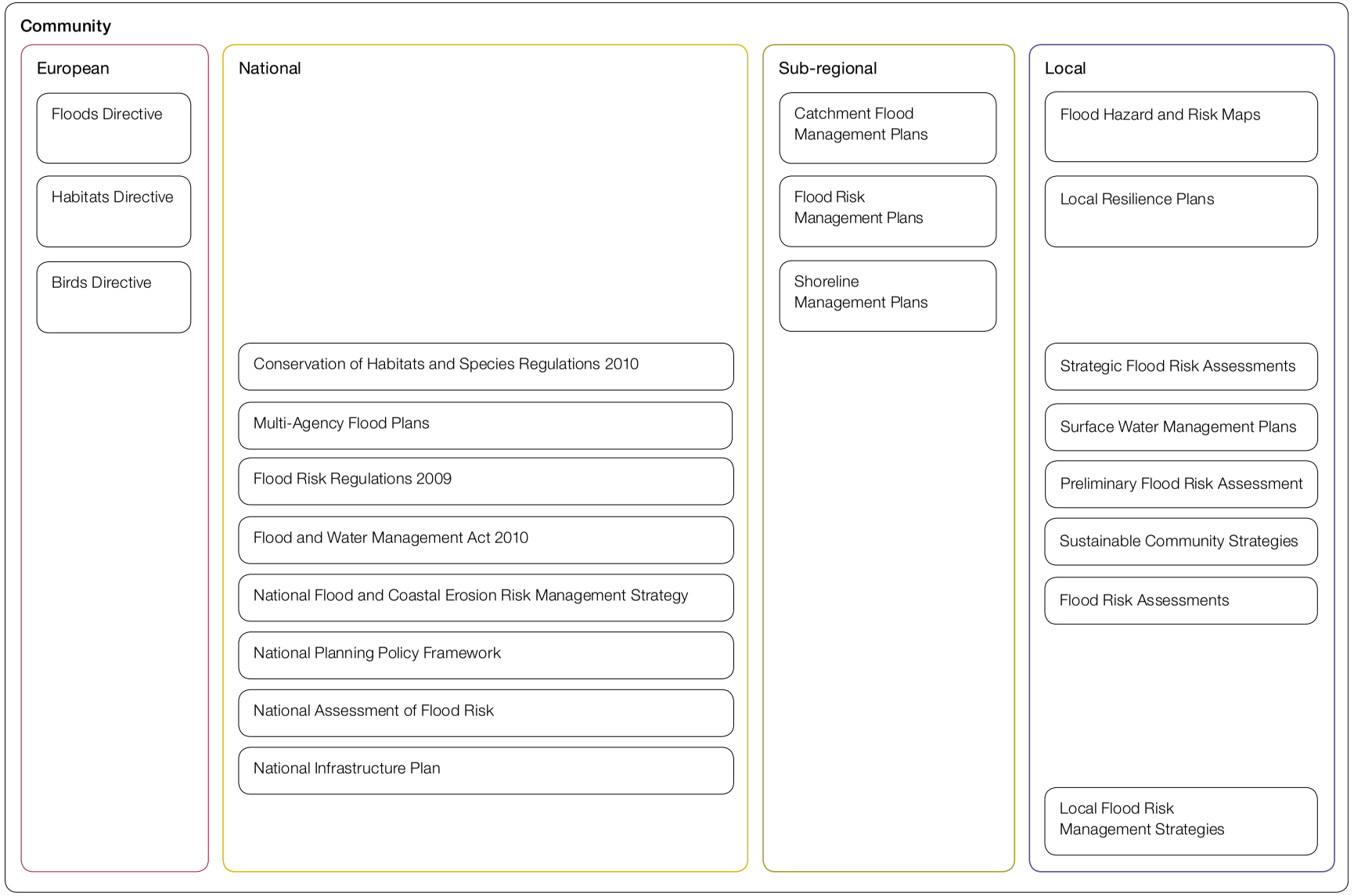
3.17 The national strategy, as outlined in paragraph 1.3, had an aspiration that local communities should take steps to manage their flood risk, and this has introduced a necessary level of complexity into the way it is delivered. However, some stakeholders we consulted considered the current system was overly bureaucratic and confusing. At the local level, there can be a profusion of plans that often duplicate or cross geographical or administrative areas; there are approximately 20 strategies, plans and legal frameworks (**Figure 14**) relating to flood risk management. Both the Agency and the Department are looking to streamline the number of plans and strategies in place around flood risk management. The Agency is currently developing new flood risk management plans, which will bring together the information from other documents into one for the first time. These plans will be completed by December 2015.

3.18 There are a large number of bodies involved at an operational level including: the Agency, 152 lead local flood authorities, 128 internal drainage boards, numerous district councils and water companies. Some of the community groups we spoke to expressed concerns about knowing which organisation to contact during a flood. Some local communities still consider that there is a lack of clarity on where responsibility for flood risk management lies.

3.19 The Agency engages with communities to explain key changes which affect them, such as the implementation of partnership funding and sustainable drainage systems, but could do more to communicate changes to its maintenance regimes. Some communities have assumed if something has been done previously it will continue to be done in the future. The Agency has aimed to address this by publishing guidance on topics such as maintenance protocols and programmes on **gov.uk**.

Figure 14

Regulations, strategies and plans from a community perspective



Source: National Audit Office analysis

Appendix One

Our audit approach

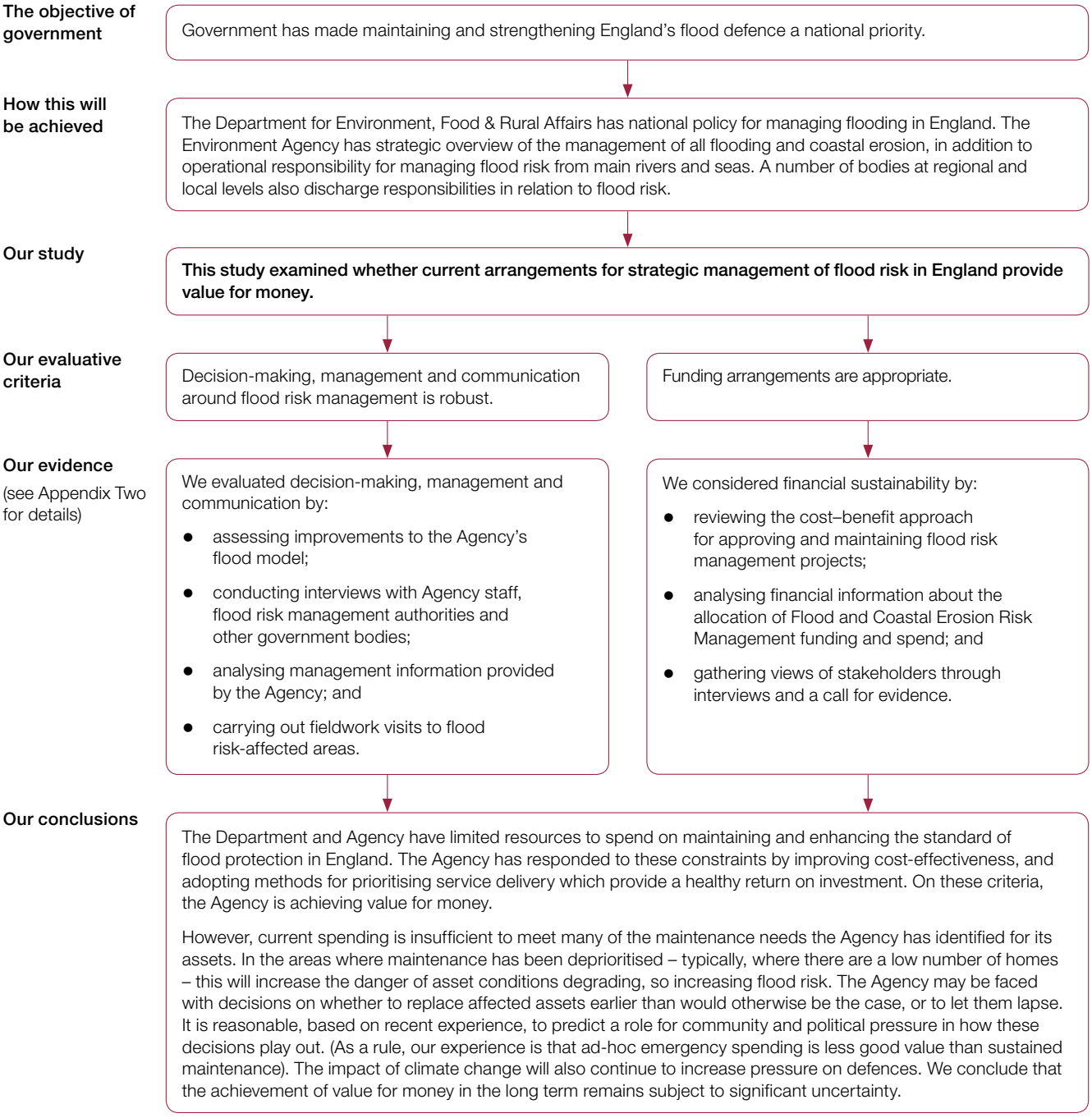
1 This study examined whether current arrangements for the strategic management of flood risk in England deliver value for money. We reviewed:

- sustainability of funding approaches; and
- how flood risk management activities are managed and delivered.

2 We applied an analytical framework with evaluative criteria to consider what optimal strategic flood risk management would look like. By 'optimal' we mean the most desirable possible while acknowledging expressed or implied restrictions or constraints.

3 Our audit approach is summarised in **Figure 15**. Our evidence base is in Appendix Two.

Figure 15
Our audit approach



Appendix Two

Our evidence base

1 We reached our independent conclusions on whether current arrangements for flood risk management in England deliver value for money following our analysis of evidence collected between June and September 2014.

2 Our main evidence sources were:

- **Presentation/discussion sessions** with the Agency and Department on:
    - Flood modelling.
    - Partnership funding.
    - Asset management/prioritisation.
    - Capital flood risk projects.
    - Policy environment.
- **Semi-structured interviews** with:
    - The Army, focusing on support provided by the UK Military following the floods of 2014.
    - Cardiff School of Engineering.
    - Department for Communities and Local Government.
    - Department for Transport.
    - Highways Agency.
    - HM Treasury.
    - Local Government Association.
    - Met Office.
    - Natural England.

- **Visits to 4 case study areas** – we visited Somerset, Thames Valley, Lincolnshire and Morpeth to understand the work in these areas around flood risk management and the flood alleviation schemes that were planned or in progress. During our visits we:
    - talked to area staff from the Agency;
    - visited areas affected by flooding and viewed schemes in progress; and
    - interviewed local risk-management authorities (lead local flood authorities, district and borough councils, regional flood and coastal committees), representatives of local community groups, and the National Farmers' Union.
- We sought to understand working in partnership, the funding landscape, the balance of different interests, and roles and responsibilities. We spoke to over 50 individuals from 28 organisations.
- **Quantitative and financial analysis** – We reviewed the benefit–cost approach for flood risk management projects for consistency with HM Treasury guidance, including a detailed review of the Agency's project appraisal guidance, assessment of an approved flood risk management scheme and consideration of the current balance between residential, economic and infrastructure benefits.
- We also reviewed the allocation of funding and expenditure, including central government grant-in-aid, external levy contributions and emergency funding. We looked at the split between capital and revenue funding and analysed maintenance spend. We reviewed funding leveraged to date against forecast expectations for the partnership funding model.
- **A review of key Departmental and Agency documents** – including strategies, risk registers, plans and board minutes.
- **Review and analysis of other literature** – a range of documents related to recent flooding events.
- **Call for evidence** – We sent a call for evidence to 10 organisations from a variety of fields including hydrology, farming, environmental protection, civil engineering, academia and flood resilience. We asked them to share views on risk assessment and investment appraisal; sustainability of funding arrangements and infrastructure security. Six organisations responded.
- **We saw and discussed the Agency's flood model.** We visited the Agency, saw the National Flood Risk Model in action and discussed how it was compiled.

Appendix Three

Follow up of previous recommendations

1 The Committee of Public Accounts made 5 recommendations following the NAO's previous report on flood risk.[29] A summary of the government's responses is provided in **Figure 16**.

Figure 16
Government's response to previous recommendations about flood risk

	Recommendation	Government response
1	The Agency should publish a long-term strategy reflecting current funding realities where the assumptions underlying its plans are transparent.	The government agreed with this recommendation and committed to making 15% efficiency savings on capital schemes delivered by the Agency through its flood defence procurement and sustainable engineering strategies. For 2011-12, it achieved its target to make savings of £6.1 million (3.8%). At end Q2, 2012-13 the Agency achieved £8.4 million (63%) of its £13.4 million target for the year. The Agency is currently updating its long-term investment strategy and aims to complete it by autumn 2014.
2	The Department should support local authorities to bring in local partnership arrangements.	The government agreed with this recommendation. The Agency has produced guidance to help risk-management authorities establish partnerships and to deliver projects with multiple funding sources. The Department also provided capacity-building support for local authorities to support them in fulfilling new responsibilities under the Flood Water Management Act.
3	The Department should articulate what information it relies on to evaluate local risk-management strategies. The public needs to know and understand where responsibility and accountability lie.	The government agreed with this recommendation. Lead local flood authorities are required to report annually to the Department on their implementation of Flood Water Management Act responsibilities. The Agency reports to the Department annually on national management and the status of local strategies. This information will be used to evaluate the effectiveness of current arrangements by 2015.

29 HM Treasury, *Treasury minutes Government responses on the Sixty-second to the Sixty-seventh reports form the committee of public accounts*, Session 2010–2012, Cm 8335, March 2012.

Figure 16 *continued*
Government's response to previous recommendations about flood risk

	Recommendation	Government response
4	The Agency needs to engage communities and local expertise on preferred solutions, and it should improve consultation processes to achieve more meaningful local engagement.	The government agreed with this recommendation. The Agency's Flood and Coastal Erosion Risk Management Change Programme revised management structures to develop better local engagement. A number of initiatives were delivered in 2012 such as 'Working with Others' and 'Flood Wise', which have supported better engagement at the local level.
5	Government needs to reach agreement and work more closely with the insurance industry to ensure affordable cover for flood risk is available.	The government partially agreed with this recommendation. Agreement with the insurance industry was reached in June 2013 on the best way to promote the availability of affordable flood insurance. The Flood RE scheme was announced November 2013 as a transitional measure to move towards a free-market (i.e. risk-based) insurance pricing system.

Source: National Audit Office

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