Targeting flood investment and policy to minimise flood disadvantage

by Kit England and Katharine Knox

Flood risk in England is growing.
This report looks at how the Government and other authorities can improve flood risk management to support vulnerable sections of society.

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Flood risk in England is growing, and the public looks to the government for a response. How can the government and other authorities improve flood risk management to better support vulnerable sections of society?

This report:

- outlines the relationship between exposure to flooding and social vulnerability and how this creates flood disadvantage for particular parts of England
- sets out how flood investment could be targeted more effectively to support those communities which may be most disadvantaged by flooding in England
- recommends how the wider national policy framework could better address underlying social vulnerability in order to increase flood resilience.

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1 Summary

Over the last ten years, the UK has seen significant floods, all of which have had a profound impact on those affected. Nearly 1 in 6 households in England is at some risk of flooding (DEFRA, 2015). The public expects the government to be managing flood responses; recent research from Cardiff University shows 71 per cent of the population feel it has the main responsibility for protecting properties from flooding (Capstick, *et al.*, 2015).

In December 2014, the government published its long term investment scenarios and six year investment programme for flooding (DEFRA, 2014a). These set out plans for £2.3 billion of government investment as part of the overall flood risk management policy framework. While sufficient investment is important, every pound spent must also provide the best long-term value for money. This should mean taking account of social as well as economic costs and impacts in investment plans.

Despite aspirations, strategic approaches are not always followed and public concerns can lead to political pressure for action when extreme flooding occurs. For example, following the winter floods of 2013–14, the government invested £20.5 million in Somerset outside the official flood investment programme, without a formal cost-benefit analysis, and with an action plan drawn up in just six weeks. A separate rivers authority is also being established in Somerset which is expected to leverage funding locally and oversee local flood risk management. Such responses raise questions of equity in the context of the national programme and also highlight a need for a fundamental re-examination of the way in social vulnerability, and social protection are addressed in flood risk management policy.

Headline message: Adopting and responding to the concept of flood disadvantage in flood risk management could support more just responses in the face of climate change, demographic change and other socio-economic policy.

What is flood disadvantage?

Flood disadvantage arises due to a combination of exposure to flooding and social vulnerability. Social vulnerability is caused by a range of factors which can be grouped into:

- personal factors (known as sensitivity) including age and health status
- social factors (known as adaptive capacity, or the ability to prepare, respond and recover), including income, tenure, mobility, social isolation, access to information and insurance
- environmental factors (which may increase or 'enhance' exposure) including housing and neighbourhood characteristics.

Overall, communities where high vulnerability and high exposure to flooding coincide may be the most flood disadvantaged – i.e. flooding may lead to a greater loss in wellbeing in these areas than elsewhere.

The University of Manchester has created a national index of social vulnerability to flooding based on the factors above and mapped the areas of greatest vulnerability and overlaid this with maps of flood exposure to identify areas of greatest flood disadvantage across England[3] (see page 24). The social vulnerability index is based on similar principles to that of the Index of Multiple Deprivation (IMD). However, the index is different in that it includes indicators which take better account of the socio-economic characteristics which affect the degree of social impacts created by flooding (see Table 1 in Section 3).

Key message: Flood socio-spatial vulnerability provides a more tailored indication of likely community preparedness and impacts than the Index of Multiple Deprivation alone.

Why does it matter?

Not all communities and individuals will be affected equally by flooding, or have equal capacity to respond to a flood. Some are likely to experience worse effects on their health and wellbeing due to their personal, social or economic circumstances, combined with the surrounding natural and built environment, making them more vulnerable.

Those who are most 'sensitive' include: children; pregnant women; older people; people with physical, sensory and cognitive impairments; people with chronic illnesses; those receiving care at home (e.g. home oxygen, dialysis) and the homeless.

The surrounding environment can also play a role; people living in environments that lack green and blue infrastructure (e.g. places that store water such as, ponds, swales, canals and controlled storage spaces) or in ground level or basement level dwellings have a greater likelihood of being flooded or face greater impacts when floods occur and so face 'enhanced exposure'.

Similarly, various factors can affect people's 'adaptive capacity'. For example, people on lower incomes are less likely to have insurance, so reducing their access to safety nets at a point of crisis, while also having fewer resources to deal with the loss of possessions after floods occur or to take precautions in advance. Other factors, such as social isolation, or having a different language and cultural background (where people are unable to understand flood warnings), may also make people more vulnerable and less able to cope in an emergency.

Climate change and extreme weather are also important considerations. Climate change can compound poverty and disadvantage and, conversely, poverty increases vulnerability to climate impacts (Banks, *et al.*, 2014). Failing to account for these factors in policy and investment plans may mean that certain parts of society are disproportionately impacted by floods over the long term, with subsequent cost implications.

Finally, vulnerability can also be significantly affected by the design of other policy frameworks, such as welfare reform or immigration policy (Wilson, *et al.*, 2013) or other socio-economic trends, such as an ageing society.

Key message: Certain parts of society could be disproportionately affected by flooding due to social vulnerability, climate change and extreme weather, and the design of related policy frameworks.

The potential social impacts of flooding for those at risk can be severe, including: trauma, illness, short-term water or power shortages (with associated health risks), displacement from homes, disruptions to livelihoods and longer term effects on mental health and wellbeing (WHO and Public Health England, 2013). These direct and indirect effects often translate into a need for further support from the government and wider society (for example in terms of meeting housing need, or relocation of care home residents), with costs and impacts falling on the state. Such impacts raise questions about whether there is the need for more holistic economic appraisal, or a fuller consideration of social vulnerability when allocating investment. In addition there is a strong case for adapting wider national policy frameworks to account for socio-spatial vulnerability and the wider impacts of flooding to avoid these costs and impacts increasing over the long term.

Key message: Flooding creates both direct and indirect costs and impacts to society and the state, which are amplified by social vulnerability. Indirect costs and impacts are less well accounted for in policy, and make a significant contribution to the total impact of flooding.

In addition, the number of people exposed to flood risk is likely to increase because of climate change, social change and policy change. Climate change is likely to result in more frequent flooding due to higher river flows, and rising sea levels (DEFRA, 2012), while by 2050, 3.2 million people will be at risk of surface water flooding in urban areas from a combination of population growth and changing weather patterns (Houston, *et al.*, 2011). Climate change is not the only pressure; the UK faces an ageing and

growing population. At the same time, the new flood insurance framework, Flood Re (DEFRA, 2014b), will support a transition to market prices for insurance. Market prices will place a higher cost burden on those who are living in areas at the highest risk of flooding, which may affect housing markets. This combination of factors has the potential to significantly increase the social impacts of flooding on communities.

Key message: Climate change will bring more frequent and extreme weather, increasing communities' exposure to flooding and the associated impacts and costs of floods, while other pressures, such as demographic change, and a transition to market pricing for insurance will increase social vulnerability.

Current approaches to addressing social vulnerability in national and local policies tend to focus on spatial exposure to hazards, rather than the broader social context, (including factors affecting people's ability to cope with floods). Current policy responses to climate change also tend not to explicitly address questions of equity in how decisions are made and actions are taken (Welstead, *et al.*, 2012; Banks, *et al.*, 2014) or take sufficient account of future social factors or climate trends. To ensure climate change does not risk compounding existing poverty, a concerted, focused effort is needed to embed these considerations across the spectrum of policy and practice, including in investment decisions.

Key message: Flood policy and investment decisions need to take account of pre-existing socio-spatial vulnerability and support actions to address the underlying issues, while also considering future climate and social trends.

Offering value for money? Comparing investment and disadvantage

The government's £2.3 billion investment programme for England seeks to minimise flood exposure through new projects, unlocking efficiencies through scale, and giving certainty to allow longer term planning. The programme includes 1,450 projects, in construction, development and in the pipeline, responding to coastal erosion and coastal and inland flood risk, with a further 47 schemes announced since. Government investment will not meet the total cost of schemes, with the rest coming from alternative sources including local authorities, businesses and communities, in a process known as partnership funding (DEFRA, 2011a, 2011b). This approach was introduced in 2011, to allow those at risk to be able to contribute to the costs of defences. The government is seeking to unlock £600 million through this approach.

When calculating eligibility for central government funding (known as Flood Defence Grant in Aid (FDGiA)), payment rates for the numbers of households protected account for deprivation levels using the Index of Multiple Deprivation (IMD). Under this approach the government pays 2.25 times more in the top 20 per cent of deprived areas, than in the 60 per cent least deprived areas. The potential benefits of a scheme known as outcome measures are monitored and regularly reported. Between April 2011 and September 2014, 19,974 households in the 20 per cent most deprived areas had been moved out of the significant or very significant river and sea flood risk categories to moderate or low risk (Environment Agency, 2015b).

While this represents good progress, a combination of increasing social vulnerability (as a result of demographic change, and policy changes such as market pricing for flood insurance), and exposure (from climate change) raises questions of whether the current approach will continue to be sufficient, or whether there will be a need to provide a greater focus on flood disadvantage in future. Therefore the authors analysed which local authorities and parliamentary constituencies contained the most flood disadvantaged neighbourhoods[1] for both river and coastal flooding and surface water flooding in England to understand how flood disadvantage aligns with planned investment.[6]

This analysis identified:

- 249 most flood disadvantaged neighbourhoods (184 from river and coastal flooding, and 65 from surface water flooding)

- across 135 of the 533 parliamentary constituencies, or 104 of the 326 district, borough or unitary local authorities.

The results were used to compare average planned expenditure per household protected[2] in a local authority, ranked by overall levels of flood disadvantaged neighbourhoods, against the national average (shown in Figure 1)[5]. In total, 100 of the 1,493 schemes analysed in the investment pipeline were located in most flood disadvantaged neighbourhoods.

The national average planned expenditure per household for a local authority was £6,610. However the analysis showed significant variations in the average expenditure in each local authority group. Some local authorities with lower numbers of most flood disadvantaged neighbourhoods will receive more on average than those with significantly greater numbers of disadvantaged neighbourhoods. For example, the average investment per household protected for local authorities with one most flood disadvantaged neighbourhood was £10,894, compared with £8,148 for local authorities with the seven most flood disadvantaged neighbourhoods. Within these groups, there a significant range in the planned expenditure per household protected. For those with no disadvantaged neighbourhoods, planned spending ranged from £0 to £145,714, while for those with six or more flood disadvantaged neighbourhoods, the range was £405 to £43,504.

Figure 1: Average planned expenditure per household protected (£) by local authority, by number of flood disadvantaged neighbourhoods

This analysis suggests there is not a strong link between those local authorities which contain the most flood disadvantaged neighbourhoods, and levels of planned expenditure. To try and take better account of the scale of areas of flood disadvantage, the research looked at how investment compared with the proportion of local authorities at most flood disadvantage. This shows that a significant proportion of total planned expenditure will be in local authority areas with a lower proportion of their area identified as most flood disadvantaged. In particular, almost half or £2 billion of total planned investment (47.8 per

cent) is for local authorities with no neighbourhoods at significant flood disadvantage (i.e. none of their neighbourhoods have both high exposure and high social vulnerability), with only 2 per cent going to those with 40 per cent or more of their area affected. In addition, those local authorities with a greater proportion of their area facing particular flood disadvantage have lower ranges of investment per household protected, and a lower average expenditure per household protected compared with areas with lower proportions of flood disadvantaged neighbourhoods.

Recognising that deprivation rather than social vulnerability is considered as a factor in determining levels of government investment, the authors also examined the extent to which the planned investment aligned with deprivation using the Index of Multiple Deprivation (IMD). However, there was no clear alignment between planned investment levels and 2010 local authority IMD scores. Similar results were found when the locations of the schemes were mapped against the IMD deciles at the Lower Super Output Area (LSOA) level. Only 13.4 per cent of schemes in the programme were located in the 20 per cent most deprived areas in England, with 65.7 per cent in the 60 per cent least deprived areas.

Finally, the authors also considered the degree of rurality or urbanisation as the emphasis on household protection within current scoring for Flood Defence Grant in Aid (FDGiA) suggests rural schemes could become increasingly expensive, as the relative costs of protection are higher in sparsely populated areas (Chartered Institution of Water and Environmental Management, 2015). Planned expenditure per household to 2021 in predominantly urban areas was 66 per cent of total national allocations (£2.83 billion), compared with 34 per cent, or £1.45 billion in rural areas. This suggests that there will be future questions to consider over the balance between investment in urban areas (given increasing trends of urbanisation), and ensuring affordable flood risk management in rural areas.

Key message: Levels of planned expenditure in flood risk management to 2021 do not appear to align with areas of significant flood disadvantage, or with wider deprivation.

While exposure is and should be a strong driver of investment, the analysis presented here raises questions about whether sufficient consideration is being given to issues of social vulnerability to flooding in current investment approaches. There are gaps to the analysis as there may be projects unfunded outside the national programme which could address flood disadvantage[7] and data on the 2010–15 investment programme was not available for consideration at the necessary spatial scale for this project[8]. There will also be other considerations in funding such as the varying construction costs of schemes, that schemes may be protecting other areas and varying levels of deprivation within local authorities.

However, taken together:

- the differences between how IMD and social vulnerability to flooding are calculated
- the fact that flood investment levels are not clearly aligned with flood disadvantage – either considering the number of most flood disadvantaged neighbourhoods or the proportion of neighbourhoods affected within a local authority
- the lack of alignment between levels of flood investment and local authority and neighbourhood level deprivation
- the urban bias in the investment, and the fact that not all social and economic costs of floods are captured in current assessments
- cumulatively make a strong case for the government to review whether the current investment approach needs to do more to address social vulnerability in the long term.

Enhancing risk reduction and social protection in long-term investment scenarios and project appraisal

Alongside the Comprehensive Spending Review, the Environment Agency's Long Term Investment Scenarios (LTIS) inform government decisions relating to the overall budget for FDGiA expenditure. The latest version takes a cost-benefit approach, setting out an investment profile for flood and coastal erosion risk management where benefits exceed costs between 2015 and 2065. This approach

recognises that investment in flood risk management creates multiple benefits for society. The Environment Agency estimates this approach provides an overall risk reduction of around 5 percent (Environment Agency, 2014).

The Long Term Investment Scenarios are based on a cost-benefit approach that seeks to obtain 'value for money'. However, the LTIS only include a limited consideration of wider costs and benefits for issues such as transport, commerce and industry. It does not address the distributional impacts or costs of flooding on the population, or social equity implications.

Such approaches have limitations. Nationally, there has been a push for alternative approaches which focus on risk reduction. The Association of British Insurers (ABI) states that *'...if such a* [value for money] *approach was actually taken, the likely result would be that areas at significant risk of flooding but with relatively low economic benefits such as rural or deprived communities would slip down the priority list'*,(ABI, 2014). This is echoed by the Adaptation Sub-Committee (ASC) of the Committee on Climate Change which points out that although levels of flood risk may fall over time:

> "...the gains will be due to hundreds of thousands of properties already at a relatively low risk of flooding being even better protected. ...These investments yield the greatest overall benefit per pound spent. But some households already in the high risk category (1-in-30 annual chance of flooding or greater) are expected to remain so, and others will join them as the climate continues to change."
>
> (Adaptation Sub-Committee, 2014a)

CIWEM (2015) highlights that:

> "...this means that in the longer term, tackling the high risk homes will become increasingly expensive, as, for example, they may be in sparsely populated areas, where the relative costs of protection are higher. This raises questions about what to do with properties in high risk areas in the longer term".

In the Netherlands, new legal flood protection standards are being set which address both economic efficiency approaches and social protection from flooding. The government follows a cost-benefit approach but also applies a minimum safety level which provides a basic level of safety for everyone behind the levees (flood bank), and also takes societal disruption due to large-scale flooding and the protection of vital and vulnerable infrastructure into account. Cost-benefit analysis and social protection requirements are first considered separately, after which the final standard is based on the higher requirement of the two. These new standards have legal force from 2017 onwards and account for changes in socio-economic development through to 2050, as well as considering climate change through addressing flood probability.

Modelling and tools have been drawn upon to support this approach. In the UK there is a similar research and evidence base to inform such approaches. At the same time local authorities in England are increasingly capturing a wide variety of local impacts and costs from flooding, such as school closures, and demands on health and social care.

The existence of a workable policy framework in the Netherlands which seeks to maximise the benefits of the varying cost-benefit analyses, risk reduction and social protection approaches, as well as solid national and local evidence here, suggests that there is scope to improve social protection elements in future iterations of the LTIS and individual project appraisal in England.

Key message: The government should clarify its overall goals for flood investment policy and consider including a clear goal relating to social protection.

Improving the partnership funding approach

As outlined above, DEFRA also raises money in partnership with local areas, or the private sector for flood risk management (DEFRA, 2011a, 2011b). DEFRA's review of partnership funding (DEFRA, 2014c) highlights other areas of concern in flood investment:

- Possible ineffective targeting of deprived communities – DEFRA's evaluation found the 'explicit policy outcome focus on communities at high risk and high deprivation is not being realised' (to date). This stemmed from the fact that they could not reach a firm conclusion 'due to a lack of data in the Environment Agency's Medium Term Plan and a lack of strong evidence from the user experience analysis'. If this is indeed the case, partnership funding could be failing one of its core objectives, a cause for significant concern.
- Clarifying the approach to raising £600 million in contributions – DEFRA's evaluation shows that the majority of partnership funding investments came from the wider public sector, and recognised '... continued public sector funding cuts could impact on this level of contributions in the future'. While 25 percent of projects came from private income, the public sector would have to continue to play a significant role if the government wants to reach its £600 million target. This reliance on the public sector looks set to continue as only £345 million in partnership funding is included in the investment plan to 2021 (Chartered Institution of Water and Environmental Management, 2015), leaving a £255 million shortfall against the government's target. To enable all parties to properly plan, the government needs to clarify how it plans to reach its target.
- Development in the floodplain – the review also found that partnership funding may potentially encourage new development in the floodplain. Private sector contributions to flood defence schemes were largely provided by direct beneficiaries such as major companies and developers. Although partnership funding cannot be used to protect properties built after 2012, some schemes will protect existing properties and open up land for development. While the planning process should ensure this does not circumvent the National Planning Policy Framework (NPPF) (DCLG, 2012), evidence from the Adaptation Sub-Committee (2012, 2014b) shows floodplain development is still increasing. There is therefore a need to explore whether partnership funding may be driving further development in floodplains and increasing longer term exposure to risk.

Ringfencing of funding for lead local flood authorities

The government allocates separate funding to lead local flood authorities (LLFAs) to fulfil their duties in relation to managing surface water. LLFAs are county councils or unitary authorities. Government funding for these functions is allocated through an annual local services support grant, based on levels of flood exposure, with further funding allocated through the main local government settlement process (known as the Settlement Funding Assessment) (DEFRA 2014d). In both cases, funding allocated nationally is not ringfenced.

This funding is not always spent on managing flood risk. The Adaptation Sub-Committee (2014b) cites a Local Government Association (LGA) study in 2012 where over a third of lead local flood authorities stated that at least some of the funding from DEFRA had not been allocated to flood risk management.

At a time when local government grant is reducing, and local authorities are feeling increased pressure from rising demands (Hastings, *et al.*, 2015), it is inevitable there will be trade-offs on using funds to meet local needs. However, failing to adequately cater for flooding brings the risk of locking in negative social consequences in future. To avoid this, funding for surface water flood management could be ringfenced to ensure local authorities have the capacity to plan appropriately over a longer term. This suggestion is also supported by the Environmental Audit Committee (House of Commons Environmental Audit Committee, 2015).

Flood disadvantage in flood risk management and socio-economic policy

While investment is a critical part of flood risk management, the wider national policy framework for managing flood risk and increasing flood resilience also needs to take better account of the social

context and equity issues. This consideration needs to be embedded across the spectrum of flood risk management policies, including in:

- national and local flood risk management strategies
- planning of maintenance of flood defences
- the implementation of sustainable drainage systems (SuDS)
- approaches to residual risk management and community and property-level protection (PLP)
- Flood Re (the new approach to flood insurance).

Key message: The national and local flood risk management policy framework should take greater account of flood disadvantage and the wider costs of flooding to increase the focus on long-term social protection as a central policy goal.

Given that the impacts of flooding are affected by social vulnerability, it follows that flood risk management is also affected by other socio-economic policies. Wider socio-economic policy can drive future vulnerability, affecting the impact of future flooding through changes to levels of deprivation, population density and wider decisions on infrastructure investment and land use. To date there has been limited consideration of this relationship. Therefore a focus also needs to be placed on reducing flood vulnerability through wider socio-economic policy.

Key message: Flood risk management and wider socio-economic policy frameworks are directly related. Socio-economic policy drives vulnerability to flooding, while failing to account for social vulnerability in flood risk management could increase pressures on related socio-economic policies.

A key opportunity in this agenda relates to planning. There is an urgent need to balance the competing pressures of avoiding development in flood risk areas and meeting the UK's housing shortage. In doing this, there are issues around local authority and Environment Agency capacity to properly scrutinise and challenge planning applications. There is also a need for a better understanding of the groups of people being affected by planning decisions (e.g. tenure types and the mix of affordable/social housing being developed in areas of flood risk) to understand whether disadvantage is increasing and to inform the debate on whether an appropriate balance is being struck between meeting housing need and reducing flood risk. In addition, more information is needed on whether new development is reinforcing the need for greater risk management, and whether there is sufficient redress for residents of new developments that are exposed to flooding.

The next UK Climate Change Risk Assessment (UKCCRA) and National Adaptation Programme (NAP) (DEFRA, 2013) offer a key opportunity to improve our understanding of the interdependencies between socio-economic policy and flood risk management. By systematically mapping these linkages and exploring their relationships, there is the potential to implement further reform which could reduce social vulnerability to flooding, while recognising the increased risks posed by climate change. A spatial analysis of flood disadvantage should also inform the UKCCRA and NAP responses.

Key message: The next UKCCRA and NAP need to develop, and respond to, a stronger understanding of the relationship between social vulnerability to flooding and policies and funding streams that could address different aspects (considering exposure, sensitivity and adaptive capacity), to maximise resilience to flooding and reduce the costs to the public purse.

Summary of all recommendations

Issue	Recommendation
Considering social vulnerability and flood disadvantage in investment decisions and the total impacts and costs of floods could improve social protection.	• The government should review its current approach to flood investment to consider whether issues of social vulnerability or wider deprivation are being adequately addressed, and whether a minimum standard of protection is needed for society.
Further reforms in flood investment policy could improve its effectiveness.	• Ahead of a formal policy implementation review, due in 2017, the government should consider how to strengthen the partnership funding framework to achieve a stronger focus on most flood disadvantaged communities, and reduce incentivisation of unprotected floodplain development. • To allow all parties to plan effectively, the government should clarify how it intends to meet the £600 million partnership funding target. • The government should consider ringfencing surface water flood funding to lead local flood authorities to ensure it is spent on flood risk management.

Flood risk management policy could more effectively consider social protection	• The FCERM strategy for England should account for the uneven distribution of flooding impacts based on enhanced exposure, sensitivity and adaptive capacity, and ensure that this informs all flood risk management activity. • The government should work with the Local Government Association (LGA) to embed a requirement to consider social vulnerability in local flood risk management strategies in guidance, and in development of plans for areas of high risk. • The government should evaluate the potential efficiencies from providing longer term certainty around maintenance, including the effects of a review process to align maintenance needs with social vulnerability to flooding. • In actively monitoring the implementation of SuDS, the government should consider: - the extent to which planning authorities have capacity to assess applications, and monitor the performance of conditions; - the extent to which exemptions of small-scale developments are impacting on overall exposure; - who is bearing the costs of SuDS maintenance, and the implications of this. • The government should continue to develop a strategic approach to the role of property level protection, as part of a wide range of approaches from the catchment to community and individual property scale. In particular: - the next Long Term Investment Scenarios should set out the role that resilience and resistance measures could have as part of an overall strategy; - research should be conducted on need and options for market intervention in relation to property level protection (PLP), including a direct support scheme for low-income households to purchase PLP as well as the role of other financial instruments and policy drivers. • Flood Re's transition plan should explicitly outline how it will seek to build resilience in highest risk areas. This should link strongly with approaches to residual risk management, such as PLP and community schemes, to ensure a joined up approach.
Better understanding the relationship between social vulnerability to flooding and socio-economic policy could further improve social protection.	• Future work on flood risk arising from planning and new development should include a focus on: - increasing understanding of the types of people affected, by linking data on new developments in all flood risk areas to data on tenure and development types; - surveying local authority planning departments and the Environment Agency to see if there is suitable capacity in place to assess both minor and major planning applications; - assessing whether local authorities have considered the impacts of unlocking land for development on their own risk management functions and those of the Environment Agency and water companies; - the difference a redress system could make to those who are put at risk of flooding due to new developments.

	• The next UK Climate Change Risk Assessment should, where possible:
	  - include a spatial analysis of the distribution of risk that takes account of social vulnerability to the impacts of climate change;
	  - examine the individual and cumulative effects of key socio-economic and adaptation policies in addressing vulnerability.
	• The next National Adaptation Programme should use a spatial analysis of social vulnerability and exposure to different hazards to better target climate adaptation responses.

2 Introduction

Over the last ten years, the UK has seen significant flooding. Flooding in Carlisle in 2005, Hull in 2007, Newcastle in summer 2012, and the widespread winter floods in 2012 and 2013/14, all had a profound impact on those affected. Many people suffered damage to their property, became homeless or suffered other impacts on their health and wellbeing, while business disruptions and losses have impacted more broadly on people's livelihoods as well as the wider economy. At present, nearly 1 in 6 households in England is at some risk of flooding (DEFRA, 2015). The public expects the government to manage flood responses; recent research from Cardiff University shows 71 per cent of the population feel the government has the main responsibility for protecting properties from flooding (Capstick, *et al.*, 2015).

In December 2014 the government published its Long Term Investment Scenarios (LTIS) and six-year investment programme for flood risk management (DEFRA 2014a). These documents set out investment plans to 2021 for the £2.3 billion of government investment announced by the Chancellor in the Autumn Statement as part of the overall national flood policy framework. This framework involves investment in 1,450 projects, with a further 47 projects supported since.

There has been a particular focus on the levels of investment in flood protection, not where this money goes. While sufficient investment is important, every pound spent must also provide the best long-term value for money. This should mean taking account of social as well as economic costs and impacts in investment plans.

Despite aspirations, strategic approaches are not always followed. The political pressure following an extreme flood can lead to responsive investment which has much longer term implications for public funding. The Environmental Audit Committee (EAC) outlined that 'the government has sometimes followed what the ASC has called a 'reactive' funding strategy, prioritising the most recent flooding events rather than long-term objective needs'. In its most recent report, the EAC also recommended that 'the government should make a clear commitment to allow the Environment Agency to allocate flood defence funds according to its objective cost-benefit models without political interference' (House of Commons Environmental Audit Committee, 2015). The government response to flooding in the winter 2013/14 in Somerset clearly illustrates how this political intervention can happen (see Box 1).

Box 1: Case study – Response to 2013/14 flooding in Somerset

Following the 2013/14 winter flooding in Somerset, and considerable media and political attention, the government committed to invest £20.5 million outside of normal funding routes, without a formal cost-benefit analysis, and based on an action plan drawn up by local partners in just six weeks. The commitment covered £5.7 million towards dredging, as well as flood and road infrastructure repair and enhancement works.

The plan also had a focus on the longer term; a separate Somerset Rivers Authority has been established whose purpose is 'to deliver higher standards of flood protection than would be funded nationally, and to create better flood protection and resilience against further flooding by joint planning and delivery (where possible)'.

A key part of the work by the rivers authority is a common works programme for Somerset, to plan, deliver and share information about all flood risk management work in the county. The organisation is expected to have a remit to leverage funding locally (possibly through a Council Tax precept), introducing new public funding for local flood risk management.

In the case of the Somerset investment, the Adaptation Sub-Committee calculated that it delivered flood risk benefits of only £1.90 per £1 spent and was indicative of a reactive approach to flood investment. The Adaptation Sub-Committee also cited concerns that, with funding scarce, the additional money made available for the Somerset Levels might have been at the expense of more cost-effective investment elsewhere (House of Commons Environmental Audit Committee, 2015).

Such issues were acknowledged by the government minister, who noted that 'the number of properties inundated was much lower than in other areas', but justified the response because the duration of the floods meant that 'there were much wider impacts that we needed to deal with' (House of Commons Environmental Audit Committee, 2015).

The interventions in Somerset to alter funding and governance arrangements suggest concerns over the adequacy and efficacy of existing flood risk management. They have also precipitated a new arrangement with longer term implications for flood risk governance and public funding. The remit of the Somerset Rivers Authority overlaps with those of the Environment Agency and local authorities, while leveraging additional funding locally has longer term cost implications for residents. Overall, the case raises questions about the equity of such responses in the context of the national funding programme and the implications for future flood risk management.

Given this, there is a need for a fundamental re-examination of the way in which flood risk management approaches social protection. This report therefore sets out to review the relationship between flood investment and social vulnerability and exposure to flooding. It suggests that national investment approaches and wider policy need to take better account of issues of social vulnerability to flooding in order to build longer term flood resilience, particularly in light of the increasing flood risks posed by climate change and likely increases in social vulnerability due to demographic and other changes.

Headline message: Adopting and responding to the concept of flood disadvantage in flood risk management could support more just responses in the face of climate change, demographic change and other socioeconomic policy.

3 Flood vulnerability, disadvantage and the cost to society

What do we mean by flood disadvantage?

The Intergovernmental Panel on Climate Change (IPCC)'s fourth assessment report recognises that social vulnerability is influenced by a combination of personal, social and environmental factors, alongside institutional factors such as planning rules, consultation processes and the distribution of the costs and benefits of policy measures (IPCC, 2007).

Research for JRF by the University of Manchester drew on the IPCC's framework to analyse social vulnerability to flooding across the UK and compare this with patterns of exposure to flood risk. Their work suggests it is the combination of exposure to flooding *and* social vulnerability which will lead to flood disadvantage, where the negative effects of flooding may be greatest for local communities.

Box 2 and Figure 2 set out their framework for understanding social vulnerability to flooding and how social vulnerability combined with exposure can create flood (or wider climate) disadvantage.

Box 2: The framework for social vulnerability, exposure and flood disadvantage

The University of Manchester's framework builds on the IPCC approach to understand who is most vulnerable to negative effects from flooding. Vulnerability relates to three main issues: personal sensitivity, enhanced exposure and adaptive capacity.

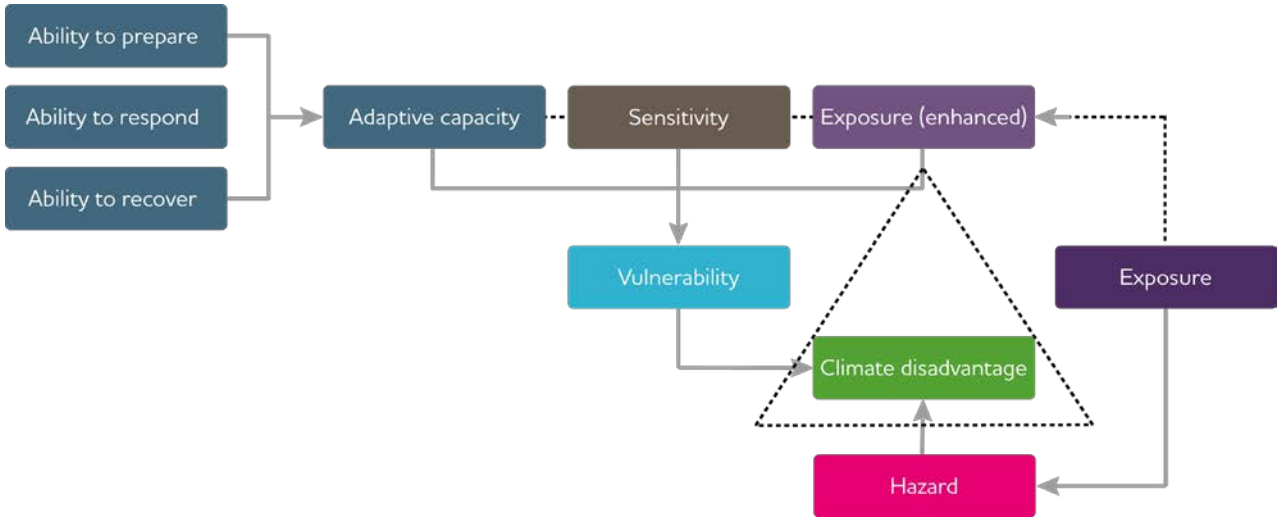
Sensitivity – refers to people's biophysical characteristics such as age and health, which affect their underlying susceptibility to negative impacts from flooding. For example, older and young children and babies are more physically susceptible to harm.

Enhanced exposure – refers to factors in the built or natural environment which may increase the effects of extreme weather. Examples include lack of green and blue infrastructure (which can mitigate run-off of water), or the proportion of properties with basements, likely to face greater damage when flooding occurs.

Adaptive capacity – refers to the factors which affect people's ability to prepare for extreme weather, take action during an event, and to respond and recover from this. It includes:

- ability to prepare – factors that affect the extent to which people are able to prepare for floods, such as income, insurance and local knowledge, as well as previous experiences of flooding;
- ability to respond – factors that enable immediate response to floods such as the proportion of the population who are homeworkers, households without a car, and factors around mobility;
- ability to recover – social factors that enable people within a neighbourhood to recover from floods, such as income and employment status, insurance, mobility and social networks.

Figure 2: University of Manchester climate disadvantage framework



The University of Manchester used the framework in Figure 2 to identify the factors which make people most vulnerable to flooding in the UK (Table 1), based on existing evidence, to create an index of socio-spatial vulnerability for flooding.

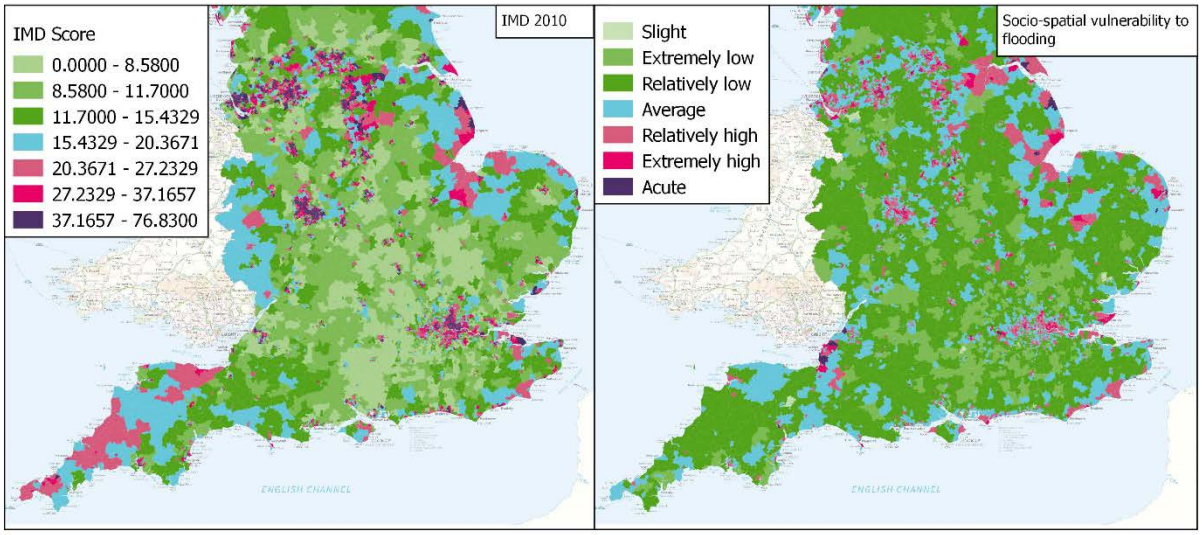
Table 1: Key factors leading to social vulnerability to flooding (based on Lindley et al.*, 2011)*

Personal factors: Sensitivity	Social factors: Adaptive capacity	Environmental factors: Enhanced exposure
Age (very young and older people)	Income	Neighbourhood characteristics (green/blue space)
Health status: illness	Tenure (ability to modify living environment)	Housing characteristics (e.g buildings with basements)
	Mobility and access to services	High housing density (urban areas)
	Social isolation	
	Information, language and local knowledge	
	Access to insurance	

Importantly these factors overlap with, but are not the same as, deprivation. Deprivation is most commonly measured using the indices of multiple deprivation (IMD). However, they do not take account of flood-specific issues which affect adaptive capacity, sensitivity, or increased exposure, such as housing characteristics, or mobility. The IMD also covers wider, less related issues (such as barriers to services or crime rates). As a result, the University of Manchester's index is more reflective of how significant a flood would be for a community as it accounts for socio-economic characteristics which affect the extent and nature of impacts that flooding can have.

To illustrate this, Figure 3 compares the rankings of local authorities in England by IMD and flood socio-spatial vulnerability scores. While the overall patterns are broadly similar in terms of the national pattern of acute deprivation and acute social vulnerability, there are also clear distinctions in the two maps.

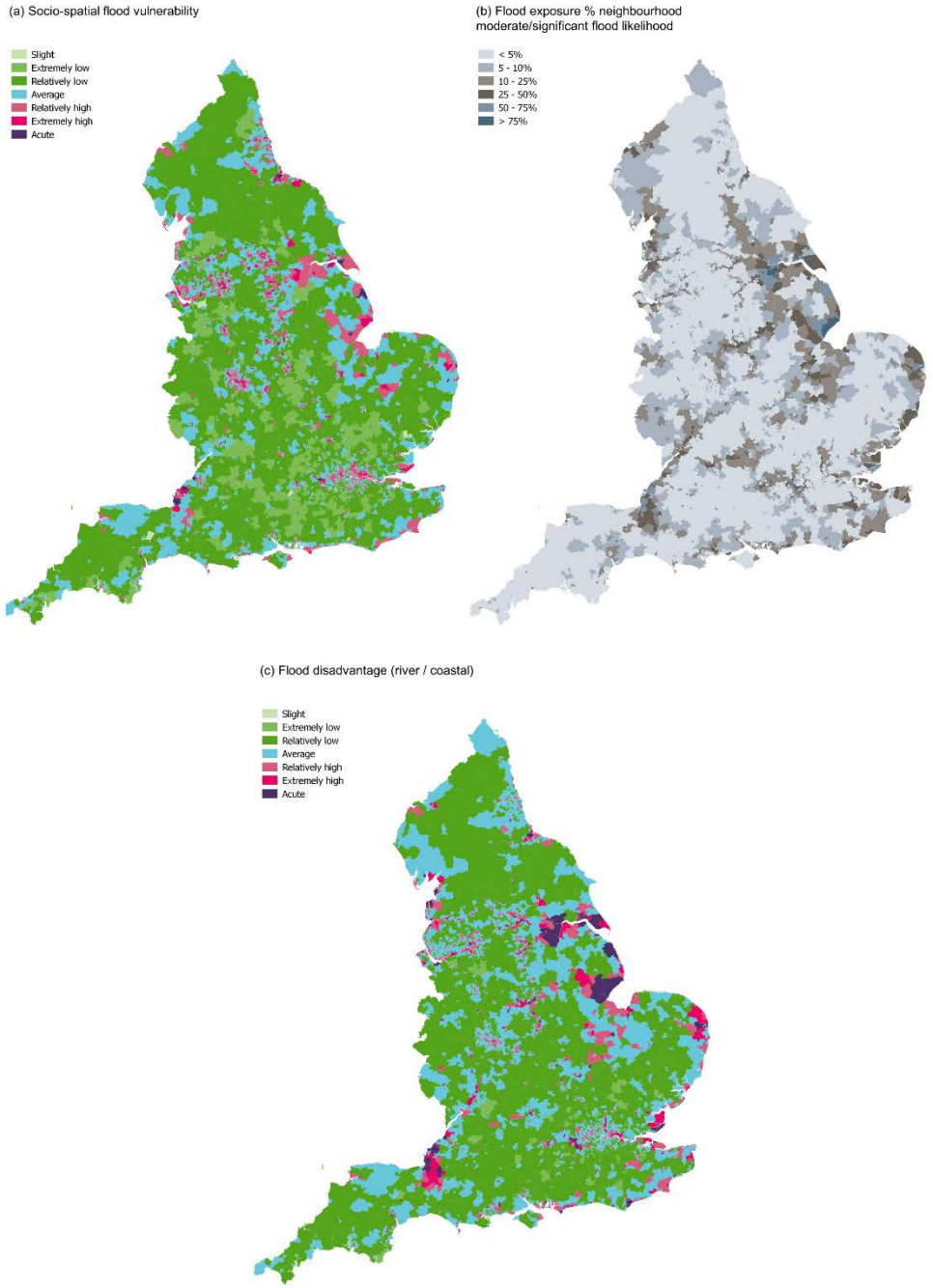
Figure 3: Distributional comparison of IMD (2010) versus socio-spatial vulnerability to flooding index (2013)



By overlaying Manchester University's vulnerability data with the Environment Agency's flood exposure data[3], it is possible to identify the areas which are both most socially vulnerable and most exposed to flooding in order to identify parts of the country which are most 'flood disadvantaged'. For illustration figures 4 and 5 show the most recent analysis of flood disadvantage for both river/coastal flooding and surface water flooding in England. The maps show that urban and coastal areas are particularly socially vulnerable to flooding but that patterns of exposure vary for the different types of flooding (river and coastal/surface water), leading to different geographies of flood disadvantage.

Key message: Flood socio-spatial vulnerability provides a more tailored indication of likely community preparedness and impacts than the Index of Multiple Deprivation alone.

Figure 4: National overview of socio-spatial vulnerability, flood exposure and disadvantage for river and coastal flooding (Source: www.climatejust.org.uk, 2015)



These maps draw on analysis by the University of Manchester for the Climate Just website to examine how exposure to flooding combined with social vulnerability creates flood disadvantage in the UK (i.e. where flooding may worst affect people's wellbeing). They depict:

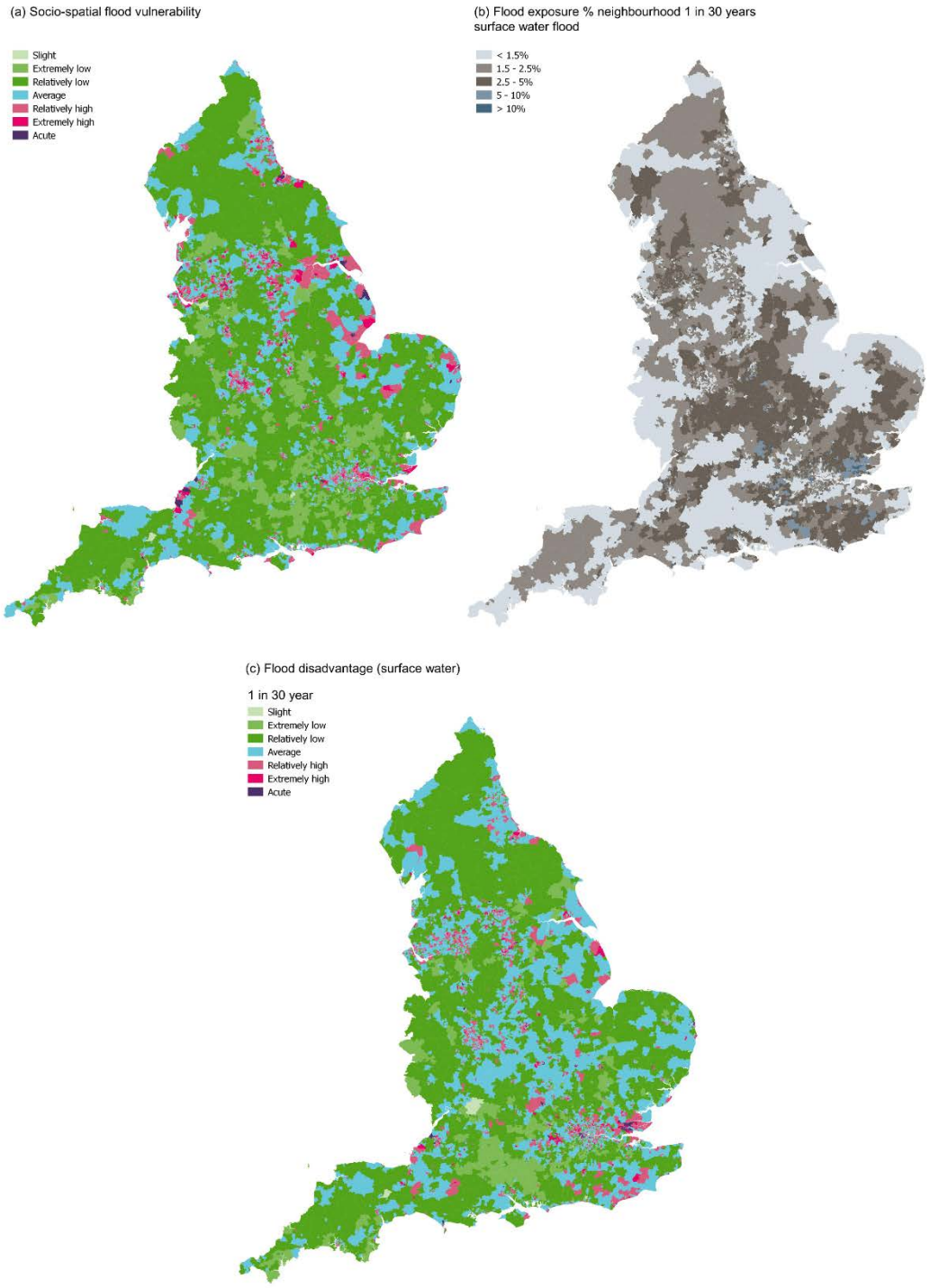
(a) social vulnerability in relation to river/coastal flooding, based on an index created by the University of Manchester;

(b) river and coastal flood exposure, based on the proportion of land area in a particular neighbourhood likely to be exposed to a moderate or significant flood event, using Environment Agency NaFRA data; significant – the chance of flooding in any year is greater than 1.3 per cent (1 in 75) and moderate – the chance of flooding in any year is 1.3 per cent (1 in 75) or less, but greater than 0.5 per cent (1 in 200);

(c) areas of flood disadvantage where exposure and social vulnerability coincide.

Developed using Crown Copyright data from EDINA UKBORDERS, Census 2011, Office for National Statistics, and Environment Agency NaFRA Spatial Flood Likelihood Category Grid (2013) AfA106.

Figure 5: National overview of socio-spatial vulnerability, flood exposure and disadvantage for surface water flooding (1 in 30 year event), England. (Source: www.climatejust.org.uk, 2015)



These maps depict a 1 in 30 year flood as follows:
a) socio-spatial vulnerability in relation to surface water flooding, based on an index created by the University of Manchester;
b) surface water flood exposure, where surface water flooding with a 1 in 30 year probability is more likely. It is based on the proportion of land area in a particular neighbourhood likely to be exposed to an event with a 1 in 30 year probability according to the Environment Agency's Risk of Flooding from Surface Water map (2013);
c) areas of flood disadvantage where exposure and social vulnerability coincide.

Further maps for a 1 in 100 year event are available on www.climatejust.org.uk
Developed using Crown Copyright data from EDINA UKBORDERS, Census 2011, Office for National Statistics, and Environment Agency NaFRA Spatial Flood Likelihood Category Grid (2013) AfA106.

Why flood disadvantage matters

The above highlights that some individuals or communities are likely to experience worse effects on their health and wellbeing when floods occur due to high personal sensitivity or low adaptive capacity, as well as issues in the built environment which place them at greater risk of exposure.

Those who are most 'sensitive' include: children; pregnant women; older people; people with physical, sensory and cognitive impairments; people with chronic illnesses; those receiving care at home (e.g. home oxygen, dialysis) and the homeless.

The surrounding environment can also play a role; people living in environments that lack green and blue infrastructure or in ground level or basement level dwellings have a greater likelihood of being flooded or face greater impacts when floods occur and so face 'enhanced exposure'.

Similarly, various factors can affect people's 'adaptive capacity'. For example, people on lower incomes are less likely to have insurance, so reducing their access to safety nets at a point of crisis, while also having fewer resources to deal with the loss of possessions after floods or to take precautions in advance. Other factors, such as social isolation, or having a different language and cultural background (where people are unable to understand flood warnings), may also make people more vulnerable and less able to cope in an emergency.

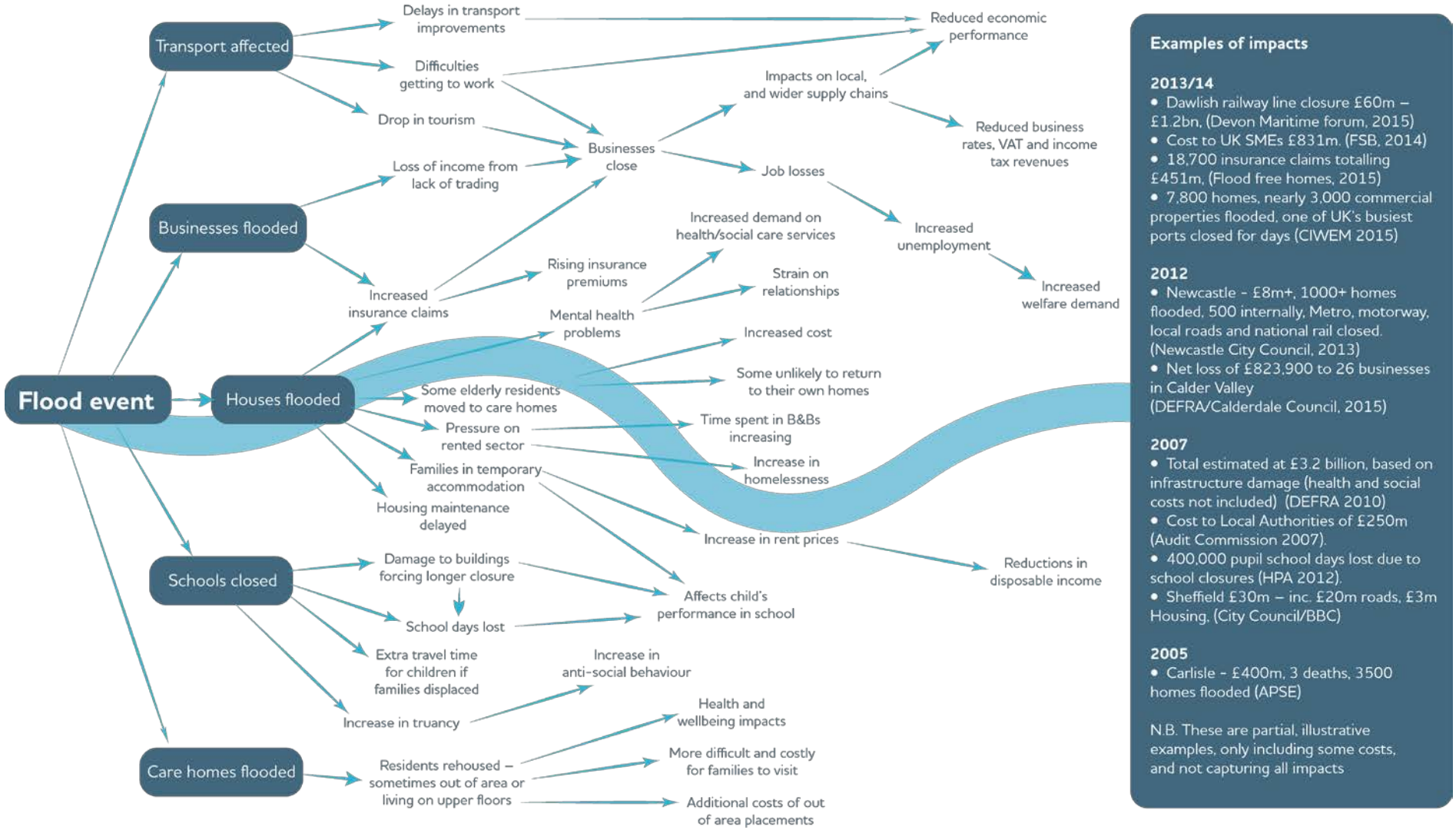
Climate change and extreme weather are also important considerations. Climate change can compound poverty and disadvantage and, conversely, poverty increases vulnerability to climate impacts (Banks, *et al.*, 2014). Failing to account for these factors in policy and investment plans risks disproportionately increasing impacts for certain parts of society over the long term. This disproportionate impact is well recognised. The UK Climate Change Risk Assessment (CCRA) outlined that, 'In future, the impacts of flooding and coastal erosion may be felt by an increasing number of people, with the consequences felt disproportionately by vulnerable groups, such as the elderly, the long-term sick and the economically disadvantaged'(DEFRA, 2012). Social vulnerability may also be significantly affected by the design of other socio-economic policy frameworks, such as welfare reform or immigration policy (Wilson, *et al.*, 2013).

Key message: Certain parts of society could be disproportionately affected by flooding due to social vulnerability, climate change and extreme weather, and the design of related policy frameworks.

The impacts of flooding for those at risk can be severe, including physical trauma, illness, short-term water or power shortages (with associated health risks), displacement from people's homes, disruption of livelihoods and income, and longer term effects on mental health (WHO and Public Health England, 2013).

The impacts from flooding also have important knock-on, or cascading effects (see Figure 6). These direct and indirect effects often translate into a need for further support from the government and wider society and other policy areas and services may not be equipped for this (for example in terms of housing responses to temporary homelessness or increased demand for mental health support).

Figure 6: Cascade effects and wider costs of flooding



Adapted from Audit Commission, *Staying afloat*, 2007

While economic assessments (such as the examples in Figure 6 and the use of the Environment Agency's multi-coloured manual) attempt to quantify the costs of flooding, in some cases they do not account for all of these wider cascade effects. This means they are likely to represent an under-estimate of the full costs to, and impacts on, society and the public purse. A clear example of this can be seen in DEFRA's estimate of the costs of the 2007 floods (DEFRA, 2010). The floods were estimated to cost £3.2 billion, with the assessment including a mixture of both direct and indirect costs. Such indirect costs included a rough estimate of some public health costs at £287 million. However, they were based on a willingness to pay to avoid health effects, which were recognised to be a significant underestimate. In addition, costs to tourism, nature conservation, community services and military services (for assistance during the floods and immediate post-flood recovery) were not included. Other assessments of impacts also have gaps around costs in relation to health and social care, welfare and supply chains, as well as reduced tax revenues. This analysis raises questions about whether there is the need for more holistic economic appraisal, or a fuller consideration of social impacts in allocating investment. It also suggests there is a strong case for adapting wider national policy frameworks to account for socio-spatial vulnerability and the wider impacts of flooding to avoid these costs and impacts increasing over the long term.

Key message: Flooding creates both direct and indirect costs and impacts to society and the state, which are amplified by social vulnerability. Indirect costs and impacts are less well accounted for in policy, and make a significant contribution to the total impact of flooding.

In addition, the number of people exposed to flood risk is also likely to increase due to climate change, social change and policy change. The UKCCRA shows that climate change may result in more frequent flooding due to higher river flows, and rising sea levels (DEFRA, 2012). Similarly JRF research suggests that by 2050, 3.2 million people will be at risk of surface water flooding in urban areas from a combination of population growth and changing weather patterns; an increase of 1.2 million from 2001 (Houston, *et al.*, 2011). In addition, the UK faces an ageing and growing population, which will affect underlying vulnerability. Policy change will also play an important role; for example the new flood insurance framework, Flood Re, will be followed by a transition to market prices for insurance, placing a higher burden on those living in areas at highest risk of flooding, which may affect housing markets. Together, this combination of factors has the potential to significantly increase the social impacts of flooding on communities.

Key message: Climate change will bring more frequent and extreme weather, increasing communities' exposure to flooding and the associated impacts and costs of floods, while other pressures, such as demographic change, and a transition to market pricing for insurance will increase social vulnerability.

While there is reference to addressing social vulnerability in national and local policies, JRF research suggests that UK policies tend to focus on spatial exposure to hazards, and personal characteristics such as the age of population affected, rather than the broader social context. These wider social factors affecting people's adaptive capacity, also need to be considered in responses alongside the more obvious drivers of vulnerability. Current policy responses to climate change also tend not to explicitly address questions of equity in how decisions are made and actions are taken (Welstead, *et al.*, 2012, Banks, *et al.*, 2014). To ensure climate change does not risk compounding existing poverty, and to provide a clearer sense of what the policy goals are in respect to levels of social protection, a concerted, focused effort is needed to embed these considerations across the spectrum of policy and practice, including in investment decisions.

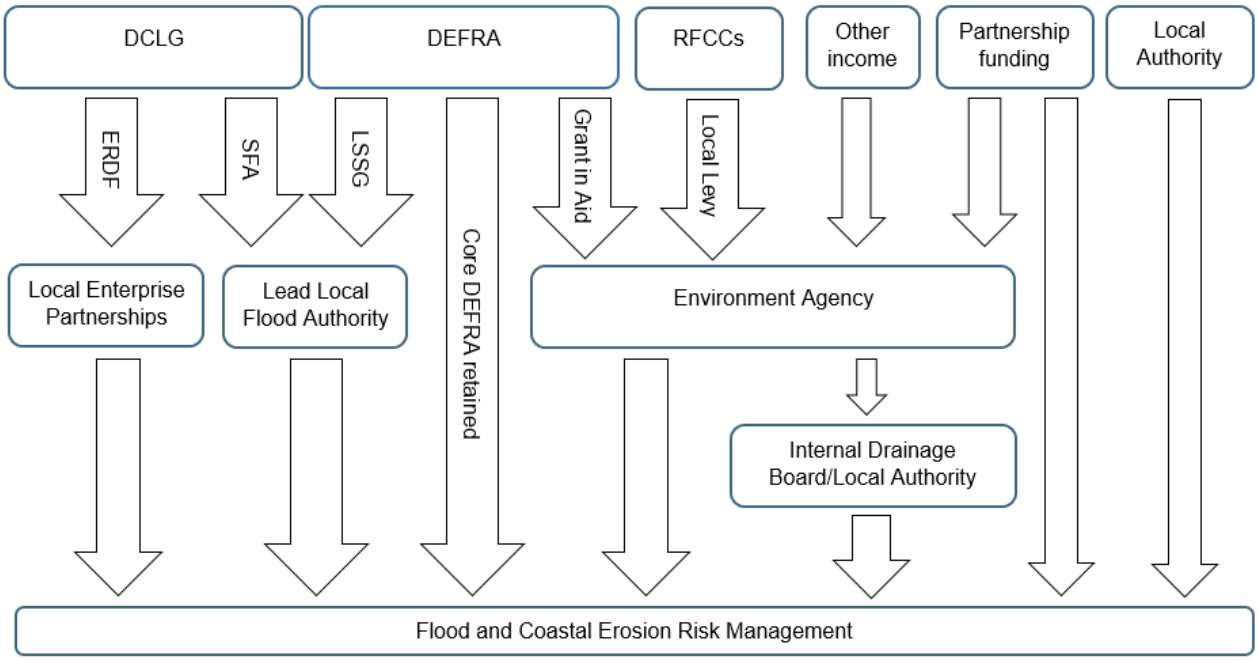
Key message: Flood policy and investment decisions need to take account of pre-existing socio-spatial vulnerability and support actions to address the underlying issues, while also considering future climate and social trends.

4 Offering value for money? Comparing investment and disadvantage

The main way to reduce the risk and impact of flooding is to reduce exposure, primarily through managing water. Historically, this has been about building flood defences against river and coastal flooding, but a broader range of measures from catchment management to community schemes and property level protection measures are also needed to cope with changing weather patterns and climate change, increasing development, and demographic change, all of which may increase exposure or levels of social vulnerability.

The majority of investment in all flood risk management is provided by the Treasury through DEFRA, and the Environment Agency, in the form of public investment, known as Flood Defence Grant in Aid (FDGiA). There are also a range of other funding sources, as set out in a recent report by the Chartered Institution of Water and Environmental Management (CIWEM, 2015) (see Figure 7). Since CIWEM produced its report, the government has announced that the European Regional Development Fund (ERDF) can also be used to support flood risk management programmes, where there is a significant economic aspect (DCLG, 2015).

Figure 7: FCERM funding routes, adapted from Chartered Institution of Water and Environmental Management, 2015



The government's new six-year national investment programme for England seeks to minimise flood exposure through new projects, primarily through creating new flood defences, supported by £2.3 billion of central government funding. By outlining a six-year plan, the government is seeking efficiencies through scale and longer term certainty. The programme includes 1,450 projects, (298 in construction, 1,109 in development and 43 in the pipeline), and aims to address risks from river and coastal, surface water and groundwater flooding. A further 47 projects were brought into the programme following a government announcement on 18 March 2015. The government's investment will not meet the total cost of all of the schemes; the rest will come from alternative sources.

Following the 2010 Comprehensive Spending Review, the proportion of public funding allocated to schemes is determined through a cost-benefit analysis, based on the following priorities (DEFRA, 2011a):

- the values of benefits for householders;
- the values of other benefits achieved (e.g. to businesses, agricultural productivity);
- the environmental benefits of the scheme.

These priorities are supported by a range of outcome measures covering: economic benefits (including protecting critical infrastructure,), number of households at flood or erosion risk, water-dependent habitat, inter-tidal habitat, and protected rivers.

Funding can also be added by local authorities, businesses and communities, to unlock schemes which may not have full central government funding, in a process known as partnership funding (DEFRA 2011a, 2011b). This relatively new approach was introduced by the Environment Agency in 2011, to allow those at risk to be able to contribute to the costs of defences. The government is seeking to unlock £600 million through this approach. Once schemes are accepted by the Environment Agency and DEFRA, they are discussed and finalised with regional flood and coastal committees (bodies of elected members who have discretion to change the order in which projects are delivered and approve lower scoring schemes, accounting for local priorities).

When calculating eligibility for FDGiA, payment rates for the numbers of households protected account for deprivation levels using the Index of Multiple Deprivation (IMD). Under this approach, the government pays up to 45p per £1 of benefit delivered in the top 20 percent of deprived areas, 2.25 times more than in the 60 percent least deprived areas. The potential benefits of a scheme, known collectively as outcome measures, are monitored and regularly reported. Between April 2011 and September 2014, 19,974 households in the 20 per cent most deprived of areas had been moved out of the significant or very significant river and sea flood risk categories to moderate or low against a forecast of 25,300 (Environment Agency, 2015b). While this represents good progress, a combination of increasing social vulnerability (as a result of demographic change, and policy changes such as market pricing for flood insurance), and increasing exposure (from climate change) raise questions of whether the current approach will continue to be sufficient, or whether there will be a need to provide a greater focus on flood disadvantage in future.

Given the potential impacts and consequences of flooding, we need a much better understanding of which communities will be protected, and how, when decisions are made on which projects should be prioritised. While levels of overall flood exposure will be a critical driver of investment decisions, social vulnerability also matters, because, as noted above, this will affect the extent to which people suffer when floods occur, and is likely to affect knock-on costs. Furthermore, levels of personal sensitivity and adaptive capacity will also have implications for deciding how to address residual risk.

JRF has therefore examined how the total costs of schemes set out in the flood and coastal erosion risk management investment programme relate to the national picture of flood disadvantage (i.e. where both high levels of social vulnerability and high levels of flood exposure are a concern). The national investment programme includes consideration of funding from Flood Defence Grant in Aid, the local levy, other public funding (including precepts and internal drainage boards), and private funding.[4]

Comparing investment against flood disadvantage

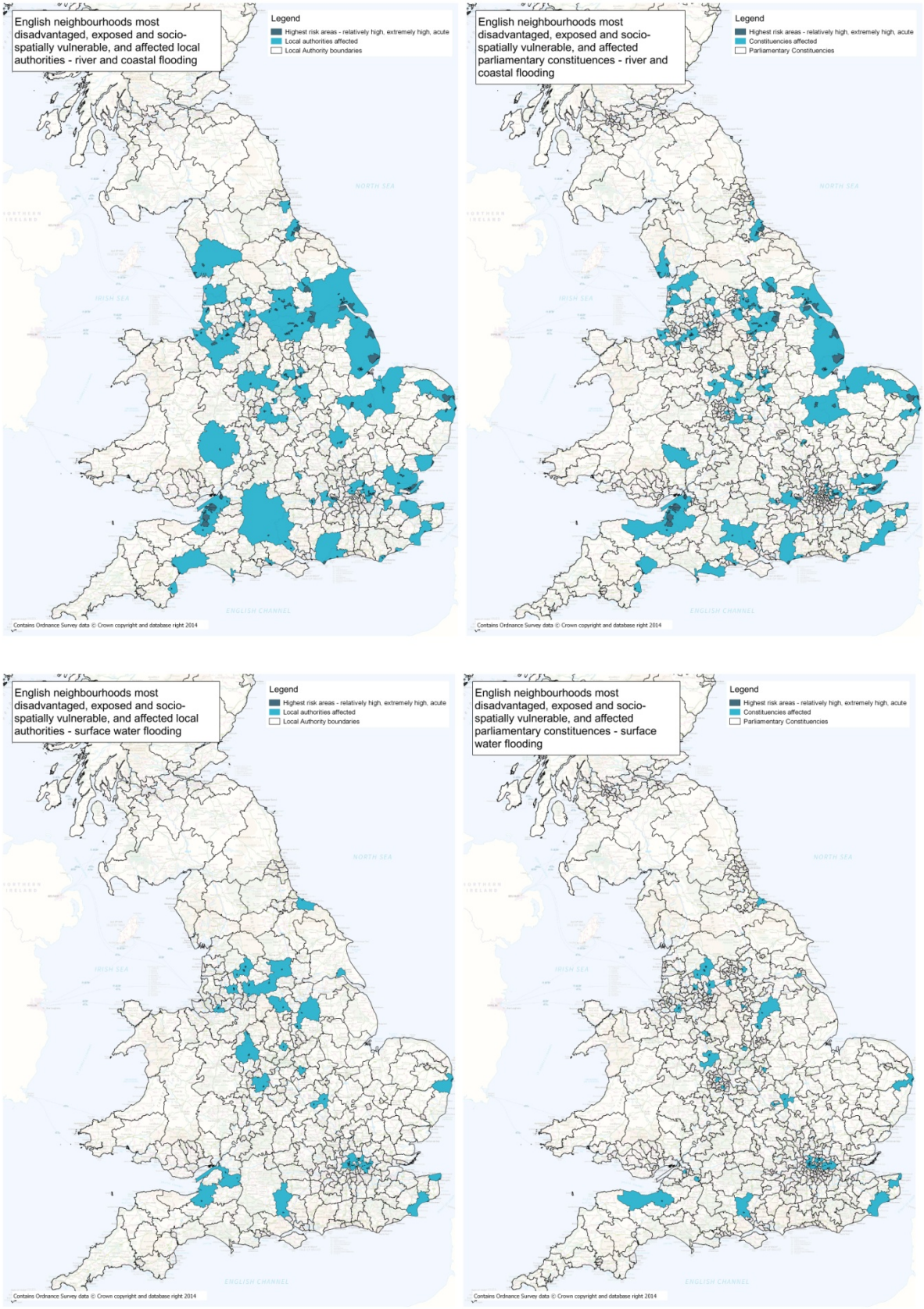
The project analysed which local authorities and parliamentary constituencies contained the most flood disadvantaged neighbourhoods for both river and coastal flooding and surface water flooding. These were neighbourhoods classed as extremely socially vulnerable to flooding, extremely exposed to flooding and extremely flood disadvantaged.[1] This identified:

- 249 most flood disadvantaged neighbourhoods (184 from river and coastal flooding, and 65 from surface water flooding)
- across 135 of the 533 parliamentary constituencies, or 104 of the 326 local authorities (districts, boroughs or unitaries) (see Figure 8)
- 100 of the 1,493 schemes analysed were located in the most flood disadvantaged neighbourhoods.

The number of most flood disadvantaged neighbourhoods was then compared against the planned expenditure[5] (outlined in government publications as 'estimated total project costs') for schemes identified in the national programme, by local authority areas and parliamentary constituencies[6]. Planned expenditure was compared by household protected to account for the varying numbers of households protected by different schemes. Initially, the data was used to compare average planned expenditure in a local authority area, ranked by overall levels of flood disadvantaged neighbourhoods, against the national average (shown in Figure 9). This approach aimed to map how well-targeted planned investment is to areas of greatest flood disadvantage. It is recognised that the precise costs of schemes and funding sources may change as the programme is developed.

Flood disadvantaged areas were derived using JRF's climate just analysis (www.climatejust.org.uk/map), while planned expenditure was allocated via geographical information systems using the Environment Agency's online map for the investment plan, data published on the new 47 projects announced in March 2015, and grid references for these new projects supplied by DEFRA[5].

Figure 8: Most flood disadvantaged neighbourhoods in England



Top pair: most flood disadvantaged neighbourhoods for river and coastal flooding, by local authority area (district, borough and unitary) and parliamentary constituency; bottom, most flood disadvantaged neighbourhoods for surface water flooding by local authority and parliamentary constituency

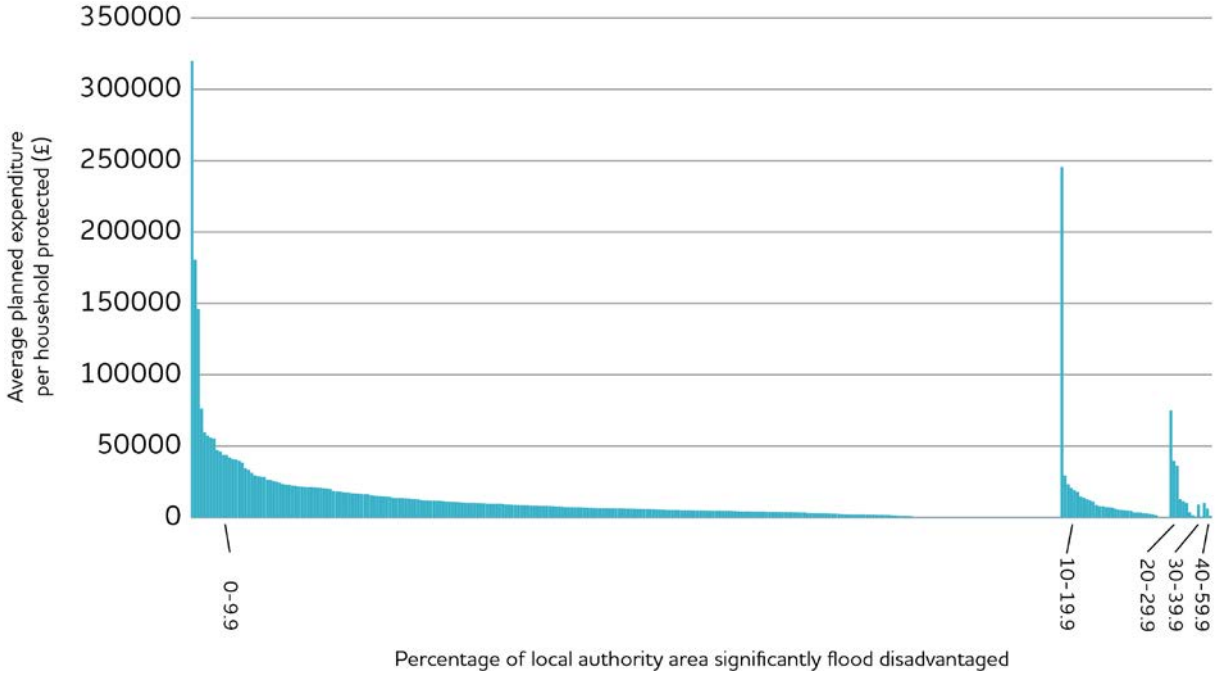
The national average planned expenditure per household for a local authority was £6,610. However the analysis showed there was significant variation in the average expenditure in each group. Some local authorities with lower numbers of most flood disadvantaged neighbourhoods will receive more on average than those with significantly greater numbers of disadvantaged neighbourhoods. For example, the average investment per household protected for local authorities with one most flood disadvantaged neighbourhood was £10,894, compared with £8,148 for local authorities with seven most flood disadvantaged neighbourhoods. Within these groups, there is a significant range in the costs per household protected. For those with no disadvantaged neighbourhoods, planned expenditure ranged from £0 to £145,714, while for those with six or more flood disadvantaged neighbourhoods, the range was £405 to £43,504.

Figure 9: Average planned expenditure per household protected (£) by local authority by number of neighbourhoods at significant disadvantage

This analysis suggests there is not a strong link between those local authorities which contain the most flood disadvantaged neighbourhoods, and the levels of planned expenditure.

Further analysis was undertaken to try and better account for the scale of flood disadvantage in an area by examining planned expenditure per household compared to the proportion of flood disadvantaged areas in the local authority. (Figure 10).

Figure 10: Average planned expenditure per household protected (£) compared with proportion of local authority neighbourhoods that are most flood disadvantaged, by local authority (district, borough and unitary)



This shows that a significant proportion of total planned expenditure will be in local authority areas with a lower proportion of their neighbourhoods identified as most flood disadvantaged. In particular, almost half or £2 billion of total planned investment (47.8 per cent) is for local authorities with no neighbourhoods at significant flood disadvantage (i.e. none of their neighbourhoods have both high exposure and high social vulnerability. Seventy-five per cent of planned expenditure is going into local authorities with under 10 per cent of neighbourhoods affected by significant flood disadvantage, with only 2 per cent going to those with 40 per cent or more of their area affected. In addition, those local authorities with higher proportions of most disadvantaged neighbourhoods have lower ranges of investment per household protected, and a lower average expenditure per household protected compared to areas with lower proportions of flood disadvantaged neighbourhoods, as shown in Table 2.

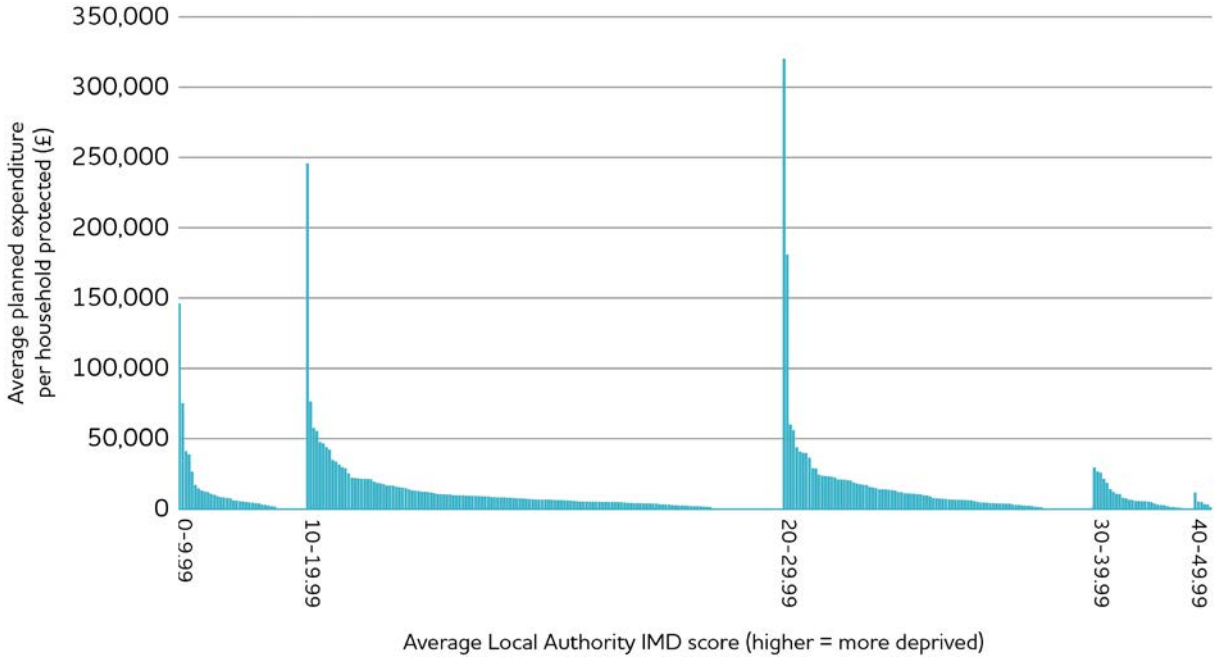
Table 2: Summary results of local authority analysis

% of flood disadvantaged neighbourhoods as proportion of total neighbourhoods per LA	Number of local authorities	Percentage of total planned expenditure	Range of investment per household protected, per local authority	Average expenditure per household protected
0%-9.99%	277	74.8%	£0 - £319,666	£8,429
10% - 19.9%	35	13.8%	£0 - £245,333	£5,232
20% - 29.9%	9	5.4%	£444 - £74,842	£8,804
30%-39.9%	2	2.1%	£476 - £8,874	£8,616
40%-59.9%	3	1.8%	£907- £10,000	£1,694

Recognising that the government considers deprivation rather than social vulnerability in its funding allocations, the authors also examined the extent to which planned expenditure aligned with deprivation using the Index of Multiple Deprivation (IMD) (Figure 11). The IMD was considered as it is used as a multiplier in the criteria for assessing viability of projects. It might therefore be expected that there would be a relationship between planned expenditure and overall levels of deprivation. The results below, however, show limited alignment between planned expenditure and 2010 IMD scores at the local authority level, with significant expenditure in the middle range, and lower amounts in higher scoring areas. Whilst this suggests that planned expenditure is not aligned with deprivation at the local authority level, it needs to be treated with caution as deprivation levels will vary within individual local authorities.

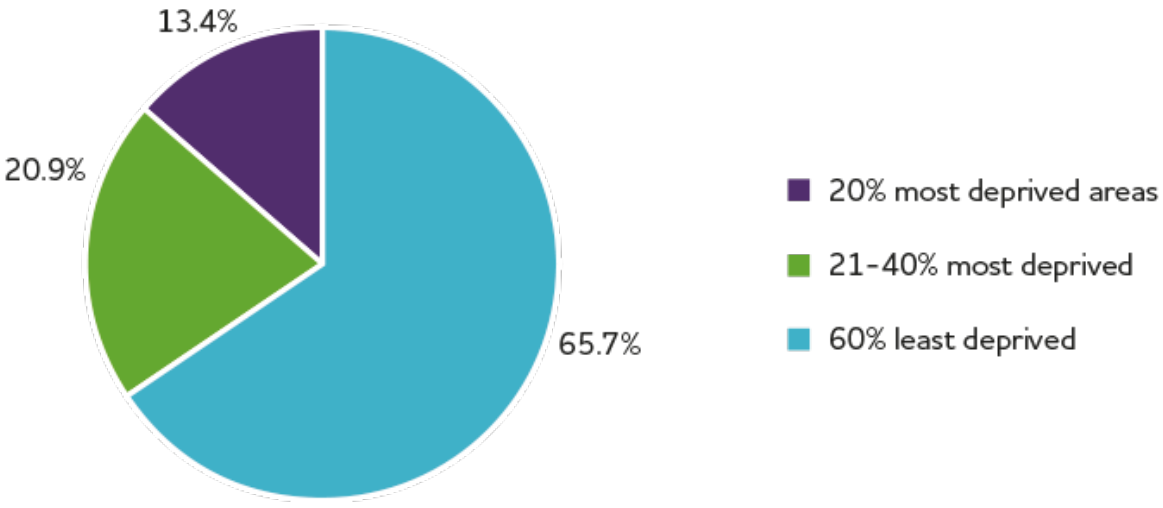
Key message: Levels of planned expenditure in flood risk management to 2021 do not appear to align with areas of significant flood disadvantage, or with wider deprivation at the local authority level.

Figure 11. Average planned expenditure per household protected (£) by local authority compared to 2010 IMD score



Similar results were found when the locations of the schemes were mapped against the IMD decile rankings at the Lower Super Output Area (LSOA) level. This level of geography is used for the purposes of calculating Grant in Aid against Outcome Measure 2 (Households with a reduced level of flood risk). Only 13.4 per cent of schemes in the programme were located in the 20 per cent most deprived areas in England, with 65.7 per cent in the 60 per cent least deprived areas (see Figure 12).

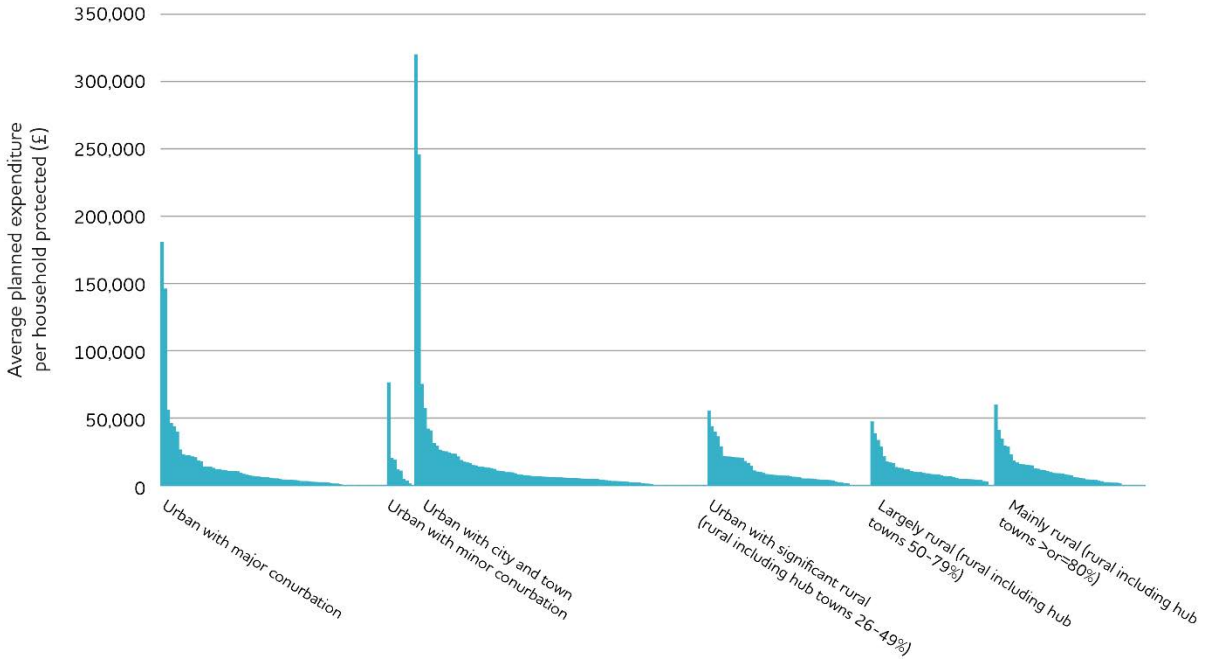
Figure 12: Flood risk management schemes located in Lower Super Output Areas by IMD categories



Finally, the authors analysed the alignment between planned expenditure per household protected and the degree of rurality (Figure 13). This was due to the potential current and future challenges in financing

rural flood defence schemes. The emphasis on household protection within current scoring for Flood Defence Grant in Aid, and the LTIS approach suggests that rural schemes could become increasingly expensive as the relative costs of protection are higher in sparsely populated areas (CIWEM, 2015). Initial results using DEFRA's rural urban classification show a bias towards expenditure in urban areas (DEFRA 2014e). Planned expenditure per household to 2021 in predominantly urban areas was 66 per cent (£2.83 billion) of total national allocations, compared with 34 per cent, or £1.45 billion in rural areas. This suggests that there will be future questions to consider over the balance between investment in urban areas (given increasing trends of urbanisation), and ensuring affordable flood risk management in rural areas.

Figure 13: Planned expenditure per household protected (£) by local authority, grouped by DEFRA urban and rural classifications



Note that the analysis of total investment for urban areas includes all of the first four categories on the bar chart including those areas described as urban with significant rural areas – this last category in particular is therefore likely to include funding in some rural as well as urban areas.

Overall the analysis presented here raises questions over whether current approaches to flood investment are taking sufficient account of social vulnerability, or wider deprivation. There are gaps to the analysis as data on schemes is only accurate to 1 kilometre, there may be projects unfunded outside the national programme which could address flood disadvantage[7] and data on the 2010–15 investment programme was not available for consideration at the necessary spatial scale for this project to assess related outcomes. There will also be other considerations in funding such as the varying construction costs of schemes, that schemes may be protecting other areas and varying levels of deprivation within local authorities.

Therefore, while it is difficult to judge the appropriateness of investment in addressing patterns of flood disadvantage overall[8], the issues raised point to the need for a further, more detailed assessment. While exposure needs to remain a strong driver in investment in flood risk management, taken together:

- the differences between how IMD and social vulnerability to flooding are calculated;
- the fact that flood investment levels are not clearly aligned with flood disadvantage – either considering the number of most flood disadvantaged neighbourhoods or the proportion of neighbourhoods affected within a local authority
- the lack of alignment between levels of flood investment and local authority and neighbourhood level deprivation;

- the urban bias in the investment, and
- the fact that not all social and economic costs of floods are captured in current assessments;
- cumulatively make the case for the government to review whether the current investment approach needs to do more to address social vulnerability in the long term.

Enhancing risk reduction and social protection in long-term investment scenarios and project appraisal

Alongside the Comprehensive Spending Review, the Environment Agency's Long Term Investment Scenarios (LTIS) inform government decisions relating to the overall the overall budget for FDGiA expenditure. The latest version takes a cost-benefit approach, setting out an investment profile for flood and coastal erosion risk management where benefits exceed costs between 2015 and 2065. This approach recognises that investment in flood risk management creates multiple benefits for society. Applying this approach provides an overall risk reduction of around 5 per cent (Environment Agency, 2014). The scenarios consider multiple futures, including changes in frequency and severity of extreme weather, ageing and deteriorating flood defences, and the benefits of investment to provide and maintain structures.

The cost-benefit approach seeks to obtain value for money. However, as a strict economic analysis, it does not include local preferences or alternative approaches such as natural flood risk management and sustainable drainage systems (Chartered Institution of Water and Environmental Management, 2015). In addition, the LTIS only includes a limited consideration of wider costs and benefits for issues such as transport, commerce and industry. It also ignores the fact that investment affects the distributional impacts of flooding on the population, and can have social equity implications.

Such approaches have limitations. Nationally, there has been a push for alternative approaches which focus on risk reduction. The Association of British Insurers (ABI) states that '...if such a [value for money] approach was actually taken, the likely result would be that areas at significant risk of flooding but with relatively low economic benefits such as rural or deprived communities would slip down the priority list' (ABI, 2014) This is echoed by the Adaptation Sub-Committee which points out that although levels of flood risk may fall over time:

> "...the gains will be due to hundreds of thousands of properties already at a relatively low risk of flooding being even better protected ...These investments yield the greatest overall benefit per pound spent. But some households already in the high risk category (1-in-30 annual chance of flooding or greater) are expected to remain so, and others will join them as the climate continues to change."
>
> (Adaptation Sub-Committee, 2014a)

The Chartered Institution of Water and Environmental Management (CIWEM) (2015) highlights that:

> "...this means that in the longer term tackling the high risk homes will become increasingly expensive, as, for example, they may be in sparsely populated areas, where the relative costs of protection are higher. This raises questions about what to do with properties in high risk areas in the longer term."

The Environment Agency recognises the limitations of a purely value for money approach, stating that 'investing at strictly economic optimum levels in the long term does not mean that all communities would see the solutions they want, and not everyone would benefit from the same level of protection'.

In the Netherlands, new legal flood protection standards are being set which address both economic efficiency and social protection from flooding. The government still follows a cost-benefit approach but also applies a minimum safety level and takes societal disruption due to large-scale flooding and the protection of vital and vulnerable infrastructure into account. The standards require:

- A basic level of safety for everyone. To be achieved by enhancing the safety in areas with relatively large individual risks. This assumes arrangements for emergency management, maximising evacuation to reduce casualties.
- Societal disruption due to large-scale flooding. Large groups of casualties, or extensive economic damage due to large-scale floods, may disrupt Netherlands' society for a long period. To counteract societal disruption, investments in protection will be made for areas which may experience large groups of casualties and/or economic damages. These investments are in addition to those needed to provide basic safety.
- Protection of vital and vulnerable infrastructure. Special attention is also required for the impacts of flooding on certain utilities, hospitals etc, as this infrastructure is of vital importance during and after the flood.

Cost benefit analysis and social protection requirements are first considered separately, and the final standard is based on the higher requirements of the two. These new standards have legal force from 2017 and account for changes in socio-economic development through to 2050 as well as climate change (Van der Most, *et al*., 2014).

The UK has a similar evidence base to the Netherlands to inform such approaches; researchers are increasingly able to model costs and impacts to the wider economy and society from flood disruption. At the same time local authorities are increasingly capturing a wide variety of local impacts and costs, such as school closures, and demands on health and social care.

The existence of a workable policy framework in the Netherlands which seeks to maximise the benefits of considering economic efficiency while also setting a goal for social protection, and research and evidence which could inform such approaches in the UK, suggests that there is scope to improve social protection elements in future iterations of the LTIS and individual project appraisal.

Key message: The government should clarify its overall goals for flood investment policy and consider including a clear goal relating to social protection.

Other concerns in the current flood risk management investment approach

Improving the approach to partnership funding

DEFRA recently commissioned a review of the partnership funding approach (DEFRA, 2014c) which also highlights other areas of concern in flood investment:

- Possible ineffective targeting of deprived communities – DEFRA's evaluation found the 'explicit policy outcome focus [of partnership funding] on communities at high risk and high deprivation is not being realised (to date)' This stemmed from the fact that it could not reach a firm conclusion 'due to a lack of data in the Environment Agency's medium term plan and a lack of strong evidence from the user experience analysis'. CIWEM (2015) also states that the Welsh Government did not adopt the partnership funding approach because of a perception that poorer communities might be unfairly disadvantaged. If this is indeed the case, partnership funding could be failing one of its core objectives; a cause for significant concern.
- Clarifying the approach to raising £600 million in contributions – DEFRA's evaluation shows that the majority of partnership funding investments came from the wider public sector, including local authorities. The report itself recognised '... continued public sector funding cuts could impact on this level of contributions in the future'. Furthermore, reduced revenue capacity may impact on the ability to unlock this contribution. While 25 percent of projects came from private income, the evaluation indicates that the public sector would have to continue to play a significant role if the government wants to reach its £600 million target. This reliance on the public sector looks set to continue as only £345 million in partnership funding is included in the investment plan to 2021 (Chartered Institution

of Water and Environmental Management, 2015), leaving a £255 million shortfall against the government's target. This represents a significant risk given the government's appetite for deficit reduction. To enable all parties to properly plan, the government needs to clarify how it plans to reach its £600 million target.

- Development in the floodplain – the review also found that partnership funding may potentially encourage new development in the floodplain. Private sector contributions to flood defence schemes were largely provided by direct beneficiaries such as major companies and developers. Although partnership funding cannot be used to protect properties built after 2012, some schemes will protect existing properties and open up land for development. While the planning process should ensure the schemes do not circumvent the National Planning Policy Framework (NPPF) (DCLG, 2012), evidence from the Adaptation Sub-Committee (Adaptation Sub-Committee, 2012, 2014b) shows that floodplain development is still increasing. There is therefore a need to assess whether partnership funding is playing a role in driving further development in floodplains and increasing longer term exposure to risk. There are also linked issues around capacity of the Environment Agency and local authorities to assess planning applications. These are explored below.

Ringfencing of funding for lead local flood authorities

The government allocates separate funding to lead local flood authorities (LLFAs), as defined by the Flood and Water Management Act 2010, to fulfil their duties in relation to managing surface water. LLFAs are county councils or unitary authorities. These duties are wide ranging, but include: developing a strategy for local flood risk management; managing flood risk from ordinary watercourses, surface water and groundwater flooding; co-ordinating work among local agencies on flood risk; and emergency planning and recovery.

In fulfilling these functions, they feed into the programme of flood risk management approved by regional flood and coastal committees. Government funding for LLFA functions is allocated through an annual local services support grant, based on levels of flood exposure, with further funding allocated through the main local government settlement process (known as the Settlement Funding Assessment) (DEFRA 2014d). In both cases, national funding allocated for use in surface water flood risk management is not ringfenced.

There is evidence that this funding is not always being spent on managing flood risk. The Adaptation Sub-Committee (2014b) cites a Local Government Association (LGA) study in 2012 where over a third of lead local flood authorities stated that at least some of the funding allocated by DEFRA had not been allocated to flood risk management within the local authority.

At a time when local government grant is reducing, and local authorities are feeling increased pressure from rising demands (Hastings, *et al.*, 2015), it is inevitable there will be trade-offs to make on using funds to meet local needs. However, failing to adequately cater for flooding carries the risk of locking in negative social consequences in future. To avoid this, funding for surface water flood management could be ringfenced to ensure local authorities have the capacity to plan appropriately over a longer term. This suggestion is also supported by the Environmental Audit Committee (House of Commons Environmental Audit Committee, 2015), which stated that '…without a legal duty to manage and reduce flood risks the local authority budgets for this work are liable to be reallocated to other duties'.

Recommendations

- The government should review its current approach to flood investment to consider whether issues of social vulnerability or wider deprivation are being adequately addressed, and whether a minimum standard of protection is needed for society.
- Ahead of a formal Policy Implementation Review, due in 2017, the government should consider how to strengthen the partnership funding framework to achieve a stronger focus on most flood disadvantaged communities, and reduce incentivisation of unprotected floodplain development.

- To allow all parties to plan effectively, the government should clarify how it intends to meet the £600 million partnership funding target.
- The government should consider ringfencing surface water flood funding to lead local flood authorities to ensure it is spent on flood risk management.

5 Addressing flood vulnerability in wider national policy

While investment decisions are a critical part of flood risk management, the wider national policy framework for managing flood risk and increasing flood resilience also needs to take better account of the social context and equity issues. By doing this, there are opportunities to further increase effectiveness of funding, and improve social protection.

Key message: The national and local flood risk management policy framework should take greater account of flood disadvantage and the wider costs of flooding to increase the focus on long-term social protection as a central policy goal.

Maximising effectiveness of flood risk management policy

Updating the national flood and coastal erosion risk management strategy and local flood risk management strategies

The national flood and coastal erosion risk management strategy (Environment Agency, 2011) recognises the crucial role that flood risk management plays in protecting lives and livelihoods, outlining that 'in prioritising FCERM [Flood and Coastal Erosion Risk Management] actions, it is important to consider the consequences of flooding in more detail'. The strategy defines the overall direction for flood risk management in England. While it highlights a range of flooding impacts, the understanding of the nature and distribution of impacts has moved on significantly, and it would be useful to ground its approach in one that better acknowledges the full dimensions of flood disadvantage.

In addition, more support is required for local authorities to better consider the social vulnerability context when undertaking flood risk management activities. Although a number of lead local flood authorities already have local flood risk management strategies, they will be revised. The guidance from the Local Government Association (LGA) was last updated in 2011, and could be updated to better support local authorities to account for social vulnerability when considering management approaches. JRF's Climate Just website (www.climatejust.org.uk) provides a useful starting point for this.

Ensuring adequate maintenance of flood defences

Once flood defences are built, they need to be maintained to ensure adequate performance throughout their lifetime. While the government is providing greater certainty on capital investment through a six-year programme, the funding for maintenance is still determined on an annual basis. Both the House of Commons Public Accounts Committee (2015) and the Chartered Institution of Water and Environmental Management (2015) are critical of this approach, with the Public Accounts Committee stating:

> "Longer term settlements from HM Treasury for the revenue budget would provide more certainty over the availability of funding, allowing the Agency to plan with certainty and secure savings. The Agency has shown its ability to secure these efficiencies, both in capital construction and on maintenance... The effects of climate change heighten the importance of being able to plan for the longer term effects of flooding."

This need for adequate maintenance is pressing. The Adaptation Sub-Committee has warned that only just over a quarter of flood defence systems would be maintained in 2014/15 according to identified needs (2014b). The Public Accounts Committee also highlighted that reducing maintenance may be a false economy, as it would require earlier capital investment in future. The Chartered Institution of Water and Environmental Management (2015) has suggested that DEFRA work with Infrastructure UK and the Treasury to commit to funding a six-year maintenance and support programme to match the current six-year capital programme. The need for longer term, regularly evaluated maintenance is important, since as

well as making good economic sense, changes in the underlying social vulnerability of communities over time, and climate change trajectories, may affect the need for such regimes.

Increasing effectiveness of sustainable urban drainage systems (SuDS)

A key provision of the Flood and Water Management Act 2010 was the requirement to implement SuDS. As well as reducing exposure, SuDS deliver additional environmental benefits which have a positive impact on livelihoods. The National Ecosystem Assessment (UK National Ecosystem Assessment, 2011) shows that they: increase air quality; store carbon; provide space for physical activity; support mental health and wellbeing, and support biodiversity and ecosystems. They are implemented and maintained using conditions in the planning system, rather than the original plans for independent SuDS approval bodies (DEFRA 2014f). However, this raises a number of problems:

- Inability of local authorities to monitor maintenance and performance – some local authorities may not have the technical expertise or capacity to monitor the ongoing effectiveness of those conditions. Insufficient capacity could make enforcement of conditions dependent on those communities most able to raise awareness of issues to local authorities.
- Exclusion of small developments from SuDS requirements – while minor developments (of under 10 dwellings) are excluded from the requirements, their cumulative effect can still increase overland flows, and SuDS could still play an important role in limiting this. Combined with the Environment Agency's focus on major applications more generally, there is a possibility that small developments could become a blind spot, driving increased flood exposure.
- Distribution of maintenance costs – developers can use a variety of approaches to implement and maintain SuDS. These include service management companies, agreements with water and sewerage companies or with local government, or the transfer of responsibility for individual household drainage systems to the householder. As SuDS become more commonplace there is a risk that leaving charges to a market based mechanism, and to households specifically, may mean protection becomes more linked to, or reliant upon, disposable incomes.
- Disparity between SuDS and development lifetime – a number of SuDS features have design lifetimes of around 25 to 40 years, which are considerably shorter than that of developments. It is unclear how refurbishment and renewal of schemes to maintain protection will be funded, and could risk further enhancing exposure.

A strategic vision for residual risk management and household adaptation

While investment in flood defences will help reduce risk, in certain situations (such as where data is uncertain, or where there is infrequent but significant risk such as from surface water flooding, or risks to small numbers of properties), property level protection (PLP) could be more cost-effective or appropriate than flood defence schemes (Lawson, *et al.*, 2015). Therefore, there is a need to improve the understanding of the role that PLP could play in improving household and community flood protection, as part of a wide range of approaches from catchment to community and property level. The LTIS identifies the need to better assess the role that businesses and householders can play, and currently only considers small numbers of PLP measures.

The term 'property level protection' is used to cover both resistance and resilience measures:

- resilience measures aim to reduce the impact of flooding and the cost of reinstating, should water enter a property (e.g. rewiring from the ceiling down, replacing white goods)
- resistance measures aim to stop water getting into a home in the first place (e.g. air bricks or flood doors).

Between 2008 and 2011, fewer than 400 properties a year installed property level measures (Adaptation Sub-Committee, 2012), with many schemes developed by local authorities, while within the new investment plan there are plans to protect (only) 1,800 homes with PLP measures over the six years (i.e. 300 a year). At this rate, it will take some 400 years to achieve the cost-effective potential to manage flood risk using PLP measures, estimated to be around 120,000 homes (Adaptation Sub-Committee,

2012). This suggests a need to review whether further government intervention is needed to stimulate this market or address partial market failure.

Prices are likely to be a deterrent to household take-up; the estimated total UK cost of resilience measures for all properties where it would be worthwhile ranges from £2.5 billion to £3.7 billion, with the average cost of a flood protection package between £3,500 and £33,000 per property (Ricardo-AEA, 2013). This suggests that although households may undertake low level coping responses without government intervention, more involved adaptations that require time and investment need state or private sector incentives (Porter, *et al.*, 2014).

While the public sector and general public markets are emerging for PLP (Lawson, *et al.*, 2015), it is likely that property level protection take-up in the UK currently depends on local authority or regional flood and coastal committee funding, government subsidies (such as the repair and renew grant), or investment by those households that are informed enough and with enough disposable income to pay for property level measures themselves.

A government framework to provide leadership and co-ordination around property level protection could be a vital step forward. This should also provide further clarity on appropriate financial, and market mechanisms that could be used to unlock their delivery, and support access by low-income households. Some key opportunities within this could include:

- A national, government-supported household/community-level flood resilience framework – a national programme of flood prevention for home-owners/landlords, targeted based on exposure with a sliding level of subsidy based on incomes and other vulnerability, could offer an opportunity to better protect households on lower incomes, and complement provision of large defence schemes in areas where PLP is an appropriate solution. It could also offer new employment opportunities.
- Better use of existing finance arrangements – a range of innovative financial mechanisms could be employed to support deployment of schemes, including levies through Council Tax (as is being considered in Somerset), tax increment financing[9], local charges, rebate approaches, or community infrastructure levies.
- Better use of policy/regulatory levers and market mechanisms – policies such as the National Planning Policy Framework, Flood Re, British Standards Institute standards and building regulations could come together to create a policy framework which better incentivises PLP. The Flood Re Ltd transition plan is due in autumn 2015, and offers a positive opportunity to outline how the scheme will better incentivise flood risk management and increase resilience over the duration of its operation.

While it is important, PLP also needs to be part of a much wider national set of responses to flood risk management, which cover catchment to community and property level interventions to support social protection. Recent research by the Environment Agency (2015a) provides a toolkit for flood risk managers to select appropriate management options from a range of schemes, including PLP. Similarly DEFRA's flood resilience community pathfinder scheme has demonstrated a range of different approaches to managing and reducing risk and reducing impact at the community level. All need to be considered to ensure efficient and effective solutions.

Ensuring flood resilience is addressed in areas of highest risk

Flood insurance provides a safety net for people when flooding occurs. However premiums can be unaffordable for low-income households and take-up rates among this group are low (O'Neill, 2012). The new flood insurance framework, Flood Re, seeks to address the current market failure where people cannot get affordable flood insurance in areas of highest likelihood of exposure, by providing transitional arrangements to risk-reflective market pricing over the next 25 years (DEFRA 2014b). The framework provides a collective response to ensure insurance premiums are affordable for households in these areas. Premiums are linked with Council Tax thresholds as a proxy for affordability.

While a number of organisations have voiced concerns with delivery of the scheme (see for example Knox, 2014), this transition means there now needs to be a cohesive policy framework and

implementation plan that builds resilience for those at highest risk over the period of the Flood Re scheme. This needs to reduce exposure and underlying social vulnerability, while also taking account of increasing risks due to climate and demographic change. Doing so will ensure the move to a free market does not result in individuals and localities at highest risk being unduly hit by high, unaffordable premiums, and the consequent negative impacts for housing markets, when Flood Re comes to an end.

A more supportive wider socio-economic framework

Given that the impacts of flooding are affected by social vulnerability, it also follows that flood risk management will be affected by other socio-economic policies. This paper has already outlined that failing to consider social vulnerability in investment decisions could well cost the public purse and society overall. However, wider socio-economic policy can also affect vulnerability through its effects on deprivation, population density and wider decisions on infrastructure investment. Despite this, there has been limited consideration of this wider relationship. Wilson, *et al.* (2013) have highlighted that some groups such as refugees and asylum seekers are excluded or marginalised in the adaptation process, and that policies such as public sector and welfare reform are increasing social vulnerability. Therefore a focus also needs to be placed on reducing flood vulnerability through wider socio-economic policy.

Key message: Flood risk management and wider socio-economic policy frameworks are directly related. Socio-economic policy drives vulnerability to flooding, while failing to account for social vulnerability in flood risk management could increase pressures on related socio-economic policies.

Spatial planning and development

Efforts to reduce exposure have in part focused on reducing development in floodplains and other flood risk areas. The LTIS suggests reducing inappropriate development offers significant benefits, stating that 'without effective planning controls, pressure to build more homes would add up to 16 per cent to the cost of optimal flood protection' compared with their baseline scenario (Environment Agency, 2014).

This recognition is also shared by industry (Chartered Institution of Water and Environmental Management, 2015). At the same time, the UK is facing a chronic housing shortage. The UK needs to build 200,000 homes a year to contain poverty to only one in four of the population (Stephens, *et al.*, 2014). Data from CLG shows that in 2013/14, there was a 60,000 shortfall on this. Others suggest a need for closer to 245,000 homes a year (Town and Country Planning Association, 2013).

Therefore a balanced approach in spatial planning is key. The National Planning Policy Framework (NPPF) attempts to do this by directing development away from areas at highest risk. Where development is necessary, the NPPF requires developers to make it safe without increasing flood risk elsewhere. Despite this, on average, 21,000 properties were built each year in the floodplain between 2001 and 2011, including 4,000 in areas of significant flood risk (after taking account of any defences in place) (Adaptation Sub-Committee (2012, 2014b). The Adaptation Sub-Committee also found the rate of new development was faster in the floodplain than elsewhere. Failing to strike the right balance ironically risks exposing parts of the country and the economy to greater risks, impacts and costs from floods, as a result of an overwhelming focus on economic growth. While in principle the NPPF broadly seeks to strike an appropriate balance, a number of issues are unknown or need resolving:

- Capacity to scrutinise and challenge planning applications – adequate scrutiny and challenge is crucial in the planning process. 12,000 minor planning applications (of less than 10 dwellings) in the floodplain did not receive site-specific Environment Agency (EA) advice in 2013 (Adaptation Sub-Committee, 2014b). Causes for this lack of challenge could include spending reductions in the EA and local government, the possibility of legal costs from challenged applications providing a disincentive, and a strong focus on economic growth. The need for the EA to advise on all applications was also advocated by the Environmental Audit Committee (House of Commons, 2015).
- Tenure type and extent of affordable/social housing built in flood risk areas – there is a need to understand the mix of properties being built in floodplains and other areas of flood risk, to understand tenure outcomes and to see if particular groups/sectors are being more exposed to risk.

This could be done by engaging planning authorities to analyse proposed tenure types and the mix of development delivered to better understand the implications of new development.

- Increasing the need for risk management activities – unlocking new land for development in the floodplains could create further risks that will need to be managed by local authorities and the Environment Agency. It also risks exposing the wider public sector and insurance industry to increased costs from flooding. While local authorities will be aware of the increasing risks through planning applications, it is not clear whether the additional work of managing future risks from new schemes to meet duties under the Flood and Water Management Act 2010 has been factored in when calculating future levels of exposure, or funding allocations provided to lead local flood authorities.
- Potential lack of redress for those affected by flooding due to new developments – in some cases developers set up bespoke companies to deliver a development and are then collapsed, leaving no public redress for inadequate consideration of flood risk. The National Flood Forum has suggested that there needs to be a bond or an insurance policy on each new development to address this, though this would set a high burden of proof (personal correspondence); it would still be difficult to prove that flooding resulted from a new development. An alternative could be to follow the Scottish system of making the planning authority liable for the decisions that it takes.

Embedding consideration of flood disadvantage in the next UK Climate Change Risk Assessment (UKCCRA) and National Adaptation Programme

Exploring the effects of all of the policy frameworks involved in reducing flood disadvantage, and assessing their impacts on different groups, is beyond the scope of this report. Therefore, it is welcome that social vulnerability analysis will be a key constituent part of the next UKCCRA as a cross-cutting issue to be considered across all sectors. DEFRA has asked the Adaptation Sub-Committee to produce an evidence report in 2016 to support this. In its method statement the Adaptation Sub-Committee has already outlined that the evidence report should cover how climate change interacts with other socio-economic factors to affect the level of risk or opportunity (Adaptation Sub Committee 2014c). The analysis should try to assess how important climate change is as a driver of change compared with other drivers, such as demographic or land use change. To support this work and ensure responses are effective, a number of key social and economic policies and funding streams should also be considered in terms of their implications for flood risk management (see Table 3).

Table 3: Illustrative policies, guidance and funding having a significant impact on flood disadvantage

Climate disadvantage	Policy/guidance	Funding streams
Enhanced exposure	• Long Term Investment Scenarios • National Infrastructure Plan • National Planning Policy Framework • Flood defence maintenance regimes • Building regulations/BRE standard on sustainable homes • Local flood risk management strategies • Local spatial planning and developments • Catchment management plans • Role of buyouts in UK policy – similar to Hurricane Sandy/Mississippi • Local green infrastructure plans	• Partnership funding • LEP implementation of European Structural Investment Funds • Lead local flood authorities funding • Regional Growth Fund • Community Infrastructure Levy • Housing revenue accounts •

Reducing sensitivity	• Health and social care integration • Local authority public health response	• Better care fund • Direct payments • Personal budgets
Ability to prepare	• Welfare reform (spare room subsidy, Council Tax Support, Universal Credit, benefit cap, Personal Independence Payments) • Resilience/emergency planning • Community flood plans and action groups	• Flood resilience community pathfinder scheme
Ability to respond	• Civil Contingencies Act • Flood warnings and communicating risk	• Local government finance settlement
Ability to recover	• Emergency response and recovery guidance for the Civil Contingencies Act	• Highways emergency payment grant • Bellwin scheme

There is also a need to better consider the spatial context to flood disadvantage within the UKCCRA and subsequent National Adaptation Programme (NAP). The recent Environmental Audit Committee enquiry into adaptation highlighted that both the UKCCRA and NAP (DEFRA, 2013) were spatially blind, and that future iterations of the NAP should have a strong geographic focus (House of Commons Environmental Audit Committee, 2015). The UKCCRA should help to highlight the spatial distribution of flood and other climate hazards and the relationship with social vulnerability. Without this consideration there is likely to be a poorer understanding of the variation of risk and cumulative impacts at a local level, leading to an inability to target adaptation responses appropriately in the next National Adaptation Programme. In contrast, adopting this approach offers a strong opportunity for the next NAP to more clearly set out how adaptation policy will spatially target responses to improve social protection.

Key message: The next UKCCRA and NAP need to develop, and respond to, a stronger understanding of the relationship between social vulnerability to flooding and policies and funding streams that could address different aspects (considering exposure, sensitivity and adaptive capacity), to maximise resilience to flooding and reduce the costs to the public purse.

Recommendations

- The FCERM strategy for England should account for the uneven distribution of the impacts of flooding based on enhanced exposure, sensitivity and adaptive capacity, and ensure that this informs all flood risk management activity.
- The government should work with the LGA to embed a requirement to consider social vulnerability in local flood risk management strategies within guidance, and in development of plans for areas of high risk.
- The government should evaluate the potential efficiencies that could be made from longer term certainty around maintenance, including the effects of a review process to align maintenance needs with social vulnerability to flooding.
- In actively monitoring the implementation of SuDS, government should consider:
    - the extent to which planning authorities have capacity to assess applications, and monitor the ongoing performance of conditions

  - the extent to which exemptions of small scale developments impact on overall exposure;
  - who is bearing the costs of SuDS maintenance, and the implications of this.

- The government should continue to develop a strategic approach to the role of property level protection, as part of a wide range of approaches, from the catchment to community and individual property scale. In particular:
  - the next Long Term Investment Scenarios should set out the role that resilience and resistance measures could have as part of an overall strategy
  - research should be conducted on need and options for market intervention in relation to property-level protection, including a direct support scheme for low-income households to purchase PLP as well as the role of other financial instruments and policy drivers.

- Flood Re's transition plan should explicitly outline how it will seek to build resilience in highest risk areas. This should link strongly with approaches to residual risk management such as PLP and community schemes to ensure a joined up approach.
- Future work on flood risk arising from planning and new development should include a focus on:
  - increasing understanding of the types of people affected by linking data on new developments in all flood risk areas to data on tenure type and development types
  - surveying local authority planning departments and the Environment Agency to see if there is suitable capacity in place to assess both minor and major planning applications
  - assessing whether local authorities have considered the impacts of unlocking land for development on their own risk management functions and those of the Environment Agency and water companies
  - the difference a redress system could make to those who are put at risk of flooding due to new developments.

- The next UK Climate Change Risk Assessment should, where possible;
  - include a spatial analysis of the distribution of risk that takes account of social vulnerability to the impacts of climate change
  - examine the individual and cumulative effects of key socio-economic and adaptation policies in addressing vulnerability.

The next National Adaptation Programme should use a spatial analysis of social vulnerability and exposure to different hazards to better target climate adaptation responses.

6 Recommendations

- The government should review its current approach to flood investment to consider whether issues of social vulnerability or wider deprivation are being adequately addressed, and whether a minimum standard of protection is needed for society.
- Ahead of a formal Policy Implementation Review, due in 2017, the government should consider how to strengthen the partnership funding framework to achieve a stronger focus on most flood disadvantaged communities, and reduce incentivisation of unprotected floodplain development.
- To allow all parties to plan effectively, the government should clarify how it intends to meet the £600 million partnership funding target.
- The government should consider ringfencing surface water flood funding to lead local flood authorities to ensure it is spent on flood risk management.
- The FCERM strategy for England should account for the uneven distribution of the impacts of flooding based on enhanced exposure, sensitivity and adaptive capacity, and ensure that this informs all flood risk management activity.
- The government should work with the LGA to embed a requirement to consider social vulnerability in local flood risk management strategies within guidance, and in development of plans for areas of high risk.
- The government should evaluate the potential efficiencies that could be made from longer term certainty around maintenance, including the effects of a review process to align maintenance needs with social vulnerability to flooding.
- In actively monitoring the implementation of SuDS, government should consider:
    - the extent to which planning authorities have capacity to assess applications, and monitor the ongoing performance of conditions
    - the extent to which exemptions of small scale developments impact on overall exposure;
    - who is bearing the costs of SuDS maintenance, and the implications of this.

- The government should continue to develop a strategic approach to the role of property level protection, as part of a wide range of approaches, from the catchment to community and individual property scale. In particular:
    - the next Long Term Investment Scenarios should set out the role that resilience and resistance measures could have as part of an overall strategy
    - research should be conducted on need and options for market intervention in relation to property-level protection, including a direct support scheme for low-income households to purchase PLP as well as the role of other financial instruments and policy drivers.

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    - assessing whether local authorities have considered the impacts of unlocking land for development on their own risk management functions and those of the Environment Agency and water companies
    - the difference a redress system could make to those who are put at risk of flooding due to new developments.

- The next UK Climate Change Risk Assessment should, where possible;
    - include a spatial analysis of the distribution of risk that takes account of social vulnerability to the impacts of climate change
    - examine the individual and cumulative effects of key socio-economic and adaptation policies in addressing vulnerability.

- The next National Adaptation Programme should use a spatial analysis of social vulnerability and exposure to different hazards to better target climate adaptation responses.

Notes

1 'Most flood disadvantaged neighbourhoods' means Middle Layer Super Output Areas classed as extremely socially flood vulnerable (i.e. extremely high and acute), extremely exposed to flooding (i.e. the standardised ClimateJust exposure score being greater than 0.5) and extremely flood disadvantaged (i.e. extremely high and acute).

For river and coastal flooding the standardised score was for the percentage of area at moderate and significant risk (1 in 30 to 1 in 200) of fluvial flooding. For surface water flooding the standardised score was for the percentage of area at risk of surface water flooding for a 1 in 100 year event given the projected increase in frequency and severity of flood events due to climate change (see for example, ASC 2014b). These areas were identified separately for both river and coastal and surface water flooding and combined for an overall analysis and to avoid double counting. For more detail on terms, definitions and limitations see www.climatejust.org.uk

2 Planned expenditure means the estimated total project costs of the entire set of schemes contained within the government's programme, and not solely the central government funding.

3 See the Climate Just website for details of the methods and the maps: www.climatejust.org.uk

4 A number of funding routes were not considered, including direct local authority expenditure outside the national programme (including Community Infrastructure Levy (CIL) funds linked to new developments), the allocations within the ERDF operational programme for England 2014–2020, the Regional Growth Fund, other local levy spending, and DEFRA's repair and renew capital grant, which was directed at households hit in recent floods. These sums are relatively small compared with primary funding routes for flooding, and in some cases a lack of clear reliable national data prevented comparative analysis.

5 The data was obtained from the government's first version of its interactive map of the investment programme. This was removed on 03 July, but was originally available at: https://www.google.com/maps/d/viewer?mid=zDlYgkD0zbyk.kkxJV47hNuMs. Four projects in the new set of schemes (Great Ouse Property Level Protection Scheme, Thames Estuary Phase 1 Programme Operational Area Works, Works arising from River Foss Flood Risk Management Strategy, and River Thames Scheme Site Investigation Surveys) were not included as there was either no location data or the works covered multiple parliamentary constituencies or local authority areas.

6 The analysis presented here focuses on local authorities as it was not possible to conduct all analysis for parliamentary constituencies such as investment by percentage of total area at risk due to a misalignment of geographies.

7 This is because data is only available on those schemes committed for funding in the overall investment programme.

8 There will also be areas containing some vulnerability at a lower level than MSOA which will be masked in the analysis.

9 Tax Increment Financing is an investment tool for financing infrastructure and other related development which has successfully been used in the US for over 40 years. It is based on reinvesting a proportion of future business rates from an area back into infrastructure and related development. It was introduced in England in 2010, with Newcastle being one of the pilot models as part of its City Deal. More information can be found at www.corecities.com/what-we-do/publications/rough-guide-tax-increment-financing

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