Briefing Note: **Flood risk in deprived communities**

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Sayers and Partners in association with Horritt Consulting and Edmund Penning-Rowsell for the Joseph Rowntree Foundation (Katharine Knox)

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Headline messages

- **Today there are approximately 4 million residential properties in the 20% most deprived areas in England.** Of those, 13% are exposed to flooding from either fluvial (river), coastal or surface water sources (with a return period of 1:1000 years or more frequent). This equates to approximately 1.1 million people (assuming a simple occupancy rate of 2.2).
- **There is strong evidence to suggest that in coastal and tidal areas subject to infrequent flooding (return period of flooding between 1:75 and 1:1000 years) the most deprived communities are over-represented** (affecting approximately 165,000 residential properties).
- **Climate change scenarios indicate that deprived households will see a disproportionate increase in exposure to more frequent floods.** This is the case regardless of adaptation effort. For example, assuming a 2°C change and a continuation of Current Levels of Adaptation (CLA) the number of residential properties in the most deprived areas exposed to frequent coastal, fluvial or surface water flooding (with a return period between 1:10 and 1:30 years) increases from 20,000 today to 41,000 by the 2050s.
- **The optimised investment scenario within the Long Term Investment Scenarios (LTIS) (R4) makes the case for significantly improving the protection provided to the most deprived areas.** Approximately 24,000 residential properties exposed to frequent flooding (i.e. a return period of 1:75 years or more frequent) in the most deprived areas are assigned an *Improve +* policy option. This suggests that there is both a need for and a direct economic case for greater investment in these areas.

Introduction

The analysis presented in this briefing note has been prepared for the Joseph Rowntree Foundation (JRF) by Sayers and Partners LLP as an initial stage of a longer term project into flood resilience in disadvantaged areas. A summary of the project brief is available online.[1] The briefing has been written to contribute the early findings from this study to the Government's National Flood Resilience Review.

The analysis presented here builds upon the work published (and peer reviewed) within the UK Climate Change Risk Assessment (CCRA): Future Flood Projections (Sayers et al, 2015) and uses the UK Future Flood Explorer (FFE); the same model used within the CCRA. In particular, it provides a more detailed analysis of the CCRA results on current and future flood risk for deprived communities. This evidence is crucial to support the development of a flood resilient society where reducing risk for the most vulnerable groups, including households in deprived communities, is appropriately prioritised.

Further analysis will take place over the coming year to explore in greater detail the relationships between exposure, vulnerability and resilience of communities across the UK, as well as the

[1] http://www.sayersandpartners.co.uk/flood-resilience-in-disadvantaged-areas.html Accessed 01/03/16

implications for policy responses. The results of this more detailed analysis are expected in Spring 2017.

Note: Limitations and assumptions underlying the evidence presented in this Briefing Note

- The focus of this analysis is on deprived communities, defined as the 20% most deprived Lower Super Output Areas (LSOAs) as determined using the Index of Multiple Deprivation (IMD).
- Residential properties are used here as a surrogate for people. This may be an important limitation given a single residential property may represent multiple households and the associated occupancy rates are likely to vary spatially and may exhibit systematic differences between deprived and non-deprived communities. This will be considered further in the main JRF study.
- Only 'exposure' is considered here. No consideration is given to differential vulnerability of communities in deprived areas (for example their ability to prepare for, response to and recovery from a flood, and levels of household income, which may be important in terms of take up of insurance and resources to address flood risk or respond to flood impacts).
- A low population growth scenario is included; no consideration is given to the demographic/building stock associated with that growth.

Supporting evidence and summary discussion

How exposed to flooding are deprived communities today? (see Table 1 and Figure 1)

- **There is strong evidence to suggest that in coastal areas subject to infrequent flooding (return period of flooding between 1:75 and 1:1000 years) the most deprived communities are over-represented** (affecting approximately 165,000 residential properties).
- There is some evidence to suggest the most deprived communities are under-represented in areas at a significant risk of fluvial and coastal flooding (return period of flooding 1:75 years or more frequent).
- Both the most deprived and non-deprived communities are equally exposed to surface water flooding across the full range of return periods.
- Around half the residential properties in the most deprived areas exposed to a significant chance of flooding (return period 1:75 years or more frequent) are concentrated in 120 1km squares. This relatively small number of hotspots are however distributed across the country with notable concentrations in London and the Thames estuary, the Lincolnshire coast and Yorkshire and the Humber. See Figure 1.

Table 1 The present day representation of residential properties in deprived communities at risk from flooding

Return period of flooding (years)	Source of flooding	Residential properties (all LSOAs)	Residential properties (Most Deprived LSOAs)	Most Deprived Areas as a proportion of all Areas (%)	Comment
All properties in England	n/a	20,172,562	3,782,915	18.8	The Most Deprived Areas are defined as the 20% of Lower Super Output Areas (LSOAs) with the highest IMD. The number of properties within each LSOA varies, therefore slightly fewer than 20% of properties are in most deprived areas.
Within the floodplain Between 1:1000 and 1:200	Fluvial	594,698	94,241	15.8	Proportionally fewer properties in the Most Deprived Areas than the national average.
	Coastal	720,411	189,932	26.4	Proportionally **a much greater** number of properties in the Most Deprived Areas than the national average.
	Surface water	1,033,303	205,294	19.8	Proportionally **a greater** number of properties in the Most Deprived Areas than the national average.
	All sources	2,282,309	478,309	21.0	Overall, the Most Deprived Areas are **over-represented** at this probability of flooding[2].
Between 1:200 and 1:75	Fluvial	525,745	79,475	15.1	Proportionally fewer properties in the Most Deprived Areas than the national average.
	Coastal	495,545	113,388	22.9	Proportionally **a greater** number of properties in the Most Deprived Areas than the national average.
	SW	544,356	105,136	19.3	Proportionally **a greater** number of properties in the Most Deprived Areas than the national average.
	All sources	1,342,070	281,053	20.9	Overall, the Most Deprived Areas are **over-represented** at this probability of flooding.
1:75 or less (i.e. more frequent)	Fluvial	213,846	28,330	13.2	Proportionally **fewer** properties in the Most Deprived Areas than the national average.
	Coastal	190,009	24,878	13.1	Proportionally **fewer** properties in the Most Deprived Areas than the national average.
	SW	287,926	52,731	18.3	Proportionally **the same** number of properties in the Most Deprived Areas than the national average.
	All sources	350,925	58,443	16.7	Overall, the Most Deprived Areas are slightly **under-represented** at this probability of flooding.

[2] The totals are not simply a summation of the totals of fluvial, coastal and surface water, because some properties are at risk from multiple sources. In deriving the total a single property has only be counted once.

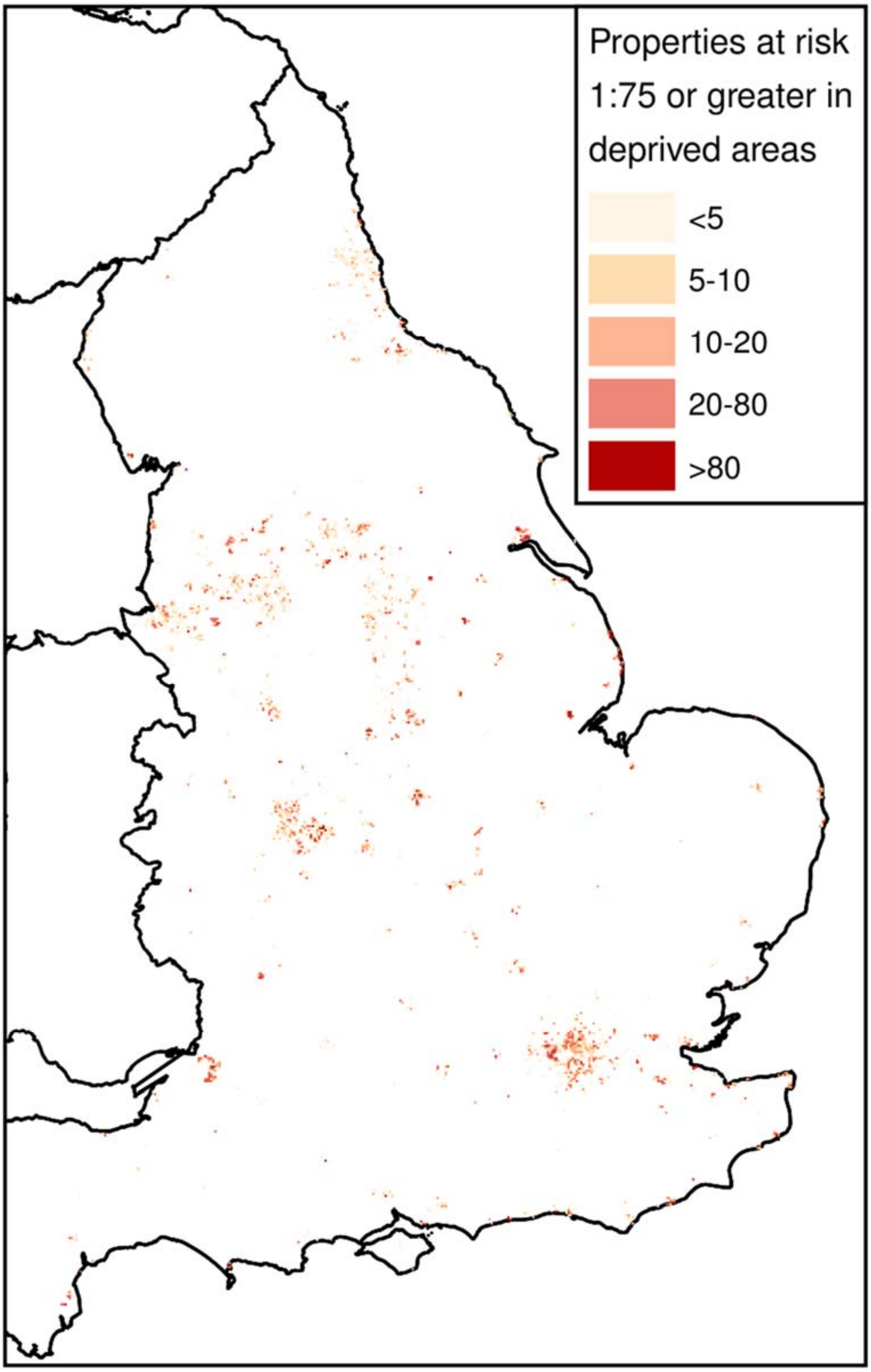

Figure 1 Number of residential properties in the Most Deprived Areas exposed to significant risk (by 1km grid)

Are the most deprived communities likely to become more or less exposed in the future? (see Figures 2 and 3)

- **Climate change scenarios indicate that deprived households will see a disproportionate increase in exposure to more frequent floods**.
- The analysis undertaken suggestions that for the 2°C and 4°C climate change scenarios (assuming low population growth) the most deprived areas disproportionately experience an increase in the probability of flooding. This is most acutely felt in areas that are likely to become exposed to frequent flooding (return period between 1:10-1:30 years) where there is a disproportionate increase in residential properties in the most deprived areas (increasing from 20,000 residential properties today, to 41,000 by the 2050s given a 2^{o}C and assuming a continuation of current levels of adaptation, and 49,000 by 2050s given a 4^{o}C even assuming enhanced whole system adaptation).
- Under the H++ climate scenario this trend is magnified, with the most deprived areas experiencing a disproportionately greater exposure to frequent flooding when compared to non-deprived areas. For example, the number of residential properties exposed to frequent flooding (a return period of between 1:10-1:30 years) increases approximately five-fold in deprived areas (from 20,000 to 106,000 properties), whereas non-deprived areas see a four-fold increase. See Figure 2.
- Under the 2°C and 4°C climate scenarios the number of residential properties in the most deprived areas exposed to frequent flooding (return period between 1:10-1:30 years) is driven by changes in surface water flooding. This is the case regardless of adaptation effort. For example, assuming a 2°C change and a continuation of Current Levels of Adaptation the number of residential properties in the most deprived areas exposed to frequent coastal, fluvial or surface water flooding increases from 20,000 today to 40,000 by the 2050s. See Figure 3.
- Under the H++ climate change scenario, fluvial (river) and surface water flooding make the largest contribution to the increase in the number of residential properties exposed to frequent flooding (return period between 1:10-1:30 years) in the most deprived areas. See Figure 3.

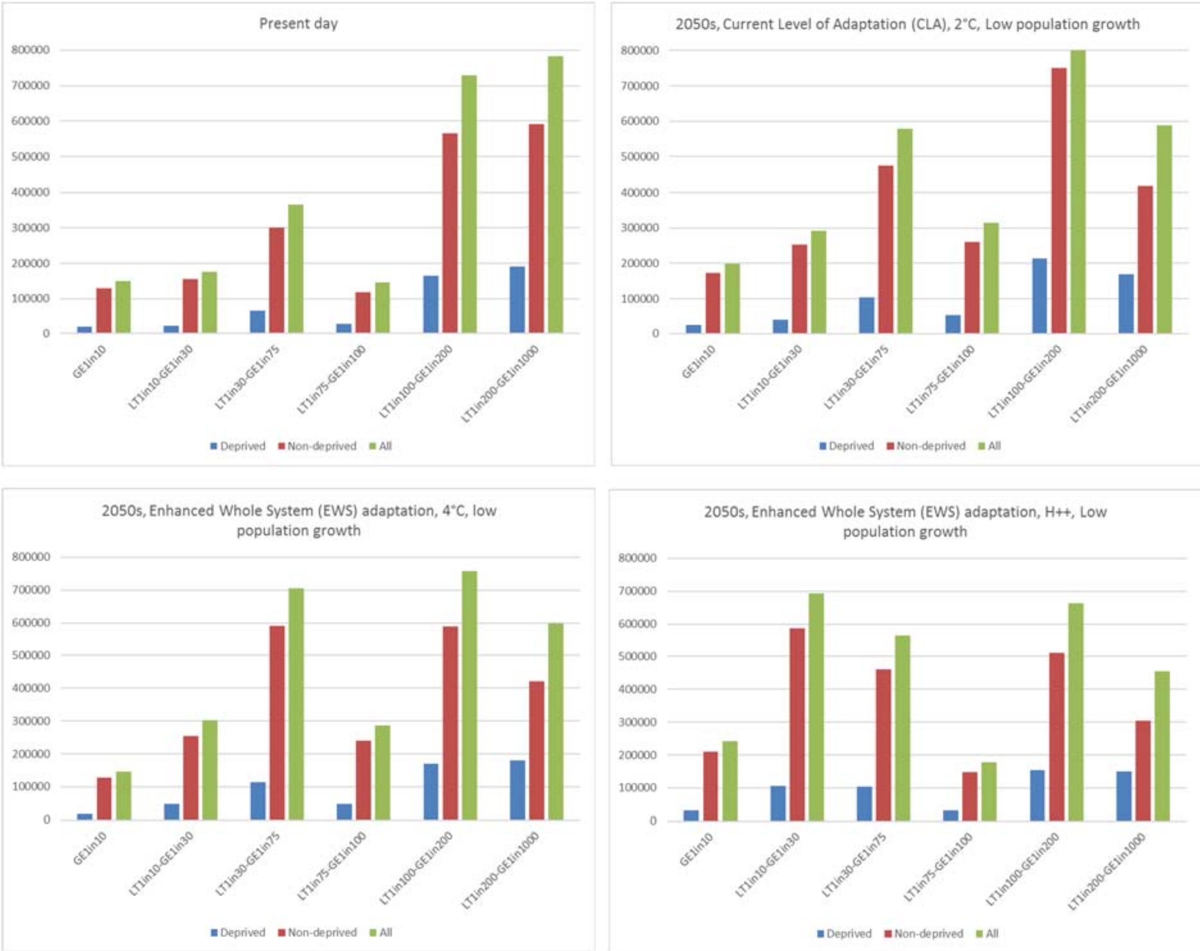

Figure 2 Exposure to flooding by the 2050s under alternative climate change and adaptation scenarios

Note

X axis: Annual probability of flooding

- The 'size' of each probability band in the figures above is not equal. They are used here as they reflect the probability banding used by the Agency.
- 'LT' refers to 'Less than'; GE refers to 'Greater than or equal to'.

Y axis: Number of residential properties

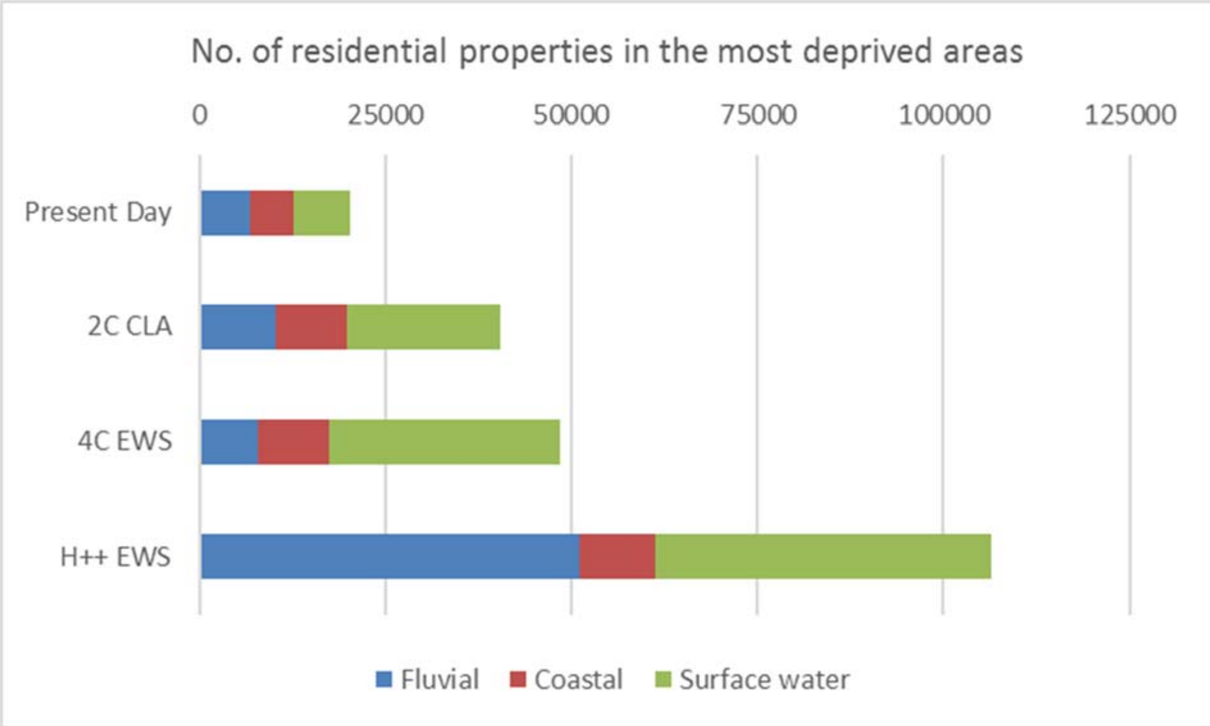

Figure 3 The contribution of different sources of flood (fluvial/coastal/surface water) to very frequent flooding (return period between 1:10 and 1:30) in the most deprived areas

How do the Long Term Investment Scenarios (LTIS) affect risk in the most deprived areas? (see Figure 4)

The Long Term Investment Scenarios (LTIS) published by the Environment Agency (2014[3]) explore how much should be spent to reduce flood risk (in England) based on optimizing the Net Present Value of the alternative investment choices (based on a simplified set of policy options from do nothing to improve – see Table 2) through to 2100. The LTIS does not attempt to set out priority short term investments but sets the long term direction of travel. The investment scenario which maximises the Net Present Value over the 100 year period (R4) is referred to as the optimised investment scenario. This optimised investment scenario is used here to explore the impact on risk in the most deprived areas.

- **The optimised investment scenario within the LTIS (R4) makes the case for significantly improving the protection provided to the most deprived areas.**
- Figure 4 shows the percentage of residential properties exposed to frequent flooding (i.e. a return period of 1:75 years or more frequent) against the selected policy for associated Flood Risk Management System (FRMS). Approximately 24,000 residential properties exposed to frequent flooding (i.e. a return period of 1:75 years or more frequent) in the most deprived areas are assigned an *Improve +* policy option. In this category residential properties in the most deprived areas are more likely to be assigned an *Improve +* policy option and consequently less likely to be assigned a less ambitious policy. This suggests that there is both a need for and a

[3] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/381939/FCRM_Long_term_investment_scenarios.pdf Accessed 03/03/2016

direct economic case for greater investment in these areas. This is however an initial hypothesis and will be explored further in the main study for the JRF.

Table 3 The LTIS policy options are defined as follows (from Long Term Investment Strategy (LTIS) Improvements – Part 1 Technical Documentation. June 2014. Environment Agency)

Policy Option	Change to expenditure	Change to risk
Do Nothing	Passive assets: no expenditure on maintenance or replacement of passive assets Active assets: not included in expenditure	Passive assets degrade and fail over a short period of time. The level of flood risk will increase quickly over time as assets fail. Non-operation of active assets increases risk on the very short term
Maintain crest level	Maintain and replace current assets to their existing crest levels	The level of flood risk will increase over time due to climate change.
Maintain current flood risk	Maintain current assets, replace with larger/longer/more robust structures. Build new assets	The level of flood risk will remain static as the size of defences keeps pace with climate change
Improve	Maintain and replace current assets. Assets to be replaced with larger/longer/more robust structures. Build new assets	The level of flood risk reduces as assets are replaced with ones that offer a better standard of protection
Improve+	Maintain and replace current assets. Assets to be replaced with larger/longer/more robust structures. Build new assets	The level of flood risk reduces as assets are replaced with ones that offer a better standard of protection

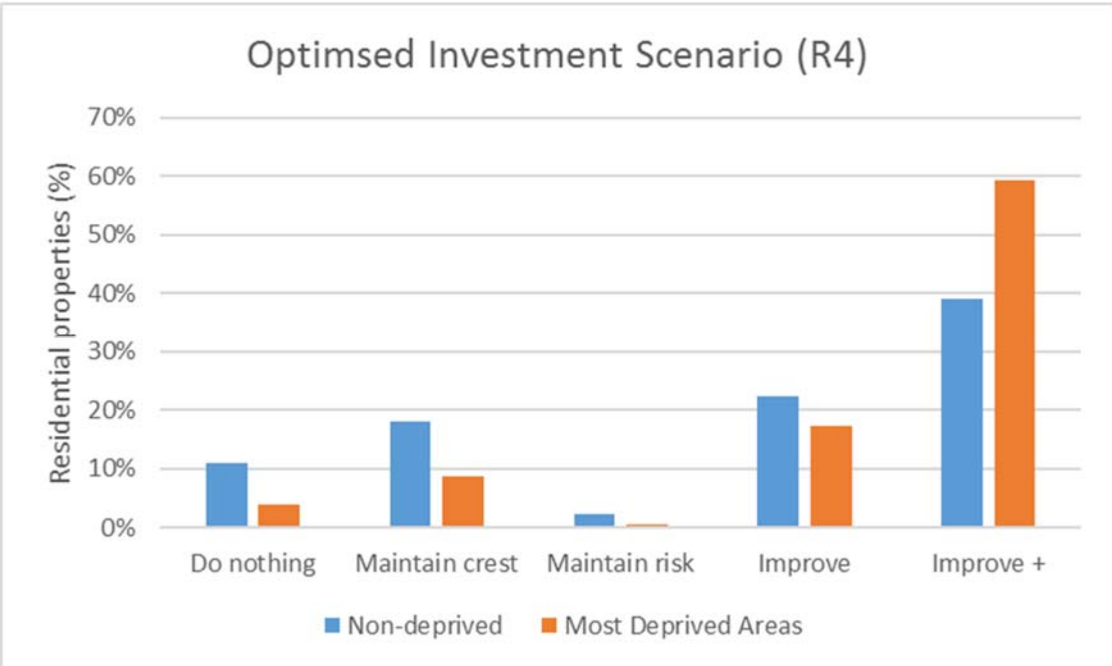

Figure 4 Percentage of residential properties in areas (exposed to frequent flooding) receiving a particular LTIS Policy choice

Links to further information

- The analysis presented here is based on the Index of Multiple Deprivation (IMD) and Environment Agency flood risk data and covers England only. The data sources used for the analysis are those that underlie the CCRA analysis and are set out in Appendix A of the CCRA: Flood Report[4].
- Further detail on the climate change scenarios (the methods and data used) can be found in Appendix C of the CCRA Flood Report[5].
- Further detail on the adaption scenarios used within the CCRA (including the detailed definition of the Current Level of Adaption (CLA) and Enhance Whole System Adaptation (EWS) can be found in Main CCRA Report[6] and Appendix D of that Report[7].

[4] https://documents.theccc.org.uk/wp-content/uploads/2015/10/Appendix-A-Supporting-datsets-Final-06Oct2015.pdf Accessed 02/03/16
[5] https://documents.theccc.org.uk/wp-content/uploads/2015/10/Appendix-C-Climate-change-projections-Final-06Oct2015.pdf Accessed 02/03/2016
[6] https://documents.theccc.org.uk/wp-content/uploads/2015/10/CCRA-Future-Flooding-Main-Report-Final-06Oct2015.pdf.pdf Accessed 02/03/2016
[7] https://documents.theccc.org.uk/wp-content/uploads/2015/10/Appendix-C-Climate-change-projections-Final-06Oct2015.pdf Accessed 02/03/2016