# Flood disadvantage
# Socially vulnerable and ethnic minorities

**Prepared for Flood Re**

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# SUMMARY

This study provides new insights into both geographic flood disadvantage and systemic flood disadvantage today and in the future. The analysis uses the Future Flood Explorer (FFE) and extends current knowledge in two important ways:

(i) Insurance penetration and incomes are disaggregated by ethnicity (enabling the evaluation of flood disadvantage experienced by Black, Asian and Minorities Ethnic (BAME) groups).

(ii) Use of the latest UK Climate Projections 2018 (UKCP18) provide a significant update of the climate driven changes in risk compared to UK09 data used in previous studies for Flood Re (Sayers et al, 2019) and JRF (Sayers et al, 2017).

To understand flood disadvantage, three core metrics are considered: the number of people exposed to frequent flooding (one in 75-year return period or more frequent), the residential expected annual damage (direct contents and structural damage), and the Relative Economic Pain (the uninsured loss as a ratio of income, Sayers et al, 2016).

The analysis highlights three key messages. First, it reinforces and emphasizes the importance of using social vulnerability to inform our understanding of flood risk and in formulating a fair management response. Second, it shows that the most socially vulnerable of all ethnicities experience systemic flood disadvantage (experiencing risk that is greater than the average), with Black Ethnic Groups particularly disadvantaged. Third, it reinforces previous findings that those living in rural towns, smaller urban settlements, and at the coast often experience more frequent flooding than others.

In summary, the findings strengthen the case for the 'levelling up' agenda and the need for joined up development planning that addresses issues of deprivation alongside flood risk as a pre-requisite for resilience.

**Keywords:** flood, risk, climate change, risk assessment, adaptation

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# 1.0 INTRODUCTION

## 1.1 Background

Flood Re Limited's purpose is to promote the availability and affordability of flood insurance for eligible homes, while minimising the costs of doing so, and to manage, over its lifetime, the transition to risk-reflective pricing for household flood insurance. The increased risk of flooding caused by climate change provides a challenge to this transition. To support the development of the Transition Vision, evidence is needed on the impact of climate change on flood risk and specifically the flood risk for the most socially vulnerable and across ethnic groups.

The assessment set out here responds to, and extends, two recent studies that concluded that the most socially vulnerable households experience disproportionally high flood risk today when compared to the UK population as a whole and that in some locations this is exacerbated by climate change. The Climate Change Risk Assessment (CCRA) highlights the higher flood risks for the most socially vulnerable living in some isolated rural communities and smaller urban cities and towns (Sayers et al, 2020). The Joseph Rowntree Foundation (JRF) supported study (Sayers et al, 2017) highlights the difficulties in accessing insurance experienced by low-income households and those living in privately rented or social housing. However, neither of these prior studies consider the issues of ethnicity.

## 1.2 Objective

The objective of this study is to provide insight into the present and future geographic and systemic flood disadvantage. In this context, geographic flood disadvantage relates to the hotspots of socially vulnerable households or ethnic groups exposed to a significant chance of flooding (one in 75-year return period or more frequent). Systemic flood disadvantage is a relative term determined by comparing the risk experienced by the most socially vulnerable or a particular ethnic group with all other groups.

## 1.3 Future scenarios

The assessment considers two different climate scenarios: a 2°C and a 4°C rise in Global Mean Sea Temperature (GMST) by 2100. It is assumed that there is no growth in population and that the current level of adaptation is maintained (as set out in CCRA3, Sayers et al, 2020).

**Box 1 Overview of the Future Flood Explorer**

The Future Flood Explorer (FFE) assesses the impact of climate change, population growth and adaptation strategies on future flood risk. The number of adaptation strategies, population and climate scenarios and sources of risk, mean that traditional modelling approaches are often too computationally intensive to explore all combinations. Instead, the approach used here builds upon lessons from past national scale studies undertaken in the UK and insights from international studies to allow an evaluation of the effects of climate and population change and adaptation strategies using the UK FFE. The UK FFE provides an emulation of the UK flood risk system that embeds nationally recognized source, pathway and receptor data from across the UK to construct a fit-for-purpose (and validate) emulation of the present-day flood risk system and to explore the future change in flood risk.

The FFE is a flood model developed by Sayers and Partners. The FFE aims to understand how climate and socioeconomic changes effect flood risk and how adaptation measures can offset these changes. It was used as part of the 2017 Climate Change Risk Assessment for the Committee on Climate Change (CCC, 2016), the assessment of flood disadvantage and in support of the National Infrastructure Assessment 2018 (Sayers et al 2018), as well as for academic research. The most recent version underpins the UK Climate Change Risk Assessment 2022 and uses the latest UKCP18 outputs as well as updated flood defence datasets. The FFE uses a combination of publicly accessible data (such as national flood maps published by UK governments) and licensed data to develop an efficient representation of the UK flood system, its response to climate change and investment in defences and other flood management measures (including property-level measures). The FFE can be used to provide individual and combined estimates of change in risk from coastal, fluvial and surface water floods to residential assets in UK. Its overall approach was scrutinised as part of the UK Climate Change Risk Assessment (both as part of 2nd and 3rd CCRA) and subsequent national studies and shown to provide credible and useful insights (Sayers, et al 2017).

*Supporting references*

Committee on Climate Change, *UK Climate Change Risk Assessment 2017, Synthesis report: priorities for the next five years* (2016).

P. Sayers, R. Brisley, S. Wingfield, S. Warren, P. Mattingley, P. Robinson, P. Horritt, & R. Lamb, A National Analytics Toolset to Support an Exploration of Alternative Investments in the Flood Risk Management Infrastructure, A Report for the National Infrastructure Commission. (2018).

P. Sayers, E. Penning-Rowsell, & M. Horritt, Flood vulnerability, risk, and social disadvantage: current and future patterns in the UK. *Regional Environmental Change*, 18 (2017) 339–352. https://doi.org/http://dx.doi.org/10.1007/s10113-017-1252-z

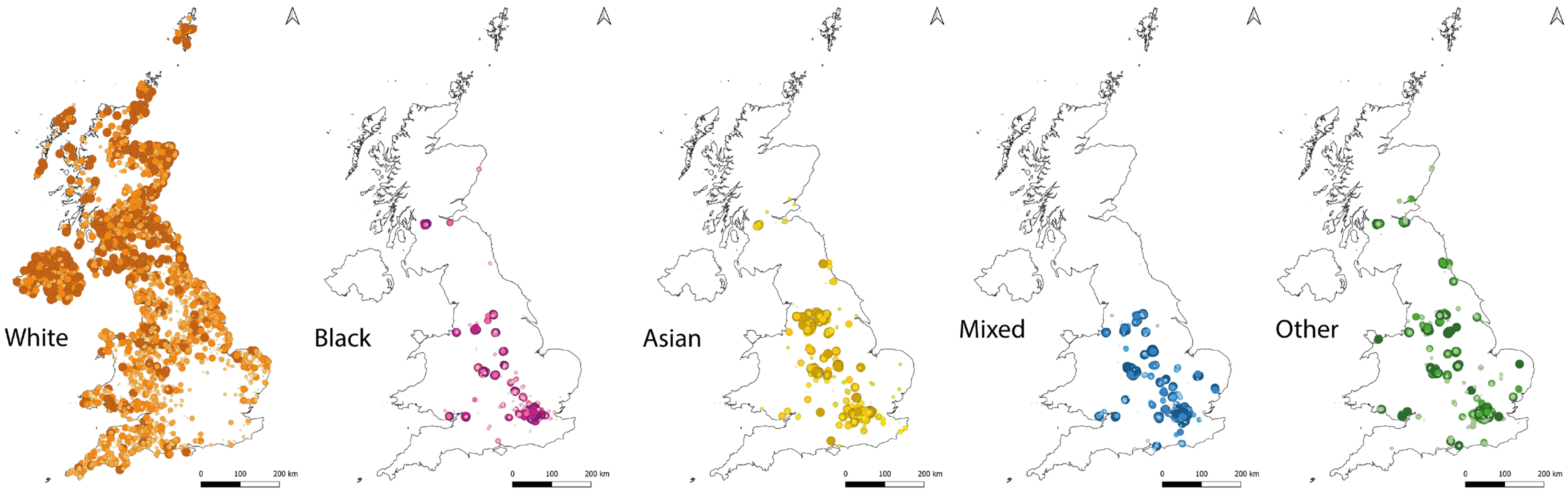
## 2.0 GEOGRAPHY OF ETHNICITY

The Census 2011 groups ethnicity into five primary ethnic groups: White, Black, Asian, Mixed and Other ethnic Minorities (Table 3). These common primary groups are used here, although it is noted that the secondary classification varies by country. The spatial distribution of ethnicity is illustrated in Figure 1. This data is carried forward into the analysis presented later in this note.

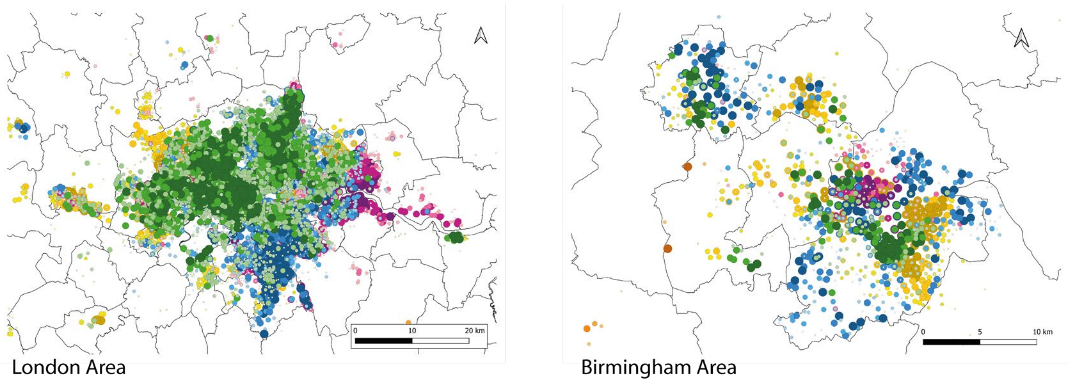
**Table 1 Census classification of ethnicity**

| Primary Groups | Secondary Groups | England & Wales | Scotland | Northern Ireland |
|---|---|---|---|---|
| *White* | White | [green] | | [green] |
| | English/Welsh/Scottish/Northern Irish/British | [green] | | |
| | White Scottish | | [green] | |
| | Other White British | | [green] | |
| | Irish | [green] | [green] | |
| | White Polish | | [green] | |
| | Gypsy or Irish Traveller | [green] | [green] | [green] |
| | Other White | [green] | [green] | |
| *Black/African/Caribbean/Black British* | Black/African/Caribbean/Black British | [green] | [green] | |
| | African | [green] | [green] | [green] |
| | Other African | | [green] | |
| | Caribbean | [green] | [green] | [green] |
| | Other Black Caribbean | | [green] | |
| | Other Black | [green] | [green] | [green] |
| *Asian/British Asian* | Asian/British Asian | [green] | | |
| | Indian | [green] | [green] | [green] |
| | Pakistani | [green] | [green] | [green] |
| | Bangladeshi | [green] | [green] | [green] |
| | Chinese | [green] | [green] | [green] |
| | Other Asian | [green] | [green] | [green] |
| *Mixed/Multiple Ethnic Groups* | Mixed or Multiple Ethnic Group | [green] | [green] | [green] |
| | White and Black Caribbean | [green] | | |
| | White and Black African | [green] | | |
| | White and Asian | [green] | | |
| | Other Mixed | [green] | | |
| *Other Ethnic Minorities* | Arab | [green] | [green] | |
| | Other | [green] | [green] | [green] |

*Green indicates the secondary groups used to classify the primary groups by each country -  England and Wales, Scotland, and Northern Ireland*
*Note: England and Wales use same system. Lower Super Output Areas, England and Wales, Data Zones, Scotland and Super Output Areas in Northern Ireland*




***UK Distribution***



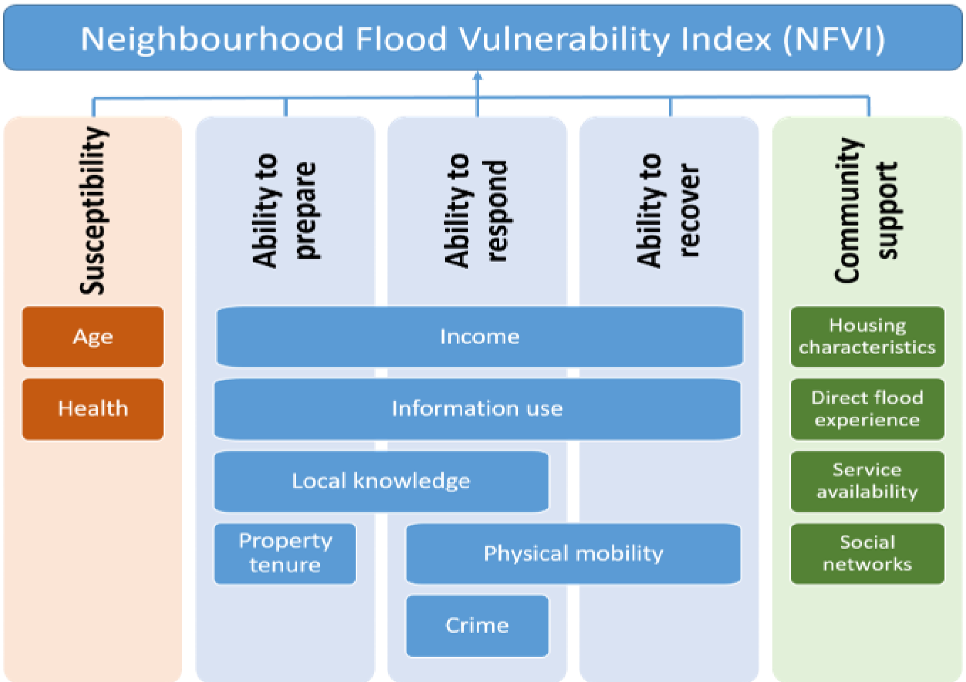

***Example city distributions***

*Note: The 10% of neighbourhoods with the greatest number of people from a given ethnic group*

**Figure 1 Spatial distribution of ethnicity**

## 3.0 SOCIAL VULNERABILITY

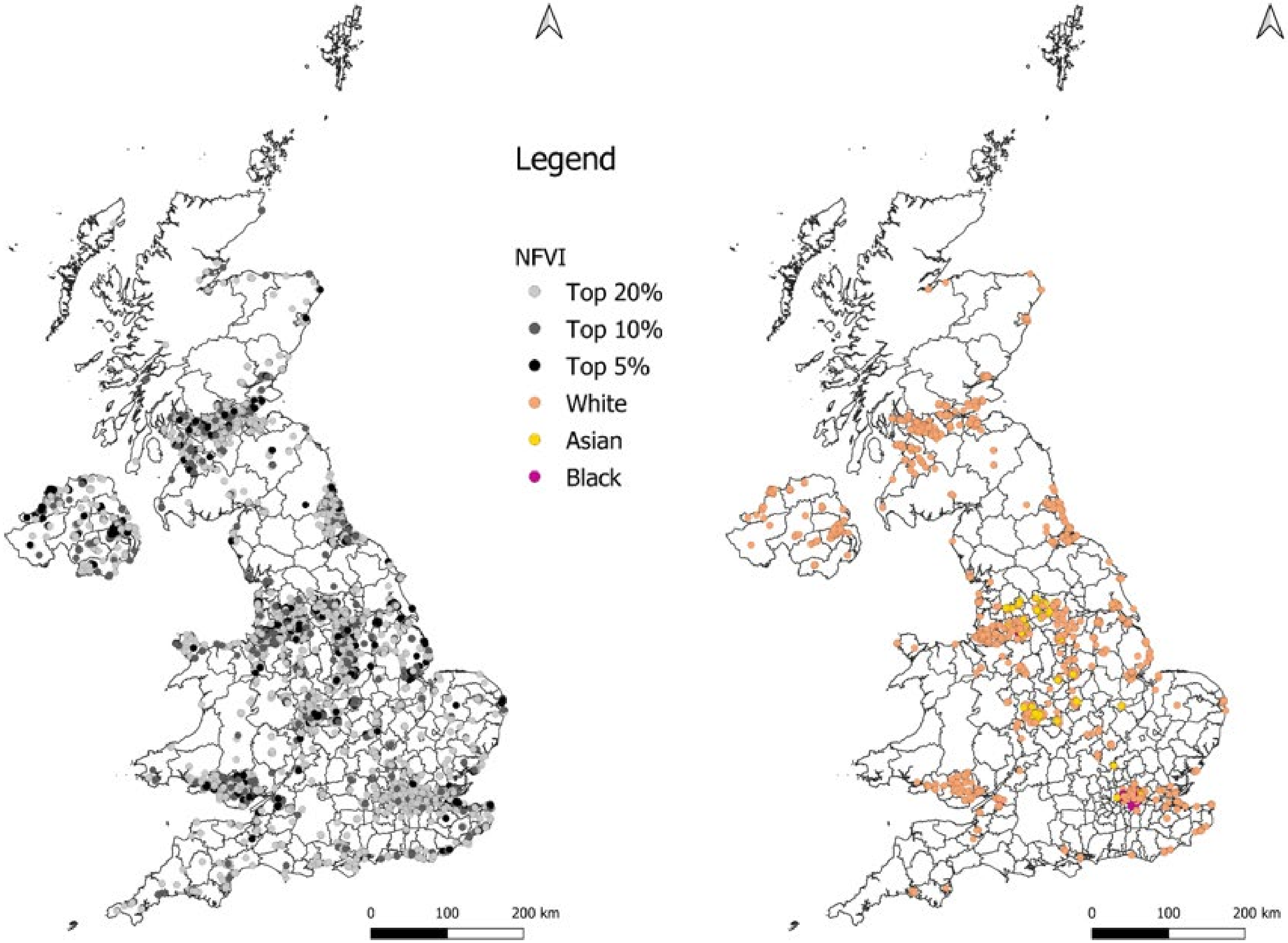
Social vulnerability is used here to describe the relationship between the flood hazard and the impact on the wellbeing of those exposed to the flood. Understanding this relationship underpins a socially just (*i.e.,* fair) approach to flood risk management by helping to ensure the needs of the most socially vulnerable groups are appropriately considered. Within the FFE, social vulnerability is represented by the Neighbourhood Flood Vulnerability Index (NFVI, Sayers et al, 2016 - Figure 2).




*Source: Sayers et al, 2016*

**Figure 2 Indicators of social flood vulnerability**

The NFVI includes multiple indicators of social vulnerability and is used in the Climate Change Risk Assessment (Sayers et al, 2020) to explore the flood risk for more and less socially vulnerable communities. For example, Figure 3 shows the distribution of the 20% most vulnerable neighbourhoods and highlights the significant number of socially vulnerable communities in post-industrial northern cities, at the coast and along estuaries. This evidence is reused and built upon here.




*Left: The 5%, 10% and 20% most socially vulnerable neighborhoods (based on the NFVI)*
*Right: The 20% most socially vulnerable neighborhoods coloured by the majority ethnicity within each neighbourhood*

**Figure 3 Spatial distribution of the most socially vulnerable neighbourhoods**

## 4.0 INSURANCE PENETRATION

The impact of flooding on social well-being is fundamentally influenced by access to insurance. In turn, insurance penetration is known to vary by:

- **Income** (those on lower incomes are much less likely to have insurance)
- **Tenure** (those living in rented accommodation – particularly social housing – are much less likely to have insurance)
- **Experience of flooding** (there is some limited evidence that direct experience of a flood increases the take-up of insurance)

The evidence for each, disaggregated by ethnicity where possible, is introduced below. The spatial understanding of income, tenure and ethnicity developed using this evidence is taken forward in the analysis set out in the following chapters.

### 4.1 Income and ethnicity

Household income (after housing costs) is known to be an important driver of access to flood insurance (Table 1). Income is also a central consideration in social vulnerability and known to vary by ethnicity with, on average, household incomes for Black, Mixed and Other ethnic minorities significantly lower than either White or Asian households (Figure 4).

**Table 2 Insurance by income (decile) in the UK (ABI, 2018)**

| | Structure | | Contents | | Structure & Contents | |
|---|---|---|---|---|---|---|
| | £ | % | £ | % | £ | % |
| Lowest 10% | 152 | 29 | 125 | 43 | 266 | 26 |
| Second Decile | 163 | 42 | 129 | 62 | 278 | 39 |
| Third Decile | 178 | 53 | 146 | 70 | 309 | 48 |
| Fourth Decile | 171 | 57 | 147 | 75 | 305 | 55 |
| Fifth Decile | 197 | 63 | 155 | 77 | 332 | 57 |
| Sixth Decile | 206 | 71 | 172 | 83 | 368 | 64 |
| Seventh Decile | 200 | 75 | 163 | 86 | 352 | 69 |
| Eighth Decile | 214 | 77 | 175 | 87 | 372 | 69 |
| Ninth Decile | 222 | 82 | 186 | 90 | 393 | 76 |
| Highest 10% | 300 | 85 | 248 | 92 | 526 | 79 |

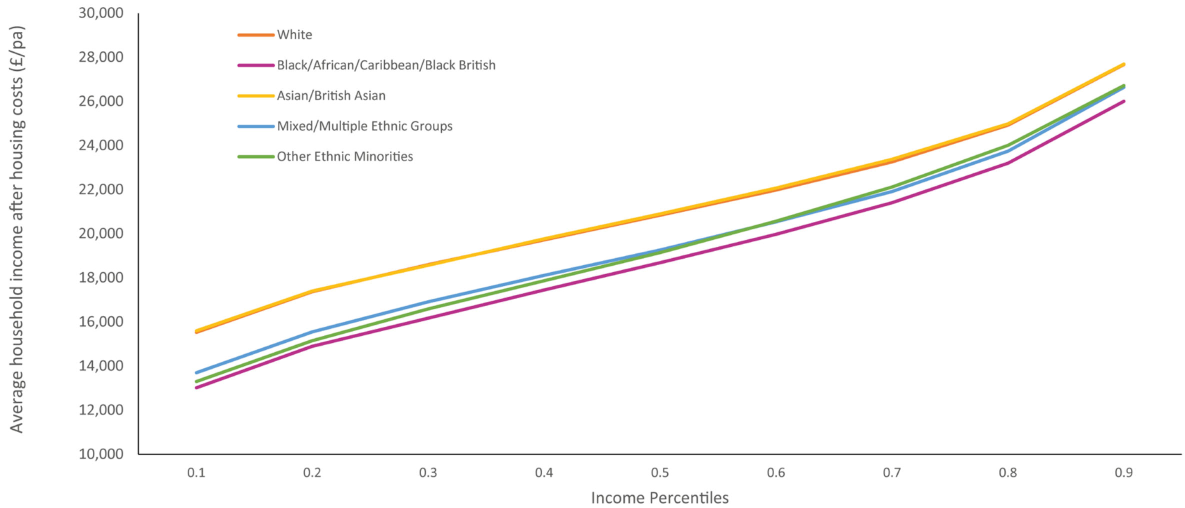



**Figure 4 Net household income by ethnicity**

## 4.2 Tenure and ethnicity

Tenure significantly influences insurance take up, and those in private or social rented accommodation are much less likely than homeowners to have flood insurance (as reported in Sayers et al., 2016 and evidence in data published by the ABI, Table 2). Direct primary data, however, remains limited. Evidence from Census data (2011) and national statistics suggests tenure exhibits a strong differential by ethnicity; with Black, Mixed and Other minorities much more likely to live in rented accommodation. Most noticeably Black households are significantly over-represented in social housing (Figure 5).

**Table 3 Insurance penetration by tenure in the UK**

| | | Structure | | Contents | | Structure & | |
|---|---|---|---|---|---|---|---|
| | | £ | % | £ | % | £ | % |
| Rented Unfurnished | | | | | | | |
| | Local Authority | * | * | 142 | 40.6 | * | * |
| | Housing Association | * | * | 135 | 41.1 | * | * |
| | Other | * | * | 191 | 47.1 | 1 | 286.1 |
| Rented Furnished | | * | * | 177 | 24.0 | 1 | 590.1 |
| Owner Occupied | | | | | | | |
| | Being Purchased | 219 | 93.5 | 178 | 93.5 | * | * |
| | Owned Outright | 202 | 93.5 | 164 | 94.7 | * | * |
| Rent Free | | * | * | 162 | 66.0 | * | * |

*Source: ABI, 2018, Table 11*

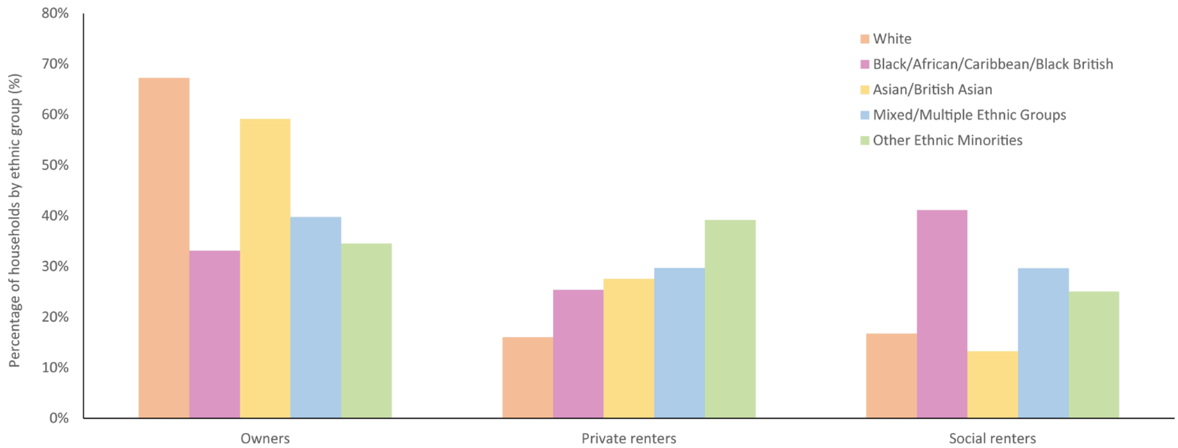



**Figure 5 Property tenure by ethnicity**

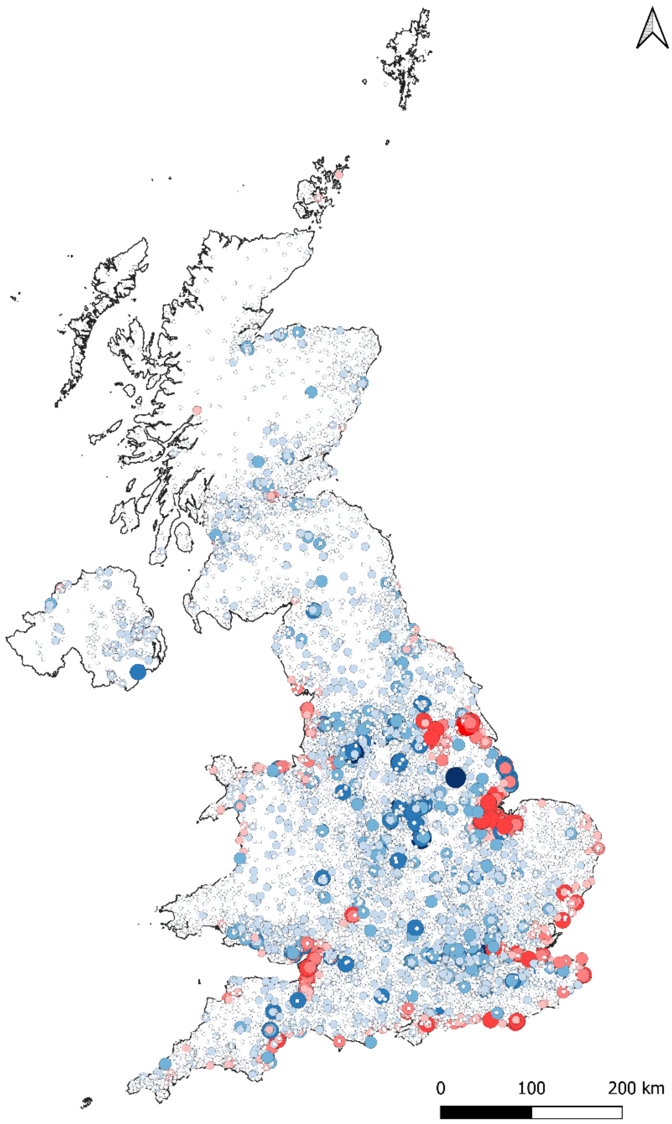
## 4.3 Direct flood experience

Evidence from the summer 2007 floods in England suggests that 76% of household losses (building and contents) were covered by insurance (Chatterton et al, 2010). This is higher than would be expected based on the median value of 57% (Table 1) suggesting that those living in flood prone areas may have a higher than average take up[1].

[1] Although widely considered to be important, and suggested by the findings of Chatterton, little primary research has been carried out on the influence of exposure to previous flooding has on insurance take up. Kates (1962) shows that direct experience triggers response, but that is not quite as direct as to say it triggers insurance.

### 4.4 Spatial distribution of households without insurance

An estimate of those households living in the fluvial and coastal floodplain that may not have insurance (structure and contents) is presented in Figure 6. This analysis, based on the assumptions set out in the previous sections, suggests that of the 1.4 million households exposed to significant flooding (today) on the fluvial and coastal floodplain, 0.45 million may be without insurance (*i.e.* 32% of all households). Those Local Authorities where the largest number of uninsured households have been estimated for each source of flooding surface water, fluvial and coastal flooding are illustrated in Figure 7. The modelled estimate is broadly consistent with EA surveys post-event (such as Chatterton et al., 2010), take-up rates published by the ABI (2018) and the findings of the Blanc Review (Blanc, 2020); although no publication provides an equivalent analysis.




*Note:*
*Fluvial floodplains (blue) and on coastal flood plains (red) scaled by the number of properties without insurance*
*Surface water flooding is excluded given the widespread nature of surface water hazards would mask the patterns within the map.*

**Figure 6 Households without insurance**


*Note:*
*Left: Surface water; Middle: Fluvial; Right: Coastal flood sources. The maps above are based on a model estimate – not primary survey results.*

**Figure 7 Local Authorities with the greatest number of uninsured households (estimated)**

## 5.0 PRESENT AND FUTURE FLOOD DISADVANTAGE

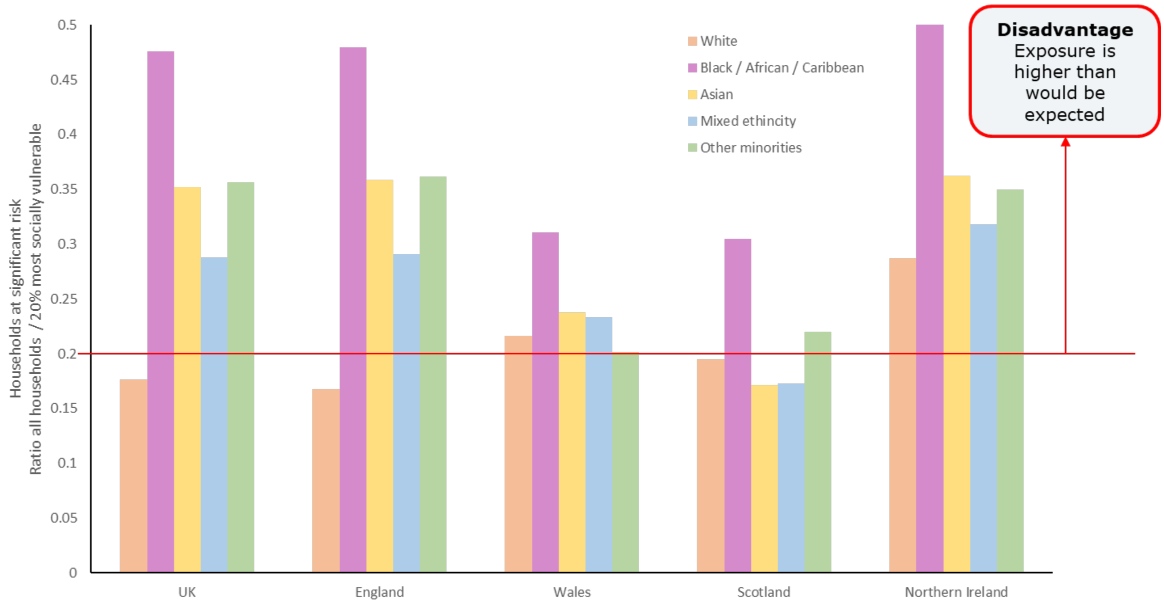
Three risk metrics are used here to provide a perspective on flood disadvantage:

- Number of people exposed to frequent flooding (one in 75-year return period or more frequent)
- Expected Annual Damage (direct contents and structural damage of residential homes, EADr)
- Relative Economic Pain (REP, Sayers et al, 2017).

The insights provided by each metric are discussed below.

### 5.1 Households exposed to frequent flooding

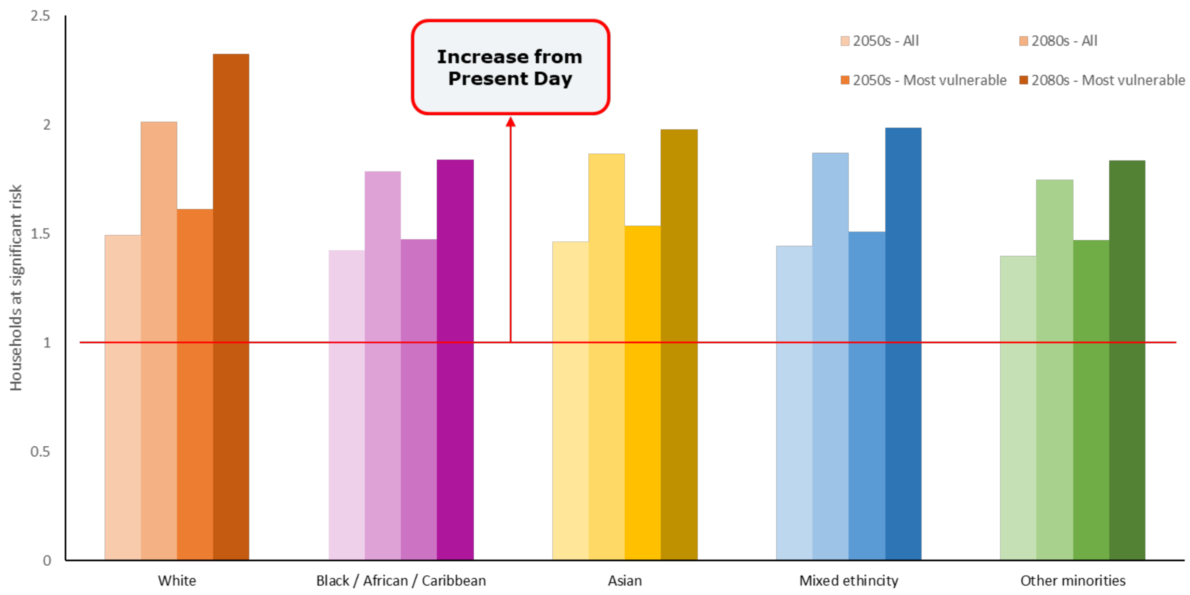
This metric focuses on the number of households exposed to flooding one in 75-year return period or more frequent (on average). A comparison of the present-day number of households exposed to frequent flooding in all neighbourhoods and those in the 20% most socially vulnerable neighbourhoods shows significant disadvantage for many BAME groups across at the UK (Figure 8). The disadvantage is most stark amongst the Black, African and Caribbean groups; with near to 50% of all households exposed to frequent flooding found within the 20% most socially vulnerable neighbourhoods.




*The y-axis shows the ratio between all households and those in 20% most socially vulnerable neighbourhoods. In the absence of bias, 20% of the households would be expected to be in 20% of the neighbourhoods (when aggregated at large scales as here). Frequent flooding refers to one in 75-year return period or more frequent.*

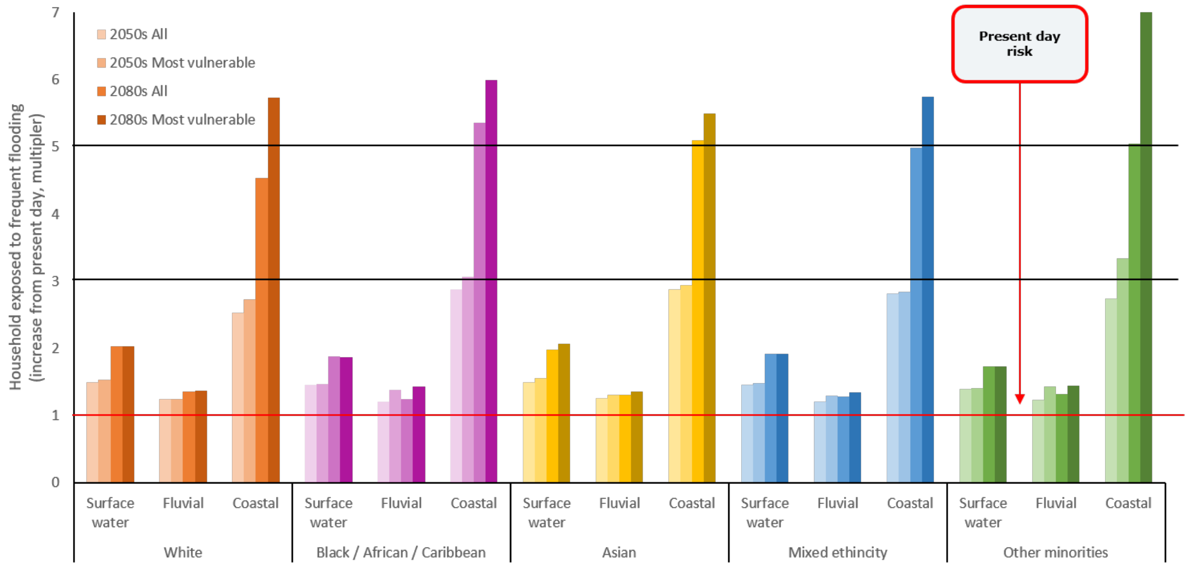
**Figure 8 Present Day - No. of households exposed to frequent flooding**

Assuming a continuation of current levels of adaptation, climate change increases the exposure for all groups (Figure 9). This is particularly the case at the coast and in areas prone to surface water flooding (Figure 10).




*The y-axis shows the ratio between present day and future exposure (in the 2050s and 2080s); with the lighter shading the change in exposure in all neighbourhoods and the darker shading for the 20% most socially vulnerable.*

**Figure 9 Proportional future increase in the number of households exposed to frequent flooding compared to present day**




*Note: Future risk in the 2050s (2°C) and 2080s (4°C) assuming a continuation of current levels of adaptation are presented relative to present day risk.*

**Figure 10 Proportional future increase in the number of households exposed to frequent flooding compared to present day: By flood source and ethnicity.**

## 5.2 Expected Annual Damage: Residential

This metric provides the conventional view of risk in direct (national) economic terms. The assessment of Expected Annual Damage (EAD) used here combines the annual probability of a property (residential) being flooded and the associated direct economic damages (using the same method as CCRA3, Sayers *et al.,* 2020). When disaggregated by ethnicity White ethnic groups dominate the national aggregations of risk (Figure 11). This is as expected given the much larger number of White households across the UK. When a social vulnerability perspective is introduced however ethnic minorities (particularly Black ethnic groups) experience disproportionally larger risk than would be expected in the absence of bias (Figure 12).

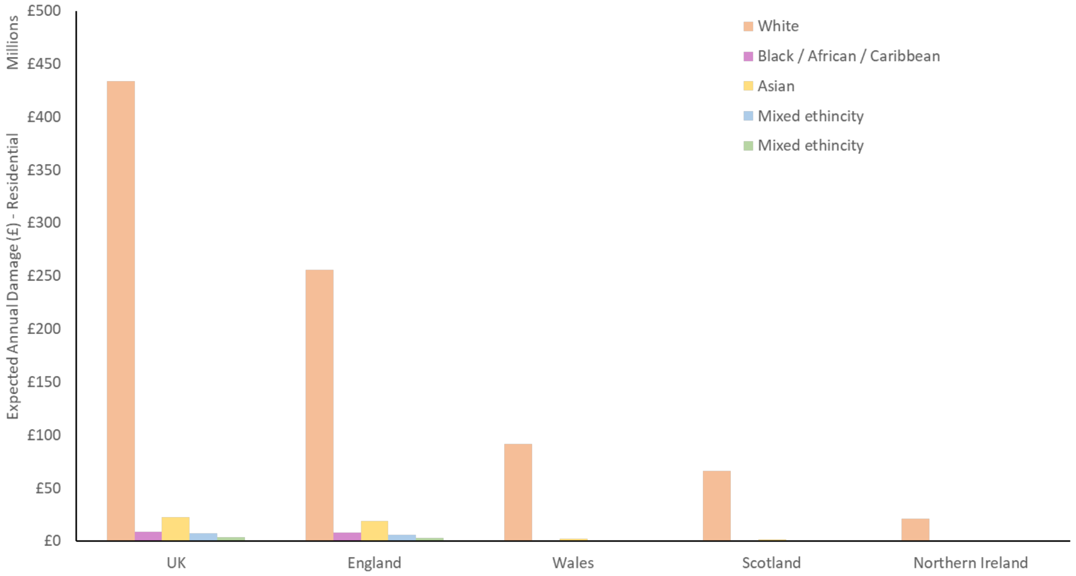
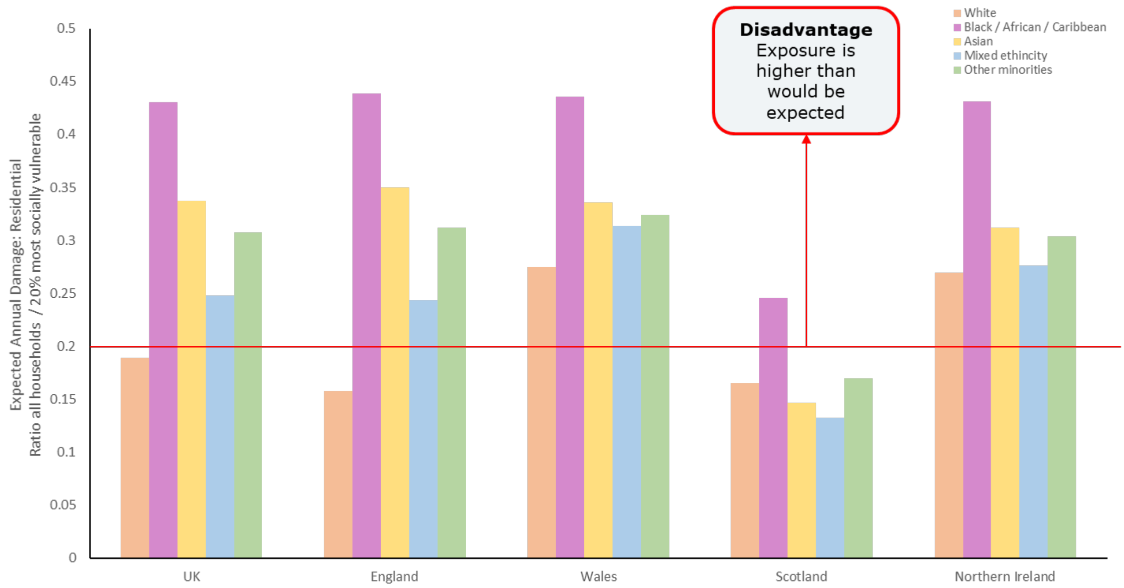



**Figure 11 Present Day - Expected Annual Damage (Residential) - By ethnicity**

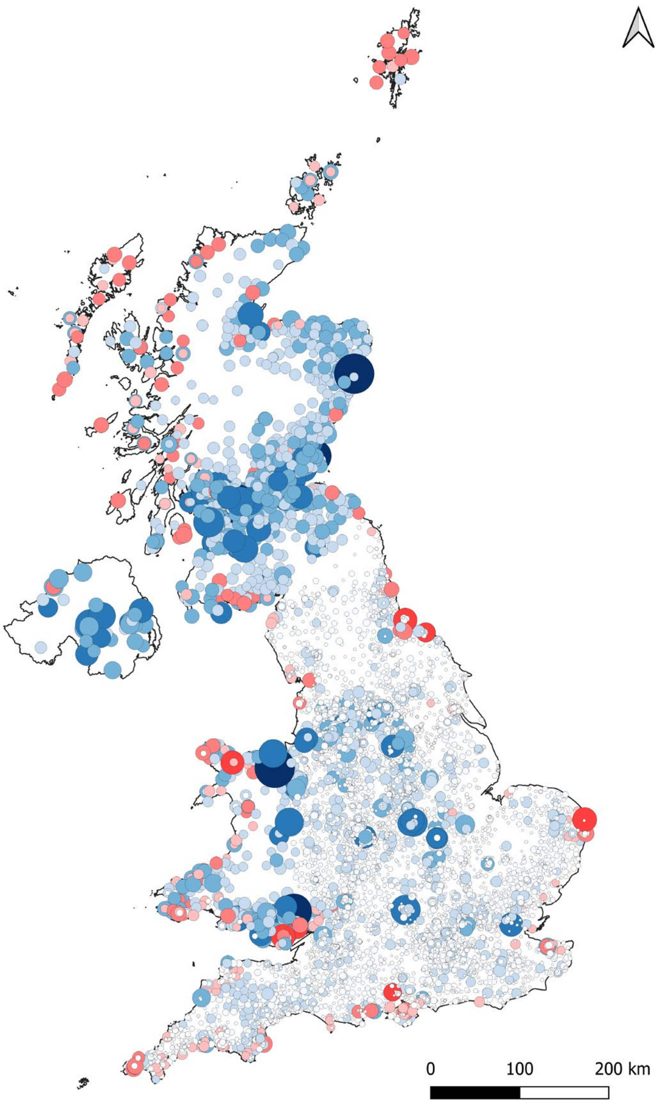



*The y-axis shows the ratio between all households and those in 20% most socially vulnerable neighbourhoods. In the absence of bias, 20% of the households would be expected to be in 20% of the neighbourhoods (when aggregated at large scales as here).*

**Figure 12 Present Day - Expected Annual Damage (Residential) - By social vulnerability and ethnicity**

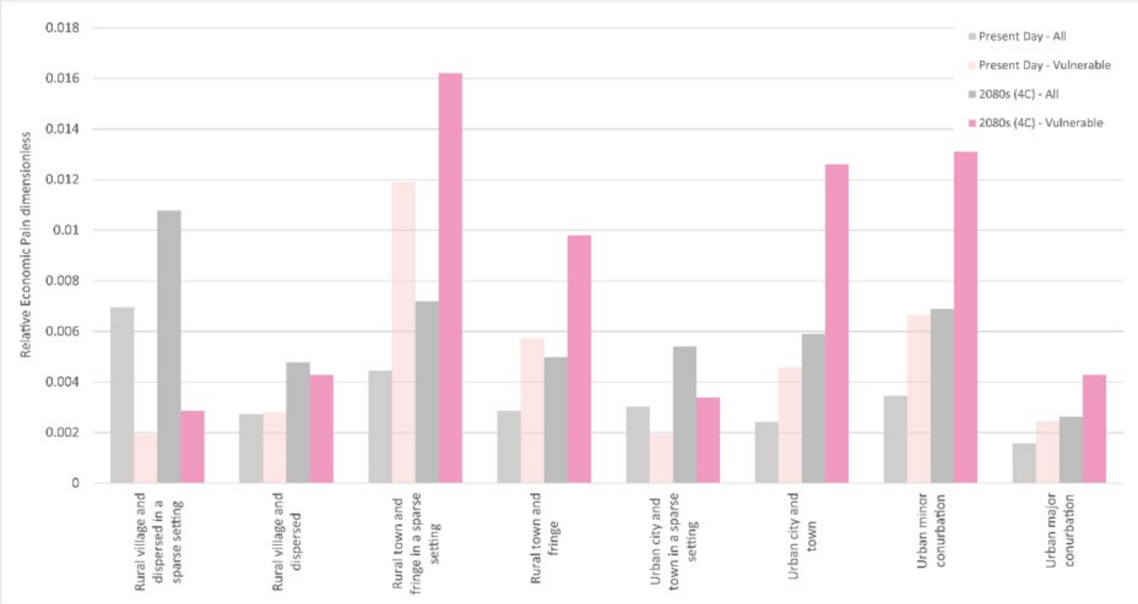
## 5.3 Relative Economic Pain

Relative Economic Pain, the REP, is defined as the ratio of uninsured loss to income. The REP varies across the UK (Figure 13) and provides insight into the significance of flooding for different households and is a central perspective to explore flood disadvantage. When considered through the lens of Relative Economic Pain the differential between the risk faced by the more and less socially vulnerable is stark (Figure 14). The REP metric also highlights how systemic disadvantage is exacerbated by climate change (Figure 15). On average, the disadvantage is significantly greater in Wales, Scotland, and Northern Ireland than in England, although all countries have disadvantaged communities. These findings reinforce previous findings (Sayers et al, 2016, 2020) that also highlight the disadvantage experienced by many coastal and estuary communities as well as many isolated rural towns and smaller urban towns and conurbations. These earlier studies also highlight the post-industrial northern cities (cities in decline) to be some of the most flood disadvantaged communities (a lens not reconsidered here).



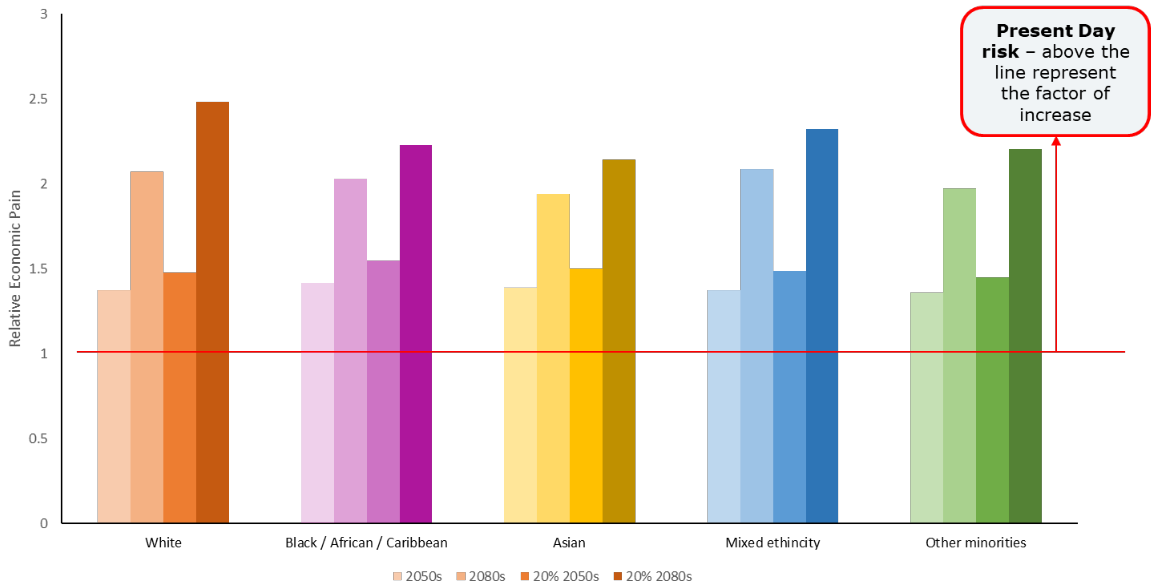

*Those neighborhoods experiencing the highest Relative Economic Pain. Red – coastal floodplains; Blue – fluvial flooding. Given the widespread nature of the surface water flooding, surface water is excluded here.*

**Figure 13 Present day - Relative Economic Pain**




*From the Climate Change Risk Assessment, Sayers et al,2020*

**Figure 14 Present and Future - Relative Economic Pain - By settlement type and social vulnerability**




*Note: Future risk in the 2050s (2°C) and 2080s (4°C) assuming a continuation of current levels of adaptation are presented relative to present day risk.*

**Figure 15 Future – Relative Economic Pain: By flood source and ethnicity**

# 6.0 CONCLUSIONS AND RECOMMENDATIONS

## 6.1 Conclusions

This analysis shows that:

- The most socially vulnerable are disadvantaged by present day flooding and in some settings the disadvantage increases with climate change.
- Those living in social rented accommodation are more likely to be on lower incomes and are less likely to have flood insurance. This combination increases the 'Relative Economic Pain' experienced when flooded.
- Flood disadvantage exists across all sources to some extent but is most acute at the coast.
- Flood disadvantage exists across all ethnicities, but Black and Other Minority Ethnic Groups are more likely to have lower income and more likely to be in rented accommodation, these two factors lead to significantly lower levels of flood insurance and higher levels of disadvantage.
- Those living in rural towns and smaller urban settlements often experience more frequent flooding. The geographic disadvantage is exacerbated by lower levels of income and hence higher levels of Relative Economic Pain.

## 6.2 Recommendations

### Policy

This study highlights the need to address flood disadvantage amongst the most socially vulnerable and ethnic minorities more directly within flood risk management decision making, including public investments, grant processes and insurance. In response, a central recommendation is to review the approach to deprivation weighting given the current appraisal process to better address the differential impacts experienced by the most socially vulnerable and many ethnic minority groups.

Analysis for the JRF in 2017 suggested that a lack of capacity within the most socially vulnerable communities restricts access to investment and may act as a brake on reducing flood risk and redevelopment. The 'levelling up agenda' and regional development pathways both offer opportunities to stimulate local incomes and reduce flood disadvantage.

The JRF Report also highlighted systemic barriers to the access of post flood-event grants, including the need for associated 'top-up funding' and difficulties in mobilizing landlords to act. The process of grant and community support needed to 'build back better' after a flood should be reviewed in this context. This includes the approach to Property Flood Resilience, and the policy mechanisms needed to ensure it takes account of, and targets, the most socially vulnerable and recognizes the challenges faced by most disadvantaged ethnicities.

The issues highlighted in this report present a challenge for Flood Re to work with Government and others to ensure that the most socially vulnerable households are able to access cover in the long term as Flood Re transitions to market reflective pricing.

### Analysis

To improve the analysis presented here a better understanding on insurance take-up is needed. Gaining an understanding on whether cultural barriers and other soft barriers to insurance take-up exist across different ethnicities will also be important.

## 7.0 REFERENCES

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