

Community Flood Vulnerability and Disadvantage in Kent and Medway



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Executive Summary

Flooding has been identified as potentially having a high impact on Kent communities. Kent and Medway are some of the most at-risk local authorities in the UK in respect of surface water flooding, as well as low-lying coastal areas at risk of fluvial & coastal flooding. Nationally, two of Kent's districts are in the top 10 most flood vulnerable districts in the country.

Kent and Medway also have some of the highest areas for social deprivation, often located in urban town centres and low-lying coastal areas. These areas are at particular risk of flooding from rivers, the coasts and surface water. City and town centres, such as Folkestone, Canterbury and Ashford, are particularly at risk as many were historically built along rivers and water courses. These places now have significant amounts of impermeable hard surfaces which restrict natural infiltration of water and river flows. Flood risk is compounded in areas where the populations are more vulnerable, due to drivers such as age, disability, lower income, or unemployment.

Climate change is expected to have both positive and negative impacts on Kent and will result in changes to the environment. Hotter, drier summers and warmer, wetter winters may increase the potential for large scale flooding. Climate change has been shown to have the greatest impact on socially vulnerable communities, and these communities are often located in or near areas of high flood risk.

This report is the findings of an analysis from the Climate Just resource to identify and assess the areas of Kent and Medway that are most likely to experience increased social disadvantage as a result flooding now and in the future. This assessment found flood disadvantage and vulnerability in Kent and Medway is lower than that of the UK. However, while the overall flood vulnerability across Kent and Medway is average Kent has some of the areas at highest disadvantage from and vulnerability to flooding in the UK, focused in 4 districts: Swale, Folkestone and Hythe, Medway and Thanet. In addition, 10 priority communities, that are in the highest categories of disadvantage and are most vulnerable to both fluvial & coastal and surface water flooding, were analysed in depth to identify the key drivers of vulnerability in each.

Further work should look to identify and use more local data, available from key Health and Social care services, to supplement that available through Climate Just. This will enable increased accuracy of results and enable conclusions to be drawn with more certainty that has been possible through this work. Examples of the type of data that could be included to improve accuracy of results are: frailty index, blue badge holders, fuel poverty data, and additional deprivation measures.

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1. Introduction

Kent County Council (KCC) is the largest local authority in England covering an area of 3,500km², with a population of 1.5 million. Together with its partners, Kent County Council has produced the Kent Environment Strategy: A strategy for environment, health and economy (KES) which aims to strengthen cross-sector partnership working on environmental, health and economic agendas. It identifies high level, evidence-based priorities and focusses on the activities that would most benefit from partnership working (KCC, 2016). The Council and its Partners have also developed the Kent and Medway Growth and Infrastructure Framework (GIF) 2018 which provides a strategic framework and evidence base for identifying and prioritising future investment across a range of infrastructure up to 2031 and visions to 2050 (KCC, 2018).

Integrated into both the KES and the GIF is the acknowledgement that our climate is changing. There is increasing evidence that there will be significant implications at global, regional and local levels for socio-economic and natural systems, as well as for the health and wellbeing of populations. The Intergovernmental Panel on Climate Change (IPCC) 5th Assessment Report, published in 2014 represents the most up to date and comprehensive evaluation of scientific, technical, social and economic information concerning climate change, its potential effects and options for adaptation and mitigation. Key findings in the 2014 report include: increasing greenhouse gas emissions over the 20th century will result in some degree of change to global, regional and local climate and weather systems that, without adequate adaptation, will have both negative and positive impacts on Kent's environment, economy, and communities (IPCC, 2014).

The UK Climate Change Risk Assessment (CCRA), which, under the Climate Change Act of 2008. Must be compiled every five years by the Committee on Climate Change, sets out the risks and opportunities arising for the UK from climate change. According to the most recent CCRA, published in 2017, climate change will have a significant impact on the UK's environment, communities and economy. It identified the following 5 top risks and 1 research priority that require more action now and into the future (CCC, 2017):

- Risks of **flooding and coastal change** to communities, businesses and infrastructure.
- Risks to health, wellbeing and productivity from **high temperatures**.
- Risk of **shortages in the public water supply**, and for agriculture, energy generation and industry, with impacts on freshwater ecology.
- Risks to **natural capital** including terrestrial, coastal, marine and freshwater ecosystems, soils and biodiversity.
- Risks to domestic and international **food production and trade**.
- **Research priority**: New and emerging pests and diseases, and invasive non-native species, affecting people, plants and animals.

The Kent Resilience Forum (KRF), set up under the Civil Contingencies Act 2004 and comprised of over 100 category 1 and 2 emergency responders, including the military and voluntary groups, has also identified climate change as a risk to Kent and Medway. The primary aim of the KRF is to work to improve the resilience of Kent and Medway to emergencies identified in the Community Risk Register such as severe weather, flooding, disease outbreaks and pollution incidents. The KRF ensures partners have a common understanding of the highest risks to Kent and Medway, the potential impacts of these risks, and that plans are in place to mitigate the impacts should incidents occur. The Kent Community Risk Register (2016) identified 4 risks related to climate change and flooding as Very High or High risks to Kent meaning that if they were to occur, impacts would be significant. Figure 1 summarises the current Very High, High and Medium risks to Kent, drawn from the most recent Community Risk Register (KRF, 2016):

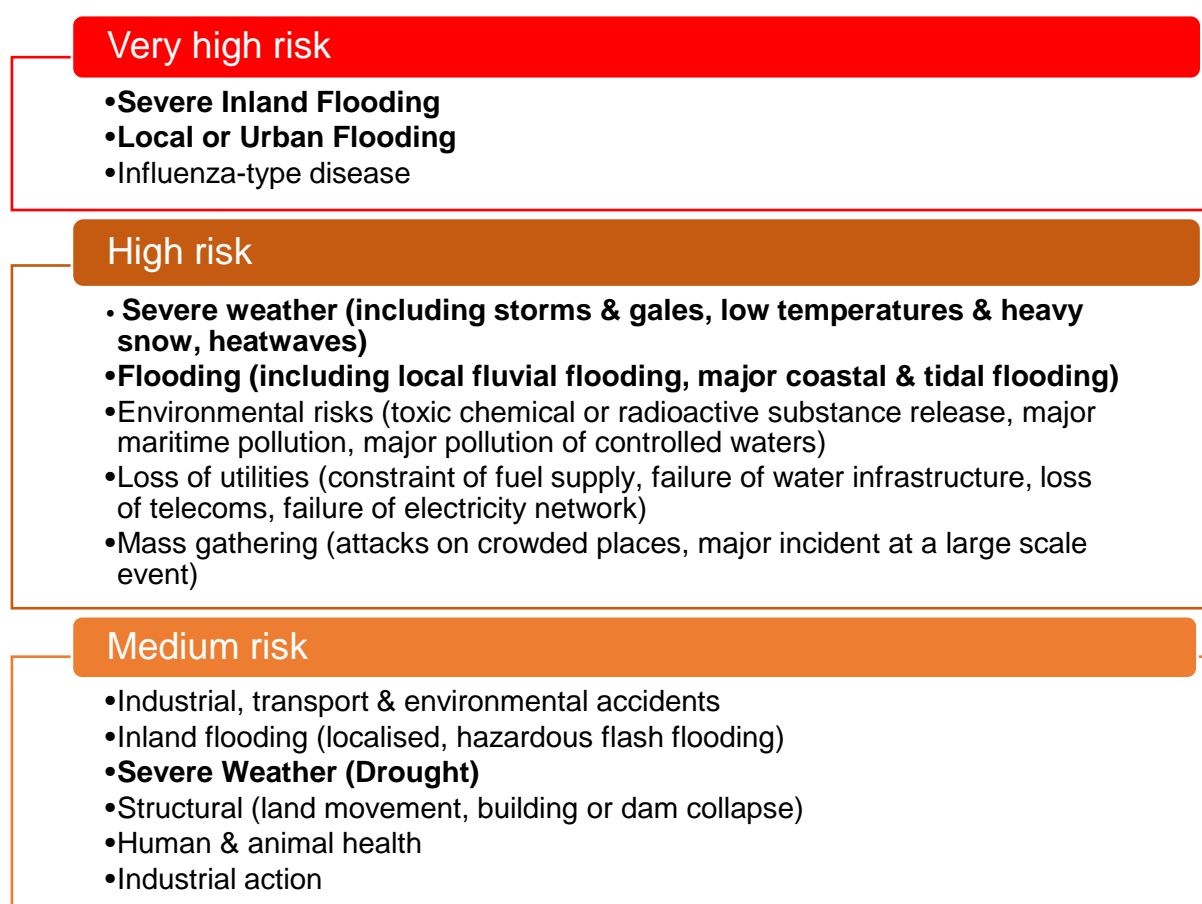


Figure 1: Risks identified in the Kent Community Risk Register (2016)

Climate change has been shown to have a disproportionate effect on the most vulnerable in society (Brooks, 2003; Alberini *et al*, 2006; Marmot *et al*, 2010; Zsomboky *et al*, 2011), as does flooding (Sayers *et al*, 2017), due to factors including wealth, age, health, and property type and tenure.

Social vulnerability is a function of how external stresses (such as flooding) impact on wellbeing (Climate Just, 2017). Sayers *et al* (2017: ii) found that:

“Socially vulnerable neighbourhoods are over-represented in areas prone to flooding (all sources), but most significantly in areas prone to coastal (and tidal) flooding.”

Linked to social vulnerability is the concept of climate disadvantage, which is a combination of the likelihood of, and degree of exposure to, a hazard and the vulnerability of a group or individual to that hazard (Lindley *et al*, 2011). A review of the impact of climate change on health and wellbeing conducted by Kent County Council in 2017 also found that those individuals and communities with greater wealth are more able to protect themselves from the impact of flooding.

Research further suggests that climate change may present additional challenges in coastal areas, and that these challenges will be exacerbated due to the deprivation present in some coastal communities (Zsamboky *et al*, 2011). With over 350 miles of coastline, comprising key international transport & travel links, infrastructure and tourism hubs, nationally important nature reserves and marshland habitats, coastal communities in Kent are at the forefront of facing these challenges and as a society we must ensure a good understanding of the risks of the coming changes in our climate.

A Department of Health review in 2012 identified a number of knowledge gaps in current health risks from flooding:

The HPA and the WHO Regional Office for Europe have identified several gaps in knowledge on the health impacts associated with flooding, including the need for: further understanding of immediate and longer term mortality following flooding; information on the causes and types of flood-related injuries; further research on the specific health impacts of flooding on vulnerable groups; and further information on the disruption of health services and facilities during and following flooding. In addition, risk communication has been identified as a key requirement of flood preparedness, with particular emphasis on how to communicate with the public in a time of power supply disruption and population movement.

This report uses open source data from the Climate Just online resource, developed by the Joseph Rowntree Foundation (JRF) and the University of Manchester, to assess the social vulnerability and disadvantage resulting from exposure to fluvial & coastal and surface water flooding. This analysis:

- Identifies countywide, district and community scale patterns where social vulnerability and flood disadvantage is at its highest across Kent and Medway.
- Establishes the key factors contributing to this vulnerability.

- Provides insight and recommendations on future action to increase resilience in the communities identified as having the greatest climate disadvantage as a result of flooding.

2. Climate Just

Climate Just is a free, open source, online mapping tool and database that brings together evidence and evaluations of how climate change and extreme weather is having differing impacts on some people and communities as a result of differences in their personal, social and environmental characteristics (Climate Just, 2017). Climate Just is structured around a set of key questions:

- Who is most socially vulnerable to climate impacts and extreme weather?
- Where are the most disadvantaged communities in relation to climate impacts and extreme weather?

Climate Just presents data on social vulnerability and climate disadvantage, enabling analysis of the variables that make a community socially vulnerable, alongside data on areas that are most exposed to climate related hazards, including fluvial & coastal flooding, surface water flooding and heat stress. A built-in mapping tool allows users to visualise this data on OS maps of the UK to Lower Super Output Area (LSOA) level – a neighbourhood scale of between 1,000 and 3,000 people that align to local authority boundaries, which makes them an appropriate measure for completing community level spatial analysis.

What makes Climate Just a unique and vital resource in understanding climate risk and vulnerability in Kent is the development of two new indices to measure social vulnerability to flooding and how this relates to exposure to flooding. The first, the Neighbourhood Flood Vulnerability Index (NFVI) indicates the susceptibility of a community to suffer a loss of wellbeing if a flood were to occur. The second, the Social Flood Risk Index (SFRI) combines the vulnerability score (NFVI) with exposure to flood risk to give a measure of where flooding is likely to have a greater impact on the community, and therefore the flood disadvantage experienced in that community (Climate Just, 2017; Sayers *et al* 2017).

2.1. What is the NFVI?

The NFVI gives insights into the social vulnerability of a neighbourhood if a flood should occur. It is a measure of the vulnerability of a community to the negative impacts of flooding. It is not a measure of how likely a flood event is to occur in an area. It is designed to be used to compare drivers of vulnerability to flooding between neighbourhoods (Sayers *et al*, 2017). The NFVI incorporates 27 supporting variables including data on health, age, income, access to information and housing characteristics into 12 composite indicators which combine into 5 characteristics that make up the overall NFVI score for an area (Figure 2). A full breakdown of these variables, indicators and characteristics is given in Table 2.

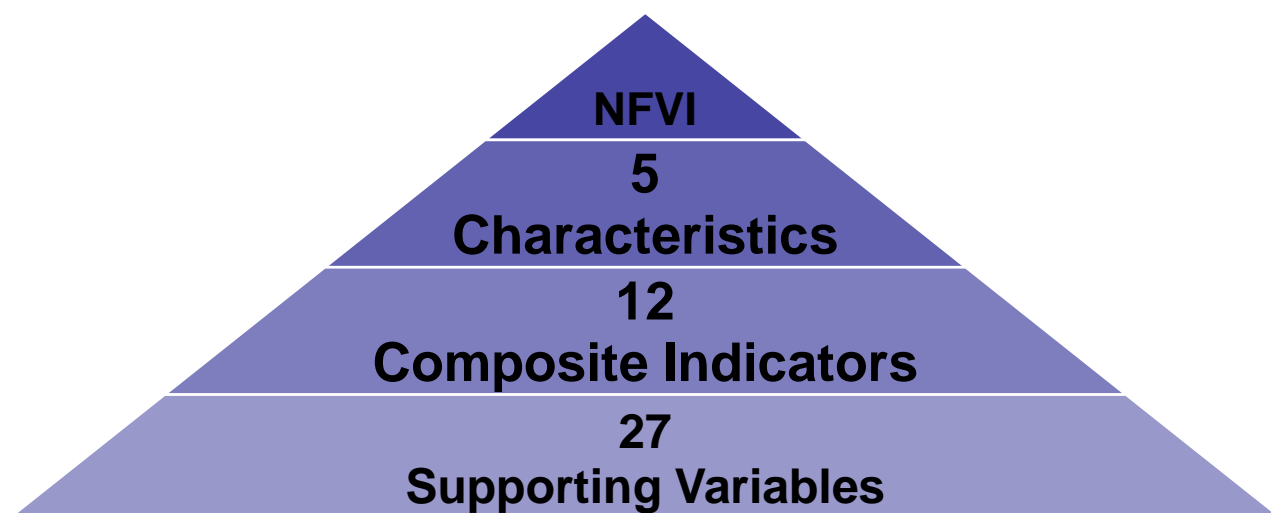


Figure 2: How the NFVI is calculated

The 5 characteristics that make up the NFVI are:

- **Susceptibility to flooding** – how likely someone is to experience a loss of wellbeing due to a flood.
- **Ability to prepare** – personal actions someone can take to reduce the harm suffered if a flood occurs.
- **Ability to respond** – why some people may act more effectively during a flood event.
- **Ability to recover** – how much someone can aid their own recovery from a flood.
- **Community support** – the availability and quality of emergency and healthcare systems.

The breadth of information incorporated into the overall NFVI score for an area makes the NFVI a useful tool to assesses the how much the wellbeing of the community would suffer if a flood occurred. However, the NFVI does not take account of the physical flood risk to an area. For example, a community that has no flood risk could have a high NFVI score based on its social vulnerability variables. Therefore, NFVI alone does not provide insight into the flood risk to an area.

Acute	Extremely high	Relatively high	Average	Relatively low	Extremely low	Slight

Figure 3: NFVI categories and colour codes

While the NFVI does not give insight into the physical flood risk of an area, it may have additional applications beyond flooding. As can be seen from the ‘supporting factors’ column in table 2, many of the supporting variables have been drawn from the Index of Multiple Deprivation, are not specific to flooding and could be equally applicable to other climate related risks, such as heat.

Composite Indicators (12)	Supporting factors (27)	Characteristics (5)				
		Susceptibility Index	Ability to prepare	Ability to respond	Ability to recover	Community support
Age	% people under 5	✓				
	% people over 75	✓				
Health	% people whose day-to-day activity is limited	✓				
	% households with at least one person having long term limiting illness	✓				
Income	% unemployment		✓	✓	✓	
	% people who are long term unemployed or have never worked		✓	✓	✓	
	% people in routine or semi-routine occupations		✓	✓	✓	
	% households with dependent children and no adults in employment		✓	✓	✓	
	% people who are income deprived		✓	✓	✓	
Information Use	% people who have been resident in the UK for less than 1 year		✓	✓	✓	
	Level of proficiency in English		✓	✓	✓	
Local Knowledge	New migrants from outside the area		✓	✓		
Tenure	% of privately rented households		✓			
	% of households renting from social or council landlords		✓			

Composite Indicators (12)	Supporting factors (27)	Characteristics (5)				
		Susceptibility Index	Ability to prepare	Ability to respond	Ability to recover	Community support
Physical Mobility	% people who are disabled			✓	✓	
	% people living in medical and care establishments			✓	✓	
	% households with no car or van			✓	✓	
Crime	High levels of crime			✓		
Housing Characteristics	% of caravans or other temporary structures in all households					✓
Direct Flood Experience	% Properties on the floodplain					✓
Service Availability	% of emergency services exposed to flooding					✓
	% of care homes exposed to flooding					✓
	% of GP surgeries exposed to flooding					✓
	% of schools exposed to flooding					✓
Social Networks	% of single pensioner households					✓
	% of lone parent households with dependent children					✓
	% of primary school age children in the population					✓

Table 1: NFVI factors, composite indicators and characteristics

2.2. What is the SFRI?

The Social Flood Risk Index is a measure of geographic flood disadvantage (defined as areas where exposure to flooding and social vulnerability combine) (Lindley *et al*, 2011; Climate Just, 2017). It is a relative index with no defined units – the greater the value, the higher the disadvantage.



- **A high positive score** means there is a high level of flood disadvantage present – large numbers of people living on the floodplain, in a neighbourhood with high social vulnerability.
- **A zero score** means there is no flood disadvantage as no-one is living on the floodplain.
- **A high negative score** indicates a low level of flood disadvantage – large numbers of people living on the floodplain, but in a neighbourhood with low social vulnerability.

The SFRI scores have been calculated for two flood sources, pluvial (surface water) flooding, and fluvial & coastal (combined) flooding. Where present, the level of protection given by flood defences has been considered when calculating the score. Flood risk data used is drawn from the Environment Agency Risk of Flooding from Rivers and the Sea data. SFRI measures have been developed at both group and individual scales:

- **Group scale** incorporates the chance of flooding occurring on the floodplain, the number of people living on the floodplain and the overall social vulnerability of the neighbourhood.
- High positive scores indicate where large numbers of vulnerable people are exposed to frequent flooding.
- **Individual scale** identifies areas where the vulnerability of those exposed is high, even if only a few people are exposed. This is calculated by dividing the group scale SFRI score by the floodplain population.

Extreme	Acute	Very high	High	Moderate	Low	Exposed, NFVI below UK mean	No exposed population

Figure 4: SFRI categories and colour coding

Index scores have been calculated for both types of flooding, at both group and individual scale for three different climate scenarios – present conditions and with a 2°C or 4°C

temperature increase by the 2050s against a 1961-90 baseline. Both the 2°C and 4°C future scenarios assume current levels of adaptation continue, and that population growth will be high. UK population is currently projected to increase to 76.2 million people by 2060, up from 65.6 million in 2016 (ONS, 2017).

2.3. Limitations of the data

Although the Climate Just resource provides an excellent source of data on social vulnerability and flood disadvantage, there are some inherent limitations in the data and in the analysis undertaken by the Climate Just team, including:

- **There is no single way to measure the welfare impacts of climate related events** – people feel different impacts at different times, to varying degrees of severity and for varying lengths of time.
- **Indicators to represent some variables are difficult to select, and selection may be contestable** – although existing literature has been used to select all variables, in some cases there is debate as to whether they act to enhance or reduce the potential for harm (e.g. flood history – may improve resilience or lead to people living in fear of the next event).
- **Some variables lack a suitable indicator available at fine geographical scale** – this impacts confidence in the findings of some indicators, such as those for social networks.
- **Weightings may not capture the true importance of the variables** – some variables may have a much greater impact than others, however relative importance is difficult to establish.
- **Units used are still broad** - although LSOAs are relatively small areas, some are (geographically) larger than others, and impacts felt by some residents may not be felt by others. This is particularly relevant for small scale flood events.
- **Groundwater flooding is not considered** – it was deemed to be a much less important when compared with fluvial & coastal or surface water flooding.

In addition to the limitations identified by Climate Just (2017), a case study on the Climate Just tool and the new indices carried out by the National Flood Forum (NFF, 2018) using the data from Sayers *et al* (2017) identified a number of important issues that need to be considered when using this data for the purpose of assessing flood vulnerability and disadvantage on a local scale.

“Participants identified shortfalls with the data in truly representing vulnerability factors at the community scale. The main finding from this pilot was that decision making regarding the targeting of flood risk management activities in disadvantaged communities, should not solely be driven by data.”

Key recommendations on the use of the Climate Just tool from the NFF case study are:

- **Data from Sayers *et al* (2017) should not be used alone** – local data and knowledge should be included where possible.
- **Some data used by Sayers *et al* (2017) may be outdated as it is drawn from the 2011 census** – in some cases it may be misleading and inaccurate as changes have occurred in the area since data was collected. The NFF report concludes:

3. The Kent Picture

Flood disadvantage and vulnerability in Kent and Medway is lower than that of the UK. However, while the overall flood vulnerability across Kent & Medway is average (according to the NFVI), Kent has some of the areas at highest disadvantage from and vulnerability to flooding in the UK. Within the county, there is significant local variability – 6 LSOAs have ‘acute’ vulnerability while 10 LSOAs have ‘extremely low’ vulnerability.

Two Kent districts are noted in Sayers *et al* (2017) as being particularly flood disadvantaged (areas where high social vulnerability and high flood risk combine) – Swale and Folkestone & Hythe are two of the top 10 most flood disadvantaged local authorities in the country. Sayers *et al* (2017) also identified Swale as one of the 10 districts nationally that contain 50% of all people in the UK who are exposed to flooding in a vulnerable neighbourhood.

Flood disadvantage from all sources is unevenly distributed. Under current conditions there is significantly higher disadvantage around Kent & Medway from surface water flooding than from fluvial & coastal flooding. Both fluvial & coastal and surface water flood disadvantage show a similar distribution pattern, with clusters of higher disadvantage around the coast and in town centres. At district level, no district is completely absent of flood related disadvantage, but 11 districts have ‘low’ disadvantage either due to a largely unpopulated floodplain or because the population that does live on the floodplain is not socially vulnerable.

3.1. Fluvial & coastal flood disadvantage

Figure 5 shows that higher disadvantage as a result of exposure to fluvial & coastal flooding is concentrated in a few areas around the coast of Kent & Medway. The primary areas that are at higher disadvantage are: Romney Marsh from Greatstone to Hythe, Faversham, Queenborough and Sheerness. There are also areas of high disadvantage around the towns of Folkestone, Deal, Herne Bay and Gravesend.

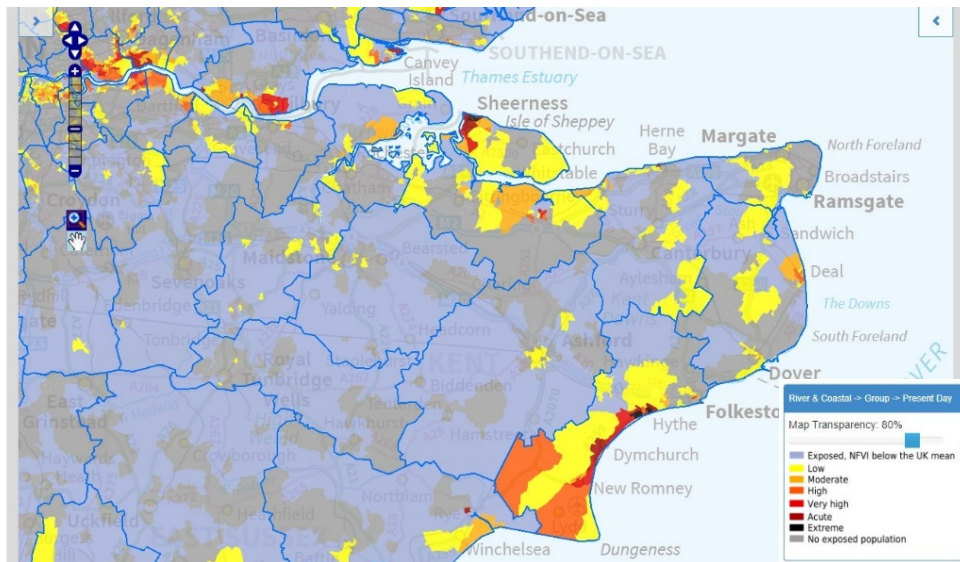


Figure 5: Present day SFRI for Fluvial & Coastal flooding

Figure 6 show the distribution (by district) of flood disadvantage to LSOAs and the number of LSOAs at all SFRI levels, and figure 6 shows only the highest levels. Most of Kent's population is not exposed to fluvial & coastal flood disadvantage, and of the areas that are, most have an index score of 'low' or have an NFVI score below the UK mean, suggesting that the population would not be socially vulnerable to the impacts of flooding. Figure 5 shows that the highest index scores are concentrated in two districts – Folkestone & Hythe and Swale, with some high scoring LSOAs in Dover and Canterbury, and one in Gravesend.

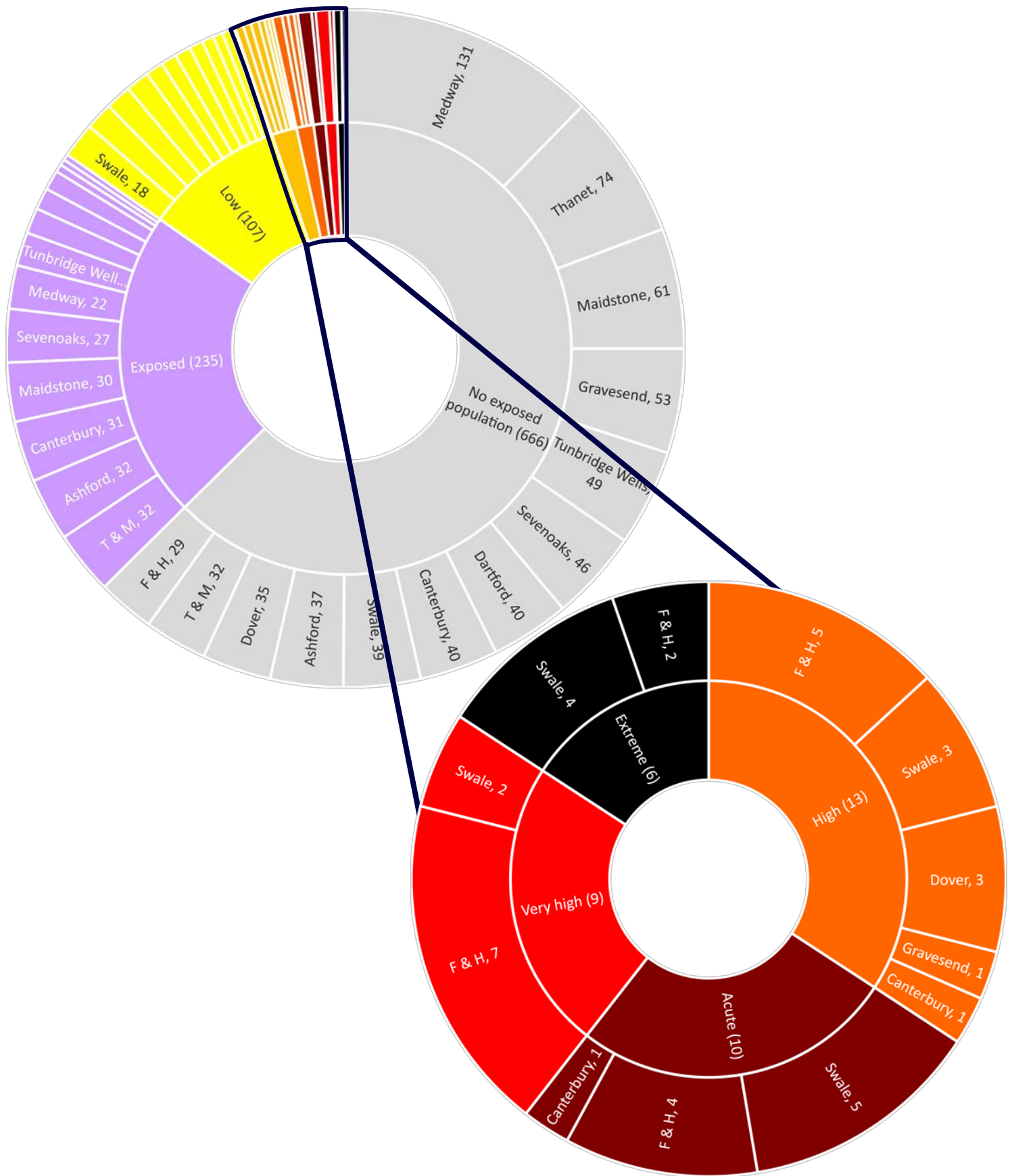


Figure 6: Distribution (by district) of flood disadvantage to LSOAs

3.2. Surface water flood disadvantage

Larger areas of Kent and Medway have higher levels of flood disadvantage from surface water flooding than from fluvial & coastal flooding. Comparison between Figures 5 and 7 shows the distribution of disadvantage is similar for both sources of flooding, but it is clear that there are many more areas that are disadvantaged from surface water flooding. Romney Marsh is a key area of high disadvantage, but a larger area of the marsh may be disadvantaged – from Dungeness through to Folkestone. There are also areas with ‘extremely high’ SFRI scores in Dover, Deal, Ramsgate, Margate, Herne Bay, Seasalter, Faversham and Sittingbourne, as well as across the Medway Towns, Gravesend and Northfleet. Nearly all of the Isle of Sheppey falls into the ‘extreme’ or ‘acute’ categories for surface water SFRI.

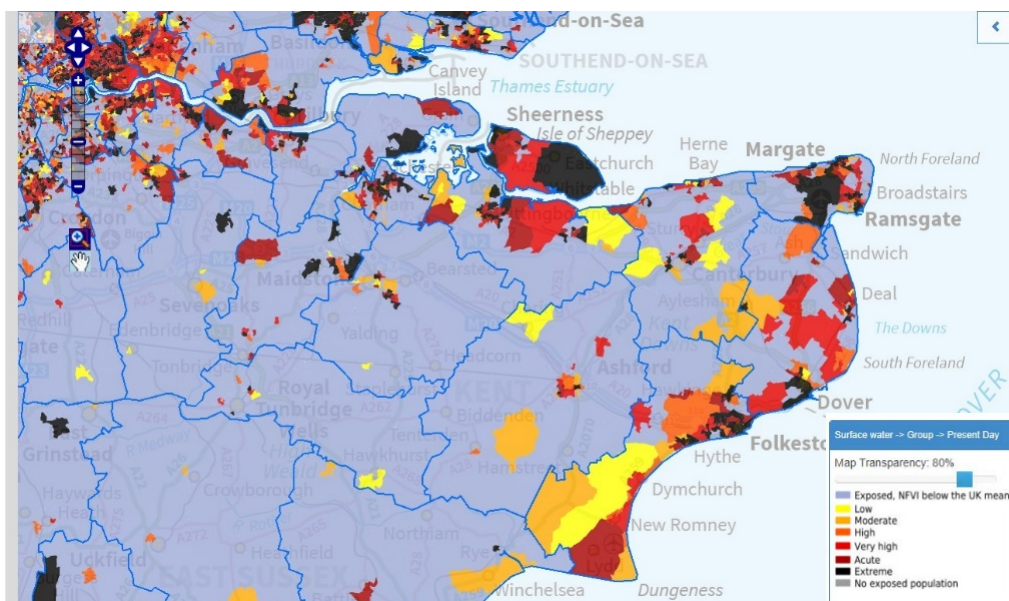


Figure 7: Present day SFRI for Surface Water

In addition to these coastal areas, there is also high flood disadvantage present in a number of inland town centres across Kent & Medway – particularly West Kingsdown, Wrotham, Maidstone, Ashford and Canterbury, along with some more isolated areas outside Tonbridge and Tunbridge Wells.

Figure 8 (overleaf) shows the number of LSOAs within each SFRI level across Kent & Medway. Unlike with the fluvial & coastal SFRI, there are no LSOAs that are not exposed, however there are 609 that may be exposed to flooding, but have a low NFVI score, therefore social impacts of flooding are likely to be low. There are significantly more areas of Kent that may be at higher disadvantage from surface water flooding than for fluvial & coastal flooding, and very few at ‘low’ or ‘moderate’ disadvantage. It also shows the ‘high’, ‘very high’, ‘acute’ and ‘extreme’ SFRI levels of figure 7 in more detail. All districts within Kent and Medway have at least 1 LSOA within both ‘very high’ and ‘extreme’ SFRI for surface water flooding, and Tunbridge Wells is the only district not to have any LSOAs in the ‘acute’ SFRI category.

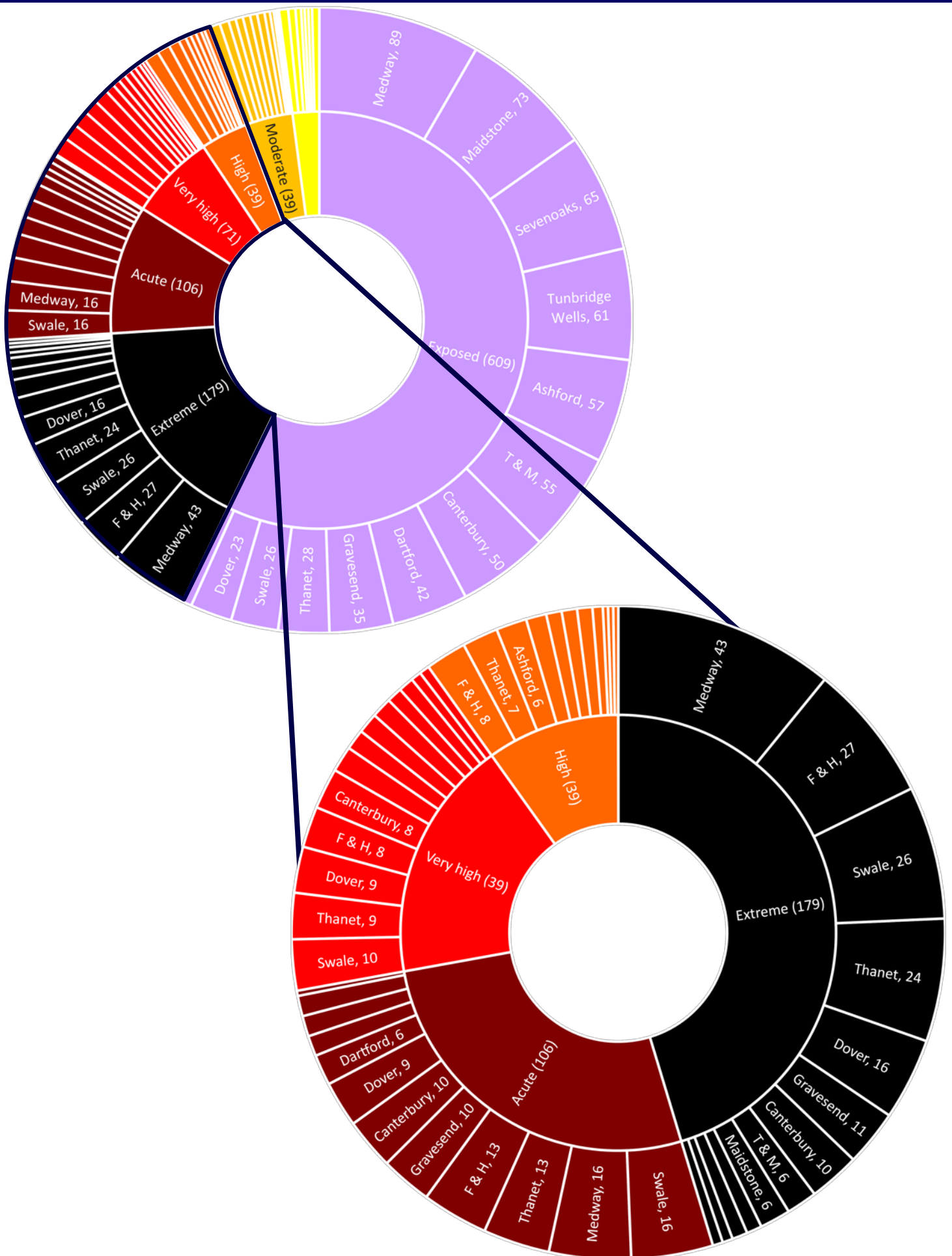


Figure 8: Surface Water flood disadvantage (SFRI) by District

Considering both fluvial & coastal and surface water flooding, the districts of Folkestone & Hythe, Swale, and Thanet, and the unitary authority of Medway have the highest overall disadvantage in Kent and Medway, assessed using the SFRI. Section 4 of this report will go on to examine these areas of Kent & Medway in more detail to better understand the drivers of vulnerability in those districts.

4. Local Authority profiles

4.1. Swale

4.1.1. SFRI profile

Swale has much higher disadvantage from surface water than from fluvial & coastal flooding, as can be seen from Figure 9. The Isle of Sheppey, and in particular Sheerness and Queenborough are areas of high disadvantage for all types of flooding considered. There is also 'high' disadvantage in Faversham from both fluvial & coastal and surface water flooding. In addition, Sittingbourne and the area near Rainham on the western border of Swale have 'very high' or 'extreme' disadvantage from surface water flooding. The rest of the district is not exposed to significant fluvial and coastal flood disadvantage, and while it is exposed to disadvantage as a result of surface water flooding, the NFVI is below the UK mean and therefore impacts of any flood will be less severe.

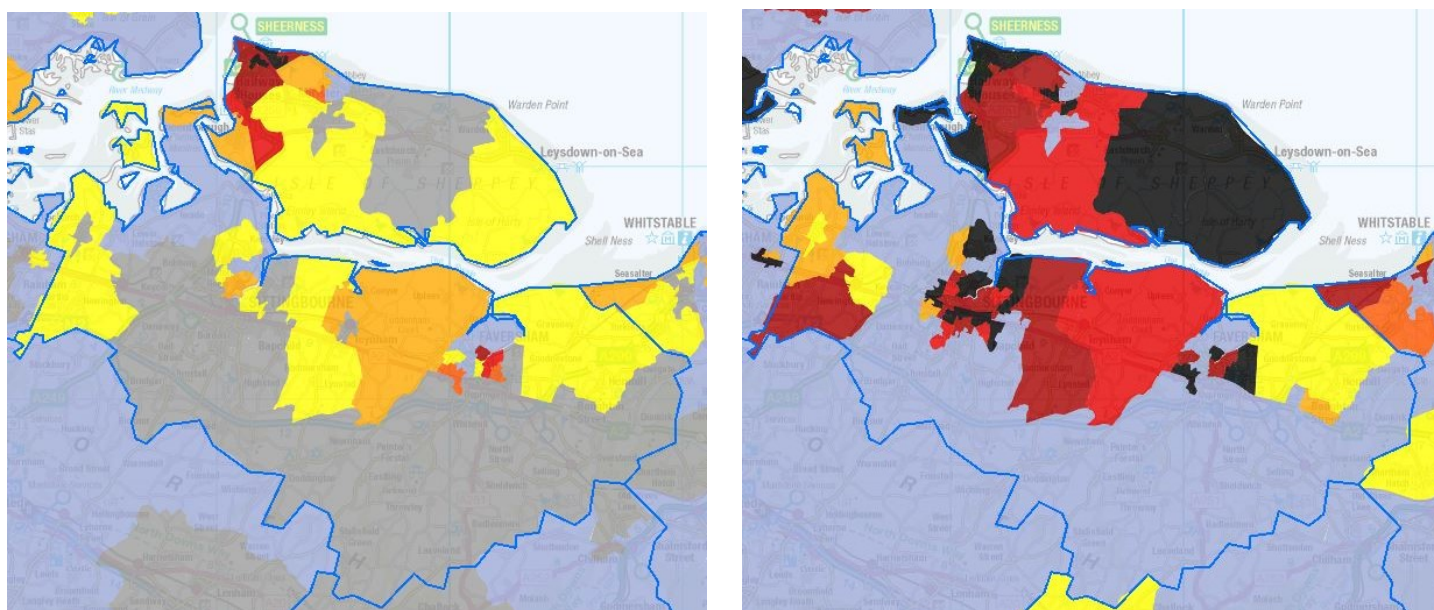


Figure 3: Fluvial & Coastal SFRI (left) and surface water SFRI (right) in Swale

4.1.2. Vulnerability profile

The main factors that contribute to flood vulnerability for Swale are vulnerabilities of the 'Community Support' characteristic, particularly concerning the emergency medical and health & social care sectors, combined with some (lower) levels of vulnerability based on population demographics (the service availability and social network indicators).

In particular, the percentage of GP surgeries, care homes and emergency services in Swale that may be vulnerable to flooding is a driving factor for high social vulnerability across the district. This is combined in some areas with increased vulnerability as a result of the percentage of people living with a disability or who are in ill health. In some LSOAs there are also high percentages of people on low incomes, lone parents and those with children of primary school age in the population, which are further driving the trend for high social vulnerability to flooding within the district.

4.2. Folkestone & Hythe

4.2.1. SFRI profile

Many of the LSOAs in Folkestone & Hythe may be disadvantaged as a result of both types of flooding considered (see Figure 10). In particular, the coastal areas of the Romney Marsh are at 'very high' disadvantage from both fluvial & coastal and surface water flooding. The fluvial & coastal flood disadvantage present in the district is limited to coastal areas, with little penetration inland, although there is some disadvantage present in inland areas of the marsh. Hard flood defences built to protect Dungeness Nuclear Power Station also provide defence for the areas around and behind the power station – this can be seen from the areas of lower disadvantage around Dungeness point.

Surface water flood disadvantage is greater and more widespread than disadvantage from fluvial & coastal flooding in Folkestone & Hythe. As with fluvial & coastal flooding, much of the Romney Marsh is likely to be disadvantaged, but the level of disadvantage from surface water flooding is greater. Folkestone town centre has higher levels of disadvantage from surface water flooding than from fluvial & coastal, and the area behind the town is an area of 'high' disadvantage from surface water flooding.

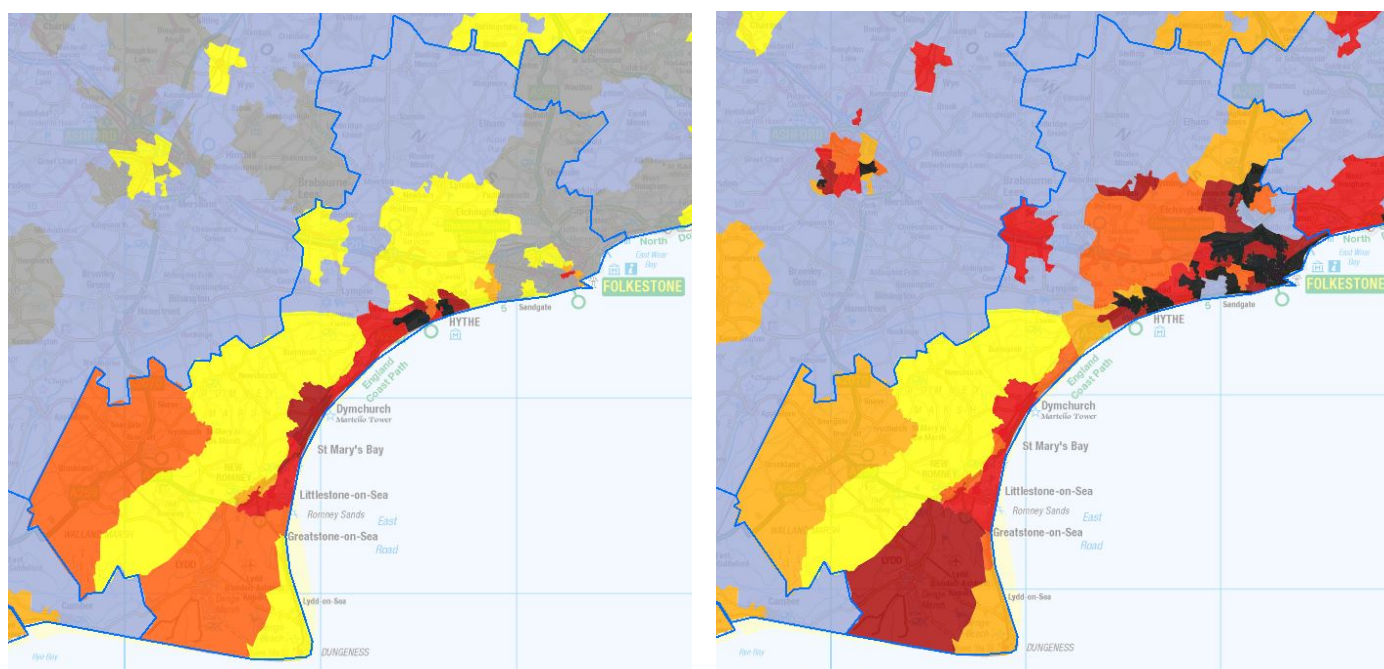


Figure 40: Fluvial & Coastal SFRI (left) and surface Water SFRI (right) in Folkestone & Hythe

4.2.2. Vulnerability profile

A lack of community support is by far the most significant characteristic that is increasing vulnerability in Folkestone & Hythe. More specifically, the greatest contributor is the service availability indicator, comprising vulnerability of health and social care assets. In addition, there are some LSOAs in which vulnerability is increased due to the mobility indicator.

As with vulnerability in Swale, the percentage of GP surgeries, emergency services, and care homes that may be vulnerable to flooding are the key drivers of vulnerability in Folkestone & Hythe. In some LSOAs, vulnerability may be increased due to the percentage of people over 75; the number of single pensioners; and the percentage of people living with a disability or in ill health.

4.3. Thanet

4.3.1. SFRI profile

Despite Thanet's position, and the presence of the Wantsum Channel on the outskirts of the district, Thanet does not have high disadvantage from fluvial & coastal flooding due to its elevation and protective cliffs – Figure 11 shows that there are very few areas above 'low' disadvantage, and that most of the district is either an area of 'low' disadvantage, or not exposed to disadvantage as a result of fluvial & coastal flooding.

However, Thanet does face significant disadvantage from surface water flooding, particularly around Ramsgate, Margate and Westgate on the coasts, and at Minster & Manston further inland. Significant areas of agricultural and farmland in central Thanet fall within the 'acute' or 'extreme' SFRI categories for surface water flooding.

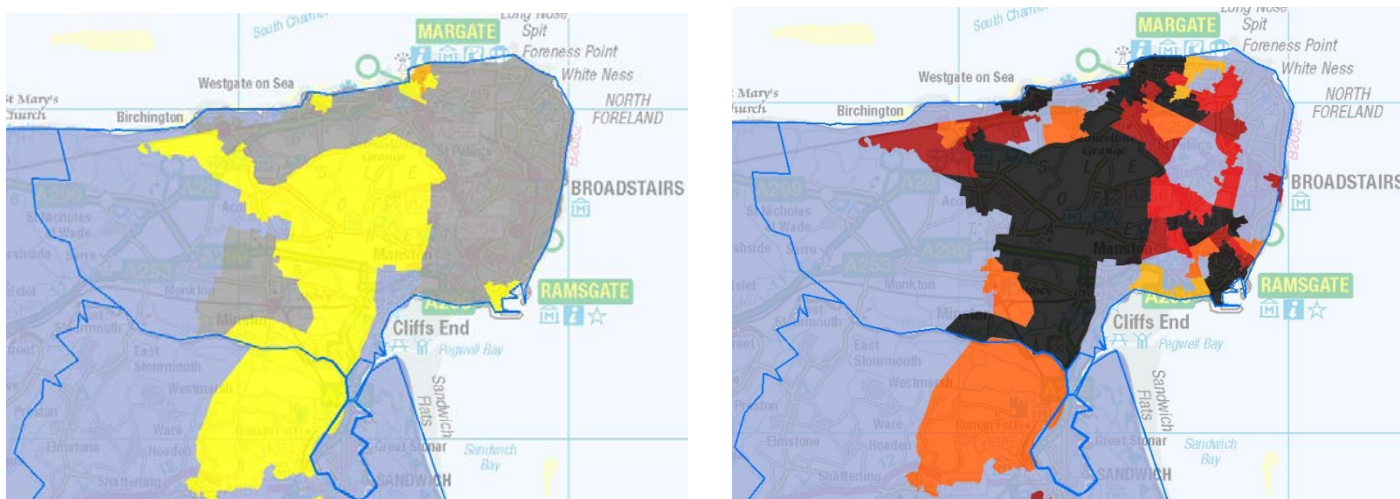


Figure 11: Fluvial & Coastal SFRI (left) and surface water SFRI (right) in Thanet

4.3.2. Vulnerability profile

Thanet does not have a clear vulnerability profile. There is no one characteristic that makes Thanet significantly more vulnerable than others. Most LSOAs are at higher vulnerability from the susceptibility index (age and health indicators). However there is more local variability in the factors that affect vulnerability in Thanet. In Cliftonville and Margate, for example, vulnerability is increased more by the ability to prepare, respond and recover characteristics than the susceptibility index.

Thanet's vulnerability is affected by the age, health, income, mobility and social network indicators, and in some areas by the property tenure and information use indicators. Across the district, key drivers of vulnerability are the age of the population (the percentages of both old and young people); the percentage of people living with a disability or long-term condition; and the numbers of single pensioners and lone parents. In some areas, such as Cliftonville West and Dane Valley, the percentage of the population that is unemployed or on a low income also affects vulnerability, and in Birchington the influence of old age, single pensioners and those living with disability has a greater effect on vulnerability.

4.4. Medway

4.4.1. SFRI profile

Medway has little disadvantage from fluvial and coastal flooding – the only area of greater than low disadvantage is around Hoo on the Isle of Grain, and Strood. In comparison, there is much greater disadvantage in Medway as a result of surface water flooding, as with the other areas examined in this report (see Figure 12)

Key areas of disadvantage from surface water flooding are around Hoo, Allhallows-on-Sea, the Medway Towns and Strood. This is primarily due to the Medway Estuary and low-lying areas around it. There are some more isolated areas of high disadvantage around Walderslade and the eastern edge of Rainham.

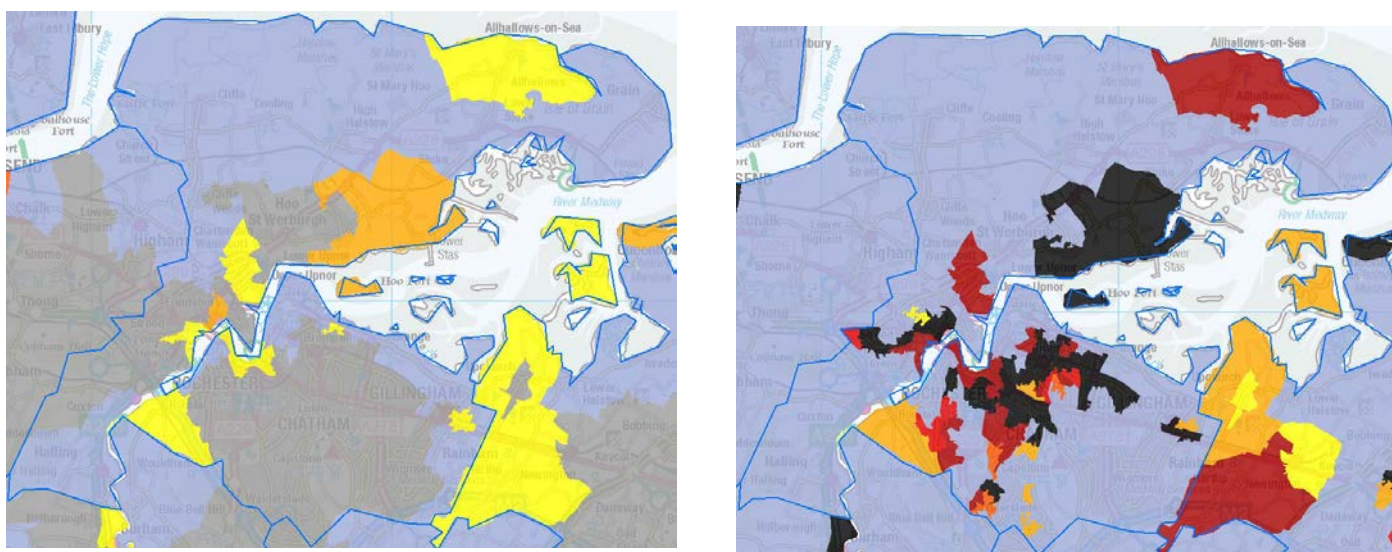


Figure 125: Fluvial & Coastal SFRI (left) and surface water SFRI (right) for Medway

4.4.2. Vulnerability profile

The main characteristics influencing vulnerability in Medway are the ability to prepare for, respond to and recover from flooding. In particular, the income, information use, local knowledge and property tenure indicators. In some areas, a lack of social networks is also increasing vulnerability.

Key driving indicators of vulnerability in many areas of Medway are the percentage of young children (under 5, and of primary school age), unemployment (including long term unemployment), low incomes, families with dependent children and lone parents. In certain areas of Medway, such as central Chatham, there are additional challenges with lower levels of English, and the percentage of privately rented accommodation. Some areas of Rochester and Rainham also have high percentages of lone pensioners, while a lack of personal transport (cars and vans) is an issue across Chatham and Gillingham.

5. Top 10 priority LSOAs

As can be seen from the maps and data, there are many LSOAs across Kent that are experiencing some level of disadvantage from one or more sources of flooding, at varying degrees of severity. This section will look at the 10 LSOAs that are in the highest categories of disadvantage and are most vulnerable to both fluvial & coastal and surface water flooding and focus on the key drivers of vulnerability in each. The 10 priority LSOAs are shown in Table 3.

LSOA name	Location	NFVI category	SFRI category	
			Fluvial & coastal	Surface water
Swale 001C	Sheerness	Extremely high	Extreme	Extreme
Swale 001D	Sheerness	Extremely high	Extreme	Extreme
Shepway 010D	Hythe	Extremely high	Extreme	Extreme
Swale 001A	Sheerness	Acute	Extreme	Extreme
Shepway 010C	Hythe	Extremely high	Extreme	Extreme
Swale 002B	Sheerness	Acute	Extreme	Extreme
Thanet 001A	Cliftonville	Acute	No exposed population	Extreme
Thanet 001D	Cliftonville	Acute	No exposed population	Extreme
Shepway 014B	Folkestone	Acute	Very High	Extreme
Swale 010C	Murston	Acute	Low	Extreme

Table 3: Top 10 flood disadvantaged LSOAs in Kent and Medway

5.1. Swale 001C

Swale 001C, in the Sheerness ward, has the highest fluvial & coastal flood disadvantage score of all LSOAs in Kent and Medway and the population may be acutely vulnerable to surface water flooding. It also falls into the 'extremely high' NFVI category as a result of high scores for community support, and the ability to prepare for, respond to and recover from flooding characteristics. The key indicators of vulnerability are age, income, property tenure,

service availability and social networks. For Swale 001C, the main variables increasing vulnerability are:

- Percentage of the population under 5
- Percentage of people unemployed
- Percentage of people who are long-term unemployed or who have never worked
- Percentage of people in a routine or semi routine job (low income)
- Percentage of people with dependent children and no adults in employment
- Percentage of privately rented households
- Percentage of households with no car or van
- Percentage of GP surgeries exposed to flooding
- Percentage of care homes exposed to flooding
- Percentage of emergency services exposed to flooding
- Percentage of schools exposed to flooding
- Percentage of lone parent households with dependent children
- Percentage of primary school children in the population

5.2. Swale 001D

Swale 001D, also in the Sheerness ward, is an area of 'acute' disadvantage from all forms of flooding and has an 'extremely high' NFVI score. This vulnerability is primarily driven by the community support characteristic, although scores for all other NFVI characteristics fall into the 'relatively high' category. Key indicators of vulnerability in Swale 001D are those concerning age, income and service availability. The contributing variables driving this vulnerability are:

- Percentage of the population under 5
- Percentage of people unemployed
- Percentage of people in a routine or semi routine job (low income)
- Percentage of people with dependent children and no adults in employment
- Percentage of privately rented households
- Percentage of people who are disabled
- Percentage of households with no car or van
- Percentage of GP surgeries exposed to flooding
- Percentage of care homes exposed to flooding
- Percentage of emergency services exposed to flooding
- Percentage of schools exposed to flooding
- Percentage of single pensioners
- Percentage of lone parent households with dependent children
- Percentage of primary school children in the population

5.3. Shepway 010D

Shepway 010D, in the Hythe Rural ward, is at 'extreme' disadvantage from fluvial & coastal flooding, and 'extreme' disadvantage from surface water flooding. The area also has 'extremely high' vulnerability to flooding, driven by acute community support vulnerability. There is very little vulnerability from most indicators apart from the housing type and service availability indicators, and this is driven by vulnerability in the following variables:

- Percentage of people over 75
- Percentage of people whose day to day activity is limited
- Percentage of households with at least one person having a long-term limiting illness
- Percentage of people in a routine or semi routine job (low income)
- Percentage of people who are disabled
- Percentage of GP surgeries exposed to flooding
- Percentage of care homes exposed to flooding
- Percentage of emergency services exposed to flooding
- Percentage of single pensioners
- Disabled people

5.4. Swale 001A

There is 'acute' disadvantage from both fluvial & coastal and surface water flooding in this LSOA, also in the Sheerness ward. Similarly to Swale 001C, vulnerability is primarily driven by the community support and ability to prepare, respond and recover characteristics, all of which fall into the 'extremely high' category. Key indicators for this area are service availability and mobility, although it also has high scores for the property tenure and income indicators. Key contributing variables are:

- Percentage of the population under 5
- Percentage of people whose day to day activity is limited
- Percentage of people unemployed
- Percentage of people who are long-term unemployed or who have never worked
- Percentage of people in a routine or semi routine job (low income)
- Percentage of people with dependent children and no adults in employment
- Percentage of privately rented households
- Percentage of households with no car or van
- Percentage of GP surgeries exposed to flooding
- Percentage of care homes exposed to flooding
- Percentage of emergency services exposed to flooding
- Percentage of lone parent households with dependent children
- Percentage of primary school children in the population

5.5. Shepway 010C

This area of the Hythe ward is at 'extreme' disadvantage from all forms of flooding and has 'extremely high' vulnerability to the impacts of flooding. This vulnerability is driven by the community support and susceptibility index characteristics. The principle contributing factor to vulnerability in Shepway 010C is the service availability indicator. Supporting this, the key variables are:

- Percentage of people over 75
- Percentage of people whose day to day activity is limited
- Percentage of privately rented households
- Percentage of people who are disabled
- Percentage of GP surgeries exposed to flooding
- Percentage of care homes exposed to flooding
- Percentage of emergency services exposed to flooding
- Percentage of single pensioners

5.6. Swale 002B

This LSOA in the Sheerness ward is also at 'acute' disadvantage from fluvial & coastal and surface water flooding and residents are acutely vulnerable to the impacts of flooding. As with other LSOAs in Sheerness, vulnerability is principally driven by the community support characteristic, but there is also 'extremely high' vulnerability from the ability to prepare, recover and respond characteristics. Underpinning these, the main indicators of vulnerability are those for age, income, service availability or social networks. The key contributing variables are:

- Percentage of the population under 5
- Percentage of people whose day to day activity is limited
- Percentage of households with at least one person having a long-term limiting illness
- Percentage of people unemployed
- Percentage of people who are long-term unemployed or who have never worked
- Percentage of people in a routine or semi routine job (low income)
- Percentage of people with dependent children and no adults in employment
- Percentage of socially rented households
- Percentage of people who are disabled
- Percentage of households with no car or van
- Percentage of GP surgeries exposed to flooding
- Percentage of care homes exposed to flooding
- Percentage of emergency services exposed to flooding
- Percentage of single pensioners
- Percentage of lone parent households with dependent children
- Percentage of primary school children in the population

5.7. Thanet 001A

This neighbourhood in the Cliftonville West ward has no population exposed to fluvial & coastal flooding according to the SFRI but does have 'extreme' disadvantage from surface water flooding. This, combined with a population who are acutely vulnerable to flooding, is what makes Thanet 001A one of the most flood disadvantaged LSOAs in Kent. Vulnerability is driven by the NFVI characteristics that address the ability to prepare for, respond to and recover from flooding. Key indicators of vulnerability are those for income, information use, property tenure and mobility, although there is also vulnerability due to the age of the population. Key variables contributing to vulnerability are:

- Percentage of the population under 5
- Percentage of people unemployed
- Percentage of people who are long-term unemployed or who have never worked
- Percentage of people in a routine or semi routine job (low income)
- Percentage of people with dependent children and no adults in employment
- Level of proficiency in English
- Percentage of privately rented households
- Percentage of households with no car or van
- Percentage of lone parent households with dependent children
- Percentage of primary school children in the population

5.8. Thanet 001D

Similarly to Thanet 001A above, this area of Cliftonville West has no population exposed to fluvial & coastal as measured by the SFRI but is an area of 'extreme' disadvantage from surface water flooding and is acutely vulnerable to the impacts of a flood. Vulnerability is driven by the ability to prepare for, respond to and recover from flooding. The indicator exerting the biggest influence on vulnerability is information use; but income, property tenure and mobility also have an effect. Key variables are:

- Percentage of the population under 5
- Percentage of people whose day to day activity is limited
- Percentage of households with at least one person having a long-term limiting illness
- Percentage of people unemployed
- Percentage of people who are long-term unemployed or who have never worked
- Percentage of people in a routine or semi routine job (low income)
- Level of proficiency in English
- Percentage of privately rented households
- Percentage of people who are disabled
- Percentage of households with no car or van
- Percentage of lone parent households with dependent children
- Percentage of primary school children in the population

5.9. Shepway 014B

This area of Folkestone Central is at 'extreme' disadvantage from surface water flooding, and 'extremely high' disadvantage from fluvial and coastal flooding. In addition, the area is also acutely vulnerable to social impacts of flooding, driven by acute community support vulnerability and extremely high ability to prepare, respond and recover vulnerability. The key indicators of vulnerability for Shepway 014B are the service availability and property tenure indicators, along with those for income and mobility. Key variables influencing vulnerability are:

- Percentage of people whose day to day activity is limited
- Percentage of households with at least one person having a long-term limiting illness
- Percentage of people unemployed
- Percentage of people who are long-term unemployed or who have never worked
- Percentage of people in a routine or semi routine job (low income)
- Percentage of privately rented households
- Percentage of people who are disabled
- Percentage of households with no car or van
- Percentage of GP surgeries exposed to flooding
- Percentage of care homes exposed to flooding
- Percentage of emergency services exposed to flooding
- Percentage of single pensioners

5.10. Swale 010C

Swale 010C, in the Murston ward, is at 'extreme' disadvantage from surface water flooding but 'low' disadvantage from fluvial & coastal flooding; however, it is also in the highest NFVI vulnerability category. The principle characteristics driving vulnerability, as in other flood disadvantaged LSOAs in Swale are the ability to prepare, recover and respond, and the community support characteristic. Income, property tenure and service availability are the key indicators underpinning this vulnerability, and the key indicators are:

- Percentage of the population under 5
- Percentage of people whose day to day activity is limited
- Percentage of households with at least one person having a long-term limiting illness
- Percentage of people unemployed
- Percentage of people who are long-term unemployed or who have never worked
- Percentage of people in a routine or semi routine job (low income)
- Percentage of people with dependent children and no adults in employment
- Percentage of socially rented households
- Percentage of people who are disabled
- Percentage of households with no car or van
- Percentage of GP surgeries exposed to flooding

- Percentage of care homes exposed to flooding
- Percentage of emergency services exposed to flooding
- Percentage of lone parent households with dependent children
- Percentage of primary school children in the population

6.Future Scenarios

Data assessed above concerns only the level of flood disadvantage present under current climatic conditions. Figure 13 on the following page show the impact of a 2°C and 4°C increase in temperature on SFRI category from present day on Folkestone and Hythe District. The maps suggest that, rather than the geographical range of flood disadvantage increasing, vulnerability of areas already identified increases. Table 4 summarises these changes.

With two degrees of warming by the 2050s, the number of LSOAs between high and extreme social flood disadvantage from fluvial & coastal flooding increases from 38 under present conditions, to 56. Although the level of disadvantage from fluvial & coastal flooding increases with climate change, the increase is not as pronounced as that for surface water flooding, where the LSOAs facing extreme disadvantage increases from 179 LSOAs (17%)

SFRI	Fluvial & Coastal LSOAs			Surface Water LSOAs		
	Present	2°C	4°C	Present	2°C	4°C
No exposed population	666	666	666	0	0	0
Exposed, NFVI below UK mean	235	235	235	609	609	609
Low	107	81	77	22	13	11
Moderate	19	27	27	39	16	10
High	13	17	15	39	27	25
Very high	9	14	18	71	47	35
Acute	10	11	9	106	66	57
Extreme	6	14	18	179	287	318

to 287 (27%) with 2°C of climate change.

Table 4: SFRI changes in Kent and Medway with climate change (number of LSOAs)

The maps on the following pages show the progression of severity of the SFRI for Folkestone & Hythe under the two additional climate scenarios considered on Climate Just (2°C and 4°C temperature rise by the 2050s), and for both types of flooding considered (fluvial & coastal and surface water).

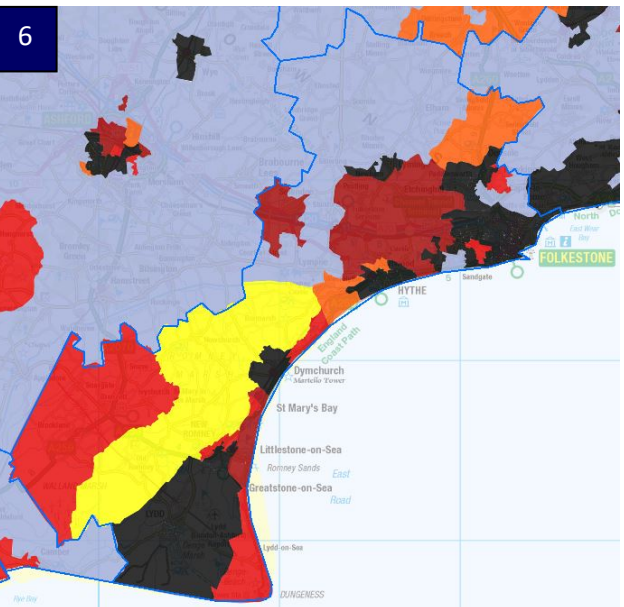
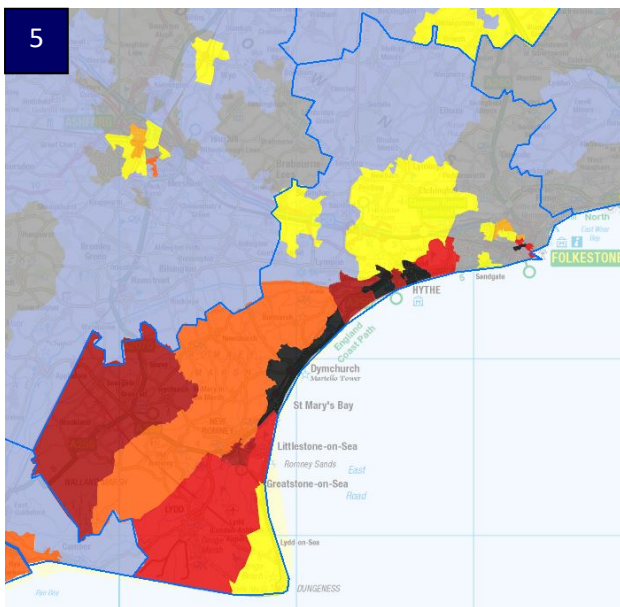
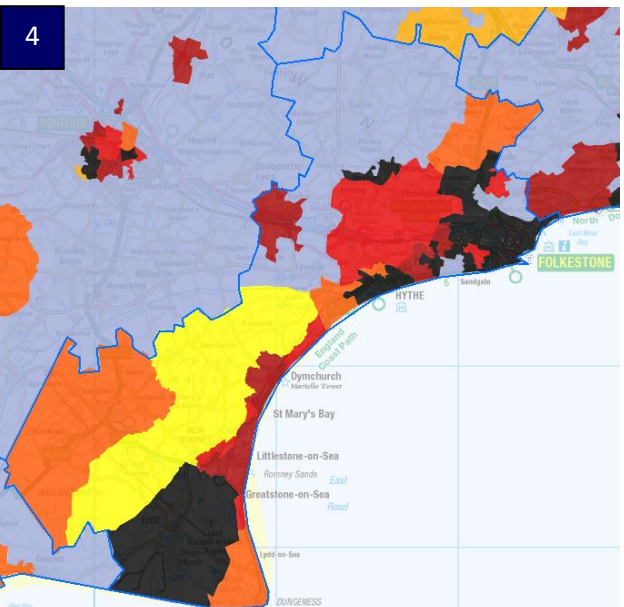
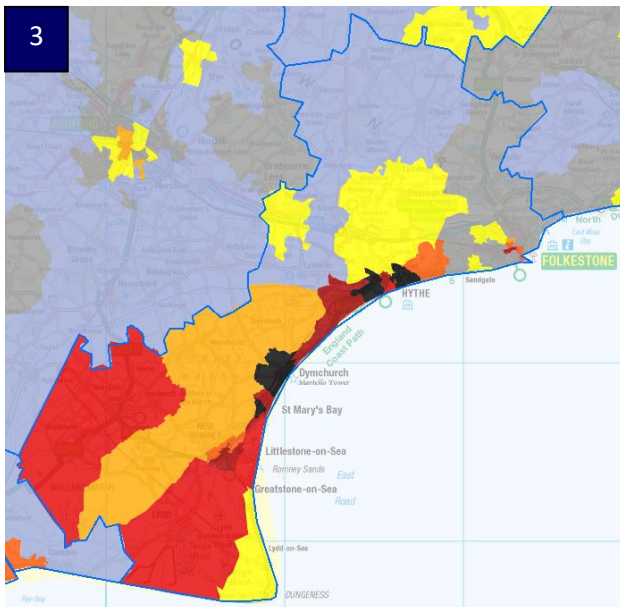
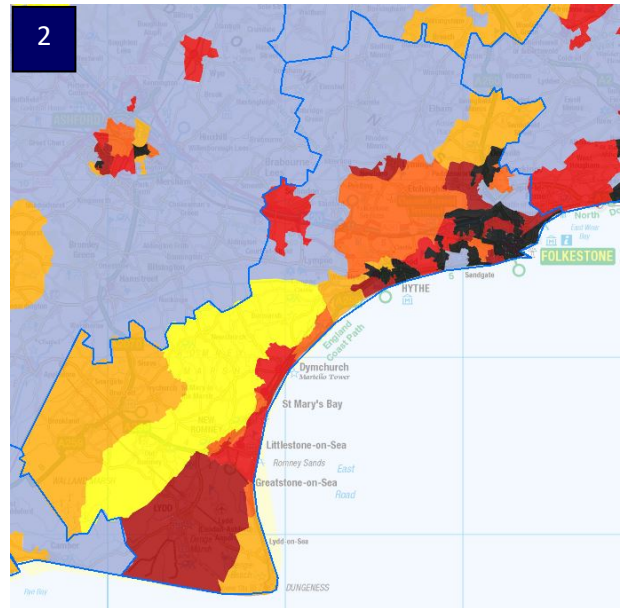
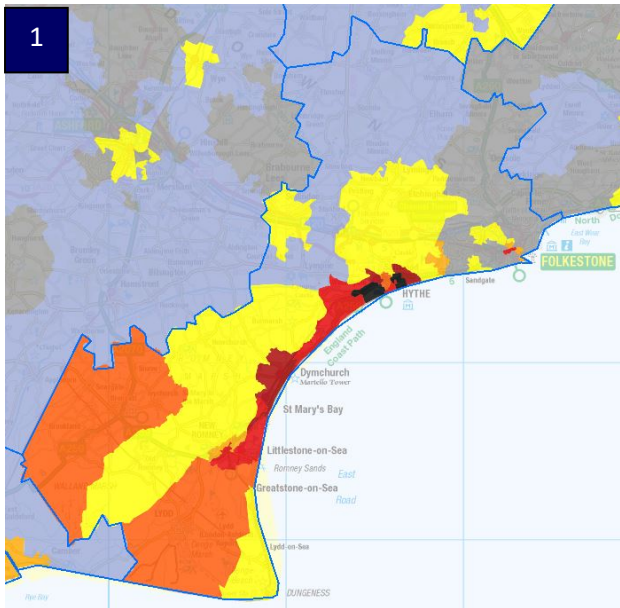


Figure 126: Fluvial & Coastal SFRI (left) and surface water SFRI (right) at present day (1 & 2), 2°C (3 & 4) and 4°C (5 & 6) for Folkestone and Hythe

7. Conclusions and Key Findings

Under current climatic conditions, there is significant vulnerability to communities in Kent from both fluvial & coastal flooding and from surface water flooding. Analysis suggests that flood disadvantage is greater from surface water flooding than from fluvial & coastal flooding in most areas, and the areas of highest social vulnerability and flood disadvantage are concentrated at the coast. Town centres in Ashford, Canterbury and Maidstone are also vulnerable to the impacts of flooding. Data assessed suggests that climate change will not increase the geographic area of Kent that is disadvantaged from flooding but will increase the severity of disadvantage in areas where it is already present, particularly in Romney Marsh and on the Isle of Sheppey.

In the districts of Folkestone & Hythe, Swale and Thanet, areas that are vulnerable to flooding overlap significantly with areas that are highly socially vulnerable to the impacts of flooding. Social vulnerability comes from a variety of sources but in many areas, overall health of residents and the vulnerability of Health and Social Care assets to flooding is likely to be a key driver.

Low lying, coastal areas of Kent where the population are generally older, have a lower income and are more socially vulnerable to the impacts of flooding than more affluent inland areas. In Folkestone & Hythe, vulnerability is driven by a lack of service availability (health & social care assets), lack of mobility, and the number of people over 75 or living with disability. This is similar to Swale, where there are additional vulnerabilities from people on low incomes and single parent households with young children. Thanet is vulnerable due to the age of the population (both those over 75 and young children), people living with disability or living alone. Vulnerability in Medway is also driven by age (young children), as well as unemployment and low incomes.

Flood disadvantage in inland city and town centres across Kent is not as severe as on the coast, however some inland areas may be disadvantaged as a result of surface water flooding. Historically, many towns were built along river banks. These towns now have significant amounts of impermeable hard surfaces which do not allow water to infiltrate naturally. In Ashford, vulnerability is driven by the number of lone parents and young children in the population, as well as a higher percentage of people on low incomes, in social housing or who have dependents and no income. Some areas of Canterbury have similar issues, and the percentage of new migrants to the area, people with long term illnesses and a lack of personal transport capability are additional drivers of vulnerability. In Maidstone, issues are similar, with a lack of transport, unemployment and the percentage of lone parents.

Key drivers of disadvantage across Kent are vulnerabilities to health and social care facilities including care homes and GP surgeries. This may cause issues with continuing provision of care during and after a flood event.

Vulnerability and disadvantage in areas that are already impacted under current conditions become increasingly severe as the impacts of climate change worsen. Data presented in Climate Just and assessed for this report suggests that geographical extent of these areas does not extend, but that flood vulnerability and disadvantage to areas scoring 'low' under present conditions increases significantly.

8. Recommendations

Future work should look to identify flood vulnerable care homes and other Health and Social Care facilities in Kent, in order to better understand the specific vulnerability to the sector. Particularly, the facilities that may be vulnerable to severe, regular flooding (1 in 30 – 1 in 100-year events). Flood risk maps from the Environment Agency, combined with data held by Local Authorities on the location and type of care facility could be used to inform this analysis.

Although the EA data also has limitations and should not be used for property level analysis, measures could be taken in data preparation to broaden the area at risk to highlight properties that may be at risk. Expert analysis of this data combined with 'ground truthing' site visits where appropriate will confirm or deny initial findings and allow increased confidence in data. Once identified, facilities that may be at risk should be engaged with to ensure they have a robust plan to mitigate the effects of a flood, and to ensure continued care of client groups in the event of severe weather. Given the limitations of the data used for this assessment noted by Climate Just and the National Flood Forum, particular focus should be on:

- Some variables lack a suitable indicator available at fine geographical scale
- Broad units of measurement for some indicators
- NFF recommendation – include local data and knowledge where possible.
- NFF recommendation – use more recent data than 2011 census

Further work should look to identify and use more local data, available from Health and Social Care teams, to supplement that available through Climate Just. This will enable increased accuracy of results and enable conclusions to be drawn with more certainty that has been possible through this work. Examples of the type of data that could be included to improve accuracy of results are: frailty index, blue badge holders, fuel poverty data, and additional deprivation measures.

In addition, to enable more accurate analysis, results and data from Climate Just could be passed to the Kent Public Health Observatory who may hold more current data on the variables assessed by Climate Just and therefore be able to provide more up to date information for analysis.

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