University of Southampton

# CLIMATE VULNERABILITY

SUSTAINABILITY & RESILIENCE INSTITUTE

SOUTHAMPTON CITY COUNCIL

Low Carbon Comfort Centre

# BACKGROUND

**We must consider how we will respond and adapt to climate change to protect our city and its residents.**

The Department for Environment, Food & Rural Affairs 2022 Climate Change Risk Assessment acknowledges that climate change is happening now. The Southampton City Council cabinet meeting of 16th April 2019 declared a climate emergency; recognising the extent of impacts climate change will bring to our communities and natural environment that are irreversible for millennia (Solomon et al., 2009; Ridley et al., 2010; Albrich et al., 2020). From 1997 to 2023, Southampton has continued to get warmer every year by ~0.036◦C, a staggering figure considering by 2100 at this linear rate our city will be almost 3◦C warmer on average.

Summers will be hotter and drier, and winter is set to be warmer too but with more rain, less snow, and retaining localised extreme colds (Met Office, 2022). Extreme rainfall and storms in the UK have increased from past levels and is projected to increase further, due to increased moisture capacity in the worlds warming air (Manning et al., 2024). In Southampton, rainfalls of ~1000mm/yr have become common place during the 2010s and will increase, showing a 21.1mm/yr increase of rainfall on average from December 2007 - November 2023 (Southampton Weather, 2024).

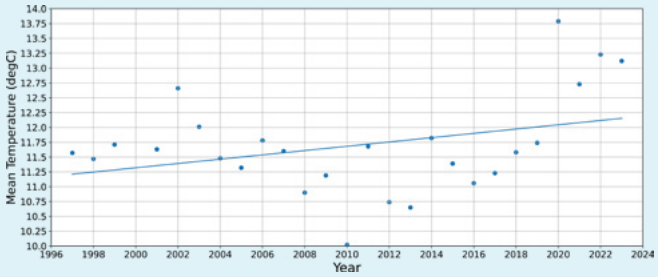


**Figure 1:** Yearly average temperature in Southampton City Centre (Weather Underground, 2024)

**"Extreme heat and rainfall can place Southampton residents' wellbeing, particularly in vulnerable communities, at risk. Not only this but severe storms can damage our infrastructure and economy, putting local cost-of-living at risk. Summers will be hotter and drier, and winter is set to be warmer too but with more rain, less snow."**

**This report aims to answer questions:**

- What impacts may climate change have on Southampton?
- Where are the current vulnerabilities? What can be done to mitigate effects on vulnerable areas?
- What can we learn from current trends to future proof our city?
- Where does our current knowledge need strengthening?

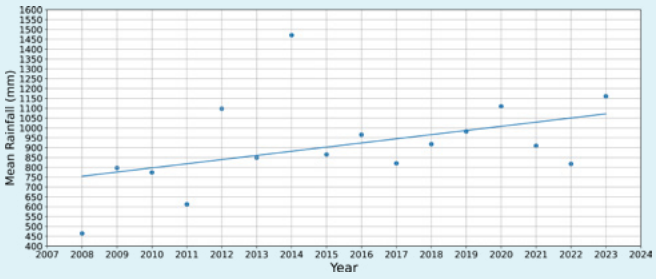


**Figure 2:** Yearly average rainfall in Southampton City Centre (Southampton Weather, 2024). The data is split into seasons, i.e., each year on the graph is 4 seasons primarily attributable to that year. For example, 2008 means December 2007 - November 2008.

# METHODOLOGY

**We define two key words: risk and vulnerability.** Vulnerability relates to the residents' preparedness for heat and flooding, if they experience an extreme weather event how well can they prepare, evacuate, and or recover from such event? Risk relates to an area's susceptibility to extreme heat due to high density urbanisation or flooding due to lack of defences.

Vulnerability is assessed with the Southampton Data Observatory, taking into account adult social care rates, children in need rates, crime rates, English speaking household percentage, percentage of 16+ ages with no qualifications, percentage green space, reports of bad or very bad health, percentage of those with limitations due to disability, percentage of pupils who are not a healthy weight, social isolation, and deprivation for both heat and flooding vulnerability. For flooding specifically, additional indices percentage of lone parent families with dependent children and pupils with special educational needs were added to indicate a lack of mobility that would not affect heat response.

During **heat analysis**, we consider vulnerable neighbourhoods and specific interventions based on local hurdles to resilience. During **flood analysis**, we consider flood reports of repetitive nature and discuss areas of flood risk from the strategic flood risk assessment, backing this data up with neighbourhood specific vulnerabilities.

# DATA-INFORMED RECOMMENDATIONS

Figures 3 and 4 show vulnerability to heat extremes and flooding events respectively in Southampton. Figure 5 shows fluvial and surface water flood risk of greater than 1%.

Figure 5 highlights the importance of **reinforcing the west bank of the River Itchen.** It is a top priority for the city to continue the River Itchen Flood Alleviation Scheme, and subsequently consider reinforcing other areas of fluvial flooding in the future.

Surface water flooding can occur due to debris. This can originate from a number of hotspots, such as: busy roads, land elevation changes, bridges, schools, green space, and gravel car parks. Similarly, poorly planned and older degraded drains can experience tide locking with nearby waterways, poor capacity, and increased blockages over functional drainage systems. Thin pipes and poor drain planning was primarily seen in Woolston ward, whereas older drains were seen in Portswood ward particularly near the coast. **Upgrading poorly planned and degraded areas is recommended.** Further, high capacity waterways such as: Holly Brook, Jurd's Lake, Monk's Brook, and Rolles Brook can cause flooding upstream as culverted areas cannot handle the high water volume. **Waterway terracing for natural water storage and adding bends to the waterways was recommended to slow the flow rate of problem waterways.**

**A flooding call and response centre** is recommended to streamline flood response and deal with immediate threats. On-the-ground agents could give contextual information to investigators and highways teams for retrofit. Similarly, **a heat call and response centre** could aid those needing advice or physical assistance to get to a safe space during extreme heat. Effective spread of information is paramount, such as **field conversations with the public, flyers, billboards, posters, clubs, events, and volunteer networks tailored to a neighbourhood.**

All neighbourhoods were analysed for vulnerability, and area specific recommendations were made for both flooding and heat. **Lordshill was shown to have the worst heat vulnerability,** followed in order by South-west Shirley, North Millbrook, North Coxford, and the Golden Grove. **Both top 2 for flooding vulnerability are in West-central Thornhill, followed by South Woolston, Central Thornhill,** and **West Millbrook** when negating neighbourhoods with no projected flood risk.

**Figure 3**: Map of Southampton with vulnerability to heat on an LSOA level.

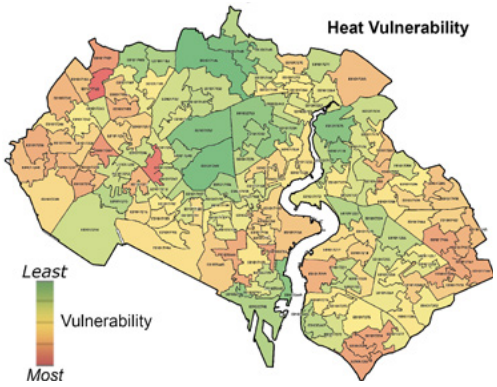


**Figure 4:** Map of Southampton with vulnerability to flooding on an LSOA level.

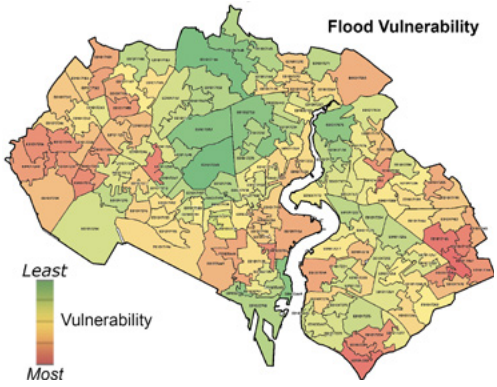


**Figure 5:** Map of Southampton overlaid with 1/30 and 1/100 surface water flood risk and type 2 and 3 fluvial flood risk.

To decrease risk of extreme heat, it is **recommended to improve distribution of green-space city-wide and encourage private property greening** to mitigate urban heat island effect, particularly in areas: Freemantle, Bevois, Coxford, Banister & Polygon, and Harefield. Improving air quality can also decrease urban heat island effect. It was also recommended to **gather in-depth buildings and infrastructure data** such as neighbourhood accessibility and insulation presence and type, such that it is known what retrofits to make in which at-risk vulnerable communities.

It is important to improve not just resilience but also issues extreme heat brings such as drought. **Fixing leaks in pipes** and encouraging Southern Water to do so is paramount as leading up to and during water insecurity ~4.5 million L/hr is inexcusable water leakage (Kersley, 2024). Other measures include increased greening to utilise permeable surfaces to store water, reviewing of water allocation leading up to drought, and encouragement or council funded voluntary installation of private reservoirs in homes such that vulnerable areas can rely on their own reservoirs rather than the mains water during a drought.

# REFERENCES


Albrich, K., Rammer, W. and Seidl, R. (2020), 'Climate change causes critical transitions and irreversible alterations of mountain forests', Global Change Biology 26(7), 4013–4027. doi: **10.1111/gcb.15118**.

Department for Environment, Food & Rural Affairs (2022), 'Uk climate change risk assessment 2022'.[Online; accessed 12-11-2024]. URL: **https://assets.publishing.service.gov.uk/media/61e54d8f8fa8f505985ef3c7/climate-change-risk-assessment-2022.pdf**

Kersley, A. (2024), 'Water firms in england and wales lost more than 1tn litres from leaks last year'.[Online; accessed 25-11-2024]. URL: **https://www.theguardian.com/business/article/2024/sep/08/waterfirms-in-england-and-wales-lost-more-than-1tn-litres-from-leakslast-year**

Manning, C., Kendon, E. J., Fowler, H. J., Catto, J. L., Chan, S. C. and Sansom, P. G. (2024), 'Compound wind and rainfall extremes: Drivers and future changes over the uk and ireland', Weather and Climate Extremes 44, 100673. doi: **10.1016/j.wace.2024.100673**.

Met Office (2022), 'Ukcp headline findings'. [Online; accessed 18-11-2024]. URL: **https://www.metoffice.gov.uk/research/approach/collaboration/ukcp/summaries/headline-findings**

Ridley, J., Gregory, J. M., Huybrechts, P. and Lowe, J. (2010), 'Thresholds for irreversible decline of the greenland ice sheet', Climate Dynamics 35(6), 1049–1057. doi: **10.1007/s00382-009-0646-0**.

Solomon, S., Plattner, G.-K., Knutti, R. and Friedlingstein, P. (2009), 'Irreversible climate change due to carbon dioxide emissions', Proceedings of the National Academy of Sciences 106(6), 1704–1709. doi: **10.1073/pnas.0812721106**.

Southampton City Council (2019), 'Public document pack, cabinet: Tuesday, 16th april, 2019 at 4.30 pm'. [Online; accessed 13-11-2024]. URL: **https://www.southampton.gov.uk/moderngov/documents/g3834/Public%20reports%20pack%2016th-Apr-2019%2016.30%20Cabinet.pdf?T=10**

Southampton Data Observatory (2024), 'Southampton data observatory: Your insight into southampton'. [Online; accessed 03-12-2024]. URL: **https://data.southampton.gov.uk/**

Southampton Weather (2024), 'Seasonal rainfall summary (mm)'. [Online; accessed 17-11-2024]. URL: **https://www.southamptonweather.co.uk/wxrainseason.php**

Weather Underground (2024), 'Southampton, england, united kingdom weather history'. [Online; accessed 13-11-2024]. URL: **https://www.wunderground.com/history/monthly/gb/southampton**


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