

# Climate Change Health Impacts Scottish Borders

---

March 2024

Dr Lisa Adams, Specialist Registrar in Public Health

Version 1.0

# Contents

What is Climate Change?	2
Scotland's Changing Climate	4
Weather Warnings and Events in Scottish Borders	5
Flooding in Scottish Borders	7
Water Supplies in Scottish Borders	9
Population of Scottish Borders	10
Expected Future Climate Changes	13
Consequences of the Expected Changes to Climate	14
Health Impacts of Climate Change	20
Physical Consequences of Climate Change for Borders	35
Areas Most at Risk in Borders	36
People Most at Risk in Borders	37
Next Steps	39
Useful Resources	41
Specific References	42

# What is Climate Change?

“The single biggest health threat facing humanity”

*World Health Organisation*



Climate change describes long-term alterations to weather patterns and temperatures. This is not a new concept, and has been occurring for millions of years due to natural events.

Since the industrial revolution however, human behaviour has been a major driver of climate change due to the burning of fossil fuels which has released greenhouse gases into the atmosphere. These have acted to insulate the earth and cause artificial warming, which in turn is anticipated to cause many other impacts.

The risks of this are now considered to be extremely imminent, and without global effort are going to have huge implications for the health of the population.

“The greatest global health opportunity of the 21st century”

*Lancet Commission on Managing the Health Effects of Climate Change*



There are still opportunities to act to mitigate or adapt to the predicted impacts that climate change will bring. If these are carefully managed and considered, they can present co-benefits for health as well as climate.

What is the current climate situation and population demographics within the Scottish Borders?

---

# Scotland's Changing Climate



## Average temperature is increasing

Over the last few decades, Scotland is becoming increasingly warmer. All 10 of the hottest years on record have occurred since 1997. The hottest year on record was 2014, and the hottest June recorded in Scotland was in 2023 (average temperature 15.8°C). 2010-2019 was 0.69°C warmer on average than 1961-1990.



## Rainfall patterns are changing

The amount of rainfall that Scotland has experienced has also been increasing over the last few decades.

More of this rainfall is being witnessed as heavy rainfall events.

2010-2019 was 9% wetter on average than 1961-1990 overall, and winters have become even wetter (19% higher in the most recent decade).



## Sea levels are rising

Since 1900, the mean sea level across the UK has increased by approximately 1.4mm a year.

# Weather Warnings and Events in Scottish Borders

The landscape of weather warnings has been changing in the Scottish Borders over the last 5 years. Weather warnings are issued by the Met Office and are classified as yellow, amber or red (least to most severe). Within Scottish Borders, a control room is stood up for all amber and red alerts.

Weather warnings are issued for:

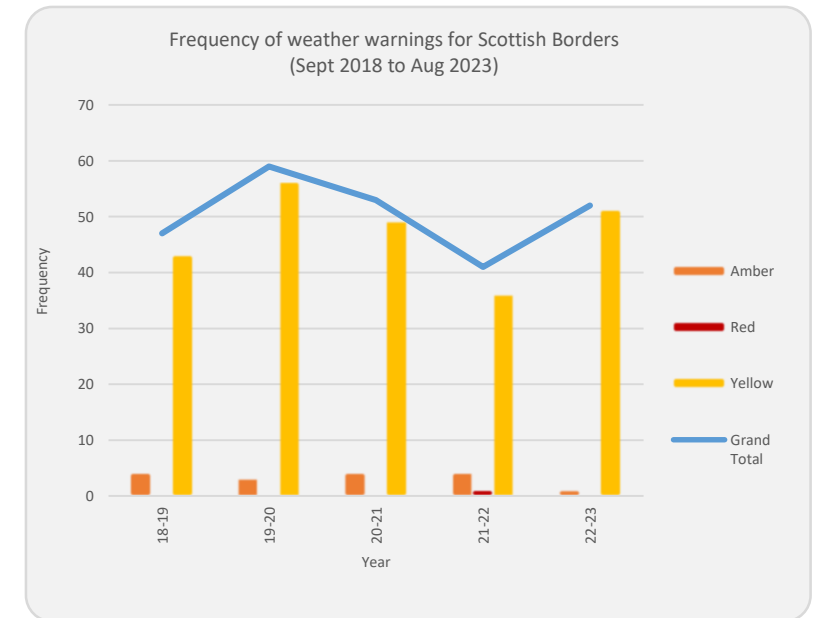
- |                |                |
|----------------|----------------|
| ☀ Extreme Heat | ☁ Rain         |
| 🌫 Fog          | ❄ Snow         |
| ❄ Ice          | ⚡ Thunderstorm |
| ⚡ Lightning    | 🌀 Wind         |

Data was examined regarding weather warnings in Scottish Borders from 2018 onwards. If multiple warnings of the same colour were issued on the same date, these were grouped into one event. The information was presented from September through to August in order to follow the time frame that the Met Office use for naming storms. It is difficult to assess meaningful weather trends over a short time period such as this, but it is helpful to pick out some interesting insights.

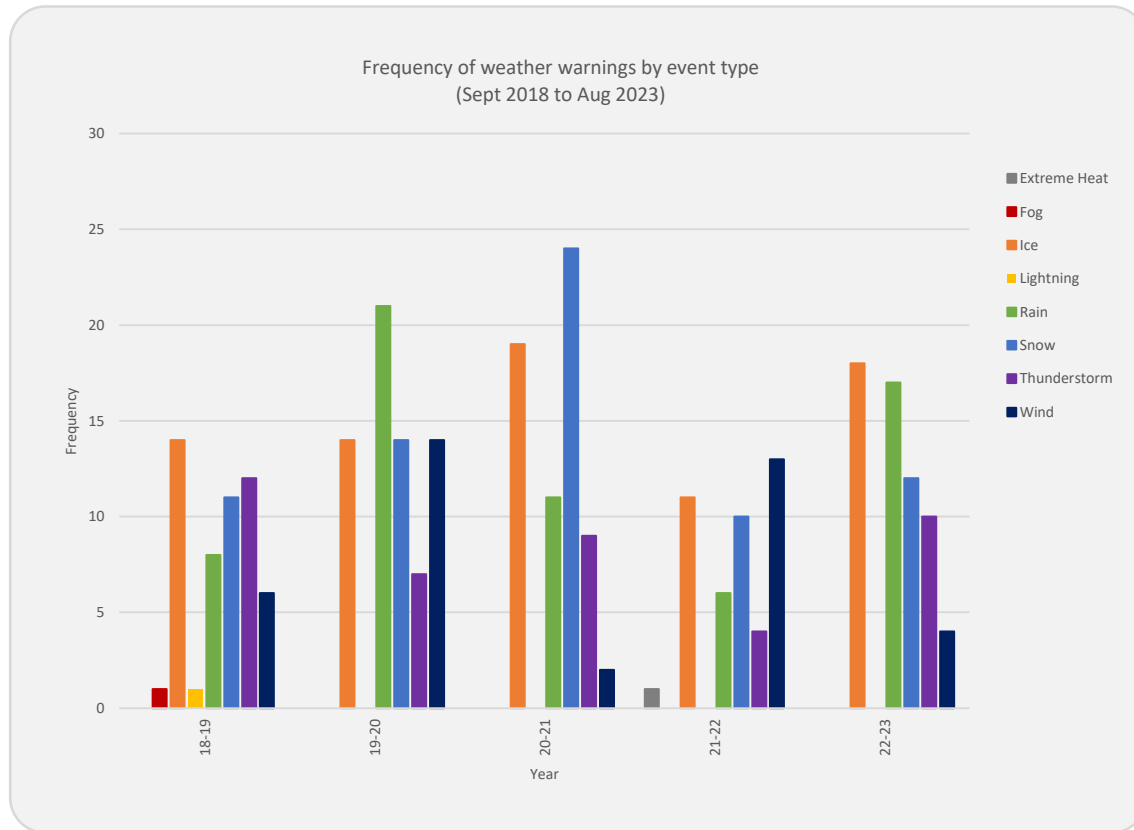
Yellow warnings are the most common weather warning to be issued each year, with the highest number recorded in 2019-20, and an upward trend being seen over the last 2 years of complete data. From September 2023 until the end of January 2024 there have already been 35 yellow warnings issued, in comparison to 29 within the same time frame last year. This indicates that the trend in yellow weather warnings is likely to continue to rise.

There are consistently around 4 amber alerts per naming year. This is likely to be the same or higher this year as there have already been 2 amber alerts so far, and in previous years at least half or more of the amber alerts have occurred post-February. The pattern of amber alerts in Scottish Borders is interesting. In 2018-2019, they were all for snow, ice or wind, but over more recent years there have been no amber alerts for colder weather events, and instead they have been for rain, wind, thunderstorms or even extreme heat. There have even been a couple of amber alerts for rain and thunderstorms in the summer time (June 2019 and July 2021) - echoing the Scottish trend of a change in pattern of rainfall and weather events. The amber alert for extreme heat was in July 2022 and was a first for Scottish Borders. At the same time, a red warning for heat was issued within England for the first time.

Red warnings are much rarer within Borders. There have only been two in the last 10 years, one for snow in February 2018 (Beast from the East), and one for wind in November 2021 (Storm Arwen).



# Weather Warnings and Events in Scottish Borders



The frequency of weather events in Borders was also investigated by weather event type.

Again, it is very difficult to come to any conclusions about trends in weather over such a short time frame, but it can be seen that ice related events are one of the most common weather warnings within each naming year, but that rain related weather warnings are becoming more common over the last couple of years.

Another important trend to highlight is related to named storms. Storms are named by the Met Office when they are likely to cause damage or disruption which could result in an amber or red warning. This is usually related to winds, but could be for another reason such as rain and flooding. Storms are named alphabetically in conjunction with the Irish and Dutch Met Offices, running from September through to August.

Within Borders the frequency of named storms is increasing. In 2019-2020, the storms had only reached **C** (**C**iara) by the end of January, but this year there has already been a Storm **J**ocelyn within the same time frame. By the end of 2023, it was the first time that **G** was reached before Christmas.

Finally, the incidents that the Emergency Planning Department within Scottish Borders Council have had to respond to are increasing. There were two events requiring recording and input in 2018/19, but so far this year (by the end of January 2024) there have already been six events of note.

# Flooding in Scottish Borders

Flooding is often thought of as a particular concern in the Scottish Borders. The main risk to Borders is related to river flooding, but there is also the possibility of coastal flooding as well as surface water run off after intense rainfall. Furthermore, sewer, groundwater and reservoir flooding also pose a risk in this area.

## What significant flooding has been witnessed recently within Borders?

### December 2015

Storms Desmond and Frank contributed to a significant amount of river flooding which caused considerable damage and affected a large number of communities.

### February 2020

Storms Ciara and Dennis caused river flooding in the Tweed Catchment area which resulted in damage to a large number of homes, businesses and transport.

### February 2021

There was a large flooding event in Newcastleton which affected 80 homes and resulted in contaminated water.

### October 2021

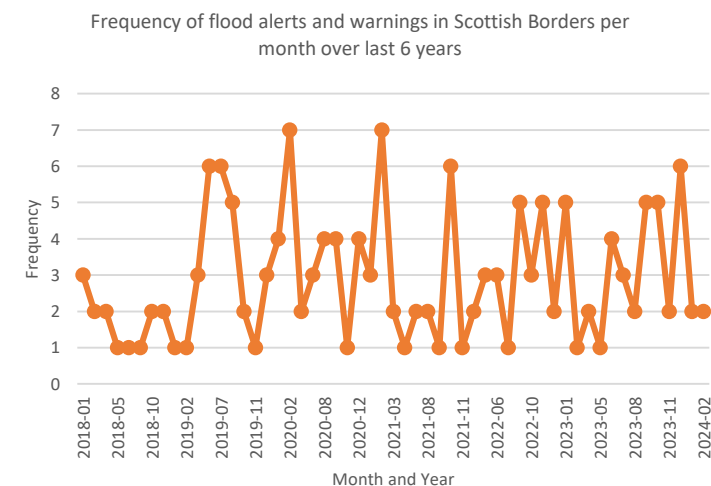
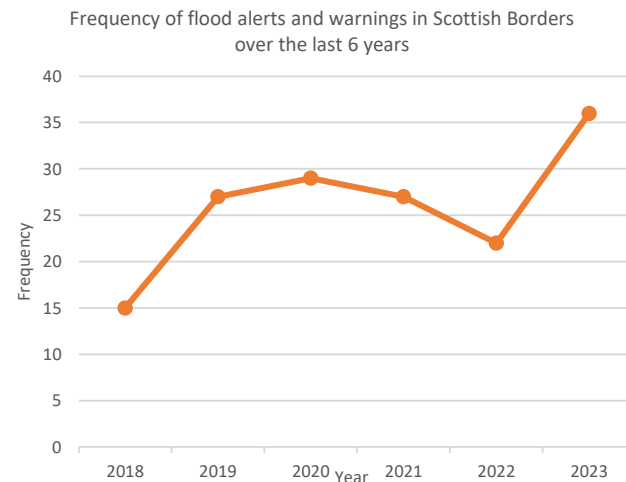
Flooding occurred within the Hawick area, resulting in a major incident being declared.

## What does the data about historic flood alerts and warnings tell us?

Flood alerts and warnings are issued by SEPA within Scotland. A flood alert is usually issued for larger geographical areas and is an early indication of flooding potential. Flood warnings are usually for smaller, more specific areas and they indicate that flooding is likely imminent with immediate action required.

Data regarding flood alerts and warnings (combined) was examined for Scottish Borders over the last 6 years. Any multiple alerts or warnings that were issued in the same area on the same date were grouped into one event.

When this is looked at annually, it can be seen that the overall trend for flood alerts and warnings is increasing across Borders, with the highest number recorded in 2023. When the alerts and warnings are broken down monthly, the two highest peaks were in February (2020 and 2021). In February 2020, 3 severe flood alerts were issued to Hawick (Slitrig), Hawick (Teviot) and Newcastleton Village. From 2018 – 2021, there were peaks in alerts/warnings, and then obvious dips in the numbers recorded. In more recent years however, there seems to be more flood alerts and warnings happening all year round, but to a slightly lower extent, with a smaller gap between the peaks and troughs.





# Flooding in Scottish Borders

## Which areas are at ongoing risk of flooding in Borders?

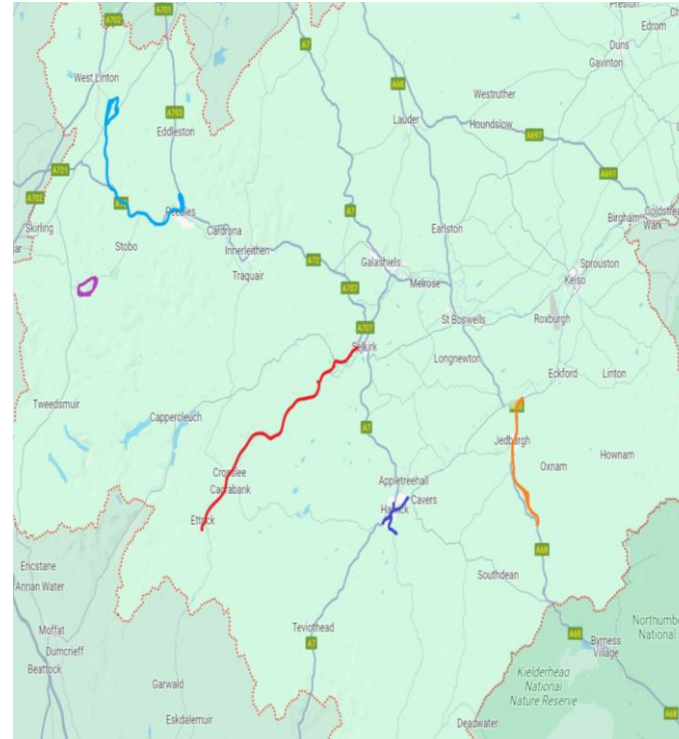
The Scottish Environment Protection Agency (SEPA) classify areas as 'potentially vulnerable' (PVAs) based on their current or future risk from all sources of flooding. A large proportion of all households in the Scottish Borders fall within PVAs from flooding, as can be seen in the map opposite.

Investigating the data around flood alerts and warnings for the last 6 years from SEPA revealed that there are certain areas which have had a higher frequency of these within the Borders.

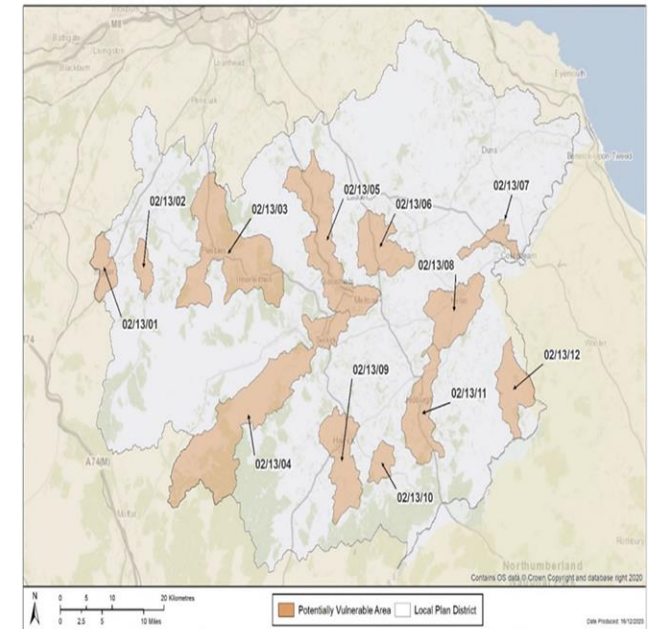
The **Hawick area** (Slitrig, Teviot and Monteviot), alongside the **Peebles area** (Eddleston Water and Romannobridge to Lyne Station) both had the highest number of alerts and warnings over the last 6 years: 31 in total each.

This was followed by **Jedburgh** (Jedburgh to Jedfoot Bridge and Camptown to Jedburgh) with 18 alerts/warnings, and finally **Ettrick Valley** and **Drumelzier to Dawyck** with 16 alerts/warnings each.

This reflects the experiences and professional knowledge of the Emergency Planning Team in Borders who identified Jedburgh, Peebles and Hawick as areas of highest concern for flooding in the area, alongside Newcastleton (given the severe previous events there), and Eyemouth (due to its coastal location and fact that it can flood in 7 different ways).



Area's with a high frequency of flood alerts/warnings in last 6 years



SEPA's potentially vulnerable areas

## What is the impact of flooding in Scottish Borders?

It is estimated that 10,000 homes and businesses are at risk of flooding, affecting almost 14,000 people. It is thought that this may increase due to climate change to approximately 11,000 homes and businesses and 16,000 people by 2080. The financial consequence of flooding is expected to reach an annual cost of £11.6million over this period of time.

# Water Supplies in Scottish Borders



## Private Water Supplies

**1479** private water supplies are recorded in the Scottish Borders.

**4142** domestic properties are served by private water supplies in Borders.

**15,000** people are served by private water supplies in Borders.

**3 times** more people use private water supplies in Borders compared to Scotland (13% vs 4%).

The number of private water supplies has increased in recent years.



## Water Shortages

**Over the last 2 years**, SEPA has had to activate their water scarcity plan.

**In July 2019**, water shortages were noted in the Innerleithen area.

**In May 2023**, private water supplies showed signs of distress due to drought in Scotland. Industrial and agricultural extraction of water from rivers was suspended and The Tweed was one of the most impacted river courses.

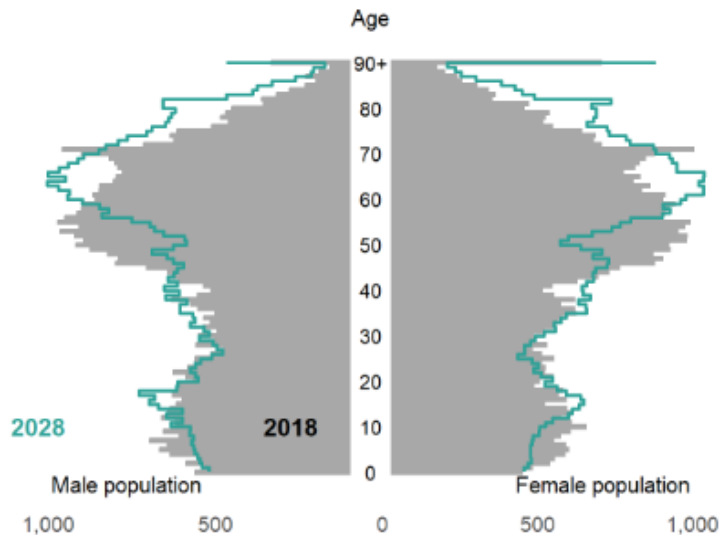
# Population of Scottish Borders



## Total Population

In 2022, 116,900 people were recorded as living in the Scottish Borders.

Between 2001 and 2021, the population of Scottish Borders has increased by 8.5%, making it the 12<sup>th</sup> highest council area in terms of population change, out of the 32 in Scotland.



Scottish Borders current (2018) and projected (2028) population pyramid



## Age Structure

The 45 to 64 age group had a population of 35,080 in 2021, making it the largest group in the Scottish Borders.

The 45-64 age group make up a larger share of the population than is average for Scotland.

This has important impacts for Borders, as this group are the ones who will be the elderly and very elderly in 10-30 years when the impacts of climate change are truly manifesting.

The 16-24 year age group had a population of 10,077, making it the smallest category within the Borders.



## Projected Changes

Between 2018 and 2028, the population of Scottish Borders is projected to increase from 115,270 to 116,435.

The average age in the Borders is estimated to rise, as the baby boomer generation ages and more people live longer.

The population of those 75 years and over is anticipated to increase by almost a third (+29.6%).

It is thought that overall the population will decrease by 3.8% due to there being more deaths than births, but that migration (within the UK and from overseas) will cause a population increase of 4.8% over the same period. Therefore a total change of +1%.

# Population of Scottish Borders



## Older Adults

Scottish Borders has the 5th-highest proportion of over 65s out of all the Council regions in Scotland.

Between 2001 and 2021, the 65 to 74 age group within Borders saw the largest rise (+52.8%), and this category is growing at the fastest rate.



## Employment

Just over 10% of the working population of Borders is employed within Agriculture, Forestry and Fishing (5,000 jobs). The Scottish average is much lower at 3.3%.

Scottish Borders is the 6<sup>th</sup> highest council area in Scotland in terms of dependency on Agriculture, Forestry and Fishing.

The Scottish Borders also has proportionally more people in 'manufacturing' and 'construction' employment compared to Scotland. Manufacturing employs 9.8% of the population of Borders (Scottish average: 6.9%), and construction employs 7.3% (Scottish average: 5.7%).



## Children

There are 21,507 children and young people aged 0-17 in the Scottish Borders.

Children make up almost a fifth of the total population in Borders (18.7%).

16.1% of the population of Borders are between 0 and 15 years old.

3.5% of the total population are 1-4 years old, and 0.75% are under the age of 1 year.



## Migration

Between 2020 and 2021, migration into the Scottish Borders (within UK and from overseas) increased by 49.3% compared to 2019-20 (3,590 to 5,360).

In 2020-21, a net total of 1,270 people moved into the Borders, making the council area the 10<sup>th</sup> highest for net migration in Scotland.



## Pregnancy

There is no exact figure available for the number of pregnant women in Borders at any one time. A proxy is the use of the number of antenatal booking appointments each year.

950-1000 women (0.8% of the population) had an antenatal booking appointment each year over last 3 years.



## Deprivation

In Scottish Borders, 6% of the population (7,099) live within the most deprived areas (SIMD 1).

15% of people (17,410) live in the second most deprived areas (SIMD 2).

The most deprived area in Scottish Borders is Central Langlee in Galashiels.

There are 3 areas in the Borders that are amongst the 10% most deprived areas in Scotland. These are all within Langlee and Burnfoot.

A further 6 areas are within the 20% most deprived in Scotland; Langlee and Burnfoot as well as other parts of Hawick, and Bannerfield in Selkirk.

What is expected to happen to climate in the future, and what does this actually mean?

---

# Expected Future Climate Changes

The projected changes to the climate echo those that are already being seen within Scotland and Borders, described in earlier pages of this report.



**Average temperature is expected to increase.** This is anticipated to be 1.5°C the next 5 to 10 years, with temperatures likely peaking in the mid to late century under optimistic projections. In Scotland, temperatures are expected to rise by approximately 1.1°C by the 2050s, and between 1.1 and 2.0°C by the 2080s. This also means that winters are likely to get warmer overall. It is important to note that severe cold spells of weather will still continue in the short – medium term, but that these are likely to decrease in frequency over time.



**The number and length of heatwaves is likely to increase.** There is uncertainty about what this means for Scotland, although one model anticipated an increase to 5-10 heatwave days per decade in the 2050s, and 10-50 heatwave days per decade in the 2070s.

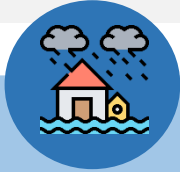


**More extreme and frequent severe weather events are expected.** This includes an increase in combined climatic effects (including storms, high winds, lightning, fog, mist and low cloud).



**Changes in rainfall are anticipated.** Wetter winters are likely to occur, with rainfall expected to rise by 7% by the 2050s, and up to 13% by the 2080s. On the other hand, summers are expected to become drier overall, with a decrease in rainfall of 7% by the 2050s, and up to 16% by the 2080s. Rainfall is projected to become more intense in both summer and winter, so although summers will be drier, precipitation events will be more severe. The intensity is expected to increase by as much as 25%.

# Consequences of the Expected Changes to Climate

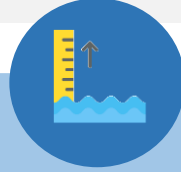


## Flooding

The likely increase in periods of intense rainfall, in conjunction with anticipated sea level rises, is expected to increase the number of river, surface water and coastal flooding events. Alongside this, wildfires are also likely to increase. Wildfires followed by heavy rainfall have the potential to increase flash flooding, runoff, and erosion. The increased temperatures may also dry out soil, which alongside ineffective drainage within agriculture land can further exacerbate flooding.

Within the UK it is thought that the number of people at risk of flooding will increase by 61% by 2050, and 118% by 2080 under modest warming scenarios (2°C). In a worst case warming scenario (4°C), the proportion at risk of flooding is expected to increase by 118% by 2050.

Flooding has widespread impacts to health and infrastructure. It is seen as one of the greatest risks to Scotland from climate change, and the costliest risk to businesses. Flooding from rivers is currently the greatest burden in terms of health and social costs, but coastal flooding is seen as the most dangerous with high levels of damage and fatalities possible. Surface water flooding can pose the most risk to the greatest number of buildings and properties. Some examples of how flooding can impact health are through changes to water quality after flooding events, mobilisation and then exposure to dangerous chemicals from storage, the environment, contaminated land sites and/or agriculture (pesticides), and providing a habitat for vector borne or carried diseases through insects or other pests such as rodents.



## Sea level rises

Sea level rises are expected across the UK due to glacial melting in other parts of the world which allows land masses to rise as a result of the decreased weight of the ice on them. It is expected that sea levels will rise more in the south of the UK, but it is anticipated that in Edinburgh, the sea level might rise between 12 and 18cm by the 2050s, and up to 54cm by the 2080 in a low warming scenario. In a worst case warming scenario, sea levels could rise by 1.5m .

The sea level rising will cause more flooding as well as coastal erosion. The combination of these effects alongside the rise in water levels will cause severe property and infrastructure damage along the coast, as well as posing a risk of e.g. chemical contamination from historic coastal landfill sites and other structures. These impacts will inevitably have widespread direct and indirect health consequences.



## Coastal erosion

Over the next 30 years, it is predicted that almost a fifth (19%) of Scotland's coastline is at risk of erosion. Worryingly, a large number of important structures and assets lie along the coast within these erodible sections; 30,000 buildings, 1,300km of roads and 100km of railway lines (between a half and a third of all coastal infrastructure). It is also expected that the balance of erosion and accretion will be much larger on Scotland's east coast – of particular note to the Scottish Borders.

If these estates are lost it has huge implications for the viability of communities along the coast, which is even more compounded by the likely sea level rises and flooding in these areas too. It will affect access to things such as housing, employment, transport, education and health services which we know has a major implication for the ongoing health of local populations, as well as widening health inequalities. There are also direct impacts to health such as injuries, death and chemical exposure.



## Cold weather events

As described, episodes of cold weather will continue in the short-medium term. Alongside this, there is expected to be more severe and intense periods of rainfall as well as other climatic events such as storms. The increased intensity of precipitation as well as the increase in storms is expected to increase flooding, and can also directly impact infrastructure due to e.g. high winds.

In terms of cold weather, it is predicted that people will continue to struggle to adequately heat their homes, especially during winter; the number of households experiencing fuel poverty is expected to increase from 6.7 million to 8.4 million in the UK this year alone. Within Scotland, 34% of households are thought to be currently affected by fuel poverty. This can lead to people living within homes that are cold and damp, which is associated with illness and mortality.

# Consequences of the Expected Changes to Climate

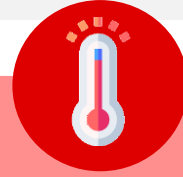


## Wildfires

Wildfires are anticipated to increase due to climate change through a number of processes. The temperature rise during winter, alongside more intense rainfall events may encourage more plant growth. In the summer, with even warmer temperatures, and periods of low rainfall, these plants can dry out and provide fuel for wildfires to ignite. If there is an increase in periods of high winds, this can also dry the soil and vegetation, again providing fuel for fires. Strong winds can also affect where and how far the smoke from wildfires moves. Areas that are at further risk of wildfires include those that are more mountainous – fires tend to spread faster uphill, and south facing slopes can dry out quicker than those in other directions.

Within the UK, it is difficult to determine the extent that climate change will impact wildfire risk. Some modelling suggests that the wildfire season will lengthen into late summer and autumn, with days of very high fire danger doubling. It is also predicted that fire danger days might rise by 3-4 fold by the 2080s.

As described earlier, wildfires can alter the composition of soil which can increase flooding and landslides, made even worse if wildfires are followed by intense periods of rainfall. Wildfires can also impact water quality, air quality from smoke dispersal, cause extensive damage to infrastructure as well as agricultural land, and can increase the release of contaminants from certain types of areas e.g. industrial sites. Again, all of these can have indirect impacts on the health of the population, as well as cause direct injuries and death.



## Overheating

The projected increase in average temperatures, alongside the likelihood of more intense and frequent heatwaves has the potential to cause overheating. Although there is limited current evidence about overheating in Scotland, several bits of research have indicated that even in the current climate, some homes in colder regions are now experiencing overheating. It is thought that over 50% of new build properties experience overheating in our current climate (having better insulation and draught proofing) – and so this is only expected to worsen. Purpose built flats, especially those on the top floors are more prone to overheating than other types of dwellings. Other buildings of concern with relation to the potential to overheat include health care settings (hospitals in particular), care homes, prisons and education settings. The health impacts from overheating range from mild discomfort to death.



## UV radiation exposure

UV radiation is a type of light that is emitted by the sun and absorbed by our bodies. Multiple factors influence the amount of UV radiation that penetrates the atmosphere and reaches us. These include the concentration of ozone in the atmosphere, the amount of cloud cover, as well as air pollution. These are all expected to change as a result of climate change and therefore the amount of exposure to UV radiation has the potential to increase. This has some health benefits such as vitamin D creation, but can also cause pose health risks such as development of skin cancers. Exposure to UV radiation is a complex area however, and it is hypothesised that the demographics of the population, and the behaviours of those living in an area (e.g. more or less time outdoors, appropriate clothing and skin protection) will likely have a greater impact on health outcomes in this arena than climate change itself.



## Drought and Water Scarcity

Drought is a period of unusually dry weather, where rainfall has drastically reduced over a prolonged period of time. It is defined as such when this lasts over a large area and longer than a month. It can be hypothesised therefore that the expected increase in average temperatures, rise in heatwaves, and change in precipitation will lead to more potential for times of drought. This in turn is predicted to lead to periods of time where there is water scarcity or water deficit.

It is thought that by 2100, large parts of England, and less so Scotland will be in water deficit. Private water supplies are thought to be more vulnerable to periods of drought, which is of importance to Scottish Borders given the proportionally large number in the area compared to Scotland. This also means that more isolated communities within Borders have the potential to be impacted more from increased periods of drought.

Another important feature of droughts is that they rarely exist in isolation, but are often experienced alongside heatwaves and wildfires, compounding the effects and risks of all three of these major types of events. The impact of drought is wide-ranging, and as mentioned, more particularly felt within areas supplied by private water supplies. It can affect water quality, land quality and therefore agriculture and crop yields (which in turn impacts employment and food security), biodiversity loss, and can increase allergens in the air. Furthermore, changing moisture content in soil can even lead to cracking of sewer pipelines leading to contamination of soil and water. These factors can all indirectly affect health, on top of the direct impacts to health from a lack of accessible clean water.



# Consequences of the Expected Changes to Climate



## Air quality

Any future changes to the quality of air is very complex to model as many factors have an impact on its composition. Weather patterns and weather events can impact the formation and dispersal of air pollutants both directly and indirectly. The key air pollutants that are of concern are particulate matter (PM), nitrogen dioxide (NO<sub>2</sub>), and ozone (O<sub>3</sub>). The predicted increase in heatwaves is thought to potentially increase O<sub>3</sub> episodes during the summer due to low wind speeds and air stagnation. Droughts can also affect air quality due to soil degradation during these periods, leading to more dust particles in the air. Wildfires produce smoke which contains particulate matter. With droughts and wildfires anticipated to increase, air quality is likely to be negatively affected. Agriculture continues to use fertilisers which contain nitrogen dioxide (NH<sub>3</sub>). Increased temperatures will warm the soil and lead to higher emissions of NH<sub>3</sub> into the air. Furthermore, higher temperatures and decreased rainfall is hypothesised to release a higher amount of persistent organic pollutants (POPs) and pesticides into the atmosphere which will also negatively affect air quality. Although mitigation measures such as switching energy sources may lead to less pollutants entering the air, care must be taken as burning biomass can in fact increase exposure to air pollutants.

As can be observed, it is predicted that some effects of climate change will worsen air quality, whereas mitigation measures against climate change have the potential to improve air quality. This is tricky to model but it is anticipated that by 2050, PM<sub>2.5</sub> will decrease by between 28% and 36%, and NO<sub>3</sub> by between 35% and 49%. It is important to note however that due to the interplay between NO<sub>3</sub> and O<sub>3</sub>, a decrease in NO<sub>3</sub> can lead to localised increases in O<sub>3</sub> within urban areas. It is expected that with more heatwaves as the century progresses, there will be more O<sub>3</sub> and PM<sub>2.5</sub> within the air. The health impacts of these air pollutants will be discussed later in the report.

Another important consideration is aeroallergens within the atmosphere. These are particles in the air which cause or exacerbate allergic conditions such as pollen or fungal spores. Again, predicting the pattern of these is difficult as increasing temperatures may allow more pollen and allergen production, but a rise in extreme events such as storms, heatwaves or drought may reduce the amount of pollen producing flora and counteract this. It is felt however that in the short term, pollen exposure within the air will increase, as well as pollen potency (due to interaction with pollutants in the air). From the 2030's onwards it is possible that this will begin to decline as temperatures rise even higher.



## Water quality

Water quality has been mentioned within most of the consequences of climate change so far within this section. It has the potential to be affected by many of the other forecasted events, and as discussed, private water supplies are more vulnerable to these effects.

Sea level rises, heavy rainfall and coastal erosion can all impact water quality directly through e.g. contamination from historic landfills or industrial sites, but also indirectly by increasing the likelihood of flooding which can then also affect water quality. In addition, droughts lead to poor water quality; reduced dilution can produce higher levels of chemicals within water sources.

The chemistry and composition of soil can be affected by droughts and wildfires, and mobilise potentially harmful chemicals into water sources. As mentioned with wildfires, this can be exacerbated if followed by extreme rainfall. Landslides can also cause mobilisation of chemicals from soil or infrastructure into water sources and cause contamination. Finally, higher temperatures can increase the rates of certain biological processes, especially related to algae, and may lead to e.g. algal blooms in water sources which can impact water quality.

# Consequences of the Expected Changes to Climate



## Biodiversity

It is important to consider the natural and marine environmental impacts that climate change may have, given the abundance of these spaces in Scotland, and the reliance on this type of industry within Borders. There are many positive consequences that the changing climate may have on biodiversity. Warmer average temperatures and drier conditions may allow for greater crop yields, longer growing times, and even new crops to be produced in different areas of Scotland. Livestock could also spend more time outdoors which can reduce costs associated with farming practices. This will have benefits to employment, economy, diversity of food products and food security.

On the other hand, extreme weather events such as storms, heatwaves, drought, wildfires, and landslides, alongside increased flooding, sea level rises and coastal erosion can all impact arable land, soil quality, water quality and availability, and exposure to contaminants. This will effect the survival of both crops and livestock. Coastal flooding and erosion are projected to reduce the availability of high quality farmland in the UK from 38% up until 1990, to 11% by 2050, again of importance to consider with the Borders. The disruption to employment, the economy and food security will all have an indirect effect on the health of the local population.

Air pollution can also impact the growth of crops and vegetation, and as described, air quality is likely to fluctuate over the next century, which will in turn provide instability to the agriculture sector. Temperature changes and weather events are likely to increase pollination and pollen intensity in the short term, but in the longer term this is likely to decrease. This has consequences for the biodiversity of an area, as well as the health of those who live in it.

The changing climate is predicted to increase the amount of pests, pathogens and invasive species within all types of natural and marine lands. There is also an expected increase in the frequency and severity of algal blooms. These can pose risks to crop growth as well as livestock survivability, and have indirect and direct health impacts for humans. Vector borne illness will be discussed in more detail in the next section.

The increase in pests is thought to naturally lead to an increase in the use of pesticides. As weather becomes more volatile and intense, the amount of pesticide required is expected to increase further. Humans may come into direct contact with these as part of their employment, but they may also be ingested in food products, or volatised into water or air, causing contamination and exposure to chemicals through those channels.

## Food security

Within the UK, nearly half of all food is imported from overseas. The proportion of fruit and vegetables that is imported is even higher (78%). More variety of food is imported now than in 1986, including cereals, dairy, fruit, meat, sugar, vegetables and starchy roots. This is interesting given that most of these food groups are predominantly produced in the UK but exported ourselves; eggs (95.7%), cereals (85.5%), starchy root vegetables (mostly potatoes, 77.4%), dairy (75.1%) and white meat (71.1%).

Climate change is likely to have a short term positive impact on food security. The warmer temperatures and change in rainfall is predicted to increase crop yields, growing seasons, allow for different crops to grow, and reduce the cost of caring for livestock. As time progresses however, more extreme weather events will occur and temperatures will rise even higher. This will affect the availability and quality of the land, and impact on the volume of crops and livestock. It is important to note that this not only affects land based agriculture but also the marine environment too. Fish as a food group is already facing a reduced supply and this is only projected to decrease further.

The impact on agriculture is expected to begin sooner in countries where the climate is already warmer, affecting food production and transport. Therefore, unless food supply chains are changed within the UK, there is likely to be changes in the amount of foods that we currently import or price hikes in what we can access. There is also a risk to the quality of food that is available due to contamination from chemicals released during severe weather events, as well as the increased use of pesticides that will likely be needed to manage the increase in pests.



## Landslides

The rise in more intense periods of rainfall is likely to be associated with more landslide events. This is predicted to be more common in the autumn and winter months. The risk to Scotland in particular has been noted due to larger rural areas where transport and other important infrastructure can often be found in areas of high landslide risk, such as steep sided river valleys. The risk of landslides can also increase further when wildfires precede large rainfall events, as the soil composition changes leading to more flash flooding, run off and erosion. As well as impacting infrastructure, which in turn has indirect impacts for health as previously described, they can also cause direct injuries and death.



# Consequences of the Expected Changes to Climate



## Employment opportunities

As described, the increase in temperatures may in the short term provide opportunities within agriculture for greater investment and growth. This in turn may increase employment within this sector. This is important to consider, given the large amount of employment within agriculture in the Borders compared to Scotland. In the longer term however, agriculture is likely to suffer as a consequence of worsening weather events and even warmer temperatures. This may then reduce the amount of employment within this area – again extremely vital to consider within Borders where there is large reliance on this as a career.

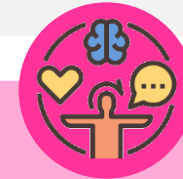
The changing climate may also alter employment opportunities in other ways. There will be a reduction in the amount of fossil fuels being used, but an increase in cleaner energy solutions. There will be changes in demand for certain services and products which may close some sectors and cause loss of jobs, but on the other hand, open up new markets and careers elsewhere. It will be important to monitor these trends to see where the opportunities arise and mitigate for the negative consequences. Given that employment is a large determinant for health, this will have impacts on the ongoing health of the local population



## Damage to buildings and infrastructure

Buildings and infrastructure have been a core component within most of the previous consequences described. They are interlinked with many other impacts that are going to be experienced as a result of climate change. Increased temperatures, cold weather events, storms, flooding, sea level rise, coastal erosion, drought, wildfires and landslides all have the potential to cause damage to vital buildings, infrastructure (such as transport, ICT, energy supplies, water treatment plants), as well as cultural landmarks. These services are all vital determinants of health and so interruption to their supply will have major indirect health impacts. Furthermore, damage to buildings and infrastructure can more directly impact health through injuries and death, as well as exposure to chemicals, exposure to biological entities such as bacteria and fungi, and exposure to damp living conditions.

Another impact to consider is the demand on certain services in the future. More frequent cold weather events in the short term may cause an increase in demand for energy supply. A change in regulation of certain vehicles may increase demand on public transport services.



## Change in Behaviours

Changes to Scotland's climate is likely to lead to a change in the behaviours of those who live there. Warmer weather all year round has the potential to cause people to spend more of their time outdoors. This has positive impacts from a mental health and wellbeing point of view, a physical activity point of view, and for the production of vitamin D. On the other hand, too much inappropriate exposure to UV radiation as discussed can cause physical harm.

There is predicted to be a change in demand for energy, with a reduction in heating in winter, but potentially an increase in cooling demand in summer. This is tied with energy efficiency measures which are also likely to increase. If these are poorly installed however, particularly those aimed at reducing air leakage, they can increase air pollutants indoors which can have negative impacts on health. Furthermore, people may look to alternative methods of heating in the short term (as cold events are still likely to continue for now), some of which have the potential to increase exposure to pollutants or carbon monoxide such as wood burning stoves or furnace style heaters.

Employee productivity is also likely to alter as the climate changes. Severe weather events that impact on housing, other infrastructure, or health are predicted to lead to a loss of work days. It is also important to consider certain occupations that will be more impacted by the change in weather. Those engaged in heavy manual labour, particularly outdoors, are anticipated to be the most affected. Given the distribution of employment types within Borders, this is of particular concern.



## Migration

Given the widespread effects that climate is likely to have across all aspects of life, it is not surprising that migration is expected to increase. This may be as a result of weather events causing loss of housing, possessions or employment, or due to conflict within areas as a result of disputes over resources. The movement of people globally has the potential to increase the spread of infectious diseases, as well as put strain on unprepared local services, including health services.

















What are the specific health impacts of climate change?

---








# Health Impacts of Climate Change

The health impacts from climate change are difficult to be able to fully estimate. They are nuanced, interdependent, and may change based on action to mitigate climate change, behaviour changes in the population, and global events that are unpredictable at this point in time. There is more evidence for some of the health impacts than others; namely the impacts of flooding, heat and cold, and vector borne diseases. The health impacts that are anticipated, and summarised below, are based on current evidence and modelling which may change in the future as more information comes to light. Any positive impacts to health have been highlighted in green.

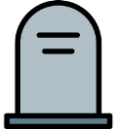
## Direct Health Impacts

-  Mortality
-  Vector Borne Disease and Zoonoses
-  Infectious Diseases
-  Mental Health and Wellbeing
-  Respiratory Disease
-  Cardiovascular Disease
-  Renal Diseases
-  Cerebrovascular and Neurological Conditions
-  Skin Conditions
-  Cancer
-  Maternal Health
-  Eye Conditions
-  Injuries
-  Heat Exhaustion and Heat Stroke
-  Hypothermia
-  Bone Health

## Indirect Health Impacts

-  Damage to Infrastructure and Access to Services
-  Ability to Care for Physical and Mental Health
-  Migration
-  Food Supply and Safety
-  Measures to Mitigate or Adapt to Climate Change
-  Chemical Exposure
-  Change in Behaviours

# Health Impacts of Climate Change



## Mortality

Climate change is expected to affect overall rates of death in the UK, through a host of different mechanisms.

- Flooding, wildfires, storms and landslides are expected to cause accidents and injuries, leading to increased deaths.
- Carbon monoxide poisoning may lead to death during and following flooding events. This is due to the use of portable generators for temporary power supplies, heating and cooking, pumping and cleaning activities after flooding, and the use of damaged boilers.
- Death from cardiovascular and respiratory diseases may rise during heatwaves. It is estimated in Scotland that heat-related deaths will increase to between 70-285 per year by 2050, and 140-390 per year by the 2080s, assuming there is no population growth.
- Despite average temperatures increasing, due to the ageing population in Scotland (and the Borders), and high burden of disease, excess deaths from cold weather may still increase in the short-medium term and dominate for the first half of the century. **From the mid-century onwards, cold-related deaths and winter mortality may begin to decrease.**
- Evidence suggests that mortality may increase during periods of drought, with inland areas more affected than coastal regions. The highest mortality as a result of drought is expected in those over 65 years old.
- Exposure to air pollutants such as particulate matter, nitrogen dioxide and ozone is predicted to cause excess deaths as well as premature mortality. The causes of poor air quality were discussed earlier in the report, and include heatwaves, drought, wildfire smoke and agricultural practices. The expected increase in mortality is due to cardiovascular and respiratory diseases, as well as mortality due to cancer related to pollutants.
- **It is thought that measures to mitigate climate change should lead to improvements in air quality and therefore reduce the number of deaths related to air pollution. These may not be as large as expected however due to overall increases in the population size over the time frame. By 2050 it is predicted that annual mortality attributable to PM2.5 and NO2 long-term exposure will decrease by 25% - 37%, depending on population changes.**

# Health Impacts of Climate Change



## Vector Borne Disease and Zoonoses

The changing climate, particularly the increase in average temperatures alongside flooding events, means that the conditions within the UK are going to become more ideal for certain vector borne diseases that would never have been able to survive previously, as well as improving the conditions for ones that already exist in the country.

- Lyme disease is transmitted via ticks, and Scotland currently has the highest rates of Lyme disease in the UK. This is thought to be due to higher levels of outdoor tourism as well as higher humidity – both of which are likely to increase with the anticipated changes to the weather. It is also thought that the increase in temperatures may extend the tick season which could impact the number of cases seen. In addition, changes in agriculture, land use and wild animal populations may also affect the number of ticks, and therefore transmission of Lyme disease. Tick borne encephalitis is a much rarer condition at the moment, but it also has the potential to become more prevalent under the same conditions.
- West Nile Virus, Chikungunya, Zika and Dengue Fever are all mosquito transmitted diseases. There is currently no evidence of mosquito transmitted disease in Scotland, but conditions in the south of England have meant the establishment of culex mosquitos in the country. As temperatures rise and climate changes, these insects (and the diseases they carry) are predicted to move further North. Under pessimistic projections, by the 2060s or 2070s, most of Wales, Northern Ireland and parts of the Scottish Lowlands could become suitable environments for the mosquitos that transmit these diseases. It is also estimated that if temperatures increase by 2°C, by mid-century there could be a 37% increase in the transmission potential for Dengue Fever in the UK.
- Another major disease of concern is malaria, also transmitted by mosquitos. Presently it tends to favour tropical climates, but it is anticipated that as the country becomes warmer, the mosquito may be able to survive at higher and higher latitudes. Already compared to 1951-1960, 10% more of the global area has become suitable for the transmission of malaria.

# Health Impacts of Climate Change



## Infectious Diseases

Changes to the climate have the potential to increase exposure to infectious diseases in many ways. Firstly, temperature increases, rainfall changes and flooding all have the possibility of improving the conditions required for certain pathogens to grow, proliferate, or even change biologically to enhance ongoing survival. Flooding events where water has been contaminated by sewage could expose the population to more infectious diseases, although research seems to indicate that there have been no significant outbreaks of infectious disease post-flooding in the UK previously. Increased rainfall and flooding can affect soil integrity and may lead to more pathogens in run-off, contaminating water supplies. Other events that can impact water quality (as discussed in the previous section) could increase transmission of infectious diseases, particularly if water supplies used in food production are affected. There may be changes in the distribution of pests and rodents which carry infectious diseases, increasing the possibility of human contact or transmission. Warmer weather in the summers may lead to greater use of cooling systems, as well as other behaviour changes such as altered food preparation or consumption habits, more outdoor living, and increased water recreational activities which can all lead to exposure to pathogens which cause infectious diseases. Finally drought leading to water scarcity could theoretically change hand-washing and hygiene behaviours which may enhance transmission of certain diseases.

- In terms of specific infectious diseases, the strongest evidence exists for salmonella, campylobacter and vibrio spp. These pathogens are all foodborne/waterborne, cause gastro-intestinal infections, and have strong evidence to suggest they are sensitive to the imminent changes in climate. It is predicted that diseases from these organisms will increase in the UK.
- Due to the increase in warmer weather, it is also hypothesised that cases of legionellosis will increase in the UK, related to cooling systems, outdoor bathing and contaminated seafood. This pathogen causes anything from a mild fever, to severe respiratory disease.
- Another organism of note is Shiga toxin-producing Escherichia coli (STEC). This is another foodborne/waterborne organism and can cause gastro-intestinal illness, as well as a severe disease called haemolytic uraemic syndrome. Cases of this bacteria are expected to increase due to warmer weather, and integrity of water supplies used in salad production.
- Finally, antimicrobial resistance (AMR) is of great concern globally, where pathogens are becoming immune to the effects of the medication that we have to treat them. It has been suggested that climate change may hasten the development of AMR due to an increase in pathogen replication which can allow for resistant strains to appear.



# Health Impacts of Climate Change



## Mental Health and Wellbeing

Many of the anticipated consequences of climate change described in the previous section of this report have been associated with impacts on mental health and wellbeing.

- Flooding has the widest evidence base in this regard. It is understandable that there could be ongoing mental health effects from flooding from a range of factors such as loss of possessions, homelessness, loss of energy and other important infrastructure, education disruption, financial losses, loss of employment and potential difficulty in accessing health or social care services. Those who experience flooding have been shown to be at higher risk of depression, anxiety and post-traumatic stress syndrome (PTSD) for 3 years following the event. This also applies to children, whose mental health can be severely impacted following a flood due to loss of support networks and familiar surroundings. Additional drivers for worsened mental health after a flood event include displacement without warning, large damage to a home, dealing with insurance claims, and living in more isolated communities where links to health and social care, employment and education are already difficult. One study found higher rates of anti-depressant medications in flooded areas in the year after the event, with this being more pronounced in more deprived areas.
- Higher temperatures have also been associated with worsening mental health. Some research indicates that there are higher emergency admissions for psychiatric reasons, worsening of schizophrenic symptoms, increased violence, and risk of suicide.
- There is evidence that wildfires can have a negative impact on mental health, including PTSD, anxiety, suicide risk and depression. Wildfires have also been linked with worsened emotional wellbeing due to feelings of fear, stress and uncertainty after the event.
- Drought is another weather event which is likely to increase, and which has also been linked with worsened mental health and wellbeing. A large amount of the research has focussed on the impact that these events have for those who work in agriculture due to the impacts on loss of crops and livestock. Most evidence suggests that they cause negative mental health effects in these groups. Drought has also been highlighted as a particular concern for rural communities – both adults and children express worry about their community, isolation, feelings of loss, and increased distress as a result of these types of events. This is pertinent for the Borders which is both rural, and has a large amount of agriculture.
- Increased periods of warm weather may lead to more time outdoors. Exposure to sunlight has positive effects on mental health and can also help with melatonin regulation which can improve sleep (and consequently mental wellbeing). More contact with nature has also been shown to be beneficial for mental health and wellbeing.

# Health Impacts of Climate Change



## Respiratory Disease

Many of the expected consequences of climate change have been noted to impact on the development or deterioration of lung conditions.

- Weather events such as storms or very heavy rainfall, alongside increased flooding events, are expected to affect indoor environmental conditions, with greater exposure to damp, fungi or bacteria. Living in these circumstances is known to increase respiratory illness and allergic diseases such as asthma.
- The trend towards higher temperatures has been modelled to increase A&E attendances and emergency admissions due to exacerbation of respiratory diseases. Previous research has noted a worsening of respiratory symptoms when indoor temperatures exceed 26°. The elderly and the very young are particularly at risk of respiratory related hospital admissions during heatwaves.
- Cold weather events are still expected to continue and dominate until the middle of the century. These also increase the risk of hospitalisation or death from respiratory illnesses such as COPD. The effect of cold weather events has been shown to last longer than hot weather events, and can persist for over 2 weeks. Cold weather events may encourage people to use alternative heat sources such as wood burning stoves. There is limited research showing an association between indoor wood burning and asthma and respiratory infections in children, as well as increased risk of lung cancer and COPD in adults. There is also the potential for carbon monoxide exposure through faulty boilers or inadequate ventilation.
- Changes in air quality are anticipated to affect respiratory disease presentations. In the short-medium term, exposure to air pollutants is predicted to increase. This is associated with respiratory mortality. The effects of ozone on respiratory illness have been modelled and it is expected that annual emergency respiratory hospitalisations will increase up to 12% by 2050. *In the longer term, it is anticipated that air pollutants will begin to decrease due to mitigation and adaption measures for climate change. This will potentially lead to a decline in respiratory disease exacerbation and development.*
- Aeroallergen increases in the short-medium term are expected to exacerbate hayfever, as well as asthma symptoms. There is also likely to be an increase in fungal allergic conditions such as asthma, rhinitis, allergic bronchopulmonary mycoses and hypersensitivity pneumonitis. *As time progresses however, and temperatures rise even further, pollen producing species and fungal spores are less likely to survive which may result in fewer allergic conditions presenting or worsening.*
- The expected increase in wildfires will lead to greater numbers of individuals being exposed to wildfire smoke. This contains chemicals that have been related to respiratory conditions. Particulate matter and isocyanic acid is associated with asthma, COPD, lung cancer and respiratory tract infections.
- *The increase in average temperatures has the potential to increase the amount of time that people spend outdoors, as well as increase the amount of physical activity that is carried out at a population level. These have both been related to improvements in the development and exacerbation of respiratory diseases.*

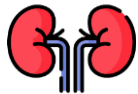
# Health Impacts of Climate Change



## Cardiovascular Disease

The consequences of changing weather patterns and other effects of climate change are predicted to impact upon the levels of cardiovascular disease in the population.

- Higher temperatures have been associated with an increase in A&E admissions and emergency hospitalisations due to exacerbation of cardiovascular diseases.
- With the continuation of severe cold weather events in the first half of this century, emergency hospital admissions associated with cardiovascular disease is expected to increase. As described above, the effects of cold weather events have been noted to last longer than those as a result of hotter weather.
- As with respiratory diseases, the short-medium term expected increase in air pollutants has been associated with cardiovascular mortality. *As mitigation and adaption measures develop and are instigated against climate change, air quality is anticipated to improve, and so too morbidity and mortality associated with cardiovascular disease.*
- The predicted increase in wildfires will mean that more of the population are exposed to wildfire smoke. This contains particulate matter which has been linked to the development of cardiovascular disease.
- *Sunlight exposure has been associated with lower blood pressure, and so the increase in average temperatures and possibility of more time spent outdoors, may contribute to lower rates of hypertension and other cardiovascular diseases.*
- *More time spent outside may also increase contact with nature, as well as increase physical activity levels which are expected to have a positive effect on the incidence of cardiovascular diseases.*



## Renal Diseases

It is anticipated that renal disease incidence, as well as emergency exacerbations of pre-existing disease will increase as average temperatures rise – particularly during heatwave events.

# Health Impacts of Climate Change



## Cerebrovascular and Neurological Conditions

Cerebrovascular and neurological conditions are expected to be impacted by the changing weather, as well as other consequences of climate change.

- The trend to higher temperatures has been hypothesized to increase the incidence of some of these conditions, as well as increasing A&E attendances and emergency hospital admissions as a result of cerebrovascular and neurological disease. Recent research identified a worsening in dementia symptoms when indoor temperatures exceed 26°C.
- As already highlighted, severe cold weather events are going to continue in the short-medium term and effects of these can persist for over 2 weeks (longer than that of heat related weather events). Severe cold weather has been associated with an increase in hospital admission or death from Alzheimer's disease, dementia and cerebrovascular disease.
- Changes in air quality in the shorter term are expected to have an impact on these types of diseases as exposure to particulate matter has been linked with cognitive decline and dementia. As mentioned above, climate change mitigation and adaption measures are likely to improve air quality in the longer term, and may then help to decrease the incidence of cognitive conditions.
- Particulate matter is also of a concern within wildfire smoke exposure, which is anticipated to increase with changing weather patterns. The particulate matter in wildfire smoke has been linked with stroke, Alzheimer's disease and Parkinson's disease.
- Again, the warmer weather that is expected, may lead to more time in the outdoors and an increase in physical activity. Both of these are related to improvements in cognition and the development of cerebrovascular disease.



## Skin Conditions

Skin conditions are expected to increase as a result of some of the weather changes associated with climate change.

- Over-exposure to UV radiation from increased periods of warmer weather may cause sunburn, premature skin ageing, and increased prevalence of skin cancers such as non-melanoma skin cancers and malignant melanoma.
- The predicted increase in aeroallergens (such as pollens and fungal spores), at least in the short-medium term, is anticipated to increase the incidence of atopic disease – one of which is eczema.
- Increased flooding events mean an increased risk of exposure to contaminated water. This may increase the likelihood of infectious skin diseases developing, although data from UK flooding events thus far has not shown an increase in outbreaks of infectious diseases post-flooding.

# Health Impacts of Climate Change



## Cancer

There is evidence that some of the changes in climate may impact upon the development of cancer.

As discussed within 'skin conditions', warmer weather may lead to time outdoors which increases exposure to UV radiation, as well as other climatic changes that increase the amount of UV radiation that can penetrate the atmosphere. Too much exposure to UV radiation can increase the risk of skin cancer development.

Air pollutants and worsening air quality has been linked to cancer mortality, therefore this may increase in the shorter term when air quality is anticipated to decline. *In the longer term however, with anticipated improvements to air pollutants from climate change adaptation and mitigation measures, cancer mortality may be positively impacted.*



## Maternal Health

There is a small amount of evidence related to the impact that climate change will have to maternal health, although more research is required in this area.

- It has been noted that increased periods of heat can impact maternal physical and mental wellbeing, likely due to the increased stress that the body is under when conditions are warmer.
- Wildfire smoke that contains particulate matter has been linked to low birth weight in affected areas post-event.



## Eye Conditions

*Again, the rise in average temperatures may lead to more people being outdoors. This can increase time spent in sunlight which has been linked to a reduction in myopia (short-sightedness) in schoolchildren and young adults.*

# Health Impacts of Climate Change



## Injuries

It is anticipated that there will be a rise in the number of injuries sustained by the population as a result of climate change. Some examples are given below.

- Car accidents, as well as other injuries may occur during storms, flooding events or landslides.
- Wildfires may cause burns, injuries from falling debris, and electrocution.
- Behaviours may change during periods of hot weather which can increase accidents and injuries, such as swimming or hiking incidents.



## Heat Exhaustion and Heat Stroke

As discussed in the previous section of the report, overheating is anticipated to rise due to a combination of temperature increases alongside modifications to homes to become more energy efficient. The impacts are likely to be felt more so in institutions such as prisons, care homes, education settings or hospitals.

People may experience mild symptoms such as general discomfort, fatigue, cramps or rashes, or it can manifest as more serious conditions such as heat exhaustion, heat stroke or hyperthermia.



## Hypothermia

On the other side of the spectrum, episodes of hypothermia may increase due to cold weather events continuing to dominate in the first half of the century in an ageing population, alongside the increased risk of flooding, which can also result in hypothermia.



## Bone Health

The anticipated warmer weather is likely to increase time spent outdoors. This will increase vitamin D production which is important for bone health and the immune system.

# Health Impacts of Climate Change



## Damage to Infrastructure and Access to Services

Damage to infrastructure was discussed within the section about the consequences of climate change. Many of the expected changes and events are likely to cause damage to important buildings and services that are vital for good health. These include fundamental infrastructure such as access to energy supplies, clean air and safe drinking water, as well as shelter, being able to source food supplies, communication links and transport. Secure employment, access to education, and green/blue spaces can also have an impact on the population's physical and mental health, which if interrupted by weather events may lead to a decline in the health of the population overall. Furthermore, weather events will not discriminate, and so health and social care buildings and structures could be affected, and service reduced due to physical damage. These determinants of health are also implicated in the widening of health inequalities, which could therefore worsen in some parts of the Borders if infrastructure to some is affected worse than others.

Tied into damage to infrastructure is access to services (unrelated to physical building damage). A large climate related event in the area, such as a wildfire or extreme flooding, could cause large amount of pressures on the health service within Borders. This would likely mean a reduction in the ability to provide routine and preventative care, therefore affecting the ongoing health of the wider population in the area.

Weather events may also prevent key workers from being able to travel to their place of work, or to their clients, which again can have an impact on access.

Health systems delivery can also be impacted by interruption to other services, for example if electricity or water supply is affected, medicines and devices may not be able to be used or stored correctly which can have negative consequences for health.



## Ability to Care for Physical and Mental Health

As has been highlighted, climate change events can lead to a loss of possessions, loss of home, disruption to employment and education, and financial stresses. Those who are affected by this may not be able to prioritise caring for their short or long term health whilst recovering. This could range from not attending health care appointments, neglecting screening offers, not being able to take part in physical activity or eating less nutritiously. The length of the recovery process will impact the severity that this will have on their longer term physical and mental health.

# Health Impacts of Climate Change



## Migration

Migration is anticipated to increase as a result of severe weather events, lack of resources, and even increases in violent conflict. This may contribute to the spread of infectious diseases into the area which have not been encountered before. If not adequately prepared for, it can also put a strain on all public services including health care, which would in turn negatively impact the health of the population living in Borders.



## Food Supply and Safety

As noted earlier in the report, the UK imports a large proportion of its food. Climate events can pose a risk to food production both internationally as well as locally. If food supply chains fail then this will have an impact on the health of the population in several different ways.

- It is predicted that the absolute availability of food within the UK is unlikely to decrease over time in this century, but that as climate events become more frequent overseas (where most of our food comes from), food prices are likely to rise. This can change food behaviour and choices, particularly for those who are within the most deprived areas of society.
- It is estimated that by 2050, 52% of vegetables and 47% of fruit will still be imported from climate vulnerable countries. This is a great reduction from current proportions, and if not increased locally, there will be a shortfall in the amount of healthy foods that are needed to meet the populations' requirements for good health. These are also likely the types of food that will see price increases, meaning that people may choose to eat less of these nutritious foods, and instead increase consumption of foods higher in saturated fat, salts and sugars. This will in turn lead to obesity levels rising, which has serious impacts for ongoing health.
- There is also the possibility of impact on food safety. If food is being imported from climate-vulnerable countries where weather events are occurring more frequently, water and soil quality could be affected which can alter the quality and safety of the food being grown and produced. The same is possible locally to a lesser extent in the short term. There may also be new vector borne diseases present in food and livestock as the climate changes, which can negatively impact health.
- Climate change does offer an opportunity in terms of food supply however. There is the possibility to diversify the crops and livestock that are being grown in the UK in the short-medium term, which has the potential to decrease prices of some of these items and therefore improve uptake of nutritious food products within the population. The imminent changes to climate, and need for mitigation and adaptation, may also act as a driver towards more plant-based and meat-substitute based diets which would have the dual effect of decreasing carbon emissions as well as improving population nutrition and health.



# Health Impacts of Climate Change



## Measures to Mitigate or Adapt to Climate Change

Many of the measures that could be used to mitigate or adapt to climate change can have dual health benefits. Some may also have negative health impacts however, and so it is important to ensure any interventions that are used have been carefully considered.

- Insulation of buildings is thought to reduce energy consumption, therefore reducing greenhouse gas emissions (GGE). Improving thermal comfort within homes has a positive impact on health and wellbeing. It can also alleviate fuel poverty. Improved insulation can also help to protect against cold related morbidity and mortality. Insulation without adequate ventilation however can increase exposure to indoor pollutants, increase the risk of mould growth and the transmission of air-borne diseases, and reduce ventilation of toxic gases such as carbon monoxide, all of which can negatively impact health.
- Switching to renewable energies is anticipated to reduce the burning of fossil fuels, and therefore GGE. By doing this, the population is less vulnerable to changing fuel prices, again reducing fuel poverty as well as fuel insecurity which has indirect impacts on health. There is also the added benefit of a reduction in air pollutants and improvement in air quality. On the other hand, hydroelectric power has the potential to disrupt local environments and reduce water quality. The impact on biodiversity in local areas has already been highlighted to have health implications. Furthermore, those living close to wind turbines have associations with reduced quality of life through noise disturbance and sleep interruption.
- Nature based solutions such as expanding green space, creating forests and protecting marine environments are thought to help reduce average temperatures. Having access to green space is associated with improved mental health and wellbeing, as well as reduced all cause and cardiovascular mortality, lower levels of obesity and reduced incidence of low birth weight. If not carried out appropriately however, there can be negative health impacts. There may be more pollen production in urban spaces if tree species are not chosen carefully. New woodlands may provide environments for vectors such as ticks, increasing tick-borne disease transmission. Increasing wetlands may also provide ecosystems for certain mosquitos.
- A shift towards active travel is thought to decrease GGE. This has huge co-benefits for health, as it is likely to improve air quality as well as increase physical activity levels. This would impact on cardio-respiratory diseases, cancers, dementia and type 2 diabetes. It would also lead to improvements in mental wellbeing. Exposure to sunlight also has added benefits that were discussed in the direct health benefits section of this report. More time outdoors has the potential to increase exposure to UV radiation, which, if not moderated or controlled, can lead to skin deterioration and skin cancers.
- Introducing measures to mitigate or adapt to climate change offers the potential to involve communities in these actions. By empowering local communities to take responsibility for climate change, they are likely to become more connected, resilient, and supportive of each other, which will positively impact physical and mental wellbeing in the local area.
- Certain food types, particularly meat based foods, have a high carbon footprint and so by changing diet practices, this could help reduce greenhouse gas emissions. By moving to a more plant-based diet, the population has the potential to consume a more nutritious diet which will have positive impacts for health. Reducing consumption of meat could also reduce the risk of zoonotic diseases, as well as anti-microbial resistance.
- If measures to mitigate and adapt to climate change are carried out thoughtfully then they also have the opportunity to reduce inequalities within a population, which can in turn reduce health inequalities. On the other hand, they have huge potential to widen health inequalities if not implemented well.

# Health Impacts of Climate Change



## Chemical Exposure

Mentioned throughout this report has been the risk of exposure to chemical contaminants as a result of some of the anticipated weather events from climate change. These include flooding, severe storms, flooding, sea level rises, coastal erosion, wildfires and landslides.

Many of these chemicals have negative health impacts.

- Some historic components within buildings may become exposed after weather events which have consequences for health, such as lead or asbestos.
- Exposure to certain metals can impact many biological systems such as the nervous system, gastrointestinal system, cardiovascular system, kidneys, liver and lung. They can also be carcinogenic, and have been associated with heart disease, diabetes and cognitive impairment.
- Persistent organic pollutants can become exposed with water and soil changes. These are linked to cardiovascular disease, cancer, metabolic disorders, as well as disrupting the endocrine system, reproductive system and immune system. Organo phosphate pesticides also have potential effects on the central and nervous systems, including associations with Parkinson's disease.
- Volatile organic compounds have also been shown to adversely affect health. They have been linked with haematological conditions, cancer, neurological conditions, liver and kidney damage, as well as decreased fertility in men.



## Change in Behaviours















Behaviour changes have been mentioned throughout the direct and indirect impacts of climate change, but it is important to highlight a few here.

- Increases in temperatures, and heatwaves have been associated with increased violence.
- Dietary behaviours are likely to change which will have knock on implications for obesity, cardiovascular disease and cancer.
- Physical activity levels will change which could have the same health effects.
- There is a potential for a change in substance use which again would have health implications.

# What does this all mean for the Scottish Borders?

---

# Consequences of Climate Change for Borders

-  Temperatures will increase overall
-  Winters will be warmer and wetter
-  Summers will be drier and warmer, but with more intense rainfall events
-  Cold weather events will continue in the short-medium term
-  More severe weather events will occur including more weather warnings and named storms
-  There is an increased likelihood of flooding events
-  Sea levels will rise and coastal erosion will worsen
-  Water scarcity may worsen, with private water supplies being particularly vulnerable
-  Water quality could be negatively impacted as a result of many types of weather events, and again impact private water supplies to a greater extent
-  There is the potential for increased high risk wildfire days as temperatures become much warmer
-  The likelihood of landslides will increase
-  Migration will likely increase
-  Biodiversity of the area will change which brings with it many risks which have been detailed in the report, but can also present opportunities for new types of crops and livestock
-  Changes to air quality will occur over the next century, depending on the extent and speed of mitigation and adaption measures

# Areas Most at Risk in Borders



Specific high areas of concern for flooding include Hawick, Peebles, Jedburgh, Newcastleton and Eyemouth, based on projected risk and historic events.



Areas that have a higher number of private water supplies are at increased risk of water quality issues from a number of climate related consequences, as well as water scarcity.



New builds, and purpose built flats (especially top floor) are more at risk of overheating and ventilation issues.



Care homes, education settings and hospital sites are also at greater risk of overheating.



Coastal communities are at risk of sea level rises as well as coastal erosion and the consequences of these.



South facing areas, particularly on slopes and with good vegetation are most at risk of wildfire events.



Steep sided river valleys are most at risk of landslides



Remote communities are at risk of much if the predicted changes to climate, imminent weather events and further impacts of all of these

# People Most at Risk in Borders



Older adults are particularly vulnerable to the changes in climate, and some of the events and consequences that are predicted to occur. In the short term, the older adults of today are at risk of current climate changes, but it is important to remember that the 45-64 year age group are those that are likely to be most vulnerable to the impacts that are anticipated by the 2050s (which in Borders is our current largest proportion of the population).



Children, pregnant women and those with pre-existing health conditions are also most vulnerable to many of the same consequences of climate change. Other groups that are vulnerable include those who are unable to alter their living environment, those who are homeless, those who use substances, and people with poor mobility and other disabilities.



Those who live in the most deprived areas of Borders are at risk of many of the impacts of climate change due to their baseline vulnerability and inability to adapt quickly to any severe weather events or infrastructure disruption and destruction. They are also at risk of some of the mitigation and adaptation measures for climate change if these are not carefully considered. This is important as 21% of the population of Borders live in SIMD 1 and 2. The most deprived areas to consider are Langlee, Hawick, and Bannerfield in Selkirk.



Those who work in agriculture are at risk of the effects of climate change, particularly flooding and drought. There are opportunities within this sector as well, in terms of crop and livestock type and yields, although this is a careful balance with the imminent risk to this type of livelihood. Again an important consideration with Borders where a large proportion are employed in this industry.



Rural communities are at risk of many of the impacts detailed in this report due to the lack of infrastructure currently in place in these areas, the remoteness of the settings, the type of employment that is available, and the ecosystems present in more rural areas. Flood disadvantage (the combination of living in an area at flood risk and the degree to which socially vulnerable communities are disproportionately affected by flooding) is greater in dispersed rural communities.



Those who live in coastal communities are at risk of sea level rises and coastal erosion. Flood disadvantage is also high within coastal areas.



Those who live in new builds or purpose built flats are at risk of overheating and ventilation issues.



Those in care homes, hospital sites and education settings are at risk of overheating.



Individuals who work outdoors and in manual labour types of employment are also at greater risk from the effects of increased temperatures.

# What are the next steps?

---

# Next Steps Within Borders

## Community wealth-building

- Continue to work with partners across Scottish Borders to enhance community wealth-building and promote resilience of places and communities. Develop and boost social connections across the area, prioritising those most vulnerable or at risk from the impacts of climate change without negating the general population.

## Partnership Working

- Work with health and social care to identify those who are most at risk from climate change, and to ensure that these services are also resilient to any climate impacts. Continue to work towards the actions outlined in the NHS Borders Climate Change and Sustainability Action Plan.

## Vulnerable Groups

- Consider specific vulnerable settings such as schools, care homes and workplaces, identifying measures could be put in place in these locations to enhance resilience and reduce vulnerability to some of the health impacts of climate change.

## Awareness Raising

- Raise awareness amongst public and professionals within Borders about the impacts of climate change and where the greatest risks are. It is important to share the messages of this report in order to start climate change conversations, empower our local communities and drive local change towards a 'climate in all policies' approach.

## Build on Great Practice

- Continue to build on the fantastic community work, asset based approach and leadership from communities that exists within the Scottish Borders.

## Evaluation

- Work with Public Health Scotland towards their development of Scottish climate change indicators for health, which will enable greater surveillance of the health impacts of climate change.

## Reduce Inequalities

- Ensure that climate change and actions are incorporated into the new NHS Borders Health Inequalities strategy, given the huge impact that climate change has on more deprived areas of the population.

## Climate Across Public Health

- Work to incorporate climate change and sustainability as a theme and consideration within all aspects of public health work within Scottish Borders.

## Promote Warning Systems

- Highlight weather warning and flood alert systems that local people can access so that they are most prepared for any imminent events (<https://www.floodre.co.uk/> and <https://www.metoffice.gov.uk/weather/warnings-and-advice/uk-warnings>).



Where can I find out more?

---

# Useful Resources

## National strategies

- NHS Scotland Climate Emergency and Sustainability Strategy: <https://www.gov.scot/binaries/content/documents/govscot/publications/strategy-plan/2022/08/nhs-scotland-climate-emergency-sustainability-strategy-2022-2026/documents/nhs-scotland-climate-emergency-sustainability-strategy-2022-2026/nhs-scotland-climate-emergency-sustainability-strategy-2022-2026/govscot%3Adocument/nhs-scotland-climate-emergency-sustainability-strategy-2022-2026.pdf>
- PHS Climate Change and Sustainability Strategic Plan: <https://publichealthscotland.scot/publications/phs-climate-change-and-sustainability-strategic-plan/#:~:text=Climate%20change%20directly%20and%20indirectly,from%202023%20through%20to%202026.>

## Health information and suggested actions/recommendations

- Health effects of climate change in the UK (UKHSA): <https://www.gov.uk/government/publications/climate-change-health-effects-in-the-uk>
- Climate Change in Wales - Health Impact Assessment: <https://publichealthwales.nhs.wales/news/health-impact-assessment-highlights-urgent-need-to-protect-health-and-wellbeing-as-the-climate-changes/>

## Flooding information

- Scottish Borders Strategic Flood Risk Assessment: [https://www.scotborders.gov.uk/downloads/file/7558/strategic\\_flood\\_risk\\_assessment](https://www.scotborders.gov.uk/downloads/file/7558/strategic_flood_risk_assessment)
- SEPA flood mapping tool: <https://map.sepa.org.uk/floodmap/map.htm>
- SEPA NFRA tool for flooding risk and historic flooding: [sepa.org.uk/data-visualisation/nfra2018](https://sepa.org.uk/data-visualisation/nfra2018)
- Tweed local plan district local flood risk management plan: <https://www.scotborders.gov.uk/downloads/file/2257/tweed-local-flood-risk-management-plan>

## National risk assessments

- Climate change risk assessment for Scotland: <https://www.ukclimaterisk.org/publications/type/national-summaries/>
- UK Climate change risk assessment 2022: <https://www.gov.uk/government/publications/uk-climate-change-risk-assessment-2022>
- Independent assessment of UK Climate Risk: <https://www.theccc.org.uk/publication/independent-assessment-of-uk-climate-risk/#key-findings>

## Water information

- Private water supply sources: [https://data.spatialhub.scot/dataset/private\\_water\\_supply\\_sources-dwqr/resource/59d7d5d3-4279-4518-9269-2eef7008d21c](https://data.spatialhub.scot/dataset/private_water_supply_sources-dwqr/resource/59d7d5d3-4279-4518-9269-2eef7008d21c) and <https://scottishborders.moderngov.co.uk/documents/s29322/Item%20No.%2014%20-%20PWS%20Executive%20Report%20Final.pdf>

# Useful Resources

## Community tools

- Place Standard with a climate lens: <https://www.ourplace.scot/Place-Standard-Climate>

## Climate related health surveillance and monitoring

- Climate change and public health indicators: scoping review: <https://www.gov.uk/government/publications/climate-change-and-public-health-indicators-scoping-review>
- Heat mortality monitoring report: 2022: <https://www.gov.uk/government/publications/heat-mortality-monitoring-reports/heat-mortality-monitoring-report-2022>
- Progress in adapting to climate change: <https://www.theccc.org.uk/wp-content/uploads/2023/03/WEB-Progress-in-adapting-to-climate-change-2023-Report-to-Parliament.pdf>

## Useful videos

- NHS Scotland Climate Emergency and Sustainability Programme – Stakeholder Event 2023: <https://www.youtube.com/watch?v=KNDjvYaLij0>
- Sustainable Scotland Network annual Conference – Public Sector Climate Action: <https://book.shsc.scot/shsc/frontend/reg/tOtherPage.csp?pageID=197825&eventID=518&traceRedir=2>

## Climate projection or mapping tools

- UK Climate projections tool: <https://www.metoffice.gov.uk/research/approach/collaboration/ukcp>
- NHS Scotland Climate Mapping tool: <https://nhs.tellus-toolkit.com/map.php>
- Climate Just tool: <https://www.climatejust.org.uk/map>
- LCAT – local climate adaption tool: [lcat.uk](https://lcat.uk)

# Specific references

## **WHO quote**

- <https://www.who.int/news/item/02-11-2023-climate-change-and-noncommunicable-diseases-connections#:~:text=Climate%20change%20is%20the%20single,in%20a%20variety%20of%20ways.>

## **Lancet quote**

- [https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(15\)60854-6/abstract](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(15)60854-6/abstract)

## **UKHSA report on health impacts of climate change**

- <https://www.gov.uk/government/publications/climate-change-health-effects-in-the-uk>

## **Population demographics Scottish Borders**

- <https://www.scotborders.gov.uk/council-2/research-data/6#:~:text=The%20population%20of%20Scottish%20Borders,the%20Council%20regions%20in%20Scotland.>
- <https://www.nrscotland.gov.uk/files//statistics/council-area-data-sheets/scottish-borders-council-profile.html>
- <https://www.scotborders.gov.uk/downloads/file/7849/simd-2020-scottish-borders-summary-report-march-2020#:~:text=The%203%20Scottish%20Borders%20Datazones,and%20in%20Bannerfield%20in%20Selkirk.>
- <https://www.scotborders.gov.uk/downloads/file/7906/bres-scottish-borders-update-2019>
- <https://www.scotborders.gov.uk/downloads/file/2448/strategic-assessment-2023-theme-2-access-to-work-learning-and-training>

## **Fuel poverty data**

- <https://fuelpovertypanel.scot/>

## **Specific thanks to the following organisations for providing specific weather event and flooding data**

- SEPA
- Emergency planning office SBC
- Met Office