

## Health and Well-Being: an assessment of our current understanding of the direct effects of climate change on physical and mental health

### How is climate change affecting health and wellbeing in Scotland?

A changing climate will have significant and wide-ranging effects on all sectors of society, with the potential to cause significant economic and social disruption. Our understanding of the risk (exposure and vulnerability) to the material fabric of society can be relatively easily quantified – the number of households at risk of a significant flood event, for example. More difficult to assess though are the non-material effects; even though there is a wealth of evidence to demonstrate that climate change is the biggest global health threat of the 21<sup>st</sup> century (Watts et al., 2015) it remains difficult to assess the risks to health and wellbeing.

The direct effects of climate change include heat stress, floods, drought, and increased frequency of intense storms.

There are also indirect effects of a changing climate, which present a potential hazard to population health through adverse changes in air pollution, the spread of disease vectors, food insecurity and under-nutrition, displacement, and mental ill health. Public Health and health care systems therefore will need to develop appropriate adaptation strategies that include prevention; preparedness; human resilience; structure resilience; response; and building the evidence base to address the health risks posed by climate change.

The consequences of climate related impacts for health are wide ranging, covering climate related mortality and morbidity due to multiple airborne, foodborne and waterborne hazards; secondary effects from changes in disease vectors and pathogens and, potentially, their effect on animal health and the food chain; tertiary effects, reflecting the material conditions in which we live; and, last but by no means least, the effects of climate related events on mental health (Scottish Government, 2011; Health Protection Scotland, 2012).

Until the 2050s, climate change effects will mainly exacerbate health problems that already exist. Longer term, increasing mean temperature may continue to alleviate pulmonary and cardiac diseases associated with prolonged exposure to extreme cold. But, over that term, in all but the 'Low Emissions' (B1) scenario, the same warming atmosphere will lead to significantly increased precipitation outdoors and an increase in indoor temperatures and relative humidity, the former increasing the likelihood of pluvial, fluvial and coastal flooding; the latter leading to elevated levels of dust mites and fungal growth with a corresponding increase in respiratory infection and allergic reactions.

These risks may be compounded further for vulnerable groups: the very old or very young; gender (there is a pattern of increased susceptibility to heat stress in women over 75 for example); pre-existing health conditions; socio-economic status; physical environment (living and working) (Scottish Government, 2011a).

Data are frequently reported only at national scale. Given the spatial variations in climate change projections, more granular data would be required to identify local mortality and morbidity patterns and trends.

Data are often sparse, notably in SMR04 (Scottish Morbidity Record 04), which covers psychiatric hospital inpatient and day cases. In other areas quantifying the link between climate change and health impacts would require changes to the classification scheme to help demonstrate a causal relation: *CRS60 for respiratory disease from algal or fungal mould*, for example, where no ICD10

code exists. However, the difficulty of establishing this causal relation makes it highly unlikely that this type of change would actually be made.

There is a growing recognition of the importance of identifying both the mental health risks – distress, depression, anxiety and addiction - and mental health impacts – psychiatric day cases and hospital admissions - of extreme weather events (EWEs) (Bourque and Cunsolo Willox, 2014; Frontier 2013; Kovats and Hajat, 2008).

This assessment - **Health and Well-Being** - considers our current understanding of the direct effects of climate change on physical and mental health in Scotland. Establishing a baseline now is important in understanding where data availability (and quality) issues currently limit our understanding and will continue to do so in the future, if this situation remains the same.

The Scottish health sector is defined here as both clinical and population health services. Other areas also have a role in reducing the health impacts of climate change - Social Services; the private care sector; third sector; Local Authorities; the water industry; Food Standards Scotland; Emergency Services, Education – some of these are considered elsewhere (**Societal Resilience, Capability and Capacity**).

## Adaptation options

Scotland's Climate Change Adaptation Framework (Scottish Government, 2009d) presented a national, coordinated approach to adaptation in Scotland. It was accompanied by a series of sectoral action plans including Health<sup>1</sup> (Scottish Government, 2011a).

As required under Section 53 of the Climate Change (Scotland) Act 2009, the Scottish Climate Change Adaptation Programme (SCCAP) responds to the risks highlighted in the Climate Change Risk Assessment for Scotland, identifying the responsibilities of a wide range of delivery agencies with respect to different aspects of Health and Wellbeing (HR Wallingford, 2012).

### 1. Scottish Environment Protection Agency (SEPA)

The **Flood Risk Management (Scotland) Act 2009** requires that the impact of flooding is assessed in terms of potential adverse consequences on human health, economic activity, the environment and cultural heritage (Scottish Government, 2009b). It places duties on SEPA to prepare flood risk assessments for each flood risk management district.

**Scotland's Flood Risk Management Strategies** (FRM Strategies) coordinate efforts to tackle flooding. They set the national direction of future flood risk management, helping to target investment and coordinate actions across public bodies. Each of Scotland's 14 Local Plan Districts has an FRM Strategy, which is used as a basis for better decision-making across flood risk management organisations.

Local Flood Risk Management Plans are due to be published in June 2016 and will provide local detail about flood management actions between 2016-2021. Both Local Flood Risk Management Plans and Flood Risk Management Strategies will be updated every six years.

In this context, human health and wellbeing is considered with respect to the extent to which

<sup>1</sup> Adaptation Framework sector action plans: <http://www.gov.scot/Topics/Environment/climatechange/scotlands-action/adaptation/AdaptationFramework/SAP>

residential properties (adjusted for vulnerable groups), community assets, utilities and transport (road, rail and air) are located within a flood extent.

## **2. Food Standards Scotland (FSS)**

Progress on tracking food borne disease pathogens in Scotland is the responsibility of Food Standards Scotland (FSS); a national agency established in April 2015 by the Food (Scotland) Act 2015. ClimateXChange will develop indicators to monitor progress against any relevant targets specified for 2016-2019 in the FSS Strategic Plan once it has been adopted by the Executive Board.

Surveillance of emergent pathogen risks attributable to climate change will be addressed as part of FSS's strategy for reducing food borne illness. This will be launched later in 2016. In collaboration with FSA and other partners, FSS will also develop a horizon-scanning programme to ensure that emerging risks to the Scottish food chain that are attributed to climate change are taken into account as new policy is developed.

Future work in this area will also be informed by work which FSS recently co-funded with the Food Standards Agency (FSA) titled 'Our Food Future'<sup>2</sup> which aimed to improve understanding of consumer interests in relation to food security including impacts of climate change.

*Incidence of new food borne diseases and pathogens as a result of climate change (CRS53) and Mortality and morbidity attributable to food borne diseases (CRS57) therefore could not be developed further for the time being.*

## **3. Drinking Water Quality Regulator (DWQR)**

The Drinking Water Quality Regulator<sup>3</sup> has responsibilities for both private and public water supplies (Scottish Government, 2006b; Scottish Government, 2014b).

The Private Water Supplies (Scotland) Regulations 2006 and Water Quality Regulations (Scotland) 2010 transpose the requirements of Directive 98/83/EC. Local Authorities are required to monitor, risk assess and report on private water supplies and provide advice to private supply owners and where necessary ensure improvements are carried out. Non means-tested, Local Authority administered grants exist to assist in one off capital costs of installing treatment works to ensure the provision of safe drinking water.

We would therefore expect risks to private water supplies to be considered in the Local Authority Flood Risk Management Plans following from the Flood Risk Management Strategies.

Connection to the public supply also remains an option (DWQR, 2014). Scottish Water is required to provide a domestic water connection (as well as surface drainage and domestic sewerage) on demand to every property within its area provided it is at reasonable cost, established in accordance with the 2006 Regulations.

The exposure of public water supplies to contamination from flooding is considered in the *Buildings & Infrastructure Networks* theme.

## **4. National Health Service Scotland (NHSScotland)**

NHS Scotland's responsibilities are complex as they include responsibilities in three distinct areas

<sup>2</sup> Our Food Future: <http://www.foodstandards.gov.scot/news/what-does-scotland%E2%80%99s-food-future-look>

<sup>3</sup> Drinking Water Quality Regulator [www.dwqr.org.uk](http://www.dwqr.org.uk)

with different adaptive actions in each area: public health under the Public Health (Scotland) Act 2008; Category 1 Response under the Civil Contingencies Act 2004; and as a Public Body with obligations requirement to develop adaptation plans under the Climate Change (Scotland) Act 2009.

#### **4.1. Public Health**

NHS Scotland's public health responsibilities are delivered through the 14 territorial Health Boards supported nationally by Health Protection Scotland in consultation with Scottish Government's Health and Social Care Directorate (Scottish Government, 2008b).

Their 2012 Scoping Report on activities related to extreme weather events and climate change – a sharp distinction retained throughout the report - considers the health impacts of heatwaves/increased ambient temperature; cold weather events; and flooding and windstorm events. For these events, twenty-two airborne, waterborne, foodborne and other physical hazards were considered, creating the first inventory of public health activity in Scotland. Knowledge and activity gaps were identified for each.

The report recognises “the significant gap in data linkage capacity between environmental monitoring and data on health impacts”.

Further, while there is a lot of risk assessment activity in the health sector, it is primarily focused on monitoring trends in infections and there is little “coordinated across different agencies in response to extreme weather impacts”. The recommendations here included close collaboration with the Scottish Government's Resilience Division in coordinating public health/health protection activity with the development of the National Risk Register due to be published in 2017.

The report concludes that “the evidence base on the health impacts of projected climate change is limited” with many gaps in both knowledge and, indeed, understanding of the relationships involved. These are detailed for each hazard in Annex B to the report.

Their recommendations include (i) on-going monitoring of the activities and capabilities identified in the ‘inventory of activities’ for climate change adaptation purposes; (ii) developing better indicators of health impacts for extreme weather events and climate change; and (iii) improving planning and coordination in response to extreme weather events (Health Protection Scotland, 2012).

In mental health, significant progress has been made in recent years as a result of research into the immediate effects of extreme weather events on wellbeing.

**Preparing Scotland – responding to the psychosocial and mental health needs of people affected by emergencies** (Scottish Government, 2013) provides supplementary advice to **Care for People affected by Emergencies** (Scottish Government, 2009c). It recommends that all Responders should be able to give Psychological First Aid, using a stepped care model, providing referrals as required. It recommends that all agencies should ensure that their staff receives appropriate training in the psychosocial aspects of emergencies. However, formal screening of everyone affected should not be conducted because there are no measures of sufficient sensitivity and specificity to make this intervention beneficial. Rather, the psychosocial response should be aimed at people who have been assessed as being ‘at risk’ or are members of vulnerable populations.

In terms of monitoring and evaluation, the guidance makes specific recommendations on systems for recording these interventions at the time as well as the support provided over the longer term. However, there are currently no data sets that could support evaluation. The data available through SMR04 covering psychiatric hospital inpatient and day cases are too sparse with respect to extreme

weather events to provide any meaningful insight.

Longer-term support from mental health professionals is recognised as necessary for those experiencing post-traumatic disorders in guidance from NICE<sup>4</sup> and NHS Education for Scotland (NHS, 2011). This is beginning to close the knowledge gap but the gap remains nonetheless (Health Protection Scotland, 2012).

#### 4.2. NHS Scotland: Category 1 Responder responsibilities

NHS Scotland has responsibilities also as a Category 1 Responder under the Civil Contingencies Act 2004. The HPS Scoping Report identifies a need for planning for “mitigating the potential impacts of Extreme Weather Events”. Progress in this area is considered further in the **Capability and Capacity** assessment.

#### 4.3. NHS Scotland: Public Bodies Duties

And finally, NHS Scotland has responsibilities to develop adaptation plans as a public body under the Climate Change (Scotland) Act 2009 (*Part 5: Other Climate Change Provisions Chapter 1, Adaptation*)<sup>5</sup>.

Health Facilities Scotland, for example, identified climate change as one of 11 sustainable priorities in its 2012 Sustainable Development Strategy (HFS, 2012). Their work has included planning guidance (Planning for a Resilient Healthcare Estate together with the annual Property Asset Management Strategies [PAMS]) although the current focus is on emissions reduction rather than adaptation (NHS Scotland, 2014); revisions to the Capital Investment Manual (Scottish Government, 2016); site specific flood risk assessments and climate change impacts assessments for both the territorial and special health Boards (JBA, 2015).

### What do the indicators tell us?

The impact of extreme weather events on physical health in Scotland is low (of the order of tens to hundreds of avoided & excess deaths depending on the presenting cause) with mixed outcomes. The decrease in winter mortality due to prolonged exposure to extreme cold as a result of increasing mean winter temperatures, for example, may be offset by the rise in heat-related deaths by the 2080s.

This may reflect the fact that many of causal pathways are indirect and attribution to a climate signal is therefore difficult.

The analysis of morbidity in the indicators is based on data coded using the *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision (ICD-10)* provided by NHS Scotland’s Information System Division (ISD) primarily from Scottish Morbidity Record 01 (SMR01) - General Acute Inpatient and Day Case dataset.

#### 1. Cold

The indicators suggest that the trend in morbidity (and mortality) as a result of prolonged exposure

<sup>4</sup> [www.nice.org.uk](http://www.nice.org.uk) (Anxiety: cg22 / Depression: cg90 / PTSD: cg26 / Substance misuse: cg51)

<sup>5</sup> The Scottish Act further establishes responsibilities for all public bodies in *Part 4: Duties of Public Bodies Relating to Climate Change*. Public Bodies Climate Change Duties provides guidance on both reporting and in fulfilment of obligations under Section 44(1) of the Climate Change (Scotland) Act 2009a.

to cold is generally downward, albeit with very low numbers. This would be expected to continue given the projected increase in *mean* winter temperature. The CCRA for Scotland (2012), using current population figures for Scotland, estimated the numbers of premature deaths avoided due to milder winters to be 550 to 890 (range 200 to 1,570) by the 2050s and approximately 800 to 1,310 (range 330 to 2330) by the 2080s.

The length of winter cold spells has reduced by 7.5 days across Scotland (since the 1961 baseline), a statistically significant trend, leading to an expectation of some reduction in the number of hospital admissions and avoided deaths as a result of cardiac and pulmonary disease and (some cases of) hypothermia associated with cold snaps.

## 2. Precipitation

Climate projections suggest significant but distributed increases in precipitation. This will increase the risk of contaminated water supplies. Private water supplies using surface or groundwater sources deliver drinking water to around 6% of the population in and visitors to Scotland. 9% of the 157,000 properties reliant of these supplies are at risk of a 1 in 200 year flooding event, principally in Highlands, Argyll and Tayside, presenting a potential health risk as a result of cryptosporidium or verocytotoxin-producing *E. coli* from cattle (*Off-grid water supplies at risk of extreme weather events [CRS54]*).

Respiratory diseases resulting from algal and fungal mould, exacerbated by precipitation and heavy rainfall events, are not coded in the Scottish Morbidity Record (SMR01) General Acute Inpatient and Day Case dataset so the indicator *Hospital admissions due to respiratory disease attributable to algal or fungal/mould growth (CRS60)* could not be populated.

## 3. Heat

Extreme heat is not considered a significant climate change risk in the *Climate Change Risk Assessment for Scotland* with perhaps 100 (range 25 to 285) heat-related (premature) deaths per year through to the 2050 reference period based on current population size, 10% higher based on future growth projections, and 200 (range 50 to 660) by the 2080s: “these projected increases in deaths are very small in relation to the number of deaths likely for all causes in any particular year” (HR Wallingford, 2012).

Since 1961, the length of summer heat waves has increased by 5.5 days across Scotland, although this is not a statistically significant trend. Upper decile, extreme summer maxima (high emissions scenario A1F1) in the third reference period in the high 30°Cs in the East of Scotland will be similar to temperatures in the South of England in the 2003 heatwave (38.5°C), c.f.: CMO’s letter in 2014 in advance of the Commonwealth Games - *Safe Summer in Scotland*. The requirement for a formal heatwave plan for Scotland remains an ongoing discussion between public health professionals. Consequently, no meaningful assessment is possible (*Heatwave Action Plans in place (CRS4)*). And, where no plans are currently in place to develop capability, it is clearly too early to establish how effective they might be: the corresponding indicator *Uptake of public awareness measures on heat waves (CRS3)*, following the example above.

Mortality and morbidity due to short term exposure to high temperature (heat-waves) – heatstroke, syncope and fatigue – can be expected to increase with increasing mean summer temperature and summer extremes, as can the incidence of allergic respiratory reaction to poor air quality and tropospheric ozone. Impacts on health and wellbeing from increased temperatures indoors are likely to be highly localised (urban heat island effects). Some increase in allergic response to elevated levels of dust mites is likely.

Spring has seen the largest temperature increase, with the average temperature increasing by 1.5°C, resulting in an increase in the growing season. This may lead to elevated allergen levels (pollen, spores) increasing the incidence of asthma, vasomotor and allergic rhinitis and hay fever and similar though less specific allergies.

Weather-related health impacts are evaluated in *Number of hospital admissions resulting from extreme weather events (CRS9)* and *Increased seasonal mortality (CRS8)*. The numbers are very low. NHS ISD data for 2012/13 indicate that cold-related hospital admissions due to hypothermia (307) and other prolonged exposures to excessive natural cold (179) were of the order of low hundreds; very few admissions due to heat stroke (17) and heat exhaustion (14) as a result of exposure to excessive natural heat; admissions as a result of flooding (0) and high winds and storms (1) were negligible (CRS9).

The potential increase in algal and fungal mould as a result of increasing temperatures and/or precipitation is considered more fully in indicators **BB17 Dampness in housing stock** and **BB18 Condensation in housing stock** and the **Societal Resilience** assessment, where a link between health effects and fuel poverty is recognised.

#### 4. Mental Health

While the number of those affected physically is low, disruption to society and the economy will have corresponding psychological impacts. There is currently though insufficient data to make any meaningful, quantitative assessment of risk.

Disruption to community services as a result of flooding will have consequences for social cohesion<sup>6</sup> with impacts on health and well-being - GP & dental surgeries, emergency services response, as well as long term closure of schools and other community facilities. Nearly 600 facilities are at risk nationally, exposed to 10, 50 and 200 year return periods, according to recent data from SEPA. There are clear distributional differences across Local Plan Districts. A disaggregation of this data by service type would be helpful in local resilience planning.

Disruption to road, rail and utilities infrastructure and hence the availability of Category 1 (& 2) Responders as well as potential constraints on their access to incidents is discussed under the *Buildings & Infrastructure Networks* theme. However, recovery, particularly psychological recovery, is highly reliant on these Responders' capabilities (Scottish Government, 2013).

This disruption or, indeed, the threat of this type of disruption, particularly where several events have occurred in short succession, can contribute to a range of psychological impacts associated with (a) acute events - stress resulting from floods, for example - and (b) sub-acute events - aggression associated with overheating - and (c) long term environmental change - anxiety about the (inter-generational) effects of climate change. Mental health vulnerability is increased by a range of factors - existing mental health conditions, mobility, reliance on the local environment for sustenance & livelihood, those living in areas most prone EWE impacts, especially repeated events. As noted previously, little quantitative data is available [SMR04] and more work is required to develop the interventions and treatment strategies outlined in *Equally Well* (Scottish Government, 2008a). Qualitative evidence where it exists tends to be localised and anecdotal (Scottish Flood Forum). So, while the impacts are reasonably well understood in general terms, lack of data means we have been unable to develop CRS43, the number of psychiatric hospital admissions due to

<sup>6</sup> A concept first proposed by the sociologist Emile Durkheim which has subsequently led to much theoretical and empirical research, see Bruhn, 2009 for a useful overview of the changing conception of social cohesion from Durkheim (1897) to Moody & White (2003).

extreme weather events.

Long-term assessment of mental health and well-being is required, going beyond the anxiety scores of post-event questionnaires such as GHQ-12, (Scottish Government, 2009c) and taking account of different impacts of acute, sub-acute and long-term events (Scottish Government, 2013; Bourque and Cunsolo Willox 2014).

The following (8) indicators were not populated due to data availability/quality issues:

- i. Heatwave action plans in place
- ii. Uptake of public awareness measures on heat waves
- iii. Incidence of new [water/food borne] diseases, including changes in disease vectors and [water/food borne] pathogens as a result of climate change
- iv. Mortality and morbidity attributable to [food/water/vector] borne diseases
- v. Number of psychiatric hospital admissions episodes attributable to flooding events each year
- vi. Hospital admissions due to respiratory disease attributable to algal or fungal/mould growth
- vii. Uptake of VTEC/E.coli Action Plan
- viii. Uptake of SQHS Guidance on reducing damp and condensation

It should be recognised that all of the indicators that were populated consider *risk* and *impact*; at this stage the *action* indicators for health are primarily concerned with building capability and capacity through information, advice and guidance. These aspects are considered more fully in the **Capability & Capacity** assessment.

Indirect effects of climate change are out of scope for reasons discussed in the Theme overview.<sup>7</sup> Other drivers of change include factors such as social cohesion and inequality. However, none of these have been included in the SCCAP and are therefore out of scope for this assessment.

#### Other relevant indicators

Buildings and Infrastructure Networks for estimates of risk from dilapidated building fabric, resulting in rising damp (**BB17**) and condensation (**BB18**)

Water quality is considered further in the **Quality of Soils, Water Quality & Availability** and **Ecosystem Goods & Services (freshwater)** narratives.

Wastewater (**BW4**) and water (**BW5**) treatment works at risk of flooding.

<sup>7</sup> SCCAP assessment: Climate Ready Society overview.



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## Version Control

v. 0.2 DRAFT	11 <sup>th</sup> February 2016	M. Bonaventura	Final draft (internal)
v. 0.3 DRAFT	19 <sup>th</sup> February 2016	M. Bonaventura	Corrections following review by HPS and SG PHID
v. 0.4 DRAFT	23 <sup>rd</sup> February 2016	M. Bonaventura	Corrections following review by Food Standards Scotland
v. 0.5 DRAFT	14 <sup>th</sup> March 2016	M. Bonaventura	Revisions following internal review
v. 0.6 DRAFT	15 <sup>th</sup> March 2016	M. Bonaventura	Final for distribution

## Reviewers:

<b>Date</b>	<b>Who</b>
16 <sup>th</sup> February	Mary Stewart, SG Population Health Improvement Directorate Janet Sneddon, SG Population Health Improvement Directorate  Colin Ramsay, Health Protection Scotland.
22 <sup>nd</sup> February	Jacqui McElhiney, Food Standards Scotland
11 <sup>th</sup> March	Ragne Low, ClimateXChange