

# Health Effects of Climate Change in the West Midlands:

## Summary Report

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## Foreword

Climate change is increasingly discussed in the media and within the scientific community, but the potential adverse effects of climate change on human health do not feature as prominently as they should. I welcome this report as it redresses the balance by drawing much-needed attention to the significant health impacts that are likely to occur in our region during this century.



Globally, climate change threatens to undermine many public health gains made over previous centuries. Although the West Midlands is not likely to suffer the direct consequences of climate change to the same extent as many parts of the world, the challenge is still a shared one. This report represents a first step in the attempt to quantify the regional human health impacts of projected climatic changes, which can cause severe events such as floods, drought, heat waves and tornadoes.

This document outlines adaptation strategies aimed at improving the ability of the West Midlands to cope with projected changes in temperature and precipitation. These strategies detail what organisations can do but also what can be undertaken by individuals. The actions required to minimise the additional health risk associated with climate change often have no associated cost as they simply involve a change in our behaviour such as following Mediterranean patterns of shading and ventilating properties.

This report would have served us well if it galvanises us into action to reduce our carbon emissions. Many of the changes that are needed to mitigate climate change are also those that will immediately improve both our health and our health care services. The threat of climate change provides yet another impetus for action to substantially increase our cycling and walking rates, use energy more efficiently, and think about how we use, reuse and recycle the goods and products that we need.

I commend this report to all those with an interest in climate change and public health.

Dr Rashmi Shukla

Regional Director of Public Health

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## Acknowledgements

This project was funded by the Department of Environment, Food and Rural Affairs (Defra) as part of the Regional Climate Change Partnerships (RCCP) programme. The main partnership bodies for this piece of work were: West Midlands Climate Change Office; West Midlands Public Health Observatory; Health Protection Agency; Department of Health West Midlands; University of Birmingham; Environment Agency; UK Climate Impacts Programme; Birmingham City Council and Birmingham Climate Change Adaptation Partnership. A workshop was held on the 12th January 2010 to inform the development of this document. The project team would like to thank to all of those involved in the workshop and the organisations listed above and wish to extend special thanks to the HPA for providing funding for the publishing of this Summary Report.

# Health Effects of Climate Change in the West Midlands: Key Findings I

## 2020s

- The mean temperature could increase by 0.5 - 2.5°C in summer under the medium and high emissions scenario (based on the 1961-1990 baseline)
- Mortality: An increase in all-cause mortality of less than 1% in summer and a decrease of up to 4% in winter
- Morbidity: An increase of 5% in food and water borne diseases and an increase of up to 18% in respiratory disease admissions during the summer, which will coincide with a rise in incidence of hay fever and allergies
- Short-term adaptation strategies
  - » Set out plans to reduce emissions as soon as possible and come to a short, medium and long term worldwide agreement
  - » Continue to use and update the Department of Health's heatwave plan and ensure insurance policies cover flooding in risk areas, such as the southwest and northeast of the Region
  - » Raise awareness of health risks during periods of warm weather and actions that can be taken to prevent flood damage

## 2050s

- The mean temperature could increase by 1.5 - 4.2°C in summer under the medium emissions scenario but could rise by as much as 4.8°C under the high emissions scenario (based on the 1961-1990 baseline)
- Mortality: An increase of up to 2% in summer and a decrease of up to 6.5% in winter mainly as a result of temperature changes affecting the incidence of cardiovascular and respiratory disease
- Morbidity: Increases in food poisoning of up to 12%. Hay fever and allergies may continue to rise and skin cancer cases could become more common
- Medium-term adaptation strategies
  - » Ensure that new builds and refurbishments are suitable for future climates, install insulation and sustainable cooling systems in buildings and introduce green space in urban areas to reduce the Urban Heat Island effect
  - » Ensure flood defences and river management systems are adequate and continually improved

## 2080s

- The mean temperature could increase by 2.0 – 6.1°C in summer under the medium emissions scenario but could rise by as much as 7.5°C under the high emissions scenario (based on the 1961-1990 baseline)
- Mortality: Annually there could be a 3% decrease in mortality due to the fall in winter deaths. Despite the overall decrease summer mortality may increase by 11% from the current summer mortality baseline
- Morbidity: Cases of some food and water borne diseases could more than double. Flooding may increase as could the prevalence of allergenic diseases. Small scale outbreaks of vector borne disease are possible
- Long-term adaptation and mitigation strategies
  - » Address food and water security issues that will exist due to climate and population change

# Health Effects of Climate Change in the West Midlands: Key Findings II

## The Urban/Rural Divide

Due to the Urban Heat Island, city centre areas will be at higher risk of extreme temperatures during warm weather, which will impact negatively on health. Outbreaks of food and water borne diseases may be more common than in rural areas due to the greater population density. Pollution episodes in urban areas will exacerbate respiratory problems.

In rural areas temperatures will be cooler than in city centres however ozone episodes may be more severe in areas downwind of cities. As well as more cases of food and water borne disease there is likely to be a rise in hay fever in rural areas as a result of the higher presence of allergenic pollens.

## Health Inequalities

There is a serious risk that climate change will increase health inequalities in the Region.

Deprived communities are likely to face greater impacts because:

- They are more likely to be located in city centre areas where the greatest temperature increases are predicted
- They have the smallest potential to adapt (e.g. cannot move, afford more expensive food, buy air-cooling systems)
- Generally they are less healthy and therefore would be more susceptible even if exposure was equal

## Sub-Regional Variation

The south of the Region is likely to experience slightly higher temperatures than the north of the Region; similarly, the west could receive more rainfall than the east. Spatial variation is most likely to be seen in flooding and areas at risk currently are likely to be at higher risk in the future. Herefordshire, South Worcestershire, North Warwickshire, South Staffordshire and Northwest Shropshire could all face more issues with flooding compared to the rest of the Region. It is likely that urban areas will experience higher temperatures than rural areas due to the urban heat island effect, particularly within the West Midlands conurbation, but also in other urban areas such as Stoke on Trent and Worcester.

## Introduction

Climate change is perhaps the most significant long-term risk that the West Midlands will face in this century. Although widely viewed as just an environmental issue, climate change has consequences for the health of the population of our Region. These health impacts are already apparent in the West Midlands and their magnitude will only increase as the century progresses.

This study utilises the latest climate change projections for the West Midlands to predict the likely effects of changing temperature and precipitation on human health in the Region over the Twenty First Century. Given the resources available the study as a whole should be viewed as a scoping report, highlighting where future work is required. However, this summary of future health effects is sufficiently detailed to help shape climate change adaptation strategies in the West Midlands. In particular this summary report along with the technical report will help stakeholders understand how health inequalities could worsen due to changes in climate. It will inform action that ensures adaptation measures are developed to protect the health of the most deprived in our society.

The 2002 “Health Effects of Climate Change in the UK” report by the Department of Health (updated in 2008) was amongst the first to provide quantitative estimates of the possible impacts of climate change on the health of the UK population. This project is the first to build on that work by refocusing the assessment of the health effects of climate change to a regional level and by utilising the UK Climate Projections 2009 (UKCP09) interface, which now allows more localised predictions, to apply the most up-to-date climate projections in the West Midlands. This report, along with the technical report, uses pre-existing literature, surveillance data and climate projections. It covers a wide variety of diseases and health effects that could be affected by climate change. The main results are summarised here but for a more detailed account please refer to the Technical Report.

The projections for health made in this report are based on current health surveillance data and their relationship with temperature. The trends found were extrapolated to future projected temperatures to estimate the number of people likely to be affected by the changing temperature. Possible future changes in population, age structure and behaviour were not included in any of the numerical projections; however, they are reviewed qualitatively in the text where necessary. Health impacts are reported for both the medium and high emissions scenarios in the Technical Report; the low emissions scenario was not used as it is lower than the projections for the “business as usual” scenario. Projections were used for three time slices: the 2020s, 2050s and 2080s. Where no data were available a literature review was carried out to assess the impacts. Recommendations are listed at the back of this summary report.

Until the 2080s the decrease in mortality from milder winters is likely to outweigh the increased mortality from hotter summers. There will be significant changes in both mortality and morbidity in the region and these changes need to be understood in order to minimise negative impacts and maximise positive ones. Furthermore, as adaptation is harder for the more deprived, many impacts will be more severe in areas of greater deprivation, and as the most deprived already experience poorer health, there is a serious risk that climate change will increase health inequalities in the Region. These impacts need to be carefully considered as climate change adaptation strategies are developed.

## Future Climate Change in the West Midlands

The UK Climate Projections 2009 (UKCP09) are provided by the UK Met Office and the UK Climate Impacts Programme (UKCIP) which offers help in understanding climate change and advice on climate change adaptation. UKCP09 demonstrate the extent to which climate change is likely up until the end of the century. For the West Midlands the models project that mean temperature in both summer and winter will increase throughout this century and that heatwaves will become more common and more severe. Periods of very cold weather are likely to decrease. Precipitation patterns are likely to be altered: summer rainfall amounts may decrease significantly; whereas during the winter a large increase in precipitation is likely which will result in a heightened risk of flooding. Relative humidity and cloud cover are likely to decrease in the summer, while changes in wind patterns are uncertain within the bounds of current understanding.

### Summary 1: Future Climate Change in the West Midlands

- **Mean temperature may increase by up to 7.5°C** in summer under the high emissions scenario by the 2080s
- **Maximum daily temperatures may increase by up to 10°C** under the medium and high emissions scenario in the 2080s, with the largest increase in July
- **Minimum daily temperatures may increase in winter by up to 7°C** under the high emissions scenario by the 2080s
- **Precipitation may increase by up to 50% in winter** under the high emissions scenario by the 2080s
- **Precipitation may decrease by up to 50% in summer** under the high emissions scenario by the 2080s
- **Rainfall days are projected to decrease in summer by five to ten days per month** during the summer in the 2080s under the high emissions scenario
- **The intensity of rainfall during the summer months is projected to increase** throughout the century
- **Rainfall days are projected to increase in winter by two to five days per month** during the summer in the 2080s under the high emissions scenario
- **Humidity is projected to decrease by up to 17% during summer** by the 2080s under the high emissions scenario
- **Cloud cover is projected to decrease during summer by up to 30%** by the 2080s under the high emissions scenario

Past climate trends and both the medium and high emissions scenario projections are available in the Technical Report.

# The Health Effects of Climate Change Worldwide and in the West Midlands

Climate change is a global issue but it will affect different countries and regions in different ways. Figure 1 summarises the difference in climate change impacts on human health globally and in our Region. The overall magnitude of the average global effect is likely to be much larger than the average impact in the West Midlands. Also the types of impacts will be very different over these two geographical areas. The arrows in the section on the right of Figure 1 indicate the size of effect relative to other effects within the West Midlands, similarly the global section, in Figure 1 on the left, shows the size of effect relative to the size of other effects globally; they are not meant to represent relative impacts between these two areas as the global impacts would be far greater.

Globally, the IPCC Fourth Assessment Report states that malnutrition, malaria and severe weather are likely to cause the biggest increases in climate change related mortality; however in the UK these are unlikely to constitute the most significant impacts by the end of the century. In the West Midlands, the largest negative impact will be the morbidity and mortality resulting from more frequent spells of warm weather and heatwaves. The magnitude of the increase in excess summer deaths will be very similar to that of the decreased excess deaths during winter as a result of milder conditions. Despite there being little net change in mortality annually, it is still vital that this

impact is addressed to prevent avoidable deaths and avoid straining resources. If the change in the pattern of deaths is not planned for and resources are not reallocated, these resources will be wasted. Similarly to the rest of the globe, food poisoning cases are projected to increase due to the warmer weather, particularly in summer, and there is likely to be a higher number of extreme weather events, such as floods, which will result in mortality and both physical and mental illness. Additional effects include the health effects of exposure to ultraviolet light, water borne diseases and changes in air quality which will increase the presence of respiratory and allergenic diseases.

<b>Globally</b> (Relative to the size of other effects globally)	<b>Negative Impact</b>	<b>Positive Impact</b>
<b>Very High Confidence</b> Malaria: Contraction and expansion and changes in transmission season	←	→
<b>High Confidence</b> Increase in malnutrition	←	
Increase in the number of people suffering from deaths, disease and injuries from extreme weather events	←	
Increases in the frequency of cardiorespiratory diseases from changes in the air quality	←	
Change in range of infectious disease vectors	←	→
Reduction of cold-related deaths	←	→
<b>Medium Confidence</b> Increase in the burden of diarrhoeal diseases	←	

<b>West Midlands</b> (Relative to the size of other effects in the Region)	<b>Negative Impact</b>	<b>Positive Impact</b>
<b>Very High Confidence</b> Seasonal Deaths: An increase in summer deaths due to warming	←	→
A decrease in excess winter deaths due to warming		→
<b>High Confidence</b> Increase in food and water borne diseases	←	
Increase in the number of people suffering from deaths or morbidity (mentally and physically) due to extreme weather events	←	
Increases in the frequency of cardiorespiratory diseases and allergies from changes in air quality	←	
<b>Medium Confidence</b> Increase in vector borne diseases	←	

**Figure 1:** The direction and magnitude of selected health impacts of climate change. Left: Adapted from Climate Change 2007: Impacts, Adaptation and Vulnerability. Working Group II. The Fourth Assessment Report of the IPCC. Figure 8.3. Cambridge University Press. Right: Compiled from the results from the Health Effects of Climate Change in the West Midlands

## The Direct Effect of Rising Temperatures

All-cause mortality will probably increase during the summer due to higher mean summer temperatures and higher temperature extremes. However during winter, warmer temperatures are projected to cause a decrease in mortality over the same period. By examining the net result of these two seasonal factors it can be seen that, until the 2080s, winter mortality will be greater than summer mortality. By 2080 it is most likely that mortality during summer will not outweigh the lives saved as a result of warmer winter temperatures, which will lead to a decrease in the number of deaths overall. Although less likely, it is possible that summer mortality could start to outweigh the decrease in deaths during winter in the 2080s under the high emissions scenario. Cardiovascular diseases, which are affected by temperature in a similar way, demonstrate the same pattern of increased summer mortality, but decreased mortality in spring, autumn and winter are projected under both the medium and high emissions scenarios.

### Summary 2: Main Effects of Rising Temperature

- **17-20°C is the temperature at which fewest deaths occur in the West Midlands;** temperature shows a direct association with mortality rates
  - » **Up to an 11% increase (1410 more deaths per season) in all-cause mortality is possible in the summers of the 2080s** as a result of higher temperatures under the high emissions scenario
  - » **Up to a 10% decrease (1380 fewer deaths per season) in all-cause mortality is possible in the winters of the 2080s** as a result of milder winter temperatures under the high emissions scenario
- **15-18°C is the temperature at which least deaths from cardiovascular diseases occur in the West Midlands;** cardiovascular diseases are one of the biggest causes of mortality in the West Midlands and mortality is directly related to temperature
  - » **Up to an 11% increase (320 more deaths per season) in cardiovascular mortality is possible in the summers of the 2080s** as a result of higher temperatures under the high emissions scenario, putting increased strain on the health service
  - » **Up to a 7.5% decrease (480 fewer deaths per season) in cardiovascular mortality is possible during autumn and winter in the 2080s** as a result of higher mean temperatures under the high emissions scenario
  - » **The baseline mortality during winter is currently larger than the baseline during summer,** which explains why the smaller percentage value relates to a larger number of actual deaths during the winter months

Percentages are based on the 2001-2008 baseline calculated from the West Midlands data used in this report. Projections for the medium emissions scenario are available in the Technical Report.

## Climate Change, Air Pollution, Respiratory Disease and Allergens

Ozone pollution episodes are likely to continue to occur as a result of more warm, sunny weather. Ambient ozone levels are also increasing. During ozone episodes respiratory diseases can be exacerbated resulting in increased summer mortality and morbidity. Hay fever is likely to follow existing trends of increasing incidence and hay fever severity could rise due to the prolonged pollen season and introduction of new allergenic species. The relationship between asthma and temperature shows a decrease in hospital admissions during warmer weather, therefore a decrease in temperature-related attacks could occur by the end of the century. On the other hand, the projections do not take into account pollution or allergen concentrations, which are capable of causing a large increase in admissions. Chronic obstructive pulmonary disease (COPD) admissions are likely to decrease as a result of reduced periods of cold weather.

### Summary 3: Climate Change, Air Pollution, Respiratory Disease and Allergens

- **Ozone pollution is likely to increase** and exacerbate respiratory problems
  - » **Up to 53% more deaths (178 deaths per year) than in 2003 (333 deaths) could occur by the 2020s** as a result of 8 hours mean ozone levels greater than 50 parts per billion
- **Allergenic reactions are likely to increase** due to increases and changes in types of pollen, mites, mould, spores and other aeroallergens
  - » **The number of hay fever sufferers is likely to increase** and symptoms could become worse according to recent trends and increases in allergenic species
- **Up to a 21% decrease (1810 fewer admissions per season) in all-cause respiratory admissions during spring 2080** could occur under the high emissions scenario. These projections do not account for increases in allergens, which could counterbalance the decrease related to temperature
  - » **Up to a 17% increase (1480 more admissions per season) in all-cause respiratory admissions in summer 2080** could occur under the high emissions scenario
  - » **Up to a 20% decrease (360 fewer admissions per season) in asthma admissions could occur by summer 2080** under the high emissions scenario according to past trends
  - » **Up to a 2% increase (22 more admissions per season) in asthma admissions could occur by winter 2080** under the high emissions scenario according to past trends
  - » **COPD incidence is likely to decrease all year round** under the medium and high emissions scenario. As mean temperature increases, decreases will occur most during spring, autumn and winter

Air pollution was researched in existing literature and the numerical impacts are based on projections made in the "Health Effects of Climate Change in the UK 2008" report. Existing literature was used to investigate allergies. Respiratory disease percentages are based on the 2001-2008 baselines calculated from the West Midlands data used in this report. Projections for the medium emissions scenario are available in the Technical Report.

## Climate Change and Extreme Weather Events

The West Midlands will probably experience more flooding and heatwave events in the future. Flooding causes loss of property and livelihoods, physical injuries and mental health effects. Mental health is of great concern following flood events with all age groups at risk. Physical health effects are less widespread and are more likely to affect the elderly population. High summer mortality will be added to by the effect of heatwaves and again, the elderly and vulnerable are most at risk. High temperatures experienced during heatwaves exacerbate health issues, such as cardiovascular diseases, resulting in an escalation of hospital admissions and mortality. People in urban areas are particularly at risk as a result of the Urban Heat Island effect, which is discussed in Summary 9.

### Summary 4: Climate Change and Extreme Weather Events

- **Flooding is likely to increase** under climate change as a result of changes in rainfall patterns
  - » **Summer rainfall intensity could increase and cause flash floods**
  - » **Heightened levels of winter rainfall could result in more flooding during winter**
  - » **The parts of the Region most affected will be those that are already at risk from flooding**, these areas include South Worcestershire, North Warwickshire, South Staffordshire and Northwest Shropshire
  - » **Flooding causes a high amount of psychological stress for victims** due to damage to personal property and the disruption caused by flooding
  - » **Elderly flood victims are most likely to be affected physically** however mental health will be the most important issue
- **Heatwaves are likely to increase** under climate change
  - » **July could see a mean of four heatwave periods per year by the 2080s under the high emissions scenario** and a mean of three heatwave periods during July under the medium emissions scenario by 2080
  - » **Heatwaves will probably cause higher mortality among the elderly and vulnerable population**
  - » **Heatwaves similar to that in 2003 will occur four times in a 40 year period until 2030**, however after 2030 heatwaves can be expected to be more frequent and much more severe
- **Windstorms, thunderstorms and tornadoes are less predictable but probably will not have a large effect on health**

This report defines heatwaves in terms of health as “two consecutive days with maximum temperatures over 30°C during the day and minimum temperatures of 15°C at night”. Research for this section was carried out by a review of the literature, UKCP09 Weather Generator use, resident interviews and analysis of datasets.

## Climate Change, Food and Water

Food is likely to be affected in a variety of ways as a result of climate change. Changes in agriculture may be needed to cope with food demands, and climate processes elsewhere in the world could affect the imported food supply. Food borne disease incidence is likely to become more common alongside temperature increases, especially during the summer. Similarly, water shortage could become a problem due to a simultaneous decrease in summer rainfall and an increase in demand. A rise in the incidence of water borne diseases is likely as the climate warms. Cases of food and water borne diseases are under-reported, however the projections still provide a good estimate of the magnitude of change in incidence.

### Summary 5: Climate Change, Food and Water

- **Climate change is likely to impact agriculture both here and abroad** so issues with food security, such as food shortage and increased food prices, may occur. This could be added to by the increase in global population, which is projected to increase by 47% by the 2050s
- **All types of food poisoning investigated are likely to increase** and cases are likely to be higher during or just after a period of warmer weather
  - » **Campylobacter cases could increase by up to 25% (300 more reported cases per season) during the summer in the 2080s** under the high emissions scenario; campylobacter accounts for most food poisoning cases
  - » **Salmonella cases could increase by up to 41% (150 reported cases per season) during summer in the 2080s** under the high emissions scenario
  - » **E. coli cases could increase by over 100% (23 cases per season) by summers in the 2080s** under the high emissions scenario; although it is comparatively rare, it is more serious than other food poisoning cases
- **Water stress could increase resulting in less water and poorer quality water** in this century
- **Water borne diseases are likely to increase** with climate change as a result of increasing temperatures, which increase the number of pathogens in water
  - » **Cryptosporidiosis cases could increase by up to 47% (640 reported cases per season) per year by 2080** under the high emissions scenario. The highest number of cases are likely to occur 1 to 3 months after a period of warm weather
- **Changes in behaviour**, such as more frequent use of recreational water and more barbeque cooking could also result in an increase in water and food borne diseases

Food security and water supply were researched by literature review. Food borne diseases and water borne diseases were assessed using data for the West Midlands and percentages were calculated from the 2000-2008 baseline. The actual numbers of cases will probably be much higher due to under reporting. Projections for the medium emissions scenario are available in the Technical Report.

## Climate Change and Vector Borne Diseases

The climatological conditions for diseases transmitted by insects, such as malaria, will become more favourable with climate change in the West Midlands; however malaria is unlikely to re-establish itself in the UK because of the public health response. Tick borne diseases such as Lyme disease could increase, although warnings of tick presence and methods of protection from tick bites could be provided to help prevent this.

### Summary 6: Climate Change and Vector Borne Diseases

- **Vector borne diseases are unlikely to cause a large problem in the West Midlands by the 2080s**
  - » **The high level of public health in the UK means that prevention and treatment for malaria will be available and unless this discontinues malaria will probably be kept under control**
  - » **Tick borne disease could increase however simple precautions can be taken to reduce the risk**

The research for vector borne diseases was carried out by literature review.

## Climate Change and Indoor Environments

Indoor environments will be affected by climate change. Milder winters could promote fungi growth and reduce the amount of building heating needed; however the energy saved from this will be offset by the more frequent use of air conditioning in the summer. Higher summer temperatures could promote bacteria, mould and mite growth which are capable of causing health problems. A lack of ventilation in buildings is generally associated with poorer air quality, which in turn will reduce the productivity of workers. Increased ventilation could cause a reduction in indoor air quality during the summer months due to the presence of ozone and pollen.

### Summary 7: Climate Change and the Indoor Environment

- **Climate change will alter the temperature and air quality in buildings, creating a need for adaptation**
  - » **Summer indoor temperatures will probably increase creating a need for sustainable cooling systems**
  - » **Increased levels of bacteria, mould and mite growth could result in ill health**

The research for indoor environments was carried out by literature review.

## Climate Change and Ultraviolet Radiation

The exposure of people to ultraviolet radiation is likely to increase in the West Midlands due to decreases in cloud cover in summer and changes in behaviour if people decide to spend more time outdoors. The result will be higher incidences of skin cancer, sunburn and cataracts, and possibly a higher incidence of some infectious diseases as a result of immuno-suppression.

### Summary 8: Climate Change and Ultraviolet Radiation

- **Exposure is highly dependent on human behaviour but skin cancer, sunburn and cataracts could all increase as a result of climate change**

Research was carried out by literature review and recent trends were viewed for skin cancer in the West Midlands data.

## Climate Change and the Urban Heat Island Effect

The Urban Heat Island effect is capable of causing health issues in city centres. It is likely that it will exacerbate all of the temperature-related health problems and expose vulnerable city centre dwellers to a heightened risk of morbidity or mortality during a heatwave. The effects of the urban heat island can be partially mitigated by increasing the green infrastructure. Work is still ongoing to quantify the health effects.

### Summary 9: Climate Change and the Urban Heat Island Effect

- **Urban areas will be warmer than the surrounding rural areas;** this will be particularly noticeable during periods of warm weather, especially at night
- **Often, the most deprived people live very close to city centres,** so these people will be affected most
- **The Urban Heat Island effect is likely to increase the incidence of health effects** that are caused by increased temperatures
- **The Birmingham Urban Heat Island could be more than 4.5°C warmer** than its rural surroundings on a heatwave day
- **The number of people who travel into city centres during the day will lead to a rise in the number of people at risk from the effects of higher temperatures**

The research for urban heat islands was carried out by literature review and by contact with researchers at the University of Birmingham.

## Recommendations: Action to be taken by the General Population

Simple action can be taken by members of the public to protect themselves from several of the factors discussed in the chapters above. The following lists include advice that can be followed in order to prevent avoidable mortality and morbidity.

### Against the effects of air pollution and allergens

- Take note of pollution levels and pollen counts broadcast in the media, especially in spring, summer and autumn
- If the media predict pollution levels to be high, windows can be closed to protect the inside of buildings from the pollution
- Report plants that are particularly allergenic to local authorities so that they can be replaced safely if necessary. Do not attempt to remove allergenic plants yourself
- If pollution levels are predicted to be high, avoid strenuous exercise, especially if you suffer from respiratory problems
- If pollen levels are predicted to be high hay fever sufferers should try to avoid meadows and woodland if possible
- Smoking and walking next to busy roads can exacerbate the effects of air pollutants because it increases carbon monoxide levels in the blood which inhibits oxygen circulation
- Make regular checks for mould and fungal spores in buildings and ensure that fabric furniture, carpets and bed linen are cleaned regularly to reduce the number of mites

### Against the direct effects of temperature

- Eat plenty of carbohydrates, eat more salt than usual and drink plenty of water to reduce the risk of dehydration during hot weather
- Ensure air conditioning, electric fans or adequate ventilation exists in the residences of vulnerable people
- Open windows to cool building during the evening and early morning (and at night if it is safe to do so) when the outside air temperature is cooler than the indoor air temperature
- Close curtains to prevent “the greenhouse effect” when sunlight shines through windows
- Take note of weather warnings in the media and avoid long periods of exposure to very high or very low temperatures
- Take care of elderly and vulnerable neighbours/friends/family members and regularly check that they are coping with the weather
- Do not take part in strenuous activity during very hot weather, especially if you suffer from a health condition that can be exacerbated by extreme temperatures
- Be aware that there is advice available for heatwaves from the Met Office

## Against the spread of food borne disease

- Always wash hands before meals and ensure that food preparation surfaces are regularly cleaned – high standards of personal hygiene will help to prevent the spread of some infectious diseases
- Take note of best before dates and ensure that food is properly refrigerated or frozen if necessary
- Be aware of the risks of consuming under-cooked meat and raw foods. Ensure that all meat is properly cooked and take extra special care if preparing food on a barbeque. Ensure that salads and raw foods are properly washed in case of cross contamination

## Against the spread of water borne disease

- Take care not to swallow water from swimming pools or other recreational water bodies
- Be aware of the health effects of algal blooms – do not enter water which contains algal blooms as they can be harmful

## Against the spread of vector borne diseases

- If you are travelling to a malaria endemic country, always take anti-malarial drugs to protect yourself from malaria and to ensure that secondary spread does not occur
- Remove stagnant water (such as that left in buckets or watering cans) as these could provide pools in which mosquitoes can lay their eggs
- Take precautions if walking in areas of woodland that may contain ticks to avoid contracting Lyme disease

## Against the effects of ultra-violet radiation

- Wear UVR-protective clothing (loose and closely weaved clothes, hats to shade the head and neck) and protect the eyes by wearing sunglasses. Encourage use of sun cream (factor 15 or over) on uncovered skin and discourage long periods of exposure
- Regularly check the skin for pigmented moles, which could be a sign of skin cancer

## Against the effects of flooding

- Sign up to the Environment Agency's Flood Warning System if you live in a property at risk from flooding (this can be assessed using the Environment Agency's website)
- Ensure that your house and contents are insured against the affects of flooding
- If appropriate use sand bags or refuse bags full of soil as a flood barrier to help protect your home

## Recommendations: Adaptation Strategies for Local and Regional Organisations

### For hot weather

- Continue to use the heatwave plan and adapt it according to the most recent research
- Maintain and increase green infrastructure in urban areas, in particular trees which can grow to a large size, to help provide significant areas of shade and cooling during warm, sunny weather. A significant increase in green infrastructure is required in urban areas to absorb UV, rainfall and to provide windbreaks. Correct usage of plants could also act to absorb pollutants
- Continue to work towards a healthier population and thereby reduce the number of people at risk from extreme temperatures. This can be done by promoting healthy eating and physical activity
- Improve public awareness of how weather conditions exacerbate cardiovascular diseases, respiratory diseases and infectious diseases
- Ensure new builds and refurbishments are suitable for a changing climate. This can be done by: providing adequate ventilation and cooling systems; providing green space; improving insulation in existing buildings
- During maintenance of specialist buildings such as care homes and hospitals make adaptations to structures which will help prevent heat build up. This can be done by using reflective glass or paint and installing wall and roof insulation

### For floods

- Continue to review flood risks and ensure the flood risks of new development areas are properly assessed before building begins
- Reduce run-off in urban areas by increasing the permeability of paved areas (such as a porous sub-surface covered with porous concrete, gravel or slabs with gaps between them)
- Ensure that buildings in flood risk areas are flood resilient – put wall sockets higher up the wall, use concrete-based substances for floors and walls
- Implement plans on a local level to ensure that problems specific to that area are addressed. Central government should provide practical advice on low cost flood defences that can be implemented by individuals, such as sand bag use
- Flood defence plans should be implemented with long term goals to ensure preparedness
- Natural flood defences such as land management and reforestation in areas upstream of the flood risk could prevent problems downstream. However risk assessment should be done as some strategies may cause contamination of flood water and increased health risks from bacteria growth in reed beds or chemical use on agricultural land
- Co-operation is needed between the central government, insurance companies and local authorities so that insurance policy is adequate for the area and claims are dealt with effectively. This co-operation should extend to include contractors who may rebuild or refurbish flood damaged properties

## Other

- Adapt and maintain appropriate temperature control in food production practices to ensure that they are able to cope with the effects of climate change. Make sure that livestock management methods do not encourage pathogen transmission in the future
- Continue the surveillance of migrating animals that may bring vector borne diseases to the country
- Food security issues can be addressed by growing food locally and aiming for self sufficiency in local areas. Allotments, community gardening and advice on food growing could be provided for the local population to promote this behaviour
- Continue to develop plans to deal with disease outbreaks that could become more common in the future

## Future Work

### For this report

- Use the baseline set out in this work to produce adaptation strategies that address future climatological conditions
- Include population change projections in the health projection model
- Continue to update the projections according to the latest climate projections
- Carry out analyses on a local scale in order that more specific issues, such as ethnicity, deprivation and population age structure, are taken in to account
- Quantify the results in terms of economic costs

### General

- Increase the number of weather monitoring stations around the Region so that inter-regional comparison of climate and weather patterns can be observed clearly. This will also allow the Urban Heat Island to be mapped and provide a more robust dataset for future and smaller scale research. Weather stations could be located in schools, universities and other public buildings
- Create a more thorough reporting system for food, water and vector borne diseases which are not statutorily notified. This will allow the diseases to be assessed more adequately in terms of climate
- Include health effects in climate models
- Further research is needed into the health impacts of flooding, particularly with respect to mental health

## Further Information

Health Effects of Climate Change in the West Midlands:  
Technical Document and Summary Report available on the WMPHO website:

[www.wmpho.org.uk/topics/climatechangeandhealth.aspx](http://www.wmpho.org.uk/topics/climatechangeandhealth.aspx)

### Climate Change and Health

Climate Change and Health Council:  
<http://www.climateandhealth.org/>

Health Effects of Climate Change in the UK 2008:  
[http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH\\_4007935](http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_4007935)

Met Office Health Information:  
<http://www.metoffice.gov.uk/health/>

Sustaining a Healthy Future – A guide from the Faculty of Public Health on the importance of tackling climate change:  
[http://www.fph.org.uk/resources/AtoZ/r\\_sustaining\\_a\\_healthy\\_future.pdf](http://www.fph.org.uk/resources/AtoZ/r_sustaining_a_healthy_future.pdf)

West Midlands Health and Wellbeing Strategy:  
<http://www.wmra.gov.uk/documents/Health&WellBeing.pdf>

### Health and Sustainable Development

Health Protection Agency:  
<http://www.hpa.org.uk/>

The NHS Sustainable Development Unit:  
<http://www.sdu.nhs.uk/>

Sustainability West Midlands:  
<http://www.sustainabilitywestmidlands.org.uk/>

### Environment and Climate Change

Defra - Climate Change Page:  
<http://www.defra.gov.uk/environment/climate/index.htm>

Department of Energy and Climate Change:  
<http://www.decc.gov.uk/>

Direct.gov - Understanding Climate Change:  
[http://www.direct.gov.uk/en/Environmentandgreenerliving/Thewiderenvironment/Climatechange/DG\\_072879](http://www.direct.gov.uk/en/Environmentandgreenerliving/Thewiderenvironment/Climatechange/DG_072879)

Environment Agency - Climate Change Page:  
<http://www.environment-agency.gov.uk/homeandleisure/climatechange/default.aspx>

Environment Agency - Flood Warnings:  
<http://www.environment-agency.gov.uk/homeandleisure/floods/31618.aspx>

Natural England - Climate Change:  
<http://www.naturalengland.org.uk/ourwork/research/climatechange.aspx>

UKCIP – The UK Climate Impacts Programme:  
<http://www.ukcip.org.uk/>

UKCP09 – The UK Climate Projections 2009:  
<http://ukclimateprojections.defra.gov.uk/>

World Health Organization - Climate Change Page:  
<http://www.who.int/topics/climate/en/>

World Meteorological Organization - Adaptation to Climate Variability and Change:  
[http://www.wmo.int/pages/prog/wcp/cca/adaptation\\_climate\\_change.html](http://www.wmo.int/pages/prog/wcp/cca/adaptation_climate_change.html)



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Identity Studio Limited  
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