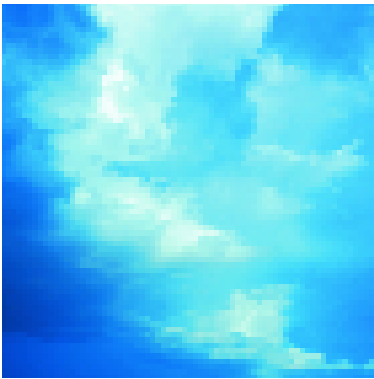




The Potential Impacts of Climate Change in the West Midlands





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FOREWORD

Sustainability West Midlands (SWM) is leading the preparation of the West Midlands' response to adapting to climate change on behalf of regional stakeholders.

As a first step, SWM commissioned Entec to conduct a regional Climate Change Impact Study which sets out the overall picture of issues, challenges and priorities in the West Midlands for the first time. This Summary Report reflects the main findings of a more detailed Technical Report. The Impact Study captures a key moment in time for the region and is drawn from a wealth of more detailed and specific research studies. The study has also engaged with specialist climate change interests around the United Kingdom as well as regional organisations, agencies, partnerships and networks, individually and collectively, to develop regional knowledge and produce these findings and recommendations.

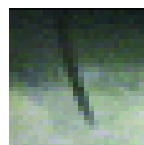
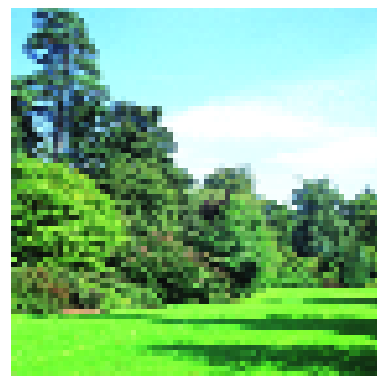
This study provides a good foundation for the next stage of the process – the development of ways of raising awareness and planning responses within the West Midlands. Discussions are already underway with the West Midlands Regional Concordat partners (comprising eleven regional decision-making bodies including SWM) and a range of sector representatives and partners who are developing responses to the climate change challenge. These policy setters and decision-makers will declare commitments to the need to give greater prominence to climate change in their own policies, programmes and projects delivering their core business.

The climate change study and outcomes are feeding into the current Review of the West Midlands Regional Sustainable Development Framework and other key regional strategies such as Regional Economic Strategy, Regional Planning Guidance, Regional Housing Strategy, Regional Energy Strategy and the West Midlands European Framework.

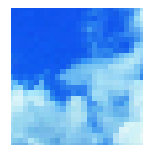
The clear message emerging out of this first stage is that no one person, organisation or community of interest can shape and deliver commitments to climate change alone. The Region is collectively determined to work together to make change happen for the better and ensure that the issues raised are addressed as part of its plans for a more sustainable future.

Bernard Doyle

Chair, Sustainability West Midlands
January 2004

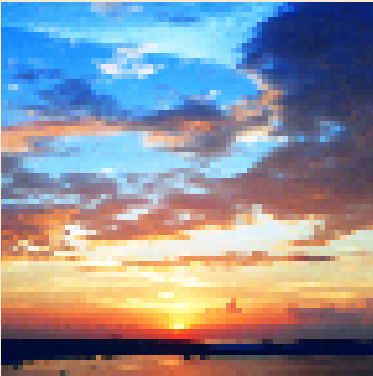


The 'Selly Oak Twister'
Birmingham, July 5th 1999



This report offers a summary of the scoping study, which is reported in more detail in the Technical Report. This report is available from the UKCIP website, www.ukcip.org.uk, or from Sustainability West Midlands website, www.sustainabilitywestmidlands.org.uk.

BACKGROUND TO THE STUDY

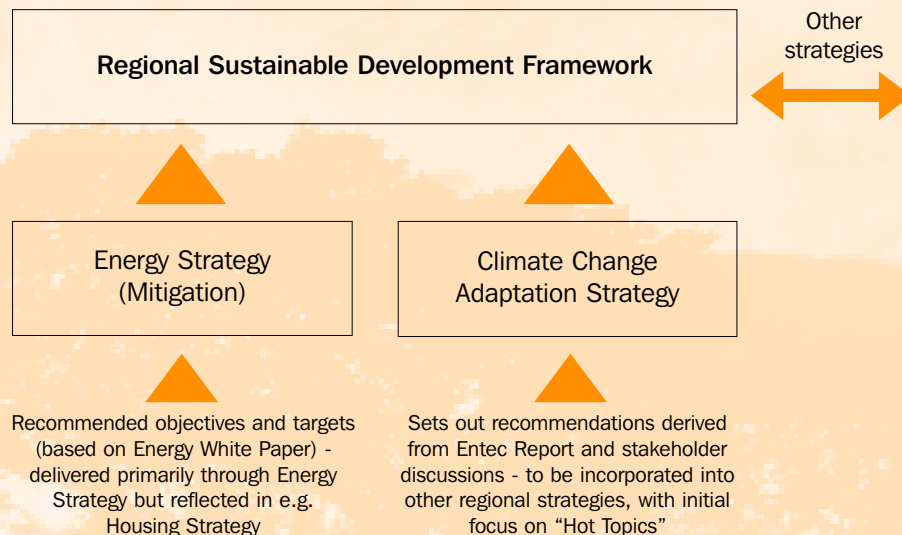


This study was commissioned by Sustainability West Midlands, a consortium of organisations from the region convened to improve the consideration of sustainable development issues within the West Midlands.

Sustainability West Midlands (SWM) seeks to communicate, promote and champion the principles of sustainable development and good corporate governance across the region. SWM is an independent partnership between 25 members of business, community, voluntary, non-governmental and public sector organisations which represent wider networks of economic, environmental and social interests. It is regional and strategic in its outlook, whether responding to international, national, regional or local sustainability concerns. SWM is a partner of the West Midlands Concordat (comprising major regional bodies) to advance individual and collective commitments to sustainable development principles and actions in all policies, programmes and projects for the region. The study was undertaken by Entec UK Ltd, the School of Geography, Earth and Environmental Sciences at the University of Birmingham and Metroeconomica.

This study will be one of the key foundations for the development of the Climate Change Adaptation Strategy for the West Midlands, which SWM is leading and co-ordinating on behalf of regional organisations. The strategy will indicate the commitments of different sectors in the region, and formulate an action plan to respond to risks and opportunities. This study will also be used as a component of the Regional Sustainable Development Framework, which offers a regional interpretation of national and local sustainability priorities, including climate change. This is illustrated in the following figure (Source: Sustainability West Midlands).

Regional Sustainable Development Framework and strategies



KEY MESSAGES

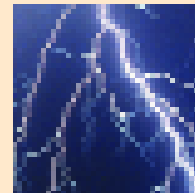
This scoping study considers the potential impacts of climate change in the West Midlands and possible ways to adapt to the risks and opportunities posed. The study is based on existing work in the region and nationally, building on a pre-scoping report for the West Midlands completed in 2001. It also involved discussion with a number of individuals and organisations from across the West Midlands in three regional workshops. However, the study is only the start of the process for understanding in more detail what climate change could mean for the region, aiming to prompt thought rather than provide a comprehensive assessment.

*“Climate change...
remains unquestionably
the most urgent
environmental challenge.”*

Tony Blair, February 2003

Climate change is happening

There is evidence to show that the climate of the West Midlands changed in the 20th century. Most notably the annual average temperature rose by 0.6°C, the growing season lengthened by 30 days, summer rainfall decreased and winter rainfall increased. Scientists believe that this climate change is due in part to the greenhouse gases emitted by human activity.



Climate change will continue

Computer models indicate that if we continue to emit greenhouse gases then this will carry on affecting the climate and we could experience more extreme events such as intense rainfall, hot summers and storms. For instance, the UK Climate Impacts Programme has estimated that by the 2020s the sort of dry summer we had in 1995 (37% drier than average) that brought with it drought and low flows in rivers could occur one in every ten years. By the 2050s it could occur once every three years and by the 2080s it could occur once every two years.

To put it another way, by the 2080s the annual average temperature could be between 1.5°C and 4.5°C warmer than today. Although the total annual precipitation may not change very much, the variation between the seasons could be much larger. Winter rainfall could increase by up to 30%, with more intense precipitation, and summer rainfall could decrease by up to 50%.

Climate change - damage and disruption

More intense rainfall events and more storms could cause damage to buildings, roads, rails, crops and drainage systems through flooding and storm damage. By the 2020s a flooding event similar to the one experienced in Autumn 2000 could cost West Midlands agriculture £20 million. The damage to households in the West Midlands could cost between £185 million and £360 million. The cost of disruption to transport could be between £30 million and £80 million. These figures are just for one event. If the occurrence of these extreme events increased, then the costs would also increase. These events not only have an economic cost but also cause disruption to people's lives.

Higher temperatures in summer could increase the demand for water, reduce water availability and cause soils to dry out, increasing the risk of building subsidence. It could also result in a deterioration of working conditions, especially in urban areas, as buildings become uncomfortably warm during work time. This could reduce workplace productivity, and could lead to an increased demand for air conditioning both at work and at home. This could increase summer energy demand and increase greenhouse gas emissions, further contributing to climate change.



Climate change opportunities

A warmer climate with more sunshine could result in a more outdoor lifestyle and opportunities for tourism and leisure. Higher carbon dioxide levels and a longer growing season could give farmers the opportunity to grow new types of crops. Higher winter temperatures could reduce the need for winter heating and reduce winter energy bills at home and work. Wetter winters could result in benefits to biodiversity in wetland areas. However, the climate is a large, complex system and the negative impacts, including unexpected large-scale changes, could easily outweigh the benefits.

Climate won't be the only change

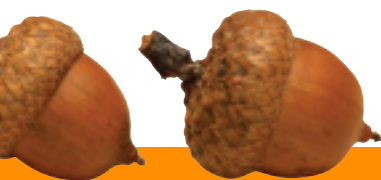
Climate change is not the only change that will affect us in the future. There will be many other economic, social and environmental changes that could affect our lives and environment, for example through changes in the size and age of the population, changes in our industries and changes in our environmental priorities. However, we need to understand the science of climate change better and what climate change could mean at the local level in more detail as it will affect other economic, social and environmental processes. This will enable us to plan more effectively for the changes that could occur. Developing a local set of climate change indicators, improving climate observations and modelling and measuring the impacts of climate change will help to understand whether climate change is continuing, its extent and what we should be doing about it.

We have a choice

Climate change is happening and will continue to happen to some extent, depending on our emissions of greenhouse gases. However, we have a choice about whether and how we adapt to these changes. Some adaptation measures will help to minimise the risks to our homes and businesses, while others will help us to take full advantage of the opportunities presented. By acting now, we can accommodate potential impacts in our long-term planning and can minimise the costs of adaptation.

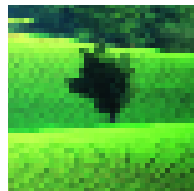
We've only just begun

This report has started the process of understanding in more detail what climate change could mean for the West Midlands. An effective regional climate change strategy will help to address climate change and adapt to its consequences, in order to avoid large-scale damage and disruption in the future.



“The cost of extreme weather events could escalate dramatically as a consequence of the increased greenhouse effect due to human activity.”

UNEP Insurers Initiative on the Environment, Bonn, 30th October 1997

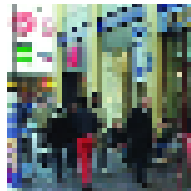
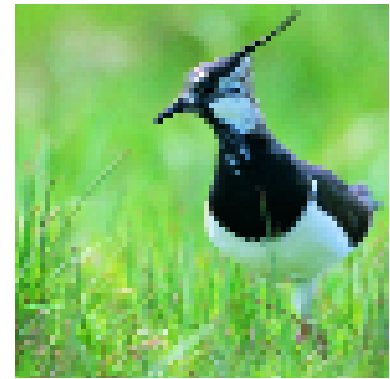


THE WEST MIDLANDS: A REGION OF CONTRASTS

The West Midlands consists of just over 13,000 square kilometres in the heart of the United Kingdom, and includes Herefordshire, Worcestershire, Shropshire, Staffordshire and Warwickshire, as well as seven metropolitan boroughs (Birmingham, Coventry, Dudley, Sandwell, Solihull, Walsall and Wolverhampton).

The environment of the region varies significantly. There are a number of major valleys comprising the Severn, Trent and Avon rivers with the upland area called the Birmingham Plateau between them. The edges of the region are bounded by the Welsh Marches to the west, the hills of the Staffordshire moorlands to the north and the Cotswolds to the south east.

The region resembles a shallow bowl with a subdued central dome. Within the region, 2% of land is within a designated National Park and 10% is in Areas of Outstanding Natural Beauty, figures slightly lower than the national averages.

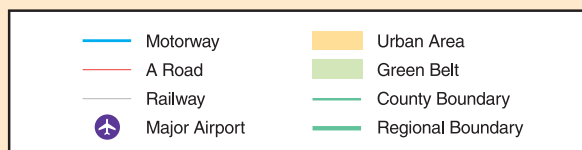


The west of the region is largely rural, with services and facilities focused around the market towns. Much of the land in this area is used for farming, with agriculture accounting for 70% of the region's land use. In contrast, urban development is concentrated on the central Birmingham Plateau, with the conurbation extending from Wolverhampton in the north, through Birmingham (centre) to Coventry (southeast). The seven metropolitan boroughs in the east of the region are the second most populated conurbation after Greater London, and are home to around 2.6 million of the 5.3 million people living in the West Midlands. The population in the region is growing at around 2% per annum, although this also differs significantly between the urban areas, where population has fallen by 5.7% over the last decade, and rural areas, where there has been a growth of 20%. The urban areas also act as a focus for the national transport network. This has economic benefits in terms of access to other regions of the country, but transport on the roads is also the main cause of air pollution problems. Economically, manufacturing industries, traditionally in the automotive sector, have a significant presence in the urban areas and the West Midlands is still the UK's main manufacturing centre, with over one fifth of all employees working in the sector.



This diagram represents key elements of policy in diagrammatic form only. It should not be used to determine detailed land use boundaries or potential scheme alignments.

Based on Ordnance Survey mapping with permission of Ordnance Survey and West Midlands Local Government Association.
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THE CHANGING CLIMATE



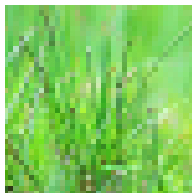
The climate in the UK is changing, and will continue to change.

The analysis undertaken in this study is based on the climate change scenarios produced by the UK Climate Impacts Programme in 2002 (UKCIP02 scenarios), which describe how the climate of the UK may change in the 21st century. These scenarios are based on a range of possible future greenhouse gas emissions.

The climate of the West Midlands has changed significantly in the last century. Key changes are given in the following table.

Climate indicators	Recent trend
Air temperature	Annual average temperature has risen by +0.6°C since the 1900s Several of the warmest years on record have occurred since 1989 Growing season has increased by 30 days since the 1900s Nocturnal urban heat island (increased temperatures in urban areas, particularly on calm nights) intensifying
Rainfall	Decreasing summer rainfall since the 1880s Increasing winter rainfall over last 150-200 years More winter rain days and longer wet-spells since the 1960s Heavy storms contribute more to winter rainfall totals since the 1960s
Snowfall	Fewer snowfall events and smaller snowfalls since the 1960s
Gales	Record wind speeds in 1987 and 1990 No long-term trend but cluster of severe gales in the 1990s





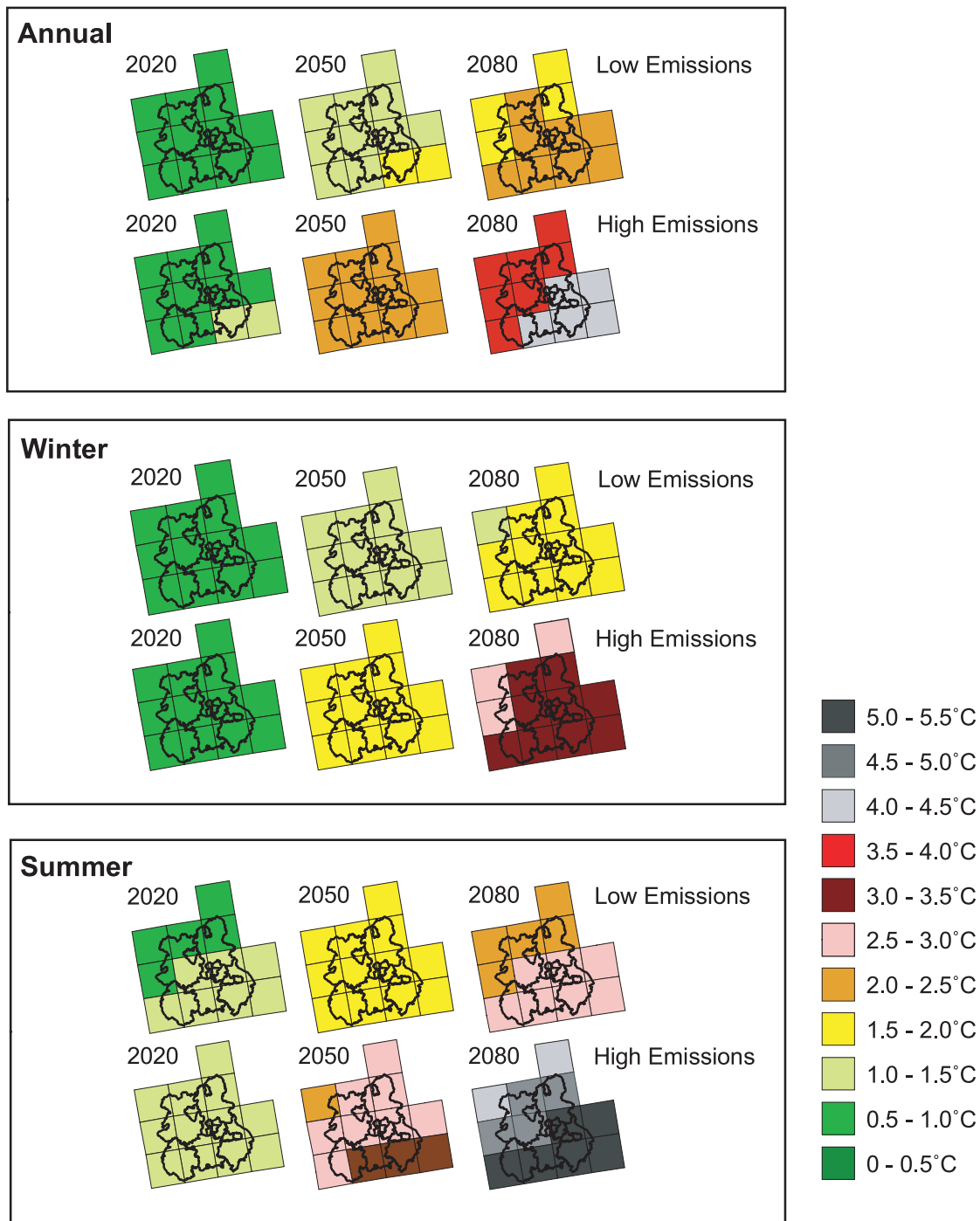
The UKCIP02 scenarios show a number of changes to the future climate in the West Midlands.

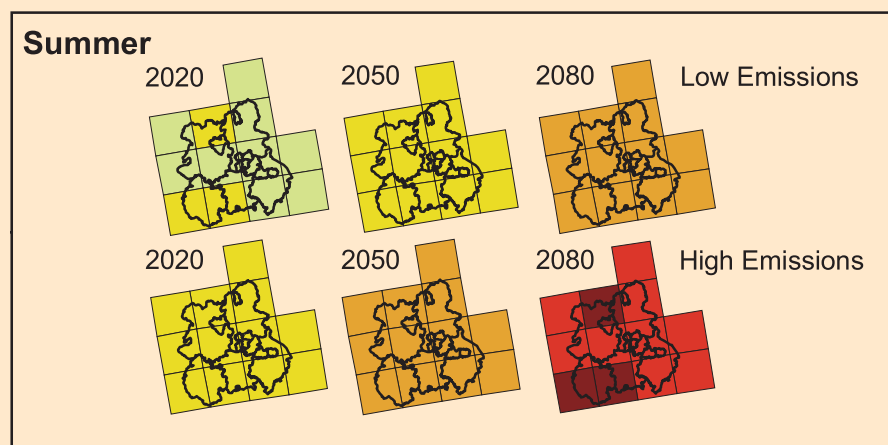
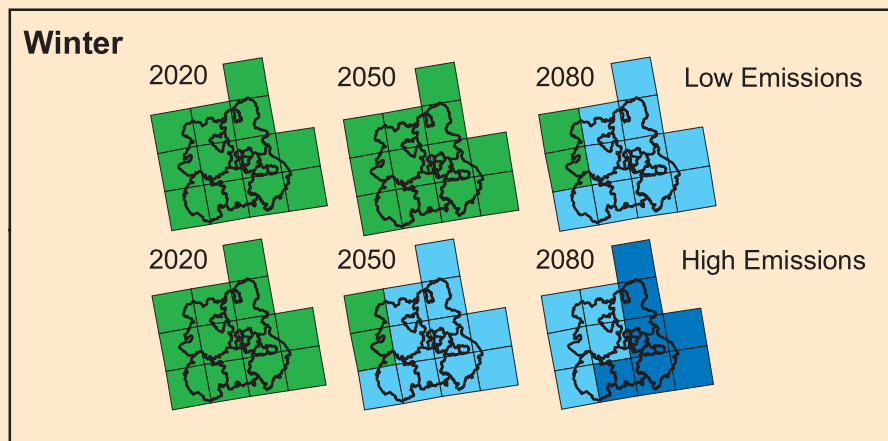
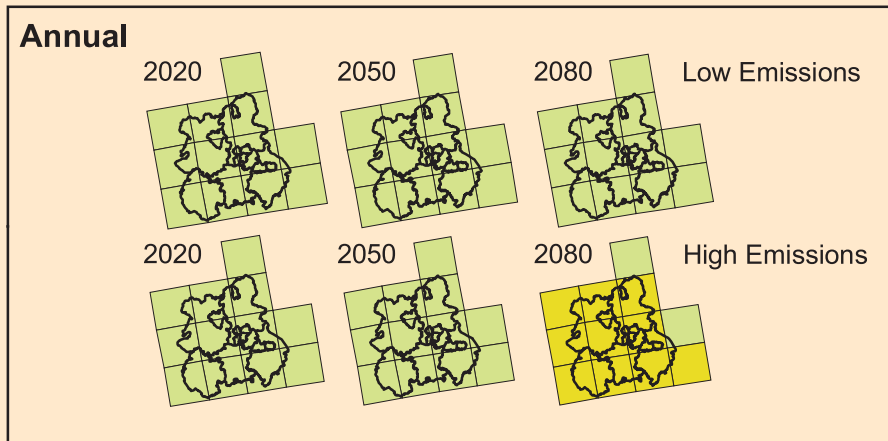
- The average annual temperature in Birmingham between 1961 and 1990 was 9.4°C. This is expected to increase by between 0.5°C and 1.5°C by the 2020s and 1.0°C and 2.5°C by the 2050s.
- Most of the warming is expected to take place in summer although winters are also expected to be significantly warmer. Warwickshire and the south east of the region are expected to warm up more than Shropshire and the north west of the region.
- The mean annual precipitation is expected to change by less than 10% by the 2050s. However this hides a dramatic change in seasonal precipitation. Winter precipitation might increase by between 0% and 10% by the 2020s and up to 20% by the 2050s. On the other hand, summer precipitation might decrease by between 0% and 20% by the 2020s and up to 30% by the 2050s.
- Cloud amounts are expected to decline slightly overall (between 2% and 6% by the 2050s) with a small increase of up to 2% in winter and a larger reduction of up to 10% in summer by the 2050s.
- Overall the mean relative humidity (the amount of water vapour in the air in comparison to the maximum saturation) is likely to decline by a small amount in winter (up to -2%) and decline much more in summer (-2% to -4% by the 2020s and -2% to -8% by the 2050s) as the air temperature is expected to increase. This may lead to a reduction in the number of fogs.
- The mean daily wind speed is not expected to change very much over the year (0% to +1%) but winter mean wind speed is expected to increase by up to 4% in the south east of the region by the 2050s. Summer mean wind speed is likely to stay the same (+/- 1%). However, there are low levels of confidence in the modelled wind speeds.
- The potential changes in soil moisture are quite dramatic. Soil moisture is a function of temperature, precipitation, humidity, sunshine and wind speed. Overall in summer the region would be drier and warmer and hence soil moisture could fall by between 5% in the north west of the region and 35% in the south east by the 2050s. In winter however the increased precipitation could lead to higher soil moisture levels and the increased probability of flooding.

As well as the changes in average climate conditions outlined above, the occurrence of extreme climate events is also expected to change.

Potential changes in daily mean temperature

The following diagrams illustrate the potential changes in temperature and precipitation for two of the UKCIP02 scenarios (Low Emissions and High Emissions) for the 2020s, 2050s, and 2080s. The changes are relative to the baseline temperature and precipitation experienced between 1961 and 1990.





CHOICES

We all have to make choices, about whether or not to take action, and what action to take. This is true whether we are responsible for making policy, managing a business or running a household. The choices that we make can have significant impacts on the way in which each of us individually and the region as a whole adapts to the potential impacts of climate change.

At a general level, there are a number of possible adaptation options to climate risk. These can be summarised as follows:

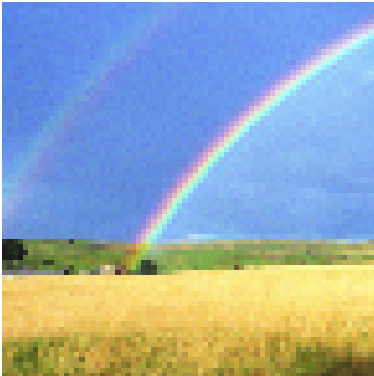
- share loss, e.g. insure business against weather losses
- bear loss, e.g. accept that some land will flood during winter
- structural or technological change, e.g. strengthen building foundations to cope with increased subsidence risk
- legislation or institutional change, e.g. strengthen planning guidance on developments in flood risk areas
- avoid risk, e.g. grow new agricultural crops better suited to new climate
- research, e.g. use research to better understand the climate risk
- education, e.g. increase public awareness about coping with flooding at home.

While some of these will be more suitable for implementation at the national and international level, many can be used at the regional and local level. These have been suggested as possible responses for the potential impacts outlined in the following sections. However, it will also be a challenge for those living and working in the region, and those developing regional plans and policies, to consider where else the adaptation strategies can be used to respond to the potential impacts of climate change.



“Doing nothing is not an option. You may doubt some of the predictions and their likely impacts, but I suggest that a sensible analysis of the risks does not allow us to sit back and wait.”

**Peter Ekins, Chief Executive,
The Meteorological Office**



To highlight some of the specific choices that we could all face, the information below indicates some of the questions that we may be faced with.

When buying new dishwashers and washing machines, do you choose the:

- cheapest to buy,
- cheapest to run,
- most water efficient?

If the risk of flooding in the winter increased, how would you protect your home from damage:

- use flood protection devices such as door seals and sandbags,
- raise furniture off the floor or move it upstairs during a flood,
- raise the height of electrical sockets and choose tiles and waterproof grout instead of carpet?

If there is less summer rainfall, what will you do in the garden:

- choose drought tolerant plants,
- save winter rainfall in water butts,
- use hosepipes, even if water costs are higher?

If water use was constrained during drier summers, would you save water by taking a shower rather than a bath? Remember, a power shower can use more water than a bath.

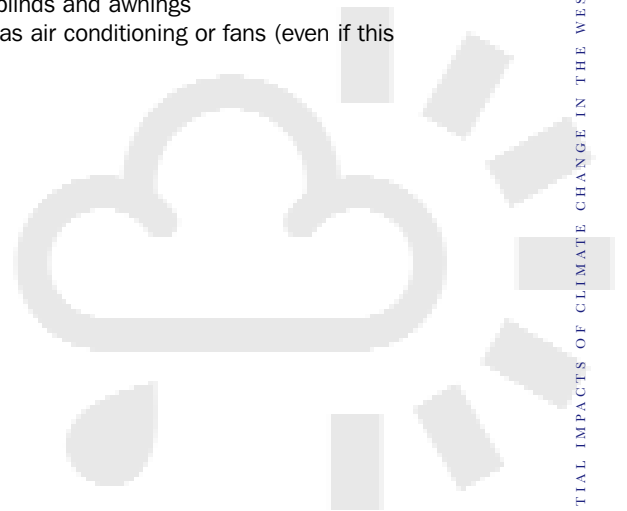
How would you deal with drowsiness while driving in hot weather:

- avoid hot times of day and take breaks,
- open car windows,
- use air conditioning, even if it used more fuel?

Would you be more likely to take holidays in the West Midlands if summer temperatures increased and there was more sunshine?

If summer temperatures increase, how will you choose to keep your home cool:

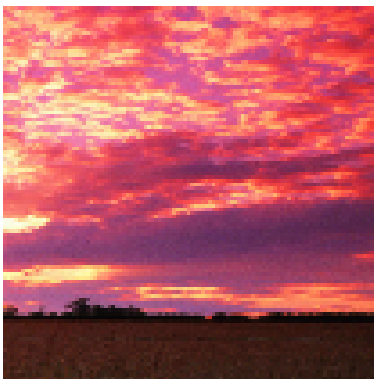
- increase shading from trees, blinds and awnings
- use mechanical cooling such as air conditioning or fans (even if this increased costs)
- use natural ventilation



THE KEY ISSUES IN THE WEST MIDLANDS

Climate change could affect many areas of the economy, environment and society of the West Midlands. A workshop was held in March 2003, at which individuals and organisations from across the region identified five issues that they felt could be most affected by climate change.

- Water management
- Agriculture
- Energy
- Land use and the built environment
- Transport



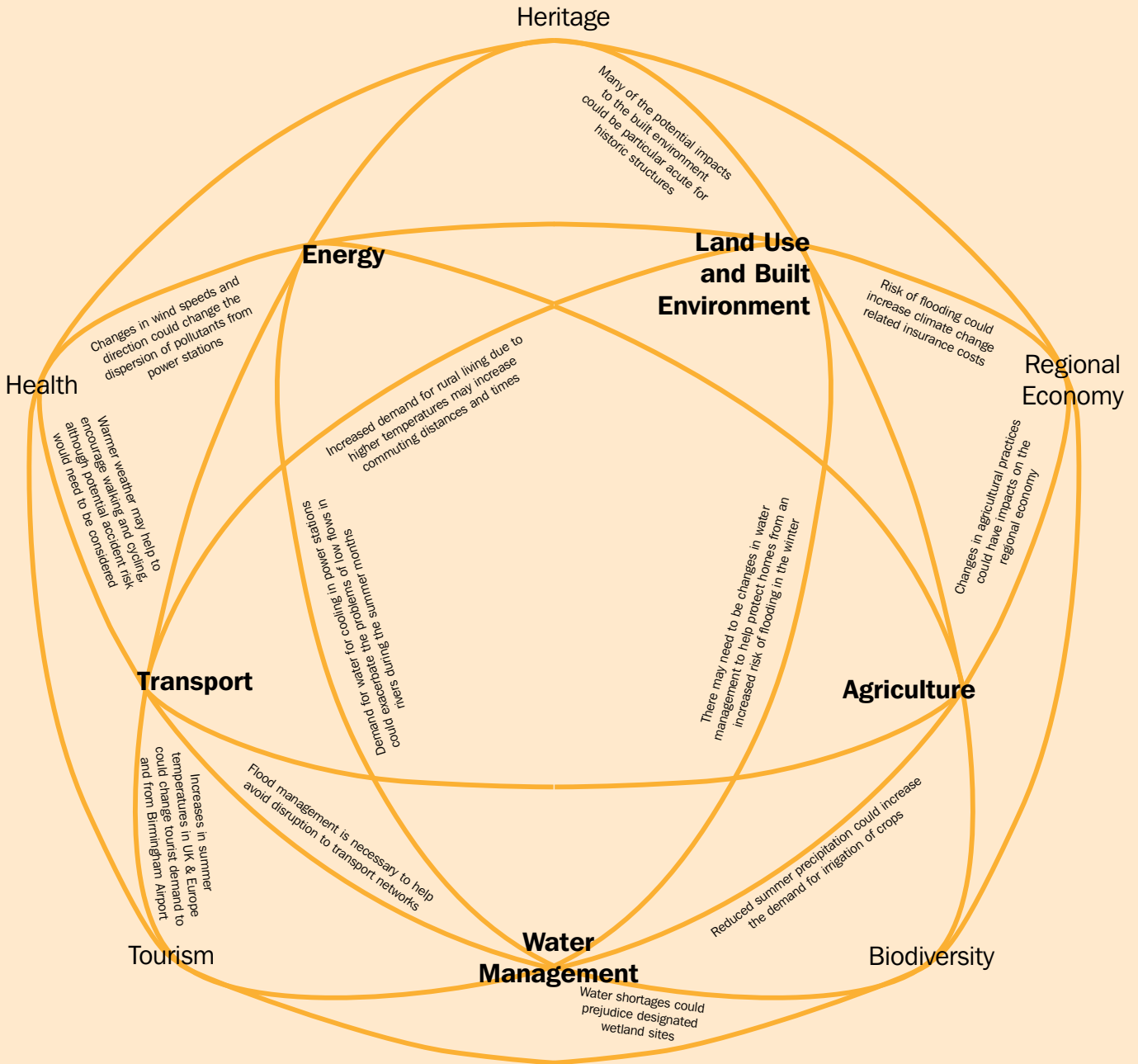
The following pages highlight some of the potential impacts on these areas as a result of climate change, and some of the options for adapting to these changes. However, as this is a scoping study and not comprehensive, there could be other possible changes or responses. The challenge for individuals, organisations and policy-makers in the region will be to ensure that the uncertain changes in climate are adapted to in ways which minimise the risks and maximise opportunities.

It is also important to note that the five 'hot issues' selected for special attention in this report are far from the only issues affected by climate change in the region. In addition, the problems and opportunities facing any one issue cannot be addressed in isolation from those facing other issues. The solution to one problem (e.g. growing biofuel crops as an alternative to other agricultural crops that may not respond well to changes in climate) may only exacerbate problems in other areas (e.g. farmland biodiversity may be adversely affected) if the implications are not thought through and handled carefully.

The figure on the right shows just a few of the links and interactions between the five 'hot issues' shown in the inner circle of the diagram and some further issues and sectors not selected for attention in this report towards the outside of the figure. Many more lines and implications are possible between the issues shown, as well as with other issues not mentioned in the figure.

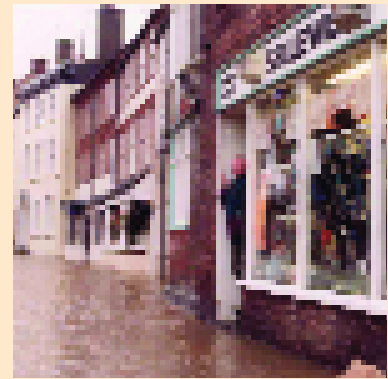


Illustrating the interdependence of the 'hot issues' and other issues in the West Midlands



WATER MANAGEMENT

Water management includes both water resources and flood management, and is a major issue in the West Midlands. There are issues both in terms of shortage, with parts of the Vale of Evesham amongst the driest areas of England and Wales, and surplus, with recent floods along the River Severn. Water management planners are already addressing these potential changes in the demand and supply of water resources across the region.



Potential impacts and opportunities

Increased winter precipitation and precipitation intensity could increase flood risk on major rivers such as the River Severn.

- Urban drainage systems, in particular those in Birmingham, may not be able to accommodate intense precipitation in the winter, impacting on the design, capacity and maintenance requirements of these systems.
- Increased winter rainfall could have potential benefits for winter recharge to reservoirs and groundwater such as the Shropshire Groundwater Scheme.
- There are concerns over greater winter recharge further increasing rising groundwater under Birmingham during winter months.
- Changes in the seasonal pattern of rainfall could require changes to water resources' operational practices in river regulation (River Severn) and direct supply reservoirs.
- Low summer rainfall could result in further low flow problems and water quality deterioration in the region's rivers and the need for greater flow regulation from existing reservoirs or groundwater.
- Reduced precipitation over the summer could result in increased water demand and stress on resources for water supply management and from direct abstractions from rivers for irrigation, navigation and industry, in particular in the drier Vale of Evesham area.
- There could be increased demand for irrigation due to higher soil moisture deficits in the summer. One study for the Midlands suggests that this increase could be as much as 23% under some climate change and socio-economic scenarios by the 2020s.
- Where water surpluses over the winter months can be controlled, this may represent an opportunity for attracting investment from other parts of the UK where more extreme water shortages are predicted (e.g. the South East).
- Water trading opportunities may arise between individual farms with potential surplus water stored during periods of increased precipitation.



Possible adaptation responses

- Improve flood risk management through use of agricultural land for flood water storage, use of sustainable drainage systems, and extension of wetlands.
- Make use of increased winter refill in storage for irrigation at the local farm level, and for low flow alleviation in summer from possible rising groundwater such as the Birmingham Groundwater and Shropshire Groundwater schemes.
- Consider public flood defence needs under future climate change conditions.
- Consider need for appropriate flood protection of individual properties.
- Promote water efficiency and demand management across industrial, commercial, agricultural and domestic sectors for both current and future developments.

Recommendations

There is considerable research and investigation on the impact of climate change on water management in the West Midlands, so the recommendations here are based on the need to improve key gaps in our understanding. Some of this has already started. For example climate change has been considered as part of the regional water resources strategy. Water companies are also assessing water resources investment needs as part of the asset management planning (AMP) process. They have received guidance from the Environment Agency on how to consider climate change in this process.

One key challenge will be the ability to influence long term ‘no regrets’ investment decisions on water management (resources and flood prevention) schemes, to ensure effective adaptation to climate change. The challenge involves the management and communication of uncertainty from climate and socio-economic change scenarios. UKCIP launched a key report on managing uncertainty and risk in climate change in May 2003. The communication of risk and uncertainty in water management will be particularly important for the non-specialist.

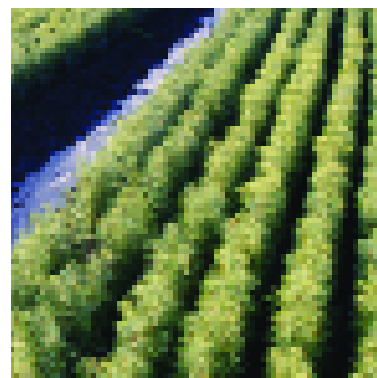
A key communication challenge for the wider public in the West Midlands is to explain that potential water shortages may arise from climate change, while at the same time, advise on potential flood risk and surplus water scenarios.

Most of the key water management policies and strategies relevant for the West Midlands take into account climate change and present recommendations for the application of climate change factors in planning and investment studies. A possible exception identified in this scoping study is the implication of climate change on the canal network, and a recommendation is that British Waterways give further consideration to climate change in future canal management and water resources development strategies.



AGRICULTURE

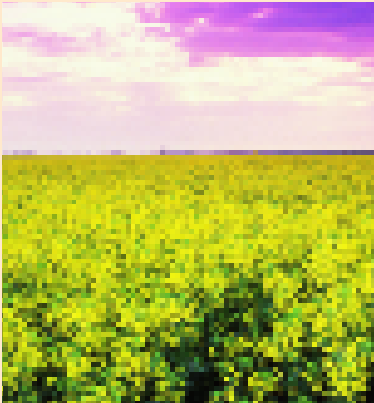
Agriculture is historically, and continues to be, one of the most important sectors in the West Midlands, not only in land use terms, but also through its contribution to the society and environment. Seventy percent of the land in the region is used for agriculture, with approximately half used for arable farming and horticulture, and half used for grazing for livestock.



Potential impacts and opportunities

- Increased precipitation and precipitation intensity during the winter could limit the use of land for agriculture due to an increased risk of flooding.
- Reduction in quality and quantity of grass caused by lower rainfall and higher temperatures during summer may require feed for livestock to be supplemented.
- There could be a reduction in yields of fruit, vegetables and cereals that do not have as much water during the growing period.
- Some crops may flourish due to higher temperatures and increased carbon dioxide in the atmosphere.
- Changing climate conditions could make it possible to grow alternative crops, including crops for energy.
- Water available for spraying, irrigation and livestock may be restricted during drier summers.
- Higher summer temperatures and reduced cloud cover could increase the risk of heatstroke and sunburn for livestock in open pasture.
- Higher average winter temperatures could reduce problems for livestock in freezing weather.
- Higher winter temperatures and fewer days of freezing weather affects vernalisation of winter cereals and formation of flower buds on some fruit trees.
- Milder winter temperatures and higher atmospheric concentrations of carbon dioxide may result in more lush growth during winter, which could in turn create more straw.
- Higher temperatures could increase the risk of pests and diseases in arable and horticultural crops.
- Higher temperatures and reduced cloud cover could increase the demand for outdoor leisure and tourism, which could create opportunities for diversification.



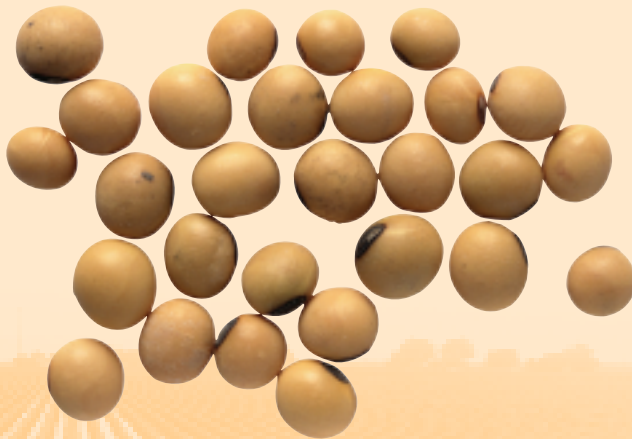


Possible adaptation responses

- Farmers and policy-makers need to consider various flood management options, including hard defences or alternative drainage systems.
- Alternative adaptation options would be to consider growing more water tolerant crops or converting the land to a non-agricultural use.
- Storage of winter precipitation in on-farm reservoirs may help to compensate for the reduction in summer rainfall.
- The change in the risk of pests and diseases could be controlled using new crop varieties, more pesticides, or natural predators.
- There is a need to maximise the opportunities presented for different crops by monitoring changes in both climate and consumer demand.

Recommendations

There is a need to raise awareness amongst farmers about the potential future changes in climate, the effects of the impacts, and how to maximise opportunities. This awareness-raising should also be extended to others in the agricultural supply chain and to consumers.



Support mechanisms for opportunities need to be integrated into regional plans, especially the Regional Planning Guidance.

The close links between the impacts on agriculture and other sectors, particularly water management and land use, need to be emphasised. This should also be the case for developing policy, with agriculture seen as part of the wider supply chain, especially linking to the Food and Drink Cluster of the Regional Economic Strategy.

ENERGY

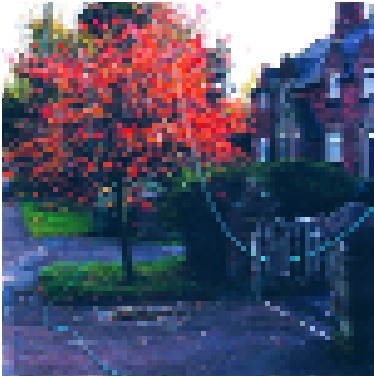
Distribution of fuels and power, and use of energy in the West Midlands tends to be very similar to other parts of the UK, although electricity generation in the region is very small. Much of our energy is used as fuel for transport, to provide heating for households, and to generate electricity for households and industry.



Potential impacts and opportunities

- Milder temperatures could reduce demand for energy to provide heating during winter months.
- Lower winter fuel demand associated with higher winter temperatures could reduce the number of households in fuel poverty.
- The risk of damage to infrastructure from freezing weather and ice could be reduced during milder winters.
- Higher summer temperatures could increase the demand for energy for cooling (air conditioning and refrigeration).
- High temperatures during summer could increase sagging of electricity distribution cables.
- The urban heat island effect could increase the demand for energy for transport to travel to cooler, rural areas for leisure.
- Possible increases in storm frequency could increase the risk of damage to electricity distribution infrastructure.
- Changes in precipitation and cloud cover could increase potential for the use of solar power and biofuels.
- Periods of increased rainfall and increased rainfall intensity during the winter could increase the risk of damage to infrastructure from flooding.
- Reduced summer precipitation could increase the risk of subsidence during summer droughts, particularly on clay soils.
- Reduced summer precipitation could impose constraints on power stations through limited availability of water for cooling during the summer.
- Changes in the pattern of wind directions and speeds could change the dispersion of pollutants from power stations and industrial plants.





Possible adaptation responses

- Use low-emission air conditioning, shading or natural ventilation to cool buildings in summer.
- Improve prediction of impacts of storms and encourage ongoing maintenance, for example clearing trees near wires.
- Respond to opportunities for West Midlands' manufacturing to contribute to electricity generation from renewable energy.
- Use alternative technologies to reduce demand from water-cooled power stations in the summer.

Recommendations

The forthcoming Regional Energy Strategy needs to reflect potential climate change impacts and adaptation options.

There is a need to raise awareness of the use of energy in buildings with clients, customers, developers and builders, and the possible changes in demand as a result of climate change. However, this must be focused on specifics, particularly that alternative technologies need not cost more than those currently used.

More generally, there is a need to raise awareness of energy and climate change, perhaps through linking it to the current trend for 'home and garden' programmes, and link this to financial incentives and regulations.

Energy suppliers and planners should consider using scenarios that describe possible changes in demand from winter space heating to summer cooling and develop appropriate plans.

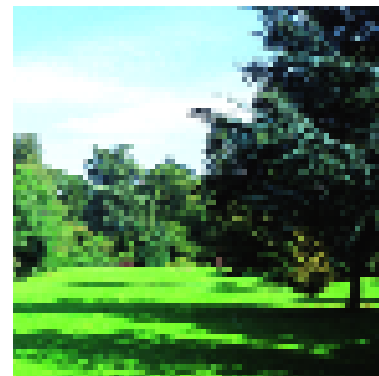
Methods for improving the energy efficiency of buildings need to be considered e.g. supplementary planning guidance and procurement specifications, to minimise the increase in the use of energy as a result of climate change.

Energy suppliers need to consider the potential impacts of climate change on their distribution networks in order to assess the potential economic costs and ensure that the necessary investment is made in any changes required.



LAND USE AND THE BUILT ENVIRONMENT

Land use in the West Midlands is dominated by agriculture and forestry, with over 80% of the land in the region used in this way. However, the region is not entirely rural, and there are significant urban areas in the east of the region, particularly around Birmingham and the Black Country. In these areas the majority of land is used for housing or industrial buildings.



Potential impacts and opportunities

- Increased winter precipitation and precipitation intensity could make more land unusable or of limited use due to risk of flooding.
- Urban developments without adequate drainage could be at increased risk of flooding during periods of intense winter rainfall.
- Buildings could be at increased risk of damage from subsidence of clay soils during periods of low rainfall in the summer.
- Changes in climate variables could result in greater opportunities for forestry and may increase land used for trees.
- Agricultural responses to changes in climate may increase or decrease amount of land used for agriculture.
- Increased winter temperatures could reduce damage to the built environment, particularly from frost.
- Milder winter temperatures might increase the growth of mould in houses.
- Higher summer temperatures in the urban areas could increase the demand for rural living.
- There may be an increased demand for green, open spaces in urban areas, especially in warm summer months.
- Increased temperatures in urban areas, particularly during the summer, could require various cooling strategies to be considered.
- Higher summer temperatures could increase the demand for outdoor activities and require more land for outdoor recreation and leisure.

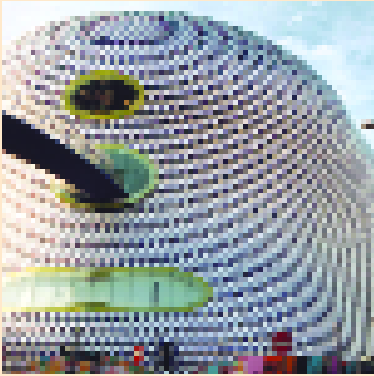
Possible adaptation responses

- Land at risk of flooding could be left undeveloped, or could include open spaces to encourage drainage.
- Larger diameter drains or sustainable urban drainage systems could improve capacity to cope with intense winter precipitation.
- More open spaces could be included in urban planning to provide local opportunities for outdoor leisure.
- Natural ventilation could be used to reduce the discomfort of high summer temperatures.



“The challenge for local authorities is to generate their own corporate response to potential climate change impacts on their services and activities.”

West Midlands Regional
Planning Guidance



Recommendations

The development of plans and policies should involve consideration of the potential changes in land use that may be appropriate in response to potential climate change in the region.

Given the life of buildings, design standards may need to be re-evaluated to take account of the potential impacts of climate change.

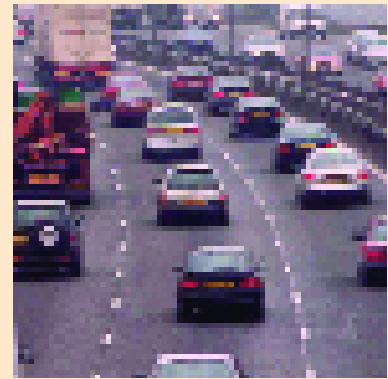
It would be useful for policy-makers to have a visual picture of the potential impacts of climate change in order to make it easier to incorporate it into policies.

There is a need to convince policy-makers that climate change and the adaptation options have economic consequences. There may be a need to link this not only to the Regional Planning Guidance, but also the Regional Economic Strategy.



TRANSPORT

Due to its geographical position in the centre of the country, the West Midlands is at the heart of the national transport infrastructure. The road infrastructure in the West Midlands includes a number of motorways, particularly the M6, M5, M40 and M42, and road congestion in the urban parts of the region is problematic. The region also includes part of the West Coast Main Line railway, and there is an international airport at Birmingham.



Potential impacts and opportunities

- Flooding during periods of intense winter rainfall could damage the foundations of roads, railways and runways.
- Increased winter precipitation and precipitation intensity could increase the risk of flooding on roads and runways with poor drainage.
- Likelihood of landslips in railway cuttings could increase due to increased rainfall during the winter months.
- Flooding on railways can mimic the effect of a train and increase maintenance and safety requirements.
- Increased summer temperatures may increase the risk of tarmac on roads and runways melting.
- Milder winter temperatures could reduce the need to grit roads, with fewer road accidents from ice.
- Higher winter temperatures could also reduce the requirements to de-ice aircraft and runways.
- There could be a reduced need for railway point heaters in winter months.
- Higher summer temperatures could increase accident risk as driver concentration is reduced.
- Reduced summer precipitation could result in damage to infrastructure from soil shrinkage and subsidence.
- High temperatures could increase buckling of rails and sag of overhead electricity cables on railways.
- A higher growth rate of trees, in response to higher temperatures and increased carbon dioxide, may increase the problems of leaves on the railways.
- Higher temperatures and reduced summer cloud cover could increase the number of leisure journeys by road.
- There could be a possible substitution from foreign holidays if the climate of the West Midlands becomes more attractive relative to other destinations, reducing demand at Birmingham International Airport.
- Warmer summer temperatures and reduced precipitation could encourage more walking and cycling, for work and leisure.
- Leisure travel could increase the number of trips from the cities and towns to the country, particularly during warm summer months.
- Higher summer temperatures could reduce aircraft lift during taking off at Birmingham International Airport.





Possible adaptation responses

- Risk of flooding should be incorporated into planning the construction and maintenance of foundations for roads, railways and runways.
- The capacity of existing and new drains should be increased to cope with greater risk of flooding.
- Driver awareness of walkers and cyclists and recognition of potential drowsiness should be improved to minimise the risks of accidents, especially in warm weather.
- Public transport systems should be developed to support increased demand for rural leisure travel.

Recommendations



There is a need to tie climate change impacts and adaptation into the Regional Transport Strategy (part of the Regional Planning Guidance) and the Regional Economic Strategy. This should include the potential impacts of higher temperatures on infrastructure, driver concentration and road safety, as well as the potential impacts of more extreme rainfall events (that could give rise to increased flooding) on infrastructure and economic disruption.

It is also necessary to consider the impacts of climate change on the construction and drainage of roads and railways.

There is also a need to consider the climate change impacts in the analysis of the alternative development options in the Air Transport White Paper, particularly in comparing expansion of Birmingham International Airport and a possible new airport at Rugby.

Further research could be useful in establishing a transport emissions inventory for the region, not only including road transport but also rail and air transport.

This inventory could also be used to assess the contribution of transport emissions to air quality under potential future climate conditions. This would combine air quality modelling and monitoring with climate predictions to allow responses for improving air quality in the region.

In order to encourage public transport there is a need to 'climate proof' new passenger facilities, particularly to ensure that they are not too hot in the higher summer temperatures and that there is sufficient protection from increased winter precipitation.



RECOMMENDATIONS

The possibilities for adaptation have led to a number of specific recommendations for the 'hot issues'. These suggest ways in which to encourage appropriate adaptation responses and support adaptation in the policy-making process. More general recommendations are outlined here. These cover the need for policy proofing, further specific research, provision of sectoral information and further sector involvement.



Policy proofing

In order to assess the potential impacts of climate change on key regional policies and strategies they should undergo a climate change appraisal to highlight the key issues and responses. This could help to address a concern voiced at the third workshop that fully considering every local policy from scratch would waste significant resources.

Further specific research for the West Midlands

Data and information on current and potential climate change could improve the understanding of the nature of potential climate change and its impacts and hence the effectiveness of planning. A number of actions could assist this:

- development of a set of climate change indicators to assess whether, and if so to what extent, climate change is happening
- improved observations and data for higher resolution modelling of future climate conditions
- measurement of climate change impacts.

Provision of sectoral information

In a number of the workshops, a need for further information was identified. This would involve specific information for the particular sector on the expected changes in climate, possible ways in which to respond to these changes and sources of information and support. This could encourage individuals and organisations to take action as their understanding of options improved.

Further sector involvement

This study has engaged a wide range of individuals and organisations in developing this report. The choice of 'hot issues' was made during this consultation, but there were a number of other issues that were not included as 'hot topics'. These sectors are also important in the region, and may benefit from discussion of potential climate change impacts.

- The finance sector should be engaged for a view on the potential market in the West Midlands for the possibility of water trading and on the potential costs to business of increased flood risk in the region (including insurance).
- Biodiversity and the impact of climate change has been a cause of particular concern nationally, and it would be useful to consider in more detail the threats, opportunities and changes possible in this sector in the West Midlands.
- The heritage sector should be consulted for key concerns and policies on the impact of climate change on key heritage features.
- Information on the potential impacts of climate change on health should be considered to improve understanding of effects at an individual level and facilitate planning in the health sector.



LOOKING FORWARD



Climate change is happening in the region and will continue. This study forms one step in an ongoing process to understand what climate change might mean for the West Midlands. This study will be used to inform the climate change strategy for the West Midlands, which will indicate the commitments of sectors across the region and formulate an action plan to respond to risks and opportunities. The study will also contribute to developing the Regional Sustainable Development Framework.



There is an ongoing need to consider the potential impacts of climate change in order to decide what to do to adapt to climate change. This is true not only of organisations and those making regional and national policy, who need to develop appropriate policies and supporting programmes to address climate change, but also of individuals throughout the region.



We all need to improve our understanding of potential changes in climate and think about how they could affect us. We also need to assess our adaptation options, particularly when we are making changes to our homes or surroundings, as changes in climate could lead to different living and working conditions in the future.

Some of these options have been highlighted in questions and comments throughout this document, but it will be a challenge for all of us in the region to think about how to incorporate consideration of climate change into our lives.

ACKNOWLEDGMENTS AND FURTHER INFORMATION



This is one of a number of studies conducted under the umbrella of the UK Climate Impacts Programme (UKCIP). Based at the University of Oxford, UKCIP was set up by the Government in 1997, to provide a framework for an integrated assessment of climate impacts and to help organisations assess how they might be affected by climate change, so they can prepare.

Acknowledgments

This study was conducted by Entec UK Limited for Sustainability West Midlands. The main contributors were:

- Michael Anderson, Sabrina Dann, Chris Hughes, Jim Kersey, Lee Chapman, John Kings, John Thornes, Alistair Hunt and Tim Taylor.
- Severn Trent Water Limited helped facilitate meetings and workshops at their premises and at Birmingham University.
- The Environment Agency, RSPB, UK Climate Impacts Programme, The Forestry Commission and the West Midlands Biodiversity Partnership helped with photographs.

SWM is grateful to the Environment Agency and the Government Office for the West Midlands for financial help in publishing this report and to Julie Vince of the Agency for helping to make it happen.

PDF versions of this report and the Technical Report are available on the SWM and UKCIP web sites. The Technical Report is not available in hard copy.

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