Herefordshire Council

Herefordshire Council Local Climate Impacts Profile

Author:
Matthew Locking M.Sc.
in conjunction with the
Sustainability Unit

Updated and formatted
Rebecca Baker,
Sustainability Intern

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Herefordshire Council and the County in general has been subjected to eighty-four significant weather events over the last ten years, of which nearly half are related to heavy rain and flooding. This total figure is probably an underestimate as this is only the number reported in one local paper and certain types of event, such as heat and drought, are thought to be under-represented within such sources. Of these eighty-four events, five were picked out for further investigation re their impact on delivery of council services and finances. In reality only one event, the July 2007 floods, was the subject of a full range of interviews with key personnel from the affected service areas. This event is by far the most significant weather event to have impacted on Council services within the last ten years.

The number of significant weather events is predicted to increase over the next ten years as a result of climate change and Herefordshire Council and the County as a whole needs to develop an increased level of adaptation strategies for events such as flash flooding. The database of events underpinning the LCLIP should continue to be updated and this LCLIP should be used as a resource to assess the authority's susceptibility to severe weather and improve its resilience to future events.

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1. Introduction

1.1 Study Context

The concept of a Local Climate Impacts Profile (LCLIP) was devised by the UK Climate Impacts Program, who were set up in 1997 to "help organisations to assess how they might be affected by climate change so they can prepare for it's impacts" (UKCIP, 2008).

Currently a number of Local Authorities are in the process of doing LCLIP studies and several have already completed them. In the West Midlands Region in particular Worcestershire County Council has already completed theirs and Staffordshire, Wolverhampton and Telford & Wrekin Borough are in the process of doing studies. Two workshops have taken place at the home of UKCIP in Oxford in order to transfer knowledge and discuss and compare methodologies for doing an LCLIP.

This study covers the period from April 1998 to April 2008 and focuses on climate changes already predicted: It does not look to prove that anthropogenic* climate change is taking place.

1.2 Purpose of Study- Aims and Objectives:

The purpose of this study is to assess the impacts of extreme weather on the services of Herefordshire Council within the last ten years with a view to highlighting the worst of these and consider how the Council could be better prepared in the future in order to deal with such events and the costs incurred.

Extreme weather events are those that fall outside of the normal distribution for a particular area and include drought, flooding (both flash and fluvial- see Page 7 for the difference between these) and heat waves, all of which have affected Herefordshire within the last ten years. Such events often combine with more local factors in order to cause significant disruption to people, services and businesses in the local area.

The most recent predictions from the UK Climate Impacts Program (UKCIP09), released in 2009, have suggested that summer temperatures in the 2020s[1] could be up to 2.6^{o}C warmer, and there could be up to 15% more precipitation during the winter months in the West Midlands region. These predictions for the future are a result of climate change and could lead to increases in the events mentioned in the above paragraph. Herefordshire Council need to be better prepared for such events and this is underlined by adaptation measures to climate change recently being included in the Local Area

* Definition: Climate change caused by humans as opposed to variation which occurs naturally within the climate system

[1] This is the 30 year defined period '2040-2069' over which the climate averages are calculated.

Agreement (LAA) Performance Indicator (PI) statistics (number 188) 'Planning to Adapt to Climate Change'.

The first step in investigating Herefordshire Council's susceptibility to severe weather was to undertake a media trawl of local newspapers, although in the case of this study only one paper was used (the Hereford times- online as well as microfilm archives). This was done for the period 1998 to 2008 (up to April). In order to extend this record, as the local media will not report on every notable weather event, it was supplemented by the use of other records such as insurance record claims, local fire service records and informal meetings with relevant officers. The next step was to interview personnel from areas identified as affected by certain events in the media trawl. A cautionary note here should be made that the majority of staff were interviewed on the July 2007 flooding event as this seems to have been the most notable event to occur in the last 10 years and was also very recent and thus relatively fresh in peoples minds. Therefore with relation to other events, the impacts catalogued are much more general but hopefully give some idea as to how the different service areas were disrupted by the event. The third step was to bring together recommendations from the interviewees to inform decisions on how best to increase resilience to future events.

1.2.1 Aims of Herefordshire Councils Local Climate Impacts Profile:

- To raise awareness of the impacts of extreme weather events as well as climate change in the wider context
- To assess the impacts of such events on the authority both from an operational and financial point of view
- To highlight these impacts in relation to future climate change scenarios
- To provide information and data that will help to inform future response to significant weather events and to help form effective adaptation/response strategies to them

1.2.2 Objectives:

- To produce a catalogue of all significant weather events that have affected Herefordshire from April 1998 to April 2008 (Appendix A)
- To establish with key council personnel how their area was affected and how we may respond better in the future (Section 3)
- To highlight the cost and impacts of such events (Section 3)
- To compare the events that have affected the authority to the UKCIP09 scenarios
- To identify some meteorological thresholds for response to such events
- To produce recommendations that can be acted on by the authority to form the basis for increasing the authority's performance in respect to National Indicator 188 from level 0 to level 1 (Section 7)

1.3 Background

1.3.1 Exposure of Herefordshire to Extreme Weather

Herefordshire has a population of approximately 178,800 (ONS, 2006), of which a significant number are vulnerable to flooding, which is the main consequence of extreme weather within the county.

1.3.2 Topography

Much of the county was covered by ice during the last ice age leaving significant areas of relatively low-lying land suitable for agriculture, particularly in western and more southern areas of the County. The area is bordered by the Black Mountains to the southwest and the Malvern Hills to the east as well as having other notable upland areas within the county itself such as the Woolhope Dome and Dinmore Hill to name but two.

The major river in the county is the River Wye, running from the west to the southeast through the county's major centre of Hereford. Other notable rivers are the Lugg, which runs from the north and joins the Wye roughly in the area around Hampton Bishop and Holme Lacy and the River Arrow, which runs across the northwest of the county from the area around Kington and joins the Lugg around the town of Leominster.

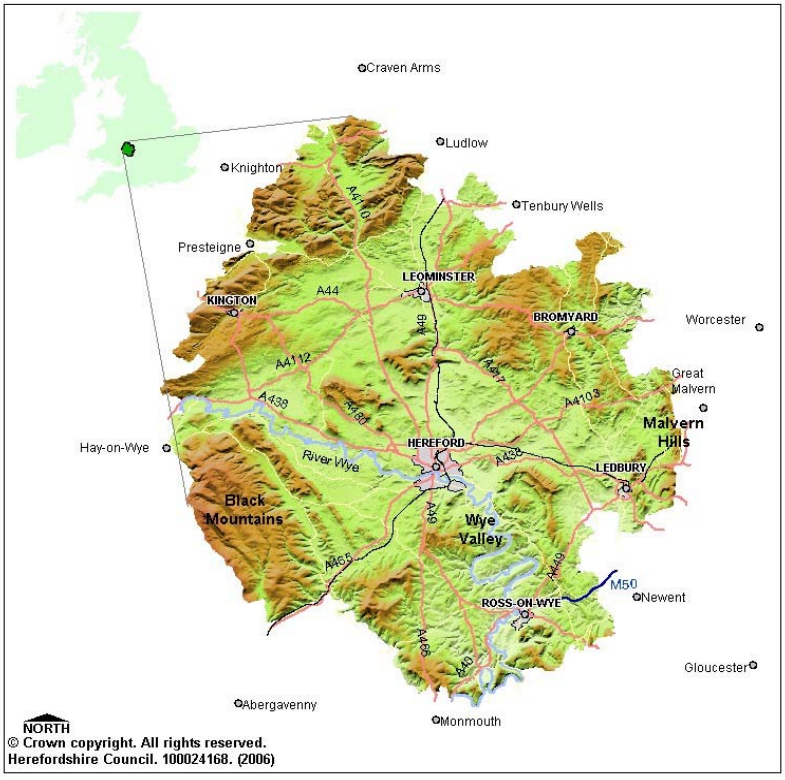

Figure 1.0: Map of Herefordshire showing location, the River Wye and major upland areas

1.3.3 Geology

The predominant geology of Herefordshire is Old Red Sandstone, which is a relatively permeable material therefore leading to well drained soils ideally suited to agriculture.

Infiltration is the process by which water drains through surface materials, such as soil and therefore is a direct result of the underlying geology.

1.3.4 Built Environment

The County consists of the major centre of Hereford, which is surrounded by the four so-called 'market towns' of Leominster to the north, Bromyard and Ledbury to the east and Ross to the south, all of which are prone to considerable disruption by flooding of the major rivers in the area.

1.3.5 Infrastructure

Many of the County's roads are vulnerable to flooding from rivers or other running water bodies such as brooks, as well as via fields and culverts.

1.3.6 Climate

The table below shows the baseline climate for Herefordshire based on the 1961-1990 average (taken from Hulme & Jenkins, 2002) and on changes over the last one hundred years.

Table 1.1 Herefordshire's baseline climate, recent and predicted changes

Climate aspect	Baseline climate (1961-1990)	Change over last century
Mean annual temperature	9.5°C	~ +1.3°C (taken from Central England Temperature figures - see Figure 1.1)
Mean max. temperature	13.2°C	
Mean min. temperature	5.8°C	
Mean annual rainfall	748mm	• Winters have become much wetter relative to summer months. • Rainfall intensity has increased (as reported in Worcester LCLIP, 2007)

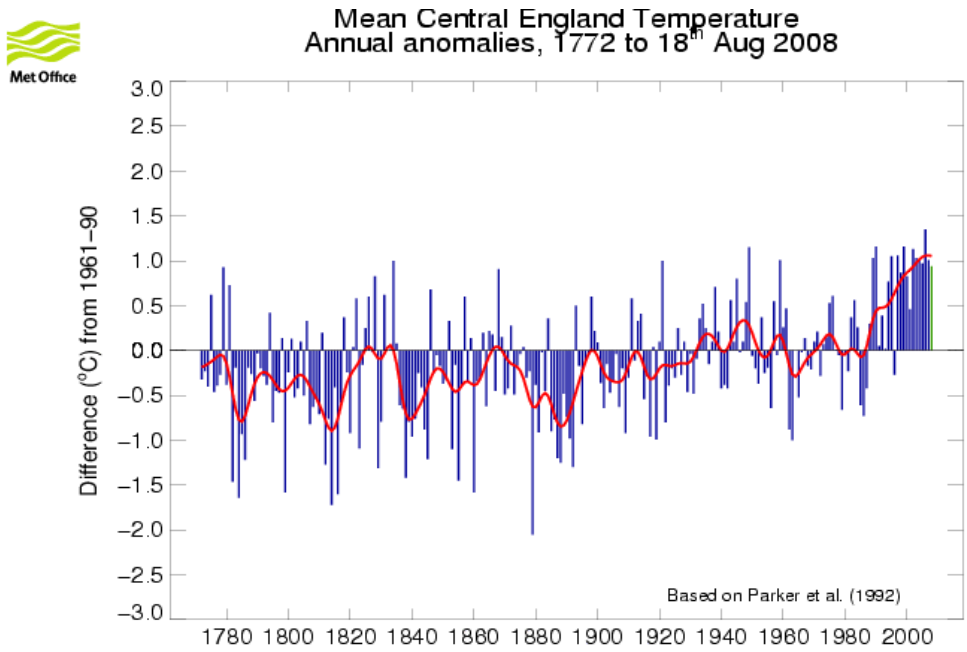

Figure 1.1 Mean Central England Temperature Anomalies (Source: UKMO, 2008)

The main features of Herefordshire's climate are:

'Spring and autumn frost; large annual temperature range; low winter temperature. Highest total annual rainfall of region' (Entec, 2003:29).

More specifically Herefordshire and neighbouring Worcestershire have the highest average annual temperatures of the region (see Table 1.1). The County is prone to frosts with minima just below 0°C.

In terms of the distribution of rainfall, Herefordshire has a marked winter maximum from October to December with a secondary maxima occurring in the months of July and August. On average rainfall intensities within summer showers and thunderstorms can reach 100mm/hour, however these usually last for less than 60 minutes.

The median number of snow days is about 30 across the region, although this is the number of days where snow was observed to reach the ground and in reality depths of snow are usually less than 2cm and less than 2% of snow days in the region record more than 30cm of snow. Snow depths are usually between 1 and 10cm (Entec, 2003).

Breaking the County down, the 1961-90 baseline figures indicate that the western borders of the county are the wettest (coinciding with areas of high relief) with annual precipitation amounts over 1000mm in some places. The driest areas are those in more central and eastern regions, towards the border with Worcestershire and in a rough line-moving south down roughly in line with the course of the River Wye, towards Ross on Wye. Mean annual rainfall in these areas is below 700mm in some places. This can be seen in Figure 1.2.

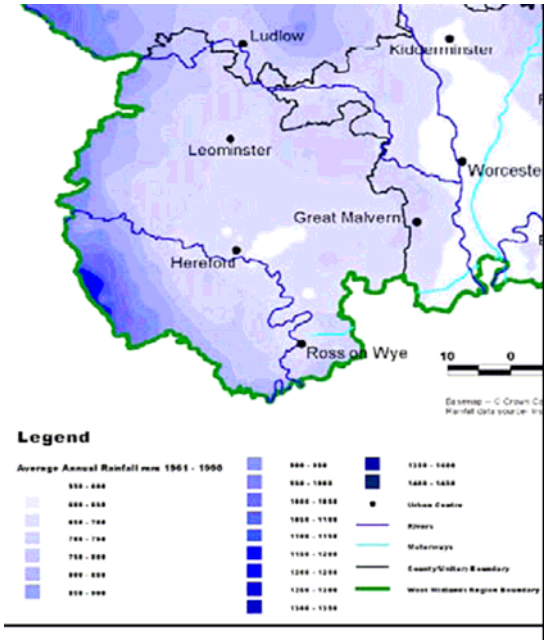

Figure 1.2 Mean Annual Rainfall in Herefordshire (1961-90) (Entec, 2003:32)

In terms of the variation in temperatures across the county again there would seem to be a west east transect with temperatures on average being warmer in the east of the county by around 0.2°C. The lowest temperatures however occur in the northwest of the county and are as much as 1°C below those in the extreme east.

1.4 Climate Change - Key Points:

"Climate Change is a more serious threat than global terrorism" (Sir David King, Government Chief Scientist).

Climate change in the current context is that which has occurred within the last hundred years or so. The global warming trend that has been identified is mainly thought to be a result of humans producing increasing amounts of what are known as Greenhouse Gases that enhance the Greenhouse effect. In essence gases such as carbon dioxide and methane trap solar energy, in the form of long wave radiation, preventing it from escaping the Earth's atmosphere and back into space. This process helps to keep the Earth at temperatures that allow us and other life forms to survive. However the extra amounts of these gases (and others) that humans are releasing into the atmosphere are now thought to be having adverse affects on the Earth's climate, with one of these being an increase in the amount of severe and extreme weather events the world over (BBC, 20/08/07).

Figure 1.3 indicates the link between the concentration of carbon dioxide in the Earth's atmosphere and global temperature

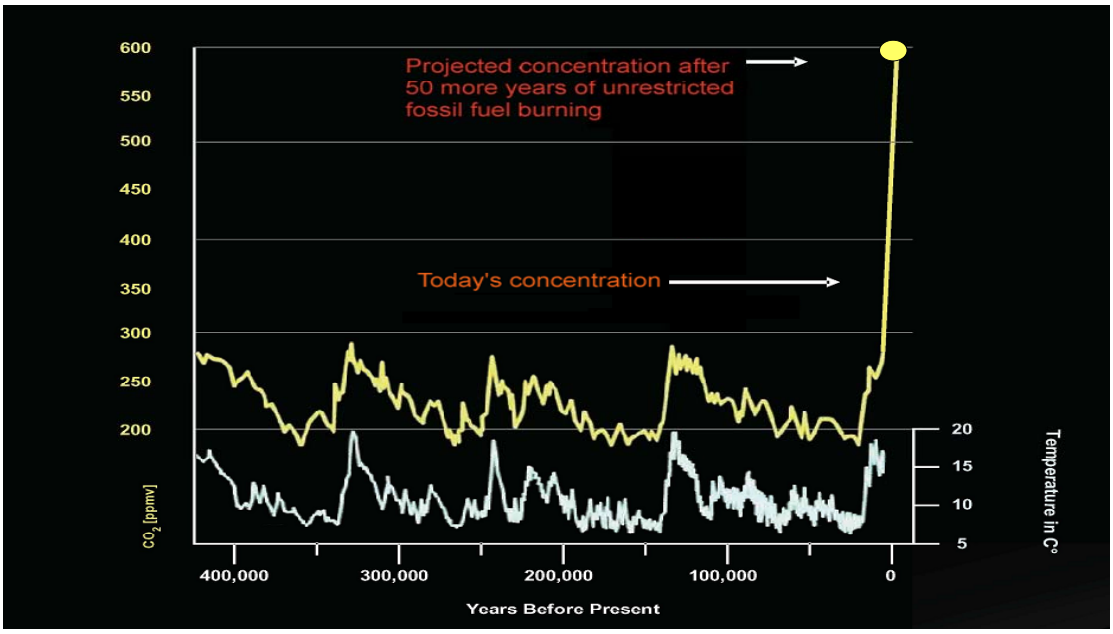

Figure 1.3 Carbon Dioxide compared to Earth Temperature, +400,000 Before Present to present, with projection for next 50 years.

1.4.1 Climate Change Statistics

- Global temperatures have risen by over 0.7C in the last 300 years. 0.5C of this warming occurred during the 20th century (BBC 21/08/08)
- Four out of five of the warmest years ever recorded were in the 1990s (BBC 21/08/08)
- Snow cover in the Northern Hemisphere has declined since the late 1960s by around 10% (BBC 21/08/08)
- In many mid and high-level areas of the northern hemisphere there has been a 2-4% increase in the frequency of heavy rainfall events (BBC 21/08/08).
- The UK's five warmest years on record have all occurred since the year 2000.
- This warming trend is predicted to continue and it will accelerate if emissions are not reduced.
- Since the 1980s, the thermal growing season has lengthened by 3 weeks (Environment Agency, 2007)
- Summer heat waves have become more frequent and winter cold spells have declined (UKCIP, 2007)
- The occurrence of El Nino events in the Pacific Ocean may add to the warming conditions during some years (Henson, 2006).

2.0 Severe Weather Impacts in Herefordshire

2.1 Summary of types of event

Figures 2.0 and 2.1 show both the frequency of the different types of event and also the different types of weather that have affected the county in the last ten years. These figures have been produced from the media trawl and insurance claim figures (the databases for these are available for viewing in Appendix A).

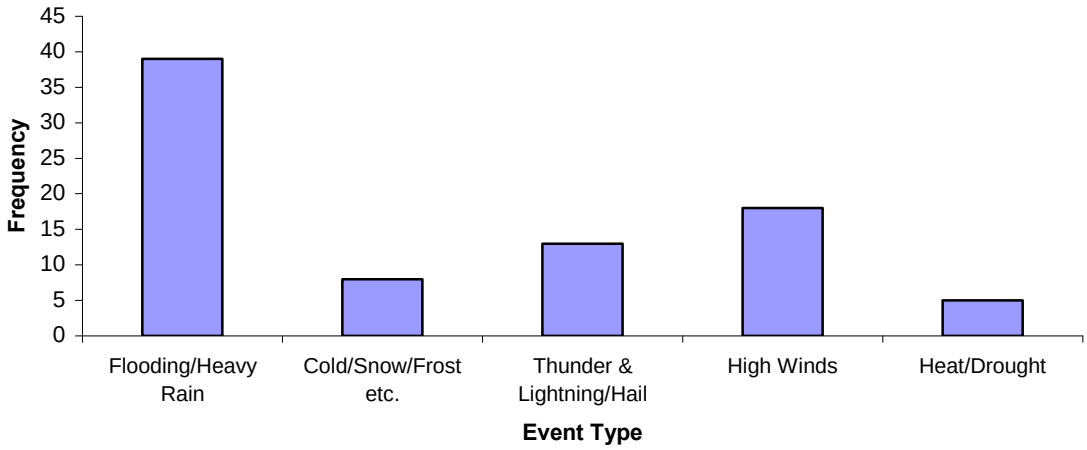

Figure 2.0 Frequencies of different significant events in Herefordshire over the period 1998-2008

As can be seen above flooding (of all types- local, flash and fluvial) and heavy rain events are the most frequent types of severe weather occurring within the county. The distinction between these is as follows:

- ***Local*** *- Flooding events that may only affect a particular building e.g. a school or even a village*
- ***Flash*** *- Triggered by intense rainfall events e.g. tens of millimetres falling in just a few hours, drains cannot cope and infiltration capacities of permeable surfaces are exceeded leading to large amounts of surface water and rapid run-off to streams and brooks, which are also then liable to flood.*
- ***Fluvial*** *- Lower intensity steady rainfall falling over the course of a few days can lead to rivers and streams bursting their banks, as water is fed into them from tributaries, run-off and groundwater from within their catchment area, thus leading to the flooding of surrounding areas.*

Heat and drought would appear to be the least frequent significant weather event occurring; however it should be pointed out that these events tend to be less frequently reported on in the media as well as less damaging to property and equipment and therefore may be under represented here due to the source of the information used.

What can also be said is that the County has been subjected to a large number of events during this period, 84 in all, ranging from severe flooding to drought and heat

wave conditions and even more isolated events such as freak hail storms and thunder and lightning. This number is likely to increase at an enhanced rate as a result of climate change (see Section 4). Again, it is worth noting that some events may have been under represented here as well for the same reasons as mentioned previous paragraph.

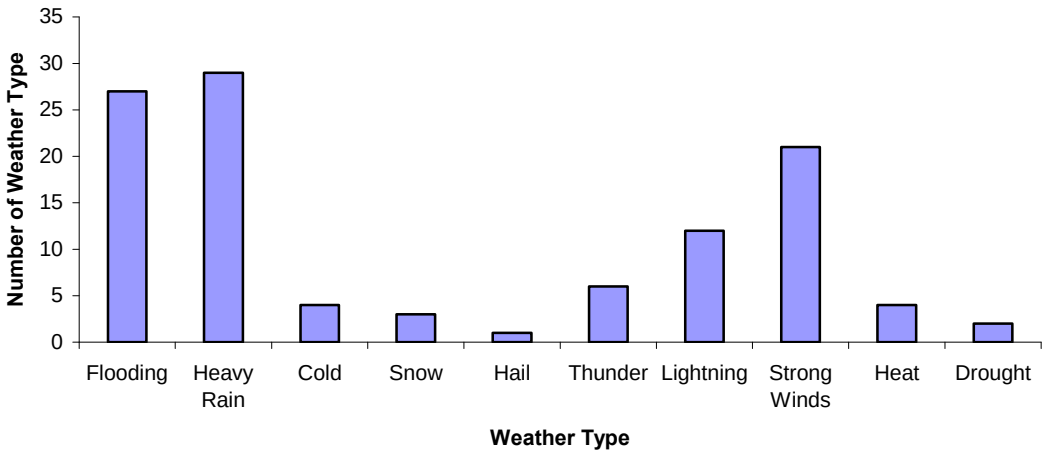

Figure 2.1 Frequencies of differing significant weather types having local impacts (1998-2008)* – more detailed categories

The table above provides a breakdown as to which different significant weather types have had implications for council services.

In addition to this Hereford & Worcester Fire and Rescue Service (2008) report:

> 'There have been 992 recorded Incidents of flooding across Herefordshire and Worcestershire over the last 10 years.'

The actual figure is likely to be far greater than listed above as during spate conditions* the Service would have multiple Incidents listed under the same Incident reference, owing to the considerable number of Incidents of the same nature, at the same location area.

* *Spate conditions refer to an unusually high number of Incidents in a relatively short period of time, for example owing to severe weather conditions such as torrential rain.*

2.2 Summary of claims relating to events

A breakdown of the number of insurance claims per event as well as the cost of each on this area can be seen in Figures 2.2 and 2.3.

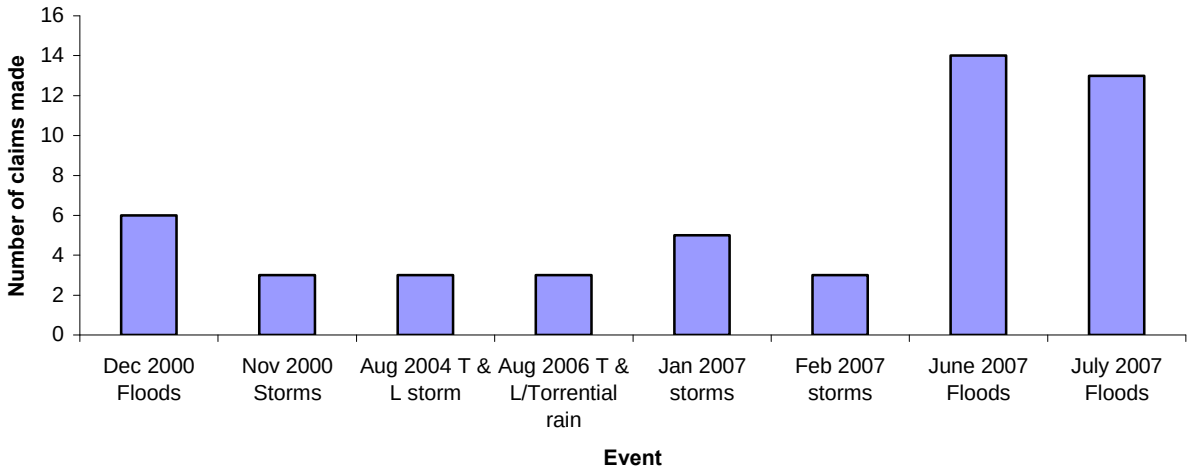

Figure 2.2: Number of claims made per event (Note: T & L refers to 'Thunder & Lightning')

These figures show that the 13 claims made for July 2007 floods cost a total of around £650,000, more than all other claims for the period from May 1999 to the present (Figure 2.2.1). The next most costly event in terms of insurance claims was the June 2007 floods, with more claims but less than a tenth of the cost of the July 2007 flood event. It would be interesting to see Council records from the Easter and October flood events of 1998 however these records were not available.

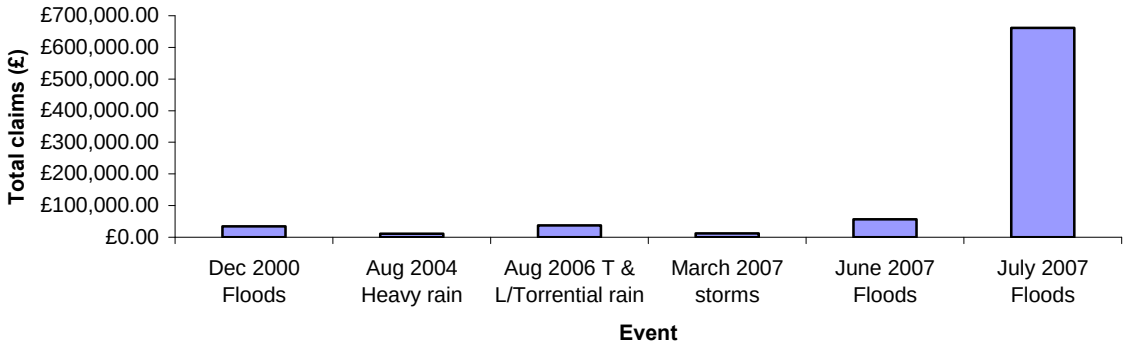

Figure 2.2.1: The six most expensive events in terms of insurance claims (Note: T & L refers to 'Thunder & Lightning')

2.3. Financial Implications of weather events

It was not possible to find the direct financial cost of many of the six events studied in detail in Section 3 and for many of the areas. However the total known cost is summarised in Table 2.3

Table 2.3 Summary of Financial Implications of Major Events

Event	Organisational Cost	Wider Costs
June / July 2007 Floods	~ £5.5 million + unknown costs on Parks and Countryside & Tourism	Businesses- Estimated ~£40 m in lost revenue (AWM, 2008); Agriculture- unquantifiable (thought hundreds of millions- NFU, 2008)
February 2007 Snow	~£ 250,000	
August 2003 Heat Wave	Unknown	Unknown - though Welsh Water spent millions upgrading it's treatment facilities and in good-will payments
October 2002 Storms	£2500 in building damage claims	
Smaller Events	£85,000	£250,000 damaged crops

2.4. Future Climate Predictions

Much of the climate change that will occur over the next thirty to forty years is inevitable as it has already been determined by historic emissions and inertia within the climate system. However if we act now we will be able to reduce current and future emissions and thus reduce the risk associated with climate change towards a level more in line with the low emissions scenarios predicted by Hulme et al. (2002).

More information on the United Kingdom Climate Impacts Program (UKCIP) and scenarios for Herefordshire for the 2020s, 2050s and 2080s is contained in section 4.

2.4.1 Key Findings for Herefordshire's Climate

- A likely increase of 1.7 - 4.0^{o}C in annual temperature by the 2050s under a high emissions scenario[2].
- The coolest days in the winter months are likely be up to 4.6^{o}C warmer than current in the 2050s
- The winter months in 2050 are very likely to be up to 27% wetter than current conditions.
- Central estimates are for heavy rain days (rainfall greater than 25mm) over most of the lowland UK to increase by a factor of between 2 and 3.5 in winter, and 1 to 2 in summer by the 2080s under the medium emissions scenario.

Data will come available on specific weather events in the New Year (for example intense rainfall days)

[2] More information can be found IPCC Special Report, Emissions Scenario (2000)

3.0 Key Events and Response

There are a number of events that have been deemed more significant than others in terms of the impacts they had, the media coverage they received and also the nature of the individual events. The events that will be dealt with in more detail in the next section are as follows:

- Summer floods of 2007- June and July (each treated separately)
- February 2007 Snowfall
- August 2003 Heat wave
- October 2002 Storms

After this a number of notable, more localised smaller events will be looked at in order to highlight the affects of events such as these.

It should be noted that while this was being written Herefordshire experienced another flooding incident (June 2008) that is detailed within the LCLIP database but not discussed within this report.

3.1 Flooding 2007

In June and July 2007 several periods of extreme rainfall gave rise to widespread flooding, not just in Herefordshire, but also across England and parts of Wales. The period of May to July 2007 was the wettest on record for this period, with a total of 415.1mm falling across this area, more than twice the 1971-2000 average figure of 186.3mm. Widespread disruption was caused to businesses, homeowners, motorists and schools to name but a few.

These events were unusual both in their intensity, causing flash flooding as opposed to the frequently occurring fluvial events that occur in Herefordshire, and also in their timing, during what is classed as British summertime. Both of these may explain why such events caused such disruption across the county and also across many other areas of England and Wales. For a full list of the impacts reported in the local media see Appendix A.

3.1.1 Flooding- July 2007

The flooding of July 2007 is by far the most notable weather event to affect Herefordshire within the last ten years. Torrential rain in the period on and around the 20th of July (over 100mm in some places) combined with the wet weather in the preceding months (see previous) to cause widespread chaos across the county. Table 3.0 shows the amount of rain that fell in Herefordshire during July along with the other worst affected counties compared, as a percentage, to the 1971-2000 average.

Table 3.0: July rainfall compared to 1971- 2000 average (worst affected counties)
Source: Environment Agency web site (2008)

County	July rainfall (mm)	% of 1971-00 average
Gloucestershire	197	411
Herefordshire	189	427
Oxfordshire	150	339
Radnorshire	222	363
Shropshire	165	330
Worcestershire	208	453
Warwickshire	201	417

In basic terms Herefordshire received over four times the amount of rain it normally receives in July, based on recent records.

The key point about both the June and July 2007 flooding events was the widespread flash nature of the flooding. Usual flooding events in the county tend to occur when the main river of the county, the Wye, bursts its banks following several days or possibly even weeks of consistent rainfall. However due to the more intense nature of the rainfall during these events it was not the Wye that flooded but smaller streams and brooks as well as the majority of the Wye's tributaries. There was also a much larger amount of runoff from fields and urban surfaces as infiltration capacities were exceeded and drains failed to cope with the sheer volume of water that was created.

The affects of the rain were county wide and far reaching. Many of the County's roads were flooded, causing some people to be trapped in their cars and having to be rescued by the emergency services, while others became stranded and had to be put up in emergency shelters. The market town of Bromyard was effectively marooned and the village of Hampton Bishop had to be evacuated.

The Council response was to open up the Emergency Information Line (open 18 hours a day for the majority of the crisis), the local media was kept informed of road closures and advisory notices were issued for the public to 'only travel if necessary'. Much of this information was broadcast on BBC Hereford & Worcester, who extended their hours of broadcasting in response to the flooding. Property Services also issued information on council owned building closures (in this case Ledbury Heritage Centre and Rugby Club) to the public via the Ledbury Advertiser. The Environment Agency, the Police and the Health Protection Agency (HPA) also provided supplementary advice. The council co-ordinated the rescue of children, provided motorist rest centres and supported the emergency agencies and provision of highways maintenance and information.

Many departments of the council as well as external organisations worked together in order to meet the demands that the flooding brought. These include Emergency Planning, Highways and Transportation, Property Services, Finance, the Children's and Young Persons Directorate, Adult and Community Services, the Environment Agency, the Highways Agency and Welsh Water. The Herefordshire Response to Major Incidents Team (HERMIT) was also put into action led by the Police.

Such response to the event fits in with the national policy via a number of different response plans and procedures, all implemented by the different departments (see below).

Areas affected by July 2007 floods

(a) Emergency Planning

This event was deemed to have had a high operational impact on Emergency Planning services requiring all staff to be active and warnings to be sent out. This impact was added to by the fact that the manager of the service was away on leave.

Acting as a result of Met Office severe weather warnings a Silver Group meeting was called comprising relevant Council departments and managers, the Emergency Services (Fire, Police and Ambulance), the Environment Agency and the Primary Care Trust (PCT) and the Civil Contingencies Act was implemented. In addition to this a response centre was set up at The Bishop of Hereford Bluecoat School in the Hampton Dene area of the City, which was also incidentally affected by the flooding. Council staffs were kept informed of events via updates from the Communications Team and the Herefordshire Flood Plan was implemented. In response to the dramatic extent of the flash flooding rest centres were opened in Hereford, Bromyard, Ledbury, Leominster and Ross to shelter stranded motorists, school children and those forced to flee their homes, including elderly residents of a caravan park in Bromyard. These were manned by staff from the EPU, Herefordshire Council's Homeless Team and Halo and also by volunteers from St John's Ambulance and Clergy. The Emergency Information Line was also open 18 hours a day. In addition to this and adding to the problem in general was the flooding of schools and roads, in fact the A438 (Hereford to Brecon road was the only main road in the county that was able to stay open.

Emergency Planning staff report that all Officers were required to work round the clock for the weekend of the 21st July (as well as Friday 20th July when the flooding began). The one administrative staff member that the section has was also required to work for a considerable number of extra hours over this period. This led to special arrangements having to be made whereby staff were paid for some of the extra hours worked, as it

would not have been feasible for them to accrue the time under the Council's flexi-time and time off in-lieu (toil) policies.

Long-term impacts of this event were that it reinforced the requirements for properly maintained contingency strategies and accurate weather warnings and in response to this the UK Met. Office now issues flash weather warnings to the authority that are better and more locally defined than those previously. The Bellwin Scheme was also implemented in response to this event. This allows Local Government Ministers to make additional revenue available to support local authorities in order to assist with the immediate, and unforeseen costs in dealing with the aftermath of emergency incidents.

The Pitt Report, published in June 2008 in response to this flooding event, made 82 recommendations, 31 of which are Local Authority responsibilities. This is expected to have a long-term operational impact on areas such as Emergency Planning. There was also long-term operational impacts relating to hours accrued by officers as a result of the floods and also the implementation of the Corporate Recovery Plan. Geoff Hughes (Director of Regeneration) led the recovery response. To date there are still some householders who have not been able to return to their properties.

No threshold has yet been set for such flash flooding events (although there is a threshold for fluvial events), although there may be scope in the future for this, probably around the 20mm mark. There are now improved flash weather warnings from the Met Office, which can also be used as a threshold to act.

It is thought that the ongoing training of staff in emergency response, business continuity, flood planning, multi-agency working and rest centre training would all be beneficial, as would increased budgets for each of these.

It is also thought that the organisational response as a whole could be improved by increased access to council volunteers to staff the Emergency Information Line and also from the increased awareness of the need for such volunteers across the council.

Estimated Departmental cost for Emergency Planning: £21,500

Case Study:
Hampton Bishop

On the evening of the 22nd July 2007 the decision was taken to evacuate residents from the village of Hampton Bishop in the east of Herefordshire. In total more than 70 people were evacuated and 41 men and women, including staff, were moved from Hampton House Residential home to safer accommodation.

Earlier in the day Herefordshire Council staff had alerted residents by knocking on doors and advising them to gather personal things ready for evacuation. Members of the Emergency Services as well as the army and volunteers were responsible rescuing people from their homes and taking them through the floods to boats and 4x4 vehicles. This evacuation took place as a result of water from the flooded River Lugg breaching it's flood defences, flowing into fields and then on to the road and the subsequently the village. As water was not leaving the village quickly enough by natural means the fire service and the Environment Agency worked together using three pumps in order to transfer the water into the relatively low-flowing River Wye (Hereford Times Archive, 2008)

As a result of this event Hampton Bishop flood plan has now been amended.

b) Highways Department

Table 3.1. Recent flooding costs for Highways (Accounts Department, Herefordshire Council 2008)

Financial Period	Flood Costs
2007/08	£2,908,000 (£1,983,000 funded through Bellwin grant)
2008/09	£162,000[3]

Table 3.2. Total flooding costs for 1998/99 (Hereford Times, 1999)

Financial Period	Flood Costs
1998/99	£1,250,000 (£170,000 minimum funded through Bellwin grant)

As can be seen in Table 3.1 the two flooding events during the 2007/08 financial year cost the Highways Authority nearly £3 million, considerably more than the costs accrued so far this year (September 2008). Unfortunately no Council records were available for previous years. However, some figures were published in the Hereford Times (28th October 1999) and these can be seen in Table 3.2 for the year 1998/99 (the first financial year of Herefordshire Council as a unitary authority). These figures are useful as a comparison and show the huge impact the summer floods of 2007/08 had on highways financially and if representative, for the rest of the Council as well.

Again this event is deemed to have had a high operational impact upon the Highways section of Herefordshire Council in the respect that work in response to the flooding took precedence over normal day-to-day work for several weeks following the event as well as many staff having to work longer hours (in many cases around the clock) in order to cope with demand.

[3] E-mail from Cathy Stokes to Matt Locking on 4th July re cost of Floods in Jan 08

The immediate management response to the event was to observe and inform on road conditions/road closures and to coordinate their response with other agencies.

Highways reported major damage to service infrastructure and a restriction in their ability to respond to problems on the roads as a result of the flooding as well as the expected increase in the volume of incoming calls to the department.

Although the majority of immediate costs was recovered through the Bellwin Scheme, such events are not accommodated for in the annual budget of the Highways section. This often means that there is an annual overspend on this as well as such areas as winter highways maintenance. In terms of long term operational impacts there has been a lot of discussion regarding alleviation works that could take place, which Highways staff need to be involved in assessing and planning, thus adding to and changing their operational role somewhat. The long-term management response has been to highlight and try to increase resources for such events, this was part of the reason behind the formation of the Network Management Team. Long-term costs relate to any flood alleviation work done to increase capacity to deal with such events in future with reduced impact.

Looking to the future, thresholds were determined in relation to monitoring of the River Lugg at times of flood. It was decided that a gauge height of 2.8 metres was the point at which Highways would contact the relevant departments and services to initiate a response.

It is thought, from a Highways perspective, that further alleviation strategies are needed to cope with flooding events, including those of flash nature such as this one, as well as an increase in the capacity of the department to cope with such events. Some research has been commissioned into risk assessment by the drainage team at certain sites. It is felt that the Pitt Report is in need of a proper assessment from a Highways point of view and also that there is still room for an improvement in communication between the various agencies involved in responding to events such as this one. One point also raised is that although the response of the department to this event in the north of the county was well coordinated, in the south of the county it is said to have been much more ad-hoc and maybe there is some room for improvement in this area.

c) Land Drainage Team (Highways)

The land drainage team liaise closely with the Highways and Bridgeworks teams and during this event their immediate role was to help in dealing with the large increase in calls that came in and either acting accordingly or passing information to the relevant department. This of course also resulted in an increase in the workload for the Land Drainage Team and also in personnel hours, however this was only for the duration of

the event. Central government made £3,000 available in order to deal with damage caused by the floods from a drainage aspect.

Long-term effects have been for the team to work with Community Regeneration in order to get Parish Councils to claim money from the government made available for drainage improvements. The team are also still processing requests from the public for work to be done as a result of stream blockages etc. Highways now keep better records of the instructions that are supplied to Amey Wye Valley for watercourse maintenance, so that these are readily available in the event that complaints/claims should be made against the Council.

The Drainage Team specifically provided information to the public on how to protect their homes during such an event as well as referring them to the National Flood Forum and Emergency Planning. Alternative advice may have been issued from the Environment Agency and the Internal Drainage Board, both of which also collaborated with the Land Drainage Team in their response.

The view of the Land Drainage Engineer is that that people should be made more aware of how sandbags are made available via their local Parish Councils and that this scheme should be better promoted in the community. It was stated that sandbags are made available to all Parish Councils but some, even those that have been affected by flooding previously, still do not take up their allocation. The question is here, that if more people in a Parish were aware of this would pressure be put on their parish councils to take up their allocation and thus improve local delivery?

d) Social Services Department

The mass disruption caused by this event meant that vulnerable groups, such as the elderly, were particularly affected. As already mentioned residents from Hampton Bishop Residential Home had to be evacuated to temporary accommodation. In addition to this Bromyard Hospital also had to be evacuated - emergency accommodation and beds were set up at Bromyard Leisure Centre.

Little further information is available as Leslie Libetta was away at the time of floods and the two major staff involved have both left.

e) Children's and Young Person's Directorate

Table 3.3 Enforced School Closures as a result of the July floods

School	Date closed and explanation
Bosbury C E Primary	20th July 2007 (p.m.) – floods

Though only one school closed as a result of the July floods, this was more a result of the 20th July being the last day of term than any enhanced adaptation mechanism. The Financial and Property Services sections for this event show that schools were more heavily impacted than this table reveals. It is thought somewhat fortunate that the event occurred when it did as many schools would have been forced to close for relatively long periods, causing significant disruption for the children and parents involved.

Case Study:

Bosbury Primary School (1)

For Bosbury Primary School July 20th was the second time in as many months that an enforced closure had taken place, forcing staff to take responsive action. In June the roads in and around the village of Bosbury were so badly flooded that the school had to be closed on the morning of the 25th. Under a month later this situation was repeated, with the Head-teacher and her staff keeping an overnight vigil at the school as waters continued to rise.

Source: Hereford Times archive, 2008

f) Property Services

The head of this service viewed this event as having has a high operational impact on his service area. Immediate management was needed making sure staff duties were covered for those who couldn't make it in and also by being available (or on call) all weekend. The main direct impact of this event was that the summer maintenance program that usually takes place was heavily disrupted, with staff having to concentrate on flood damage repair works, mainly within schools and the accompanying increase in workload that this brought with it. External agency staff and consultants also had to be employed to cope with the rise in demand.

There was no damage to their own service infrastructure though it was stated that some school telephone lines were damaged.

Although there was no change in any person's job role, as with most services, some staff were required to work extra hours through the event. Direct property costs from schools are thought to have totalled around £2 million plus the more indirect costs of paying caretakers to come in during the school holidays and the unplanned increase in workload on Property Services.

Longer term impacts include work being done (and the associated costs) to alleviate flooding at some schools e.g. at Bosbury and Holmer. At the latter funds for such measures have been made available via the Capital Program. However at Bosbury this is not as straightforward as £160,000 was spent on a flood defence scheme on the River

Lydon less than 2 years ago in a combined effort by Herefordshire Council and the Environment Agency. Additional information on this can be found in section 3.1.2.

The long-term management response within Property Services has been to remind schools that it is their own responsibility to keep drains and guttering etc clear and thus help to reduce flood risk in this way i.e. taking a more proactive approach to flood risk management. A cautionary note should be made here though that where schools move expensive equipment in order to protect it from flood damage it should be kept in an equally secure location. One school suffered theft after moving equipment.

As a result of this event some small pumps have been put in at Holmer Primary School. There are now improved severe weather warnings from the Met. Office so it is hoped that both the Schools and Property Services will be better prepared. It is thought that a section on emergency procedures could be included in the induction program. However the Property Services Managers thought that all necessary management strategies are already in place for insurance reasons alone.

Further research suggested includes more work on flood mapping and recurrence intervals and also further investigation of culverts and drainage networks.

Total cost to Property Services: £2.2 million

g) Financial Services / Risk Management

There were 11 Insurance claims by Herefordshire Schools for this event coming to a total cost of over half a million pounds. Just over £1500 of this was contributed by the schools themselves as excesses on their policies.

Claims on other council buildings were much less than the above figure, just 2 in total, with £125,000 claimed, of which £5,000 was contributed as excesses on the policy.

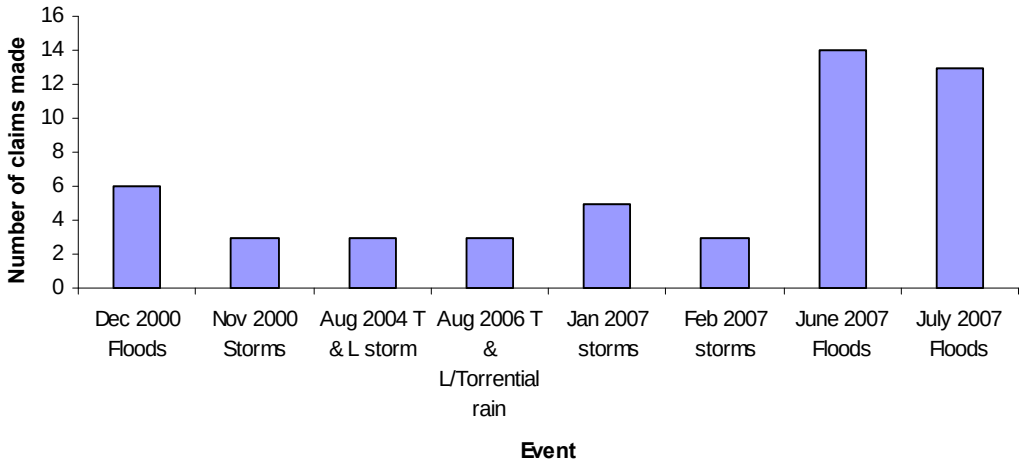

Figure 3.0: Number of claims made per event (Note: T & L refers to 'Thunder & Lightning')

As can be seen in Figure 3.0, 13 claims were made for this event at a total cost of around £650,000, which is in fact more than all other claims for the period from May 1999 to the present; this is emphasized in Figure 3.1.

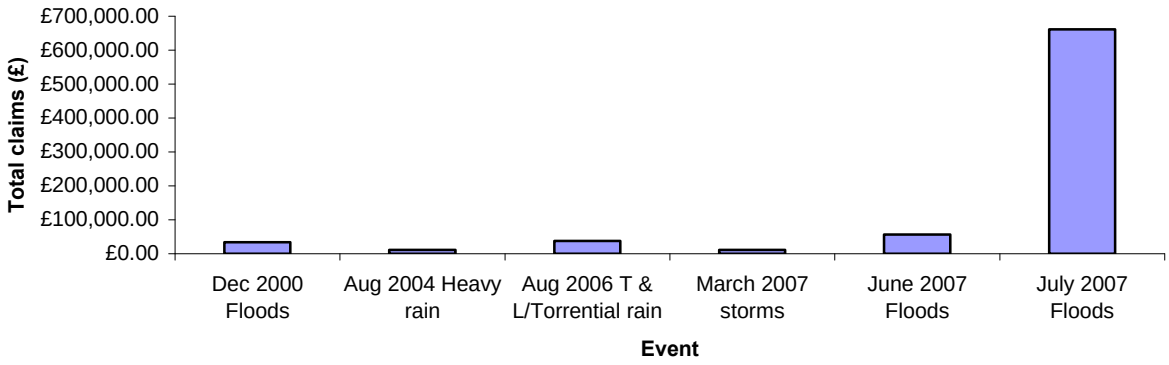

Figure 3.1: The six most expensive events in terms of insurance claims (Note: T & L refers to 'Thunder & Lightning')

From an operational point of view this event is again deemed to have had a high operational impact on the Risk Management section with workloads increasing severely in response to and in the aftermath of the floods. The majority of this was as a result of seven schools being damaged by the floods and the associated torrential downpours that caused it. This meant that the risk assessor had to be contacted and together with the Corporate Risk Manager each affected school had to be visited and assessed with the aid of the school's bursar once it was safe to do so.

The immediate response to the event was to liaise with Emergency Planning and the immediate collation of information for the Bellwin Claim. In terms of more long-term

effects, this event has caused premiums paid to the Council from the schools to be raised*, especially in light of the fact that money had been released from the self-insurance fund around a year previously back to the schools. There is also an issue as to whether such an approach to insurance will be cost effective in the future in light of events such as this one. The section also had regular meetings with Highways, Public Rights of Way, Finance, Property Services, Social Care and the Environment Directorate in general (now Environment & Culture) in order to produce the Bellwin Claim, which was submitted early this year.

The only real long-term operational impact was that, as a result of this event, the loss adjustor, who acts on behalf of both parties to minimise financial losses, is now the first port of call and can be called out directly by the schools for such events. The only long-term management response related to the handling of the claims made i.e. processing these and determining how much should be paid out.

The relevant policies for this event relevant to this area are insurance policies and the Bellwin Scheme.

Continuity plans were highlighted as an area on which staff training could be given with contingency plans improved for future events.

An important issue raised from this interview is that the impacts of this event seem to have been exacerbated by school children becoming stranded and workers trying to get home early. The point has been raised therefore as to whether there should be a more proactive response to such events, especially within the council i.e. in light of the severity of the forecast would it have been advisable for schools to be shut for the day and Herefordshire Council staff to be allowed to go home early (or not to travel in at all, particularly those travelling in from rural areas)? Currently both of these are particularly grey areas with individual Head-teachers making the decision for their own school and staff receiving only advice and no compensation from service managers if they take the decision to remain at home or finish early. Some staff are essential during events like these such as those in Highways and Emergency Planning and suitable contingency plans need to be put in place for circumstances in which they cannot get to work.

Organisational Cost: £6600 + Premiums

Total Claims: £661,651

* Herefordshire Schools pay their premiums to the Council: this is self-insurance and is deemed as a cost effective method that also allows money to be put back in to the schools.

h) Education Transport

The July 2007 floods had a localised effect on this service area, yet where this occurred the effect was high. Hereford to Ledbury and Hereford to Ross services (and visa versa) were those most heavily disrupted affecting both mainstream and special needs pupils.

The immediate management response to this was for the Transport and Admissions Officer to co-ordinate response from the Emergency Centre at the Bishop of Hereford Bluecoat School.

Direct impacts were that some school transport was not able to run and in fact some pupils were stranded and not able to return home (including some visiting from outside of the County). Over 100 pupils in fact were forced to go to Emergency Centres and remain there overnight, although some living more locally were fortunate enough to be able to return home with the aid of some 4x4 vehicles.

There was no real damage to service infrastructure although one bus operator's depot was flooded.

As a result of the event the Transport and Admissions Officer as well as a number of the escorts to the Special Educational Needs (S.E.N.) pupils worked longer hours than normal.

Direct costs of the event have not been quantified, but consist of overtime costs for staff coordinating the response and also those of setting up Emergency Centres.

In general the long term affects of this event are thought to be fairly minimal although the event is thought to have drawn attention to the area of continuity planning for such events.

There are emergency procedures in place for individual schools in such circumstances, which then advise school transport. However as this event happened very quickly this coordination may not have been as organised from this perspective as it might have been.

It is thought that Police advice for such an event may have varied slightly and the Hereford School Transport operation involved collaboration with Bus companies and Emergency Planning.

There was a feedback meeting between council departments on this event, however the School Transport team reports that as yet it is yet to receive what outcomes came as a result of this.

Thresholds determined for such events were just to act accordingly to severe weather warnings. It is thought that specific training on such event response coordination is a good idea, this has been requested although nothing has been provided as yet.

i) Parks & Countryside

This event had a medium level affect on this service area and the work that was created as a result was mainly repairs and maintenance. The heavy rain was responsible in the short-term for the flooding of paths down along the riverside and around Bodenham Lake.

Indirect costs were not quantifiable but are mainly those resulting from time being diverted away from normal working functions. It is also worth noting here that many of the Rangers vehicles were used by other services during the emergency.

The main long-term impact of such an event is the erosion of pathways and access points, meaning that again increased maintenance in this area was again needed. The long-term management response has been to dedicate a response to this maintenance and to be aware of the impacts of more extreme weather events. The possibility of some sort of contingency budget for events such as this one was mooted.

Long-term costs were again not quantifiable, these related to increases in tree surgery and other increasing costs relating to work above and beyond what would normally be done. Extra inspections and site surveys took place as a result of this event and the Rangers worked in collaboration with Public Rights of Way Officers.

No real thresholds were determined as a result of this event but it was stated that flash weather warnings are monitored.

No methods of improving the services response were thought necessary though it is thought that more practical measures could be put in place to mitigate the effects of such events e.g. options for improved drainage of paths.

Total Cost to Parks & Countryside: £ ***Not supplied***

j) Biodiversity

It is quite clear that any significant weather event will have an affect on this area of Herefordshire Council's operations. One immediate impact of the flooding was the production of certain types of blue-green algae on Bodenham Lake, as a result of eutrophication from enhanced run-off. This led to deaths among some fish species within the lake.

Although no specific event details were obtained flooding is thought to have a high operational impact on this area although, as they work in more of an advisory capacity, the team could not quantify many of the operational impacts. This event and the one immediately preceding it were also deemed to have badly affected projects to record biodiversity sites within Herefordshire and Worcestershire. Some staff were forced to work from home during this flooding event, as their office was made inaccessible by the

flooding. This supports the organisation's policy of flexible working and specifically better home-working facilities.

Long-term impacts on the service are more tailored to flooding in general. The team help to advise on flood defence planning, citing areas of current habitat and where new ones could be created. From a long-term operational viewpoint the effectiveness of such flood defences is also monitored.

During such events liaison is made with many outside organisations, such as the Environment Agency, the National Wildlife Trust, the National Park Authorities and the Wye and Usk Foundation.

There is no real relevant policy for the Conservation Team for such an event, though the Biodiversity Strategy (2007-2010) does aim to take into account the impacts of climate change on biodiversity and promote a better understanding of the linkages between the two.

k) Community Regeneration

Although this is not such an obvious area that one would expect to be affected by this July 2007 flooding event certain issues were raised as a result of the July 2007 floods. These mainly related to the local provision of sandbags and preparedness of Parish Councils as a whole, something that has already been highlighted in section 3.1(c). There was an increased volume of calls to the Council requesting sandbags due to this event. If the Parish Councils were informed and prepared enough for such events then there should have been an adequate supply of sandbags held at dispersed locations i.e. within the village halls, churches, community centres, schools etc, thus reducing the number of individuals calling the council during such events. The result of the poor take-up by parishes was that, when the team within Community Regeneration directed individuals phoning in to their Parish Councils for sandbags, there were several occasions on which insufficient supplies were kept, even though sandbags are freely available via the Highways Drainage Team at request.

It is thought therefore that there is a need for increased preparedness at local (Parish) level for such events and that maybe some sort of asset register should be put in place e.g. vehicles that can be used to help aid rescue/evacuations should the situation arise. Such a register would need to take into account the advice of Emergency response authorities with regard to Health & Safety risks but may be a useful resource to have. Available resources are not always predictable, for instance, during this event elderly residents in an affected part of Bromyard were rescued by the Fire Service using a holidaymaker's boat that just happened to be passing through the area at the time (Hereford Times, 2007).

l) ICT Services

On the day of the flooding there were problems with the Herefordshire Council website (meaning that emergency information could not be viewed) and also with one of the servers. A support engineer was therefore required to fix these problems. Two extra phone-lines were also put in to cope with the sheer volume of calls received by the council in response to the problems called by this event.

m) Local Businesses, Industry & Agriculture

Although this study looks primarily at the impact of severe weather events on council services, it is worth outlining some of the affects such an event had on the county's businesses and industry and thus the economy of the region as a whole:

Local businesses in general were affected by such issues as decreases in custom, inability to distribute and receive orders; staff being unable to get to work as well as flood and heavy rain damage in general e.g. the warehouses of M & M Direct, a local mail-order sportswear and equipment business were flooded during this event.

Case study:

Agriculture July 2008

The heavy rain during the July flood event caused the ground to become so soft that farm machinery was continually getting bogged down, affecting the production of hay and silage for cattle farming.

In terms of how crop yields were affected, this is thought by some to have been compounded by the hot weather in April e.g. one farmer reported a 25% decrease in Barley yields due to the delayed harvest. Oil seed rape crop yields were very variable through winter, however, the quality of milling wheat and cereal crop yields in Herefordshire does not appear to have suffered too badly.

In addition to this, crops became waterlogged and blight was a problem, with potatoes being one of the most affected crops. Where fields were under water for several days the crop had to be completely written off (although the critical period is though to be as little as 12 – 18 hours, NFU 2008). Elsewhere, incessant wet weather increased disease levels, making blight control difficult and costly (Hereford Times Archive, 2008).

Contacts within the National Farmers Union (NFU) report that the event had a large impact on the farming community. Farmland east of Weobley, in the north of the county, experienced serious damage to varying degrees, which became mush more serious further east towards the county border. Other immediate impacts, in addition to those above, include land and building damage and subsistence, livestock-feed crops being lost, access problems in getting produce such as milk out as well as damage, and loss of vehicles to floodwater.

In terms of infrastructure, fences, hedges and farm-tracks were all damaged, requiring maintenance and, in some cases, replacement.

Other notable issues raised by correspondence with the NFU are that it is commonly

misconceived that any crops lost during the floods were compensated by insurance; this, however, is not the case as crops are not insurable and thus the landowners bore the cost of the losses.

One of the Environment Agency's current thoughts on alleviating flood risk is to allow floodwater to drain onto unpopulated agricultural land. This approach has been brought into question by agricultural landowners and it has been suggested that Mediterranean drainage style diversion channels may be more appropriate, particularly during summer months.

Another issue that has been raised is that the frequency of maintenance of streams, in terms of the clearing of debris and material that can cause channel blockages, by the Environment Agency has seemed to decrease in recent years, and is thought by some to have contributed to recent flooding events.

n) Emergency Services

All of the emergency services were called to respond during the July flood event- Hereford & Worcester Fire & Rescue Service for instance received over two thousand calls in one day and rescued more than seven hundred and fifty people from their homes and vehicles all over the county as a result. They also helped to advise on road closures and issued safety advice as well as being heavily involved in the evacuation of Hampton Bishop (as described earlier in this section) and two caravan parks in the north and northwest of the county.

It is also worth noting that Leominster Ambulance Station was flooded during the event forcing the crew there to move.

o) Environment Agency

This event was only deemed to have had a medium operational impact on the Environment Agency as operationally the Agency Area Office covers the whole of south east Wales and Herefordshire. This event was not widespread throughout the whole area and it was primarily Herefordshire that was affected. No effects have been seen in the Agency long-term as a result of this event.

The Agency states that in terms of improving it's response as an organisation it is always seeking to refine flood warning trigger thresholds for flooding and states that the more events that happen, the better the service will become.

Immediate management was required to coordinate an operational response in the village of Hampton Bishop in order to provide pumping equipment to relieve the pressure on the River Lugg and also in opening the Area Flood Incident Room.

Direct impacts of the event on the Environment Agency's Area flood response team were that the Agency Incident Room was operational for several days during this period to monitor rivers and rainfall, and to forecast flooding and issue appropriate flood

warnings. The Agency's operational response was also managed from this incident room.

Although no damage was seen to service, Agency infrastructure staff were required to cover the incident room for several days around the clock preventing them from doing their day-to-day jobs and also having to work additional hours to cover the incident room.

Direct costs from the event are thought to have been in the order of £10,000 although this is only a rough estimate. Indirect costs were not quantified but were described as consisting of lost time from several members of the Agency Area team for a period of 5 days and also lost time needed for reporting and data gathering after the event.

Looking to the future, flood warning and operational response thresholds were reviewed following this event with minor modifications made to flood warning trigger levels and a new flood warning service was introduced for Hampton Bishop. Operational responses were not changed however.

Further management strategies have been to undertake a study of flood risk at Hampton Bishop, considering the options available to reduce the frequency of flooding to the village. No significant strategic/work was highlighted.

In relation to any further research needed relating to this event the Environment Agency deems none necessary locally but states that they are considering a number of the Summer Floods 2007 Pitt Review Urgent Recommendations at a national level. Examples of this are mapping of surface water flooding and working with the Met Office in order to improve forecasting. The Local Resilience Forum will also influence how the operating authorities deal wit this type of event in the future.

Information specific to the Environment Agency response in the Herefordshire region was also found on the web site and is summarised below.

In the market town of Bromyard excess water from the River Frome spread onto the natural flood plain, the area on which Linton Caravan Park is situated causing fifty-eight caravans to become flooded.

In response to this the Environment Agency (2008) state that they 'do not currently monitor river levels or forecast flooding in the Bromyard area' although they also add that 'prior to the floods a project had already been commissioned to improve flood forecasting throughout Herefordshire'. This, they say will take into account recent events from the June and July 2007 floods. They also add that although no flood warning service is currently provided in this area 'flood watch' alerts are and that a project is currently taking place in order to extend the flood warning service throughout Herefordshire. Following the flood the Environment Agency inspected the River Frome

for blockages, which would have increased the risk of flooding, however none were found.

The Environment Agency communicated both during and after the event with those affected to collect information about the timing, source and extent of the flooding. The Area Flood Risk Manager also gave an interview on BBC Radio Hereford & Worcester with information provided to other media partners.

In the village of Eardisland, in the north of Herefordshire, excess water from the River Arrow and Southall Brook spread into the village, which is on the natural flood plain causing ten properties to become flooded.

The Environment Agency again state that they do not currently monitor river levels or forecast flooding in the Eardisland area but that again a study is underway, presumably part of that mentioned above. Again although no flood warning service is currently provided in this area 'flood watch' alerts are and a project is currently taking place in order to extend the flood warning service throughout Herefordshire. Blockages of the stream and sluices were also checked for in the aftermath of the flooding but again none were found.

Those affected were communicated to in the same way as in Bromyard although the Environment Agency also stated that it was to attend a public meeting in the village towards the end of last year.

As already mentioned the Environment Agency were also involved in the flooding response operation that took place at Hampton Bishop. A 'flood watch' alert was issued on the river but again no flood warning service is available at this location. The Environment Agency and the Fire & Rescue service were responsible for pumping water from the flooded village and into the Wye and reducing flood risk in the village has been the subject of a bid for Government funding.

As in Eardisland, the Environment Agency planned to attend a public meeting at Hampton Bishop towards the end of last year as well as communicating with affected residents in order to try and reduce flood risk in the future.

In addition to the above the Environment Agency carry out routine river and bank inspections on the Arrow and Lugg as well as other measures such as controlling grass and plant growth and clearing occasional steam and sluice blockages although there is no indication as to how regularly these maintenance measures take place.

3.1.2 Effect of the July 2007 Floods on Herefordshire Council Reputation

Herefordshire Council was criticised by some as being too slow to release government money to private householders. It could be argued however, that due to more rigorous assessment processes, those that did receive money were more deserving in contrast to other local authorities who released funds much more quickly but didn't take as much time to assess people's individual situations and circumstances. The Head of the Regeneration Directorate and particular members of staff within this area led this response. It should be pointed out that none of these were talked to for this study and this is something that should be done in order to get a picture of the council's response from this perspective.

The general consensus from this event is that Herefordshire Council did not suffer any damage to its reputation as a result of this event. In fact this may have even been enhanced as a result of the efforts made by the various departments in responding to the July 2007 floods e.g. Insurance and Property Services, which enabled all schools affected to be back up and running by the start of the new school year in September. There were some concerns raised by Governors' boards at different schools in relation to the contribution of the state of gutters and drainage to the effects of the flooding. However, as previously stated, keeping the gutters and drains clear are the responsibility of individual schools. This fits in with the thoughts of one senior manager that more could be done to alleviate flood risk generally, not just by the Council point of view but also by landowners and building occupants.

3.1.3 Key Messages and Recommendations from July 2007 floods

A number of points of interest were raised during the interviews- they are as follows:

- No thresholds for action across much of the Council have yet been set for flash flooding events, such as the July 2007 event and this may therefore need to be considered if response and adaptation is to be improved.
- Training of staff in emergency response and procedures, business continuity, flood planning, multi-agency working and rest centre training would all be beneficial, as would an increase in budgets for each of these.
- There is increased need for volunteers across the council to man help lines and also more awareness of the need for volunteers at times of emergency response. Info Centre staff should also be trained to take emergency calls at times of flood in order to reduce the pressures on departments such as Highways
- Risk assessment and business continuity strategies should ensure they address response to flooding events, especially those of flash nature.
- All relevant departments should properly assess the Pitt Report
- There is still room for an improvement in communication between the various agencies involved in responding to events such as this one.
- Department response to events needs to be consistently well coordinated throughout the county and not just in some areas.

- There is still room for an improvement in communication between the various agencies involved in responding to events such as this one.
- Department response to events needs to be consistently well coordinated throughout the county and not just in some areas.
- Parish Councils need to take more responsibility for flood response by making sure they have sufficient amounts of sandbags to protect those at risk locally, formulating flood plans and even holding asset registers for extreme circumstances.
- In addition to the above the public need to be made more aware of how sandbags are made available via their local Parish Councils and should therefore be putting pressure on their parish councils to take up their allocation.
- Those whose properties, schools and work buildings are susceptible to flooding should consider small scale flood adaptation measures well in advance of such events, such as moving expensive equipment during times of flood and formulating flood plans (see Environment Agency website for how to do this). Equipment should also be kept securely.
- Officers in charge of buildings and building maintenance staff should do what they can to identify flood risk and alleviate it e.g. clearing gutters and drains.
- From a risk analysis point of view future work could include calculating recurrence intervals for events, flood mapping (particularly with reference to flash flooding) and further investigation into culverts and drainage networks.
- In light of the prediction that severe events such as this one are due to increase in the future Herefordshire Council's current self insurance policy should be reviewed to ensure that it is cost effective.
- In the event of predictions for extreme rainfall and flooding Herefordshire Council may need to develop more proactive measures such as shutting schools for the day and allowing certain staff to stay and work from home to reduce the risk of stranding of motorists and pupils.
- Messages from feedback and debrief meetings should be clearly communicated back to relevant departments in order to enhance response and adaptation measures.
- Flood alleviation strategies should take into account the views of all parties and the best compromise made with regards to both group interests and costs.
- The maintenance of watercourses, ditches, culverts and gullies is important and active measures should be taken to inform landowners of their riparian responsibilities, including those outside of Herefordshire Council's control. The state of these watercourses should be monitored and maintained in order to reduce flood risk.
- Those responsible throughout the authority for assessing and releasing payments out to those effected by the floods (made available from central government) should be interviewed as part of the continuing nature of this LCLIP about the affect and actions of their area during this event.

Finally it is worth noting that as a result of this event the problem of flash flooding is being investigated at a national level. Severe weather impacts as a whole are already part of the Herefordshire Council Risk Register.

3.2 Flash Flooding - June 2007

The events of June 2007 were somewhat overshadowed by the events one month later but this event was significant in its own right. In some areas of the county up to a month's rainfall is said to have fallen in twenty-four hours. Shobdon in the very north of the county recorded 34.5mm on the 15th of June and Credenhill, around 5 miles to the west of Hereford City, recorded a substantial 41.7mm on the 25th June.

As a result of these heavy downpours thousands in the county were left without electricity. Homes and businesses in Ross and Ledbury were particularly badly hit (Hereford Times archive 2008). It was not just the heavy rain that caused problems, high winds felled trees in the county and a funnel cloud, closely resembling a tornado was also seen by two weather watchers heading towards Hereford although further sightings of this are scarce. Lightning strikes also caused some damage and subsequent insurance claims from council properties.

Areas affected by flash flooding

a) Emergency Services

Hereford & Worcester Fire and Rescue Service received over three hundred flood related calls within the first few hours of the flooding and again were required to rescue members of the public from cars and properties in the rural market town areas of Leominster and Bromyard and pump floodwater from inundated properties.

b) Highways

The flooding affected a four-mile stretch of the A44 between Bromyard and Worcester, which became totally submerged, as well as many other roads around this and the market towns of Leominster and Ledbury. Within Hereford itself the Belmont roundabout became flooded, as did the Eign Gate subway. There was also the problem (as with the July event) of water and mud flowing off fields and onto the roads. The Highways department was therefore required to put out flooding signs, supply emergency sandbags as required and tend to any problems related to road drainage. They were also responsible for clearing a number of trees that fell throughout the county as a result of high winds.

c) Children's and Young Person's Directorate

Table 3.4. Schools closed as result of June flooding

Name of School	Date(s) Closed and Reason
Bosbury C E Primary	**25th June 2007 – floods**
Michaelchurch Escley Primary	**25th June 2007 – floods**

As can be seen above only two schools were forced to close as a result of the flooding although there was also some damage caused to school property, this is outlined in the Property Services and Insurance/Financial Services sections for this event.

Case Study June 2007

Bosbury Primary School (2)

As the school became cut off my the floods, villagers and members of staff helped Head Teacher Liz Farr, to sandbag rooms and move vulnerable and expensive equipment out of reach of the floodwaters. Once this was done, all parents of pupils were notified that the school was closed and the message was also relayed over local radio/

Both this and the July 2007 flood events occurred, despite a £160,00 flood defence scheme that was completed in the autumn of 2006 by the Environment Agency and Herefordshire Council. As detailed earlier in the report however, these events were not 'the norm' when flooding is referred to in Herefordshire.

The heavy 'flash' nature of this event and the July 2007 flooding probably meant that, as in many other areas of the county, it was more the inability of drains and gulley, rather that the inability of the flood defence scheme, to cope with the sheer volume of water created by these events that caused the problem.

d) Emergency Planning

This event caused Emergency Planning to issue several flood warnings via the Council's Communications Team and the local media and also to open up the emergency information line to the public.

e) Property and Financial Services

As highlighted earlier, the June 2007 event in fact caused more claims for damage to council property than any other including the July 2007 event. There were 14 claims in total, although as can be seen the cost was significantly less than for the July floods.

This therefore would have caused a significant increase in the workload upon Property Services, causing disruption to their usual pattern of maintenance work.

Total cost of claims made: ~£57,000

3.2.1 Key Points and Recommendations: June 2007 floods

- Drains, gulleys and culverts need to be monitored and maintained by all of the relevant parties. All of these should be mapped (if they are not already) and frequencies of maintenance by those such as the Environment Agency on streams and watercourses need to be confirmed and clarified.

3.3. Heavy snow, February 2007

On the evening of the 7th February 2007 temperatures were predicted to drop well below freezing, although no more than -10°C, with some snow set to fall in the early hours of the morning on Thursday 8th February. From what has been ascertained from the interviews and from personal experience, this was not what caused the problems. On Friday 9th February it had been reported that snowfall was forecast by the UK Met Office for around an hour. What actually transpired is thought to have been the most significant snowfall event in over a decade, with over 20cm of snow falling in some places. This led to what can only be described as chaos throughout the County as people struggled to get home. Workplaces and schools closing early in order to make sure that staff and pupils got home exacerbated the situation. This in turn led to gridlock on the county's roads, making access for the gritters that much more difficult.

The Highways department liaised with BBC Hereford & Worcester Radio Station in order to issue warnings to motorists to only drive if necessary and that, if this was the case, to adjust their driving accordingly. Advice was also issued via most local media outlets and also the Police.

As with the July 2007 flooding event liaison was mostly between Emergency Planning, Schools, the Emergency Services and the external contractors involved.

Areas affected by heavy snow

(a) Highways

This event is described as having a high operational impact on this service area- all winter equipment; personnel and contractors were called into action around the clock for four days. The immediate management response was to coordinate the winter maintenance team on the ground as well as external contractors. Unusually in response to the severity of this event the snow blower was also mobilised.

Direct impacts of the event were a massive increase in calls to the department and a subsequent increase in the demand of personnel on the ground.

The winter maintenance budget for Highways has already been mentioned fleetingly but it should be stated that overspends have consistently been in the order of around £500,000 (see Table 3.5), which incidentally is the total budget for this area- thus although some adjustment to this has been made (around £250,000) maybe there is room for more. This is much more difficult in reality however with the budget pressures handed down to service managers. The question may be raised here as to why winter maintenance costs continue to stay at this level even though winters are becoming persistently warmer. The problem seems to be that winter temperatures, in particular

minimum daily temperatures, are becoming increasingly marginal i.e. around 0ºC and thus quite problematic to predict and it is therefore necessary to salt as frequently as before in order to prevent any negligence occurring on behalf of the Highways Department.

Table 3.5. Winter Maintenance Expenditure

Financial Year	Expenditure
2003/04	£811,000
2004/05	£966,000
2005/06	£953,000
2006/07	£1,026,000
2007/08	£959,000

Another point that was brought out in interviews with Highways staff is that the daily road weather forecasts that are received during the winter provided by the UK Met Office would seem to be increasingly unreliable. This is thought to be due to the system they are using being somewhat dated. Other companies have now developed route-based forecasting systems that claim to be more accurate and it may be advisable to trial such systems in order to see if an improvement could be made.

The Snow procedure within the Winter Maintenance Plan (the relevant policy for this event- required by all Local Authorities) was adjusted slightly as a result of this event although it is apparent that the winter maintenance teams response on the Friday would have been very different if the forecast had have been accurate.

The department may have come in for some criticism in some sectors due to the seeming lack of communication between Highways and the schools in that it has been questioned as to why the gritters were not out on the Friday. It is now understood that the gritters did go out once it had been ascertained that the snow was not going to stop (as predicted), but that they were unable to get through, due to the sheer volume of traffic on the counties roads as people scrambled to get home.

There is also the question again, as with the July 2007 flood event, as to why children were allowed to go to school. The nature of the forecast was such however that closures may not have been deemed necessary, although as will be seen in 3.2 (b) a significant amount of schools decided to close, particularly in rural areas.

In the months since this event and the subsequent summer floods there has been some discussion about the implementation of an improved control room within the Thorn building not just for Highways but also for the Council response team as a whole. There

is also the common theme that those coordinating the response should not have to respond to incoming phone calls from the public.

Total cost to the Department: ~£500,000

(b) Children's & Young People's Directorate- Schools

The other major area of Herefordshire Council Services affected by this event was the schools and their associated transport services. Over 80 schools in Herefordshire were forced to close at one time or another during the two days that this event affected them and this can therefore be said to have had a high impact on this service area.

(c) Emergency Services

The considerable disruption caused by this event on the roads and the inability of the gritters to get out fast enough to complete their rounds led to many roads becoming icy and dangerous. The emergency services were called to a number of accidents across the county, although reports in the media suggest none of these was very serious.

(d) Waste Management

The condition of the roads led to three refuse lorries in Hereford becoming stuck and, with conditions being even worse in rural areas, refuse collections were abandoned for the day on the Friday (Hereford Times Archive, 2008). Thus this event had a high operational impact on this section and their contractors FOCSA, who provide the front-line element of the service.

(e) Social Services

Although this area of Herefordshire Council Services is only mentioned fleetingly within the media, considerable disruption would have been caused to home visits by social workers to vulnerable persons. This event would thus have had a large impact on this service area.

(f) Local Businesses

Many staff were forced to walk to work in light of the terrible road conditions however there were some benefits to businesses such as supermarkets, who reported increases in the sales of essential household items and outdoor clothing and equipment stores also report an increase in sales in response to this event.

3.3.1 Key Messages and Recommendations relating to the February 2007 Snow Event:

- Where budgets linked specifically to dealing with weather events are consistently overspending adjustment should be made accordingly.
- Alternative road weather forecast providers should be trialled in order to see if improvements can be made in this area and savings made.
- Communication between those responding could again have been improved, as could the forecast of snow from the UK Met Office.

The notion of a purpose built central control room for events such as this and the floods should be discussed

3.4. Heat wave / Dry-spell August 2003

Figure 3.2 shows that during the month of August 2003, in particular the period from the 3rd to the 10th, Herefordshire experienced temperatures above average for this time of year. The highest, recorded at Credenhill station, was 32.5ºC (tutiempo.net, 2008). It is no coincidence that the highest temperature ever recorded in this country, 38.5ºC at Brogdale near Faversham (Kent), was also recorded during this period, on the 10th August 2003 (UK Met Office, 2008).

Perhaps the most notable feature of Figure 3.2 is that the rainfall at Credenhill in August 2003 was around a fifth of the 1961-90 averages calculated at Ross-on-Wye and Lyonshall.

This event was part of the Europe wide heat wave that took place at this time, in which 20,000 people are thought to have died. It is also thought to have been the hottest summer in Europe for some 500 years (UK Met. Office, 04/09/08)

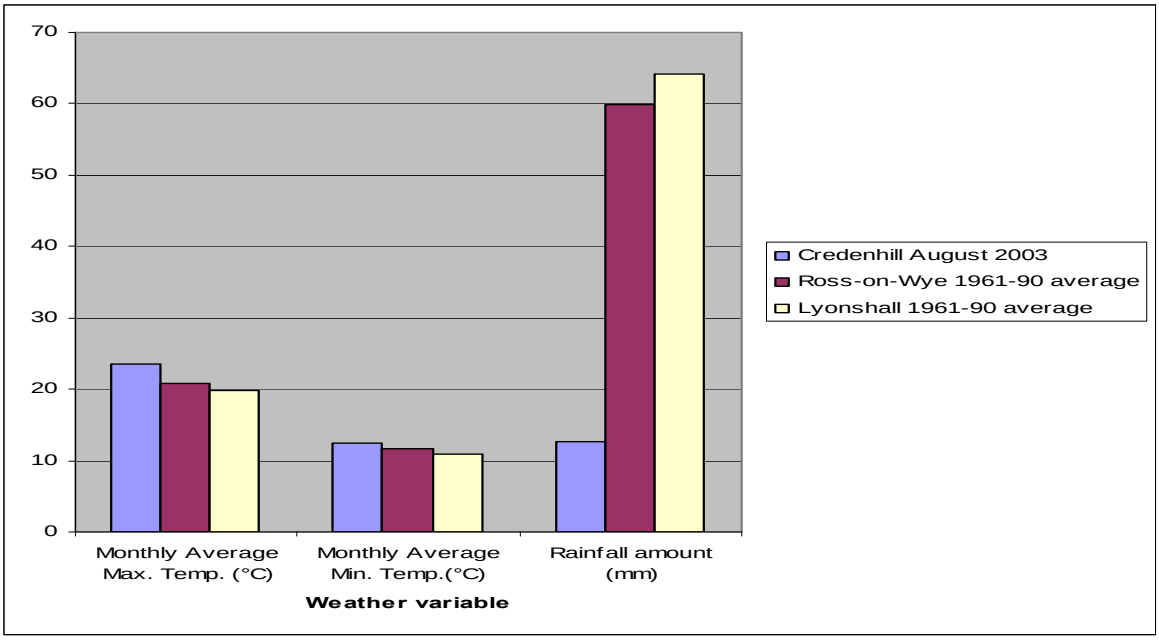

Figure 3.2. Comparison of August 2003 to long-term averages

Areas affected by heat wave

(a) Herefordshire Health Care Services

The Hereford Times (2003) reported uncomfortable conditions within Hereford County Hospital as a result of this event, with this situation exacerbated by a lack of air conditioning. Fans were brought in to try and relieve the situation and water-cooling towers had been installed previously. The lack of air conditioning in some areas is apparently not unusual as the system can be responsible for the spreading of germs from ward to ward. Air conditioning was in operation in operating theatres, intensive care and coronary care departments.

The reliance on the natural circulation of air was also criticized, as windows within the hospital are restricted to opening no more than around six inches for safety reasons.

The Hereford County Hospital is a relatively new building and issues such as this one should and could have been considered in the design of the building, e.g. air flow can be maximised to cool at times of high temperatures.

Heat events such as this one have implications for human health, the main ones being dehydration, sunburn and heat stroke. During this event in London, deaths among people aged over 75 rose by 60 per cent (Department of Health, 2004).

Herefordshire Council was due to run a heat-wave scenario exercise in spring 2008 with its emergency network partners. Unfortunately the member of staff coordinating this left the authority, leading to the scenario being put back. As of yet no revised date has been set.

(b) Utilities Companies

Welsh Water was forced to delay it's upgrading of the water mains system in the Sellack area as a result of increased demand caused by the heat-wave (Hereford Times archive, 2008). Heat events such as this one, causing low stream and groundwater flows, can also impact upon water quality. In June 2001 there were many complaints from residents of both Hereford and Ledbury of water tasting 'earthy' and smelling 'funny'. This was a direct result of the high temperatures and dry conditions causing the growth of algae known as geosmin. The story does not stop here however in that after inspections by the water industry regulator Ofwat, advice was issued for Welsh Water to supply complainants with bottled water, advice that was resisted by the supplier. A campaign was also launched by some residents of Ledbury, where the problem was particularly bad, to gain reductions in water bills for this period, something that was not achieved although the company did give out some good-will payments and also claims to have

invested several million pounds in order to ensure the problem does not reoccur in the future (Hereford Times Archive, 2008).

(c) Agricultural Sector

Hereford Times Archive (2008) reported that low water tables and drying pastures forced many to either carry water or feed to stock and caused concerns over whether autumn grass also required for feeding would materialise.

(d) Emergency Services

As well as those who were admitted to hospital with heat related afflictions and those who required ambulance and paramedic services there is also the problem caused by grassland and scrub areas drying out and being made susceptible to burning and fires.

Although specific data could not be obtained for this event Hereford & Worcester Fire and Rescue Service (2008) did provide this:

> "There have been 6584 recorded Incidents of secondary fires including grass/heath-land/stubble across Herefordshire and Worcestershire over the last 10 years. However, as with instances of flooding… without conducting a review of each individual Incident, it is not possible to ascertain whether an Incident occurred as a result of accidental, malicious or deliberate actions or as a result of weather events."

Although as stated above some of these fires may have been started deliberately, it is worth pointing out that dry conditions would have had to be prevalent for such actions to succeed.

(e) Environment & Culture Directorate – Environmental Health, Air and Water team

In general hot, still conditions, such as those prevalent during this event, cause air quality to worsen leading to pollution episodes. Pollutants in the atmosphere that are of primary concern are particulate matter under ten micrometres (PM10) and oxides of nitrogen, such as nitrogen dioxide.

> "It is thought that one third of the deaths caused by the heat wave in the UK were caused by poor air quality." (UK Met. Office, 04/09/08)

This poor air quality is clearly indicated in Figure 3.3 in which the average amount of PM10 peaks during the month of August 2003. It should be noted that it is not only meteorological factors that are acting here as anthropogenic factors such as car use, agriculture and burning (hence the high November figure due to Bonfire Night) are also of influence.

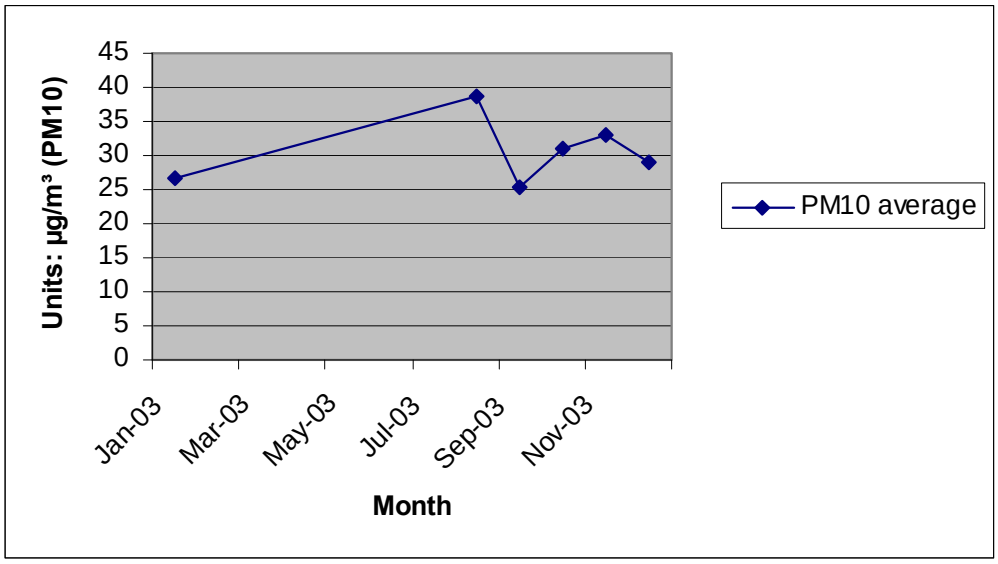

Figure 3.3: 2003 PM10 monthly averages

Figures 3.4 and 3.5 show the levels of PM10 and Nitrogen Dioxide throughout August 2003 and also the average daily temperature (shown separately so that clear comparison can take place). It can be seen from these that there is a rough correlatory pattern between the three variables, particularly during the first half of the month. The fact that high average temperatures around the 23rd August 2003 did not correspond with high concentrations of PM10 and Nitrogen Dioxide can be explained by the higher winds around this time of the month. These did not allow pollutants to become concentrated and thus improved air quality.

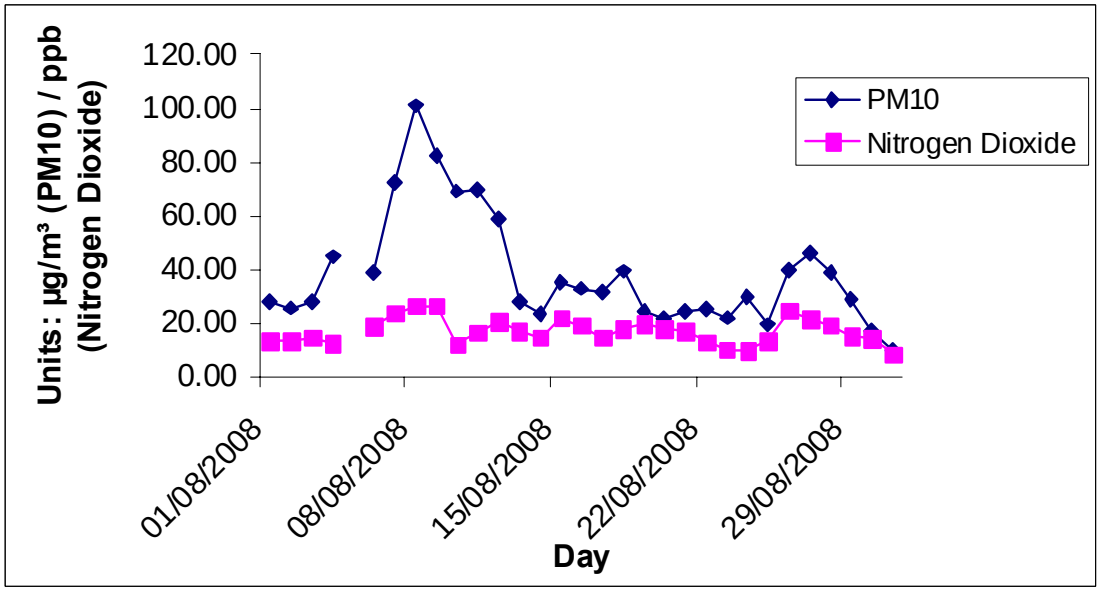

Figure 3.4: Average daily concentrations of pollutants in the atmosphere, August 2003

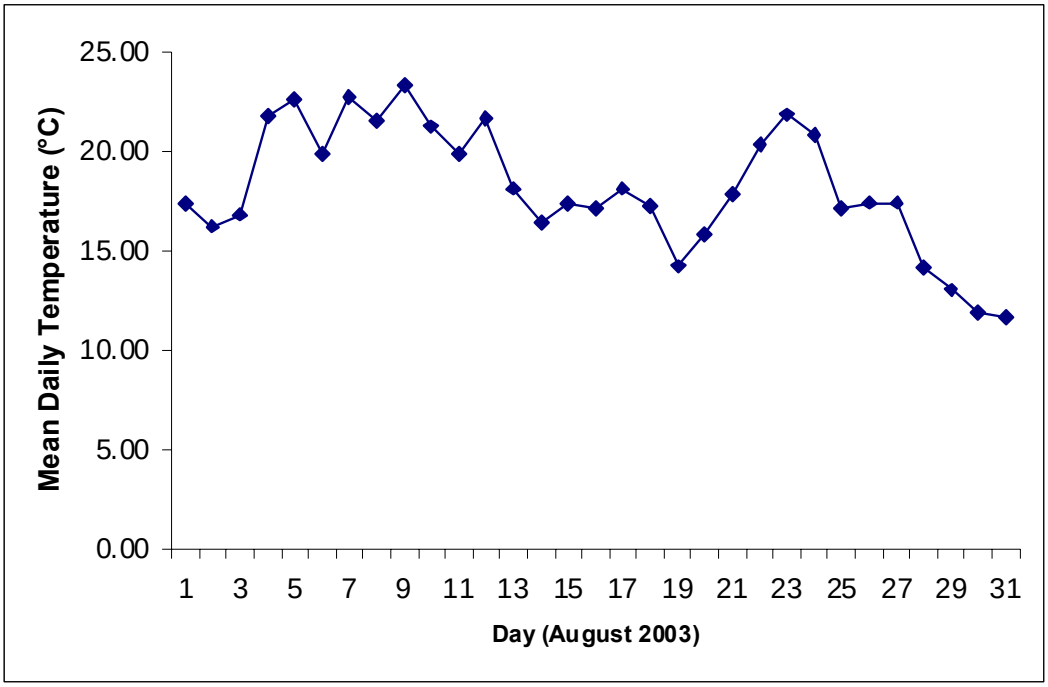

Figure 3.5: Average daily temperature, August 2003 (source: TuTiempo.net, 10/09/08)

(f) Conservation

The hot weather led the Hummingbird Hawk Moth, more common to southern Europe, to become prevalent throughout gardens in the county during the month of August 2003. Usually only a handful of these are seen (Hereford Times Archive, 2008).

(g) Highways

Although no specific details for this event were ascertained it is known that this event caused some problems on other transport networks, such as the railways. High temperatures can cause deterioration of the road surface, in particular the surface dressing, which is seasonally maintained during the months of June and July. If high temperatures occur around this time, it can be particularly problematic and surfaces may not set properly leading to patchy disintegration and further maintenance to be required.

(h) Property Services

Again, although no specific details were given for this, heat events such as this one can cause fire alarms to be set off and thus require Property Services personnel to respond.

3.4.1 Key Messages and Recommendations of the August 2003 Heat-wave:

- Where air conditioning is not available or installed facilities should be in place to keep building temperature as comfortable as possible e.g. plentiful amounts of fans available and water cooling towers in place. Air circulation should also be maximised and should be incorporated into new buildings.
- Staff should be put in place and a date set for the running of a heat wave scenario exercise as planned earlier this year.

3.5. Storms October 2002

In October 2002 the storms that hit Herefordshire were the worst seen for 30 years, at least in terms of the strength of the winds (Hereford Times Archive, 2008). Wind speeds peaked at 87mph according to a local weather enthusiast, who also stated that such events were becoming more frequent (see Section 4 for more detail on this). Specifically the winds were the strongest since 1980 and the longest in duration (15 hours) since 1975 (Damari, 2002).

As a result of this event properties were damaged, trees were uprooted and around 20,000 homes were left without electricity as the hurricane strength winds damaged power lines throughout the county. In terms of the services and agencies immediately affected by this event Highways were required to clear fallen trees, Utilities companies to fix the damaged power-lines and the emergency services to rescue people trapped in cars and properties by the fallen trees (although one fire service crew actually became trapped themselves in Colwall). Some of the trees that fell were significant in a biodiversity sense e.g. the Shobdon Oak, which is one of the largest and oldest trees in the county (Hereford Times Archive, 2008).

3.6. More Localised and Smaller Events

Although not as significant as any of the aforementioned events there were a number of events that were written about in the local media that serve to show the nature of our changing climate and the affects they can have. It is also worth pointing out that had some of these occurred in one of the major population centres of the County the effects may have been much more serious.

(a) Hail Storm- Dormington (Hereford Times, 24th June 1999)

This storm, described as 'freak' in nature, caused £250,000 worth of damage to a 100-acre area of hop crops and bines at Claston Farm, Dormington over a period of just 10 minutes. The storm itself consisted of square, sharp edged ice particles, around half an inch square, which at times lay 6 inches deep. It was also preceded by thunder and lightning.

(b) Violent Thunder & Lightning Storms / Heavy Rain- North and South of County (Hereford Times, 8th July, 1999)

At Dunfield House, Kington, in the northwest of the county a 120-foot high Wellington Redwood tree species, over 100 years old, was 'exploded' by a bolt of lightning.

Other impacts include electricity and telephone lines being struck and fire alarms being set off in this area. Wigmore High School had to be shut for the day as the offices became flooded due to the heavy rain.

In the south of the county, flooding and mudflows required the fire service to pump water out of some properties in the areas of Wormelow and Kingsthorne. Drainage problems in the Kingsthorne area caused local Parish Councillors to call a meeting with Herefordshire Council to discuss the matter.

One adaptive measure that Herefordshire Council has employed is the installation of PowerPerfectors in some of the Secondary Schools of the County. These are relevant because they reduce the incidence of power surges that can be caused by thunder and lightning storms by regulating electricity flow to appliances, hence preventing damage to expensive IT equipment etc.

(c) Cloud burst / Flash flooding- Newent (Hereford Times, 16th September 2005)

In the town of Newent, on the Herefordshire / Gloucestershire border the tenth annual Onion Fair was 'decimated' and town centre shops and homes flooded as over three inches of rain in just three hours was reported. One person had to be rescued from a car caught in floodwaters and levels up to three feet were reported.

(d) Strong winds / Gales / Heavy rain- Herefordshire, (Hereford Times, December 2006)

Although this event is not like those categorised (a) to (c) in that it is of a longer duration and seemingly affected the whole county, it is highlighted here because, as with the June 2007 event, there is some evidence of a possible tornado sighting, this time in the Leominster area of the county where one licensee likened the winds there to a "twister" after the 20 foot wooden sign outside his pub was ripped up by them and thrown into the middle of the road. The winds are thought to have later moved to the east of the county where a marquee was partially blown away at Eastnor Castle leading to the postponement of the Christmas fair due to Health & Safety fears.

4. Future Climate Predictions

Much of the climate change that will occur over the next thirty to forty years is inevitable as it has already been determined by historic emissions and inertia within the climate system. However if we act now we will be able to reduce current and future emissions and thus reduce the risk associated with climate change towards a level more in line with the low emissions scenarios predicted by Hulme et al. (2002).

The United Kingdom Climate Impacts Program (UKCIP) has been working on climate change scenarios for a number of years now and has produced a number of reports detailing possible scenarios for the UK and it's various regions. The first of these was produced in 1998 and the same format continued in their following work (UKCIP02) and finally the UKCIP09. The most up-to-date projections propose three emissions scenarios, Low (IPCC SRES:B1), Medium (IPCC SRES: A1B) and High (IPCC SRES: A1F1), reflecting uncertainty in the amount and rate of future greenhouse gas emissions (IPCC SRES, 2000). Projections are made over seven 30-year periods from the 2020s to the 2080s. An average of the climate period 1961 – 1990 is used as a baseline to map future changes identified in the table below.

4.1 Key predictions for Herefordshire's climate:

- A likely increase of 1.7 - 4.0^{o}C in annual temperature by the 2050s under a high emissions scenario.

- The coolest days in the winter months will very likely be up to 4.6^{o}C warmer than current in the 2050s

- The winter months in 2050 are very likely to be up to 27.2 % wetter than current conditions.

- Central estimates are for heavy rain days (rainfall greater than 25mm) over most of the lowland UK to increase by a factor of between 2 and 3.5 in winter, and 1 to 2 in summer by the 2080s under the medium emissions scenario.

Table 4.0: Summary Table of changes in seasonal climate in Herefordshire (source: Hulme et al. 2002)

Description of change and variable	Likely Range under High emissions scenario (Herefordshire)	Time Period
Annual Temperature (°C)	0.8 – 2.4	2020's
Annual Temperature (°C)	1.7 – 4.0	2050's
Annual Temperature (°C)	2.8 – 6.2	2080's
Summer Temperature (°C)	0.5 – 2.5	2020's
	1.4 – 4.9	2050's
Winter Temperature (°C)	0.5 – 2.0	2020's
	1.4 – 3.5	2050's
Annual Precipitation	-4.5 – 6.0%	2020's
	-5.9 – 6.2%	2050's
Summer Precipitation	-21.2 – 15.2%	2020's
	-39.0 – 6.8%	2050's
Winter Precipitation	-2.2 – 16.1%	2020's
	2.4 – 3.24%	2050's

**Will be able to complete when the Threshold Generator is launched in the New Year*

Data will come available on specific weather events in the New Year (for example intense rainfall days)

Table 4.1 Summary Table of changes in day-to-day climate in Herefordshire (Hulme et al. 2002)

Climate Variable	Range between low & high emissions scenarios (Herefordshire)	UK Comparison figures
Inter-annual variation of temperature in summer	*	*
Summer soil moisture anomalies	*	*
Winter soil moisture anomalies	*	*
Amount of intense rainfall days in winter	*	*
Winter daily average temperature change (°C)	*	*
Summer daily average temperature change (°C)	*	*
Number of extremely warm days in winter	*	*
Number of extremely warm days in summer	*	*
Length of thermal growing season (days)	*	*

**Will be able to complete when the Threshold Generator is launched in the New Year*

4.2 Relevance to the Occurrence of Significant Weather Events

The predicted increases in annual, seasonal and daily temperature combined with increases in the frequency of extremely warm days, as seen in Tables 5.0 and 5.1, particularly in summer would seem to indicate higher possibilities of heat wave events, such as those seen in 2003 and 2006. The decreases in summer precipitation levels and subsequent negative soil moisture anomalies also indicate that drought episodes may also be expected to increase.

Table 5.1 also shows (as detailed at the start) an increase in the number of intense rainfall days in winter, indicating the increased possibility of winter flash flooding events in the future.

This increase in temperatures also represents an increased capacity of the atmosphere to hold moisture as well as the possibility of instability within it. This may be the reason for the predicted increase in intense rainfall days in winter and may also increase the possibility of thunder and lightning storms in summer. Predictions of the latter (Hulme et al, 2002) change little overall from those seen today by 2080, due to atmospheric

variables that would essentially both increase and decrease such events effectively cancelling each other out. As a final point these predicted temperature increases would also decrease the annual frequency of frosts within the county.

In addition to the data seen in Tables 5.0 and 5.1, storm incidences within winter are predicted to increase in the UK as whole by the 2080s from five to eight, though storms are predicted to decrease during summer months from five to four. Confidence in these predictions is however low and should therefore be viewed with caution. The same is true of 10 metre wind speeds, which are predicted to increase by 2% in winter and stay roughly the same in summer by the 2080s (Hulme et al, 2002; Entec, 2003).

Other global climatic phenomena are thought to have influenced the UK, and therefore Herefordshire's climate, in addition to global warming. For example, the flooding in 1998 may have been linked to the El Nino event in the Pacific Ocean influencing the climate of the Northern Hemisphere. La Nina events, essentially the opposite of El Nino, have been linked to a strengthening of the Jet Stream and subsequently the summer flooding that has occurred over the last two years. Regional pressure systems are also thought to be of influence. For instance the North Atlantic Oscillation or NAO (the difference in pressure between the Azores and Iceland) reflects the general climatic situation during UK winters. However it is a highly variable phenomena and therefore difficult to predict. The UK Met. Office did manage this to a certain degree of success for the winter of 2005/06 when it predicted a 'colder than average winter'.

5. Local Government Performance Framework: National Indicator 188 - Planning to Adapt to Climate Change

NI188 is designed to measure progress in preparedness in assessing and addressing the risks & opportunities of a changing climate (Defra, 2008). The indicator is arranged over 5 levels from 0-4. The levels are cumulative and build on the actions in the last level. DEFRA are expecting local authorities to move up one level each year, which will be a considerable challenge. See Appendix B for more details or for full details go to: http://www.defra.gov.uk/environment/localgovindicators/ni188.htm

This study and work resulting from it will help to raise Herefordshire Council from level 0 (Baseline) up to level 1 (Public commitment and prioritised risk-based assessment), i.e. that the council has identified those vulnerabilities and opportunities that are significant to the Local Area Authority (LAA) in order to prioritise its adaptation responses. This is just one of four requirements; however the authority has made progress on some other

required steps as it is already signed up for the Nottingham Declaration and has the appropriate flood risk plans etc.

The major challenge therefore will be to demonstrate that the vulnerabilities have been identified and these have been communicated to all relevant departmental/service heads. This should occur as a follow up to and direct result of this study. No arrangements are currently agreed.

Requirements for reaching NI 188 Level 1	**Current position**
Bringing together existing sources of risk assessment and adaptation related planning & identifying who will take the process forward	Director of Environment & Culture identified as overall lead. Method not yet identified.
Decision on how to approach NI188 in partnership	Not yet addressed - though wide range of agencies have input into LCLIP (see acknowledgements)
Public commitment to managing the risk of climate change	Nottingham Declaration signed
Council leaders and senior managers are aware of the commitment and developing adaptation programme	Not yet: climate change training session booked for 10th Feb 2009 may provide opportunity
Significant vulnerabilities and opportunities identified to prioritise response to adaptation	Prioritisation not yet undertaken- respondents asked to identify key recommendations
Impact assessment undertaken –both of impacts already covered by risk management systems and new/emerging risks	LCLIP largely complete- sent round for comment. Included interviews with both Emergency Planning and Risk Manager. Analysis of existing arrangements in place not fully covered.
Prioritised assessment in place – vulnerabilities communicated to all relevant senior managers	Not yet undertaken. Presentation at HC/PCT training day on Jan22nd will be first step.

6. Overall Recommendations

These have not been presented together until now so the authors are seeking input on which are most important and which may be impractical or unhelpful. Please send responses to the Sustainability Unit.

Please mark recommendations in the left hand column as follows:-

++ Strongly support recommendation –high priority

+ Support recommendation

0 Neutral

- Do not support recommendation: please explain why

-- Actively opposed to recommendation: please explain why

	NT	**AB**	**Please mark**
(a) Certain key staff involved in event recovery still need to be interviewed as part of the LCLIP process.	0	++	
(b) There is a need for increased preparedness in response to significant weather events. Examples here include formulating flood plans and installing/storing equipment for heat events.	++	++	
(c) Thresholds for action across the Council need to be set for significant events i.e. when a certain threshold is predicted to occur flood plans/ cooling methods /winter maintenance teams should all be put in place.	+	++	
(d) Staff training in all areas related to significant weather response needs to be increased.	+	++	
(e) A drive to recruit more volunteers across the council to provide emergency response, such as during flood events should take place.	++	+	
(f) Officers in charge of buildings and building maintenance staff should do what they can to identify flood risk and alleviate it e.g. clearing gutters and drains. Further alleviation strategies are also needed to cope with flooding events, especially those of flash nature and should take into account the views of all parties involved. Such measures should aim to be as sustainable as possible e.g. green roofs in order to reduce run-off and sustainable urban drainage measures.	++	+	
(g) The maintenance of watercourses, drains, gulleys and culverts should be monitored and maintained by the relevant parties in order to reduce flood risk. All of these should be mapped (if they are not already) and frequencies of maintenance by those such as the Environment Agency on streams and watercourses need to be confirmed and clarified.	++	++	
(h) The Pitt Report is in need of proper assessment from all relevant departments.	++	+	
(i) There is still room for improvement in communication	++	+	

	between the various agencies involved in responding to significant events.			
(j)	Department response to events needs to be consistently well coordinated throughout the county and not just in some areas.	0	++	
(k)	Parish Councils need to take more responsibility for flood response by making sure they have sufficient amounts of sandbags to protect those at risk, formulating flood plans and even holding asset registers for extreme circumstances.	++	+	
(l)	The public need to be made more aware of how sandbags are made available via their local Parish Councils and that they should therefore be putting pressure on their parish councils to take up their allocation (see www.herefordshire.gov.uk for more information)	++	**+**	
(m)	From a risk analysis point of view future work could include calculating recurrence intervals for events, flood mapping (particularly with reference to flash flooding) and further investigation into culverts and drainage networks.		+	
(n)	In the event of predictions for extreme rainfall/snowfall and flooding Herefordshire Council may need to develop more proactive and unprecedented measures such as shutting schools for the day and allowing certain staff to stay at home at no disadvantage to them.	++	++	
(o)	Messages from feedback and debrief meetings in response to significant weather events should be clearly communicated back to relevant departments in order to enhance response and adaptation measures.	+	++	
(p)	Where budgets linked specifically to dealing with weather events are consistently overspending adjustment should be made accordingly.		+	
(q)	Alternative winter road weather forecast providers should be trialled in order to see if improvements can be made in this area and savings made.		**+**	
(r)	The notion of a purpose built central control room for significant weather triggering the need for Council led emergency response should be discussed.		**+**	
(s)	Staff should be put in place and a date set for the running of a heat wave scenario exercise as planned earlier in 2008.	Date set- May 2009	0	
(t)	One department should be made responsible for updating the LCLIP and reporting back the Council's performance on this aspect of climate change.	0	0	
(u)	The responsibility for the coordination of NI 188 needs to be allocated to a suitable party because of its link with business continuity practices.	+	**+**	

7. Summary and Conclusions

Overall then, although Herefordshire Council has shown that it can adequately respond to events such as the July 2007 floods, there is a need for increased preparedness and alleviation strategies for events such as this and others across the organisation. This is particularly important in the light of the increased possibility of such events and the inclusion of adaptation in the recently published National Performance Indicator set.

This conclusion also applies to many of Herefordshire Council's partner organisations as well as the people of the county in general. We all need to be better prepared for a changing climate, whilst also taking into account what we can do to mitigate our emissions to reduce the risk of dangerous climate change.

Eighty-four events were recorded in the database as having impacted upon the County over the ten years of focus in this study, nearly half of which were due to heavy rain and/or flooding. The lowest represented type of event was heat and/or drought, although this is thought to be partly due to media bias.

The financial impacts of those weather events recorded have been the hardest to establish, as many of these have not been identified. What has been established however is that, in terms of both the cost to the county and the council, the flooding of June /July 2007 had the largest impact. The areas affected worst here appear to be Highways and the Schools within the Council and local businesses and agriculture from a countywide point of view.

This study also shows that Herefordshire Council operations, as well as the county as a whole, is significantly affected by all weather types ranging from flash flooding to heavy snowfall and heat wave events. Within the ten year period this study covers there have been reported sightings of tornado/twister like phenomena as well as a freak hail storm decimating one farmer's crop. Thunder and lightning events can also have significant impacts on Council property, as can high winds.

The final note of this study is that this is not the end of the Local Climate Impacts Profile. This report and the database that accompanies it should be a resource that is continually updated as significant weather events occur. For instance, while this study was being written another two flooding events have occurred within the county. The goal is that in future years is that resilience to extreme weather events will increase and negative impacts will lessen as a result of improved preparedness and adaptation throughout both Herefordshire Council and the county.

8. Useful Links / Wider Context

www.herefordshire.gov.uk

Herefordshire Council web site providing information on what to in a flood, the issuing of sandbags to Parish Councils, the authority's road winter maintenance plan as well as climate change and sustainability issues in general.

www.environment-agency.gov.uk

The Environment Agency are the leading public body for protecting and improving the environment in England and Wales, they are responsible for monitoring many of the countries main streams and rivers, alerting the public at times of flooding and are one of the lead agencies in coordinating response to such events

www.metoffice.gov.uk

The UK Met Office is the UK's primary weather forecasting service as well as being one of the leading advocates in climate change science. They are also responsible for providing flash severe weather warnings to many local authorities, including Herefordshire Council as well as road weather forecasts for their winter maintenance operation.

www.bbc.co.uk/climate/

This site provides some an interesting insight into climate change and all it entails!

www.bbc.co.uk/hereford&worcester

Source of local news and information

www.ukcip.org

The UK Climate Impacts Programme in it's own words 'helps organisations to adapt to inevitable climate change'. They are responsible for producing all of the climate scenario work referenced within this study (in liaison with the Hadley Centre of the UK Met Office) as well as the concept of the LCLIP.

www.tutiempo.net/en/

This site contains archive data of weather observations from many of the UK's weather stations.

www.nfuonline.com

The National Farmers Union represents farmers in England and Wales and is responsible for the promotion of successful and responsible agriculture. This web site has links to specific farming sectors with reference documents available also for each.

www.defra.gov.uk/environment/climatechange/index.htm

The Department for Environment, Food and Rural Affairs is a UK Government department. This page looks at what climate change is, the challenges faced by it and what can be done to adapt and combat it.

www.nottinghamdeclaration.org.uk

The new Nottingham declaration website:

- Is a portal to all available advice and support for local authority services on both adaptation and mitigation

- Explains how climate change is tackled in the local Performance Framework, including Performance Indicators, Comprehensive Area Assessments and Local Area Agreements
- Has the latest news on what is happening in the world of climate change
- Provides updated guidance on developing a Climate Change Action Plan for both adaptation and mitigation, including case studies and downloads

9. Disclosure, References and Acknowledgements

Nb. The latest edition of Climate Change Scenarios (UKCP09) can be found at http://ukclimateprojections.defra.gov.uk/

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Appendix A

Database of weather events

Appendix B

NI188, Planning to adapt to climate change

http://www.defra.gov.uk/environment/localgovindicators/documents/ni188-guidance-2008.pdf

Aim of the indicator

The aim of this indicator is to embed the management of climate risks and opportunities across the all levels of services, plans and estates. It is a process indicator which gauges progress of an LAA to:

- Assess the risks and opportunities comprehensively across the area;
- Take action in any identified priority areas;
- Develop an adaptation strategy and action plan setting out the risk assessment, where the priority areas are – where necessary in consultation & exhibiting leadership of local partners - what action is being taken to address these, and how risks will be continually assessed and monitored in the future; and
- Implement, assess and monitor the actions on an ongoing basis.

What are we expecting for good performance?

1. To achieve the level to an appropriate timescale and to good quality
2. To display leadership and innovation in adaptation

1. As set out in the technical definition, we are looking for year on year improvement for this indicator. How far an LAA progresses each year will largely be dependent on local circumstances, but we are expecting the levels to be agreed to reflect the requirements of the LAA. As a minimum we are expecting 1 level per year but depending on circumstances, this could mean achieving 2 levels within a year.

2. A key part of this indicator will be around leadership and innovation in adaptation.

What does Level 0 look like ?

The baseline is about recognising and pulling together existing sources of risk assessment and adaptation related planning E.g. a community risk register, water resources plans, any existing coastal/flood risk management plans, climate change strategies, planning assessments, and identifying how and who will take the process forward.

At a basic level, this will be identifying a lead official, having discussions in the area as to how to approach 188 in partnership, and compiling a list of the documents that will support the risk assessment at the next stage.

Level 1: **Public commitment and prioritised risk-based assessment:**

What does Level 1 look like ?

The LAA has made a public commitment either through the Nottingham Declaration or an equivalent to managing the risks of climate change. Council leaders and senior management are aware of the commitment and the developing adaptation programme.

The aim at this stage will be to identify those vulnerabilities and opportunities that are significant to the LAA in order to prioritise its adaptation responses. This is likely to be some form of local climate impacts profile or an equivalent process.

The LA/LSP should be able to demonstrate that it has undertaken an impact assessment including both impacts covered by its existing risk management systems (e.g. flood risk plans, community risk registers etc) and the identification of new or emerging risks arising from projected climate changes.

We are aiming for adaptation to be embedded across all services although at this stage we are looking at prioritised assessment. Therefore, the LAA should be able to demonstrate that the vulnerabilities have been identified and these have been communicated to all relevant departmental/service heads.

Level 2: **Comprehensive risk-based assessment and prioritised action in some areas:**

Level 3: **Comprehensive action plan and prioritised action in all priority areas:**

Level 4: **Implementation, monitoring and continuous review:**

1. As set out in the technical definition, we are looking for year on year improvement for this indicator. How far an LAA progresses each year will largely be dependent on local circumstances, but we are expecting the levels to be agreed to reflect the requirements of the LAA. As a minimum we are expecting 1 level per year but depending on circumstances, this could mean achieving 2 levels within a year.

2. A key part of this indicator will be around leadership and innovation in adaptation.

Leadership

Local authorities play a key role as community leaders and we want to encourage leadership in adaptation. As part of this indicator this could involve activities such as:

- Leading the establishment of an MAA(s) on adaptation
- Setting up, chairing or participating in adaptation networks or groups on common issues including LSP partners and other relevant bodies
- Presenting at conferences, workshops and other events to share knowledge and experience
- Pooling and transferring skills
- Undertaking research on specific issues and sharing the findings
- Securing the engagement of the private sector e.g. local business associations
- Building skills capacity on adaptation within the local authority and partners
- Promoting adaptation beyond the locality e.g. regionally, through a Beacon Council type initiative etc
- Working with local communities to promote adaptation e.g. small businesses

Innovation

As adaptation is at an early stage, we want to encourage innovation in both assessment of climate risks and opportunities and in the measures that are taken to adapt. As part of the indicator this could involve activities such as:

- Commissioning or undertaking research or other projects to help inform the adaptation impacts in their area (linking with local universities, research organisations and consultancies)

Email from NFU

Our members would be very keen to become involved in voluntary action on severe weather events. Members have machinery at their disposal that could be used to help out with weather related problems e.g. snow clearance, access through floods on tractors etc.
Is there a mechanism for creating some sort of contact between the Council and our members in case of future events?

Sarah Faulkner
Policy Adviser (Environment), NFU West Midlands
Agriculture House, Southwater Way
Telford ., Shrpshire
TF3 4NR

Tel: 01952 409 247
Mobile: 07817 726 190
Fax: 01592 409 380

http://www.ipcc.ch/ipccreports/sres/emission/index.htm