# Cumbria Local Climate Impacts Profile

**Carlisle Floods 2005**

## A portrait of the impacts of extreme weather events on local services, communities, economy and natural environment in Cumbria.

**Developed by the Climate Change Task Group for the Cumbria Strategic Partnership**

**July 2010**

# Cumbria Local Climate Impacts Profile

# Project background & Executive Summary

## 1. Project Background

The Cumbria Local Climate Impacts Profile (LCLIP) has been assembled to enable local authorities in Cumbria and the Cumbria Strategic Partnership (CSP) to better understand their exposure to extreme weather and climate change. The LCLIP represents only the starting point in a longer, more detailed process of evaluating the level of risk and opportunity that future climate change trends may bring. The study was commissioned by the CSP's Cumbria Climate Change Task Group (CCTG) and compiled during the Summer of 2010. To help partners consider future impacts of climate change, the project has examined the impacts of recent severe weather events in Cumbria focussing on the past twenty years, highlighting where these events have affected Local Authorities' (LA) assets and services, the local community, businesses and the natural environment.

The LCLIP seeks to help meet the objectives of National Indicator 188, the overall aim of which is to embed the management of climate risks and opportunities across all local authorities and partner services, strategic plans and estates and to take appropriate adaptive actions where required. The LCLIP aims are twofold;

- to underline where vulnerabilities might occur in the services of local authorities (LAs), strategic partners (CSPs) and the wider Cumbrian community;

- to raise awareness of the impacts of severe weather and climate change in Cumbria, thereby helping to promote an evidence based response.

The LCLIP concludes by making generic recommendations that aim to enhance LA and CSPs resilience to extreme weather events and that are particularly relevant to Cumbria County Council, the six district authorities and the Lake District National Park. It is proposed that this broad level assessment is then used by LAs and CSPs to produce more refined and tailored LCLIPs specific to their own areas and services, informing their own risk assessments and adaptation strategies.

## 1.1 Methodology

This report draws its weather and climate change information from the records of the Cumbria Weather Forum, from the Environment Agency and from UKCP09 (UK Climate Projections 2009), respectively. A review of media reports on recent extreme weather events between 1996 and 2009 provided an indication of responses to the impacts of some of these events by local authorities, communities and members of the public. Discussions with several of Cumbria's emergency services and Resilience Unit have further supported the process of evaluation. However, the study stopped short of interviewing senior departmental managers within LAs and CSPs as this was considered a task for each organisation to undertake during the development of their own LCLIPs.

## 1.2 General findings – Impacts of Recent Extreme Weather Events

Using data supplied by the Cumbria Weather Forum and Environment Agency, the LCLIP found that Cumbria has been affected by at least 93 recorded significant weather events in the past 60 years. More recent media reports show that these events are associated with varying levels of severity and impacts for LAs, communities and the environment. Heavy rainfall and severe flooding are the most frequent events to impact Cumbria, closely followed by windstorms and snow. Many communities have experienced repeat incidences of flooding, such as Carlisle, Keswick and Cockermouth. It has been all too evident in the major floods of recent years that affected communities have suffered substantial psychological and economic trauma; those that are repeatedly flooded often complain both to and about organisations they see responsible for either failing to prevent the flood in the first instance or failing to cope adequately with the aftermath.

The very dry summers of 1992, 1995, 2003 and 2010 have all seen disruptions and hosepipe bans due to drought conditions, whilst even as recently as 2006 Cumbria experienced temperatures as high as 34oC in Whitehaven, with ambulance services receiving 152 heat related calls in just one day; road surfaces melted and increased incidences of blue green algal blooms were reported in Cumbria's lakes. Meanwhile, damaging winds in January 2002 killed 7 people, causing lorries to overturn, motorways and rail lines to close and costing millions of pounds to repair damage to property and buildings.

Severe weather can impact LA services in various ways. Fallen trees and debris frequently cause disruptions to the county's road network which not only affects direct road users but services that rely on transportation, such as primary care workers visiting vulnerable clients or the thousands of LA workers that travel to schools and offices everyday. Unexpected extremes of weather, such as periods of hot weather and windstorms, can lead to unforeseen costs for LAs and budgets can become stretched as well as leading to burgeoning workloads, delayed programmes of work and increased pressures on staff.

The floods of November 2009 exemplify the scale of climate change impacts when over 500 Environment Agency staff became involved in the response to the Cumbrian floods, fielding 22,000 calls from the public. A number of bridges across West Cumbria were damaged or collapsed (one with a tragic loss of life), with several bridges remaining closed for months, resulting in huge additional travelling distances (in Workington, a 10 minute, 1 mile journey to get to work became a 2-3 hour, 20 mile journey).

The floods put additional pressures on social services, housing, economic regeneration, waste and trading standards. For example, Impact Housing Association reported 78 properties badly damaged by the floods, of which 38 had to be evacuated, with repairs costing around £1.4m. Annual premiums increased from £280,000 pa to nearly £500,000 pa, with some tenants unable to obtain contents insurance. The effects of such extreme events often last far longer than the event itself - it took nearly 5 months to complete the final reinstatement works to Impact's damaged homes, although many tenants moved back in very quickly. The tenants who were out longest were in properties where there was structural damage (for example, to lifts and lift shafts) or where sewage contamination required extensive drying, disinfecting and

reinstatement. Flood defence works are scheduled to start in Keswick in 2011 if funding is secured and would not normally be completed until the following year. Investigations are ongoing in Cockermouth and Workington to identify ways to reduce flood risk but there is no guarantee of major flood defence schemes. The estimated cost to insurers of the 2009 flooding for Cumbria and South West Scotland has been estimated at over £100 million, with United Utilities incurring £450,000 alone in repairs to flood damaged water pipes in Cumbria.

Meanwhile, responses to a survey by Cumbria Tourism at the time showed 72% of tourism businesses had been affected by the flooding, some directly by water damage, but others as a consequence of cancellations precipitated by adverse national media coverage which, amongst other sensationalism, questioned the safety of all of Cumbria's 1800 bridges. Cumbria Tourism attempted to counter this negative publicity with over £450,000 worth of print and radio coverage, a sum that needs to be taken in the context of an estimated £15.4million loss to the tourism economy and a further £7.9million incurred through damage to infrastructure within the National Park (see Appendix 4). With these figures representing only some of the financial records, and not those of the LAs, the total cost of severe weather on property and services would be considerably more.

Alongside the unexpected impacts, weather events also have similar repetitive impacts on LA assets and services, such as road networks and building maintenance. These repetitive impacts have a dual cost in terms of resources and labour hours that largely go unaccounted for, as they are a part of routine work. Such impacts will likely be exacerbated by predicted increases in the intensity and frequency of extreme weather events and other climatic changes; these are commonly not formally considered.

## 1.3 Positive Impacts

Records of the positive impacts of climate change events are much harder to find, especially in the context of this report which focuses on extreme events which by their very nature assume a level of disruption. This does not mean that positive impacts do not currently occur or won't have greater influence in years to come. The impacts of periods of warm, dry settled summer weather may well be attracting greater visitor numbers to Cumbria already as well as improving crop yields, for example, but disaggregating these increases from factors such as foreign currency exchange rates or more accurate use of fertilisers is extremely difficult. In the future, the Cumbrian tourism industry might well benefit both from the displacement of tourists away from traditional Mediterranean resorts (which themselves increasingly face extreme, disruptive summer temperatures) and also from improvements in Cumbria's own summer weather.

## 1.4 Recent and future weather trends

Recent trends for the North West of England indicate that there has been a general move towards drier summers and wetter winters and that annual mean temperatures have significantly increased since 1961 with 2006 being the warmest year since records began. The experiences of the extreme flooding in Cumbria in November 2009 followed by the drought conditions and hose pipe bans of July 2010 is indicative of this trend (though clearly the examination of a single year 2009/2010 is not sufficient to claim statistical validity for longer term trends).
This move towards wetter winters and drier summers is, however, unlikely to manifest itself uniformly across Cumbria due to the county's diverse topography, influenced by a predominantly maritime weather pattern and leading to variations in local micro climates responses. With a significant proportion of the county characterised by steep sided, upland fells flanked by flat plains (much of which are represented by extensive coastline) Cumbria is particularly vulnerable to extreme weather events. For example, high rainfall in Cumbria's uplands has led to a number of downstream flooding events in recent years with devastating results for local communities, in particular, Carlisle. This topographical diversity also makes it additionally difficult to predict with confidence the very locally specific impacts of climate change.

Nevertheless, there is a strong scientific base of evidence that suggests Cumbria will experience changes to its climate over the course of this century, including sea level rise, increased heat waves, drier summers and increased frequency and intensity of extreme weather events, such as intense rainfall and windstorms (UKCP09). The UK public and Government are demanding that more be done to address climate change issues and the Climate Change Act (2008) and other key legislation seeks to translate this demand into action.
Even in the short term, climate change predictions for the Northwest indicate temperature and rainfall variations which, whilst on face value appear to show minimal change, are in fact significant and already being associated with increasingly unseasonal and extreme weather events.

**Table 1: Source: UKCP09**

| ***2020's*** | ***Emissions scenario*** These predictions are realistic, as they relate to emissions that have already been released. | | |
|---|---|---|---|
| | ***Low*** | ***Medium*** | ***High*** |
| **Winter Mean Temp.** | **1.2 ºC** (0.4 to 2 ºC) | **1.2 ºC** (0.5 to 2 ºC) | **1.2 ºC** (0.3 to 2 ºC) |
| **Summer Mean Temp** | **1.6 ºC** (0.8 to 2.5 ºC) | **1.5 ºC** (0.6 to 2.5 ºC) | **1.5 ºC** (0.6 to 2.5 ºC) |
| **Summer Mean Daily Max Temp** | **2 ºC** (0.6 to 3.5 ºC) | **1.9 ºC** (0.4 to 3.5 ºC) | **1.8 ºC** (0.5 to 3.3 ºC) |
| **Summer Mean Daily Min. Temp** | **1.5 ºC** (0.6 to 2.6 ºC) | **1.5 ºC** (0.5 to 2.6 ºC) | **1.4 ºC** (0.5 to 2.5 ºC) |
| **Annual mean precipitation** | **1%** (-3 to 7%) | **0%** (-4 to 6%) | **0%** (-4 to 6%) |
| **Winter Mean precipitation** | **4%** (-3 to 14%) | **6%** (-1 to 14%) | **4%** (-3 to 13%) |
| **Summer mean precipitation** | **-5%** (-19 to 9%) | **-7%** (-22 to 9%) | **-4%** (-18 to 10%) |

## 1.5 Key findings – Organisational response and exposure

Using media sources and drawing from information gathered from Cumbria Weather Forum, partners on the Climate Change Task Group, the emergency services and Resilience Unit this project has highlighted a number of significant areas where LA assets and services and the wider Cumbrian community are affected by weather. Significant findings include:

- **LAs and CSP organisation are vulnerable to large-scale and/or unexpected weather events.**

- **Weather events are generally responded to rather than planned for.** Extreme weather events are also largely seen as the responsibility of Emergency Planning. There are indications that limited consideration has been given by LA departments, the CSP, organisations and businesses as to how severe weather might impact on their service delivery in the future, though some have included aspects of weather impacts in their Business Continuity Plans. Although there are examples of good Emergency Planning, steps also need to be taken to mitigate impacts of weather through long-term planning. With severe weather predicted to increase in the future, forward planning may provide a more stable basis in which to handle the effects of severe weather within the LAs.

- **Many local authority departments have either scant records of the impacts of weather on their services** or no record systems at all. Knowledge of past weather events, in terms of impacts and consequences to council services, local communities, businesses and the environment, is more often than not informal (e.g. stored in individual's memories or journalistic sources) rather than systematically recorded and maintained. In addition, due to modern working patterns people tend not to stay in the same job as they might have done in the past. More needs to be done to counter the loss of institutional memory due to quicker staff turnovers. More accurate recording of weather events and their impacts and consequences could help counteract this

- **Weather events impact on LAs' reputations,** with poorly handled events often receiving negative press and well-handled situations often going unnoticed. Nevertheless, the responses of the emergency services and voluntary sector to the November 2009 floods was generally reported in a very positive light, whilst at the same time unfounded rumours abounded about the Environment Agency and United Utilities' role in failing to contain the flood. The local and national press has enormous power in influencing the public's perception and response to extreme weather events, potentially exacerbating the economic and social impacts.

- **Inadequate drainage is a big problem and is expensive**, time consuming to deal with and has an adverse affect of council reputation. Surface water flooding incidents are relatively common and increasing, further exacerbated by weather related factors.

- **There is a growing body of experience and expertise in Cumbria** in dealing with the impacts of extreme events, in planning, in operations and in dealing with the press; this presents an opportunity for sharing this wealth of expertise across service delivery partners and other institutions. Various departments within Cumbria County Council (including the Constabulary, Fire and Rescue and Highways) as well as within the NHS / PCT have developed risk registers and contingency plans and these will provide useful guidance to other service providers in assessing risk and building a response.

- **There is generally a heavy reliance on 'good will' service** when departments deal with the impacts of extreme weather events. More frequent and intense weather events may increase pressures and challenge such informal arrangements. Additionally, new EU legislation over break times and increasing concerns for staff health & safety might require greater forward planning. Introducing more formal procedures which detail how individuals/delivery partners can be released from their usual duty to be reassigned – for duties such as door knocking/filling sandbags – could help to overcome potential tensions.

## 1.6 Recommendations

Based on these findings the report proposes the following recommendations for LA's and CSP members in their approach to developing comprehensive adaptation strategies:

- **The Climate Change Task Group should present this report to the CSP Environment Thematic Partnership.**

The Task Group recommends that the Partnership use this report as a platform for increasing awareness and action on adaptation in Cumbria.

- **CSP member organisations need to undertake individual climate change risk assessments for their own buildings, staff, resources and services.**

In line with objectives defined by NI 188, requirements under the Climate Change Act and also commitments given to delivering the Cumbria Climate Change Action Plan, all LA and CSP organisations need to complete their own individual risk assessments of the potential severity and frequency of the impacts of climate change, identifying the vulnerabilities and opportunities to their services (public health, transport, tourism, agriculture, economy etc.) The findings of these risk assessments should lead to detailed action plans which should be shared corporately across departments and also be included in project risk registers.

- **Agree a means to share information on climate change risk impacts and management strategies.**

The CSP Environment Thematic Partnership needs to consider how best to gather and share information which records the impacts and costs of climate change in Cumbria, maintaining a register of risk assessments and management strategies. This central database would enable the development of an overall, strategic assessment of risk across Cumbria. This role might be undertaken either by Cumbria County Council or through the CSP. It would also inevitably help individual organisations which had yet to develop their own responses to climate change by providing real case studies and a template for risk assessment. The CSP website might offer a possible 'home' for this information, whilst an initial workshop on adaptation facilitated by the Cumbria Climate Change Task Group is also recommended.

- **Building local resilience by engaging communities**

Increasing community-based resilience to weather is an important adaptation measure for Cumbria, particularly for communities at risk to flooding and is also recommended by the Pitt Review (2007). Work being done on this by Emergency Planning and the Resilience Unit will help to raise the profile of this both within and outside the LAs.

- **Increase understanding of surface water flooding**

Producing GIS maps of surface water flooding will increase understanding of which communities are vulnerable and help inform long term planning decisions. (The Environment Agency has produced indicative surface water flooding maps and shared these with Local Planning Authorities to help them with their LDF preparations. However, they are not yet sufficiently refined to inform individual planning application decisions and are not therefore widely publicised.)

- **Develop IT capacity to enable staff to work remotely from home**

Developing technical capacity to enable staff to work remotely from home will help to minimise service disruption occurring from staff difficulty getting to work. At least in the first instance section managers should identify which members of staff might be able to work from home from their own PCs in the event of an emergency. Cumbria is generally poorer than the rest of the UK for connectivity and this will continue to constitute unnecessary disruption when extreme events cause travel difficulty.

- **Formalise 'good will' working agreements and train more staff**

Training LA workers from other departments or service areas that are not so directly affected by weather events so that they can respond in an emergency situation would result in better deployment of staff in an emergency situation. The contribution of personnel from many different Cumbria County Council departments during the floods of November 2009 and the aftermath demonstrates the benefits of cross sectoral training and participation. In addition more formal agreements that detail how individuals/delivery partners can be released from their usual duty to be reassigned – for duties such as door knocking/filling sandbags – are recommended.

- **The role of spatial planning needs to be investigated**

With severe weather predicted to increase in the future, long term strategic planning may provide a more stable basis in which to handle the effects of severe weather within the LAs. New developments and building design could play a key role in this, such as use of sustainable drainage systems. Additionally, traditional ways of making decisions may need to become more creative and flexible; for example, adjustments to existing transport networks may be necessary.

## 1.7 Conclusion

The LCLIP project provides evidence demonstrating that the all LAs, CSP delivery partners, and communities are impacted when severe weather events strike Cumbria, though not uniformly nor predictably. Research shows that whilst some Cumbrian organisations have developed contingency plans for responding to the impacts of extreme weather in the aftermath of an extreme event, most organisations fall short of having developed corporate strategies for minimising the risks of adverse impacts from climate change or maximising the opportunities; fewer still have invested in adaptation measures. In spite of this shortfall, the flood protection measures installed after the Carlisle floods of 2005 suggest that successful preventative measures can pay dividends, even in the short term (in this case, as early as November 2009 when the new £38million defences installed by the Environment Agency prevented flooding in parts of Carlisle).

A process of engaging with policy makers, senior managers, staff and community representatives across the Cumbria Strategic Partnership members is now urgently required. This LCLIP provides a starting point for this awareness raising and planning. Comprehensive risk assessments need to be carried out by each LA, CSP organisations and lead agencies for each sector in Cumbria. These need to identify the vulnerabilities and opportunities for services, developing detailed action plans and embedding those actions corporately, including sharing these with key delivery partners and local communities. It is recommended that these risk assessments and action plans be gathered centrally and shared on the CSP website and through a pan Cumbria event, enabling best practice to be identified and serving to accelerate and co-ordinate the Cumbria response.

Figure 1.Haweswater – Drought Conditions 1995 (Courtesy of United Utilities plc)

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# 2. Introduction & background to Cumbria LCLIP

## 2.1 A Local Climate Impacts Profile (LCLIP)

This report has been commissioned by the Cumbria Climate Change Task Group, authors of the Cumbria Climate Change Strategy and Climate Change Action Plan 2009-2014, in order to meet objectives as set out by National Indicator 188, part of the Local Area Agreement, on 'planning to adapt to climate change'. Whilst the future of the CAAs and National Indicators under the new Coalition Government is unresolved at the time of this report, there is still a requirement under the 2008 Climate Change Act for local authorities to address adaptation.

An LCLIP is a tool that has been developed to enable local authorities to better understand their exposure to weather and climate. The LCLIP process is designed, by focussing on the reported impacts over a limited period at community-level and on specific sectors in Cumbria (e.g. tourism), to quickly identify regional vulnerability to extreme weather; in particular, it identifies how these events affect a local community, local authority's assets and their capacity to deliver services. The LCLIP aims to raise awareness of the impacts of severe weather events and will increase understanding of where LAs and the CSP need to adapt existing procedures.

## 2.2 Political and Performance Context

### 2.2.1 The Climate Change Act (2008) and National Indicator 188

NI 188 is designed to measure progress in preparedness in assessing and addressing the risks and opportunities of a changing climate. Progress on the indicator is graded through four levels (0-4), with the LCLIP project working towards achieving level 1. The overall aim of NI 188 is to embed the management of climate risks and opportunities across all local authorities and partner services, plans and estates and to take appropriate adaptive actions where required. Cumbria LAA target is to reach Level 3 of the Government's performance framework by 2011. This means conducting a comprehensive risk assessment for Cumbria, identifying the vulnerabilities and opportunities for each sector, developing a detailed action plan and embedding those actions in the strategies of all service areas including key delivery partners.

### 2.2.2 The social and political profile of climate change

Climate change is no longer just a scientific issue but also a societal one. The IPCC Fourth Assessment Report (2007)[1], The Stern Review (2007)[2] and the Climate Change

[1] The Fourth Assessment Report (AR4) of the United Nations Intergovernmental Panel on Climate Change (IPCC), is the fourth in a series of reports intended to assess scientific, technical and socioeconomic information concerning climate change, its potential effects, and options for adaptation and mitigation. The report is the largest and most detailed summary of the climate change situation ever undertaken, involving thousands of authors from dozens of countries, and states in its summary: *"Warming of the climate system is unequivocal."* And that *"Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations."*

[2] Stern's report suggests that climate change threatens to be the greatest and widest-ranging market failure ever seen. It is the largest and most widely known report on the effects of climate change on the global economy. Its main conclusions are that one percent of global gross domestic product (GDP) *per annum* is required to be invested in order to avoid the worst effects of climate change, and that failure to do so could risk global GDP being up to twenty percent lower than it otherwise might be global economy. Its main conclusions are that one percent of global gross domestic product (GDP) *per annum* is required to be invested in order to avoid the worst effects of climate change, and that failure to do so could risk global GDP being up to twenty percent lower than it otherwise might be.

Act (2008)[3] have done much to raise the profile of climate change. A recent MORI study (2008) found that the UK public have a high awareness of climate change and are concerned about it with 68% demanding that the '*Government do more on climate change'*. In addition, the Pitt Review (2008) and The Civil Contingencies Act (2004) are also influencing policy development in this area.
The Pitt Review (2008), commissioned as a result of the 2007 summer floods, does much to highlight UK vulnerability to heavy rainfall and flooding. The report calls for improved weather forecasting, better planning by local councils and the emergency services, and emphasises the need to '*be prepared for whatever the weather might throw at us'*. The report also mentions that climate change may be more extreme than had previously been estimated and emphasises that this has serious implications for flood risk. It makes particular reference to predicted increases in rainfall volume and intensity, to rising temperatures and the increased risk of extreme sea level rise.
Cumbria is particularly vulnerable to all three types of flooding; fluvial; pluvial; and tidal flooding[4], but was luckily not seriously affected by the 2007 heavy rains and flooding.
Another pertinent piece of legislation is The Civil Contingency Act (2004). The Act requires Local Authorities to maintain a 'Community Risk Register' (CRR). The Cumbria CRR formally recognises that weather events present 'very high' risks to the economic, social and environmental well-being of Cumbria, particularly flooding. Some of Cumbria's coastal and estuarine areas are low lying and flat, making them especially vulnerable to storms and gales.

All this indicates that Local Authorities need to do more to increase understanding of their relationship with extreme weather.

### 2.3 Aims and Objectives of the Cumbria LCLIP

This project has been commissioned for two main reasons:

- to underline where vulnerabilities might occur in the services of local authorities (LAs), strategic partners (SPs) and the wider Cumbrian community;
- to raise awareness of the impacts of severe weather and climate change in Cumbria, thereby helping to promote an evidence based response.

The project has four main outputs:

1. A compilation of the main extreme weather events over the last 100+years, including more detailed information on a number of recent extreme weather events.
2. A description of the impacts of some of these extreme weather events on communities, businesses and services in Cumbria as an indication of the breadth and cost of impacts.
3. The production of an executive summary.

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[3] The Climate Change Act became law in the UK on 26 November 2008. Ed Milliband stated that the act would mandate an 80% cut overall in six greenhouse gases by 2050, and include the aviation and shipping sectors.

[4] Fluvial Flooding - (from rivers) most commonly caused by intense bursts of rain causing flash floods or prolonged rainfall on saturated ground in the river catchments, which results in rivers or other watercourses overflowing their banks. Tidal Flooding – occurs when land is flooded from the sea or estuary. Surface Water Flooding - principally runoff from saturated and impermeable surfaces and often linked to heavy rainfall.

4. The presentation of this paper as a means to spark discussion, raise awareness and develop an action plan across the CSP.

## 2.4 Methodology

### 2.4.1 The Project and UKCIP

Standard LCLIP project methodologies have been developed by UKCIP for individual councils, piloted in Oxfordshire in 2006-7 and are now adopted by many local authorities across the UK. The Cumbria LCLIP uses this methodology as a guide rail only, since it does not have the resources nor intention to be as thorough as individual organisational LCLIPs. The Cumbria LCLIP presents an overview of the impacts across the whole of Cumbria and the CSP, rather than a 'deep dive' into the impacts on the services of any one local authority.

The UKCIP method has two phases. Firstly, a media search to ascertain how severe weather has impacted services in the past. Secondly, departmental and section interviews are undertaken to develop the information found in the media, to generate a fuller understanding of the impacts of severe weather within the council and to raise awareness of these impacts on a local level. The Cumbria LCLIP uses both media and organisations' records to provide a picture of the impacts, but it does not follow through with the second phase of interviewing key personnel. This is left to individual organisations during the process of compiling their own LCLIPs.

### 2.4.2 Media search

Copeland Borough Council generously agreed to use two Future Jobs Fund work placements to scour local papers in search of articles relating to extreme weather events occurring over the previous 14 years and to record this onto a templated spreadsheet developed by UKCIP specifically for LCLIP projects. (This templated format can be found at www.ukcip.org.uk ) The results of the search can be found in Appendix 10 of this report. The recorders simply listed the events and their impact on the community, stopping short of exploring the significance of these events in terms of cost, staff time, reputation etc on Copeland Borough Council or other CSP organisations.

### 2.4.3 Appraisal of Media Searches

Some care needs to be taken when relying on media searches to expose the impacts or a true record of events. In developing their own LCLIP, Norfolk County Council identified a number of considerations in their own media search, all of which are relevant here:

- Weather records do not always correspond with journalistic sources, suggesting that numerous weather events go unreported.
- On-line databases do not always represent a fully comprehensive archive of all local media; microfilm archives may reveal more weather events.
- Reported media events are not always backed up by weather detail, which has two implications; 1) the media sometimes exaggerates the significance of an event; and 2) weather, especially rainfall, is often so localised that weather station records are unable to record all events.
- Media searches are sometimes time consuming, with the focus on the impact on communities rather than on the impacts to the council. Information tends to be informal (e.g. stored in individual's memories or journalistic sources) rather than systematically recorded and maintained.

### 2.4.4 Cumbria weather record and Cumbria Weather Forum

One of the first searches for information involved exploring the weather records for Cumbria. Cumbria has 7 registered Met Office weather recording stations (Carlisle, Crosby, Keswick, Shap, Spadeadam, St Bees Head and Walney Island), though it was not possible to obtain past records from the Met Office for these. However, Cumbria is fortunate in having a network of dedicated, volunteer meteorologists and recording stations, linked through the Cumbria Weather Forum. Paul Crabtree, who hosts the Brampton Weather Station, was pivotal in using the Forum's collective knowledge and data to compile a list of the recorded extreme weather events, stretching back to 1771 (see Table 4). This record represents an excellent source of information for all local authorities and CSPs to refer to when searching for media reports or internal documentation on the impacts of weather events. Of course, it also clearly illustrates the frequency of events, which are set to increase according to UKCP09 predictions.

### 2.4.5 Information submitted from partners

Several partners from the CSPs Climate Change Task Group (Cumbria Tourism, Cumbria Housing Group through Impact Housing, The Environment Agency, Carlisle City Council and Cumbria County Council (Fire and Rescue and Resilience Unit) also submitted information detailing the impacts of extreme weather, particularly the impacts of the floods of 2005 and 2009. Whilst obviously not a comprehensive picture of the wider scale impacts of these events and others, nevertheless they paint a meaningful picture of the type of costs and resources that are entailed in tackling these events. (See appendices for these reports).

### 2.4.6 Generic Impacts on Services – Lancashire County Council (see Appendix 9)

Lancashire County Council has demonstrated strong leadership and commitment to adaptation, prioritising National Indicator 188 in its Local Area Agreement. As part of its approach, Lancashire has drawn up a generic list of the potential impacts on a wide range of services. It provides an excellent resource for all organisations to refer to when assessing the risk of climate change.

### 2.4.7 Interviews

A common component of an LCLIP is a series of interviews with key personal and senior managers. These interviews seek to establish how departments have been affected by severe weather and also investigate their awareness and level of preparedness for a changing climate (see Appendix 1 for a list of questions typically asked). The Cumbria LCLIP relied on the information supplied by partners and through the media search to develop the broad picture of impact and exposure. It is nevertheless recommended that individual organisations carry out similar interviews when developing their own LCLIP and risk assessments.

# 3 Project Results: Extreme Weather Events and Impacts

## 3.1 Extreme weather events

Using data supplied by the Cumbria Weather Forum and Environment Agency, the LCLIP found that Cumbria has been affected by at least 93 recorded significant weather events in the past 60 years. This data is supported by the 1996-2010 media search which was carried out by Copeland Borough Council on behalf of the Climate Change Task Group (see Appendix 10), revealing how some of the extreme weather events have impacted on local communities and local authorities. These recordings are both augmented by the reports of more recent extreme events submitted by various Climate Change Task Group Partners.

The following Table (4) details these events and includes information reaching back to 1771. Five main types of weather event can be identified: heavy rain; snow and cold; windstorms; heat wave; and drought. It is very likely that many more extreme weather events will have occurred across Cumbria during this period; however, due to their more localised impacts and/or the lack of robust record keeping, these have escaped capture.

At the time of writing in July 2010, Cumbria was experiencing its driest first six months of the year for 74 years, with drought orders and hose pipe bans covering much of central and south Cumbria. 125mm of rainfall then fell in one day in July 2010 in Seathwaite, Borrowdale.

**Table 2: Recorded Extreme Weather Events 1771-2009.**

**Compiled by Paul Crabtree, Cumbria Weather Forum & Brampton Weather Station 2010**

| Date | Event |
|---|---|
| 16th Nov 1771 | Solway Moss Landslide 20 farmhouses buried |
| 1908 | Train blown off Ulverston Viaduct |
| September 20th 1919 | Heavy snowfall down to 800ft |
| February 1932 | Seathwaite – no rainfall throughout the whole month |
| 26th January 1940 | Barrow area severe snowstorm 2feet level snow with drifts to 8feet buses and trains buried. |
| 1954 | Sprinkling Tarn 257” rainfall (6500mm) UK Record ? |
| 10th August 1958 | Severe and long lasting T/storms Scafell area. Rainfall estimated at 6” per hour. Changed the look of the screes for ever more. Large boulders ended up as far away as Eskdale |
| October 1967 | Wettest for 100years 29” Rainfall at Langdale |
| August 1969 | Warmest in 10years |
| 20th August 1969 | Freak T-storm Bewcastle 4” (100mm) Rainfall |
| April 1970 21-22nd | Continuous Rainfall - Borrowdale 6”, Seathwaite 7.15” and Sty Head 8” |
| August 9th | Earth Tremor Kirkby Stephen |
| June 1970 | Prolonged dry spell 1-21st |
| June 10th | Ambleside 89F |

| | |
|---|---|
| June 11th | Freak Thunder storms Langdale to Blea Tarn Rd washed away. Hail ¾" diameter |
| November 1970 | 91mph Gust Langdale. 64mph Carlisle structural damage reported |
| April 1971 | Drought 30th March - 14th April |
| August 1972 | Drought 20-31st – No Rain recorded generally |
| February 1st 1972 | Widespread snow 22cm at Hawkeshead |
| July 23rd 1972 | T/storms 43mm in one hour Ambleside |
| September 1972 | Driest Sept on record Rydal/Windermere 24-25days no rain |
| April 1st 1973 | Pennine Roads blocked with snow |
| 30th November 1973 | Cold -11.6c in Carlisle, coldest city in Europe |
| April 1974 | Driest April since 1903 |
| August 1975 | Warmest for 20 years |
| 22nd January 1975 | Major flooding Ambleside |
| 28th January 1975 | 30cm of snow Kirkstone Pass |
| June 1975 | Drought 6-30th June ( North) no rain |
| August 1976 | Driest since 1947, sunniest since 1935 |
| December 1976 | Consistently Cold throughout, colder than Winter 62/63 |
| 2nd January 1976 | Widespread Gales, damage |
| 11th June 1977 | Hill snow |
| 30th October 1977 | Wettest Day of the century !, widespread flooding, Landslide A591 Thirlmere |
| 1st January 1979 | Severe Frosts -11.5c at Carlisle, |
| 5th January 1979 | Severe frosts -18c at Appleby, -16c at Hawkeshead |
| 14th February 1979 | Blizzards. Appleby 30cm, High passes closed for several days |
| Winter of 1979 | Statistically coldest since 1962/63 |
| March into April1980 | 35days no Rain |
| May 1980 | Driest in 55 years |
| 24th April 1981 | Blizzard 35cm at Whasdyke, Drifts 4-5ft 15cm at Newtown Rigg |
| December 1981 | Exceptionally Cold, Coldest this century. 13th 25cm snow at Ambleside, 19th 30cm of snow at Whasdyke, deep drifts<br>December 1981 colder than Jan 1979 1963, Feb 1963 and Feb 1947. Not as cold as Jan 1940 ( -21.1c at Ambleside 21st 1940) |
| February 1981 | No rain 5th-26th |
| January 1982 | 2nd/3rd Flooding rain and melting snow, River Brathay 2ft over the road at Brathay Hall.<br>2nd/3rd Honister 265mm UK 48hr record |
| January 1982 6th-15th | V Cold, -10c generally. Windermere froze<br>-13.9c at Carlisle, record for January |
| 3rd March 1982 | Gales 78mph Carlisle |
| July 1982 | Drought 16th-30th |
| 6th July 1982 | Severe t/Storms Carlisle area 50mm in 1-2hrs caused flooding |
| 19th December 1982 | Widespread Flooding, particularly Ambleside and Coniston. Waterhead Car park under water. Reason rain and melting snow. Coniston 89mm in 3hrs Roads 3feet under water |
| July 1983 | Hot 6th-14th.; Hottest month in 25years possible since 1930 |
| 17th July 1983 | Severe t/Storms. Person killed by lightning at Easdale. |
| 13th January 1984 | Blizzards, accumulated snowfall 53cm at Ambleside, 45-50cm at Grasmere and Whasdyke |
| 31st January 1984 | Wind and Tide reduced Arnside Pier to rubble |

| | |
|---|---|
| May 1984 | Very dry generally, driest May in Ambleside for 50years |
| July 1984 | DRY, private water supplies reported dry by mid July |
| 3rd November 1984 | Very wet. M6 South of Carlisle blocked by flooding |
| August 1985 | Exceptionally wet, Wettest August for 25years, Grasmere 537mm wettest August going back to 1891 when 456mm fell |
| 14th December 1981 | Very wet, Rescues reported of people in Carlisle from flood water. Flooding in Keswick up to 5 feet deep. Boats used in Shap to rescue people ! |
| February 1986 | Very Cold throughout. 21st -14.8c in Carlisle. Many lakes frozen |
| January 1987 | Severe cold .13th -4.9c Max at Carlisle<br>-12.7c at Aspatria (min) . Reports of penetrating frosts and damage to water supplies |
| 27th March 1987 | Heavy rain, considerable flooding throughout Cumbria. 2 Day totals 223mm Honister, 201mm at Coniston |
| July 1988 | Wettest July this century |
| 12th September 1988 | Earthquake 2.9 on the Richer Scale, felt at Ambleside, Windermere and Hawkeshead |
| 9th march 1989 | Windermere Lake rose to 133.25ft or 5 feet above normal, caused ferry to stop running. March was wettest in the central lakes since 1932 |
| 4th February 1990 | River Eden in full flood |
| 25/26th February 1990 | Very stormy, many trees felled and roads blocked. Report of 1000 trees felled in Esthwaite |
| February 1990 | Keswick - wettest February in 150years |
| February 1991 | Long cold spell, Heavy drifting snow in Pennine areas 6-8th 20cm in Brampton on the 7th |
| 1992 – June | Driest since 1925 in Coniston, Driest o0n record in Hawkeshead and Carlisle |
| 20th July 1993 | Flash Flooding Sedbergh area 700mm in 5hrs following a t/storm |
| 3rd Feb 1994 | Gales East Cumbria, trees brought down |
| 23rd Feb 1994 | Heavy Snow South Cumbria 33cm at Sawrey,30cm at Grizedale,25cm at Ambleside. Traffic chaos in the Furness area |
| 1995 – August | Driest throughout Cumbria since 1947. 16% normal rainfall. Hosepipe Ban from the 16th. River Lune at 6% normal flow rate |
| 31st Jan 1995 | Prolonged rainfall Central Fells area, much flooding and roads blocked. Thirlmere- Dunmail Raise covered with large boulders. Honister 225mm in 48hrs |
| 11th July 1995 | Violent T/storm Cartmel and Furness areas. Cartmel Priory struck by lightning. Roads blocked by rubble in Great Urswick |
| 29th November 1995 | Hosepipe Ban lifted ( August 16th) |
| December 1995 | Very cold after Christmas. Ice Floes on the Solway. Max of -6.7c at Aspatria 27th |
| 5th February 1996 | Disruptive snowfall 23cm widely. 48cm by the 6th Feb in Places, west of county and towards Penrith |
| 28th October 1996 | Remnants of Hurricane Lilli , destructive winds throughout Cumbria |
| 10th February 1997 | Strong winds and high tides, coastal flooding |
| 17th Feb 1997 | Prolonged rainfall A590 at Thirlmere blocked for 4 days by large boulders and debris |
| 13th July 1997 | T/storms caused local flooding North Cumbria . Wetheral 54.7mm and Drumburgh 43.7mm |
| 24/25th Dec 1997 | Storm Force Winds, widespread damage and power failures |
| 26th December 1998 | Damaging winds . Gust to 80knots recorded, widespread damage. Worst winds since 1966 |
| 28th November 1999 | Flooding in the Keswick Town area 60mm in 12hrs |

| | |
|---|---|
| 24th December 1999 | Gales, structural Damage |
| 19th September 2000 | Heavy Rain, general flooding North and North East Cumbria |
| 28th Jan 2002 | Severe Gales. Gust in excess of 70mph. M6 closed at Shap lorries overturned. Main Rail line closed |
| 24th February 2002 | Heavy snowfall East Cumbria 18cm level with drifts to 1m |
| 25th February 2002 | Heavy rain and snow melt combined to create widespread flooding especially Eden Valley |
| 30th July 2002 | T/storms Penrith area 40-50mm in an n hour. Widespread flooding and business affected. Police HQ flooded. |
| 31st December 2003 | Blizzard East Cumbria, power cuts |
| 28th Jan 2004 | Intense cold front brought heavy snow and whiteout conditions 4cm in Carlisle in 40mins city traffic at a standstill. A69 near Brampton stationary traffic |
| 3rd August 2004 | Severe t/storms. Wet month in general East Cumbria 300% normal rainfall |
| 7th/8th January 2005 | Worst flooding in 140 years. Carlisle very affected with loss of life and power cuts for several days. Gales also affected area 80-90mph gusts at low level.Great Dun Fell reported 128mph |
| 24th Feb 2005 | Blizzards Pennines, worst snowfall in Alston for 20years. Drifts 10feet deep and roads blocked. |
| 12th March 2006 | General snowfall of over 20cm with drifting. 30cm in Grasmere and A590 closed by the 13th a rare event. |
| July 2006 | Heat wave 31c throughout Cumbria |
| 10th Dec 2006 | Widespread flooding. Grasmere 110mm. Wettest December since 1852 |
| 19th November 2009 | 314mm of Rainfall Seathwaite – widespread flooding in Keswick, Cockermouth and Workington. Bridges collapsed and loss of life |
| | (In addition to this record, Cumbria experienced exceptionally cold temperatures in January 2010, accompanied by heavy snowfalls on and around the 10th January 2010. By July 2010, one extreme had been supplanted by another, with the least rainfall recorded for the period Jan-July since 1929, leading to drought conditions across much of the County.) |

# 4. The Impacts of severe weather events in Cumbria

## 4.1 General Findings

Recognition first needs to be given to the fact that different individuals (the elderly, the isolated, those living in exposed locations, those living alone etc) and different services (those dependent on travel, those dependent on IT, those involved in distributing goods, those involved in attracting visitors etc) will be affected in different ways and with different levels of disruption by the same extreme weather event. This lies at the heart both of understanding the impacts of past extreme weather events and also in determining who, where and what are most at risk from future events; it may ultimately determine where resources need targeting.

Supporting this assertion, more recent media reports show that these events are associated with varying levels of severity and impacts for LAs, communities and the environment. Heavy rainfall and severe flooding are the most frequent events to impact Cumbria, closely followed by windstorms and snow. Many communities have experienced repeat incidences of flooding, such as Carlisle, Keswick and Cockermouth. It has been all too evident in the major floods of recent years that affected communities have suffered substantial psychological and economic trauma;

those that are repeatedly flooded often complain both to and about organisations they see responsible for either failing to prevent the flood in the first instance or failing to respond adequately with the aftermath.

The very dry summers of 1992, 1995, 2003 and 2010 have all seen disruptions and hosepipe bans due to drought conditions, whilst even as recently as 2006 Cumbria experienced temperatures as high as 34oC in Whitehaven, with ambulance services receiving 152 heat related calls in just one day; road surfaces melted and increased incidences of blue green algal blooms were reported in Cumbria's lakes. Meanwhile, damaging winds in January 2002 killed 7 people, causing lorries to overturn, motorways and rail lines to close and costing millions of pounds to repair damage to property and buildings.

Severe weather can impact LA services in various ways. Fallen trees and debris frequently cause disruptions to the county's road network which not only affects direct road users but services that rely on transportation, such as primary care workers visiting vulnerable clients or the thousands of LA workers that travel to schools and offices everyday. Unexpected extremes of weather, such as periods of hot weather and windstorms, can lead to unforeseen costs for LAs and budgets can become stretched as well as leading to burgeoning workloads, delayed programmes of work and increased pressures on staff.

The floods of November 2009 exemplify the scale of climate change impacts, when over 500 Environment Agency staff became involved in the response to the Cumbrian floods, fielding 22,000 calls from the public. A number of bridges across West Cumbria were damaged or collapsed (one with a tragic loss of life), with several bridges remaining closed for months, resulting in huge additional travelling distances (in Workington, a 10 minute, 1 mile journey to get to work became a 2-3 hour, 20 mile journey).

The floods put additional pressures on social services, housing, economic regeneration, waste and trading standards. For example, Impact Housing Association reported 78 properties badly damaged by the floods, of which 38 had to be evacuated, with repairs costing around £1.4m. Annual premiums increased from £280,000 pa to nearly £500,000 pa, with some tenants unable to obtain contents insurance. The effects of such extreme events often last far longer than the event itself - it took nearly 5 months to complete the final reinstatement works to Impact's damaged homes, although many tenants moved back in very quickly. The tenants who were out longest were in properties where there was structural damage (for example, to lifts and lift shafts) or where sewage contamination required extensive drying, disinfecting and reinstatement. Flood defence works are scheduled to start in Keswick in 2011 if funding is secured and would not be completed until the following year. Investigations are ongoing in Cockermouth and Workington to identify ways to reduce flood risk but there is no guarantee of major flood defence schemes. The estimated cost to insurers of the 2009 flooding for Cumbria and SW Scotland has been estimated at over £100 million, with United Utilities incurring £450,000 alone in repairs to flood damaged water pipes in Cumbria.

Meanwhile, responses to a survey by Cumbria Tourism at the time showed 72% of tourism businesses had been affected by the flooding, some directly by water damage, but others as a consequence of cancellations precipitated by adverse national media

coverage which, amongst other sensationalism, questioned the safety of all of Cumbria's 1800 bridges. Cumbria Tourism attempted to counter this negative publicity with over £450,000 worth of print and radio coverage, a sum that needs to be taken in the context of an estimated £15.4million loss to the tourism economy and a further £7.9million incurred through damage to infrastructure within the National Park. (see Appendix). With these figures representing only some of the financial records, and not those of LAs, the total cost of severe weather on property and services would be considerably more.

Alongside the unexpected impacts, weather events also have similar repetitive impacts on LA assets and services, such as road networks and building maintenance. These repetitive impacts have a dual cost in terms of resources and labour hours that largely go unaccounted for, as they are a part of routine work. Such impacts will likely be augmented by predicted increases in intensity and frequency of extreme weather events and other climatic changes and are presently not formally considered.

Extreme flooding events can have major impacts on farmland by depositing huge volumes of debris and gravel on land making it very difficult for farmers to farm their land. The cost of remediation can be substantial and it is often the farmers best valley bottom land that is affected. Following the floods of November 2009 significant grant money was made available to farmers to undertake this work. Fences, hedges and other farm infrastructure can also be damaged leading to further inconvenience and expense. Significant areas of land can also be eroded away by flooding leading to loss of productive land.

## 4.2 Impacts recorded in the media search

The short media search carried out by Copeland Borough Council confirms the shear breadth of the disruption to people's lives and to services across Cumbria over the last 14 years. These impacts include:

Loss of life and serious injury; damage and disruption to transport networks and travel in general; damage to buildings and infrastructure; damage to the natural environment; power cuts; school closures; increased work pressures; flooded buildings; increase in emergency calls; evacuations; disruption to water supply and sanitation; closure of shops and businesses; increased demand for salting and gritting of roads (both for ice and for melting road surfaces); increased insurance costs; a rise in respiratory problems; disruption to health services; increasing subsidence; high demand on energy use (for heating and cooling).

(For a more comprehensive though generic list of the possible impacts on local services, see Appendix 9).

## 4.3 Impacts on the Natural Environment

During droughts the natural environment can be put under significant pressure. Water temperatures may rise threatening cool water species such as salmon and arctic char that live in the rivers and lakes. The reduction in water levels also decreases the amount of available and suitable habitat for aquatic species. The lower summer river flow will lead to lower dilution of outflows into freshwater increasing Algal blooms and

de-oxygenation of the water can also create additional stress to wildlife as well as affect recreational users of water.

The drying out of our upland peat soils will lead to greater areas of bare soil which can be easily eroded as intensity of rain increases which has been the trend over recent years. This also leads to greater fire risk for these areas with the potential negative landscape and biodiversity impacts that large burns can have on an area for many years afterwards.

Increasing winter storms combined with higher sea levels will lead to the potential loss of areas of salt marsh and sand dune that presently provide a natural protection to much of the Cumbria coast. Changes in water hydrology of coastal aquifers during drought or with added sea level rise have the potential to make some of them more saline, this is likely to happen first on the Limestone around Morecambe Bay in south Cumbria.

## 4.4 Impacts of Hot weather and Heat waves

Severe weather impacts are not always negative and hot days often see increased numbers of tourists who flock to the Lake District, to the Cumbrian coast, rivers and parks to enjoy the sun. Hot weather can have agricultural benefits too, such as an improved crop yields.

However, high temperatures impact on road maintenance costs as illustrated by the excessive temperatures of Summer 2006 causing road surfaces to melt.

Hot temperatures and sunshine trigger new health & safety concerns for staff working in the sun without appropriate clothing or taking sufficient breaks for working in the heat. Meanwhile Adult Social Services and health care workers need to increase monitoring of the vulnerable for respiratory problems and heat stroke. Productivity of staff can decrease dramatically in high temperature conditions.

Dry periods / droughts are also associated with increased incidences of wildfires. Cumbria Fire and Rescue have recorded 2,263 grass or associated fires between 2001-2010, ranging from 147 grass fires in one year to 490 in 2003. A Cumbria Wildfire Group was established in 2007 to plan for and manage such incidences.

Figure 2. 490 grass fires occurred in Cumbria in 2003 owing in part to very dry conditions

## 4.5 Impact on staff resources

While some services are more directly impacted by severe weather, such as Highways and Emergency Planning, it should be stressed that all services are affected by extreme weather events even if they do not act as emergency responders. For example, all services experience staff shortages if workers cannot get into work. Less obvious impacts and hidden consequences of extreme weather, such as health issues and crime rates, are also important and more understanding is needed.
LA switchboards and help lines are areas directly impacted by weather and can see a steep increase in calls in times of severe weather conditions. For example, the Cumbria Ambulance Service received 152 999 calls in just one day in June 2006 on account of the extreme temperatures. LAs are frequently regarded as the first port of contact to report problems such as fallen trees and damaged buildings. As a result increased numbers of calls to Local Authorities can cause services to become overwhelmed. The diversion of staff from daily tasks is often unaccounted for in terms of the true cost to service providers and businesses. Additionally, if calls remain unanswered then frustration can build and this in turn can adversely affect public perception of the council and in turn its reputation.

Services that rely on the road networks become especially vulnerable to extreme weather events, such as care workers visiting vulnerable patients and the thousands of Council workers that travel to schools and offices every day.

## 4.6 Spread of weather impacts

When considering all of the weather events together, damage to buildings along with disruption to the road network are the biggest impacts to affect LAs and local communities. Issues with flooding, particularly related to drainage and sewerage are also widely reported with both negative and positive consequences for council reputation. If LAs were perceived to have responded well to weather events this may have a positive affect on reputation. Praise for the response of the local authorities, emergency services, communities, businesses and housing providers in the floods of November 2009 was widely reported in the media. This demonstrates that good preparation and management of weather events can benefit public relations and greatly benefit the reputation of those involved.

## 4.7 Measuring the demand on local services

If preparation for extreme weather events means more successful management and minimised impacts when dealing with the subsequent impacts, then a clearer understanding of the levels of demand for services in such circumstances is crucial. Local authorities are increasing their knowledge and understanding of these events through the development of business continuity plans and risk assessments. The relationship between the level of 999 emergency calls and extreme weather events is an area of particular interest to health services, police, Fire and Rescue services and the Environment Agency, amongst others.

# 5. CASE STUDY: Anatomy of a Severe Weather Event: Impacts of the November 2009 Floods **(extracted from the Cumbria Intelligence Observatory)**

## 5.1 Overview & meteorological circumstances

Between Wednesday 18th November and Friday 20th November up to 372mm of rain fell over Cumbria. In the 24 hours ending 00:45 on Friday 20th 314mm of rain fell in Seathwaite. This is a record daily rainfall for the UK. The air mass responsible for this rainfall was formed in south tropics where unusually high sea surface temperatures ensured that the air was particularly rich in moisture. The air mass tracked north as part of a "warm conveyor". As the air was blown over the Cumbrian fells it cooled causing the moisture to condense and begin to fall as rain. The warm conveyor remained over the fells for a period of 36 hours maintaining a steady downpour resulting in the exceptional rainfall levels. Rain earlier in the week ensured that the ground was already saturated in many areas. Flooding occurred in 5 of Cumbria's 6 district areas, the only one escaping being Barrow. The effect on properties was concentrated in Allerdale and South Lakeland with most significant infrastructure damage occurring in the former district.

## 5.2 Damage to Property

Records show that a total of 2,239 properties were inundated with water as a result of flooding in November (80.1% residential and 19.9% commercial). Properties in Allerdale suffered from the highest levels of inundation. Of the 1,721 properties flooded in the Borough 917 were in Cockermouth.

**Table 3. Properties flooded by district and use classification**

| | CUMBRIA | Allerdale | Barrow | Carlisle | Copeland | Eden | South Lakeland |
|---|---|---|---|---|---|---|---|
| Residential | 1,794 | 1,299 | 0 | 15 | 22 | 74 | 384 |
| Commercial | 445 | 422 | 0 | 0 | 0 | 5 | 18 |

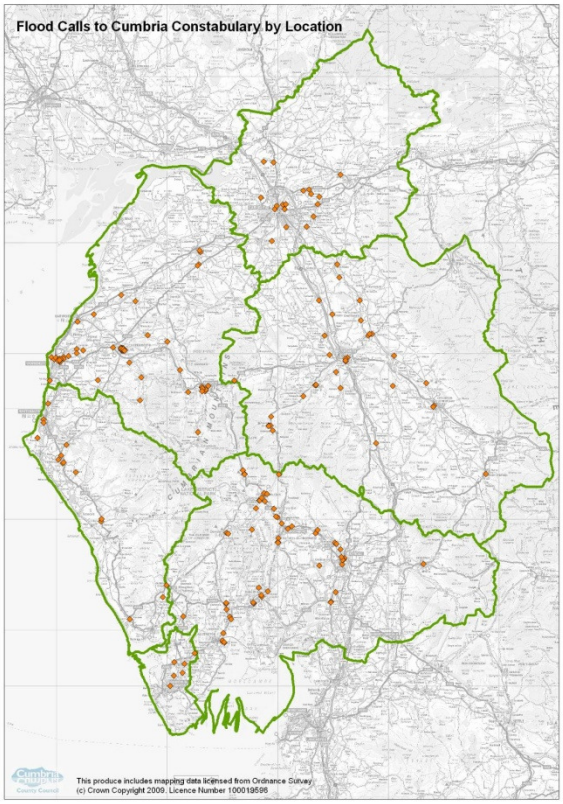


**Figure 3. Flood-related incidents reported to Cumbria Constabulary (18/11/09 – 22/1109)**

As noted in the table above)

**Figure 4: Cockermouth flooding 2009** *(source: Environment Agency)*

## 5.3 Impacts on community welfare

- According to information gathered from affected householders the most commonly occurring need immediately after the floods was for accommodation (24.8% of residents), with advice about insurance ranking second (9.5%), business support (8.5%), council tax advice (8.2%) and information about the Cumbria Flood Appeal (7.8%).
- Insurance companies reported that they arranged temporary accommodation for 470 policyholders.
- Local services all felt the pressure that demand resulted from the increased demand for services, including those covering reception centres and frontline policing.
- Flood waters forced some services to relocate from their usual operating bases such as GPs and Police in Cockermouth.
- Concerns associated with the spread of disease led to a localised vaccination programme being carried out in Cockermouth.
- Socio-economic analysis of the communities affected across Allerdale, using the ACORN dataset, indicates that older residents have been disproportionately affected. Around 63% of residents are from older social groups compared to only 17% in the wider population.
- The transport problems in Workington meant that around 7,000 residents were unable to access their local GP surgery. The same problems also affected the ability of the emergency services, such as the ambulance service, to meet their commitments to the public.
- Health issues have shifted from the immediate threat to life, through concerns about access to medication, and are now focussed on long term psychological problems of residents affected.

## 5.4 Impacts on the environment

- One of the most significant impacts was associated with changes to river courses where both erosion and deposition occurring in different parts of the course. Significant deposits were experienced in the region of the Port of Workington
- Natural England recorded 110 farms as suffering from severe effects of the flooding.
- In addition to the significant volumes of river sediments the floods led to the generation of waste from households and businesses. Pressure was felt throughout the waste system.
- Many farm suffered from fallen stock with carcasses deposited on neighbouring farms or washed out to sea.

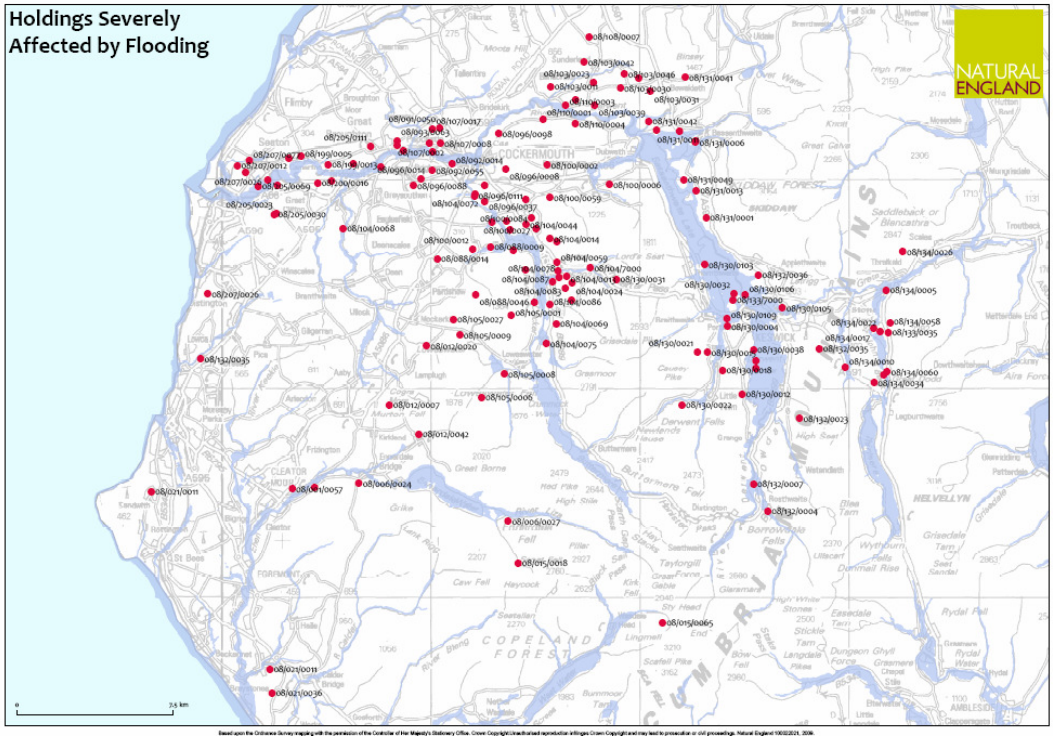


**Figure 5: Holdings severely affected** *(Source: Natural England)*

## 5.5 Impacts on the economy and businesses

- The flooding affected 80% of businesses in Cockermouth
- The County Council-operated Port of Workington was forced to close as a result of sediment deposition. An emergency dredging campaign was promptly instigated to allow a rapid return to full operations. The total cost of flood damage to the port is estimated to be in excess of £6.75m.
- Some businesses in South Lakeland were badly damaged (inc. National Trust Information Centre, Windermere Marine, and Windermere Lake Cruises).
- Very few businesses in Workington were directly affected but businesses lost trade due to the collapse of the bridges.
- Other businesses not directly affected lost business due to the negative message in the media that Cumbria is closed for business.
- Weddings were cancelled with an associated effect on the catering and hospitality industries.
- Operation in parts of the agricultural sector were impeded due to damage to fields and walls
- Business Link data suggested that 3,057 businesses are affected in Allerdale (1,606 in Workington, 693 in Cockermouth, and 758 in Keswick)
- Dunmail Park, north of Workington, reported 90% loss in revenue through November/December; Debenhams reported 80% reduction in footfall
- Residents from the relatively affluent Seaton area were unable to get through to Workington, which had a big effect on the Workington economy.
- Survey by Cumbria Tourism noted that 72% of respondents had been affected by the floods, and 6% had to close their business as a direct result. The biggest effect on hotels was experienced in South Lakeland.
- Ten tourism businesses reported damage in excess of £100,000. These were concentrated in Cockermouth, Workington, and areas surrounding lake Windermere, including Windermere, Bowness, Newby Bridge, Lakeside and

Ambleside. Between them these businesses suffered almost £12m worth of damage.

- Almost half of all tourism businesses were affected by access issues. 41% have suffered cancellations, a fifth believe bookings and enquiries were down, and more than a quarter were concerned about the impact on public perceptions.

## 5.6 Impacts on infrastructure

- In terms of impacts on the transport network the most significant effects were seen in the destruction and severe damage to the county's road and public rights of way bridges. 3 significant road bridges were lost completely and around 20 others were temporarily closed (some remaining closed) because of evidence of structural damage. Elsewhere roads were inundated as drainage was overwhelmed and surface water run-off flooded the highway.
- Across the Lake District and other rural areas 244 rights of way bridges were damaged or lost and in some cases the surfaces of rights of way were destroyed.
- The flood waters demolished and severely damaged two road bridges in Cockermouth leading to their closure, demolished a key footbridge and inundating large parts of the town centre; and finally overwhelmed the Calva Bridge in Workington causing structural damage requiring its closure and destroyed the Northside bridge and Navvies footbridge.
- These severed the A596 and A597 connections across Workington and to the A66 trunk road and cut the community in two. A further footbridge linking the banks of the River Derwent was destroyed within the Port of Workington. Sadly the collapse of the Northside Bridge resulted in the death of Police Constable Barker.
- With the loss of both road bridges across the lower Derwent the relatively deprived community of Northside was rendered inaccessible from the rest of Workington.
- The loss of functionality previously provided by the bridges in Workington severed the community and necessitated a forty mile round trip to access work, schools, healthcare and shopping. These journeys were previously of the order of a mile or two via the bridges. This placed huge time penalties on everyday trips with some journey times increasing by up to two hours in the peak. The time penalty was compounded by traffic congestion throughout the day and very long queues at peak periods on the diversionary routes which had insufficient capacity to accommodate the diverted traffic.
- Some schools (mainly in West Cumbria) closed temporarily and 461 additional pupils required the provision of transport as their usual routes to school were impassable;
- Smaller roads and bridges were kept closed to prevent rat running and the consequent further collapse of roads and bridges.
- Elsewhere across the county, while flooding was less dramatic it nevertheless overwhelmed and closed roads and damaged bridges resulting in their longer term temporary closure.
- Power supplies and telecommunications were interrupted in some areas (including contact with the emergency services).
- In the 24 hours following the rainfall, teams from across the Highways and Transport Division commenced the inspection of the road and rights of way network looking for and making safe damage, as well as putting up closures and reopening roads as flood water levels began to drop. Approximately 1,600 structures were checked during this exercise.

# 6. Climate change recent trends and predicted impacts.

## 6.1 Climate Change predictions for the North West region of England

This section provides an overview of the UKCP 09 data for the North West region based on information available at www.ukclimateprojections.defra.gov.uk. The following table 4 presents data for the time period 2020, 2050 & 2080. It provides an indication of the range and level of certainty concerning future climate change in the North West of England based on 3 greenhouse gas emission scenarios. This section also includes sea level rise data for the North West which can be used when considering coastal impacts and inundations.

## 6.2 UKCP09 NW Key findings

**How to interpret the following table:**

The outputs from the key findings part of UKCP 09 for the NW can be found at: http://ukclimateprojections.defra.gov.uk/content/view/2150/680/ , and this splits the findings into low, medium and high emissions scenarios.

In Table 4, under low emissions, the central estimate of increase in winter mean temperature by 2020 is 1.2ºC; it is very unlikely to be less than 0.4ºC and is very unlikely to be more than 2ºC. A wider range of uncertainty is from 0.3ºC to 2ºC. In tabulated format we have represented this as 1.2 ºC (0.4 to 2 ºC) and left out the wider range of uncertainty.

Under low emissions, the central estimate of change in annual mean precipitation is 1%; it is very unlikely to be less than –3% and is very unlikely to be more than 7%. A wider range of uncertainty is from –4% to 7%. In tabulated format we represented this as 1% (-3 to 7%) and left out the wider range of uncertainty.

It needs to be stressed that these figures relate to averages only. There is strong scientific evidence that connects small changes in averages to the increase frequency of extreme weather events. The significance of such small average changes in temperature and precipitation should therefore not be under estimated or misunderstood.

**Table 4 – UKCP09 for the NW – showing range of possibilities.**

| ***2020's*** | ***Emissions scenario*** These predictions are realistic and more dependable, as they relate to emissions that have already been released. | | |
|---|---|---|---|
| | ***Low*** | ***Medium*** | ***High*** |
| **Winter Mean Temp.** | **1.2 ºC** (0.4 to 2 ºC) | **1.2 ºC** (0.5 to 2 ºC) | **1.2 ºC** (0.3 to 2 ºC) |
| **Summer Mean Temp** | **1.6 ºC** (0.8 to 2.5 ºC) | **1.5 ºC** (0.6 to 2.5 ºC) | **1.5 ºC** (0.6 to 2.5 ºC) |
| **Summer Mean Daily Max Temp** | **2 ºC** (0.6 to 3.5 ºC) | **1.9 ºC** (0.4 to 3.5 ºC) | **1.8 ºC** (0.5 to 3.3 ºC) |
| **Summer Mean Daily Min. Temp** | **1.5 ºC** (0.6 to 2.6 ºC) | **1.5 ºC** (0.5 to 2.6 ºC) | **1.4 ºC** (0.5 to 2.5 ºC) |
| **Annual mean precipitation** | **1%** (-3 to 7%) | **0%** (-4 to 6%) | **0%** (-4 to 6%) |
| **Winter Mean precipitation** | **4%** (-3 to 14%) | **6%** (-1 to 14%) | **4%** (-3 to 13%) |
| **Summer mean precipitation** | **-5%** (-19 to 9%) | **-7%** (-22 to 9%) | **-4%** (-18 to 10%) |
| ***2050's*** | ***Emissions scenario***: Predictions have a greater variation and are determined by previous emissions and estimated 2010-2050 emissions. | | |
| | ***Low*** | ***Medium*** | ***High*** |
| **Winter Mean Temp.** | **1.8 ºC** (0.8 to 2.8 ºC) | **2 ºC** (1 to 3 ºC) | **2.2 ºC** (1.2 to 3.3 ºC) |
| **Summer Mean Temp** | **2.4 ºC** (1.1 to 3.8 ºC) | **2.6 ºC** (1.2 to 4.1 ºC) | **3 ºC** (1.4 to 4.7 ºC) |
| **Summer Mean Daily Max Temp** | **3 ºC** (1 to 5.3 ºC) | **3.3 ºC** (1 to 5.8 ºC) | **3.8 ºC** (1.3 to 6.5 ºC) |
| **Summer Mean Daily Min. Temp** | **2.3 ºC** (0.9 to 3.9 ºC) | **2.5 ºC** (1 to 4.4 ºC) | **2.9 ºC** (1.3 to 4.9 ºC) |
| **Annual mean precipitation** | **0%** (-6 to 6%) | **0%** (-5 to 6%) | **0%** (-6 to 7%) |
| **Winter Mean precipitation** | **8%** (0 to 20 %) | **13%** (3 to 26%) | **13%** (3 to 27 %) |
| **Summer mean precipitation** | **-13%** (-32 to 8%) | **-17%** (-34 to 1%) | **-17%** (-36 to 3%) |
| ***2080's*** | ***Emissions scenario:*** These predictions have the greatest variation and are determined by the pace we move towards a low carbon society | | |
| | ***Low*** | ***Medium*** | ***High*** |
| **Winter Mean Temp.** | **2.3 ºC** (1.3 to 3.6 ºC) | **2.6 ºC** (1.4 to 4.1 ºC) | **3.2 ºC** (0.3 to 2 ºC) |
| **Summer Mean Temp** | **2.8 ºC** (1.3 to 4.6 ºC) | **3.7 ºC** (0.6 to 2.5 ºC) | **4.7 ºC** (2.5 to 7.3 ºC) |
| **Summer Mean Daily Max Temp** | **3.6 ºC** (1 to 6.6 ºC) | **4.7 ºC** (1.7 to 8.3 ºC) | **6 ºC** (2.4 to 10.1 ºC) |
| **Summer Mean Daily Min. Temp** | **2.8 ºC** (1.1 to 4.9 ºC) | **3.8 ºC** (1.6 to 6.4 ºC) | **4.6 ºC** (2.2 to 7.8 ºC) |
| **Annual mean precipitation** | **0%** (-5 to 8%) | **0%** (-6 to 8%) | **0%** (-8 to 12%) |
| **Winter Mean precipitation** | **15%** (4 to 30%) | **16%** ( 3 to 35%) | **26%** (9 to 50%) |
| **Summer mean precipitation** | **-15%** (-34 to 4%) | **-21%** (-42 to 0 %) | **-27%** (-50 to 0%) |

## 6.3 Recent trends

### 6.3.1 Global and National Trends

The IPCC Fourth Assessment Report (2007) states a global rise in temperature of 0.74 ℃ during the last century and forecasts a 2 – 4.5℃ increase by the end of this century. These temperature rises are being constantly reviewed in the light of new scientific evidence which suggestions that temperatures could rise by as much as 6oC by 2100. Eleven of the last twelve years (1995-2006) rank among the twelve warmest years in the instrumental record of global surface temperature (since 1850). July 2010 was the 304th consecutive month above the mean 20th Century average for global land and oceanic temperatures (The Sunday Times July 18th 2010). In England, four of the five warmest years in a 340-year record were experienced in the 1990s, whilst 2006 was the warmest year ever by a considerable margin.

### 6.3.2 Cumbria Level: Predicted impacts

There is a strong scientific base of evidence that suggests Cumbria will experience changes to its climate over the course of this century. The UKCP09 uses the latest in climate modelling techniques to highlight some specific changes that we are likely to see in Cumbria. These predictions are highlighted below for the 21st Century:

- Average annual temperature is certain to increase by the 2080s, with a rise of 1℃ to 5℃ extremely likely.
- Winters are extremely likely to be warmer, as average winter temperature is likely to increase by 1℃ to 4℃ by the 2080s.
- Winters are also likely to be wetter, as average winter rainfall will more likely than not increase 50% by the end of the century.
- Increased winter rainfall, combined with a likely increase in the quantity of rainfall from intense events in winter, will result in a greater risk of flooding.
- Summers are virtually certain to be hotter, as summer average and average maximum temperature is likely to increase between 2℃ to 5℃.
- Acute temperature events such as heat waves are extremely likely to increase. The longest summer heat wave duration is likely to grow by up to 10 days over the 21st century.
- Summers are also likely to be drier. Future summer average daily rainfall is likely to significantly decrease. In conjunction with this, summer dry periods are likely to increase in duration, more likely than not increasing by up to 10 days. Extreme hot days at present will become the normal for summer by 2050.
- Sea levels are likely to rise by up to +0.3m by 2080, rising at rates faster than present (IPCC, 2007), having a significant impact on coastal erosion, coastal and estuarine flooding. Recent scientific findings find this estimation to be very conservative.
- Extreme events are also projected to increase. Higher wave and storm surge elevations with low pressure weather systems, and increased frequency of winter storms, resulting in increased wind speeds, will have major impacts on the low lying coastal areas.

Recent trends for the North West of England indicate that there has been a general move towards drier summers and wetter winters and that annual mean temperatures have significantly increased since 1961 with 2006 being the warmest year in the NW

since records began. The experiences of the extreme flooding in Keswick, Cockermouth and Workington in November 2009 followed by the drought conditions and hose pipe bans of July 2010 is indicative of this trend (though clearly the examination of a single year 2009/2010 is not sufficient to claim statistical validity for longer term trends).

This move towards wetter winters and drier summers is, however, unlikely to manifests itself uniformly across Cumbria due to the county's diverse topography, influenced by a predominantly maritime weather pattern and leading to variations in local micro climate responses. With a significant proportion of the county characterised by steep sided, upland fells flanked by flat plains (much of which are represented by extensive coastline) Cumbria is particularly vulnerable to extreme weather events. For example, high rainfall in Cumbria's uplands has caused a number of floods in recent years with devastating results for local communities, in particular, Carlisle. This topographical diversity also makes it additionally difficult to predict with confidence the very locally specific impacts of climate change.

### 6.3.3 Predicted Change in Sea Level

There is also strong scientific evidence pointing towards a sea level rise around the coast of Cumbria.

**Table 5**

| Changing Sea level in the NW | 2040 | 2080 |
|---|---|---|
| Liverpool | +15cm | + 32 cm |
| Blackpool | +15cm | + 30 cm |
| Barrow-in- Furness | +14cm | + 30 cm |

Based on the 'Central Estimate, Medium Emissions' scenario (UKCP 09), which equates to scenario A1B of IPCC. (Global rise of 2 $^{0}$C by 2080)

**High-plus-plus (H++) mean sea level scenario**

The H++ scenario produces a model in which high emissions cause feedback into the climate system, leading to significant rises in sea level. This points towards a range for mean sea level rises around the UK of 0.93m to approximately 1.9 m. Beyond our qualitative statement that the top of this range is very unlikely to occur in the 21st century we make no attempt here to assign a precise probability to this event.

The use of the H++ scenario might seem extreme, as it is 4-5 times greater than the UKCP09 estimate for sea level rise in the North West at 30cm. However, the significance of having to adapt to a 30cm rise in sea level is enormous. It follows that in implementing many of the flood responses to a 30cm rise (building sea walls and other flood defence controls) the cost of simultaneously preparing for a 1.9 m sea level rise would not be correspondingly 4-5 times higher. Planning for a 30cm sea level rise, but then having to retrofit for a 0.9cm - 1.9m rise once the 30cm defences had proven inadequate would be a far more expensive approach. Such scenarios point to the need for very careful risk assessments to be made.

## 7. Key Findings – Organisational Response and Exposure to Extreme Weather Events

Using media sources and drawing from information gathered from Cumbria Weather Forum, partners on the Climate Change Task Group, the emergency services and Resilience Unit this project has highlighted a number of significant areas where LA assets and services and the wider Cumbrian community are affected by weather. Significant findings include:

- **LAs and CSP organisation are vulnerable to large-scale and/or unexpected weather events.**

- **Weather events are generally responded to rather than planned for.** Extreme weather events are also largely seen as the responsibility of Emergency Planning. There are indications that limited consideration has been given by LA departments, the CSP, organisations and businesses as to how severe weather might impact on their service delivery in the future, though some have included aspects of weather impacts in their Business Continuity Plans. Although there are examples of good Emergency Planning, steps also need to be taken to mitigate impacts of weather through long-term planning. With severe weather predicted to increase in the future, forward planning may provide a more stable basis in which to handle the effects of severe weather within the LAs.

- **Many local authority departments have either scant records of the impacts of weather on their services** or no record systems at all. Knowledge of past weather events, in terms of impacts and consequences to council services, local communities, businesses and the environment, is more often than not informal (e.g. stored in individual's memories or journalistic sources) rather than systematically recorded and maintained. In addition due to modern working patterns people tend not to stay in the same job as they might have done in the past. More needs to be done to counter the loss of institutional memory due to quicker staff turnovers. More accurate recording of weather events and their impacts and consequences could help counteract this

- **Weather events impact on LAs' reputations,** with poorly handled events often receiving negative press and well-handled situations often going unnoticed. Nevertheless, the responses of the emergency services and voluntary sector to the November 2009 floods was generally reported in a very positive light, whilst unfounded rumours abounded about the Environment Agency and United Utilities' role in failing to contain the flood. The local and national press has enormous power in influencing the public's perception and response to extreme weather events, potentially exacerbating the economic and social impacts.

- **Inadequate drainage is a big problem and is expensive**, time consuming to deal with and has an adverse affect of council reputation. Surface water flooding incidents are relatively common and increasing, further exacerbated by weather related factors.

- **There is a growing body of experience and expertise in Cumbria** in dealing with the impacts of extreme events, in planning, in operations and in dealing with the press; this presents an opportunity for sharing this wealth of expertise across service delivery partners and other institutions. Various departments within Cumbria County Council (including the Constabulary, Fire and Rescue and Highways) as well as within the NHS / PCT have developed risk registers and contingency plans and these will provide useful guidance to other service providers in assessing risk and building a response.

- **There is generally a heavy reliance on 'good will' service** when departments deal with the impacts of extreme weather events. More frequent and intense weather events may increase pressures and challenge such informal arrangements. Additionally, new EU legislation over break times and increasing concerns for staff health & safety might require greater forward planning. Introducing more formal procedures which detail how individuals/delivery partners can be released from their usual duty to be reassigned – for duties such as door knocking/filling sandbags – could help to overcome potential tensions.

## 8. Recommendations

Based on these findings the report proposes the following recommendations for LA's and CSP members in their approach to developing comprehensive adaptation strategies:

**The Climate Change Task Group should present this report to the CSP Environment Thematic Partnership.**
The Task Group recommends that the Partnership use this report as a platform for increasing awareness and action on adaptation in Cumbria.

**CSP member organisations need to undertake individual climate change risk assessments for their own buildings, staff, resources and services and update business continuity plans**
In line with objectives defined by NI 188, requirements under the Climate Change Act and also commitments given to delivering the Cumbria Climate Change Action Plan, all LA and CSP organisations need to complete their own individual risk assessments of the potential severity and frequency of the impacts of climate change, identifying the vulnerabilities and opportunities to their services (public health, transport, tourism, agriculture, economy etc.) The findings of these risk assessments should lead to detailed action plans which should be shared corporately across departments and also be included in project risk registers. These action plans need embedded as part of organisations' business continuity plans.

**Agree a means to share information on climate change risk impacts and management strategies.**
The CSP Environment Thematic Partnership needs to consider how best to gather and share information which records the impacts and costs of climate change in Cumbria, maintaining a register of risk assessments and management strategies. This central database would enable the development of an overall, strategic assessment of risk across Cumbria. This role might be undertaken either by Cumbria County Council or through the CSP. It would also inevitably help individual organisations which had yet to develop their own responses to climate change by providing real case studies and a template for risk assessment. The CSP website might offer a possible 'home' for this information, whilst an initial workshop on adaptation facilitated by the Cumbria Climate Change Task Group is also recommended.

**Building local resilience by engaging communities**
Increasing community-based resilience to weather is an important adaptation measure for Cumbria, particularly for communities at risk to flooding and is also recommended by the Pitt Review (2007). Work being done on this by Emergency Planning and the Resilience Unit will help to raise the profile of this both within and outside the LAs. The identification of vulnerable people within communities is a particularly important issue. Parishes can individually create emergency plans to make themselves more resilient. This is particularly pertinent in light of changing demographics and social structures, which have often led to the loss of social focal points, such as post offices, pubs etc, and less information is held within individuals about their local community. Trained community emergency co-ordinators could be really good at contacting and identifying vulnerable people and helping communities themselves to be prepared.

**Increase understanding of surface water flooding**
Producing GIS maps of surface water flooding will increase understanding of which communities are vulnerable and help inform long term planning decisions. (The Environment Agency has produced indicative surface water flooding maps and shared these with Local Planning Authorities to help them with their LDF preparations. However, they are not yet sufficiently refined to inform individual planning application decisions and are not therefore widely publicised.)

**Develop IT capacity to enable staff to work remotely from home**
Developing technical capacity to enable staff to work remotely from home will help to minimise service disruption occurring from staff difficulty getting to work. At least in the first instance section managers should identify which members of staff might be able to work from home from their own PCs in the event of an emergency. Cumbria is generally poorer than the rest of the UK for connectivity and this will continue to constitute unnecessary disruption when extreme events cause travel difficulty.

**Formalise 'good will' working agreements and train more staff**
Training LA workers from other departments or service areas that are not so directly affected by weather events so that they can respond in an emergency situation would result in better deployment of staff in an emergency situation. The contribution of personnel from many different Cumbria County Council departments during the floods of November 2009 and the aftermath demonstrates the benefits of cross sectoral training and participation. In addition more formal agreements that detail how individuals/delivery partners can be released from their usual duty to be reassigned – for duties such as door knocking/filling sandbags – are recommended.

**The role of spatial planning needs to be investigated**
With severe weather predicted to increase in the future, long term strategic planning may provide a more stable basis in which to handle the effects of severe weather within the LAs. New developments and building design could play a key role in this, such as use of sustainable drainage systems. Spatial planning and design of new developments could play a key strategic role to avoid exacerbating existing pressures on drains and reducing flooding, such as recommendations made by PPS 25 (on development and flood risk) and PPS 1 (planning and climate change).Additionally, traditional ways of making decisions may need to become more creative and flexible for example, adjustments to existing transport networks may be necessary.

## 9. Conclusion

The LCLIP project provides evidence demonstrating that the all LAs, CSP delivery partners, and communities are impacted when severe weather events strike Cumbria, though not uniformly nor predictably. Research shows that whilst some Cumbrian organisations have developed contingency plans for responding to the impacts of extreme weather in the aftermath of an extreme event, most organisations fall short of having developed corporate strategies for minimising the risks of adverse impacts from climate change or maximising the opportunities; fewer still have invested in adaptation measures. In spite of this shortfall, the flood protection measures installed after the Carlisle floods of 2005 suggest that successful preventative measures can pay dividends, even in the short term (in this case, as early as November 2009 when the new £38million defences installed by the Environment Agency prevented flooding in parts of Carlisle).

A process of engaging with policy makers, senior managers, staff and community representatives across the Cumbria Strategic Partnership members is now urgently required. This LCLIP provides a starting point for this awareness raising and planning. Comprehensive risk assessments need to be carried out by each LA, CSP organisations and lead agencies for each sector in Cumbria. These need to identify the vulnerabilities and opportunities for services, developing detailed action plans and embedding those actions corporately, including sharing these with key delivery partners and local communities. It is recommended that these risk assessments and action plans be gathered centrally and shared on the CSP website and through a pan Cumbria event, enabling best practice to be identified and serving to accelerate and co-ordinate the Cumbria response.

## Appendices:

1. UKCIP LCLIP Risk Assessment: Template
2. UKCIP LCLIP Questionnaire: Template
3. Environment Agency: Cumbria Floods Technical Report
4. Cumbria Tourism: Report on the floods of November 2009
5. Carlisle City Council: Report on the Floods of 2005
6. Impact Housing Association: Report on the Floods of 2009
7. Environment Agency: Report on the Droughts of 2006
8. Environment Agency: Cumbria Flood History
9. Cumbria Media Search: 1996-2010
10. Generic Impacts of Extreme Weather Events on Services (Lancashire)

## References

**The best reference and support can be found through www.ukcip.org.uk and through www.ukclimateprojections.defra.gov.uk**


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Lancashire County Council Adaptation and LCLIP http://www3.lancashire.gov.uk/corporate/web/view.asp?siteid=3945&pageid=26049&e=e