Angus Council Local Climate Impacts Profile
2009-2012

The impacts of severe weather events in Angus on towns, organisations and services

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Local Climate Impacts Profile 2001-09

Main findings and recommendations

Aims

- **Catalogue extreme weather events in the Angus region since 2001**
- **Log Angus Council's, community planning partners and selected business responses to extreme weather conditions**
- **Assess Angus's vulnerability to weather events;**
- **Inform decision making on effectiveness of responses;**
- **Assist awareness raising in staff , community partners and the public;**
- **Contribute information towards a service approach for adapting to the impacts of climate change.**

Findings 2009-12

- There is an Increase in use of the internet and social media for issuing weather warnings and recording information.
- The occurrence of keeping records of weather events, their impacts and the financial implications has improved slightly however this could be improved further and there will possibly be a further need, when adaptation planning and reporting is integrated into more services.
- In 2009 LCLIP 2 highlighted that none of the participants had an adaptation strategy. In 2012 it was clear that adaptation had begun to feature in many more organisations strategic planning.

Findings 2001-09

- **Although it was straightforward in collecting data of the number of events, incidents and impacts and responses from the media trawl, collecting data on costs, responses and attitudes from departments and agencies proved more difficult.**
- **Organisational support for the data gathering process with high profile senior management support is critical.**
- **Most weather events, impacts and costs were not recorded by organisations in any consistent manner.**

Recommendations

- **Angus Council have a corporate climate change strategy which includes adaptation targets. The council's climate change working group would benefit from widening its membership and developing its remit.**
- **Continue to work alongside community planning thematic groups such as the Angus Rural and Environment Partnership and regional planning bodies such as TAYplan.**
- **Angus and Tayside partners could look to forming a partnership similar to the The North East Scotland Climate Change Partnership (NESCCP). The findings of the LCLIP 2 will be shared with Council Services and will be made publicly available on Angus Council's website.**
- **The full LCLIP database will be shared with "Adaptation Scotland" so that it can be added to their national database online and made available to the public and other agencies.**

1. Introduction

In 2007 Scotland's 32 local authorities signed up to **Scotland's Climate Change Declaration.** Signatories acknowledge the reality and importance of climate change and are committed to mitigating their impact on climate change. Scottish local authorities play a key role in our collective response to the challenge of climate change, and publicly demonstrate their commitment to action.

Scotland's Climate Change Act 2009 has created the statutory framework for greenhouse gas emissions reductions in Scotland by setting an interim 42 per cent reduction target for 2020, with the power for this to be varied based on expert advice, and an 80 per cent reduction target for 2050.

In July 2009 Angus Council elected to participate in the Local Climate Impacts Profile (LCLIP) project. The LCLIP is a resource that Local Authorities can compile so that they better understand their exposure to weather and climate. It is based on evidence of a locality's vulnerability to severe weather events and in particular, how these events affected a local community as well as the authority's assets and capacity to deliver services. The 2009 project objectives were to:

- Catalogue extreme weather events in the Angus region since 2001
- Log Angus Council's, community planning partners and selected business responses to extreme weather conditions
- Assess Angus's vulnerability to weather events;
- Inform decision making on effectiveness of responses;
- Assist awareness raising in staff , community partners and the public;
- Contribute information towards a service approach for adapting to the impacts of climate change;

In 2012 Angus Council elected to revisit the LCLIP project and the original research techniques were applied during the period of October 2009 to December 2012. Only slight comparisons can be made between the two time periods. The aim of the newest report is to provide a summary of any visible progression from 2009 in terms of financial recording and mitigation and adaptation planning of the stakeholders who participated in the first report. It is also helpful to note the range of extreme weather events experienced in Angus and it is hoped that new records can aid in climate change mitigation in some way.

Adaptation: The adjustment in economic, social or natural systems in response to actual or expected climatic change, to limit harmful consequences and exploit beneficial opportunities.

Scotland's Climate Change Adaptation Framework (2009)

2. Adaptation planning

The LCLIP can help inform some of the many pieces of legislation, strategies or projects that Angus Council services and partners are in the process of implementing including:

- Flood Risk Management Act 2009
- Climate Change (Scotland) Act 2009
- Angus Council Shoreline Management Plan 2 (2012)
- Tayside Biodiversity Action Plan
- Nature Conservation (Scotland) Act 2004
- Angus Local Plan Review 2009 / future Angus Local Development Plan

Adaptation planning within Angus Council and some partner organisations is a relatively new process and our main objectives should be to:

- Highlight the possible impacts of climate change throughout the Angus area.
- Assess the vulnerability of communities to climate impacts.
- Encourage council departments and partners to keep detailed information of severe weather events that have had an impact on their service.
- Raise the awareness of cost implications and encourage services to keep separate records relating to weather event impacts.
- Investigate the possibility of partners combining records to create a concise database of weather and climate impacts throughout Angus.
- Produce an Adaptation Strategy for Angus Council.

A national approach to dealing with the impacts of climate change:

- World leading Climate Change (Scotland) Act passed in 2009. Public bodies climate change duties require that a public body must: in exercising it's functions, act in the way best calculated to deliver the statutory climate change adaptation programme in the way that it considers most sustainable
- Scotland's Climate Change Adaptation Framework published in 2009
- UK Climate Change Risk Assessment published in January 2012
- Scottish Biodiversity Strategy: 2020 Challenge
- Getting the best from our land - A land use strategy for Scotland
- Scotland's statutory climate change adaptation programme due for publication in 2013 ((Scottish Government. 2013).

Case Study 1 - Climate extremes are 'unprecedented'

The Earth experienced unprecedented recorded climate extremes during the decade 2001-2010, according to the World Meteorological Organisation (WMO) Its report, The Global Climate 2001-2010, A Decade of Climate Extremes, analysed global and regional trends, as well as extreme events such as Hurricane Katrina, floods in Pakistan and droughts in the Amazon, Australia and East Africa. The warmest year ever recorded was 2010, with a temperature estimated at 0.54C above the 14.0C long-term average of 1961-1990 base period, followed closely by 2005. Results from WMO's survey showed that nearly 94% of reporting countries had their warmest decade in 2001-2010. No country reported a nationwide average decadal temperature cooler than the long term average. (BBC. 2013).

3.1 Climate change trends - Europe

The European Environment Agency (EEA) has warned in the report - Climate Change, Impacts and Vulnerabilities in Europe 2012 that the effects of climate change are already evident in Europe and the situation is set to get worse. Jacqueline McGlade, EEA Executive Director said: “Climate change is a reality around the world, and the extent and speed of change is becoming ever more evident. This means that every part of the economy, including households, needs to adapt as well as reduce emissions.” Compiled by more than 50 authors from a range of organisations, a number of "key messages" were listed, including:

- The last decade (2002–2011) included the warmest **temperatures** on record in Europe. Various model projections show that Europe could be 2.5–4° C warmer in the later part of the 21st Century, compared to the 1961–1990 average.
- **Heat waves** have increased in frequency and length**,** causing tens of thousands of deaths over the last decade. Heat waves could increase the number of related deaths over the next decades, unless societies adapt. However, cold-related deaths are projected to decrease.
- **Precipitation** is increasing in northern Europe. This trend is projected to continue. Climate change is projected to increase **river flooding**, particularly in northern Europe, as higher temperatures intensify the water cycle.
- **Sea levels** are rising, raising the risk of coastal flooding during storm events. Global average sea level has risen by 1.7mm a year in the 20th century, and by 3mm a year in recent decades.
- The **Arctic** is warming faster than other regions. Record low **sea ice** was observed in the Arctic in 2007, 2011 and 2012. Melting of the **Greenland ice sheet** has doubled since the 1990s. **Glaciers** in the Alps have lost approximately two thirds of their volume since 1850. (Climate Change, Impacts and Vulnerabilities in Europe 2012).

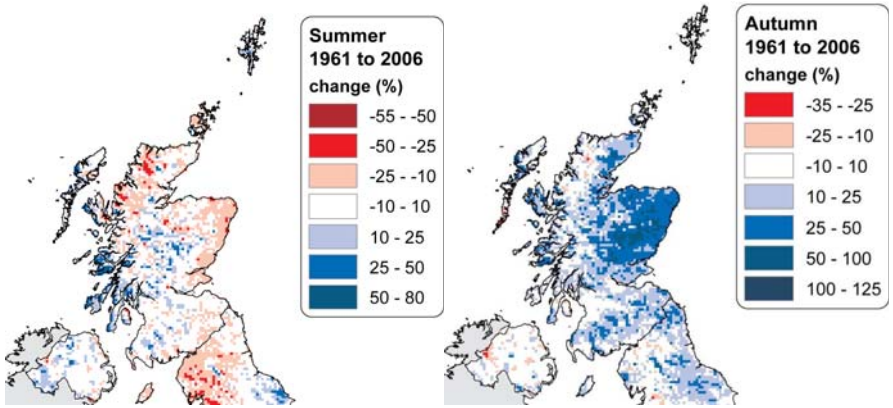

Figure 1. Recent rainfall measurements from the latter part of last century, during summer and Autumn show that Angus has experienced significant changes in rainfall patterns.(UKCIP. 2013).

- Climate change plays a part in many **human health effects** including the transmission of certain diseases. Warming may make parts of Europe more suitable for disease-carrying mosquitoes and ticks.
- While there may be less water available for **agriculture** in southern Europe, growing conditions may improve in other areas. The growing season for several crops in Europe has lengthened and this is projected to continue, alongside the expansion of warm-season crops into more northerly latitudes.

3.2 Climate Change trends- Ecosystem services & Biodiversity

The Terrestrial Biodiversity Climate Change Impacts Report Card 2012-13 provides an overview of how climate change is affecting UK biodiversity and highlights potential future changes. The project has been overseen by a working group of senior scientists, and both the card itself and the review papers that support it have been peer-reviewed. The Report Card shows where observed changes in UK biodiversity are likely to have been caused by changes in the UK climate over recent decades and assesses potential future impacts of climate change on biodiversity and ecosystems.

Why does this matter?

The Millennium Ecosystem Assessment report 2005 defines *Ecosystem services* as "**benefits people obtain from ecosystems"** and distinguishes four categories of ecosystem services. The following lists represent the definition and examples of each:

***Supporting services*:** ecosystem services "that are necessary for the production of all other ecosystem services"

- nutrient dispersal and cycling
- seed dispersal
- primary production

***Provisioning services*:** "products obtained from ecosystems"

- food (including seafood and game), crops, wild foods, and spices
- water
- minerals (including diatomite)
- pharmaceuticals, biochemicals, and industrial products
- energy (hydropower, biomass fuels)

Figure 2. The River South Esk catchment. River catchments are major providers of essential ecosystem services. © KAD

***Regulating services*:** "benefits obtained from the regulation of ecosystem processes"

- carbon sequestration and climate regulation
- waste decomposition and detoxification
- purification of water and air
- crop pollination
- pest and disease control

Cultural services: "non-material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences"

- cultural, intellectual and spiritual inspiration
- recreational experiences (including ecotourism)
- scientific discovery

CASE STUDY 2 - Britain's wheat crop 'down by third after extreme weather'

Britain's wheat crop could be below average for the second year in a row. Britain's wheat harvest this year (2013) could be almost 30% smaller than it was last year because of extreme weather, the National Farmers' Union has warned.

In a snapshot poll, it found a smaller area was planted last autumn because of the wet soil conditions. Most of the UK's wheat crop is harvested between July and September and last year's harvest had lower volumes and quality because of weather extremes, with months of drought followed by downpours and flooding. (BBC. 2013).

There is strong evidence that climate change is already affecting UK biodiversity. Impacts are expected to increase as the magnitude of climate change increases. It is expected that there will be regional differences in the impact of climate change on biodiversity, reflecting different species, climate, soils and patterns of land use and management.

- Climate change will interact with, and may exacerbate, the impact of other continuing pressures on biodiversity, such as land-use change and pollution.
- Extreme weather events, such as droughts and floods, have clear impacts on ecosystems and the ecosystem services they provide; climate change may alter the frequency and severity of such events.
- The protected area network, which includes Sites of Special Scientific Interest and National Nature Reserves, will continue to have a valuable role in conservation although there will be changes in populations, communities and ecosystems at individual sites.
- Some habitats are particularly vulnerable to climate change; the risks are clearest for montane habitats (to increased temperature), wetlands (to changes in water availability) and coastal habitats (to sea-level rise)
- Many species are occurring further north and at higher altitudes than in previous decades, including some species which have colonised large parts of the UK from continental Europe.
- Climate change exacerbates the risk that non-native species (including pests and pathogens) may establish and spread. (Terrestrial Biodiversity Climate Change Impacts Report Card 2012 -13).

"**Climate Change** is not just an environmental issue – the impacts are also felt by businesses, communities and individuals. Our climate affects people's health, our road and rail services, water supplies, energy demands, tourism – the list is almost endless".

Paul Wheelhouse Minister for Environment and Climate Change

4. Severe weather trends - Angus 2009/12

The geographical range of the LCLIP project is the Local Authority area of Angus Council. Angus covers an area of 2,200 square kilometers and has a population of 110,630 (2011 census). Angus has seven main towns - Arbroath, Brechin, Carnoustie, Forfar, Kirriemuir, Monifieth and Montrose. Most of the population lives within these towns and the coastal & Strathmore areas, with the remote glens to the north of the county having a very sparse population. Figure 3 shows the frequency of events in locations throughout Angus. Generally weather affects Angus as a whole and there are localised events occurring in settlements through the county.

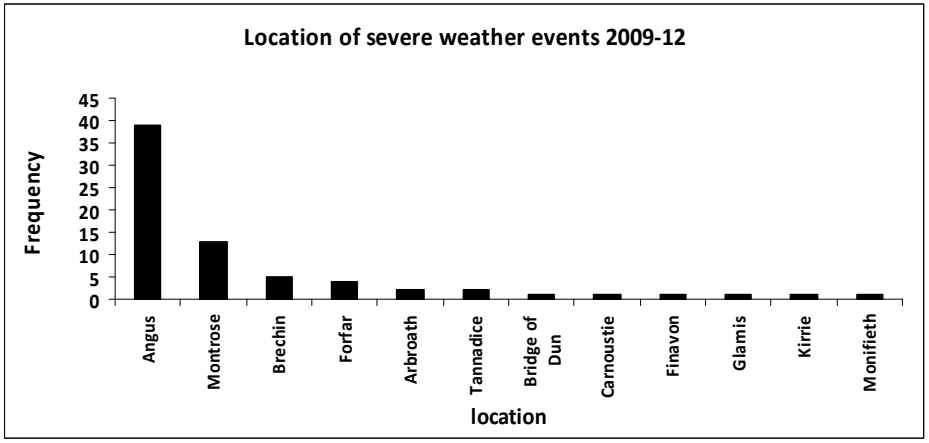

Figure 3. Many locations are affected by localised weather events but often a widespread weather event will affect all of Angus.

The data collected from the media trawl and anecdotally can also be summarised in a format, which at a glance, gives us an idea of what patterns underlie weather events, impacts and who is most at risk. The severe weather types that Angus most frequently experiences are generally high winds, heavy rain and heavy snow, all three weather types significantly affect infrastructure. Figure 4 also shows how other weather types such as lightning and even icicles can often have an affect on lifestyles and services.

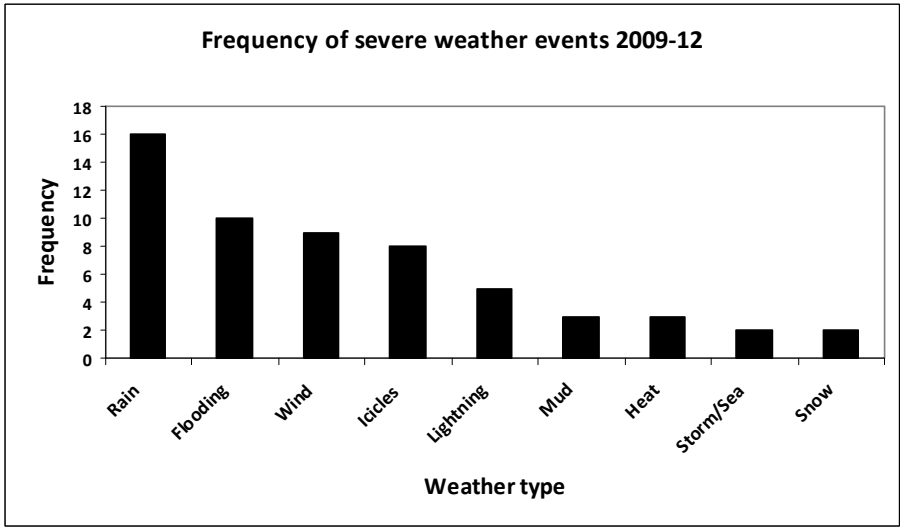

Figure 4. A large variation in extreme weather events leads to the disruption of services and lifestyle in Angus.

Changes in **temperature**, **precipitation** and **sea level** rise will affect all nations... resulting in both **new risks** and as acting as a '**risk multiplier**'. (UKCIP.2013).

5.1 Trends and comparisons – LCLIP 1 & 2

Although no formal comparisons are being made between the 2001-09 and 2009-12 LCLIP reports tables 1 to 3 below give an indication of the range of different effects felt during both time periods. Appendix 2 includes further weather event statistics.

From 2009 to 2012 Angus suffered some extremely cold winter temperatures and periods of intense rainfall over prolonged periods of time. Heavy rain is perhaps the most destructive and in recent years riverine and surface flooding has increased in frequency throughout the entire area.

Table 1: Records of the most frequent impacts experienced during both LCLIP time frames.

Frequency of impacts 2001-09	**No of**	**Frequency of impacts 2009-12**	**No of**
Disruption to services	**32**	Event cancellation	14
Changes in lifestyle	**13**	Damage to infrastructure	13
Damage to health	**8**	Disruption to services	11
Riverine flooding/ evacuation	**5**	Changes in lifestyle	8
Damage to buildings	**5**	Injury risk	5

KEY
Damage to infrastructure - roads, railways, communications networks etc
Disruptions to services - transport services, refuse collection etc
Changes in lifestyle – event cancellation, school closures etc
Damage to health – accidents, injuries, death
Riverine flooding/ evacuation – properties at risk of flooding
Damage to buildings – flood damage, roof damage etc
Event cancellation – cancellation of sporting and community events
Injury risk – Icicles, frozen paths

Two large rivers the North and South Esk, the River Isla and many tributaries meander through Angus. Historic catchment management and planning practices in the past mean that some areas are now more at threat from flooding than others. Surface flooding is also a major cause of problems as more frequent heavy rain fall does not allow the ground to dry out and many areas remain waterlogged, meaning that water is not absorbed into the water table as readily, causing flooding on roads, fields and residential areas. Table 1 highlights how increased summer rainfall has in recent years led to the cancellation of many of our summer activities such as highland games, mainly due to intense summer flooding.

Case study 3 – Rainfall

The frequency of extreme rainfall in the UK may be increasing, according to analysis by the Met Office. Statistics show that days of particularly heavy rainfall have become more common since 1960. The analysis is still preliminary, but the apparent trend mirrors increases in extreme rain seen in other parts of the world. It comes as the Met Office prepares to reveal whether 2012 was the wettest year on record in the UK. The study into extreme rain is based on statistics from the National Climate Information Centre, the UK's official climate record.

Scientists say that as the world has warmed by 0.7C, the atmosphere is able to hold 4% more moisture, which means more potential rain. The change in the UK trend is slight, but if the trend is confirmed it will clearly increase the risk of flooding. This year is already the wettest in England's recorded history. And a series of downpours in late November brought one of the wettest weeks in the last 50 years, causing major disruption. (Met OFFICE/BBC. 2013)

Table 2: Records of the most frequently affected services during both LCLIP time frames. ***Note that no data was available for Montrose Port from 2009 and that that all Angus Council's records were merged from 2009.**

Frequently affected services 2001-09	No of	Frequently affected services 2009-12	No of
Montrose port authority	21	Angus Council	27
Roads Division	21	Tayside police	14
Education services	14	SEPA	7
Tayside Fire & Rescue	11	Montrose football club	2
Tayside police	8	Montrose Highland games	2

Heavy rain and prolonged periods of snow has also had significant effect on local infrastructure see table 1 and 2. The damage to road surfaces and increased access issues has meant that Angus Council, Tayside Police and Scottish Environment Protection Agency in particular, have had a challenging three years. High winds cause damage to buildings, roads blocked by fallen trees and windblown forestry plantations. High seas have often led to the temporary closure of Montrose Port result due to no vessel movement, boat strandings and localised flooding.

Table 3: Severe weather warnings issued, broken down into year and weather type

Year	Snow	Rain	Ice	Wind	Total
2009	7	9	5	0	21
2010	11	6	20	0	37
2011	6	3	5	9	23
2012	4	22	6	3	35

Heavy snow leads to blocked roads, increased snow ploughing, transportation problems, delays in services such as waste collection and periodic school closures throughout the area. School closures in particular lead to many other changes to daily life as many parents are forced to remain at home looking after children creating a knock on affect for local employers.

Figure 5. Severe surface flooding in 2012. © D.C. Thomson & Co Ltd

5.2 How Significant are these events?

Each of the 80+ weather events recorded were given a significance indicator level i.e. low, medium or high impact, see figure 6. It is clear that medium level impacts occur most commonly. The 2001 to 2009 LCLIP also saw this trend - medium significance events increased steadily from 2005. The trend for Angus as a whole and could be further broken down for individual areas. **Low impacts** are mainly cancelled events, Slight property damage, some surface flooding and damage to vegetation. **Medium impacts** include school closures - December 2010 saw a total of 147 days school closures throughout Angus when the county experienced particularly prolonged, heavy snow fall, power failure, blocked roads and some surface flooding etc. **High Impacts** include serious riverine flooding, drought and unfortunately fatalities.

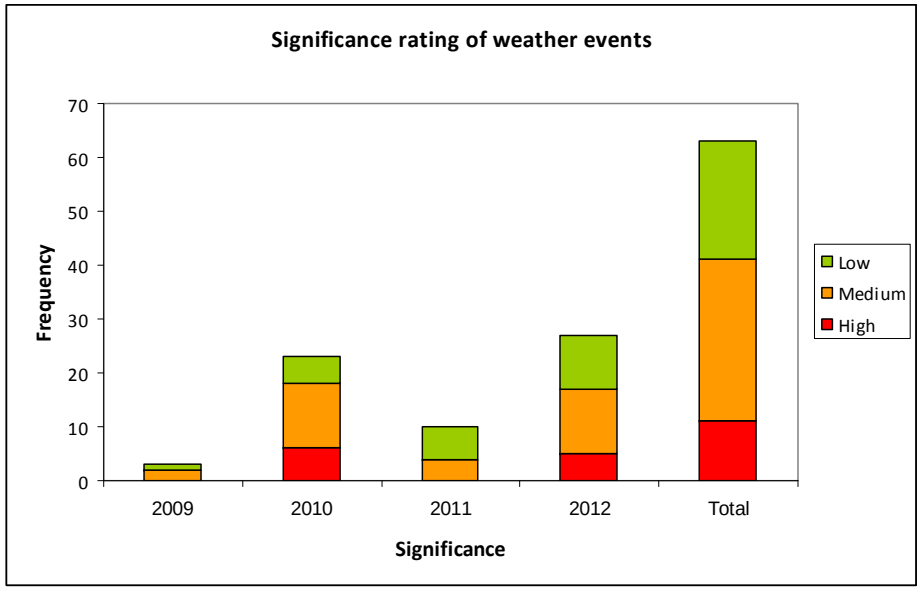

Figure 6. The significance of impacts varied annually however moderate impacts seem most common.

Infrastructure i.e. roads and structures throughout the area are affected most frequently by extreme weather events. School closures generally occur every year at a wide range of locations and result in children missing classes, parents having to take additional days off work and changes to transport systems on these days.

Based on all of the information collected including media trawl results it is apparent that from 2009 to 2012, event cancellation came out as the most frequent impact throughout the region. Although event cancellation is common, the significance level is generally only low. Infrastructure, particularly the roads of Angus and local education services are affected most frequently by extreme weather events. Many other Angus Council departments such as Property, Neighbourhood services and even the Rangers service are affected. Tayside Fire and Rescue and Tayside Police are involved in many wide ranging incidents throughout the study period, mainly of a reactive emergency nature. Service providers dealt with power failure, flooding and drought. At times more than one service can be involved in an incident with each carrying out its own specific role. Generally these events fall into the more significant medium and high impact categories.

6. LCLIP Partner survey results

LCLIP 1 2001-09

The LCLIP process aids in highlighting local vulnerabilities to extreme or changing weather and can be used to raise awareness of the consequences of weather that we might expect in our locality in the future. The 2001-09 LCLIP was a means of investigating how aware community planning partners were of climate change effects, adaptation and the monitoring the impact and cost of weather events.
The most significant findings to arise from the first LCLIP process were:

- Although it was straightforward in collecting data of the number of events, incidents and impacts and responses from the media trawl, collecting data on costs, responses and attitudes from departments and agencies proved more difficult.
- Organisational support for the data gathering process with high profile senior management support is critical.
- It proved difficult to contact appropriate personnel within some organisations which caused delays and in some cases information was never submitted and interviews never carried out due to lack of knowledge or recording systems within certain organisations.
- Most weather events, impacts and costs were not recorded by organisations in any consistent manner.

Throughout the process it proved extremely difficult to obtain details of the financial costs to Angus Council and its partners, on an annual basis and over the entire study period. This figure will possibly have run into millions of pounds. Kent County Council's LCLIP gives a figure of in excess of £440m for the Kent community and £25m to the council alone. These figures were obtained from detailed records that council departments kept. In 2009 Angus Council committee reports were the only means of collating any definite costing for extreme weather events. In 2012 the same questionnaire process was carried out. Were results any different from in 2009?

LCLIP 2 2009-12

The LCLIP 2 was carried out in the same manner as the first and the results were also analised in the same way. The following section makes some simple comparisons of both surveys and highlights some obvious behavioral changes.

i) Increased proficiency of the internet

One of the first important observations made after carrying out the second LCLIP media trawl was the increase of press articles found on the internet. The first

LCLIP published in 2009 and looked at press releases between 2001 and 2009. A total of 100 weather incidents were logged. The second LCLIP looked at the period from November 2010 to July 2011 and logged a total of 88 weather incidents. This is comparatively a 163% per annum increase. Although a shorter study period, increased use of the internet to report news of weather has made searching for events by type and locality a much easier task. This trend was evident in the first LCLIP as in the later years of the study period the frequency of reports was much higher than at the beginning e.g. 2001.

ii) Increased Use of social media

Angus Council as an example didn't use social media in early 2009 but by 2012 was proficient in its use. Facebook and Twitter were first used in Sept 2011 and have sent out 1,446 tweets by late 2012. At this time there were 1489 followers on Twitter and 562 page "likes" on Facebook. The council's reach will actually be higher than this, as these statistics do not take account of retweets and Facebook shares. Overall, they are effectively building an audience through social media and are always looking for ways to increase this.

As far as severe weather in winter is concerned, Angus Council used social media as their main vehicle for communicating with the public during winter and publicised this widely. Twitter in particular is the best way of getting information out quickly to residents. Twitter has been used to post 'real time' information on road conditions, school closures etc during the winter. Internally within the council, arrangements are in place so that teams are kept in the loop during severe weather by colleagues in roads, education etc, and information from them is used to inform the public through social media. There are also joint arrangements in place at a Tayside level, whereby agencies such as the police and fire also share items e.g. severe weather warnings.

iii) Adaptation planning and record keeping

As in the first LCLIP a parent survey was circulated to gather critical information. Responders included Angus Councils Roads, Civil contingencies, Fleet services, Rangers service, Education and Finance departments. Scottish Natural Heritage, Tayside Fire & Rescue and Tayside Biodiversity Partnership.

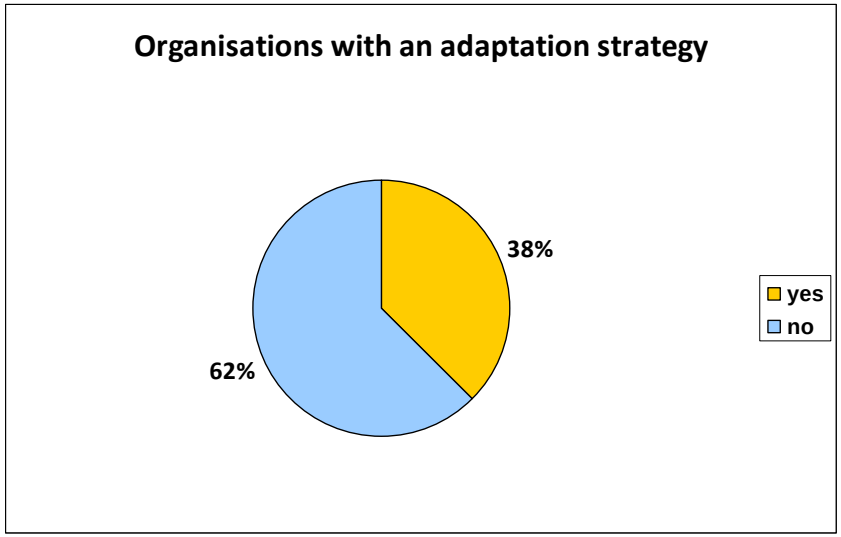

Figure 7. The significance of impacts varied annually however moderate impacts seem most common.

The main findings have been analysed and there are mixed results identifying areas of increased adaptation awareness and areas for improvement such as record keeping. Comparison between LCLIP 1 and LCLIP 2 can be made and can help direct future adaptation awareness raising and planning. In 2009 LCLIP 2

highlighted that none of the participants had an adaptation strategy. In 2012 it was clear that adaptation had begun to feature in many more organisations strategic planning see Figure 7. In 2013 the Scottish Government's consultation document - Climate Ready Scotland: Draft Scottish Climate Change Adaptation Programme was issued to all local authorities. It was noted that it was likely that the proposed Adaptation Programme would have implications for various services within Angus Council. The programme has three main themes: Natural Environment, Buildings and Infrastructure Networks & Society. This finished programme will strongly influence Angus Council and other agencies adaptation strategies.

The occurrence of keeping records of weather events, their impacts and the financial implications has improved slightly since 2009, now 64% of responders collect data, in 2009 only 38% did and 13% were unsure, the remaining 49% did not. However this could be improved and there will possibly be a further need if adaptation planning and reporting is integrated into more services. This process is already underway within the council through corporate carbon and climate change plans; the latter has introduced adaptation objectives that can be used as a basis, see appendix 3.

iv) Monitoring financial costs

Recording the frequency and impact of severe weather events lets an organisation understand the actual and perceived threats to their service and also, if implemented correctly, facilitates an understanding of the financial costs that can be incurred. In 2009 LCLIP 1 showed that people's perceptions of the impacts focused mainly on the physical implications of weather events, such as structural damage to buildings (38%), travel disruption (37%) and damage to infrastructure (25%).

Although a physical impact will obviously have a financial implication during LCLIP 1 it was found that these were near impossible to quantify considering the scale of the impacts faced throughout the region. Survey participants were much more aware of the financial implications in LCLIP 2. This is reflected in responses which highlight loss of productivity (50%), deployment of emergency services (33%) and loss of income (17%) as most apparent.

From the survey the only financial impacts provided were:

1. Loss of revenue and time spent on windblow – approximately £5,000 (Angus Council Ranger service).
2. Nov 2010 to Jan 2011 - severe snow and ice in Angus caused structural damage to council properties Financial payment of insurance claims QLAS claims database = 298 claims Cost £223,000 (Angus Council property services). 23 May 2011 - high winds Angus - £15, 000 (Angus Council property services).

There has been no amalgamation of costing in departments or throughout the entire council. It has been recognised during the interview process that to pull together this information would stretch resources. Hopefully in the future, we will have concise records of the true cost of extreme weather events so that appropriate adaptation can be instigated.

V) Main Observations and comments from participants

Since 2009 the summers have been particularly wet, with 2012 being the wettest April, May & June on record. From memory I think September 2009 was the wettest on record also. The winters of 2010/11 had a lot of snow fall, more typical with winters in the 1980's but 2012 was very mild in comparison.
Since 2009 there have been many severe to gale force winds that have had an impact on woodlands in particular (Angus Council Rangers Service.2012).

"The weather can be predicted to an extent but there is always the chance that something might be missed or that a small area (a micro climate) is created that has a negative impact on an area. Tayside Fire and Rescue can react to any event and conduct rescues and attempt to mitigate the effects of climate change, the true course of action is to be as prepared as you can be and to ensure that people and property are safe" (Tayside Fire & Rescue. 2012).

"We have procedures in place which enable us to react to situations as necessary including tree removal; flooding emergency response; flood clean up and preventative measures; application of winter services/ increased activity for snow clearance" (Angus Council Roads Division. 2012).

"Climate change will be taken into consideration in the Tayside LBAP Review 2013, in particular the increase of tropical/foreign diseases in trees, the affect of bad weather on breeding populations (birds, butterflies, bumblebees, etc). Long-term surveys of specific species will help note changes and advise of potential future management" (Tayside Biodiversity Partnership. 2012).

"There has been many more 'Severe Weather warnings' issued since 2009. The wet summers have resulted in poorer than expected uptake on our outdoor activity programmes. This has resulted in a fall in revenue" (Angus Council Rangers Service.2012).

Figure 8. The significant snow falls since late 2009 impacted heavily on infrastructure in Angus. © D.C. Thomson & Co Ltd

7. Concluding remarks and the way forward

Since the 2009 LCLIP's recommendations that Angus Council and community partners should consider carrying out their own LCLIP's and develop adaptation strategies there has been a lot of progress strategically. These developments will hopefully strengthen the adaptation response throughout the whole Angus area.

The main purpose of the LCLIP process is to encourage partners to monitor and record the affects of severe weather events on their service. Events occur throughout the year, perhaps not reaching the emergency scale contained in this register, but happening none the less. It is still very difficult to find the true cost to Angus Council and partners without a financial recording system in place. This record would be valuable and could be used in future mitigation measures. It is vital that work is ongoing to develop record keeping and encourage partnership projects that aid in climate change adaptation.

Previous recommendations from the 2009 initial LCLIP included:

- Highlight the possible impacts of climate change through out the Angus area.
- Assess the vulnerability of communities to climate impacts.
- Encourage council departments and partners to keep detailed information of severe weather events that have had an impact on their service.
- Raise the awareness of cost implications and encourage services to keep separate records relating to weather event impacts.
- Produce an Adaptation Strategy for Angus Council.

Many of these objectives have been in part progressed. There are other actions we could take as the national understanding of climate change adaptation has evolved and there is a much wider support network for organisations.

- Angus Council have a corporate climate change strategy which includes adaptation targets. The council's climate change working group would benefit from widening its membership and developing its remit.

- Continue to work alongside community planning thematic groups such as the Angus Rural and Environment Partnership and regional planning bodies such as TAYplan.

- Angus and Tayside partners could look to forming a partnership similar to the The North East Scotland Climate Change Partnership. There are 17 members' organisations and all the members have agreed the remit for the group and have signed a Climate Change Declaration.

- The findings of the LCLIP 2 will be shared with Council Services and will be made publicly available on Angus Councils website.

- The full LCLIP database will be shared with "Adaptation Scotland" so that it can be added to their national database online and made available to the public and other agencies.

8. Further reading and advice

For further information on climate change adaptation please see:

- **The Scottish Government**
- The Scottish Government recognises that climate change will have far reaching effects on Scotland's economy, its people and its environment and is determined to play its part in rising to this challenge.
  For information on legislation, targets for renewable energy, opportunities for Scottish industry.

- **Climate Change (Scotland) Act 2009**
- The full text of the Act is available on the Office of Public Sector Information website, along with explanatory notes which help place the effect of the Act in context.

- **Scotland's Climate Change Adaptation Framework**
- Scotland's Climate Change Adaptation Framework was published on December 8, 2009. It will play a vital role in building Scotland's resilience to the changing climate.

- **Adaptation Scotland**
- The Scottish Climate Change Impacts Partnership (SCCIP) is an initiative that brings together stakeholders in Scotland to collectively address and prepare for the impacts of climate change.

- **Learning and Teaching Scotland**
- Learning and Teaching Scotland have produced a very useful website covering climate change, with links to many more organisations and sources of information.
- **Intergovernmental Panel on Climate Change**
  The IPCC assesses the scientific, technical and socio-economic information relevant for the understanding of the risk of human-induced climate change.

- **United Nations World Meteorological Organization (WMO)**
  World Meteorological Organization coordinates global scientific activity in several areas, including: air pollution research, climate change and ozone depletion studies.

- **United Nations Framework Convention on Climate Change**
  Includes methodologies and tools to evaluate strategies for adaptation to climate change.

- **World Wildlife Fund: Climate**
  Mission: "By 2001 we aim to ensure that industrialized nations set in motion a permanent downward trend in their domestic emissions of carbon dioxide (CO2) - the leading global warming gas - as a first step towards substantial reductions in emissions by 2010.

- **BBC News: Global Climate Change**
  News site exploring the issues, impact, and politics behind global warming.
- **NERC**
  NERC is the leading body in the UK for research, survey, monitoring and training in the environmental sciences.
- **Centre for Ecology and Hydrology**
  The Centre for Ecology and Hydrology is an environmental research organization undertaking high quality, internationally recognized research.

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Acknowledgements
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Appendix 1

Angus Council Local Climate Impacts Profile (LCLIP)

Questionnaire 2012

A Local Climate Impacts Profile (LCLIP) is a resource that Local Authorities can compile so that they better understand their exposure to weather and climate. It is based on evidence of a locality's vulnerability to severe weather events and in particular how these events affected a local community as well as the authority's assets and capacity to deliver services.

By completing this questionnaire, you are contributing valuable information to the main body of the report and towards future planning efforts which will help Angus Council assist the Angus community in responding to unpredictable weather scenarios. Things to note can be:

……lightning strikes, school closures, flooding, road accidents, road closures, power cuts black ice – gritting, fire, wind, drought, algal blooms, boat strandings, crop failure, drownings, drifting top soil and erosion, fallen trees.

Please complete the questions below as fully as possible.

1. **How long have you been with your organisation and in which roles?**

Name & organisation:

Contact no:

email:

Please feel free to answer the next four questions in the table provided below. This can edited, making it easier to add more events etc.

2. **What data do you collect on weather related events in Angus?**

3. **Are there any particular severe weather events in Angus that you recall since 2009**

4. **How did this impact on your organisations services?**

5. **How did your organisation respond to this event?**

DATE	WEATHER TYPE	LOCATION	IMPACTS	RESPONSE	IMPACTS FOR ORGANISATION	SOURCE
e.g. 22.11.02	***Heavy rain/flooding***	***Angus***	***Severe flooding of areas surrounding major rivers***	***SEPA issued a severe flood warning for 3 rivers in the Angus area,***	***?***	***News.scotsman.com 03.07.10***

6. **Does your organization have a record of the financial or physical costs of severe weather events**

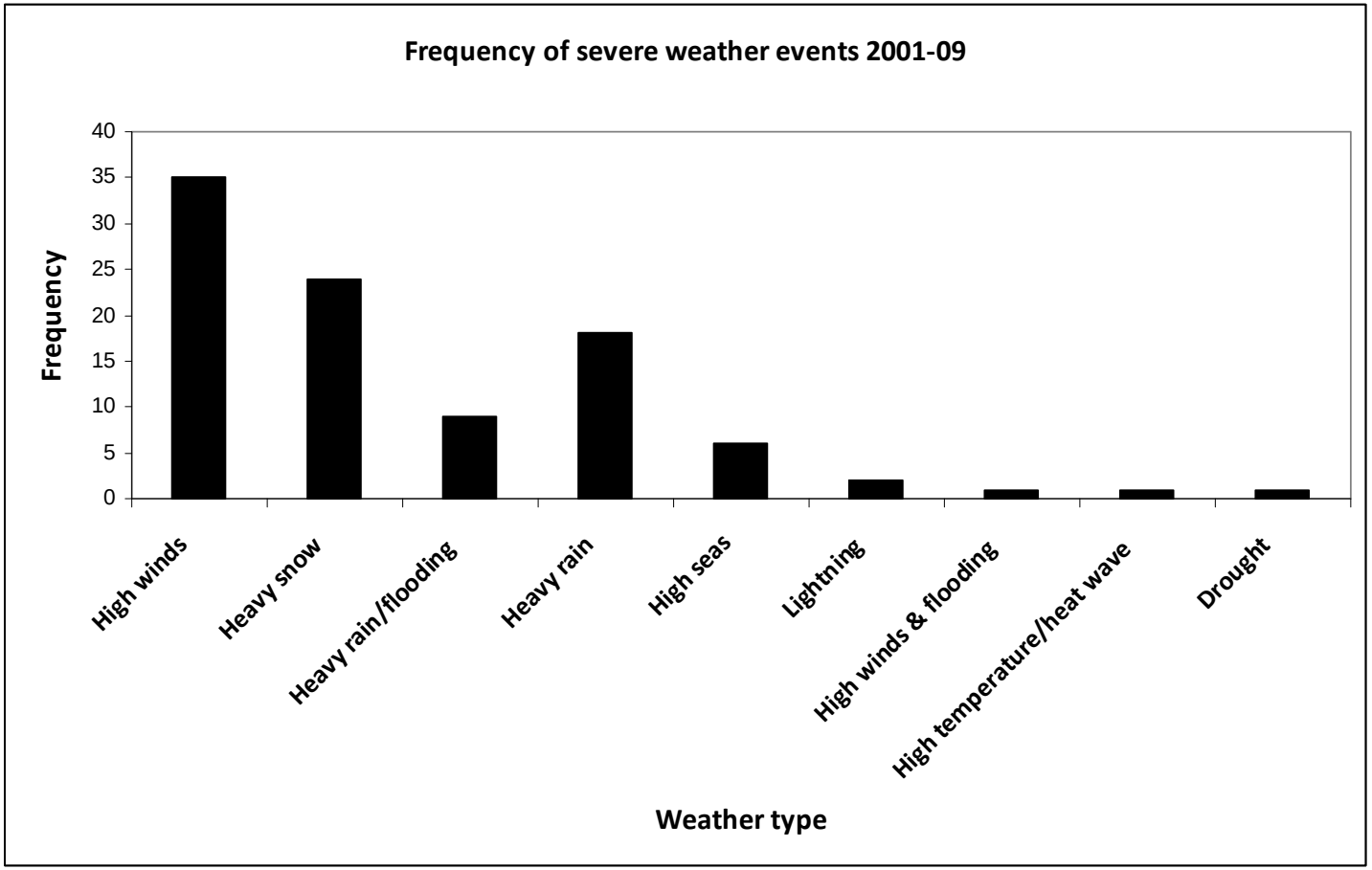
7. **What measures are being taken within your service to respond to weather events and climate change?**

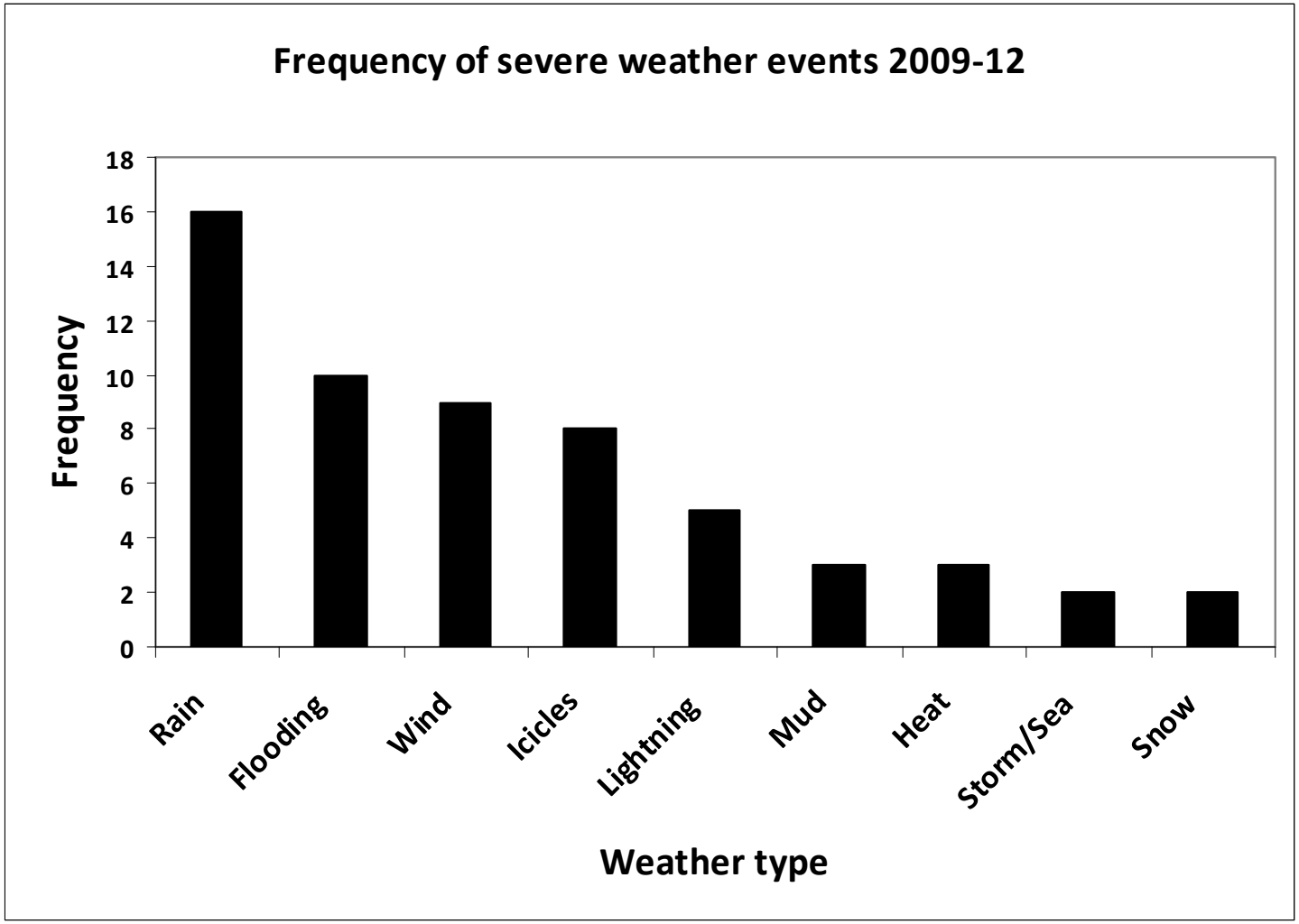
8. **Has, or do you think that your service should, develop an adaptation/mitigation strategy? What do you think it should cover?**

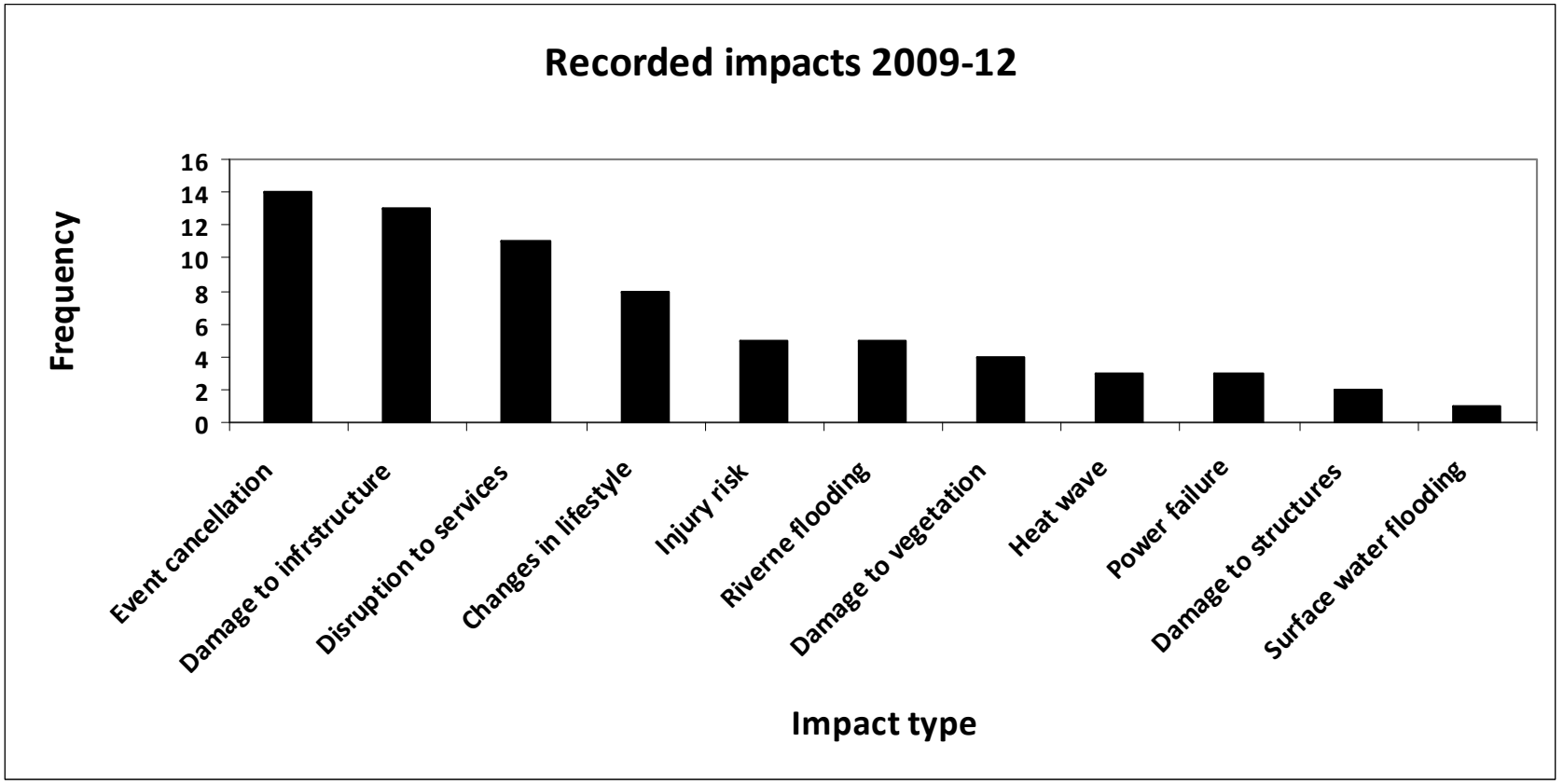
9. **What is your perspective on climate change?**

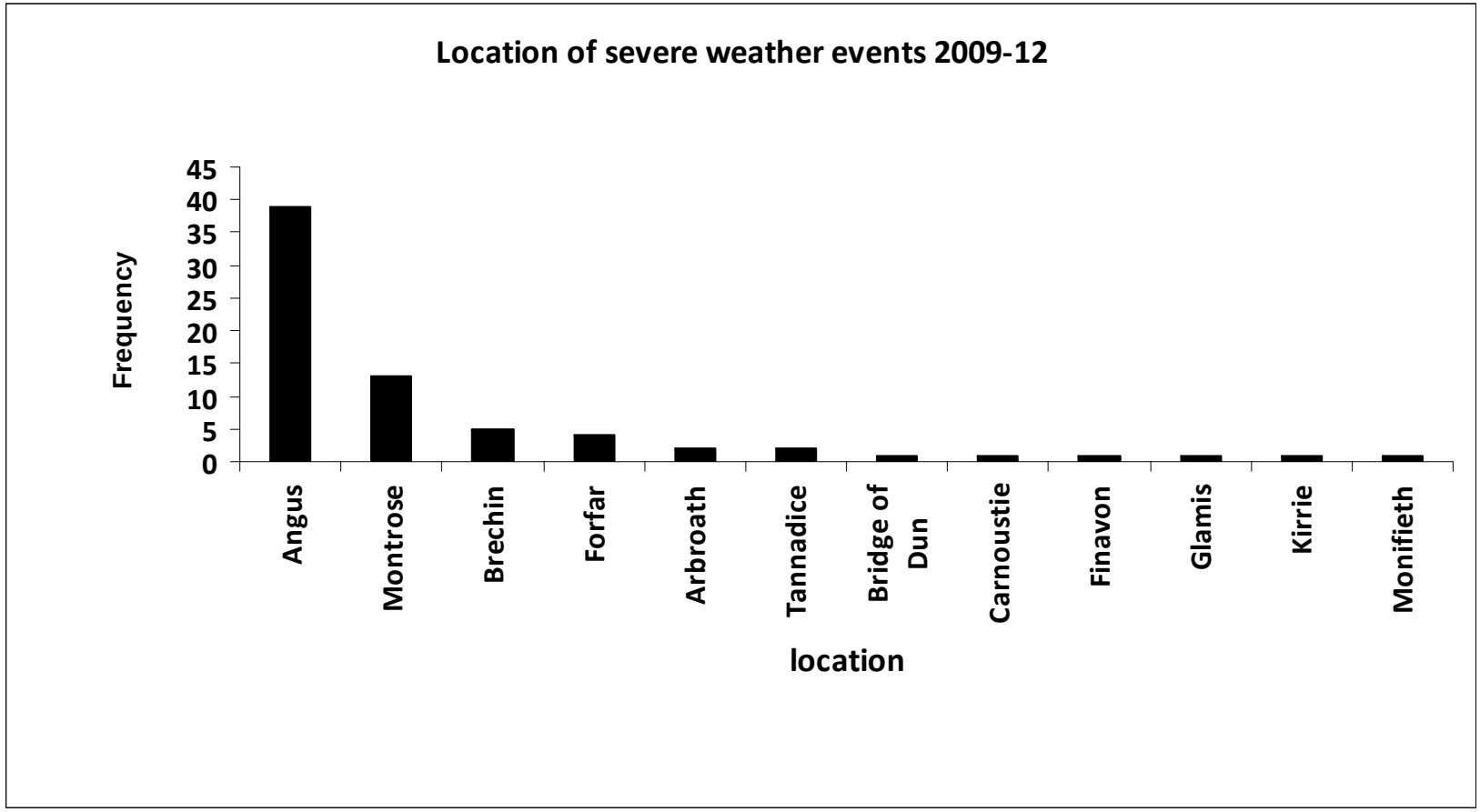
Thank you

Appendix 2
The range of different severe weather impacts during LCLIP 1 & 2




Frequency of severe weather events 2009-12
Frequency
18
16
14
12
10
8
6
4
2
0
Rain
Flooding
Wind
Icicles
Lightning
Mud
Heat
Storm/Sea
Snow
Weather type


Recorded impacts 2009-12
Frequency
16
14
12
10
8
6
4
2
0
Event cancellation
Damage to infrstructure
Disruption to services
Changes in lifestyle
Injury risk
Riverne flooding
Damage to vegetation
Heat wave
Power failure
Damage to structures
Surface water flooding
Impact type


Location of severe weather events 2009-12
Frequency
45
40
35
30
25
20
15
10
5
0
Angus
Montrose
Brechin
Forfar
Arbroath
Tannadice
Bridge of Dun
Carnoustie
Finavon
Glamis
Kirrie
Monifieth
location

Appendix 3
Climate Change Strategy & Action Plan Angus Council 2012-2016 - Adaptation Action Plan

Ref No	Action	Lead Dept/Service	Timeline	Progress
Adaptation **Main Objective:** *To prepare, plan and adapt to the changing weather patterns in Angus in an effort to reduce and manage those impacts, especially on those most vulnerable in our community.*				
A.1	To embed climate change into corporate plans, improvement plans, action plans, and service plans and to measure and record the outcome of these plans.	Chief Executive's	2012/13	Embedded in Community Plan and SOA, corporate plan and some service improvement plans.
A.2	To incorporate climate change impacts within Committee reports.	Chief Executive's	2012/13	This has not been actioned but will be considered in the review of Standing Orders and the scheme of delegation to officers planned for summer 2013 in the light of new council management structures and reporting officer requirements.
A.3	To influence the culture of the organisation in relation to training and awareness raising of climate change issues and how all services can contribute to climate change adaptation.	Climate Change Strategy Working Group	Ongoing	E-learning module for staff training on sustainable development & climate change issues in development.
A.4	To develop skills and capacity building across the Council, investment is required in skills, e.g. how do we measure greenhouse gas emissions? How do we reduce carbon? How do we monitor trends?	Climate Change Strategy Working Group	Ongoing	Methods of measuring climate change reduction efforts are still to be developed for some areas. Maintain a watching brief for emerging methodologies
A.5	More effective community engagement in relation to climate change mitigation and adaptation in Angus.	Climate Change Strategy Working Group/Community Planning Partners	Ongoing	• Tactran launched "Travelknowhow", a web-based toolkit to support public and private sector employers to develop and implement travel plans. • Four employers are registered with "Travelknowhow" - Angus Council, Angus College, Dundee and Angus Chamber of Commerce, and Arbroath Infirmary. Further contacts are being made to encourage other employers to register.
A.6	Increase the use of SUDS in new developments.	Infrastructure Services	Ongoing	Investigation of and the use of SUDS (where appropriate) is now a requirement for every development.
A.7	Effective adaptation and mitigation measures which set integrated objectives	Neighbourhood Services	Ongoing	• Funding form the Angus Environment Trust has enabled works to be carried out at Elliot SSSI to reduce invasive species and protect the natural habitat

Ref No	Action	Lead Dept/Service	Timeline	Progress
	to establish resilient ecosystems for people and wildlife.	Ranger Service Ranger Service & Tree Officer Ranger Service Ranger Service/SNH/TVF Ranger Service Ranger Service Ranger Service	Ongoing Completed Annually Annually Ongoing Ongoing Ongoing	through the use of boardwalks, paths and interpretative signage. • Downie Moor Woods, Nr Crombie Woodland Improvement – create semi natural native woodland. • Angus Community Orchard Project – 1000's of native fruit trees planted around Angus. • Grass Cutting Regimes (Country Parks) – improve wildflower diversity. • Salmon in the Classroom Project – increase salmon populations. • Forfar Loch Country Park Garden Project – create pond & marshland habitats. • Monikie Country Park Meadow Project – wildflower meadow, small woodland. • Crombie Country Park, Peddieston West Heathland Restoration - Removing scrub/non native species.
A.8	Angus Council will fully engage with Scottish Environment Protection Agency (SEPA) in the setting of actions to be included within flood risk management plans.	Infrastructure Services	2012	Local Flood Risk Management Strategies being developed.
A.9	Angus Council will participate fully in the establishment of advisory groups under the Flood Risk Management (Scotland) Act 2009 and subsequent decisions made.	Infrastructure Services	2012 onwards	Local advisory group, local district partnerships and sub-groups established.
A.10	Angus Council will prepare a schedule of clearance and repair works.	Infrastructure Services	2012 onwards	Schedule prepared.
A.11	Angus Council will prepare maps of water bodies and Sustainable Urban Drainage Systems (SUDS).	Infrastructure Services	2012	Mapping exercise under development.
A.12	Angus Council will work with the local advisory group to develop Flood Risk Management Plans.	Infrastructure Services	2012	Local advisory group, local district partnerships and sub-groups established.
A.13	Angus Council will work with the local advisory group to develop and publish Flood Risk Management Plans.	Infrastructure Services	December 2015 onwards	
A.14	Angus Council will work with the local advisory group to develop and publish implementation parts of Flood Risk Management Plans.	Infrastructure Services	June 2016	
A.15	Angus Council will begin implementing the measures in Local Flood Risk Management Plans.	Infrastructure Services	June 2016	

Ref No	Action	Lead Dept/Service	Timeline	Progress
A.16	Provide policy and technical advice on the provision and management of paths and infrastructure in response to climate change or changing patterns of recreation resulting from climate change.	Planning & Transport	Ongoing	Ongoing.
A.17	Adaptation measures to ensure the movement of species through the Angus landscape and fresh waters in response to climate change is supported.	Planning & Transport	Ongoing	Ongoing projects carried out by the River South Esk Catchment Partnership, Tayside Biodiversity Partnership and Tay Estuary Forum.
A.18	Promote action to support biodiversity adaptation such as habitat networks, and to promote adaptation measures that work with natural processes.	Planning & Transport Neighbourhood Services	Ongoing	Ongoing projects carried out by the River South Esk Catchment Partnership, Tayside Biodiversity Partnership and Tay Estuary Forum.
A.19	Promote adaptation and mitigation measures that enhance the sustainability of the use of natural resources.	Planning & Transport Economic Development	Ongoing	Working towards achieving the Silver Timber Pledge Award (see P.5 above)
A.20	Ensure those areas most vulnerable to rising sea level and/or storm surge and wave overtopping are identified to improve understanding, management and policy	Infrastructure Services	Ongoing	Shoreline Management Plan 2 - consultation commenced.

Appendix 4
Glossary

Adaptation - in the climate change context, adaptation implies an adjustment in natural or human systems in response to a changing/changed climate.

Anthropogenic climate change - climate change with the presumption of human influence, usually warming.

Arctic shrinkage - the marked decrease in Arctic sea ice and the observed melting of the Greenland Ice Sheet in recent years. **Climate** - the average and variations of weather in a region over long periods of time.

Climate change - changes of climate in general, usually with no presumption of human influence. Note, however, that there is one important exception to this: the UNFCCC defines "climate change" as anthropogenic

Contingency planning - A plan devised for a specific situation when things could go wrong. Contingency plans are often devised by those who want to be prepared for any eventuality.

Extreme weather events - Extreme weather describes weather phenomena that are at the extremes of the historical distribution, especially severe or unseasonal weather.

Global warming - usually: the warming trend over the past century or so; also: any period in which the temperature of the Earth's atmosphere increases; also the theory of such changes.

Infrastructure - the basic physical and organizational structures and facilities (e.g. buildings, roads, power supplies) needed for the operation of a society or enterprise:

Invasive Species - introduced species that adversely affect the habitats and bioregions they invade economically, environmentally, and/or ecologically.

Meteorology - the interdisciplinary scientific study of the atmosphere that focuses on weather processes and forecasting.

Mitigation - Reducing greenhouse gas emissions in order to slow or stop global climate change. For further information, see the Mitigation page.

Regions/Regional - The term used to refer to the administrative regions of England and the devolved administrations of Northern Ireland, Scotland and Wales.

Risk assessment - The structured analysis of hazards and impacts to provide information for decision making. Risk assessment usually relates to a particular system which may be individual, population, infrastructure, building or environmental asset etc. The process usually involves identifying hazards that could have an impact, assessing the likelihoods and severities of impacts, and assessing the significance of the risk. This is usually related to the probability multiplied by the severity of the impact.

Weather - Weather refers to the state of the atmosphere with regard to temperature, cloudiness, rainfall, wind, and other meteorological conditions.

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