



From mountain to sea

Aberdeenshire
COUNCIL



Local Climate Impact Profile (LCLIP)

May 2019



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Executive Summary

Aberdeenshire Council services are broadly affected by extreme and unusual weather occurrences. Understanding these impacts and taking appropriate adaptation measures will put Aberdeenshire in a better position to manage the consequences of climate change and ensure the region continues to thrive - socially, culturally, environmentally and economically.

Weather can cause damage and destruction to infrastructure, for example the transport network (roads, bridges, railways), buildings (residential, community, commercial, historic) and utilities (electricity, gas, telecommunications, water). This poses the threat of substantial direct costs of repair and restoration, as well as indirect costs, which might include productivity losses from employees unable to travel to work, school closures, strained health and social care delivery, environmental pollution, losses to businesses (customers, stock, premises), communications failure, and strained emergency response.

The purpose of this report is to portray the ways that Aberdeenshire Council's services are affected by weather events through drawing together evidence from interviews, media articles and internal documents. The report follows the framework of the United Kingdom Climate Impacts Programme (UKCIP) Local Climate Impact Profile (LCLIP). Evidence from 2011 to 2018 was gathered to follow on from Aberdeenshire Council's previous LCLIP (2000-2010).

Between 2011 and 2018 there were eighteen incidents of excessive rainfall documented in the media, impacts included surface water flooding, towns flooding, building damage, environmental health issues, road and school closures. There were eleven storm incidents with impacts including building damage, debris on roads, power failure, travel network disruption and school closures. Seventeen periods of snow/ice had notable impacts including round-the-clock gritting, transport network disruption and power failure. Heatwave/warm spell entered the media on sixteen occasions, with consequences including water shortage, heat-induced fog, increased air pollution, wildfires, road damage and health warnings.

In this report, figures are detailed where available but for many services additional costs from weather events have been absorbed by budgets and routine service delivery, so isolating them was not easily achieved. This was not the case during Storm Frank (2015/16), when financial assistance was required from the Scottish Government through the Bellwin Scheme. These funds are released on receipt of a full breakdown of costs associated with the emergency.

There is boundless potential for documenting every impact that weather has across areas, communities, operations and services. The scope of this report is broad in that each core Council Service and some key impacts are listed, with added perspectives from the emergency services and external bodies. These sections are not exhaustive but aim to provide an overview and a basis for Services to further investigate risks and opportunities related to specific assets/operations.

Services across the Council display an awareness of the financial, operational and social costs associated with severe weather and recognise a need to be forward-thinking when it comes to lessening the worst impacts of climate change and capitalising on the opportunities.

Such includes cross-service contingency planning for severe weather scenarios, engaging communities in community resilience actions, upgrading infrastructure to be more resilient to changing weather conditions, and exploring new technologies that improve monitoring the condition of essential infrastructure.

However, Aberdeenshire Council does not have full responsibility of building regional resilience to climate change. The responsibility also lies with other public bodies, businesses, communities and individuals.

The main recommendation is that Aberdeenshire Council develop a Climate Change Adaptation Strategy that outlines how it can build capacity to manage the opportunities and threats associated with a changing climate.

Many adaptation actions will require more data to understand the financial cost and benefit of implementing measures. It is recommended that a recording system is established that allows weather-related expenditure to be identifiable across Services, therefore tracked over time, monitored for trends and used to highlight the cost-saving benefit of adaptation options.

It is also recommended that Aberdeenshire Council's Climate Change Risk Register is updated to reflect the evidence presented by this LCLIP as well as the latest United Kingdom Climate Projections 2018 (UKCP18).

This will help shift the focus towards proactive spending to prepare for weather events and embed climate risk into decision-making.

The extent that extreme weather affects the region is largely influenced by the impact on infrastructure. It is recommended that research and development of climate-resilient infrastructure is expanded, to ensure critical services are better protected and the potential damage and disruption to the region caused by severe weather (e.g. flooding) is lessened.

Finally, it is recommended that community resilience continues to be recognised as an essential component of building the region's resilience to climate change. It should be considered how a community's capacity to adapt interlinks with social, economic and environmental factors, in addition to physical infrastructure and emergency planning.



Aerial of River Dee near Braemar

1. Introduction

Extreme local weather events are perhaps the best examples of the consequences we might experience of a changing climate. These changes bring both threats, for example water shortages caused by drought, or building damage caused by flooding, and opportunities such as investing in resilient infrastructure and increased tourism.

If Aberdeenshire Council is to withstand the threats and realise the opportunities associated with climate change, it is vital to first understand the consequences of extreme weather for our region and investigate the necessary adaptations.

1.1. What is an LCLIP?

The Local Climate Impact Profile (LCLIP) tool was developed by the UK Climate Impacts Programme (UKCIP) to assist local authorities and organisations assess their exposure and vulnerability to past weather events, as a step towards preparing for future climate risk. The LCLIP framework was initially developed to be used by the local government community but has since been popular with an audience beyond due to its relative simplicity and ease of use^{1,2}.

Aberdeenshire Council put together an LCLIP in 2011, based on weather impacts occurring between 2000 and 2010³. This report is an update to this LCLIP, detailing how extreme weather has affected services, people and infrastructure across the region between 2011 and 2018 using data from a media trawl and interviews with key staff.

The LCLIP is primarily a communication tool to raise awareness of vulnerability and resilience across Aberdeenshire Council.

The project has been led by the Sustainability and Climate Change Team, situated within Economic Development, Infrastructure Services.

1.2. Why carry out an LCLIP?

Under the Climate Change (Scotland) Act 2009⁴, Section 44 of the Act places duties on public bodies relating to climate change which requires them to: contribute to carbon emissions reduction targets; contribute to climate change adaptation; and to act sustainably.

Aberdeenshire Council's Environmental and Climate Change Policy⁵ sets out ways in which the council will fulfil its commitment to sustainable development and safeguarding the environment, as well as meeting the duties laid out in the act.

There are several other policy drivers for building resilience to consequences of climate change, including The Civil Contingencies Act (2004)⁶, National Planning Framework 3 (2014)⁷, and Aberdeenshire Council's Local Development Plan (2017)⁸.

It is widely accepted that climate change is being experienced across Scotland (see 7.1). Many of the services provided by Aberdeenshire Council and their partners will be affected by climate change.

Through studying the impacts of extreme weather in the past, the LCLIP can help to identify and manage risks, bring forward policy responses and embed these into appropriate plans, policies and service delivery. It will help shift focus towards preparation and adaptation to the weather conditions likely to accompany climate change.

The LCLIP provides a starting point for developing Aberdeenshire Council's Adaptation Strategy and updating the Climate Change Risk Register.

1.3. Aberdeenshire Context

Aberdeenshire Council is a local authority in the North East of Scotland, with 15,847 employees (10,196.2 full time equivalent), as of September 2018⁹, working across hundreds of locations, including schools, offices, parks and harbours.

Aberdeenshire is a rural area that extends to 6,313 sq. km, representing 8% of Scotland's overall territory. The landscape extends from the mountainous Cairngorms National Park through agricultural lowlands to a long coastline. The population of Aberdeenshire is 261,800 (as of 2017)¹⁰.

Aberdeenshire's economy is closely linked to Aberdeen City and the energy industry, and also comprises agriculture, fishing, forestry and tourism. These industries are reliant on supporting infrastructure. Aberdeenshire has 10% of Scotland's road network (5,712 km/3549 miles)¹¹ and over 1,800 bridges¹².

The diverse and rich built heritage of Aberdeenshire is reflected in its 3,500 listed structures, 41 Conservation Area designations and 13 proposed designations¹⁰. The special natural heritage is demonstrated by 16 Special Protection Areas, 21 Special Areas of Conservation, 85 Sites of Special Scientific Interest, two Local Nature Reserves, nine National Nature Reserves and one National Park¹⁰.

Aberdeenshire has over 4,000 kilometres of watercourses and around 200 kilometres of coastline¹³. Under the Flood Risk Management (Scotland) Act 2009¹⁴, Aberdeenshire Council has a statutory duty to manage flood risk, promote sustainable flood management and use appropriate mechanisms to do so.

Aberdeenshire Council is the Lead Local Authority for the North East Local Plan District¹⁵ under the Flood Risk Management (Scotland) Act 2009, publishing the Local Flood Risk Management Plan 2016 and 2022¹⁶.

The North East Local Plan District contains approximately 13,000 residential and 3,600 non-residential properties at risk with an estimated Annual Average Damages of £29 million (comprising three local authorities: Aberdeenshire, Aberdeen City and Moray).

2. Methodology

The method used to complete this report was taken from UKCIP's online LCLIP pack for local authorities, from the guidance document¹⁷.

The geographical scope is Aberdeenshire Council's area. The timeframe studied was from 2011 to present, to follow on from the previous LCLIP completed in 2010.

There were five stages: project planning, media search, staff interviews, weather data, and reporting project findings.

The media trawl involved using an online search engine and inputting a number of keywords taken from UKCIP's guidance, searching within a set timeframe. The online archives of local newspapers were used where possible.

The data collected from the media trawl was collated in a Microsoft Excel spreadsheet, using a template provided by UKCIP amended to suit the needs of Aberdeenshire Council.

This review of events recorded in the media was used to gain an overview of the range and type of weather events that have affected the area and identify the impacts and consequences.

Interviews were carried out with members of Council staff and externally. Interviews were used to gather more detail on specific weather events and how services, organisations and areas were impacted, as well as what actions are being taken to build resilience. Two interview templates adapted from UKCIP were used to direct the interviews.

3. Media Trawl Findings

Detailed below is a summary of findings from a media trawl between January 2011 and August 2018.

3.1. Summary

3.1.1. Excessive rainfall

18 dates identified with incidents related to heavy or prolonged rainfall.

Incident detail includes towns flooding, localised surface water flooding, riverine flooding, record-breaking rainfall, road and school closures, power failure, building damage, environmental health concerns, major incident declared, danger to life, emergency rescues by helicopter, stranded vehicles, landslides.

3.1.2. Storms

11 dates, including events that lasted several days. Storms identified by strong winds, often with rainfall/snow/high tides.

Incident detail includes building damage, debris on roads, power failure, travel plan disruption, event cancellations, school closures, landslides, fire caused by electrical cables.

3.1.3. Snow/ice

17 dates identified, including cold spells and not overlapping with those classed as storms.

Incident detail includes round-the-clock clearing of roads, travel warnings due to dangerous driving conditions, power failure, school closures due to power failure, pupil transport issues and road closures.

3.1.4. Heatwave/warm spell

16 dates identified of varying significance, each date reflects temperature periods ranging from one record breaking day to a month of unusually hot weather.

Detail includes unusual high temperatures/low rainfall compared to long term average, broken records, increased visitors to outdoor recreation activities, heat induced fog, increased air pollution, changes to insect activity, wildfires, health warnings, extreme temperature fluctuations, road damage and water scarcity.

3.2. Major events

3.2.1. Peterhead and Stonehaven storm and coastal flooding 14/12/12

Conditions: Tidal surge, strong winds, heavy rain.

Impacts: 25 people from two sheltered housing complexes in Stonehaven evacuated, windows smashed by wave action, 30 people evacuated in Peterhead from coastal properties, 15 properties suffered severe damage, structural damage to factories, electricity and gas supplies in the area down due to flooded and severely damaged substation.



Shingle washed up on Stonehaven seafront following coastal flooding 2012



Stonehaven beachfront flooding

3.2.2. Stonehaven river flooding 23/12/12

Conditions: River Carron overwhelmed with water and burst its banks, water above waist-height in streets.

Impacts: 40 homes evacuated, 100 searched by the fire service, temporary accommodation established at Mackie Academy, raw sewage entering streets, landslip at Cairnrobin rail crossing with 1 m of water on tracks, advice centre set up at town hall in aftermath.

3.2.3. Storm Frank 24/12/15-11/01/16 (see section 4.1)

December conditions: River Dee bursts its banks, rapid river level rise.

Impacts: Ballater inaccessible due to part of the road being washed away, extensive detour required as the A93 was closed for 70 miles, people needing rescued from houses, cars and floodwater, several caravan parks destroyed and caravans washed away by floodwater, fire station destroyed, Invercauld bridge damage cutting off Braemar, hundreds of residents evacuated, Abergeldie castle on the verge of being swallowed by river, thousands of properties without power and heat, one year on 170 households living in temporary accommodation.

January conditions: River Don at highest since records began and burst banks, River Ythan burst banks.

Impacts: Two care homes evacuated at Aboyne (precaution), temporary accommodation established for people in Inverurie, 38 residents evacuated at Port Elphinstone, 18 homes evacuated at Ellon, 42 care home residents evacuated in Huntly, part of Aberdeen Airport runway collapsed.



High water levels River Don - Flooding at Kintore, Port Elphinstone, Inverurie

3.2.4. Portsoy storm and flooding 07/07/17

Conditions: heavy rain, rising water levels, strong winds.

Impacts: teachers unable to get to school, four schools closed due to adverse conditions, properties evacuated due to risk of coastal flooding, people rescued from homes, six properties and a care home affected by flooding, road disintegrated next to Sail Loft Bunkhouse.



Destruction near Ballater along the River Dee



Flooding at Soy Avenue

3.2.5. "Beast from the East" 28/02/18

Conditions: heavy and prolonged snowfall.

Impacts: 170 schools shut in Aberdeenshire at one time, first red alert in Scotland, Government buildings shut, courts closed, thousands of workers sent home, Council offices shut, people advised to take extra precautions.



Snow gritter through Aberdeenshire road

3.2.6. Heatwave and low rainfall June-August 2018

Conditions: prolonged dry spell and heatwave.

Impacts: melting roads in need of gritting, increased wildfire risk, water usage surge, water reservoirs running dry, private water supplies residents in need of assistance with bottled water/ bowsers (support ongoing beyond August).

4. Case Studies

This section contains four case studies of weather incidents that had a significant impact across the Council. These periods exemplify some of the conditions that climate change is expected to bring to the region: wetter winters, warmer and drier summers, and more variable extremes¹⁸.

The significance of these events was understood by either the financial impact to the Council, the establishment of an Incident Management Team in response, or the undertaking of a full review of service delivery, laying out resilience building actions.

4.1. Storm Frank 2015/16

The series of incidents that occurred in December 2015 into early January 2016 saw several periods of exceptional, persistent rainfall across Aberdeenshire, combined with snowmelt to cause widespread and largescale flooding in multiple locations.

This was part of a series of storms across the UK, and the second wettest winter on record, with estimated costs to the UK economy £1.6 billion¹⁹.

On the 3rd January 2016, 104mm rainfall was recorded at the Spittal of Glenmuick and 77mm 48-hr total recorded at Aboyne. Parts of Aberdeenshire saw their monthly average rainfall in the first week²⁰.

A major incident was declared on two occasions and an extensive multi-agency response and recovery effort was needed to restore normality. The scale of the incident was remarkable, with three major watercourses bursting their banks – the Dee, Don and Ythan. Transport systems were disrupted and damaged, with widespread bridge closure and flooded roads.

In Aberdeenshire, based on records of grant assistance, around 857 domestic properties and 119 business premises, including farms and estates, were damaged²¹. Residential units housing vulnerable individuals had to be evacuated, including care homes and sheltered housing units. Several residential caravan sites were destroyed.

Aberdeenshire Council staff were called out to volunteer in rest centres and provide any local assistance they could. There were outages of power and IT connections, which also affected some rest centres. Major utilities failure included loss of power lines, telephone lines and damage to waste water treatment plant.

Total costs to Aberdeenshire Council were £8.286 million, with £4.187 million received from the Scottish Government through the Bellwin Scheme, at the time of this report²².

The Bellwin Scheme is retrospective support that reimburses local authorities for their costs over a pre-defined threshold.



Deeside Holiday Park at Maryculter



A93 washed away due to the flooding between Bridge of Gairn and Crathie

	Consequences
Economic Development	Assisting recovery effort for businesses and flood victims through disseminating advice; Grants for businesses to recover. <i>See 5.1.9.</i>
Planning (Environment and Specialist Services)	Pohollick and Cambus O'May bridges damaged; 2.1km Deeside Way damaged, bridges and paths damaged along the coast. <i>See 5.1.7.</i>
Environmental Health	Private water supplies were tested to ensure they were safe; contaminated debris washing down the river needing removed
Education and Children Services	School closures; rest centres established in Schools; flooded roads
Emergency Planning	Local Resilience Partnership triggered; 29 teleconferences over 18 days of event; full debrief and evaluation of response following event
Flood Risk Management	Emergency works reinforcing Abergeldie Castle; putting together a Recovery Plan; assisting in immediate response effort
Scottish Ambulance Service	Relocation of operations to Aboyne following destruction of Ballater station; challenged by limited access to Braemar and Ballater
Scottish Fire and Rescue Service (SFRS)	Property evacuations; fire station destroyed; responding to multiple incidents and mobilising resources from across Scotland
Finance	Scottish Government's Bellwin Scheme claims required cost centre to be set up
Properties and Facilities	£45,000 spent on aftermath
ICT	Communication lines failed in Ballater; emergency wifi established
Waste	1000 tons of waste to shift carried by river and outside properties; emptying sandbags for proper disposal; employing contractors to dispose displaced caravans
Roads	Destroyed A93 cutting off main road into Braemar
Bridges	144 bridges damaged; Invercauld bridge damaged cutting off vehicle access to Braemar. Bridges had to be individually inspected to assess the degree of damage. <i>See 5.1.4.</i>
Housing	Sluiehor sheltered housing flooded; Bonty Court evacuated; 50 council properties evacuated; setting up temporary housing



Army assisting with debris clean-up along River Dee



River Ythan in Ellon flooding

4.2. Winter 2017/18

Over the season, the Roads Service were challenged during two periods of wintery weather extremes in particular. The impact of these conditions varied between the two periods and is outlined in this case study to demonstrate that winter weather extremes can take different forms.

The information used for this primarily comes from the Mid-season Review of Roads Winter Services, report to the Infrastructure Services Committee (2018)²³.

4.2.1. Conditions during December 2017

- Overnight snowfall on Thursday 7th Dec followed by a prolonged period of temperature fluctuations to and above freezing
- Snow, sleet and rain continued for 11 days
- Overnight temperature below zero for 21 days in December (12 consecutive)
- Freeze/thaw/refreeze of snow on roads and footways compacted relatively quick to make thick ice sheet
- Unusual conditions of road surface temperature being below zero and whilst it is raining
- Relatively uncommon in Aberdeenshire, previously seen in 2010

The mixture of rainfall and sub-zero road surface temperatures, as well as milder conditions during the day, made it extremely difficult to deal with for the Service.

4.2.2. Conditions during February/March 2018

- Relatively dry leading up to event
- Debonding layer applied preventatively was effective
- Temperature remained consistently cold
- Powdery snow accumulations were easier to remove

The second storm event the so-called “Beast from the East” occurred towards the end of February and caused difficult driving conditions and blocked roads due to drifting snow.

4.2.3. Response and impacts

Service operations were reviewed comprehensively in order to evaluate the response and put measures in place to improve the service delivery for the 2018/19 winter season.

Overall impact can be seen in the cost and resource usage. The Winter Budget for the 2017/18 season was £4,332,000. Average salt usage is 40,000-45,000 tonnes and labour required is approximately 56,000 hours. Costs amounted to £7,115,000, salt usage was approximately 61,000 tonnes and labour in excess of 70,000 hours²³.

Reflecting on the public response to the two events, there is anecdotal evidence that public tolerance is greater when there is higher accumulations of snow.

From the Service's perspective, it was more challenging to effectively address the conditions less visible seen in December 2017, e.g. salt wash-off, freezing wet road surface, freezing rain and adhering ice.

It happened in the lead up to Christmas and affected the roads during weekends. Adding further pressure was a high number of staff were on leave and as it was a weekend, fewer staff were on duty. The timing of the February storm event was more favourable than December; it was during the working week and fewer staff were on leave.



Winter maintenance - snow gritter vehicle near Crathes & A957 Slug Road

4.3. North East Water Scarcity 2018

The prolonged dry spell of 2018 caused unprecedented shortages to private water supplies across Aberdeenshire with issues from June and continuing into December. Across Aberdeenshire there are 11,500 properties reliant on 7,600 private water supplies – the highest in Scotland²⁴.

4.3.1. Response

- Cross-service Incident Management Team and Local Resilience Partnership activated to monitor emergency July 30th until August 21st, and again on September 27th until December 11th.
- Cost centre established to claim costs from Scottish Government after incident has been declared over
- Environmental Health, Roads, Emergency Planning, Finance, Corporate Communications and Health and Social Care represented in response team
- Bowsers delivered to households with children/ vulnerable adults
- Bottled water available to collect for remaining households

4.3.2. Conditions

As of the end of November, 163 water supplies had requested assistance and 325 properties were affected.

In August, more than half of Aberdeenshire was at Significant Scarcity (highest level) and the rest being Moderate Scarcity. The latter status remained into November across the region.

As of January 2019, the north east has been exceptionally dry in terms of winter rainfall. Groundwater levels in the region remain very low for the time of year and loch levels are also relatively low²⁵.

At the time of this report the regional status is medium risk of spring/summer water scarcity, taking into account current conditions and the time remaining for sufficient recharge to occur prior to next spring.

4.3.3. Impacts

Environmental Health lead the response to the households affected by the private water supply shortages. The level of assistance given is considered highly unusual for the time of year²⁶.

Eight Private Water Supply Officers assess what assistance they can offer as calls come in, visiting properties affected, and giving information on available options e.g. connecting to the mains, improving existing source/infrastructure, or identifying a new source.

The conditions have restricted time and resources available for routine service delivery and delayed preparations for new regulations (2018) introduced²⁶. These modify how private water supplies are classified and when they ought to be sampled, as well as put greater emphasis on water safety plans.

4.3.4. Resilience outlook

Further resilience building could happen through addressing issues that put pressure on the water network.

At a national level, planning policy does not reflect the present and future water systems and the risk that climate change has on water security and private water supplies.

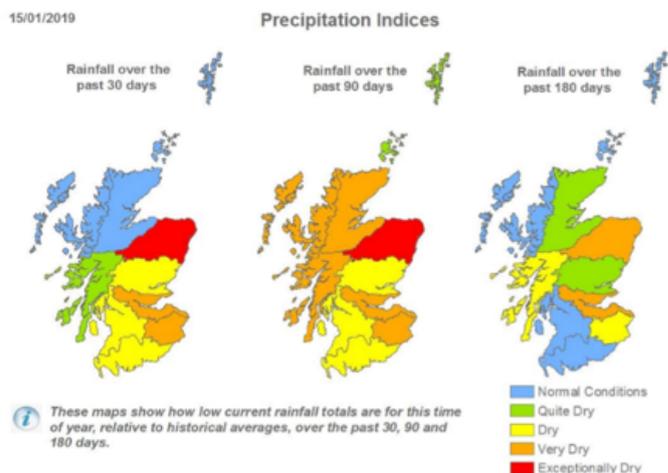
Scottish Government grants are available to improve private water supplies but cannot be used to connect to the mains.

Aberdeenshire Council has put forward recommendations to the Scottish Government to expand this grant to include financing mains connection.

"The autumn/winter 'recharge' period is one of the most crucial in terms of water resources as lochs, reservoirs and groundwater are all replenished and can buffer dry spells in summer months. Dry winters can lead to water resource issues later in the year and the worst drought conditions generally follow more than one successive 'dry' winter."

– Scottish Environmental Protection Agency²⁷

Scottish Water currently has no targets or strategies to expand their network and take over private water supplies.



Rainfall in Scotland as of January 2019

4.4. Gardenstown Landslide 2017

4.4.1. Conditions

Heavy rainfall and snowmelt triggered a landslide overnight on 27th November 2017 in Gardenstown²⁸.

This cut off vehicular access to a cluster of properties in November 2017. Between November 28th and April 27th 2018, Harbour Road was either open a few hours at a time, with supervised access only, or entirely closed.

Over this period, heavy rains and strong winds continued to impact the remedial works and local access, as well as deepen the landslip into the slope. Plans to fully re-open the road was compromised with a second bout of heavy rain and snow melt in March. This set back works and continued the disruption.

4.4.2. Response

The Grampian Local Resilience Partnership and an Incident Management Team (Aberdeenshire Council) was activated because of the risk to public health and safety from both the landslip and restricted access. The groups were active in ensuring essential services could reach the area.

Emergency services had to formulate contingency emergency plans for access. The alternative access involved steps/paths and required imposing waiting restrictions on the Main Street for months.

SFRS carried out on the ground checks for smoke detectors and offered basic fire safety advice. The Scottish Ambulance Service formulated an agreement with the Coastguard to obtain assistance with patient extraction if necessary.

The road re-opened to 24hr full access on the 27th April 2018, with works continuing on the slope.

4.4.3. Impacts

- Displacement of households
- Restriction of local fisherman's ability to transport their catch to market
- Residents and holiday cottage owners with contractors requiring full-days of access concerned about the knock-on impact on tourism
- Temporary disruption of bus service to village
- JCBs required to move the concrete blocks when opening/closing the road before switching to plastic barriers
- Continuous public engagement and communication regarding road opening times and works progress
- Contingency planning for Scottish Water waste plant that required emptying every 8 weeks
- Waste collections and deliveries of coal/wood disrupted and then facilitated by use of quad bike & trailer and a power barrow
- Assisting residents to get essential materials delivered (e.g. fuel, heavy goods)

5. Impacts on Council Services

This section details a wide range of impacts across Council services, with data primarily coming from interviews and internal publications.

5.1. Infrastructure Services

5.1.1. Waste Management

Weather-related impacts:

- Closure of Household Waste Recycling Centres during windy weather for health and safety reasons²⁹
- Long shifts outside put strain on staff welfare and productivity during heatwave 2018²⁹
- High public expectation during winter, but challenging conditions strain service delivery and worker safety²⁹
- Many access roads are low priority on Winter Maintenance Operational Plan – during Winter '17/18 one area missed eight consecutive weeks of bin collections due to access issues²⁹

5.1.2. Roads and Quarries

Weather-related impacts:

- Extreme weather diverts resources from routine maintenance and causes unplanned roadworks
- High number of failures on surface dressing sites during the heatwave of 2018, more than previously seen – gritters required³⁰
- Weather affects the demands for materials coming out of the quarries
- Aberdeenshire Council is ranked third best for road conditions across Scotland's local authorities¹¹ with twelfth highest spending – unplanned expenditure on weather-related repairs puts this at risk
- Expenditure on Roads following Storm Frank accounted for 70% of the incident's total revenue costs over three years since 2015/16 (£3,044,000)²²

5.1.3. Flood Risk Management

Situated within Roads, Landscape and Waste services, the team operates to fulfil Aberdeenshire Council's statutory duties under the Flood Risk Management (Scotland) Act 2009.

Example responsibilities:

- Stabilisation following landslip affecting Council assets
- Immediate response to major flooding incidents, e.g. Storm Frank; pumping water away, securing the bund at Abergeldie Castle, engaging in the evacuation and public protection efforts such as making sand bags accessible



The impact of flooding on roads surface, Ballater January 2016

All minor flooding incidents and enquiries are recorded by the Flood Team, there have been hundreds of localised flooding events and several major floods between 2011-2018, with digital records going back to 1995.

Between 2011 and 2018 there were 357 flooding enquiries/incidents recorded. Information includes council assets affected (yes/no), source of flooding and action taken.

Figure one demonstrates that flooding incidents are processed whether it affects council assets or not, occupying staff time and resources to some degree. Often

when enquiries are made that do not affect council assets, the Flood Team might give advice, engage with private bodies if necessary, and consider possible measures to alleviate the issue. Consequently, the Flood Team's responsibility extends beyond council assets and major flooding events.

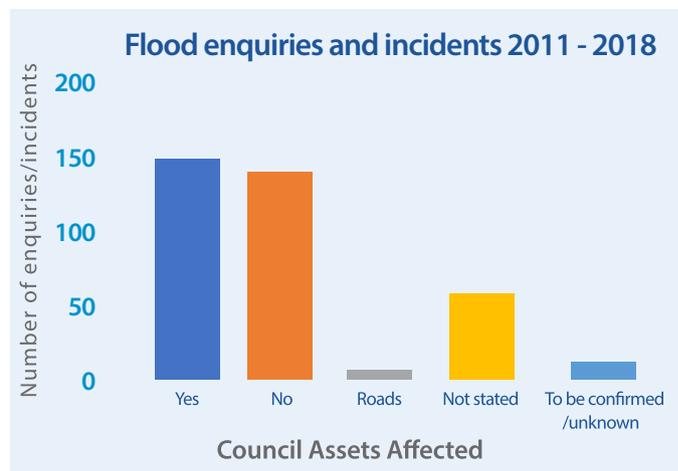


Figure 1: flood incidents and enquiries between 2011 and 2018

Main causes of minor flooding include:

- Flash flooding due to surcharged sewers
- Poor road drainage
- Culverted watercourses
- Overflowing drainage ditches
- New sealed surfaces, e.g. footpath

Key impacts include:

- Road flooding (public and private)
- Domestic properties flooding (council owned and private)
- Gardens and garages flooded
- Agricultural land flooded

Surface water flooding can be highly localised which makes putting an intervention in place more difficult. Addressing the causes of minor flooding where the Council does not own the asset can involve lengthy deliberation and engagement with external bodies to reduce flood risk.

For example, combined sewers that are outdated and require investment, owned either by Scottish Water or ownership unknown, can leave the Council unable to take action to alleviate risk³¹.

Revenue Budget 2018/19 Flood Management¹³ allocation, actions include:

- Culvert replacements (costs between £25,000 and £120,000)
- Flood emergency planning and response (£40,000)
- Contribution to research and works benefitting Aberdeenshire (£6,000)

From the Harbours, Coast and Flooding line in the Capital Plan¹³:

- Four Flood Protection Studies (between £50,000 to £180,000)
- Development of Surface Water Management Plans for eight areas in Aberdeenshire (£100,000)

Community resilience and homeowner responsibility is an essential part of reducing the impact of flooding³¹. This Service area is exploring this through engaging with communities, e.g. the Flood Warden Scheme and selling flood equipment at cost price.

Moving forward there is need for greater focus on flood resilience for critical public infrastructure and financial mechanisms that can encourage property level protection.

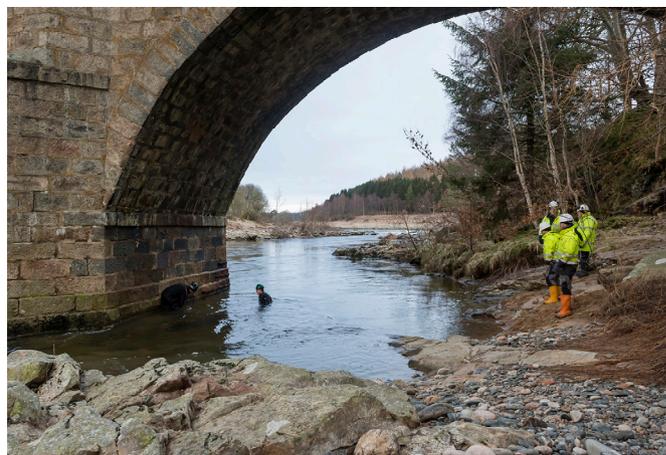
At a higher level, it would be beneficial to integrate flood resistant techniques into building regulations and ensure no development is permitted on floodplains.

5.1.4. Bridges

Bridges carry critical infrastructure, such as gas, electricity, telecommunications and water. Bridge failure can result in disastrous disruptions to the transportation network and essential services³².

Aberdeenshire's 1307 bridges on the public road network are critical to connecting places and supporting a wide range of service delivery. Each year £3.5 million is spent on monitoring, inspection and repair of bridges across the region³³.

The widespread damage to 144 bridges during Storm Frank demonstrated the vulnerability of Aberdeenshire's transport network²².



Potarch Bridge divers carrying out an underwater bridge inspection

Each damaged bridge required individual assessment of the extent of the damage/deterioration.

Large amounts of heavy debris were washing down the rivers, including caravans, septic tanks and trees. This process exacerbates scour and erosion, exposing the masonry and compromising the structure's integrity.

The cost of bridge scour during flooding events to Aberdeenshire has not been quantified and although bridges on the critical network are monitored and routinely maintained, there is backlog of bridges needing repairs/defects³².



Debris build-up at Ballater bridge

Braemar was cut off from communications and electricity in the entire village, and the damaged Invercauld bridge cut off access from the A93 heading east.



Repair works to Invercauld Bridge, reconnecting Braemar

Since Storm Frank, monitoring of bridges has improved, with webcams widely installed on spatey rivers, and an alert-system to monitor locations vulnerable to scour.

A response plan has been put in place for short notice bridge closure when their capacity is being pushed, which can severely constrain the work of emergency services³².

Key messages:

- Backlog of bridges in need of repairs/with defects and insufficient budget to do so
- Bellwin money is not used for improvement but to restore previous standard
- Aberdeenshire's fast responding rivers increase pressure on bridges through scour which undermines structure
- The combined effect of snowmelt and rainfall presents major uncertainty for bridges
- Bridge collapse can cut physical access and utility access
- There is an urgent need to assess the risk associated with bridge failure across Aberdeenshire
- At the current rate of bridge replacement, it would be 800 years before all bridges are replaced³²

5.1.5. Landscape Services

The outdoor operation of this service makes it susceptible to the influence of the weather, e.g. service delivery, strategic goals and staff time.

Key impacts and risks^{34, 35}.

- Extreme and prolonged wet weather spring/summer 2012 caused public complaints about open space maintenance standards and performance issues
- Grass cutting issues with extremely wet conditions (health and safety, unsightly)
- Torrential downpours – footways become a ready seed bed for weeds due to soil/silt build up
- Changing rainfall and temperature patterns increase tree's susceptibility to disease which can damage ecosystems, as well as the economy and recreational value of trees
- Trees on roads following storm conditions require contractors to remove

- Dry spell 2018 reduced need for grass cutting, freeing up resources in the service
- Heavy rainfall can cause issues at burial grounds as soil becomes heavy and wet, risking collapse and grave exposure

Climate change is anticipated to extend seasons, cause stronger vegetation growth and increase demand for better quality/quantity of open space³⁴. This could strain the budget in the future and increase pressure on landscape maintenance.

5.1.6. Housing

Storms, heavy rainfall and temperature extremes can cause damage to building structures and fabric.

Aberdeenshire Council's Outturn Housing Revenue Accounts often show that periods of adverse weather are reflected in overspends for the service. These costs are often masked overall by underspends in other areas.

Examples taken from Housing Revenue Account reports:

- 2015/16 – £562,000 above budget (Storm Frank flooding; notably Inverurie and Ballater)³⁶
- 2011/12 – £150,000 overspend (partially caused by extreme weather over previous winter and flooding)³⁷
- 2013/14 – £251,000 underspend (partially attributed to lower repair costs arising from a milder winter)³⁸

During cold spells, housing with external drip piping can experience drainage/heating system breakdown due to the pipes freezing, resulting in water to back up into the system.³⁹

The pressure of freeze-thaw cycles has caused pipes to fall off houses³⁹. Periods of heavy snowfall have damaged roofs, not collapsed them but the design is not equipped to deal with the weight, e.g. caused gutters to fall off.

Works carried out on housing across Aberdeenshire has included modifications to improve resilience to weather and are outlined below³⁹.

Resilience building housing modifications:

- Upgraded guttering system on many houses to cope with the increased intensity and frequency of rainfall events
- Automatic shut-off valves and prevention against sewage pipe backflow
- Flood gates for windows and doors
- Private water supply conversion to mains
- Insulation
- Greywater collections
- Solar panel installation
- Rerouting/insulating pipes internally

5.1.7. Planning and Building Standards – Environment and Specialist Services

Outdoor access

Paths and non-motorised bridges can deteriorate and get damaged by fierce winds, freeze-thaw cycles and prolonged heavy rainfall⁴⁰.

Limited budget to absorb response repairs and keep up routine maintenance can make weather events more significant than they should be⁴⁰.

Costs to the network from Storm Frank⁴⁰.

- £700,000 each for Pohollick and Cambus O'May Bridge repairs (Pohollick had £425,000 upgrade prior to Storm Frank)
- £11,000 bridge repair Gardenstown
- £7,000 bridge repair at New Aberdour Beach
- £55,000 damage along the Deeside Way
- £20,000 along coastal path, incl. bridge replacement

The damage along the Deeside Way included severe scouring and surface erosion, fallen trees across the path, damaged fencing and flotsam covering path and fencing. Works were prioritised based on risk facing path users.



Scour on path at West Wood



Damaged fencing at Potarch from flotsam during Storm Frank

Past impacts⁴⁰.

- Storms 2012 damage to coastal path South Aberdeenshire
- Landslips near Findlater Castle (£4000)
- Landslip onto path at Sandend June 2017

The coastal path is maintained by Aberdeenshire Council for 22 of 35 miles. Whole coastal path improvement and upgrade was estimated at £1.7-£2.3 million – no action was taken to go forward with this⁴¹.

Trials are underway with community management of path network and the Council is working with groups to advise on sourcing funding⁴⁰.

Historic Environment

Risks and impacts⁴⁰.

- Historic assets and archaeological sites on the foreshore and coastal edge are at risk of damage or destruction through coastal erosion, coastal flooding and storm surges
- Historic assets and archaeological sites on known (and previously unknown) floodplains at risk of damage or destruction by flood events
- Storm events causing trees to damage neighbouring historic assets and archaeological sites (falling on them, uprooting and undermining them) – e.g. plantation next to Aikey Brae Stone Circle
- Below ground/buried archaeology being exposed in the hot and dry conditions -summer 2018, many new archaeological sites identified through cropmarks/parch marks across UK, including a section of the Aberdeenshire canal not previously noted

Restorative works at Kincardine O'Neill Church as part of the Historic Asset Management Project were affected by the hot dry conditions of 2018 which caused materials to dry too quickly and had to be redone⁴⁰. During Storm Frank, archaeology was lost and infrastructure projects damaged⁴⁰.

5.1.8. Transportation

Transportation companies are key partners of Aberdeenshire Council Public Transport Unit (PTU) and weather can significantly impact service delivery⁴⁵.

Storm Frank consequences for Aberdeenshire Public Transport Unit⁴⁵:

- Public Transport Unit (PTU) impacted by closure of the A93 following Storm Frank, significant work required to maintain travel connections to Braemar for public and school transport
- Shuttle services provided connecting at the Old Bridge of Dee through a combination of in-house Council and Stagecoach vehicle and driver resource
- Additional work was covered by existing staff resources
- The PTU provided the emergency response team with details of operators willing to assist but did not carry out the detailed co-ordination unless under the exception of the PTU itself providing the vehicle and driver

Following an incident with a double deck vehicle in 2013, the Service introduced an explicit policy on the operation of such vehicles during strong winds⁴⁵. The responsibility to adhere to this policy is ultimately with the operator.

Aberdeenshire Council's Terms and Conditions of Contract for local bus and school transport services provides for payment at 50% of the daily rate on days of non-operation up to a maximum of 10 days in any School Year, whereby the contract payment revert to 100% of the daily rate⁴⁵.

On any day (during the first 10 days) where all school transport is cancelled a saving of £47,000 per day will arise⁴⁵. Adverse weather and pupil transport cancellation can therefore free up resources within the Service and save money.

5.1.9. Economic Development

Storm Frank had a significant impact on businesses and properties, particularly in towns along the River Dee.

According to a survey undertaken by the Visit Royal Deeside, Cairngorms Business Partnership and Cairngorms National Park Authority, between 50% and 60% of businesses in the Royal Deeside area were either directly or indirectly affected by Storm Frank⁴⁶.

In Ballater, physical damage was the main impact on businesses (71%) and in Braemar, it was reduced customer access (89%)⁴⁶. Retail and catering businesses and those based in Ballater appeared the hardest hit.

The survey overall found businesses were hoping to return to normal capacity in four to five months at the time of survey (Feb 2016). Marketing was considered the most valuable assistance at the time.

Aberdeenshire Council's Economic Development Service provided a variety of support measured, some listed below.

Economic Development Storm Frank support measures⁴⁷:

- Commissioning Public Relations to get the positive story across that Ballater was open for business
- Issuing newsletters to publicise assistance and schemes such as the Scottish Flood Relief Grants and other assistance
- Issuing the Scottish Flood Relief Grants
- Paying for freight containers for flooded businesses to use for storage for over a year
- Organising a drop-in evening for effected businesses to get information on VAT, business advice, insurance etc.
- Grants to help with marketing in relation to individual businesses being open for business
- Assistance in getting the Ballater Caravan Park cleared and funds to help the Park replace equipment and install touring pitches

- Surveying of businesses for needs, impact, scale of economic damage, etc
- Implemented short term rates relief

5.2. Health and Social Care

Floods, storms, snow, cold and hot weather and heatwaves affect health system infrastructure and service delivery, i.e. staff, buildings and equipment, as well as the prevalence of seasonal illnesses.

5.2.1. Care homes

Care homes have been frequently evacuated when flood warnings are issued. Regular evacuation drills, experienced staff and clear emergency procedures reduce the strain of evacuating during a flooding emergency. Sites are buddied, so staff can be drafted in from elsewhere during an emergency⁴⁸.

During storms in 2012, Health and Social Care staff and volunteers supported and gave shelter to people in need. This was enabled by resourceful and dedicated staff, maximising resources to the right places and people at the right time.

5.2.2. Health and Social Care Partnership (HSCP) - Winter Planning

Annually the experience of the previous winter is reviewed and fed into an updated winter plan for the upcoming season, identifying measures that will increase resilience.

Winter '17/18 put particular strain on the health and social care system. Road closures due to heavy snowfall made travelling treacherous⁴⁹.

Access to individual's homes and travelling to work was significantly impacted - continued service delivery was largely the result of tenacity, pragmatism and staff's goodwill⁴⁹.

A key indicator of pressure on the health & social care system is the severity and impact of winter virus, such as influenza-like illness (ILI). The graph below shows the

unusual spike experienced this year, as well as in winter 2010/11 (figure 2).

Example actions coming out of the winter plan draft 2018/19 to build resilience⁵⁰:

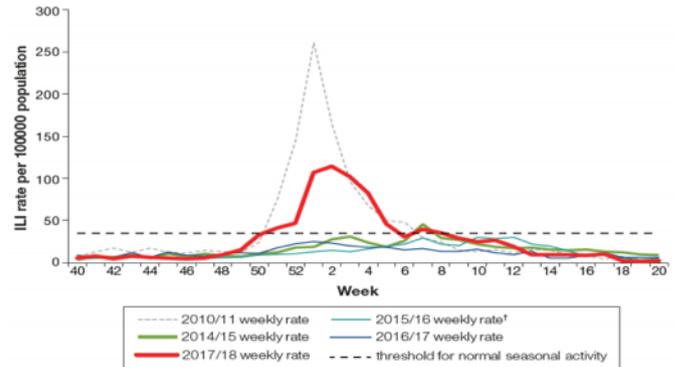


Figure 2: GP consultation rates for influenza-like illness in Scotland, compared to last three seasons, including 2010/11 taken from the Report to Aberdeenshire Integrated Joint Board – 20 June 2018, Review of Winter 2017/1849

- Expanding staff flu vaccination programs (e.g. to those snow clearing and gritting)
- Greater joint working with Infrastructure Services, Police and Fire & Rescue service to consider how best to maintain access to health and social care sites in extreme conditions
- Ensure all staff aware of policies in place to deal with adverse weather and registered for MET Office severe weather warnings

5.3. Business Services

5.3.1. Properties and Facilities Management

- 600 buildings across its estate, most unlikely to be replaced in next 20/30 years
- Resilience beyond building standards and regulations not carried out generally⁵¹
- Attributing damage to weather is perceived to be difficult⁵¹
- Health and maintenance budget considered insufficient to keep buildings in good condition and make resilient to extreme weather⁵¹
- Survey/repairs of buildings across the estate currently underway, no noted trends in increasing damage to buildings⁵¹

5.3.2. Human Resources and Organisational Development (HR&OD)

People underpin the effective operations of Aberdeenshire Council. Extreme weather can strain the ability to have the right people in the right place at the right time.

Highlighted in the Severe Weather Incident Report (24 December 2015-11 January 2016) are issues arising during Storm Frank related to staff and communications²¹.

Mobilising staff on the ground was challenged by lack of information on who was available during holiday period, lack of area-based contact information, lack of clarity on calling staff in over holiday period, and lack of awareness of roles and responsibilities amongst staff²¹.

The prolonged nature of the event challenged staff resilience and mental health. Working long hours and/or being unclear on roles and responsibility meant in some cases staff were facing risks to physical safety and mental health.

The Incident Report identified actions to address each issue that surfaced and to ensure measures are in place to prevent them arising again.

5.4. Education and Children's Services

5.4.1. Resources and Performance

- School closures primarily occur when adverse weather prevents safe access to the school for pupils and staff, as well as power failure⁵²
- Closure at the discretion of the Headteacher based on the information available for their local area⁵²
- Janitors on stand-by from 6am December-March⁵²
- Roads Team clear 15 academies, Landscape Services clear smaller campuses⁵²
- Schools not on Priority 1 or 2 roads disadvantaged during wintery weather⁵²
- Academies are often the designated rest centre in the event of an emergency as they have adequate facilities for supporting many people⁵²

5.5. Area Management and Communities

5.5.1. Community resilience

Aberdeenshire's six Area Management Teams work closely with communities in preparation and response to extreme weather events. Across Aberdeenshire, Community Councils are being encouraged to develop Community Resilience Plans^{53,54}. They are tailored to the needs of the community they serve. The key points are:

- Accessible document detailing designated safe place (i.e. providing shelter, food, advice) and key contacts in case of an emergency
- Serves to increase preparedness for all eventualities with a community-wide impact
- Represents a local-level response to complement the work of the emergency services
- It can hold a record of useful information/resources across the community, e.g. 4x4 car, electricity generators, elderly and disabled residents

5.5.2. Community impact example 1 - Stonehaven

Stonehaven December 2012 River Carron flooding, consisting of heavy persistent rain and severe flooding in the town centre.

Key points⁵⁴:

- Flood Warden Scheme – volunteers knock on doors at different levels of flood alert to inform residents of best action, helping elderly put flood gates up
- Residents transported by Aberdeenshire Council from Market Square to Mackie Academy (designated rest centre) – improved communication compared to the severe flooding of 2009 where no one arrived but instead went to the town hall – considered the local place of safety by residents
- Weekly community meetings for months after 2012 event
- Debris piling up in the streets awaiting insurance inspection
- Fan companies out of stock pulling fans and heaters from across Scotland
- 2/3 inches of sludge on streets – field run-off, oil and petrol, backflow from sewage



Flooding outside Stonehaven leisure centre

5.5.3. Community impact example 2 – Kemnay

Kembhill Park and Milton Meadows, in Kemnay, were both affected by Storm Frank. Both communities exemplify the different challenges flood risk can present and the different responses required to protect the people⁵⁵.

Kembhill Park

- Houses cannot be protected against flooding at property level due to a two-inch gap all around the houses between concrete base and bottom of wooden cladding attached to the house's timber frame⁵⁵
- Flood water came up through gaps in external cladding, under external doors and under the flood boards during Storm Frank⁵⁵
- Exploring options for a permanent large-scale flood protection scheme cannot be considered by Aberdeenshire Council without the area being identified as a Potentially Vulnerable Area which is determined in six year cycles⁵⁵
- Aberdeenshire Council purchased a deployable flood barrier (£75,000) and employed a standby contractor to deploy the barrier and three high volume storm pumps to shift flood waters in an emergency (£16,000) to reduce flood risk in the area⁵⁵

Milton Meadows

- 137 households in the area, since they are brick built, they can be protected at property level, homeowners understand individual responsibility; cost of this estimated for one household £20k and £1.5k is available from the Scottish Government⁵⁵
- During Storm Frank, the information held by the Residents' Association (i.e. estate maps, contact details of homeowners, locations of vulnerable individuals) were valuable tools on the night of the incident, quickly after the event a resilience sub-group was formed⁵⁵

- Since the incident, with assistance from Aberdeenshire Council, a river monitoring system with gauges has been installed in the burn nearby, and other grants have funded resilience equipment, including personal protective equipment (PPE), walkie-talkies, additional pumps, eco-friendly sandbags⁵⁵

Household insurance premiums tripled following the flood events, with some residents fearing the Potentially Vulnerable Area status would make this worse⁵⁵.

6. External Bodies

6.1. Scottish Fire and Rescue Service

- Category 1 responders in an emergency, part of Local Resilience Partnership
- Service keeps a Community Asset Register of useful skills/resources in an emergency
- Resources assembled from across Scotland to assist in Storm Frank response⁵⁶
- Biggest challenge facing service during Storm Frank was access as the main road entering Ballater was washed away⁵⁶
- Increased specialist water rescue training across the region following Storm Frank⁵⁶
- Engaging with Floodline to incorporate flood risk advice into home safety visits⁵⁶
- Acknowledgement that climate change is likely to increase flooding and wildfire risk in Aberdeenshire⁵⁶
- Wildfire forecasting system in place⁵⁶

6.2. Scottish Ambulance Service

The pressures on service in adverse weather include staff absence due to sickness, access or childcare issues if schools are shut, and access problems to an emergency⁵⁷.

Specialist Operations Response Team (SORT) was set up following Elgin floods 2002. This involves training paramedics with enhanced skills in technology and equipment, and 4x4 capabilities.

Example impacts of severe weather/flooding⁵⁷:

- Pressure on service when vehicle access to Braemar was cut off (Storm Frank)
- Contingency planning when Gardenstown community cut off in landslip
- Station flooded in Ballater, operations had to be moved (Storm Frank)
- Staff working flat out during the first flooding incident of Storm Frank, when the second event hit Inverurie they were already exhausted – not working at a sustainable intensity

6.3. Peterhead Port Authority

- Substantial damage around much of the port due to a storm in December 2012 (totalled over £5m)⁵⁸
- Some damage, centred on the North Breakwater in January 2016⁵⁸
- Both events considered unusual and resulted in insurance claims of over £1m⁵⁸
- Response: approximately £2m spent improving sea defence and planning to supplement with a further £3.5m investment 2019⁵⁸



Peterhead seafront 2012



Peterhead seafront 2012

6.4. Scottish Environmental Protection Agency (SEPA)

SEPA carried out a number of actions following the floods of 2015/16 to capture new data arising from the storms, to improve service delivery and advise flood studies and structural work⁶⁰:

- Supported the response of the local authority and emergency services by providing information during the flood event on current and expected river levels
- Attended public meetings after the flood
- Responded to Official Ministerial Enquiries after the flood
- Completed a post flood survey which we used to update the flood warning processes
- Assessed the effect of sediment on flood risk on agricultural land (including kayaking down the Dee to assess the impacts of the flood on the channel)
- Supported Aberdeenshire Council with their flood studies (data provision, expert comments on consultant's reports, modelling advice)
- Updated flood event database, to help inform future flood risk related decisions
- Provided regulatory advice for re-instatement and repair of embankments to the local authority and land owners

6.5. Agricultural Weather Advisory Panel

The new weather advisory panel announced in November 2017 has released updates five times since December 2017⁵⁹.

It facilitates rapid sharing of information, best practice and encouraging co-operation across industry to help farmers and crofters to respond effectively to challenging weather conditions over both the short and long term.

Some weather impacts of 2017/18⁵⁹:

- Wet weather during 2017 likely to continue effect on 2018 calving, lambing and planting
- Increased prevalence of fluke in cattle and sheep due to wet summer weather (2017)
- Impacts on agricultural business from weather events can have adverse effect on human health, increase level of interest in the support services available
- As of April 2018, sustained wet weather over past nine months plus heavy snow; panel concerned about cumulative impact – including loss of stock, long working hours and farmers' wellbeing, potential impact on health and welfare of animals
- August 2018 had ~73% normal level of rain falling during the months of May, June and July (most falling in the last four days of July) - much of it run-off over land because of dry soil conditions
- Warm and dry weather experienced across Scotland, comes on the back of prolonged persistent wet period over the summer, autumn and winter 2017, followed by late cold period leading to delayed onset of spring 2018
- Dry weather limited grass growth used for making silage or livestock grazing purposes, the farmers and crofters to use up feed and fodder stocks being saved for winter ahead



7. Weather data

7.1. Changes in UK Climate

Changes to Scotland's climate are being observed already. The State of the UK Climate 2017 report identifies several deviations to its long-term weather averages⁶¹:

June 2017 was the second wettest June for Scotland in a series from 1910 and annual rainfall over Scotland has increased since 1970. There are 14-15% fewer days of ground frost compared to 1961-1990.

9 of 10 warmest years for the UK have occurred since 2002 and all 10 have been since 1990. Seven of the 10 wettest years for the UK have occurred since 1998. Nine of ten warmest years for near-coast sea surface temperature in a series from 1870 have occurred since 1989.

The highest rainfall accumulation over five days during the most recent decade (2008-2017) is 4% higher than 1961-1990. The amount of rain from extremely wet days has increased by 17% when comparing the same periods. Changes are largest for Scotland.

The United Kingdom Climate Projections 2018¹⁸ (UKCP18) general climate change trends projected over UK land for the 21st century show an increased chance of milder, wetter winters and hotter, drier summers along with an increase in the frequency and intensity of extremes.

- | | |
|------|--|
| 2011 | "Scotland had its wettest year in the series from 1910, but much of central, eastern and southern England had a persistent rainfall deficiency" |
| 2012 | "December rainfall totals were above average with Scotland overall receiving 131%; it was particularly wet in the east, with Aberdeenshire recording over twice the normal December rainfall, and for Eastern Scotland this was the wettest December since 1929" |
| 2013 | "A late winter and exceptionally cold spring, with unseasonably late snowfalls."
"December was the wettest any calendar month on record in Scotland in a series from 1910." |
| 2014 | "For Scotland, it was the warmest spring in a series from 1910." |
| 2015 | "Warmest December on record for the UK and Central England (since 1659) with the highest anomaly of any month by a margin of over 1°C." |
| 2016 | "For eastern Scotland January was the second wettest calendar month in the series, with December 2015 having been the wettest" |
| 2017 | "UK-average anomalies in February, March, May, June and October were all well in excess of +1 °C, and mid-June saw a significant hot spell." |
| 2018 | "UK monthly mean temperatures were 1.8 °C above average in June, 2.2 °C above in July, and 0.3 °C above in August. Overall this summer was provisionally the equal warmest on record for the UK." |

7.2. Annual summaries 2011-2018

Office Annual Climate Summaries⁶²

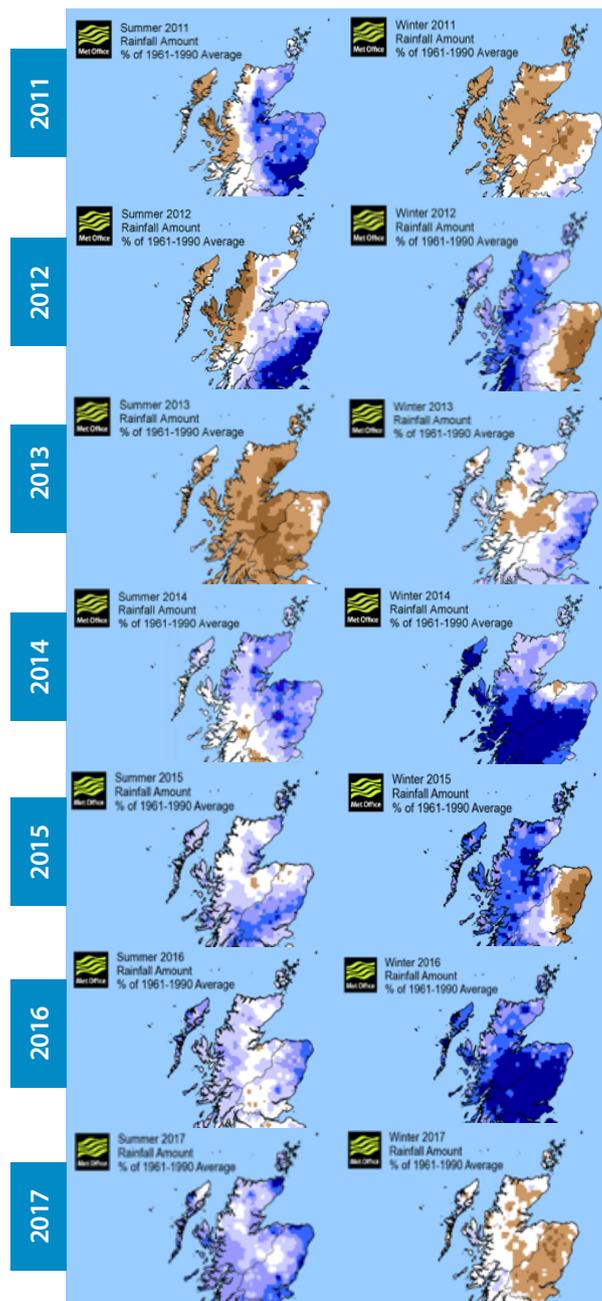
7.2.1 Summer and winter rainfall amounts

Comparing the summer and winter levels of precipitation across Northern Scotland demonstrates seasonal and regional variation.

This map series is useful to highlight that Aberdeenshire has experienced winters with less rainfall than average whilst other areas of Scotland have had above average, and vice versa.

This emphasises the importance of exploring beyond headline messages of the UKCP18 and looking at regional projections too.

It must be noted that water scarcity in spring and summer is significantly influenced by winter recharge, snowmelt and winter temperatures (see section 4.3).



*Images taken from the Met Office's UK actual and anomaly maps. Images contains public sector information licensed under the Open Government Licence v1.0.
(source:<https://www.metoffice.gov.uk/climate/uk/summaries/anomacts>)*

8. Summary

8.1. Conclusion

Aberdeenshire Council has experienced a broad range of weather events and associated consequences in the period 2011-2018. Both major and minor event have and can absorb resources from across Council Services and have and can have profound impacts on communities.

Aberdeenshire Council Services have proved effective in responding to, and restoring normality, following adverse weather events. In addition, reviews following weather events often lead to actions and improvements in business as usual procedures to ensure ongoing resilience to weather events.

However, a purely reactive approach may not be sufficient to cope with the more frequent and intense weather events predicted as a result of climate change. Taking proactive measures and increasing adaptive capacity can ensure the Council is best placed to face the challenges of more frequent and intense weather events and to avoid and mitigate negative consequences and minimise future costs.

The evidence of climate change is rapidly growing at both national and global levels. Adaptation to climate change is becoming a key global objective as greenhouse gases already emitted are expected to drive decades of warming. The impacts of these changes will be worst felt with inadequate preparation.

Aberdeenshire Council must widely consider which past impacts will be costly over time if they are to reoccur and current action is sustained/no action is taken to improve resilience, as well as how decisions today will fare in future scenarios of climate change.

8.2. Key Recommendations

- Development of a Climate Change Adaptation Strategy to ensure a uniform approach across services in addressing climate change risk
- Consideration of impacts outlined in LCLIP when supporting climate change mitigation and adaptation action across Aberdeenshire
- Updating the Climate Change Risk Register to reflect the UKCP18 projections and the findings of the latest LCLIP
- Explore the options around having a cost code that is explicitly linked to severe weather events and further investigate possibilities of having a central fund for climate change costs and adaptation measures
- Capture costs from weather-related incidents so that cost benefit analysis for adaptation can be included in future decision making
- Explore research and development opportunities in adaptation and resilience-building technologies
- Explore opportunities for Aberdeenshire to tap into the growth potential of climate change adaptation and resilient infrastructure
- Engage communities through workshops to explore climate risk and adaptation measures

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