Moray Council Local Climate Impact Profile

2018 - 2023

Contents

Cover image credit: Scottish Fire and Rescue Service

1. Introduction

1.1 Local Climate Impact Profile (LCLIP) and Useful Definitions

The Local Climate Impact Profile (LCLIP) was designed by the UK Climate Impacts Programme (UKCIP) to assist organisations in identifying their exposure to climate change and extreme weather events. The LCLIP looks at the impacts of previous extreme weather events to inform organisations and help improve resilience to future events.

- **Climate** – The average weather in a specific area over a prolonged period[1]
- **Climate Change** – Long-term shifts in temperatures and weather patterns, primarily driven by human activities[2]
- **Weather Events** – Day to day atmospheric conditions in a specific area for example, sun, rain, snow, or wind. [3]
- **Extreme Weather Events** – Unusual or unexpected weather events, they are usually severe or unseasonal. For example, extreme hot or cold temperatures, high winds, and excessive rainfall. [4]
- **Climate Adaptation** – Actions to reduce the impacts of observed and projected climate change. This can include but is not limited to, emergency planning, flood protection, adaptable buildings, and green infrastructure.[5]
- **Climate Mitigation** – Actions to reduce the pollution that causes climate change. This can include but is not limited to, renewable energy, electric vehicles, and avoiding food waste.[6]
- **Adapt to 2°C, assess up to 4°C** – The Climate Change Committee report recommends the UK adapt to a minimum global temperature rise of 2°C while considering the risks of warming up to 4°C.[7] If global emissions fail to decrease, the UK could experience temperature rises by 2080-2100 that would severely limit the impact of adaptive measures, increasing the risks to public health, economic damage, and biodiversity destruction.

In Moray, a global average 4°C temperature increase could result in over 20 days a year exceeding a daily maximum average temperature of 25°C with some days exceeding 30°C with increased chances of heat related illness and fatality.

1.2 Purpose and Outputs of the LCLIP

Purpose

- Develop a story of climate change in Moray and raise awareness of weather/extreme weather events.
- Provide an evidence base for recommendations and actions to combat climate change.
- Provide recommendations for improving the resilience of Moray Council.
- Bring awareness of climate adaptation to Moray Council. Knowledge of adaptation is low within Scotland[8]; it needs to be understood by policy makers and those who implement it.

Outputs

- Summary report outlining impacts of climate change on Moray Council from 2018 to 2023.
- Recommendations to reduce the risk and cost of climate impacts to Moray Council.

[1] Greenpeace, *Climate Change and Extreme Weather*.
[2] United Nations, *What is Climate Change?*
[3] Greenpeace, *Climate Change*.
[4] World Meteorological Organisation, *Extreme Weather*.
[5] Adaptation Scotland, *What is Adaptation?*
[6] Ibid.
[7] Climate Change Committee, *Independent Assessment of UK Climate Risk, p24*.
[8] Scottish Government, *Scottish National Adaptation Plan 2024-2029*, p173.

1.3 Climate Change in Scotland

Scotland is already experiencing the effects of global climate change; the average temperature between 2014-2023 was 1.02°C hotter than the 1961-1990 average[9]. Scotland has also experienced a 10% increase in the amount of rainfall within the same timeframe[10]. Increasing temperatures result in more extreme weather events and more unstable weather patterns. Higher temperatures increase the frequency of unbearable heatwaves and contribute to biodiversity loss and food insecurity[11]. The Scottish Government have identified fifteen key consequences of climate change including damage to Scotland's environment, food and water supply, infrastructure, business, cultural heritage, and the health of its population[12]. Moray is experiencing the same patterns observed across Scotland. The graph below shows that Moray's average temperature has steadily increased from 1960.

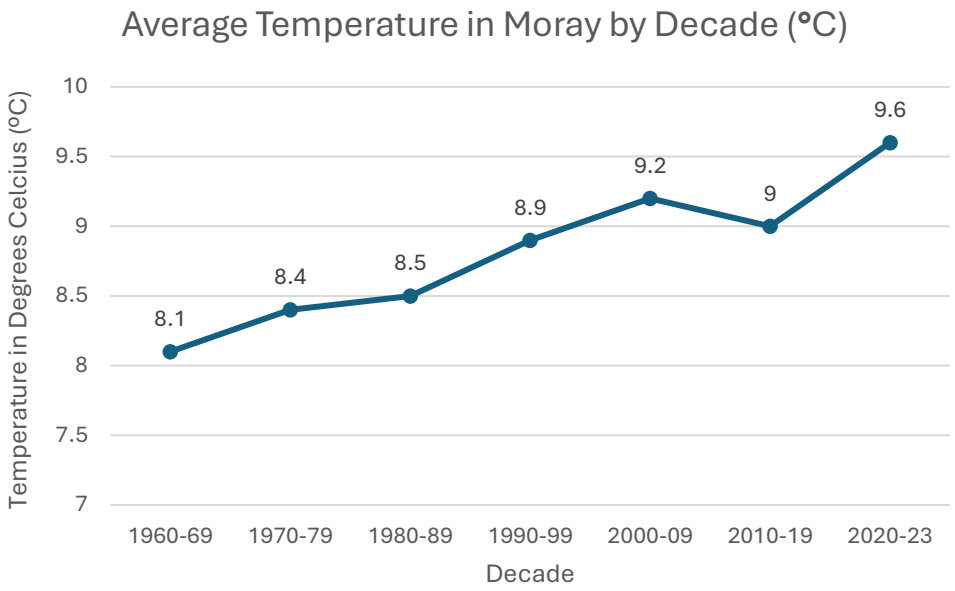

Figure 1 Data from Met Office Lossiemouth Weather Monitoring Station

Moray is particularly at risk from increased rainfall and rising sea levels. Even if global warming continues at the lowest level, Moray may experience sea level rises of up to 32cm by 2080, increasing to 72cm by 2080 at the highest global warming level[13]. Areas of Moray are already feeling the effects of rising sea levels. Residents in Kingston fear another severe storm event could turn the area into an island[14].

Moray Council must act now to protect Moray from the local impacts of global climate change. The Climate Change Committee emphasises that significant governmental and societal goals will be harder to achieve due to climate change; housing availability, food insecurity and poverty will be exacerbated by a changing climate. These issues will also be up to three times more expensive to cope with in a 2°C temperature increase scenario , the projection the council is required to prepare for under Government guidelines.

Moray Council must integrate adaptation into its policy making to ensure the organisation and communities it serves are resilient and prepared for these risks, while also assessing the risks for a much higher rise in global temperatures.

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[9] Adaptation Scotland, *Climate Change Trends and Projections.*
[10] Ibid.
[11] Met Office, *Effects of Climate Change*.
[12] Adaptation Scotland, *Climate Change Impacts in Scotland.*
[13] Met Office, *Climate Report, p8*.
[14] BBC News, *Another Storm Could Turn Our Village Into An Island*

1.4 Local Profile

Moray is located within the North-East of Scotland, nestled between the Highlands and Aberdeenshire. Moray is home to approximately 95,500 people with around a quarter of its population living in the area's biggest town, Elgin. Moray's other major towns include Forres, Keith, Buckie and Lossiemouth. Moray's population has increased by just under 10% from 2001-2024[15]. The number of households in Moray increased by 7.6% from 2011-2022[16] with Moray Council managing 6,380 of these properties accounting for around 15% of Moray's total housing stock.

Moray covers an area of 2,238km^2 and is famous for its stunning landscapes. Moray is home to Ben Rinnes, The Moray Firth, part of the Cairngorms National Park, and several special protection areas, special areas of conservation, sites of special scientific importance and eleven special landscape areas. The area is also home to several buildings of historic significance such as Elgin Cathedral, Pluscarden Abbey, and multiple castles, including Brodie and Duffus. Moray is renowned for its walking trials, 'The Moray Way' encompasses three of Moray's 'great trails' to form a 100-mile circular walking route around the region[17]. 'The Moray Coastal Trail' provides visitors with the opportunity to experience Moray's beaches and see its resident bottlenose dolphin population. Next, 'The Dava Way' takes walkers through lush woodlands and provides stunning views of the Cairngorm Mountains. Finally, 'The Speyside Way' travels through Moray's whisky region while following the River Spey. Moray's trails attract visitors who wish to experience the areas rich history, scenery, and vibrant communities.

Moray's economy is reliant on manufacturing and the tourism industry. Several global brands such as Walker's Shortbread, Baxter's of Speyside, and Johnstons of Elgin have been major employers within Moray for over 100 years. Roughly 15% of Moray's workforce is employed in manufacturing, this is more than double the national average[18]. Tourism accounts for a further 10% of Moray's workforce[19]. Over 877,000 tourists are attracted to Moray Speyside every year by the area's distilleries, fishing, history, and natural heritage[20]. Moray also has close links to the Ministry of Defence and Royal Air Force; RAF Lossiemouth and MOD Kinloss have both had a presence in the area since 1938.

Figure 2 Erosion at Kingston Beach

[15] Scotland's Census.
[16] Ibid.
[17] The Moray Way, *The Moray Way.*
[18] Highlands and Islands Enterprise, *Moray Key Statistics*, p2.
[19] Moray Council, *Moray, Official Guide*, p23.
[20] Scottish Licensed Trade News, *Rising Visitor Numbers Deliver £187 Million Tourism Boost for Moray Speyside*.

1.5 Relevant Legislation

The Climate Change (Scotland) Act 2009 requires public bodies to conduct actions in the best way calculated to support delivery of the Scottish adaptation programme. The Climate Change (Duties of Public Bodies: Reporting Requirement) (Scotland) Order 2015 requires public bodies to annually report on its contributions to the programme. The current Scottish National Adaptation Programme covers 2024-2029 and outlines the following outcomes:

- Outcome 1 – Nature Connects across our lands, settlements, coasts and seas.
- Outcome 2 – Communities are creating climate-resilient, healthy and equitable place.
- Outcome 3 – Public services are collaborating in effective and inclusive adaptation action.
- Outcome 4 – Economies and industries are adapting and realising opportunities in Scotland's Just Transition.
- Outcome 5 – Scotland's international role supports climate justice and enhanced global action.

The National Planning Framework 4 (NPF4) identifies the Scottish adaptation programme as a cross-cutting policy link. NPF4 Policy 1 states that Local Development Plans 'must address the global climate emergency and nature crisis by ensuring the spatial strategy will reduce emissions and adapt to current and future risks of climate change by promoting nature recovery and restoration in the area'. Further policies within NPF4 emphasise the need to consider and take steps to address a range of climate risks within any development and use nature-based solutions.

The Civil Contingencies Act (2004) requires Public Bodies to assess the risk of emergencies occurring and maintain plans to ensure services continue to be delivered in the event of an emergency. Severe weather and climate change can cause emergencies that may limit the availability of and delivery of council services.

Under the Flood Risk Management (Scotland) Act 2009 the council has a statutory duty to implement and maintain flood protection actions and prepare local flood risk management plans. Moray Council is the lead authority for the Findhorn, Nairn, and Speyside Local Plan District, and works with partners to deliver the plan. The council's climate change strategy identifies the importance of progressing adaptation actions alongside mitigation (reducing carbon) and for adaptation to be embedded across all departments.

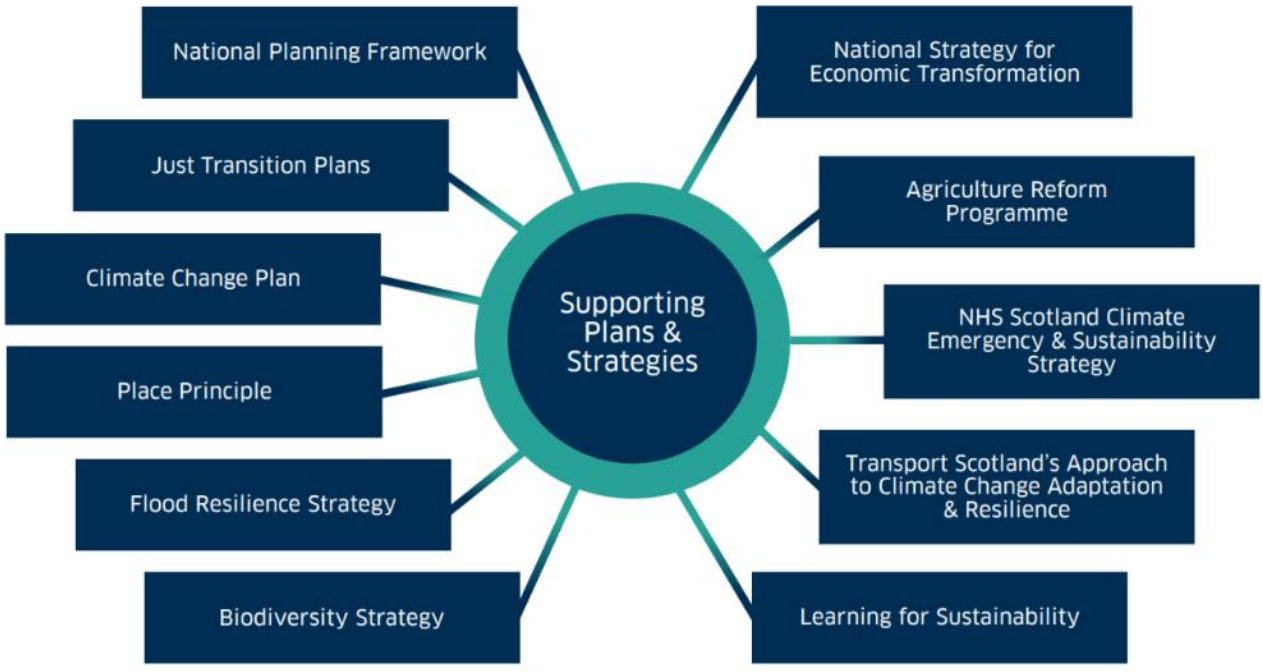

Figure 3 Scottish Government plans and strategies critical to delivering inclusive and effective adaptation action during the Adaptation Plan five-year implementation period (2024 – 2029), SNAP3

2. Methodology

2.1 Data Investigation

Several different sources of data were investigated to contribute to the Moray 'Local Climate Impact Assessment' including:

- Desk-based research.
- A media search to establish the number of extreme weather events in Moray that were reported in local and national news between 2018-2023.
- Understanding Scottish Government legislation and guidance including the 'Climate Change (Scotland) Act 2009 and 'Scottish National Adaptation Plan 2024-2029'.
- Contacting internal departments to assess the impacts of extreme weather on different services within Moray Council.
- Contacting external organisations including the Met Office and the Scottish Fire and Rescue Service to gather specific data on extreme weather events in Moray which Moray Council does not record.

2.2 Data Used

- The Met Office provided daily readings between 1960 -2023 of maximum and minimum temperature from its monitoring station in Lossiemouth. This data was used to calculate the annual number of 'summer days' in Moray. A day is considered a 'summer day' if the maximum air temperature reaches 25^{0}C or above at any given time during the day. Summer days were chosen as a measure of extreme weather as temperatures exceeding 25^{0}C can increase the likelihood of heat-related illness among more vulnerable people.
- The Scottish Fire and Rescue Service provided the number of wildfire events in the moray area between 2010-2023.
- The Met Office archive of storm events was used to gather data on named storms that affected Moray between 2012-2023[21]. For storm events pre-2015, the Met Office archive was used to gather dates of extreme weather events. These dates were then searched on the archival section of local newspapers (Press & Journal and The Northern Scot) to assess if any weather events had caused enough disruption to be reported on. These articles were then cross-referenced with archival Met Office weather warnings to assess the impact of the storm event in Moray.[22]
- Air Quality in Moray was collected from Moray Council air quality monitoring reports.[23]

2.3 Research Limitations

While researching this project, several limitations impacted the ability to collect information, including:

- Hard to measure impacts, for example a loss of teaching hours due to school closures cannot be measured as easily as the financial costs of building damage.
- Incomplete records, for example building damage caused at the time of a storm event but not explicitly linked to extreme weather could not be used as evidence.
- Slow onset climate impacts and global system impacts due to climate change in other regions have not been tracked/measured.
- Confusion between climate mitigation and adaptation within Moray Council staff.
- Some services lacked capacity to fully engage with the data collection process.
- Staff capacity and deadlines to feed into the climate change strategy update.

[21] Met Office, *Past Weather Events*.
[22] Met Office, *National Severe Weather Warnings Archive*.
[23] Moray Council, *Public Health – Air Quality*.

3. Yearly Weather Events in Moray

2018 The year began with Storm Georgina in January, followed by significant snowfall in late February into early March. Two amber alerts for snow resulted in the closure of 39 schools, a majority shut for three days. The summer months brought Storm Hector in June and a 3-day heatwave in July with an average temperature of 27.5^{o}C. Storm Ali and Storm Callum affected Moray in September and October. In December Storm Deirdre battered the area bringing an amber snow warning for southern Moray; 80 mph winds damaged a residential property leading to the closure of the A961 to protect motorists[24].

2019 Moray experienced a relatively calm year of weather conditions with only two storms affecting the region in the first few months of the year. 2019 was a year of high temperatures across the UK, with a heatwave in late July. On the 25th of July, Moray experienced its second highest ever maximum temperature of 31^{o}C. This is only 0.2^{o}C away from the 2003 record.

2020 Several storms affected Moray in 2020. Storm Brendan caused damage to Moray College, forcing it temporarily shut in January. Storm Ciara and Storm Dennis hit within one week of each other, bringing flood warnings to the area. In August, an amber weather warning was issued for most of the region due to severe thunderstorms and flooding. Storm Alex and Storm Barbara both brought windy conditions in October, followed by Storm Bella on boxing day.

2021 Storm Christoph and Storm Darcy brought wintery conditions for two weeks at the start of 2021 with February recording -13.9^{o}C, Moray's coldest minimum temperature in over 10 years. Storm Arwen caused significant disruption in November. 80mph winds resulted in damage to Buckie High School, closing it for two days. Communities experienced power cuts and some were cut off by fallen trees[25]. Storm conditions continued two weeks later with Storm Barra.

2022 The end of January saw Storm Malik and Storm Corrie hit Moray within three days of each other. A large proportion of rural schools were closed due to a lack of power linked to storm damage[26]. Moray experienced a stormy February with Storm Dudley, Storm Eunice, and Storm Franklin all impacting the region within the same week. The UK experienced a year of record-breaking temperatures in 2022. Scotland, Wales, and England all broke their highest temperature record, with UK temperatures surpassing 40^{o}C for the first time[27]. December in Moray was particularly cold with minimum temperatures below 0^{o}C for over a week. This cold snap brought up to 10cm of snow in rural areas[28] causing the closure of schools for up for three days.

2023 Storm Otto hit in mid-February, closing Buckie High School due to wind damage. 2023 was another hot year in Moray with two heatwaves and the number of 'summer days' (days over 25^{o}C) almost tripling from the previous year. Storm Betty and Storm Agnes brought high winds in mid-August and late September. An amber rain warning was issued in late October during Storm Babet. Power cuts, rising river levels and travel disruption affected Moray for almost five days. Forres Academy was closed due to flooding, linked to the storm. The storm season continued with Storm Ciaran, Storm Debi and Storm Fergus all bringing heavy rain in early November and December. Storm Gerrit brought travel disruption and wind warnings during the festive period.

[24]Mackay, David., (The Press and Journal), *North of Scotland Battered by Strong Winds and Snow as Storm Deirdre Sweeps Through*.
[25]Whitfield, Alistair., (The Northern Scot), *Storm Arwen: The Aftermath in Moray*.
[26] The Moray Council, *Moray's Storm Malik/Corrie Update- Facilities Available for Residents*.
[27] The Met Office, *Record High Temperatures Verified*.
[28] BBC News, *'Arctic Blast' to Bring Scotland Snow and Ice*.

4. Results

4.1 Extreme Weather Events 2018-2023

Between 2018-2023 Moray was affected by 99 extreme weather events, including summer days (over 25^{0}C) storm events, and wildfires. Compared to the previous 6-year period, (2012-2017) the number of storm events and summer days significantly increased; the number of wildfires remained fairly constant.

The graph below shows the number of recorded extreme weather events in Moray between 2018-2023 compared to 2012-2017; this graph shows temperatures are rising and storm events are becoming more frequent.

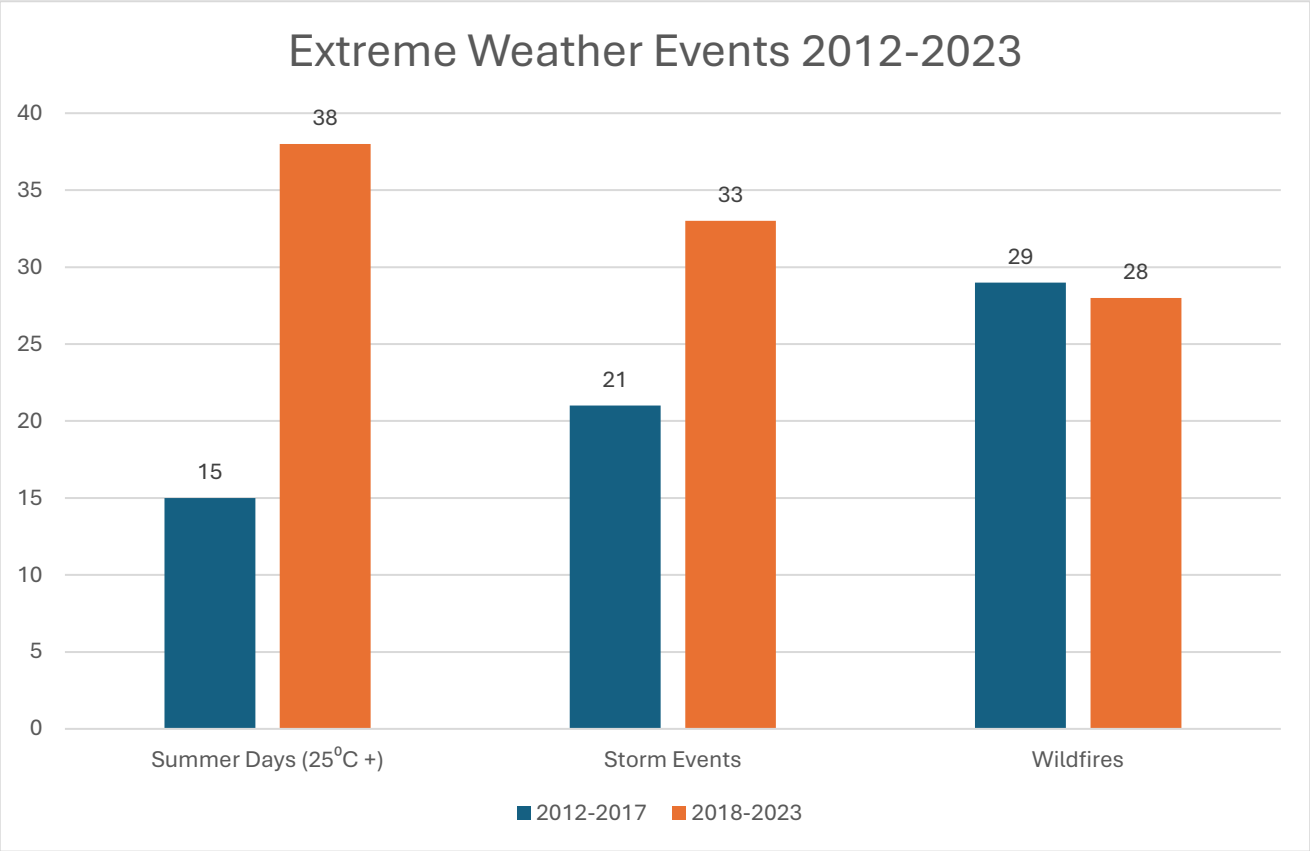

Figure 4 Data from Met Office, Local News, and Scottish Fire and Rescue Service

4.2 Flooding

Flooding has always been a significant threat to Moray. The region has experienced severe flooding events for almost 2 centuries, with the first recorded event occurring in 1826[29]. More recently, significant flooding in 1997 caused £35 million worth of damages to property, transport links and infrastructure within Elgin[30].

Figure 5 Cooper Park flooding

Additional flood events in 2002 and 2009 damaged multiple residential properties and infrastructure resources. Since 2014, Moray has benefitted from over £170 million of investment into flood alleviation schemes across multiple towns in the area, estimated to have prevented around £86 million worth of damages[31]. However, several areas of Moray remain affected by flood events.

In 2021, sudden heavy rainfall combined with a long dry period overwhelmed the drainage system in parts of Forres. A handful of properties were flooded and whole streets lost power[32]

The frequency and severity of flood events is expected to increase due to climate change. A warming climate will intensify the water cycle; for areas like Moray, this will result in higher levels of rainfall and more frequent flood events[33]. Met Office data confirms that Moray is already experiencing increased levels of rainfall; the average daily rainfall in the decade 2010-2019 was 1.82mm, an almost 20% increase from a daily average of 1.52mm from 1970 to 1979[34]. Moray is currently experiencing higher numbers of 'summer days' (+25°C) *and* higher levels of rainfall. These factors, combined with rising sea levels will pose a serious threat to Moray's communities if adaption action is not implemented.

Parts of Moray are still affected by instances of flooding. In 2021, parts of Forres were affected by flash floods after a long dry period combined with sudden heavy rain, overwhelmed drainage system. Properties flooded and caused a power cut.

Figure 6 Garmouth flooding

[29] SEPA, *Elgin (Potentially Vulnerable Area 05/05)*.
[30] Ibid.
[31] Moray Council, *Our Flood Alleviation Schemes – Elgin*.
[32] McCartney, G., *Forres hit by flash floods and thunder storms during an expected 48 hours of rain*
[33] NASA, *How Does Climate Change Affect Precipitation?*
[34] Met Office Data

4.3 Case Study – Storm Babet

In October 2023, Storm Babet caused extreme rainfall and strong winds that affected several parts of Moray, the storm was worsened by high sea temperatures.

Across the UK, 7 people lost their lives[35] and over 30,000 Scottish homes lost power[36]. The total cost of storm damage across the UK was up to £630 million[37].

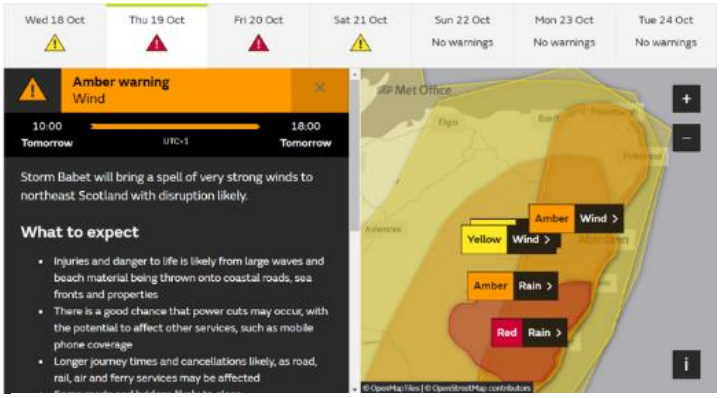

Figure 7 Met Office October 2023

Recorded Impacts in Moray

- Extreme waves at harbours, the Lossiemouth emergency plan was enacted, and five households were evacuated. Marina Quay road was also closed.
- Coastal erosion of up to ten metres resulted in a partial loss of the Moray Coastal Path.
- Multiple power cuts, a community hall opened to offer respite in Aberlour.
- Surface water flooding caused the A98 road to close.
- Trees felled.
- Water levels in the Spey River tripled.
- Forres Academy was closed due to flooding.
- Flood bank damage on agricultural land, a Scottish Government fund offered to support with repair costs after the event.

While actual costs for Moray Council are not recorded for weather events, the impact of Storm Babet was widespread.

A significant response was required from the Incident Management Team and action was taken by services including emergency planning, comms, road, consultancy, education, open spaces, housing and property, customer services and GIS.

Response and Resilience Measures

On the 18th of October 2023, Moray Council issued a news item alerting the people of Moray to the risk posed by high winds and heavy rain. Helplines were published by local news agencies and the council provided social media updates during the storm. Behind the scenes, a co-ordinated response was taking place. Multi agency meetings and correspondence were ongoing throughout the event, with a wide range of partners standing ready with plans in place to respond. The council's Incident Management Team met regularly and discussed the need for emergency rest places, catering, heaters, accommodation, road closure alert systems, and other communications. People at risk were contacted to offer support and there was liaison with community resilience groups. There was consideration that Moray may be required to assist communities from the worst affected areas in Aberdeenshire, and that ambulance response times may be affected.

The incident highlighted that robust systems are in place for planning, but implementation of an emergency response would not be sufficient in the event of more severe impacts occurring in Moray.

[35] The Independent, *Storm Babet death toll rises to seven,* 22 October 2023
[36] The Independent '*Improving picture' in worst hit area, but Storm Babet flooding fears remain,* 21 October 2023
[37] The Insurer (Reuters), *UK's Storm Babet to cost insurers up to £650mn*, 2 November 2023

4.4 Air Quality

Moray Council measures nitrogen dioxide (NO^2) as a key indicator of air quality. High concentrations of this gas, released through the burning of fossil fuels can irritate the lungs and lower resistance to respiratory infections, especially in children, the elderly and people with underlying health conditions.

The Scottish Government recommends a safe annual mean level of NO^2 exposure of 40 micrograms per cubic metre (40ug/m^3). Moray has comparatively good air quality, with an average NO^2 level from 2018 – 2023 of 18.3 ug/m^3 which is well below Scottish Government guidelines. However, in 2021 the World Health Organisation (WHO) recommended a lower safe exposure level to NO^2 of 10ug/m^3. The new WHO levels put Moray's average air quality readings over the safe levels of exposure.

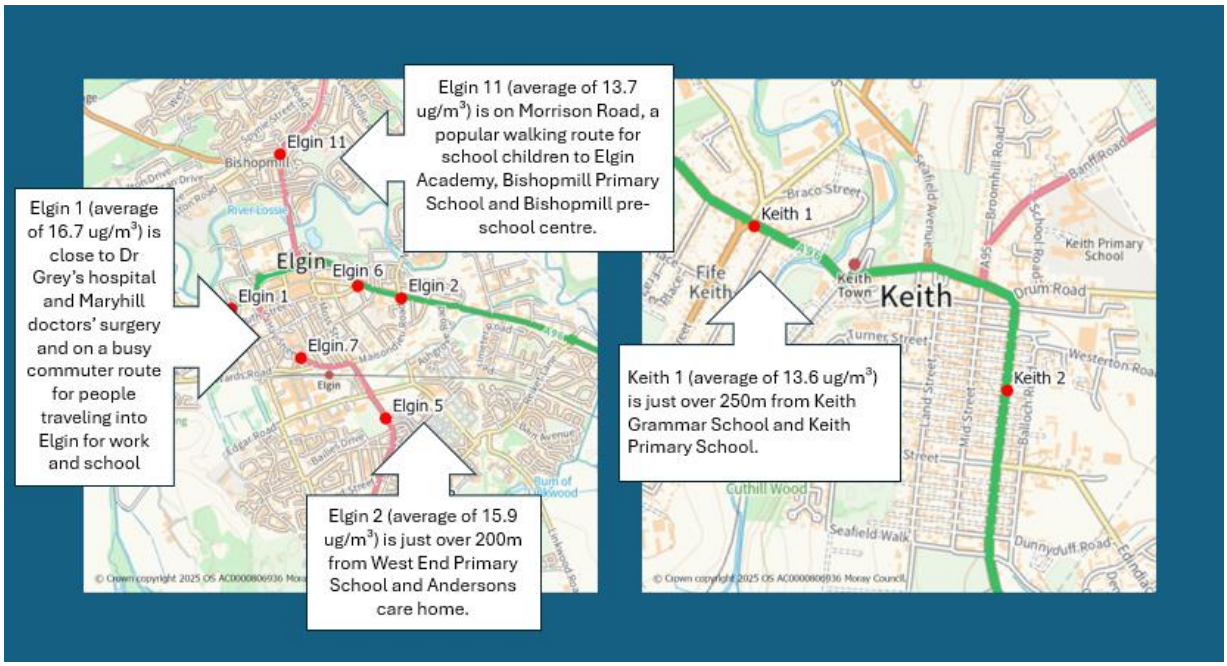

Figure 8 Air quality record averages 2018-2023

Using the Moray Council air quality monitoring reports covering 2023/24, just over half of Elgin's monitoring stations recorded a yearly average that exceeded 10ug/m^3. The only other stations that exceeded this level were both stations in Keith.

Some stations with the highest recorded levels of NO^2 are in close proximity to young children, teenagers, and elderly people. These groups are more susceptible to pollution related illnesses.

The United Kingdom Climate Change Risk Assessment 2022 (UKCCRA) identifies the 'risk to health and wellbeing from changes in air pollution' as a potential financial implication of climate change, estimated to cost up to £10 million per year[38]. The World Meteorological Organisation has concluded that heatwaves worsen air quality[39].

Figure 9 Asthmatic child

If temperatures continue to increase in Moray, council services such as Health and Social Care are likely to be impacted. Poor air quality can result in an increased demand on health services, particularly for respiratory issues. Asthma UK estimates an extra 20,000 hospital admissions each year in the UK are linked to air pollution[40].

[38] UK Government, *UK Climate Change Risk Assessment 2022*.

[39] World Meteorological Organisation, *WMO Bulletin: Heatwaves Worsen Air Quality and Pollution*.

[40] Asthma+Lung UK, *How Air Pollution Impacts our NHS*.

4.5 Water Scarcity

The Scottish Environmental Protection Agency (SEPA) issue water scarcity warnings when dry conditions occur over a prolonged period of time, and there is a need to protect the environment and water resources for critical functions.

Each year between 2018-2023, moderate to significant scarcity warning were issued in Scotland with 2021 being the only year that the North-East was not an at-risk area.

2018 saw the worst impacts in Moray with significant scarcity[41]. The council provided free bottled water to those at risk from low private water supplies.

Eastern Scotland has experienced a decrease in water availability over the last half a century[42]. Agricultural and manufacturing industries in Moray, especially distilleries, rely on significant volumes of water from both surface and ground water sources for everyday operations. Warmer, drier summers are likely to negatively affect these industries in Moray.

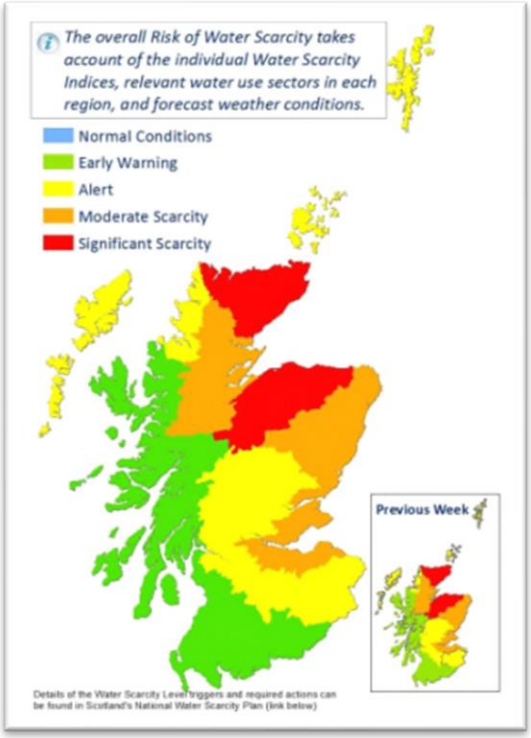

Figure 10 SEPA 31st August 2018

4.6 Fire Risk

Changing weather patterns caused by human driven global heating and biodiversity loss through land use change are both contributing to the increasing occurrence and severity of wildfires. There are other contributing factors to this increase, including a rise in recreational activity in rural land (leading to more campfires and barbeques).

The Scottish Fire and Rescue Service recorded 28 wildfires ('large outdoor fires' over 100sq. m) between 2018 and 2023. This was a similar number compared to the previous six-year period, however 11 of these occurred in 2018 alone.

Media reports suggest that the worst of these fires was on Paul's Hill in 2019, at the time cited as being one of the largest wildfires in the UK over a long period[43]. Research by the Met Office shows that the damaging fires (not only wildfires) during the UK's record-breaking 2022 heatwave were made at least six times more likely due to human-caused climate change[44].

Fires are expected to increase in magnitude and frequency due to the warmer and drier summers associated with climate change. An increase in high fire risk conditions could lead to devastating impacts and significant demand on emergency response teams.

[41] SEPA, *Water Scarcity Situation Report 2018*
[42] Centre of Expertise for Water, *Future Predictions of Water Scarcity in Scotland: Impact on Distilleries and Agricultural Abstractors*
[43] BBC News, Major wildfire could be one of the largest for years 2019
[44] Met Office, Climate change made severe UK fires in 2022 six times more likely 2025

5. Impacts on Council Services

The following data was collected by asking officers from across the council to detail the impacts of extreme weather on their service.

5.1 Economy, Environment & Finance

Building Services

Extreme weather events cause significant disruption to council housing. Heavy rain and winds caused damage to council houses between 2018-2023. In 2021, Storm Arwen caused £82,000 worth of damage, with Storm Otto causing a further £20,000 worth of damages in 2023. These damages put extra pressure on the building services team; emergency repairs and building maintenance both increase workload for staff. Extreme weather conditions are affecting the productivity of the building services team. Staff have limitations on working in certain areas due to weather conditions; work on rooftops is restricted during high winds and work in lofts is restricted during times of excessive heat. Building services has been forced to adapt to more extreme weather conditions. Harsher winters have required investment into 4-wheel drive vehicles to ensure staff can continue to perform their duties. For times of extreme heat, the service has issued new safety guidance for staff working in these conditions and also provides bottled water on the hottest days.

Environmental Services

Extreme weather has significantly impacted Moray's landscape; damage to trees, paths and open spaces all increase workload for Moray Council's environmental services team. Storm events cause damage to open spaces and infrastructure; fallen trees require reactive tree maintenance, putting pressure on an already strained resource. Additionally, storm events caused just over £8,000 worth of damage to various walls between 2022-2023. Flash flooding, often linked to storm events has caused damage to open spaces and council depot buildings. As temperatures increase, the environmental services team has had to alter normal working habits. For example, warmer weather has resulted in a longer growing season for grass pitches. Environmental services now experience an increased demand for pitch maintenance for a longer period of time, stretching an already in demand resource.

Damage to Moray's core paths has been linked to extreme weather events. Heavy rain, rapid snow melt and storm events have all contributed to land slips and riverbank erosion. Some core paths have been rerouted or closed due to weather related damage. An increase in extreme weather events could increase pressure on the environmental services team. Harsher conditions could result in more areas of Moray's landscape being damaged, requiring more maintenance from environmental service officers.

Figure 11 Core path erosion at Burghead Bay

Road Services

Moray's road networks are also disrupted by extreme weather events; damage to roads due to flooding, snow, and wind all require additional attention from staff. Winter is a particularly challenging time for the road services team. Snow and ice can make roads inaccessible and harder to maintain; additionally, snowmelt can flood roads and refreeze causing cracks and damage. In extreme cold, grit salt has frozen in -16^{0}C temperatures, significantly affecting road safety. Road services have adapted their normal operations to cope with changing weather conditions. The winter gritting season has remained the same length but shifted back by two months, forcing a change in normal scheduling. Furthermore, the heatwave of 2023 forced work to be halted mid-day to prevent staff exposure to extreme temperatures. Although days of extreme cold are likely to decrease as global temperatures increase, storm events and floods are likely to increase. A major change in climate will force road services to reevaluate its normal operations to cope with new challenges.

5.2 Education, Communities & Organisational Development

Organisational Development

Extreme weather events have increased the workload of Moray Council's organisational development team. The need for weather-related emergency communications, increased demand for out-of-ours support and the sharing of guidance/information from partner organisations all contribute to an increased workload. Additionally, weather-related power cuts have affected power supply and connectivity, impacting the ability of the service to function effectively. Climate change is affecting the organisational development team out-with times of extreme weather events. The service has seen an increased demand for health and safety information and clarification of policy provision from other services within the council due to the harsher working conditions experienced by staff. Services often require increased clarification of policy provision regarding the impact on extreme weather on employees and what terms and conditions apply. The organisational development team has the ability to work on a hybrid model which has helped to mitigate some effects of extreme weather.

Figure 12 Example of guidance provided to staff

Sport & Culture Services

Extreme weather events have impacted the sport and culture services team. A significant impact of extreme weather on this service is the closure of facilities. Facilities faced closure due to weather-related damage, a lack of staff due to weather-related travel disruption, and for re-purposing during emergency response/evacuation of local residents. These closures prevented staff from working and inconvenienced users of these facilities. The sport and culture service has identified heatwaves and rising temperatures as a significant impact on service delivery. Summer heatwaves increased the temperature of swimming pool halls, this, combined with failing air-con units made it difficult for staff to work. Additionally, this service has also received complaints from users of grass pitches due to an earlier growing season and limited resources within Open Spaces to maintain grass to appropriate levels. Heatwaves have also limited water supply at some facilities. Storm events have caused power cuts and the cancellations of buses which impact the delivery of sports and cultural activities. The sport and culture team use hybrid work practises and online meetings to reduce travel requirements; this can help reduce the impacts of extreme weather on service delivery.

Education

Extreme weather events have a significant impact on the education service. Dangerous conditions caused by severe snow and ice were the main reason for disruption during this period, followed by high winds and flooding. A warming climate will reduce the impacts of wintery conditions while also exacerbating the impacts of storms events and flooding. Over the next few decades, it is expected that a majority of school closures will be a result of storm damage to buildings and infrastructure. For example, Buckie High School was closed in 2021 and 2023 due to building damage related to storm conditions. Increasingly severe storm conditions will also affect the infrastructure that schools rely on to operate. For instance, when Buckie High School was forced to close in 2023, 3 primary schools were also closed due to a loss of power and heating. The cause of the power disruption was not recorded therefore it is more than likely, the storm conditions that directly damaged Buckie High School also indirectly affected 3 primary schools due to infrastructure damage. Schools are also used as local evacuation centres. Learning Estate is taking projected climate impacts into account on major infrastructure projects. However, they have found that adaptive infrastructure measures increase costs by 20%.

5.3 Health and Social Care Moray

Extreme weather predominantly affects Health and Social Care Moray (HSCM) by disrupting transport. Road closures, cancelled transport, and dangerous driving conditions all affect the ability of HSCM to operate effectively. Weather-related disruption in the supply chain can affect the availability of medication and nursing supplies. Weather events that disrupt power supply can affect service provision, HSCM requires power for medical devices like pumps, beds, and alarms. The service has protocol in place for providing batteries to vulnerable people in times of electricity shortage.

6. Recommendations

Providing recommendations to reduce the risk, and particularly the cost, of climate impacts is difficult within the limitations of this report and further work is required to engage with services and improve recording.

Areas that the LCLIP has identified as requiring further consideration in ongoing adaptation work include:

Improve recording and reporting of climate impacts

- For example SEPA report-a-flood data likely includes duplicate reports of the same event. How can we capture the number of actual flood events and identify the severity or type?
- Record emergencies where the Incident Management Team was activated due to extreme weather events.
- Name storms if they are the cause of disruption - for example school closures due to power cuts are usually the consequence of storm rather than an isolated power failure but records often don't capture the cause of the power cut.
- Where repair or other costs can be separated for a specific weather event, these should be recorded.

Embed resilience into building/infrastructure improvements

- Buildings should be able to withstand storms and power supply etc should be protected. For example when energy efficiency measures are being put in place, battery backup that can function in the event of a power cut should be installed.
- Apply interventions that provide multiple benefits at low cost, such as nature-based solutions can be particularly effective for cooling and flood management.

Embed resilience measures into service delivery and workforce health/safety /wellbeing

- Systems need to adapt to increased instances of extreme heat, high wind, flooding, pests and disease etc. For example, new procedures may need to be put in place, staff be made awareness of risks, managers be prepared for impacts on productivity.
- Emergency plans should anticipate increase in climate driven impacts.

Ensure long term forward planning and budgeting takes projected climate impacts and associated costs into account.

- Increase understanding among decision makers
- Corporate risk register, business continuity to maintain and build awareness of projected impacts
- Should include chronic impacts: Global with local effects e.g. risk of rising food price and availability, refugees fleeing conflict caused by increased competition for resources or more direct climate caused losses; Slow onset local impacts such as coastal erosion, water scarcity, staff productivity.

Share learning from adaptation measures that are already in place

- Increase knowledge of ways that addressing climate helps solve multiple issues – such as health and inequality in communities to financial savings for the council.

LCLIP recommendations within the wider context

This report has been produced alongside updating the Moray Council Climate Change Strategy, which will embed the council's adaptation strategy and action plan within it. Adaptation actions from the Climate Change Strategy are included in Appendix C.

The actions within the Climate Change Strategy have taken into account findings from the LCLIP, but are largely based around Adaptation Scotland's Capability Framework which is designed to guide public bodies on their adaptation journey. A separate report produced in 2023[45] explains that framework and summarises the council's baseline adaptation activity, highlighting gaps and opportunities through the use of a benchmarking tool. It found that the main risks to the council were likely to be infrastructure damage, keeping vulnerable

[45] Moray Council, Climate Change Adaptation Benchmarking 2023, 25 September 2024

people safe, and loss of ecosystem services. Adaptation was very clearly evidenced in some key services areas such as coastal change, flood management and local development planning, being the first local authority in Scotland to produce Coastal Change Adaptation Plans. Some areas were also found to be implementing adaptation measures through business-as-usual activities, but at an organisational level (which the Capability Framework assesses) the council was found to be in the initial stages of preparing for climate impacts.

An informal working group of volunteers from some key services oversaw the benchmarking process, learned about adaptation and agreed the baseline results. That groups should be reconvened with wider membership to support ongoing adaptation work. Annual reports following the structure of the Adaptation Capability Framework will be produced to monitor progress.

7. Conclusion

This report has collated available information on the experiences of council services in response to extreme weather. Services reporting at times significant increased demand or pressure due to extreme weather events include Open Spaces, Roads, Consultancy, Housing and Property, Communications and customer service roles. Schools and leisure facilities have had to close, and hot working conditions have been known to impact wellbeing and productivity for employees and service users.

Many services have already changed their ways of working due to the weather. Some services have introduced different ways of working for other reasons, but with results that help them be well adapted to cope with climate impacts, for example the introduction of hybrid working policy.

Preparing for a 2^{0}C increase in global temperatures over the next century is conservative at best, and a rise of 4^{0}C would require significantly greater, and earlier, adaptive measures to be taken to protect our communities, economy, and environment.

Greater understanding of how services are likely to be affected by an increase in climate driven extreme weather will help to strengthen business continuity, improve responses to emergencies and chronic impacts.

8. Appendices

Appendix A – Storm events

Storm Name	Storm Dates	Storm Name	Storm Dates
N/A	03/01/2012	Brendan	13/01/2020 - 14/01/2020
N/A	06/12/2012	Ciara	08/02/2020 - 09/02/2020
N/A	14/12/2012	Dennis	15/02/2020 - 16/02/2020
N/A	23/12/2012	N/A	11/08/2020 - 12/08/2020
N/A	21/01/2013	Alex	02/10/2020 - 04/10/2020
N/A	05/02/2013 - 06/02/2013	Barbara	21/10/2020
N/A	13/02/2013	Bella	26/12/2020 - 27/12/2020
N/A	19/03/2013	Christopher	18/01/2021 - 21/01/2021
Cyclone Xavier	05/12/2013	Darcy	07/02/2021
Winter Storms	14/02/2014 - 15/02/2014	Arwen	26/11/2021 - 27/11/2021
Ex-hurricane Bertha	10/08/2014 - 11/08/2014	Barra	07/12/2021 - 08/12-2021
Abigail	12/11/2015 - 13/11/2015	Malik	29/01/2022
Clodagh	29/11/2015	Corrie	30/01/2022 - 31/01/2022
Frank	31/12/2015	Dudley	16/02/2022 - 21/02/2022
Gertrude	29/01/2016	Eunice	16/02/2022 - 21/02/2022
Henry	01/02/2016	Franklin	16/02/2022 - 21/02/2022
Barbara	23/12/2016	N/A	08/12/2022 - 18/12/2022
Conor	26/12/2016	Otto	17/02/2023
Doris	23/02/2017	Betty	18/08/2023 - 19/08/2023
Aileen	13/09/2017	Agnes	27/09/2023 - 28/09/2023
Caroline	07/12/2017	Babet	18/10/2023 - 21/10/2023
Georgina	24/01/2018	Ciarán	01/11/2023 - 02/11/2023
N/A	28/02/2018 - 02/03/2018	Debi	13/11/2023
Hector	13/06/2018 - 14/06/2018	Fergus	10/12/2023
Ali	19/09/2018	Gerrit	27/12/2023 - 28/12/2023
Callum	12/10/2018 - 13/10/2018		
Deirdre	15/12/2018 - 16/12/2018		
Erik	08/02/2019 - 09/02/2019		
Gareth	10/03/2019 - 16/03/2019		

Appendix B – Impact on services feedback form

Risks	
Have weather or climate events had an impact on your service at any time? This could be directly, for example damage or forced closures due to extreme weather events, or indirectly such as supply chain disruption Please give details.	•
Have climate risks been assessed for your service? Please give details. Impacts such as damage and disruption caused by severe weather/ flooding/ overheating of buildings/ changes in the natural environment will become more likely.	•
Please list the plans/ documents you use that you consider to be important in managing climate related risks – these could be for team planning, risk assessment, health and safety, business continuity etc	•
What is your service already doing to manage/ increase resilience to the impacts of weather/ climate? This could be anything from putting infrastructure in place to changing work practices or enabling adaptation to take place within the community	•
How effective are the measures currently in place to deal with the impacts of weather/ climate?	•
What more could your service do to improve resilience to weather/ climate?	•
And what is preventing you from improving resilience in your service?	•
What do you see as the main priority for your service in responding to climate change impacts?	•

Appendix C – Adaptation actions in the draft Climate Change Strategy 2025

Increase understanding of climate risk	
We will	**How to measure success**
Create and maintain a climate impacts log	• Include summary of log in annual report • # towns with mapping complete • Training delivered (# of sessions/staff) • CCRA completed
Produce climate risk and nature-based solution maps for larger towns	
Embed adaptation within climate training and mainstreaming	
Eventually move towards the production of a Climate Change Risk Assessment (CCRA)	

Align adaptation activities with Council's priorities	
We will	**How to measure success**
Integrate or mainstream adaptation action into relevant service plans, strategies and reports.	• # of these referring to adaptation and climate risk

Deliver and monitor adaptation action	
We will	**How to measure success**
Undertake annual benchmarking exercise	• Incorporate adaptation guidance into CC guidance for developers • Measure proxies for adaptation works as per SNAP3 eg nature network, # of local place plans, roads maintenance (RCI) etc • Flood Risk Management Plan and Coastal Change Adaptation actions delivered (3 yearly)
Implement flooding and coastal risk action plans	
Incorporate adaptation into LDP	
Implement Nature Network	

Work collaboratively with partners to progress adaptation action	
We will	**How to measure success**
Encourage communities to consider climate risk and adaptation	• No. of resilience plans in place

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