ABERDEEN ADAPTS

Evidence Base

January 2022

Version 0.1	December 2019
Version 0.2	January 2020
Version 0.3	January 2022

Introduction

This evidence base aims to identify the impacts from climate change for Aberdeen. Many of the decisions we make now will have consequences for the future. Understanding how climate change will affect the city will help with managing these risks; it can inform decision-making and by gathering information on local adaptation actions already in place can be used to assess the actions and policy needed to strengthen resilience.

It is anticipated this will be a live document, with information developed as evidence and research becomes available and as national data on climate risks and projections is updated.

The changing climate

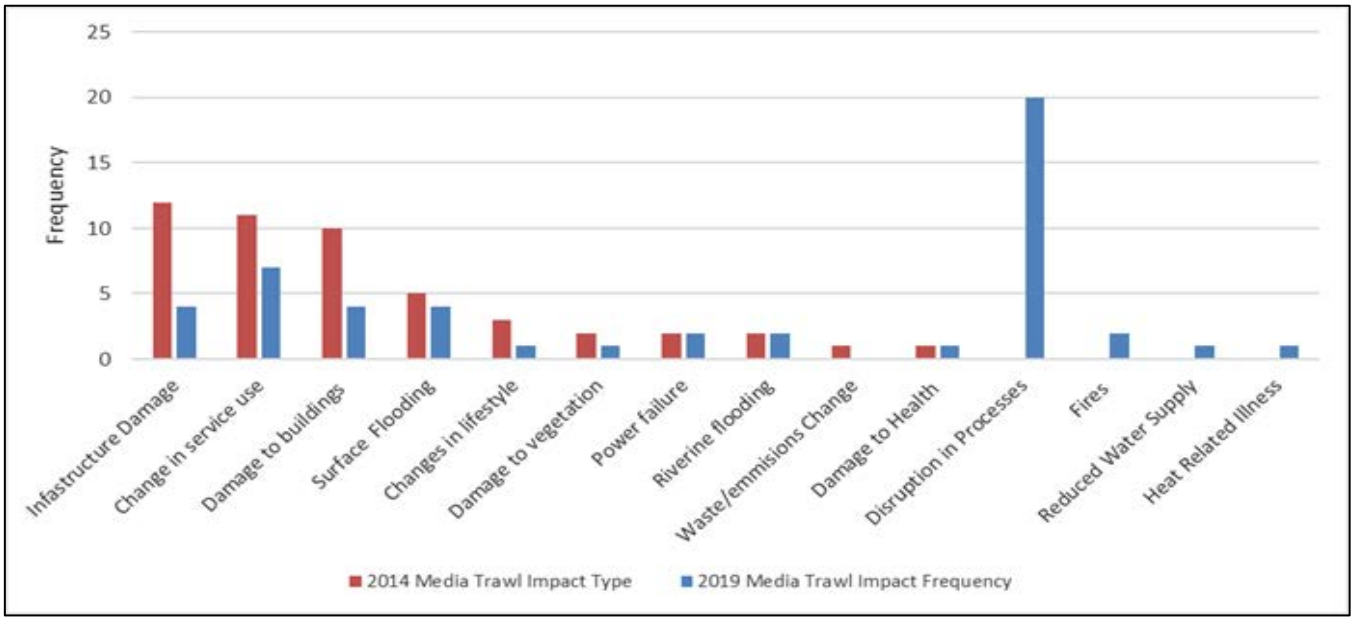
Observed changes

There are already signs of changes to the climate. The top 10 warmest years for the UK since 1884 have occurred since 2002. UK sea level has been rising by about 3mm a year and 2020 was the UK's fifth wettest year since 1862, 122% of the 1961–1990 average rainfall.[1]

Scotland was 11% wetter than 1961–1990 and the wettest day in record in Aberdeenshire was recorded in 2020. Temperature and rainfall increases have been observed over the last few decades and there has been a reduction in air and ground frost, as well as snow cover.

In Aberdeen trend data has shown temperature increases but less variability in annual average rainfall. A media trawl of the effects of weather in the city *(Figure 1)* reflects some of the changes in weather impacts over the last 10 years.

Figure 1 – Weather Impacts Aberdeen



About climate change

Climate refers to long term weather patterns, averaged over a period of time. While there is a natural climate variability, the influence of greenhouse gas emissions in the atmosphere is causing a more rapid change in climate and this will accelerate in the decades to come.

The impacts could include affect species, bring risks to global and regional food security and in some areas, for parts of the year, high temperature and humidity could impact on normal human activities, such as working outdoors.[2]

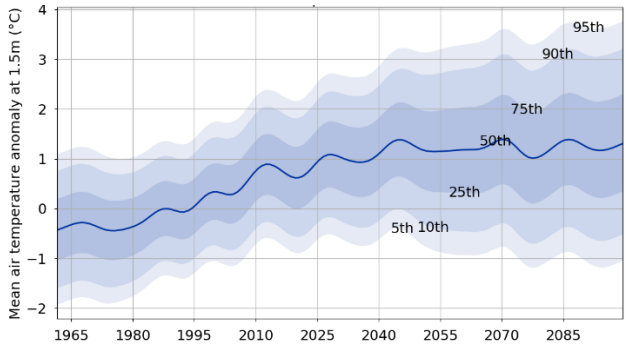
Global agreements to reduce emissions aim to limit global warming to 1.5ºC but change will still happen. Even if greenhouse gas emissions were to stop tomorrow, past and present emissions in the atmosphere will continue to drive a change in climate for several decades.

What will climate change mean for Aberdeen?

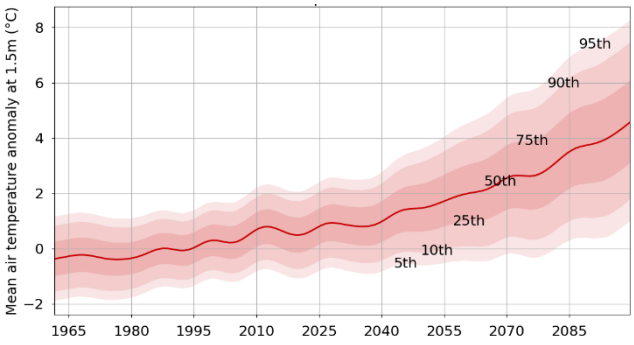
The UK Climate Projections (UKCP18)[3] provide comprehensive data on future climate projections for the UK. Scenarios for the east of Scotland, indicate an increase in the frequency and severity of extreme weather events. For Aberdeen, this will mean warmer temperatures, wetter winters, drier summers, a rise in sea level and less snow ice and frost.

Temperature

Provisional UK mean temperature for 2021 was 9.3 °C. In the UK an increase in temperatures is projected across all seasons. For the north east of Scotland the range of probabilistic projections for **summer** (low and high emission scenarios) is indicated below, mean temperature increase is shown by the 50th line.

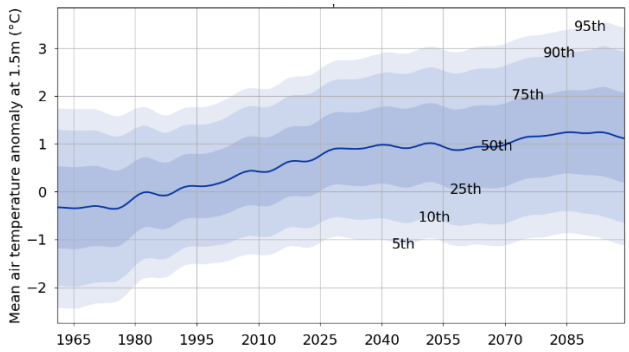


low emission scenario

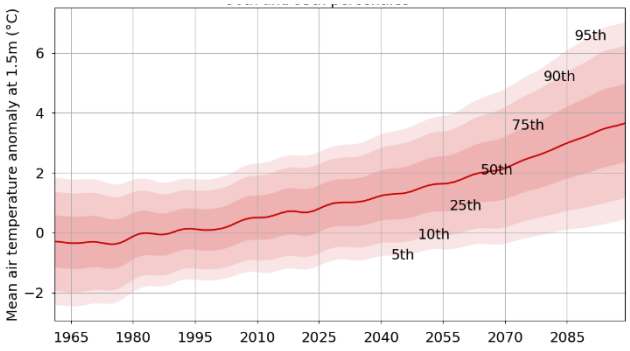


high emission scenario

For the north east of Scotland the range of probabilistic projections for **winter** (low and high emission scenarios) are below. There will be an increase in temperature with less snow, ice and frost days, however the potential for an extreme snowfall event will remain.



low emission scenario

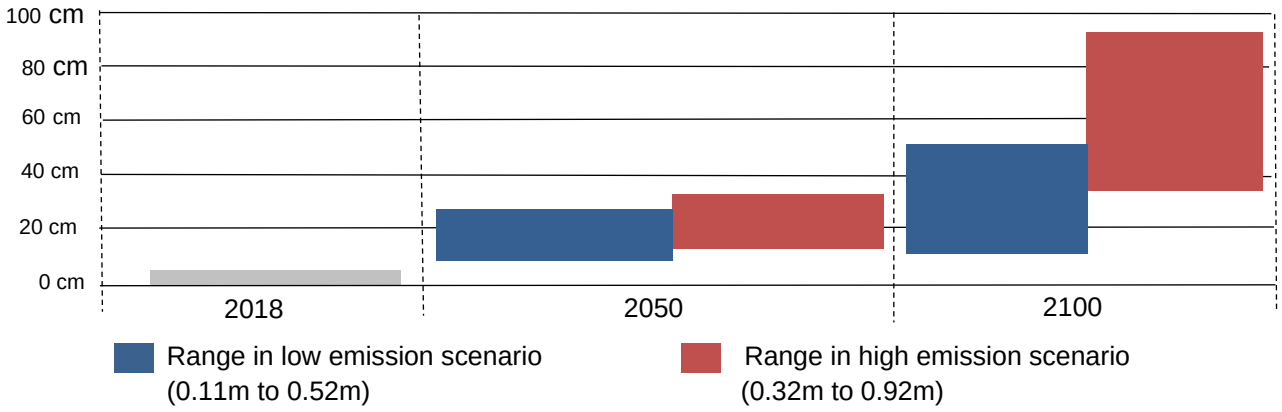


high emission scenario

Rise in sea level

Sea level is gradually rising and this will rapidly accelerate in the coming decades. There will be a rise in sea level under all emission scenarios, with a mean increase of 0.56m under a high emission scenario and a mean increase of 0.36m under a low emission scenario. *(Figure 2)*
Alongside the risk of tidal surges and wave overtopping, this could cause flooding and erosion for coastal areas. Dynamic Coast, Scotland's Coastal Change Assessment[4] has identified areas at risk of future erosion, highlighting a few small areas along Aberdeen's soft coastal areas, north of the River Don that may be susceptible to future erosion. A dynamic coastline is a natural process. However, coastal inundation has potential consequences for natural habitats and defences, such as the coastal dune ridge north of the River Don. Change in sedimentation pattern may lead to erosion at the coast or sedimentation processes in adjacent areas to existing coastal defences.

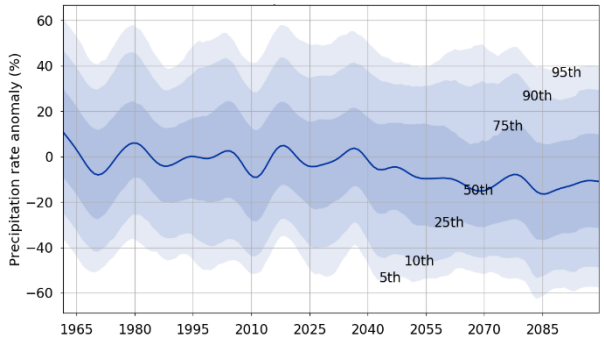
Figure 2: Projections for sea level rise (Aberdeen) – up to 2100



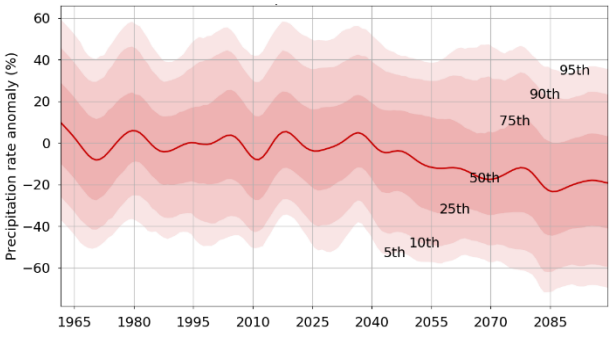
UKCP18 – probabilistic projections RCP2.6 and RCP8.5, 1981–2000 baseline (range 10% - 90% probability)

Rainfall

Projections indicate a reduction in spring/ summer rainfall which could affect water quality and availability in the long term. **Summer rainfall** (low and high emission scenarios), for the north east Scotland.

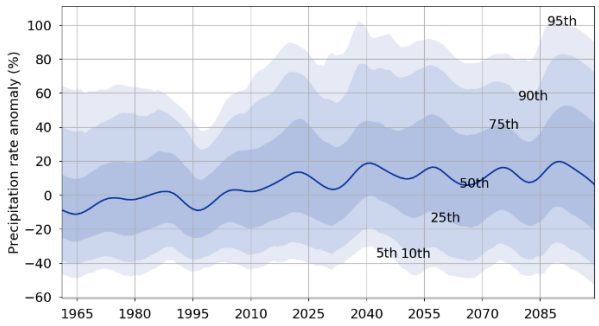


low emission scenario

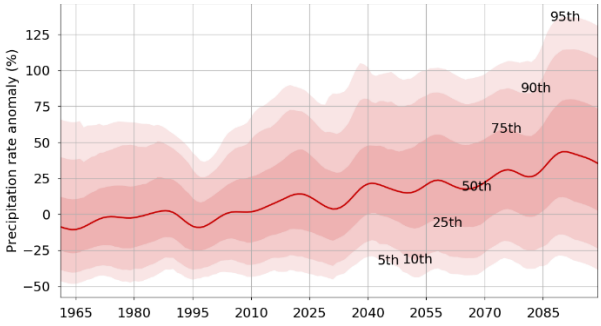


high emission scenario

In winter there will be an increase in rainfall, not more rainy days but more intense bursts of rainfall. **Winter rainfall** (low and high emission scenario), for the north east Scotland



low emission scenario



high emission scenario

UKCP18 - Average temperature and precipitation summer and winter, baseline 1981 – 2000 showing 5th, 10th, 25th, 50th,75th, 90th and 95th percentiles. Met Office Hadley Centre

River levels: Average water levels for the **River Dee are 1.017m** and for the **River Don 1.193m**.[5]
Peak flows: SEPA records show that in December 2015 river levels on the River Dee reached the highest level at Garthdee of 6.195m following extreme rainfall. This caused widespread flooding and damage and hundreds of tonnes of riverbed and bank materials were washed out onto riverbanks and floodplains.
A highest level of 5.56m was recorded on the River Don during extreme weather events in January 2016.
Low flows: The lowest water level on record at the Garthdee station is 0.531m. The River Dee is the main source of public drinking water, supplying around 300,000 homes in Aberdeen and Aberdeenshire.

Climate risks and implications for Aberdeen

The Technical Report for the Third UK Climate Risk Assessment (CCRA)[6] identifies sixty-one climate risks for the UK across multiple sectors. This includes risk of: flooding and coastal change; water shortages; as well as risks to health, well-being and productivity from high temperatures; to nature and wildlife; and to food production and trade. The report includes a national summary for Scotland.
Information on risks and opportunities for Aberdeen was gathered using desk-based research, to inform the development of Aberdeen Adapts. This section:

Sets out climate risks and opportunities relevant to Aberdeen

A. Buildings and heritage	E. Soil	I. Health and wellbeing
B. Transport & infrastructure	F. Trees and woodlands	J. Economy
C. Water, energy & communications	G. Watercourses and coastline	K. Food
D. Species, habitats & landscape	H. Communities	

- **Includes additional information challenge and opportunities for research and awareness.**
- **Summarises the current policies and actions relating to adaptation in Aberdeen.**
- **Identifies ways to strengthen resilience**

More action needed	Further investigation	Sustain current action	Monitor

A. Buildings and heritage

Context

- 120,980 dwellings in Aberdeen in 2020, an increase of 15.2% since 2001.[7]
- 6,700 dwellings were vacant in 2020[8]
- 5% of city homes are affected by damp and 16% by condensation. [9]
- 10,440 residential properties in Aberdeen are in areas potentially vulnerable to flooding [10]

Climate hazard		Climate impact
Flooding/ storms	A.1	Damage to buildings and heritage. Loss of/ or damage or degradation of city heritage.
	A.2	Temporary, long term closure or relocation of buildings.
	A.3	Risk of waste water entering property, backing up through toilets, sinks, doorways, cable ducts or air bricks.
	A.4	Waterlogged grounds, playing fields and sports pitches, access and use restricted.
	A.5	Suitability of areas for future development may be restricted.
Extreme rainfall/ storms	A.6	Risk of water penetration, damage and erosion to stonework, risk of falling masonry.
	A.7	Risk of damp and mould.
Subsidence	A.8	Subsidence from shrinkage and swelling of clay soils.
Extreme heat	A.9	Buildings at risk from glare and heat gain during hotter temperatures affecting thermal comfort levels.
	A.11	Increased demand for cooling.
Sea level rise	A.12	Coastal inundation and wave overtopping - damage and degradation to coastal buildings and heritage.
Extreme cold	A.13	Snow, ice and frost increase energy demand and result in burst pipes.

* *shrink-swell subsidence is generally less likely in Scotland where there is a lesser prevalence of high plasticity clay soils*

Current adaptation actions

Planning

- The Aberdeen City and Shire Strategic Development Plan includes an aim to take on the urgent challenges of climate change.
- Aberdeen Local Development Plan 2017 includes policy and guidance on Flooding, Drainage and Water Quality. This aims to manage and reduce flood risk, ensuring that new development does not take place on areas susceptible to flooding and incorporates appropriate, sustainable surface water management measures. It also covers protection of land and green infrastructure, with the potential to contribute to natural flood risk management. Supplementary Guidance provides guidance on statutory roles and responsibilities, Flood Risk Assessments, Drainage Impact Assessments, Sustainable Drainage Systems (SuDS), Regional SuDS and Waste and Foul Drainage. These plans also aim to encourage water efficiency in new development.

Buildings

- Conservation Area Regeneration Scheme (CARS)[11] aims to encourage the regeneration and conservation initiatives within Union Street Conservation Area.
- Traditional construction skills and training, including property owner training by Aberdeen City Heritage Trust and partners.

Ways to strengthen resilience

More action needed	Further investigation	Sustain current action	Monitor
• Retrofit, property protection. • Reduce water & energy demand. • Protect heritage. • Green Infrastructure. • Skills development.	• Assess buildings at risk. • Review/ strengthen plans, policy. • Increase understanding. • Guidance and training. • Tools to support decision making.	• Plans & policy • Drainage Impact Assessments. • Conservation initiatives.	• Monitor change. • Condition & suitability assessments.

B. Transport and infrastructure

Context

- There are around 174 road bridges in the city, with 100 over waterways. [12]
- Local Roads Authority covers 913km of city roads
- Around 50% of school pupils walk to school in the city. 24% adults in Aberdeen walk or cycle to work

Climate hazard		Climate impact
Flooding and storms	B.1	Pressure on drainage systems from increased rainfall.
	B.2	Damage and corrosion to transport surfaces.
	B.3	Peak river flows result in erosion to riverbanks, undermining bridge structures.
	B.4	Risk of structural damage or failure, if bridges are hit by floating debris.
	B.5	Threat of scour on bridges with footings in the watercourse.
	B.6	Reduction in active travel to due to extreme events.
Extreme rainfall	B.7	Run off from transport routes causes contamination of water courses.
Extreme heat	B.8	Prolonged high temperatures damage rails, road, footway surfaces.
	B.9	Thermal comfort levels of public transport staff and passengers may be affected.
Sea level rise	B.10	Coastal surge/ wave overtopping affects coastal transport routes.
	B.11	Scour to sea walls and defences.
	B.12	Coastal erosion and recession, especially to soft coastal areas Aberdeen Beach and northward.
Landslide	B.13	Slope failure transport infrastructure – (high rainfall/ combined with spells of dry weather).
Extreme cold	B.14	Damage to transport surfaces, such as pot holes.

Current adaptation actions

- Aberdeen's Local Transport Strategy 2016 - 2021 includes objectives for resilient transport networks and infrastructure.
- NESTRANS 2040 - Regional Transport Strategy includes: reduce our impact on climate change and protect the environment.
- National Roads Development Guide[13] takes into account climate threats in new road developments, however much of the road network pre-dates current guidance.
- Aberdeen City Council has a Roads Safety Inspection Manual outlining inspection, assessment and recording. Roads under the Local Roads Authority are maintained and protected through a Winter Services Plan 2019-20, Roads Asset Management Plan and Roads Maintenance Programme. Footways are inspected at intervals and a skeleton 24 hour roads operation squad is in operation.
- Core path remediation took place to address flooding erosion on a number of paths and this has included adaptation measures to help future proof these paths. The measures primarily relate to drainage which has been designed to cope with higher rainfall events.
- Transport Scotland and Aberdeen City Council operate routine bridge safety and inspection schemes.
- Network Rail have Route Weather Resilience and Climate Adaptation Plans[14]. Weather impacts on routes include work to repair minor incidences of earth slip between Aberdeen and Stonehaven and indicates several incidences of delays due to snow and cold.
- Aberdeen Local Outcome Improvement Plan includes the stretch outcome of 38% of people walking and 5% of people cycling as main mode of travel by 2026.
- FirstGroup UK Bus (Scotland), harvest rainwater at their depots for cleaning vehicles.[15]

Ways to strengthen resilience

More action needed	Further investigation	Sustain current action	Monitor
• Improve transport connections. • Remote working. • Porous surfaces, SUDs • Green infrastructure.	• Strengthen plans, policy. • Develop skills and knowledge. • Increase understanding. • Shoreline Plan.	• Maintain inspections. • Roads design Guidance. • Maintain gully clearance. • Regional & Local Transport Strategy.	• Assess infrastructure at risk. • Monitor change.

C. Water, energy and communications

Context

- North East Flood Risk Management Plan (cycle 1) [16] indicated 33 utilities assets as potentially vulnerable to flooding.
- Around 150 private water supplies in Aberdeen.
- River Dee and tributaries provide domestic water to most of Aberdeen and half of Aberdeenshire.

Climate hazard		Climate impact
Flooding/extreme rainfall/ storms	C.1	Cascading risks from damage, disruption and outages to communication and IT infrastructure. Impacts for emergency response.
	C.2	Damage, disruption and outages to decentralised energy networks.
	C.3	Cascading risks from damage, disruption outages to national energy networks – (resilience planning).
Lightning	C.4	Localised power outage from lightning strike.
Extreme heat	C.5	Overheating of IT servers and equipment.
	C.6	Reduction in output of solar PV.
Drought	C.7	Low water flows affect power production, water generating energy schemes.
	C.8	Low flows in the River Dee, alongside demand for water supply, affects water quality and availability.[17]
	C.9	Low flows in the River Dee increase concentrations of pollutants.
	C.10	A reduction in groundwater affects the quality and water levels in private water supplies.
	C.11	City growth and low flows limit levels of water abstraction.
Cumulative impacts	C.12	Damage to decentralised energy infrastructure and reduction in energy generation.

Current adaptation actions

Planning

- Aberdeen City and Shire Strategic Development Plan has set targets to avoid having to increase the amount of water abstracted from the River Dee and for all new developments to use water-saving technology.
- The Aberdeen Local Development Plan includes policies on water efficiency as well as Supplementary Guidance on Flooding, Drainage and Water Quality.

Water

- Limited examples of use of rainwater harvesting and grey water recycling in the city.
- Aberdeen City Council has a responsibility for sampling and the risk assessment of private water supplies in the city and investigating pollution incidences.
- Contingency measures are identified for local private water supplies in case of dry spells.
- Scottish Water has contingencies measures for public water supplies.
- SEPA Water Scarcity reports monitor groundwater levels in Scotland. National Water Scarcity Plan[18] is in place. SEPA Water Supply and Waste Water Sector Plan.[19]

Flood management

- The North East Flood Risk Management Plan has assessed local areas potentially vulnerable to flooding and outlined actions to contribute to managing flood risk and recovering from any future flood events. Work is taking place on cycle 2 of the plan. An Integrated Catchment Study, has involved surveying sewers and watercourses, measuring flows and rainfalls and building a computer model all water courses in Aberdeen and how they integrate. Key liaison meetings are held every quarter on drainage
- A number of Flood Prevention Schemes currently in place or under construction in Aberdeen. Flood gates at Bridge of Dee Court, as part of the Dee View Court Flood Protection Scheme. Merchant Quarter, collaborative project with Scottish Water to prevent city centre sewer flooding. Inchgarth, flood wall to protect road and properties. Deeview Court, flood gates. Riverside Drive. River Don early warning system. Maidencraig Flood Alleviation project.
- Introduction of Sustainable Urban Drainage systems (SUDs).
- Introduction of gauges and sensors for early response.

Utilities

- Utility companies manage and maintain their own assets.
- Resilience planning, partnership and procedures.
- City decentralised energy networks, such as the Combined Heat and Power network are diversifying the energy mix, helping to support local energy security.

Ways to strengthen resilience

More action needed	Further investigation	Sustain current action	Monitor
• Expand collaboration on infrastructure. • Engagement with resilience partners. • Water efficiency.	• Shared data infrastructure interdependencies. • Liaison on water conservation. • Protection developing digital infrastructure.	• Flood Risk Management Partnership work. • Flood risk assessment. • Flood risk planning cycles.	• Water scarcity. • Water dependent • Decentralised energy.

D. Species, habitats and landscape

Context

- 6 city parks, 7 local parks, 32 neighbourhood parks, 4 Local Nature Reserves, 4 Sites of Special Scientific Interest.
- 25% moths disappeared Scotland, butterflies risen by 9%, decline in seabirds.[20]
- Scottish Fire and Rescue Service spent 307 hours tackling wildfires in Aberdeen 2018/19. Weather during this period involved long spells of high temperatures and low rainfall.

Climate hazard		Climate impact
Flooding	D.1	Risk of habitat fragmentation.
	D.2	Erosion of habitats.
	D.3	Damage to parks/ greenspace areas. Loss of and/or contamination of amenities.
Extreme rainfall	D.4	Increased risk of landslip.
Extreme heat	D.5	Increased risk of wildfire due to drought, dry surfaces, wind and low humidity.
	D.6	A northward movement of some species with warmer temperatures. Change to bird migratory patterns and movement of aquatic species.
	D.7	Increased length of growing season.
	D.8	Increased risk of wildfire - drought, dry surfaces, coupled with wind and low humidity.
Drought	D.9	Degradation of green spaces and vegetation.
	D.10	High temperatures/ a reduction in summer rainfall may dry out wetland areas.
Cumulative impacts	D.11	An increase in invasive non-native species (INNS).
	D.12	Change in species distribution and numbers.
	D.13	Increase in pests and diseases. More pests will be able to survive over winter as temperatures increase.
	D.14	Loss of habitats, reduced food sources. Hard for some species to survive.

Current adaptation actions

- Climate change is considered in the Aberdeen Nature Conservation Strategy, and Aberdeen's Open Space Strategy.
- A city Green Space Network aims to improve connectivity between habitats and open spaces. It also takes into account climate change adaptation opportunities and flood risk or alleviation.
- The North East Scotland Biodiversity Partnership works collaboratively to deliver a range of projects that aim to make a difference for biodiversity in the region.
- Monitoring and recording of current species numbers and distribution takes place through North East Scotland Biological Records Centre.
- Work has taken place at Hazlehead Park to develop a Climate Change Park.
- A multi partnership education programme has worked to reduce wilful fire raising at a number of city nature reserves.
- City projects working with nature to improve water management include the Seaton Wetland Project and Maidencraig flood alleviation scheme.

Ways to strengthen resilience

More action needed	Further investigation	Sustain current action	Monitor
• Greenspace networks. • Nature based solutions. • Reduce existing pressures. • Pollinators.	• Liaison on water conservation. • Data.	• Partnerships. • Strategy, policy, plans. • Species records.	• Biodiversity data. • Vigilance for INNS and pests and disease.

E. Soil

Context

- There are some small pockets of peat soil in Aberdeen[21]

Climate hazard		Climate impact
Flooding	E.1	Contamination of soil.
	E.2	Erosion of habitats.
	E.3	Damage to parks/ greenspace areas. Loss of and/or contamination of amenities.
	E.4	Increase risk of run off and flooding due to soil sealing and compaction.
Extreme rainfall	E.5	Prolonged rainfall results in soil saturation.
	E.6	Soil instability, increased risk of landslip.
	E.7	Loss of soil organic matter. Impact on growing.
	E.8	Increased risk of water-based soil erosion and loss of top soil. Risk of pollutants to water courses due to run off from bare soil in agricultural areas.
Drought	E.9	Dry, bare and unprotected soil is less able to absorb rainfall.
Cumulative impacts	E.10	Reduction in soil quality and function - soil less able to store and retain water and filter pollutants.
	E.11	Invasive non-native species (INNS) affect soil biodiversity, such as New Zealand flat worm.
	E.12	Risk of subsidence from the shrinkage and swelling of soils.
	E.13	Loss of soil carbon.

Current adaptation actions

Planning

- Policies under the Aberdeen Local Development Plan cover carbon-rich soils and degraded and contaminated land. Scottish Planning Policy states that the planning system should seek to protect soils from damage such as erosion or compaction.
- There is some use of permeable and porous surfaces in the city.
- The Scottish Soil Framework[22] aims to protect soils.
- Further information on risk to soils is available at Scotland's soils risk maps. [23]

Ways to strengthen resilience

More action needed	Further investigation	Sustain current action	Monitor
• Reduce erosion. • Permeable/ porous surfaces. • Reduce soil sealing/ compaction. • Soil protection, good soil management. • Green infrastructure.	• Protection of soil carbon. • Soil protection embedded in policy. • Data.	• Partnerships. • Strategy, policy, plans. • Species records.	• Reductions in soil health/ quality.

F. Trees and woodlands

Context

- Area of native woodland in Aberdeen is 514ha.[24]
- Area of woodland affected by invasive non-native species is 10.3ha.
- 140 sites of ancient woodland.
- Estimated 115,000 individual street, park and garden and civic trees Aberdeen.
- 2,410 hectares of woodland in Aberdeen, representing 13% of its total land area of 18,830 hectares.

Climate hazard		Climate impact
Extreme rainfall	F.1	Waterlogged soils, weaken tree roots. Trees vulnerable to wind throw.
	F.2	Opportunity - trees and vegetation alongside river banks can help to absorb excess water, slowing run off to rivers.
Storms	F.3	Loss of branches, fallen trees.
Extreme heat	F.4	Increased risk of wildfire due to drought, dry surfaces, wind and low humidity.
	F.5	Risk of leaf scorch to street trees in the vicinity of buildings –glass reflection.
	F.6	Opportunity - Increased length of growing season. Eastern Scotland favourable for growth high-quality broadleaved trees.
	F.7	Opportunity -Trees and vegetation provide shade. Can help with cooling/ insulating.
	F.8	Increased risk of wildfire - drought, dry surfaces, coupled with wind and low humidity.
Drought	F.9	High temperatures and a reduction in summer rainfall affect drought sensitive trees*. Trees with restricted root growth vulnerable to less summer rainfall.
Cumulative impacts	F.10	Increase in pests and diseases, such as green-spruce aphid. Pinewood already affected by red band needle blight due to warmer conditions.**
	F.11	Some tree species may not enter full dormancy (warmer winters). Damage during colder periods.
	F.12	Warmer temperatures/ less in summer rainfall impacts tree condition/ growth.
	F.13	Opportunity - Trees including Scots pine, Common Alder and Silver Birch can reduce air pollution.

**increased drought risk in eastern Scotland will affect growth/ timber quality. More drought-tolerant species will have a competitive advantage over Sitka spruce (impacts on oak and beech also projected to be severe).*
***Dothistroma needle blight has continued to particular affecting east and north Scotland*

Current adaptation actions

Plans and strategy

- The Aberdeen Local Development Plan includes policy and Supplementary Guidance on trees and woodlands.
- Consultation on a Tree and Woodland Strategic Implementation Plan for the city.
- A Survey of Native Woodland in Aberdeen indicated the main priority habitat types are Upland birchwoods, Native pinewoods and Wet woodland. The most common native species in the upper canopy are downy birch & Scots pine.
- Invasive non-native species affecting woodland includes rhododendron, Himalayan balsam, giant hogweed, Japanese knotweed, snowberry.

Tree planting

- The Granite City Forest woodland creation and enhanced management of existing woodlands.
- Outwith the city, community reforestation work is taking place in catchment areas of the Dee, helping to slow down run off and reduce downstream flooding.

Ways to strengthen resilience

More action needed	Further investigation	Sustain current action	Monitor
• Increased tree planting • Nature based solutions.	• Mix of tree species. • Liaison with shire - riparian planting. • Sequestration.	• Plans. • Tree protection.	• Tree health. • Vigilance for pests and disease. • Canopy cover.

G. Watercourses and coastline

Context

- The River Dee is a Special Areas of Conservation (SAC) supporting internationally important freshwater pearl mussel, Atlantic salmon and otter.
  Aberdeen has over 600km of waterbodies (open & culverted).
- The area at the mouth of the Don has moved over 200 m landwards[4] in the last one 100 years and continues to do so.
- A Marine Special Protection Area has been extended into Aberdeen's coastal zone.[25]

Climate hazard		Climate impact
Flooding	G.1	Increased peak flows. Damage and debris to water courses. Adverse impact on river corridors.
	G.2	Erosion of river banks.
Extreme rainfall	G.3	Water courses affected by diffuse pollutants.
Drought	G.4	Low flows/ warmer rivers. Water quality and health of invertebrates and fish affected. Protected species in the River Dee
Rise in sea level	G.5	Movement of sand dune systems and sediment. Leads to coastal erosion.
	G.6	A rise in sea level -affects shoreline and cliff nesting birds.
Cumulative impacts	G.7	Increased risk of algal bloom - warm temperatures/ low river flows.
	G.8	Shifts in ranges of plankton and fish abundance - contributes to a decline in seabirds
	G.9	Warmer North Sea drives cold-water species north.
	G.10	A northwards movement of marine invasive non-native species.

Current adaptation actions

- The Dee Catchment Partnership aims to return the River Dee catchment to good order throughout, with sufficient high quality water, habitat and amenity to allow all its inhabitants, flora and fauna to flourish.
- At the coast, the East Grampian Coastal Partnership is facilitating the delivery of Integrated Coastal Management between Fraserburgh and the mouth of the River North Esk, on the east coast of Scotland.
- A River Basin Management Plan (RBMP)[26] is addressing issues of water quantity and quality.
- The Aberdeen Local Development Plan includes policy on coastal planning and has Supplementary Guidance on flooding, drainage and water quality.
- Scotland's National Marine Plan[27] states: Wherever possible, flood risk management and coastal protection solutions should work with natural processes and features.
- At Aberdeen beach groynes are in place to protect the beach from coastal erosion by interrupt long-shore water flow, this limits sediment movement and removal.
- Beach levels are also monitored on a bi-weekly basis, these can vary naturally along the Aberdeen coastal front, low sand levels present a risk to the stability of the seawall and a risk to the public access and safety.

Ways to strengthen resilience

More action needed	Further investigation	Sustain current action	Monitor
• Joined up shoreline planning. • Pollution risk. • Habitat restoration.	• Awareness/ understanding. • Measures to address erosion.	• Coastal inspection and monitoring. • Catchment planning.	• Erosion - Dynamic Coast • Data - impacts for watercourses

H. Communities

Context

- Population Aberdeen 229,060.[28]
- 108,893 households in Aberdeen an increase of 12.3% since 2001.[29]
- 1 Community Risk Register and 2 Community Resilience Plans.
- Aberdeen was rated 18th out of 33 areas in Scotland in the Scottish Index of Multiple Deprivation.[30]
- Climate change can widen inequalities - health, social and economic factors.[31]
- 26% homes in fuel poverty.[32]

Climate hazard		Climate impact
Flooding/ storm/ sea level rise	H.1	Flood/ storm events may result in displacement, isolation.
	H.2	May be a need to evacuation of residents in flood/ emergency.
	H.3	Damage to homes and property.
Extreme rainfall	H.4	Increased risk of damp affecting health.
Snow	H.5	Injury from slips, trips and falls.
Cumulative impacts	H.6	Climate change can widen inequalities - health, social and economic factors.
	H.7	Opportunity - Warmer temperatures less winter heat demand.
	H.8	Extreme weather prevents access to services.
	H.9	Increased insurance costs.
	H.10	Clean up costs following flood events.

Current adaptation actions

- Community resilience is a priority under the Local Outcome Improvement Plan[33]. Culter Community Council has put together the Culter Community Resilience Plan[34] to increase individual, family and community resilience to emergency situations. This plan aims to: raise awareness and understanding of the local risks and emergency response capability in order to motivate and support self-help; increase community resilience against emergencies; and enable self-help arrangements to commence until support from the emergency services or other agencies are in place. Work to develop a resilience plan has also taken place in Cults, Bieldside and Milltimber. Supporting community resilience, community flood wardens are in place in a couple of city areas.
- The North of Scotland Regional Resilience Partnership[35] has produced a Community Risk Register which highlights the risks likely to cause disruption to the region and its communities. The Local Resilience Partnership provides multi agency co-ordination for response and recovery in emergency situations, including severe weather.
- A Property Protection Flood Scheme is open to residential and business properties meeting relevant criteria. If the property has been previously flooded internally and damage was sustained; that the property is in an area at risk of flooding shown on the SEPA flood maps[36] or shown on the Integrated Catchment Study model.
- Sandbags are provided to support community resilience.
- Friends of Seaton Park achieved an Overcoming Adversity Award from Britain in Bloom for volunteer work to clean up the park following extensive flooding during Storm Frank in 2016.

Ways to strengthen resilience

More action needed	Further investigation	Sustain current action	Monitor
• Signpost to resources and public information. • Community resilience plans. • Consider climate in contingency planning. • Climate Just.	• Assess community risks and vulnerability - addressing inequalities • Community funding routes.	• Resilience partnership, plans & arrangements.	• Tools and technology to monitor change.

I. Health and wellbeing

Context

- 3 Air Quality Management Areas in Aberdeen.[37]
- Growth of 16.1% of over 75s by 2028.[38]

Climate hazard		Climate impact
Flooding	I.1	Flooded areas contaminated by raw sewage or chemicals.
	I.2	Increase in injury or ill health from severe weather events eg storms and flooding.
	I.3	High volumes of standing water. Breeding grounds for disease. Increase in water borne infectious diseases.
	I.4	Damage to health and social care premises.
	I.5	Damp caused by cold houses and condensation could lead to an increase in fungal growth in buildings, affecting people with respiratory illness.
Extreme temperatures	I.6	Warmer weather increases the rate that pollutants are formed.* Impact on respiratory health.
	I.7	People with pre-existing health problems may be affected by heat.
	I.8	Increased UV exposure.
	I.9	Increased risk of gastro-intestinal illness and food poisoning.
	I.10	Increase in vector borne disease, e.g. tick borne, Lyme disease.
Snow, ice and frost	I.11	A reduction in risk for cold related illnesses and accidents.
Cumulative impacts	I.12	Increased levels of stress. Impact on mental health due to extreme weather.
	I.13	Residents with health conditions may be less able to prepare for and respond to extreme weather.
	I.14	Disruption to health and social care services and patient transport**.**
	I.15	Demands on health & social care during, after extreme weather.
	I.16	Incidences of disease and changes in health and disease patterns.

**Consider alongside air quality benefits net zero efforts to transition from fossil fuels*

Current adaptation actions

- Measures to improve air quality are being delivered through a city Air Quality Action Plan**.**[39]
- Business Continuity Planning is in place for health and social care providers, to ensure the continuous operational delivery of critical health and wellbeing services.
- The Aberdeen Health and Social Care Partnership Strategic Plan[40] has priorities including health inequalities and to strengthen existing community assets and resources to help local people.

Ways to strengthen resilience

More action needed	Further investigation	Sustain current action	Monitor
• Protect critical health and social care facilities. • Consider climate in contingency planning.	• Better understanding of the impacts of climate change on local health. • Education to support preventative measures.	• Resilience partnership, plans & arrangements. • Climate risk assessment & planning NHS boards.	• Monitoring for incidences in disease/ change in disease patterns.

J. Economy

Context

- GVA per head for the north east is above the Scottish and UK averages.[41]
- The north east share of growth sector employment in relation to Scotland 14.1% food and drink sector, 53.52% energy sector and 9.17% sustainable tourism.[42]

Climate hazard		Climate impact
Flooding	J.1	Damage to business stock, assets and premises.
Extreme rainfall	J.2	Construction sites water logged by heavy rainfall. Delays to city development.
Extreme temperatures	J.3	Warmer seas impact the fishing industry - cold water species move north.
Rise in sea level	J.4	Water dependent businesses affected by drought.
	J.5	Impacts to maritime industries including the harbour, ferry, fisheries, marine tourism and offshore service industry.
	J.6	Stress from high waves may cause impacts for offshore infrastructure.
Cumulative impacts	J.7	Businesses vulnerable to utility, communication and transport disruptions.
	J.8	High temperatures and drought. Global availability/ price of products affected.
	J.9	Failure to prepare for and respond to extreme weather events impacts city investment and economic growth.
	J.10	Weather events may impact the agriculture and forestry sector in the city and wider region.
	J.11	Financial losses. Increased insurance costs.
	J.12	Loss of land and property values
	J.13	Business opportunities for adaptation skills, products and technology.
	J.14	Flooding, snow ice and frost restrict staff travel to work.
	J.15	Flooding, storms and snow, ice and frost disrupts supply chains.

Current actions

- The Regional Economic Strategy[43] - states “The region’s natural assets and clean environment are also its economic assets and therefore must be safeguarded to support our sectors particularly tourism, food, drink, agriculture and fisheries.
- The Scottish Cities Alliance carried out a Mini Stern review for all 7 cities in Scotland. This included the identification of potential economic risks and opportunities arising from climate change and the low carbon agenda.

Ways to strengthen resilience

More action needed	Further investigation	Sustain current action	Monitor
• Business resilience. • Integrate climate adaptation into economic strategy. • Remote/ flexible working.	• Local skills adaptation. • Opportunities for tourist, food growing sectors. • Climate related financial risks.	• Partnerships.	• Impact for business/ economy.

K. Food

Context

- 517 city allotment plots managed by the Council across 21 sites.[44]
- 3,170 food and drink businesses in the north east

Climate hazard		Climate impact
Flooding	K.1	Flooding and heavy rainfall. Damage to crops.
	K.2	Soil erosion and flooding. Loss of land at food growing sites.
	K.3	Extreme weather events including storms and floods result in food supply chain disruptions, delays to deliveries.
Extreme rainfall	K.4	Run off from fertilisers and pesticides affects water courses.
Extreme temperatures	K.5	Higher summer temperatures/ reduced rainfall. Degraded crops.
	K.6	Higher global temperatures and drought affect the availability and cost of goods.
Drought	K.7	Increased watering requirements. Reduction in water availability.
Cumulative impacts	K.8	Supply chain disruptions from flooding and landslide may affect food transportation and distribution.
	K.9	Food safety risks due to pathogens or contamination.
	K.10	An increase in pests and disease affects food growing.
	K.11	Longer growing season. Opportunities for food growing.

Current actions

- Aberdeen is developing a Food Growing Strategy, to meet the Community Empowerment (Scotland) Act 2015.[45] Identifying land in its area that may be used as allotment sites - and other areas of land in its area that could be used by a community for the cultivation of vegetables, fruit, herbs or flowers.
- Partnership work is taking place locally under Granite City Good Food[46] to promote healthy and sustainable food.
- The Food Standards Agency and the Council's Protective Services work to protect city food standards and safety.

Ways to strengthen resilience

More action needed	Further investigation	Sustain current action	Monitor
• Build resilience into growing sites.	• Impact of climate change on local food growing and agriculture.	• Partnerships. • Food standards, inspections & guidance.	• Pest and disease on local crops. • Food safety – pathogens/ contamination.

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