

Transport and Environment Committee

10.00am, Tuesday, 28 October 2014

Resilient Edinburgh: Climate Change Framework 2014-2020

Item number	7.3
Report number	
Executive/routine	
Wards	All

Executive summary

Resilient Edinburgh, a Climate Change Adaptation Framework for the city until 2020, has been developed to set out the City of Edinburgh's strategic approach to building resilience to the impacts of climate change. Climate change adaptation provides a unique opportunity for the Council and its citywide partners to work together to ensure that Edinburgh becomes a climate resilient city.

The Council is leading on this Framework working closely with partners, and the final draft, evidence base and risk analysis are provided in appendices of this report

Links

Coalition pledges	P8 , P15 , P28 , P33 , P40 , P48 , P50
Council outcomes	CO8 , CO10 , CO14 , CO15 , CO16 , CO18 , CO19 , CO20 , CO21 , CO22 , CO23 , CO26
Single Outcome Agreement	SO1 , SO4

Resilient Edinburgh – Climate Change Framework 2014-2020

Recommendations

- 1.1 To approve the draft adaptation framework and evidence base.
- 1.2 To note an action plan will be developed and presented to Committee for consideration in Winter 2015.
- 1.3 To note a further report will be submitted to the next Transport and Environment Committee meeting on the potential benefits of signing up to the 'Mayors Adapt' initiative for consideration.
- 1.4 To agree that this report is circulated to the Corporate Policy and Strategy Committee for information.

Background

- 2.1 Climate change adaptation is about building resilience to the unavoidable consequences of a changing climate, through identifying climate change impacts, minimising the negative effects and responding appropriately.
- 2.2 . The effects of climate change on Edinburgh will vary depending on the severity of global warming but even when only relatively modest increases in temperature are assumed, the impacts are likely to be significant.
- 2.3 The following changes to Edinburgh's climate are predicted:
 - 2.3.1 warmer, drier summers;
 - 2.3.2 milder, wetter winters;
 - 2.3.3 greater frequency of severe weather events including extreme rainfall; and
 - 2.3.4 rising sea levels
- 2.4 The Framework sets out Edinburgh's strategic approach to building resilience to the impacts of climate change.

Main report

- 3.1 The Framework consists of two documents:

- 3.1.1 Framework: this identifies high level actions across key sectors of the city to help Edinburgh adapt to the impacts of a changing climate.
- 3.1.2 Evidence base: an additional document provides the evidence base on which the Framework is built. It provides greater detail about observed and predicted changes for Edinburgh's local climate and an assessment of the risks associated with these changes.
- 3.2 There is now scientific consensus that climate change is happening and the impact in the East of Scotland is warmer and wetter weather. The effects of changing weather patterns on Edinburgh will vary depending on the severity of global warming but even when only relatively modest increases in temperature are assumed, the impacts are likely to be significant. The following changes to Edinburgh's climate are predicted:
 - 3.2.1 warmer, drier summers;
 - 3.2.2 milder, wetter winters;
 - 3.2.3 extreme rainfall;
 - 3.2.4 greater frequency of severe weather events; and
 - 3.2.5 rising sea level.
- 3.3 The Framework takes a risk-based approach:
 - 3.3.1 assesses how vulnerable Edinburgh is to weather-related risks and predicted climate change impacts;
 - 3.3.2 uses climate projections to understand how climate change accentuates existing risks or creates new risks/opportunities in the future;
 - 3.3.3 identify the essential city services and sectors that may be affected by these existing and future risks and/or opportunities; and
 - 3.3.4 highlight a number of actions that should be taken to address the most significant risks identified.
- 3.4 A number of high level actions have been identified to address the most significant risks identified. These aim to:
 - 3.4.1 improve governance and management through enhanced partnership working;
 - 3.4.2 assess the risks to the city's property and land use planning from the impacts of climate change, and identify actions to address these;
 - 3.4.3 develop a Disaster Risk Reduction Strategy for the new Management Plan for Edinburgh's World Heritage Site;
 - 3.4.4 monitor the impacts of climate change on our transport infrastructure and use this to incorporate adaptation into future transport planning and development;

- 3.4.5 review Edinburgh's priority species and habitats to identify those at greatest risk from climate change, and utilise greenspace and ecological services to help mitigate and adapt to future impacts;
 - 3.4.6 develop a fuller understanding of the potential impacts on communities and health, and from this, identify actions to address community concerns and changing care needs across all sectors;
 - 3.4.7 develop a fuller understanding of the potential impacts of climate change on air and water quality, pest and disease control, and other environmental health factors, and from this identify actions to address these;
 - 3.4.8 work together to raise awareness of climate change impacts among Edinburgh's business community and to inform future planning of major events and attractions;
 - 3.4.9 ensure more robust risk management strategies that give prominence to climate change issues and informed resilience planning;
 - 3.4.10 ensure ongoing monitoring, evaluation and research to inform our decision-making on climate change adaptation; and
 - 3.4.11 develop a communications strategy to ensure up-to-date information on climate change effects and impacts are fully disseminated.
- 3.5 Subject to Committee approval of Resilient Edinburgh, work will begin on an adaptation action plan which will set out in detail how the city will manage the risks of a changing climate. This will be done in partnership with key organisations across the city. The draft action plan will be brought to committee towards the end of 2015.
- 3.6 In 2013, the EU adopted its strategy on Adapting to Climate Change which calls for national adaptation strategies and a more multi-level perspective on contributing to a climate resilient Europe. In this strategy, the Commission also envisaged building up more links with local authorities by setting up a local adaptation initiative, modelled on the EU Covenant of Mayors.
- 3.7 Earlier this year the Commission launched the 'Mayors Adapt' initiative. Participating local authorities sign a political statement, committing to developing a comprehensive local adaptation strategy or to integrating climate adaptation into existing plans. Upon becoming signatories, local authorities conduct a vulnerability assessment, develop and implement a local adaptation strategy, monitor and eventually evaluate and review this strategy within a given timescale.
- 3.8 Mayors Adapt aims to increase support for local activities, provide a platform for greater engagement and networking by cities, and raise public awareness about adaptation and the measures needed. As a member of the Mayors Adapt initiative the Council may benefit from improved access to EU-wide resources to progress and develop a climate resilient city.

- 3.9 Further information on this initiative will be provided to this committee within one cycle.

Measures of success

- 4.1 Delivery towards statutory requirements, specifically the Climate Change (Scotland) Act 2009, which requires the Council to contribute to national emissions reductions targets, deliver any statutory adaptation programmes and act in a sustainable manner.
- 4.2 Delivery towards the Capital Coalition Pledge commitments and Sustainable Edinburgh 2020 objectives.
- 4.3 Delivery of an Adaptation Framework for the Council and the city, to help Edinburgh adapt to the unavoidable impacts of climate change in partnership with key stakeholders and local communities.

Financial impact

- 5.1 There are no direct financial implications arising from this report. However, there may be financial impacts arising from the implementation of adaptation action in the future.

Risk, policy, compliance and governance impact

- 6.1 The Climate Change (Scotland) Act 2009 places duties on public bodies in respect of climate change mitigation and adaptation and of sustainable development. The preparation of Resilient Edinburgh provides evidence of compliance with these duties.

Equalities impact

- 7.1 There are no direct equalities impacts arising from this report.

Sustainability impact

- 8.1 There are no direct sustainability impacts arising from this report. However, the report does address a strategic level city-wide priority to build resilience to a changing local climate. Resilience to climate change will be a key component of future sustainability of Edinburgh.

Consultation and engagement

- 9.1 An internal consultation exercise was undertaken between 8 May and 2 June 2014, targeted at Council officers whose work directly or indirectly contributes to

lessening the impacts of climate change or dealing with the aftermath of these impacts.

- 9.2 This was followed by an external consultation, held between 17 July and 29 August 2014 to encourage citywide ownership of the Framework, define partnership roles in its implementation, collate any additional key actions being brought forward by partners, and also provide an opportunity to obtain citywide case studies.
- 9.3 The following stakeholders were contacted: members of the Edinburgh Sustainable Development Partnership, the Edinburgh Partnership, Adaptation Scotland, the higher education institutions, biodiversity organisations, various members of the Edinburgh business community, and members of the Transition Edinburgh movement.
- 9.4 Responses were received from a number of key stakeholders. Adaptation Scotland, as well as submitting a consultation response, provided expert guidance and assistance throughout the process. Edinburgh World Heritage is investigating the potential impacts of climate change on Edinburgh's historic buildings, and as such, the framework has adapted a high-level action proposed by them. Other key responses were received from the Edinburgh Centre for Carbon Innovation (ECCI), Scottish Water, Forestry Commission Scotland, transport partners, Transition Edinburgh and community councils. Glasgow City Council also provided a response and background information on their adaptation work so far.

Background reading/external references

[Sustainable Edinburgh 2020](#)

Alastair Maclean

Director of Corporate Governance

Contact: James Garry, Corporate Policy and Strategy Officer

E-mail: james.garry@edinburgh.gov.uk | Tel: 0131 469 3578

Contact: Fiona Macleod, Corporate Policy and Strategy Officer

E-mail: fiona.macleod@edinburgh.gov.uk | Tel: 0131 469 3513

Links

Coalition pledges

P8, Make sure the city's people are well-housed, including encouraging developers to build residential communities, starting with brownfield sites

P15 Work with public organisations, the private sector and social enterprise

to promote Edinburgh to investors
P28 Further strengthen our links with the business community by developing and implementing strategies to promote and protect the economic well being of the city
P33 Strengthen Neighbourhood Partnerships and further involve local people in decisions on how Council resources are used
P40 Work with Edinburgh World Heritage Trust and other stakeholders to conserve the city's built heritage
P48 - Use Green Flag and other strategies to preserve our green spaces
P50 Investigate the possible introduction of low emission zones

Council outcomes

CO8, CO10, CO14, CO15, CO16, CO18, CO19, CO20, CO21, CO22, CO23, CO26

Single Outcome Agreement

SO1 Edinburgh's Economy Delivers increased investment, jobs and opportunities for all

SO4 Edinburgh's communities are safer and have improved physical and social fabric

Appendices

Appendix 1 – Resilient Edinburgh – Climate Change Adaptation Framework for Edinburgh

Appendix 2 – Resilient Edinburgh – Climate Change Adaptation Framework for Edinburgh: Evidence Base and Risk Analysis



RESILIENT EDINBURGH

CLIMATE CHANGE ADAPTATION FRAMEWORK
FOR EDINBURGH 2014 - 2020



FORWARD FROM XXXXXXXXXX

Climate change is already happening. While working to reduce the causes of climate change, and avoid catastrophic change, the City of Edinburgh Council and its strategic partners also need to prepare for the unavoidable impacts of climate change over coming decades. Climate change will present many risks and threats to Edinburgh. But there will also be many opportunities for local businesses and communities if they take appropriate adaptation action now.

The Scottish Government has made it clear that community planning partnerships have a key role to play in making Scotland 'climate ready'. The Edinburgh Partnership is firmly committed to tackling climate change impacts. In particular, the Community Plan for Edinburgh recognises the importance of adapting to climate change. The Edinburgh Partnership, through the recently established Edinburgh Sustainable Development Partnership, will play its part in ensuring that partners work together to build a city-wide resilience to a changing local climate.

We intend to build on the Edinburgh Partnership's proactive approach in developing a response to climate change, and will work in partnership with other organisations in the city to deliver our programmes of work. In this way we are committing to thinking globally and acting locally.

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CONTENTS

Executive Summary	3
Edinburgh and climate change	5
Introduction	5
Mitigation and Adaptation	6
The strategic context	7
Why we need to adapt	8
Our changing climate	8
Edinburgh's recent climate trends	9
Edinburgh's recent weather	11
Challenges & Key Risks	12
Working Together	21
Working in Partnership	21
What needs to be done	25
Citywide priority actions	25
Monitoring and Reporting	29

EXECUTIVE SUMMARY

This Framework sets out Edinburgh's strategic approach to increasing resilience to the impacts of climate change. Climate change adaptation provides a unique opportunity for the Council and its citywide partners to work together to ensure that Edinburgh continues to be a climate resilient city.

The remit of the Edinburgh Sustainable Development Partnership, comprising the Council, key external public and private stakeholders across the city, third sector and community groups, is aligned with [Sustainable Edinburgh 2020](#) (SE2020). The Council, through SE2020 is committed to ensuring that by 2020 Edinburgh will have "adapted to the unavoidable impacts of climate change in partnership with key stakeholders and local communities".

OUR CHANGING CLIMATE

There is now scientific consensus that climate change is happening. The climate in the East of Scotland is set to get warmer and wetter, with an increased risk of severe weather events, extreme rainfall and flooding, warmer temperatures and periods of drought. As global average temperatures increase, we will also experience rises in sea level around the East Scotland coast.

The effects of changing weather patterns on Edinburgh will vary depending on the severity of global warming but even when only relatively modest increases in temperature are assumed, the impacts are likely to be significant.

The following changes to Edinburgh's climate are predicted:

- Warmer, drier summers
- Milder, wetter winters
- Extreme rainfall
- Greater frequency of severe weather events
- Rising sea levels

KEY CLIMATE APPROACH FOR EDINBURGH

The Framework takes a risk-based approach that:

- Assesses how vulnerable Edinburgh is to weather-related risks and predicted climate change impacts;
- Uses climate projections to understand how climate change accentuates existing risks or creates new risks/opportunities in the future;
- Identifies what city services and sectors may be affected by these existing and future risks and/or opportunities;
- Presents a number of high level actions that should be taken to address the most significant risks identified.

OUR PRIORITY ACTIONS

A number of high level actions have been identified to address the most significant risks identified. We will:

- identify new ways of working with our partners and stakeholders to make the best use of available resources and expertise to secure a well adapted future for Edinburgh;
- undertake a detailed analysis of the risks posed to the city's property and land use planning from the impacts of climate change to identify the most vulnerable buildings, locations and neighbourhoods, and identify specific actions to address these;
- working in partnership, develop a Disaster Risk Reduction Strategy for the new Management Plan for Edinburgh's World Heritage Site;
- monitor the impacts of climate change on our transport infrastructure and use this information to incorporate adaptation into future transport planning and development;

- review Edinburgh’s priority species and habitats to identify those at greatest risk from climate change, and utilise greenspace and ecological services to help mitigate and adapt to future impacts;
- work with our partners to develop a fuller understanding of the potential impacts on communities and health and from this, identify actions and develop recommendations to address community concerns and changing care needs across all sectors;
- work with our partners to develop a fuller understanding of the potential impacts of climate change on air and water quality, pest and disease control, and other environmental health factors, and from this identify actions to address these;
- ensure more robust risk management strategies that give prominence to climate change issues and aid informed resilience planning;
- work together to raise awareness of climate change impacts among Edinburgh’s business community and to inform future planning of major events and attractions;
- ensure ongoing monitoring, evaluation and research to inform our decision-making on climate change adaptation;
- develop a communications strategy to ensure that up-to-date information on climate change effects and impacts are fully disseminated.

MONITORING AND REPORTING

The proposed timetable for the Framework is:

- Approval of the draft Framework by autumn 2014;
- By mid to end of 2015, development of a detailed Action Plan through engagement with partners and based on the high-level actions in the Framework;
- Development of indicators for the Action Plan linked to indicators already developed for Sustainable Edinburgh 2020;
- Progress on these actions reported as part of the Edinburgh Sustainable Development Partnership and Sustainable Edinburgh 2020 annual progress reports, starting in 2016;
- Three year review and update in 2018;
- A full review of the Framework in 2020.

INTRODUCTION

Edinburgh is the capital city of Scotland and our country's second most populous city. As our capital city, Edinburgh is of strategic importance to the rest of Scotland and to the UK as a whole. Edinburgh's Old and New Towns are jointly listed as an UNESCO World Heritage Site. Our city is a centre for learning, has the biggest annual international arts festival in the world and is the second largest financial and administrative centre in the UK and the second most popular tourist destination. It is essential that Edinburgh successfully adapts in order to minimise the social and economic impacts of climate change that could affect the city.

The Framework sets out Edinburgh's strategic approach to increasing resilience to the impacts of climate change. Climate change adaptation provides a unique opportunity for the Council and its citywide partners to work together to ensure that Edinburgh continues to be a climate resilient city. A lot of work has already been done by the Council and its partners to adapt the city to the impacts of climate change and the objective is to build on this work. The decisions and investments we make today will determine how we live with climate change in years to come.

The Adaptation Framework consists of the following sections:

1. The strategic context under which this Adaptation Framework has been developed;
2. The predicted future climate change trends for the East of Scotland and the Edinburgh area, and recent climate trends for the city;
3. An analysis of the results of a Local Climate Impact Profile (LCLIP) which helped identify Edinburgh's key vulnerabilities to severe weather and what future climate change impacts could mean for the city;
4. The scale of the challenge in terms of how climate change could impact on the city, taking a sectoral approach;

5

5. An identification of the key risks to Edinburgh from these climate change impacts;
6. Working in Partnership – only through working together with our citywide partners and communities, can Edinburgh continue to be a climate resilient city;
7. Our Priority Actions - A number of high level actions have been developed to address the most significant risks identified from the risk assessment, presented by sector;
8. Reporting and Monitoring – how progress on actions to adapt Edinburgh to the opportunities and challenges of climate change will be reported and monitored.

To support the Adaptation Framework, an accompanying document provides the evidence base on which this Framework is built. The evidence base summarises the background research that provided the reasoning behind the assumptions reached in the Framework, including the scientific evidence of past climate change and predicted future climate trends for the East of Scotland, their impact on Edinburgh and the way we deliver services. Finally the risks to the Council and the city from climate change impacts are assessed and graded.



MITIGATION AND ADAPTATION

Climate is what you expect, weather is what you get

Robert A. Heinlein

It is important to note the difference between climate and weather.

- **CLIMATE** is a long term average of weather (usually over a 30 year period) and trends in these average conditions are climate change.
- **WEATHER** is what we experience hour-to-hour, day-to-day, year-to-year, and as anyone living in Scotland will know, it can be highly variable.

On occasion weather may appear at odds with long-term climate change. The cold winter weather Edinburgh experienced in 2010-11 is a prime example of this. However short-term variations are expected to occur now and into the future.

There is scientific consensus that climate change is happening, that it is directly related to man-made greenhouse gas emissions and that we have little time remaining to stabilise and reduce these emissions if we are to avoid devastating impacts on our planet¹. Even if we dramatically reduce our emissions in the short term some climate change is now unavoidable. This will present us all with new challenges but also with new opportunities.

MITIGATION AND ADAPTATION

Mitigation means taking action to tackle the causes of climate change, that is reducing concentrations of greenhouse gases in the atmosphere. A [Sustainable Energy Action Plan](#) is being developed to reduce the city's energy use and carbon emissions.

¹ [Climate Change 2013 – The Physical Science Basis – Summary for Policymakers – Working Group 1 Contribution to the Fifth Assessment Report](#), IPCC, October 2013

Adaptation will be crucial in reducing vulnerability to climate change and is the only way to cope with the impacts that are inevitable over the next few decades...

The Stern Review on the Economics of Climate Change

Adaptation is about building resilience to the unavoidable consequences of a changing climate, through identifying climate change impacts, minimising the negative effects and responding appropriately. Adaptation recognises both risks and opportunities arising from climate change, and the need to plan for them now.

In order to build adaptive capacity we need to develop an understanding of how climate change is likely to affect Edinburgh. This includes assessing the risks to the city in terms of:

- taking no or limited action – in terms of cost and potential damage to services, infrastructure, property, transport, biodiversity, local communities and the economy;
- the potential savings to be made by taking appropriate early and long-term action to respond to the impacts of climate change.

An important aspect of adaptive capacity is ensuring that decision makers are equipped with an adequate understanding of the issues being faced and are therefore able to decide appropriate action.

To deliver adaptation, we need to take action. The action we take will vary across services and locality but will include improving education, awareness and training on the impacts of climate change, as well as taking tangible steps such as increasing reservoir storage capacity or restricting housing development in areas of high flooding risk (in light of predicted climate change modelling scenarios), and to develop a range of flood proofing measures for existing properties.

THE STRATEGIC CONTEXT

CLIMATE CHANGE (SCOTLAND) ACT 2009

The [Act](#) introduces ambitious, world-leading legislation to **reduce carbon emissions by at least 80% by 2050**, equal to the 2050 target contained in the UK's Climate Change Act.

The Act places a statutory climate change duty on public bodies. A public body must, in exercising its functions, act in a way:

- best calculated to contribute to delivery of the Act's emissions reduction targets;
- best calculated to deliver any statutory adaptation programme; and
- that it considers most sustainable.

The Scottish Government's [Climate Change Adaptation Programme](#) addresses the impacts identified for Scotland in the UK Climate Change Risk Assessment and sets out Scottish Ministers' objectives in relation to climate change adaptation, their plans and policies for meeting these objectives, and the period within which these proposals and policies will be introduced. The programme requires all public bodies to conduct their business in a way that will help deliver climate change adaptation as per the Climate Change Act.

SUSTAINABLE EDINBURGH 2020

[Sustainable Edinburgh 2020](#) (SE2020) sets out the City of Edinburgh Council's vision for the sustainable development of the city to 2020.

The Council, through SE2020, is committed to ensuring that by 2020 Edinburgh will have adapted to the unavoidable impacts of climate change in partnership with key stakeholders and local communities.

RESILIENCE PLANNING - COMMUNITY SAFETY

Under the [Civil Contingencies Act 2004](#), the Council has a statutory obligation to promote business continuity to the wider community. The Council works with local organisations to ensure that the city is ready for any incident and is able to return to normal as soon as possible.

[Scottish Government guidance](#) states that all public bodies need to be resilient to the future climate and to plan for business continuity in relation to delivery of their functions and the services they deliver to the wider community.

OUR CHANGING CLIMATE

OUR CHANGING CLIMATE

The climate in the East of Scotland is set to get warmer and wetter, increasing the risk of storms, flooding and the potential for extended periods of drought. As global average temperatures increase, we will also experience rises in sea level around the East Scotland coast.

Some of the general trends for Scotland are as follows²:

- Warmer, drier summers and milder, wetter winters
- Rising sea levels
- More very hot days – extremes of temperature increase in intensity as well as frequency
- More intense downpours of rain - extremes of precipitation increase in intensity as well as frequency
- Snowfall will become less common.
- The growing season is now nearly 5 weeks longer in Scotland (1961 to 2004) with the greatest change occurring at beginning of the season.

If there continues to be a discharge of medium to high amounts of greenhouse gases into the atmosphere then in the East of Scotland it is possible that:

- Average daily temperatures will rise between 1 and 2 degrees by the 2050s. The largest temperature increase, up to 2°C will be in the winter months.
- Summer rainfall will reduce by as much as 10% by 2050s.

- Winter rainfall is predicted to show a consistent increase of up to 10% by the 2050s. Winters will be milder and wetter, with increased risk of storms and flooding.
- Around the East Scotland coast snowfall will reduce by up to 80%.
- The sea level in Edinburgh is projected to increase by 10 to 18cm by 2050 and 23 to 39cm by 2095.
- Weather patterns could become more extreme e.g. high temperatures recorded occasionally today could become the norm by 2080
- There will be a greater frequency and intensity of extreme events – storms, floods, heat waves and drought
- The growing season may become longer by 20 to 60 days by 2080

The effects of changing weather on Edinburgh will vary depending on the severity of global warming, but even when only a relatively modest increase in temperature is assumed, the impacts are likely to be significant.

From the data, the following changes to Edinburgh's climate are predicted:

- Warmer, drier summers
- Milder, wetter winters
- Greater frequency and intensity of extreme rainfall
- Greater frequency of severe weather events
- Rising sea levels

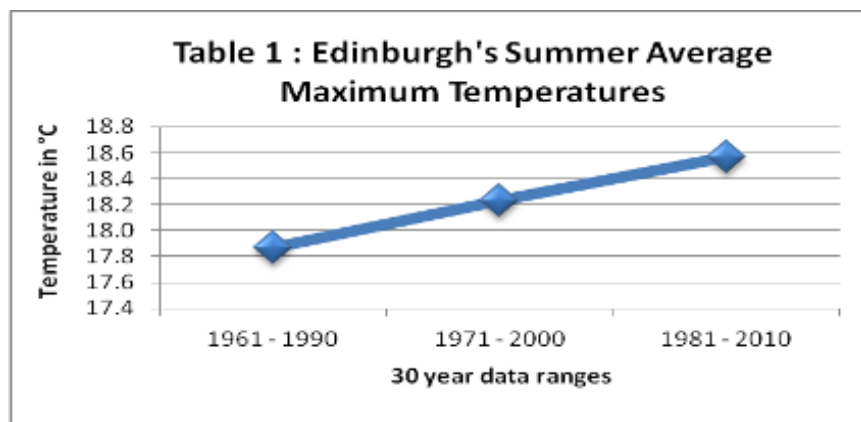
² [Scottish Compendium of UKCP09 Climate Change Information](#), Adaptation Scotland Website, 2013

EDINBURGH'S RECENT CLIMATE TRENDS

Warmer, Drier Summers

Data from the Met Office³ shows a distinct warming trend for Edinburgh in line with climate change predictions. Table 1 shows a daytime temperature rise of 0.75 °C comparing 1961-1990 averages with those of 1981-2010.

As well as warming, climate change trends predict drier summers for South East Scotland, with periods of intense rainfall shifting from summer towards autumn.

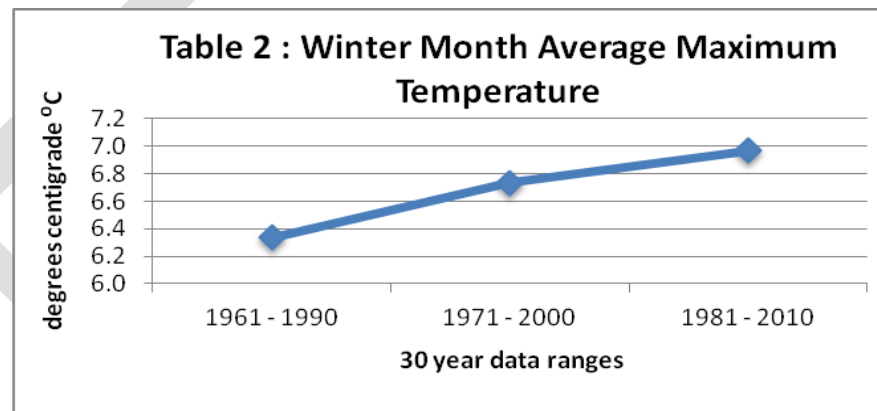


Milder, Wetter Winters

Edinburgh's winters are predicted to become milder. The winter temperature data for Edinburgh from 1961 to 2010 (Table 2) shows a clear rising trend that is consistent with climate change predictions.

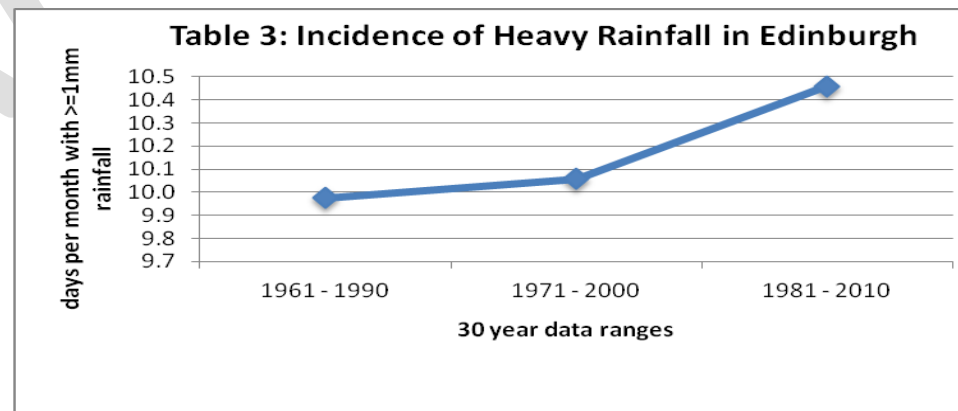
Weather data suggests Edinburgh is already experiencing up to 4% wetter winters, with increased rainfall intensity in autumn and winter.

This trend towards wetter winters is expected to continue into the future. The wettest year on record at Edinburgh's Royal Botanic Gardens was 2008 with a total of 907.9mm (981.4mm in 12 months in 2007/08 or 141% of the average)⁴.



Extreme Rainfall

The incidence of heavy rain (days when the quantity that fell was equal to or greater than 1mm) in Edinburgh has grown by 5% comparing the period 1961-1990 with that of 1981-2010 (Table 3).



³ [Met Office Climate Averages](#),

⁴ [Royal Botanic Gardens Edinburgh – Edinburgh Weather Station](#), webpage last updated 1 March 2012

Rainwater volumes have also increased over the same period. On average an extra 6mm of rain per month fell in the 1981-2010 period compared with the 1961-1990 one.

Severe Weather Events

There have been high profile consequences of severe wind and storm events in Edinburgh in recent years. Edinburgh, in common with Scotland as a whole, is prone to severe gales in the winter months. Eastern Scotland is one of the more windy parts of the UK. The strongest winds are associated with the passage of deep areas of low pressure close to or across the UK. The frequency and strength of these depressions is greatest in the winter half of the year, especially from December to February. The predicted trend is for a greater frequency of extreme events, including storms and high winds.

Rising Sea Levels

As global average temperatures increase, we will experience rises in sea level around the coast. Two major factors contribute to sea level rise. Firstly, as the sea warms it expands. This is called thermal expansion. Secondly, melting of land-based ice adds further water to the world's seas.

While Edinburgh has suffered from a number of river floods, coastal flooding has not been a significant issue up to now. However there are concerns that climate change could lead to more widespread coastal flooding, resulting from a combination of rising sea levels, increased frequency of storm surges, and rougher sea conditions.

Tidal surges caused by storms can occur in Scotland and mainly affect the East coast. However they are less significant around Scotland than further south. The most significant storm surge recorded over the last 100 years occurred in 1953. Surge levels of 0.60m and 0.83m were recorded in Aberdeen and Leith respectively but reached 2.97m in southern England and 3.36m in the Netherlands. The 1 in 50 year storm surge predictions for Scotland are around 1.25m.

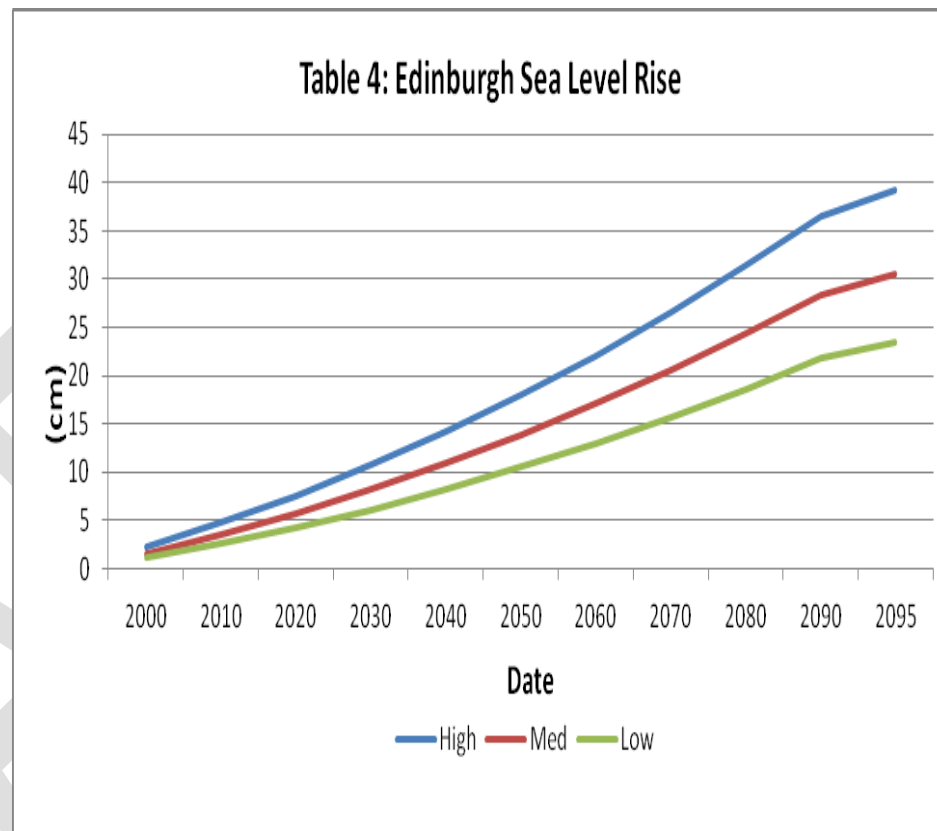


Table 4 shows UKCP09 projections for future sea level rise around Edinburgh's coast, based on the three scenarios of future levels of greenhouse gas emissions⁵.

⁵ [UK Climate Projections – Sea Level Rise](#), updated 11 March 2011

EDINBURGH'S RECENT WEATHER

The Council carried out a Local Climate Impacts Profile (LCLIP) to identify Edinburgh's key vulnerabilities to severe weather and help assess what future climate change could mean for the city.

The research showed the impact of severe weather events on the city. The prevalence of storms and gales and extreme rainfall seem to be happening with increasing frequency. The research also highlighted a warming trend, with earlier springs and warmer summers.

The research provided an assessment of Edinburgh's vulnerability to extreme weather events, especially flooding and high winds, over the short term. Using existing regional research and recorded local weather events, the potential impact of climate change on the city's buildings, local infrastructure and the ways we manage our services, was assessed.

The LCLIP identified the following types of extreme weather causing disruption to Edinburgh:

- Extreme rainfall and flooding, impacting on infrastructure, property and transport movement, leading to road and rail closures and damage to homes and businesses. The most recent severe flooding occurred in April 2000. Since then mainly short duration storms or periods of extensive rainfall have led to a number of localised flooding incidents;
- Severe weather events, leading to, for example, the cancellation of the Hogmanay celebrations and closure of the Winter Wonderland, closure of major city attractions and loss of business revenue, street and road closures and transport disruption, and public safety concerns;
- Edinburgh experienced two bouts of particularly severe winter weather in 2009/10 and 2010/11 causing major disruption to the city and its residents, especially the most vulnerable.

- Climate change is having a direct impact on the city's biodiversity, evident in the shift in timing of seasonal events⁶. It is also acting as a further stress on some ecosystems already under pressure. The longer growing season means that city buildings are more likely to have some degree of fungal growth on walls and plant growth in gutters. Wetter winters may increase damp problems in housing and other properties. There has also been a rise in complaints about pests.

Edinburgh World Heritage, together with climate scientists and conservation experts, are currently working on a climate modeling tool for the whole city. This tool aims to assess risks and impacts on the built fabric, particularly in their historic centres, to help understand future climate impacts. The tool will look at 100 years worth of data in order to establish historic weather patterns and model more accurate projections. This project will provide further historic data about weather patterns in Edinburgh over a hundred year period.



⁶ [Edinburgh Spring Index](#), Royal Botanic Garden Edinburgh, 2013

INTRODUCTION

THE SCALE OF THE CHALLENGE

Adaptation is about building resilience to the impacts of climate change. Without decisive action, climatic change will impact on our infrastructure, transport, economy, natural environment and communities' health and quality of life.

It is therefore crucial that we prepare and plan for these changes, to adapt and build resilience into our services and activities, maximise the benefits and minimise the costs that a changing climate presents.

This includes managing the risks from extreme weather events and designing environments and buildings that can withstand the impacts. By taking proper adaptation measures now, the city can help to avoid the worst impacts and costs.

KEY CLIMATE RISKS FOR EDINBURGH

The Local Climate Impacts Profile report helped identify potential risks. To further this process, a high level analysis of existing climate risks for Eastern Scotland was conducted, based on the known climate trends outlined in this Framework

A number of high-level risks have been identified for Edinburgh and should act as a precursor to a more rigorous sector-based risk assessment. This step will also be vital in identifying and developing appropriate actions for responding to the climate risks.



The following pages describe the scale of the challenge and key climate risks facing Edinburgh by sector.

PROPERTY, PLANNING AND FLOOD PREVENTION

THE SCALE OF THE CHALLENGE

Climate change will impact on the design, construction and ongoing upkeep of Edinburgh's buildings and land. Based on current projections, the main consequences for the city's buildings include:

- Flooding damage to housing and commercial buildings;
- Damage to the building fabric;
- Loss or damage to historical buildings and heritage;
- Potential loss of insurance for at risk buildings.

A changing climate will influence the location and design of new development as more information becomes available on flood risk. Increases in the variability of river flows, intensity of rainfall events, surface water flooding, seasonality of rainfall and intervals of drought will present numerous and complex challenges for the city. Wetter winters and more intense downpours throughout the year may increase the risk of flooding of property.

The predicted increase in intense rainfall will increase the risk of pluvial and fluvial flooding⁷ and ground water and drainage surcharge. Property located in areas that are at increased risk of flooding or landslips will be especially vulnerable. The Scottish Environment Protection Agency's indicative [river, coastal and surface water flood map](#) shows areas of Scotland that are at increased risk of flooding. Building in high-risk locations may become extremely expensive to insure.

While Edinburgh has suffered from a number of river floods, coastal flooding has not been a significant issue up to now. There are concerns that climate change could lead to more widespread coastal



flooding. Rising sea levels and storm surges will increase the risk of flooding in low-lying areas. Rising seas will also see increased occurrence of coastal flooding, erosion and coastal retreat. Integrated Coastal Zone Management will be important in managing rising sea level risks to communities, infrastructure and assets near the coast.

SEPA's indicative flood map shows areas of Edinburgh's waterfront potentially at medium to high risk of coastal flooding, taking into account climate change.

An increase in severe weather events poses significant risks for older and historic buildings, and new build. New buildings must be designed to withstand the impacts of climate change. The National Planning Framework and Scottish Planning Policy state planners and developers should address these issues in their plans and designs.

Flooding and severe weather damage to housing could have serious consequences for residents, especially the most vulnerable. Edinburgh's City Housing Strategy 2012-17 aims to reduce the impacts and consequences of climate change wherever possible.

Some buildings are an important part of Edinburgh's historic environment. Buildings and other structures of significant historical importance may be particularly vulnerable and special consideration must be given to how these cultural assets can be preserved in the face of a changing climate. Rising sea levels and the impacts of

⁷ Flooding that occurs after excessive rainfall that is not able to get absorbed into the ground or drainage system due to excessive water flow is referred to as pluvial flooding. Fluvial flooding is caused by river water overflowing/bursting of river banks.

coastal erosion also make protecting Edinburgh's vulnerable historic archaeology and coastal landscapes vital.

The risks of overheating of buildings in summer will increase in Scotland. Although the temperature rise is expected to be less than England and Wales there may be an increase in the number of heat waves over time. Consideration has to be given to the effect this will have on the ability of buildings to deal with a period of raised temperatures.



The longer growing season means that city buildings are more likely to have fungal and plant growth in gutters etc. This combined with more frequent instances of heavy rainfall will impact on building maintenance, particularly as regards historic buildings. Wetter winters and increased

summer temperatures means that there is a greater chance of dampness and condensation.

In assessing the effects of climate change on land use, the main challenges are seen to be from increased flooding, coastal erosion, warmer temperatures and changing precipitation patterns and the consequences of these impacts for land use and spatial planning.

KEY CLIMATE RISKS

In summary, significant risks to property and planning arising from climate change include:

- Increased energy consumption in summer months due to increased need for air conditioning/cooling in existing buildings
- Increased bioproductivity promoting growth of problem species, pests infestations and vermin
- 'Heat island' effect⁸
- Damage to property from wetter winters and severe weather events
- Increased dampness and mould in buildings
- Disruption to construction work due to severe weather
- Vulnerability of key heritage and cultural assets
- Increased insurance costs
- Increased incidence of inundation and flood damage
- Damage to sea defences and increased vulnerability to storm surges
- Tourism and recreational demand
- Storm water management and flooding infrastructure.

⁸ Temperatures are often a few degrees higher in cities than in surrounding areas. This temperature discrepancy is known as the urban heat island effect. Normally the temperature disparity is not very large but even a few degrees can make a huge difference.

THE SCALE OF THE CHALLENGE



The potential for increased flooding, erosion and landslides, storms and high winds, and rising sea levels may damage Edinburgh's transport infrastructure and lead to disruption and delays.

More intense rainfall could result in flooding, which could disrupt traffic, delay construction activities and weaken or wash out the soil and culverts that support roads, tunnels and bridges. Heavy precipitation could also lead to delays and disruption on the railway.

The location and design of new infrastructure, whether for road, tram or

cycle, must take into account an increased likelihood of risks from flooding and landslips.

High winds can have an impact on the routes high-sided (particularly freight) vehicles can take, for example if bridges on key routes have to close more often. This limits route options and can add significantly to journey times and length, increase emissions and reduce overall business efficiency.

Severe weather events may make it more difficult for commuters, resulting in staff absence from key organisations which deliver essential services to the community just at the point when demand for these services is acute due to the immediate impacts of the severe weather.

As average temperatures increase, disruptions from snow and frost may become less frequent, reducing reliance on resources to deal with cold weather. However higher temperatures are likely to require the provision of air conditioning on public transport, particularly buses. This could adversely affect the purchase and operating costs of vehicles.

KEY CLIMATE RISKS

In summary, significant risks to Transport arising from climate change include:

- Failure of essential road infrastructure
- Road deterioration
- Failure of drainage infrastructure
- Disruption to work programmes and operational issues
- Significant increases in maintenance costs and requirements for new infrastructure
- Disruption to public transport, cycling and pedestrian networks due to the increased incidence of localised and widespread flooding
- Increased number of emergency call-outs
- Failure of coastal defences
- Storm surge inundation
- The economic and reputational ramifications of major transport disruption to Edinburgh

PARKS AND GREENSPACES

THE SCALE OF THE CHALLENGE



Climate change is already having a direct impact on biodiversity. Certain species and ecosystems may be adversely affected by droughts and flooding. As the climate becomes wetter and warmer, some species may move north, so that the species mix suiting a warmer Edinburgh may change.

Trees, being long lived (potentially 100 years+), will experience more environmental change than short-lived flora such as grasses, herbs and shrubs that can be replaced with adapted species relatively quickly and easily.

Some species moving north may be 'pest' species, adversely affecting local habitats and species, while some will increase the diversity of species found locally.

Climate change could also have implications for the spread of plant diseases. It is crucial that action is taken to manage the consequences on Edinburgh's existing biodiversity.

There will also be physical effects on habitats, including loss of habitat to coastal erosion. Ultimately, the effects of a changing climate and the loss of species diversity could degrade ecosystem function. Action will be required to secure the ecosystem services that support nature, the economy and contribute to quality of life, as well as to reduce their vulnerability to the impacts to climate change.

As projected trends in temperature and rainfall become more evident in Edinburgh some form of intervention or active management may be necessary to maintain the city's current natural habitats and wild species and to accommodate new species moving into the area.

KEY CLIMATE RISKS

In summary, significant risks to parks and greenspaces arising from Climate Change include:

- Summer drought
- Deterioration in river and wetland environments
- Species and habitat stress
- Introduction of new species
- Tree damage and changes in woodland ecosystems
- Deterioration of public parks
- Increased soil erosion and land instability
- Erosion of coastal habitats



HEALTH AND COMMUNITY WELLBEING

THE SCALE OF THE CHALLENGE

Weather and climate play a significant role in people's health. Changes in climate affect the average weather conditions that we are accustomed to, with a disproportionate impact on vulnerable groups. High risk groups include the elderly, individuals with pre-existing illnesses, children and the economically and socially vulnerable.

Warmer average temperatures could lead to hotter days and more frequent and longer heat waves, increasing the number of heat-related illnesses and deaths. According to a Health Protection Agency report⁹, rising summer temperatures may lead to a rise in hospital admissions and premature deaths from respiratory problems. Higher temperatures could also increase the spread of disease, cases of food poisoning and affect air quality. A warming climate threatens to make air quality worse, with the prevalence of harmful photochemical smogs likely to increase throughout longer, hotter summers.¹⁰ Poorer air quality will directly result in poorer health for greater numbers of people, more hospital admissions and a greater risk of cardiovascular disease.

Climate change may also increase risks to health from buildings overheating, and increases in vermin and pests. Living in a ground or basement flat may increase health risks related to flooding. Hospitals and care homes may be adversely affected by high temperatures during heatwaves. Heavy precipitation and flooding may also adversely affect health care infrastructure.

Increased frequency and/or severity of extreme weather events will increase the risk of flooding, high winds and other direct threats to

⁹ [Health Effects of Climate Change in the UK 2012](#), Sotris Vardoulakis and Clare Heaviside (Report Editors), September 2012

¹⁰ [Air Quality and Climate Change: Integrating Policy Within Local Authorities](#), Environmental Protection UK, 2011

people and property. Flooding, damage and disruption from severe weather have already had major impacts on communities, damaging property, flooding homes and gardens, and disrupting transport.

Extreme weather-related events are likely to increase mental as well as physical health problems, as well as placing unusual strain on Edinburgh's emergency services. Severe weather events could also disrupt local service delivery if healthcare and social services staff are unable to commute to work or visit clients.



KEY CLIMATE RISKS

In summary, significant risks to Health and community wellbeing arising from Climate Change include:

- Disruption to essential community services
- Increased incidence of vector borne diseases¹¹
- More heat stroke, dehydration and respiratory problems.
- Increase in pest numbers and distribution, and increased demand for pest control services
- Increased incident of food poisoning
- Reduced water and air quality
- Mould and fungal illnesses and associated respiratory problems
- General increase in public health and safety risks

¹¹ Disease that results from an infection transmitted to humans and other animals by blood-feeding insects, such as mosquitoes, ticks and fleas.

EMERGENCY AND RESCUE SERVICES

THE SCALE OF THE CHALLENGE

The demands on emergency and rescue services will change – in a changing climate emergency services may need to respond to an increased frequency and severity of extreme weather and flooding events, and increase the number of incidents requiring a multi-agency emergency planning response.

There may also be changes in social and recreational behaviour that present new challenges to emergency and rescue services.

KEY CLIMATE RISKS

In summary, significant risks to Emergency and Rescue Services arising from Climate Change include:

- Changes and increases in demand for emergency and rescue services
- Increase in number of incidents requiring a multi-agency emergency planning approach



ECONOMIC DEVELOPMENT

THE SCALE OF THE CHALLENGE

Climate change poses threats to the future prosperity of the city. A healthy economy is vital for protecting and enhancing Edinburgh's environment over the long term. In addition to local impacts, potential disruptions to global trade are highlighted as risks. Although there is limited scope to influence global events, there are some responses to such risks that can improve the city's resilience, for example, sourcing goods with shorter and more reliable supply chains.

Flooding has caused significant economic disruption to the city, with both localised and general impacts, including major operational difficulties, insurance claims and anxieties about recurrence. The effects of high winds on business in the city has been similar with general disruption to travel and essential services as well as localised damage to business premises.

Severe weather is particularly disruptive of events and facilities which have a major outdoor component. Edinburgh Castle, Ratho Climbing Centre and the Botanic Gardens have all closed for limited periods in recent years because of high winds. The cancellation of Hogmanay celebrations in 2003 and 2006 because of high winds and heavy rain had some immediate impacts on business revenues but the greater concern has been for the long term reputation of the event and its ability to continue to attract tourist interest and revenue to the city in the winter holiday season.

Climate change may influence Scotland's capacity to generate weather-dependent renewable energy. Climate change can also impact on power distribution, with impacts ranging from damage caused by extreme weather events to reduced transmission efficiency occurring as a result of temperature fluctuations and so may increase energy costs. Impacts on global energy markets may also affect energy supplies in Scotland and consequently our overall energy security. Our energy, transport, water, and ICT networks support services are vital to our health and wellbeing and economic

prosperity. The effect of climate change on these infrastructure systems will be varied. They are likely to be impacted by an increase in disruptive events such as flooding, storms, drought, and heatwaves. Our infrastructure is closely inter-linked and failure in any area can lead to wider disruption across these networks.



KEY CLIMATE RISKS

In summary, significant risks to the economic development of the city arising from Climate Change include:

- Changes in demand for goods and services
- Heat stress impact on service provision
- Closure of water reliant recreational activities
- Lost work days
- Disruption to transport and supplies
- Disruption to energy supplies/increasing energy costs
- Increased insurance and repair costs
- Loss of land and property values
- Disruption and/or cancellation of winter festival and Hogmanay celebrations

ADAPTATION OPPORTUNITIES

As well as negative impacts, Edinburgh's changing climate offers opportunities. The trend towards warmer, drier summers may increase outdoor leisure and community activities and events, improving health and increasing fitness. Milder winters may reduce heating bills and the likelihood of outside events being cancelled. The longer growing season will benefit gardeners and allotment owners.

A changing climate and the need to adapt to it also presents a number of economic opportunities for business, for example:

- **Financial and Business services** where ethical and green investment is expanding;
- **Life Sciences** where developing responses to climate change related threats to human health offers the potential for new business;
- **Tourism** where hotter drier summers will be more attractive to visitors and more outdoor events are possible;
- **Universities** where adaptation related research work may be a growth area.
- **Edinburgh Centre for Carbon Innovation (ECCI)** where leaders in the low carbon sector, academics, government, other public sector organisations, networks for business and finance can work together to help find solutions to the impacts of climate change. ECCI also jointly manages ClimateXClimate, which is Scotland's centre for expertise on climate change.

KNOWLEDGE GAPS

There are always going to be gaps in our understanding of the challenges, risks and potential opportunities of Edinburgh's changing climate. Ongoing research is needed to ensure we continue to learn how our climate is changing and the impacts of this, now and into the future.

This knowledge acquisition is particularly important when Edinburgh is affected by major climatic impacts and events, in order to gauge how resilient the city will be to them, for example: how resilient the heat and energy systems that the city depends on are or what would be the impact of major transport disruption to the city (e.g. east coast mainline disruption).

This will also help to assess the economic and reputational impacts to the city of climatic events or disruptions and how these can be minimised.



Climate change adaptation presents a unique opportunity for the Council and its citywide partners to work together to ensure that Edinburgh becomes a climate resilient city. Community planning in Edinburgh involves a wide range of partnerships, initiatives and projects, supported by public, private, third sector and community organisations, in the delivery of agreed joint outcomes.

The Edinburgh Partnership encompasses all of the city's community planning partnership arrangements, brought together under the auspices of the Edinburgh Partnership Board, which oversees and coordinates the delivery of the Plan's vision and four priority outcomes. The Community Plan presents the partnership's agreed priorities and outcomes, including its vision of Edinburgh as a "...sustainable capital city". A cross-cutting priority is carbon management and climate change. The partnership is committed to helping to reduce greenhouse gas emissions, raising awareness and assisting in adapting the city to the impacts of climate change.

The Edinburgh Sustainable Development Partnership (ESDP) will provide the lead for adaptation across the city and will co-ordinate communication and responses on behalf of the Edinburgh Partnership.

EDINBURGH SUSTAINABLE DEVELOPMENT PARTNERSHIP

The remit of the Edinburgh Sustainable Development Partnership (ESDP), comprising the Council, key external public and private stakeholders across the city, the third sector and community groups,

WORKING IN PARTNERSHIP

is aligned with Sustainable Edinburgh 2020. This means that the ESDP is perfectly placed to coordinate adaptation work throughout the city.

The key adaptation roles of the Partnership are to:

- facilitate joint working across the city on climate change adaptation issues, policies and projects;
- develop best practice, which can be shared throughout the city and the city region;
- stimulate debate and raise awareness of the opportunities as well as the challenges presented by a changing climate for residents, businesses and organisations;
- assess, monitor and report on how prepared Edinburgh is for climate change; and
- work in ways which contribute to sustainable development and are complementary to the work of other organisations and partnerships.

RESILIENCE PLANNING - COMMUNITY SAFETY

Linking to the Edinburgh Partnership through the [community safety partnership](#), the city has a number of partnerships and organisations involved in wider citywide resilience issues and concerns. The Council leads the Edinburgh Resilience Forum, with membership from large business and public bodies who have established resilience functions. The Forum recognises the need to strengthen local urban resilience. Severe flooding in 2000, severe winter weather events in 2009/10/11 and pandemic influenza in 2009/10 has raised concern about the resilience risks facing the city and the need for comprehensive resilience building at all levels including individual

citizens. This is complemented by a need for a more holistic, all-risks approach, to include climate change and economic risks and one which builds on new technology opportunities.

Within this wider over-arching context the city's key resilience priorities are to:

- compile an Edinburgh Risk Register, taking an holistic approach including key areas such as climate change;
- develop an integrated city wide resilience strategy and plan;
- nurture and support resilience communities in partnership with other Responders, the Edinburgh Partnership, neighbourhood partnerships and community councils;
- safeguard infrastructure, homes, businesses and historic buildings against severe weather, including flooding;
- plan and design, ensuring our buildings and housing are as resilient as possible by developing relevant planning guidance and land-use planning.

RESILIENT HERITAGE

A World Heritage Site (WHS) Management Plan is being prepared in partnership with Edinburgh World Heritage, The City of Edinburgh Council and Historic Scotland. The Management Plan identifies risks and actions undertaken by partners on sustainability, energy efficiency and climate adaptation and mitigation in order to preserve the Old and New Towns of Edinburgh WHS Outstanding Universal Value. The Edinburgh City Local Plan includes general policies focused on the city-wide built heritage as well as specific reference to the WHS Management Plan as a material consideration for decisions on planning matters.

RESILIENT ECONOMY

A vibrant economy is vital to the continued success of the city and the well-being of its communities. Appropriate adaptation is required to maintain a city that remains attractive to investors and businesses.

Informing and encouraging local business is of crucial importance to achieving this goal. Taking early action now will ensure businesses are best prepared for the impacts of climate change and able to take full advantage of the business opportunities offered by a changing local and global climate.

A number of organisations represent business interests on the Edinburgh Sustainable Development Partnership, including Scottish Enterprise, the Edinburgh Chamber for Commerce and the Edinburgh Centre for Carbon Innovation. These organisations will help ensure that business is fully engaged with the adaptation work being done in the city and is proactively involved in finding solutions to the potential economic and business impacts of a changing climate.

As part of the wider Edinburgh Partnership family of partnerships, the [Economic Development Strategic Partnership](#) will be able to influence and work with a range of partners who are delivering a range of strategic priorities including supporting business, encouraging inward investment and international trade, supporting regeneration and infrastructure development, helping the unemployed into work or learning, and promoting the development of the city's highly skilled workforce. All these areas of activity now require a proactive approach to climate change adaptation.

RESILIENT COMMUNITIES

Greater community cohesion is needed to build local resilience to the impacts of climate change. Communities working together and in partnership with the Council and its partner organisations will help build self-reliance and enable residents to address the impacts of climate change at a community level.

The Third Sector, a key part of the ESDP and wider Edinburgh Partnership, has a pivotal role in Edinburgh's resilience to the impacts of climate change. The sector has immense potential to link up grassroots community action, communicate policy initiatives, and run training programmes. The Third Sector is often best placed to connect with individuals that the public and private sector finds hardest to

reach, working with the most vulnerable in our society and helping tackle the 'equality gap' which could be widened by the impacts of climate change.

The Third Sector also provides a valuable contribution to the collection of data, through their networks of staff and volunteers who observe wildlife and undertake research, as well as providing advice about managing protected areas and other valuable habitats.

RESILIENT COUNCIL

The Corporate Resilience Unit, in conjunction with stakeholder and partner organisations, is responsible for ensuring the Council complies with the emergency planning and business continuity obligations contained in the Civil Contingencies Act 2004 and other relevant legislation. Resilience planning is managed through three main groups, each of which addresses a key resilience issue. These are: the Council Resilience Group, the Edinburgh Resilience Partnership and the Council Contest Group. The Council Resilience Group drives the Council's Resilience Management Programme, and is the focus for the Council's resilience activities including planning, training and exercise initiatives, and facilitates the sharing of information across the Council on business continuity, emergency planning and preparing for major events.

The Council's Corporate Severe Weather Resilience Plan aims to ensure continued delivery of essential Council services during periods of severe weather and their aftermath. The Plan aims to enhance the Council's resilience, ability to respond to, cope with and recover from the consequences of a severe weather event that impacts on the normal service delivery of essential services and activities.

The Council, through [Sustainable Edinburgh 2020](#) (SE2020), is committed to ensuring that by 2020 Edinburgh will have "adapted to the unavoidable impacts of climate change in partnership with key stakeholders and local communities". The Council's Carbon, Climate and Sustainability (CCS) Team is taking SE2020 forward through the development of this Adaptation Framework and subsequent development of an Adaptation Action Plan for the city.

Planning and Design

Spatial planning, development and building design will play a major role in helping Edinburgh to adapt. As a planning authority, the Council is best placed to ensure that the future development of Edinburgh takes climate change adaptation into consideration. The current Edinburgh City Local Plan and Rural West Edinburgh Local Plan contain measures to ensure climate change adaptation and flood prevention is incorporated into planning policy, as does the second proposed [Edinburgh Local Development Plan](#) (ELDP). The ELDP aims to promote development in sustainable locations and enhance the city's green network by encouraging land management practices which capture, store and retain carbon, and prevent and manage flood risk. This includes managing surface water drainage, treatment and flood risk through sustainable urban drainage, providing amenity and biodiversity benefits e.g. green roofs, swales and ponds, planting trees to intercept and absorb rainfall.

In 2010, the Council prepared an [Open Space Strategy](#) to ensure a co-ordinated and consistent approach to meeting Edinburgh's open space needs and protect and develop the city's network of open spaces. The Strategy sets standards for the provision of different types of open space and identifies where these standards are not currently met, identifying opportunities to improve the quantity and quality of open space provision in Edinburgh.

Flood Prevention

Edinburgh has two Flood Prevention Schemes in place to protect vulnerable communities adjacent to the Water of Leith and the Braid Burn. The Council's flood prevention schemes were developed in response to past severe flooding events. The Braid Burn scheme has been completed. The Water of Leith scheme is being implemented. The Council has also identified undeveloped areas of land which fulfil an important flood function and which should be allowed to flood in order to protect other, built-up areas from floodwater. These are shown on the ELDP Proposals Map as areas important for flood management. The ELDP identifies up-to-date Areas of Importance for

Flood Management and has been informed by SEPA's most recent flood area modelling.

As part of a Scotland-wide initiative, a Flood Risk Management Plan for the Firth of Forth area will be published at the end of 2015. The City of Edinburgh Council, neighbouring local authorities, the Scottish Environmental Protection Agency and Scottish Water are currently developing this plan which will describe an agreed set of actions to manage flood risk locally.

Housing

The City Housing Strategy is the Council's key strategic document for housing in the city. One of the three outcomes of the strategy is to ensure people live in warm, safe homes, in well managed neighbourhoods. As this outcome is concerned with housing quality, repair and maintenance issues, and the management and creation of successful neighbourhoods, it takes into account adaptation.

The Council has invested over £205 million in bring homes up to the Scottish Housing Quality Standards since 2006/07. The effect of climate change on Council owned homes is one of the research topics under the 2014/15 Changeworks service level agreement.

Greenspace

Edinburgh's green network forms part of a wider Central Scotland Green Network (CSGN), which is identified as a national development in National Planning Framework 2. The Council is a signatory to the CSGN declaration and is working in partnership with neighbouring authorities and other stakeholders to support and deliver a range of projects. [Edinburgh's Local Biodiversity Action Plan 2010-15](#) (LBAP) includes a new section and various actions on climate change mitigation and adaptation.

The Edinburgh and Lothians Forestry and Woodland Strategy provides a long term vision of woodland creation and management to increase woodland cover and create better links. Forestry Commission Scotland provide financial support for woodland planting and management of existing woodlands, and advice on developing resilient woodlands and planting species adapted to predicted climate change. The Council's Natural Heritage Strategy sets out how planning can meet the objectives of national policy on biodiversity and fulfill the commitments of the Biodiversity Duty and the Scottish Geodiversity Charter.

RESILIENT EDINBURGH

Working in partnership is crucial to achieving a Resilient Edinburgh. We will work cooperatively with key citywide stakeholders and local citizens to design creative, effective and sustainable solutions to the challenges and opportunities of a changing local climate.

The main mechanism for driving this forward is the Edinburgh Sustainable Development Partnership, made up of key organisations, business interests and community groups throughout the city. The Partnership's central coordinating function will ensure that key risks are addressed, optimising efficiencies in terms of sharing lessons learnt and providing accountability for delivering actions.

All the organisations and groups in this Framework will play a crucial role in climate change adaptation. These key organisations and groups are the main agencies driving adaptation forward, and as such, must work together to achieve our shared vision of a Resilient Edinburgh.

CITYWIDE PRIORITY ACTIONS

This chapter presents a number of high level actions to address the most significant risks identified in the preceding risk assessment chapter. The actions are presented by sector.

ACTION: GOVERNANCE

Working together, we will identify new ways of working with our partners and stakeholders to make the best use of available resources and expertise to secure a well adapted future for Edinburgh.

This could include:

- Facilitating joint working across the city on climate change adaptation issues, policies and projects, and highlighting best practice, which can be shared throughout the city and the city region;
- Including the impacts of climate change into Edinburgh's Risk Register and citywide resilience strategy and plan;
- Identifying processes and guidance which can incorporate climate resilience into, for example, Strategic Environmental Assessment, Environmental Impact Assessment, sustainability checklists, sustainable procurement guidance and estate asset management guidance.

ACTION: PROPERTY AND PLANNING

We will undertake a detailed analysis of the risks posed to the city from the impacts of climate change to identify the most vulnerable buildings, locations and neighbourhoods, and specific actions to address these.

This could include:

- Working in partnership to analysis fully the risks posed to our built environment from the impacts of climate change;
- Ensuring the climate change adaptation actions integrated into the second proposed Local Development Plan (green roofs, flooding, green networks etc), are fully implemented;
- Encouraging developers to ensure that all new buildings and drainage systems are 'climate ready' for future impacts;
- Encouraging developers to 'piggyback adaptation onto development projects, undertake sympathetic retrofitting measures for older buildings, and other measures such as incorporating green roofs, green walls and/or rainwater collectors on buildings where appropriate;
- As far as possible, protecting residents' property from damage from climate change impacts through awareness raising and community action.

ACTION: DISASTER RISK REDUCTION STRATEGY

Working in partnership, we will develop a Disaster Risk Reduction Strategy for the new Management Plan for Edinburgh's World Heritage Site

This could include:

- Edinburgh World Heritage (EWH) drafting a Disaster Risk Reduction Strategy (DRR) for world heritage properties in the city in partnership with The City of Edinburgh Council and Historic Scotland;
- Developing a climate modelling tool for the city, to assess risks and impacts on the built environment to help understand future climate impacts. This will involve looking at past data to establish

more accurate historic weather patterns and trends, and future climate projections;

- Ensuring the project's governance is coordinated by the Edinburgh Sustainable Development Partnership (ESDP) as the facilitating umbrella body.

ACTION: TRANSPORT

We will monitor the impacts of climate change on our transport infrastructure and use this information to incorporate adaptation into future transport planning and development.

This could include:

- Ensuring climate change adaptation is fully incorporated into all city transport strategies, plans and guidance;
- Retrofitting green infrastructure onto existing streets and public spaces through, for example, the development of rain gardens, permeable paving on pavements, paths and roadways, etc.
- 'Piggybacking' adaptation onto future transport infrastructure development, roadworks and repairs.

ACTION: PARKS & GREENSPACE

We will review Edinburgh's priority species and habitats to identify those at greatest risk from climate change, and utilise greenspace and ecological services to help mitigate and adapt to future impacts.

This could include:

- Promotion of natural flood management in catchment planning;
- Using natural features in urban environments to assist adaptation, for example through the use of living roofs to improve habitat connectivity, reduce heat gain and slow the movement of rainwater drainage into the urban drainage system;

- Increase planting of street trees for their cooling effect, to reduce flooding through canopy capture and evaporation, and for improvement of solid drainage by their deep root structure;
- Management of nature conservation sites to take account of a changing climate, and to consider the placement of these sites in the wider ecological network;
- Managing species conservation priorities to take account of a changing climate;
- Reducing pressures on habitats vulnerable to climate change;
- Promoting ecological connectivity to assist in species movement in response to climate change, and as a means of building larger, resilient species populations and habitats;
- Continuing pressure on invasive non-native species that impact on native biodiversity, some of which may be even more successful in a warmer climate, and a considered response to the gradual northwards movement of species.

ACTION: HEALTH AND COMMUNITY WELLBEING

We will work with our partners to develop a fuller understanding of the potential impacts on communities and health and from this, identify actions and develop recommendations to address community concerns and changing care needs across all sectors.

This could include:

- Ensuring climate change risks are addressed in the commissioning and provision of health and social care services, and the refurbishment programmes of the health and social care estates;
- Ensuring climate change adaptation is incorporated into all Edinburgh's community planning processes and city organisations work in partnership with communities to ensure climate change

impacts are minimised for residents, especially the most vulnerable;

- Ensuring the engagement of all Edinburgh's citizens in the process.

ACTION: ENVIRONMENTAL HEALTH

We will work with our partners to develop a fuller understanding of the potential impacts of climate change on air and water quality, pest and disease control, and other environmental health factors, and from this identify actions to address these.

This could include:

- Ensuring an Air Quality Action Plan for the city reflects a growing understanding of the interrelationship between climate change and local air quality;
- Ensuring the impacts of climate change are taken into consideration when developing actions to improve water quality;
- Ensuring the threat of a rise in pests and diseases due to climate change is fully realised, and that pest and disease control services are fully prepared to meet potential increased demand for their services;
- Raising awareness of the potential environmental health risks of climate change and ensuring the engagement of all Edinburgh's citizens in this process.

ACTION: RISK PLANNING

We will ensure more robust risk management strategies that give prominence to climate change issues and aid informed resilience planning.

ACTION: ECONOMIC DEVELOPMENT

We will work with our partners to raise awareness of climate change impacts among Edinburgh's business community and to inform future planning of major events and attractions.

This could include:

- Working with a range of local economic development partners to ensure a proactive approach is taken to climate change adaptation;
- Ensuring businesses are able to take full advantage of the business opportunities offered by a changing local and global climate;
- Encouraging local production and markets to try to offset disruptions in global trade due to climate change impacts.

ACTION: RESEARCH

We will ensure ongoing monitoring, evaluation and research to inform our decision-making on climate change adaptation.

This could include:

- Collating key sets of evidence (flood risk maps, Urban Heat Island/coastal change info etc) and making these available to inform risk assessments and decision making;
- Carrying out further research to enable options appraisal and cost benefit analysis of different adaptation responses;
- Acknowledging the gaps in our understanding about climate change impacts.

COMMUNICATION AND EDUCATION

Climate change will impact upon every individual, business and organisation in Edinburgh.

Communications and education campaigns will be actively developed to promote awareness about these impacts throughout the Council, partner organisations, other stakeholders and the general public, in collaboration with the local media.

The following action is proposed:

ACTION: A communications strategy will be developed to ensure that up-to-date information on climate change effects and impacts are fully disseminated.

DRAFT

MONITORING MILESTONES

This preparation of this Climate Change Adaptation Framework will be the start of a major process that will deliver a wide range of actions and measures to adapt the city to the impacts of climate change over a long period of time.

The proposed timetable for the Framework is:

- Approval of the draft Framework by autumn 2014;
- By mid to end of 2015, development of detailed Action Plan through engagement with partners and based on the high-level actions in the Framework;
- Development of indicators for the Action Plan to show active progress towards achieving the below measures of success;
- Progress on these actions reported as part of Edinburgh Sustainable Development Partnership and Sustainable Edinburgh 2020 annual progress reports, starting in 2016;
- Three year review and update in 2018;
- A full review of the Framework in 2020.

MEASURES OF SUCCESS

The following measures will show how successfully the Framework is being implemented across the city:

- Levels of technical capacity increase across the city to assess and respond to the risks of climate change;
- The extent to which climate change considerations are increasingly incorporated into high level policies, plans and practical programmes in priority impact areas;
- Growing evidence that implemented adaptation strategies are increasing citywide resilience to extreme weather events;
- The extent to which climate change adaptation strategies continue to reduce stress on vulnerable members of society;
- Growing evidence of engagement between the Council and its partners, city-wide communities, local communities of interest, non-governmental organisations and other levels of government on addressing climate change issues;
- The extent to which climate change adaptation is integrated into Edinburgh's risk planning agenda, resilience strategy and action plan;
- Increase level of public, staff and stakeholder awareness about climate change and its impacts, and support for actions to protect against climate change.

If you would like more information, please contact:

Carbon, Climate & Sustainability Team

Corporate Governance

City of Edinburgh Council

Waverley Court

4 East Market Street

Edinburgh EH8 8BG

E-mail: sustainability@edinburgh.gov.uk



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RESILIENT EDINBURGH

CLIMATE CHANGE ADAPTATION FRAMEWORK FOR EDINBURGH 2014 – 2020 EVIDENCE BASE AND RISK ANALYSIS



CONTENTS

Introduction	3
Predicted Climate Trends	4
Edinburgh's Local Climate Impact Assessment	8
Key Climate Risks for Edinburgh	22

INTRODUCTION

Climate change is one of the most serious threats facing Scotland and the world today. Due to past emissions, a certain degree of climate change is now unavoidable. Effects of changing weather patterns on Edinburgh will vary depending on the severity of global warming but, even when only a relatively modest increase in temperature is assumed, the impacts are likely to be significant. It is widely accepted that the effects of climate change are already being felt in Scotland.

A Climate Change Adaptation Framework for Edinburgh has been prepared, setting out Edinburgh's strategic approach to building resilience to the impacts of climate change. Climate change adaptation provides a unique opportunity for the Council and its citywide partners to work together to ensure that Edinburgh continues to be a climate resilient city.

This document provides the evidence base on which the Adaptation Framework is built. It summarises the background research that provided the reasoning behind the assumptions reached in the Framework, including the scientific evidence of past climatic change and predicted future climate trends for the East of Scotland, their

impact on Edinburgh and the way essential services are delivered. Finally the risks to the city from climate change impacts are assessed and graded.

The Evidence Base consists of three parts.

1. The predicted future climate change trends for the East of Scotland. These were extrapolated for Edinburgh.
2. A summary is provided of the results of a Local Climate Impact Profile (LCLIP) which was initially done in 2008 and updated in 2012. The LCLIP helped identify Edinburgh's key vulnerabilities to severe weather, the impacts and responses by the Council and key city stakeholders, and an assessment of what future climate change could mean for the city.
3. The potential risks to the city from these impacts were identified and weighted as to their likelihood and severity.

PREDICTED CLIMATE TRENDS

Global Climate Change

There is now scientific consensus that climate change is happening. The Intergovernmental Panel on Climate Change concluded that the “scientific evidence for warming of the climate system is unequivocal” (IPCC AR4, 2007). All major reconstructions of global surface temperatures show a warming trend over the last century, with most warming occurring since the 1970s and the ten warmest years on record after 1998 (NASA).

The global climate is changing with far-reaching implications for Scotland. Greenhouse gases already emitted into the atmosphere mean that some climate change is unavoidable regardless of future emissions.

Climate Trends for the East of Scotland

The climate in the East of Scotland is set to get warmer and wetter. This will increase the risk of storms, flooding and the potential for extended periods of drought. As global average temperatures increase, we will also experience rises in sea level around the East Scotland coast.

The UK Climate Projections 2009 (UKCP09) provide the latest climate change scenarios for the UK. Some of the general trends for Scotland which can be drawn from UKCP09 are as follows:

- Warmer, drier summers
- Milder, wetter winters

- Rising sea levels – the sea level in Edinburgh is projected to increase by 10 to 18cm by 2050 and 23 to 39cm by 2095.
- More very hot days – extremes of temperature increase in intensity as well as frequency
- More intense downpours of rain - extremes of precipitation increase in intensity as well as frequency
- Snowfall will become less common.
- The growing season is now nearly 5 weeks longer in Scotland (1961 to 2004) with the greatest change occurring at the beginning of the season.

According to projections from current baselines, if we continue to discharge medium-high amounts of greenhouse gases into the atmosphere then, in the East of Scotland, it is possible that:

- Average daily temperatures will rise between 1 and 2 degrees by the 2050s. The largest temperature increase, up to 2°C will be in the winter months.
- Summer rainfall will reduce by as much as 10% by 2050s.
- Winter rainfall is predicted to show a consistent increase of up to 10% by the 2050s. Winters will be milder and wetter, with increased risk of storms and flooding.
- Snowfall in Scotland will by the 2080s be 40-60% less. Around the East Scotland coast snowfall will reduce by up to 80%.

- Weather patterns could become more extreme e.g. high temperatures recorded occasionally today could become the norm by 2080
- There will be a greater frequency and intensity of extreme events – storms, floods, heat waves and drought
- The growing season may become longer by between 20 and 60 days by 2080

Effects of changing weather patterns on Edinburgh will vary depending on the severity of global warming, but even when only a relatively modest increase in temperature is assumed, the impacts are likely to be significant.

From the data, the following changes to Edinburgh's climate are predicted:

- Warmer, drier summers
- Milder, wetter winters
- Extreme rainfall
- Severe weather events
- Rising sea levels

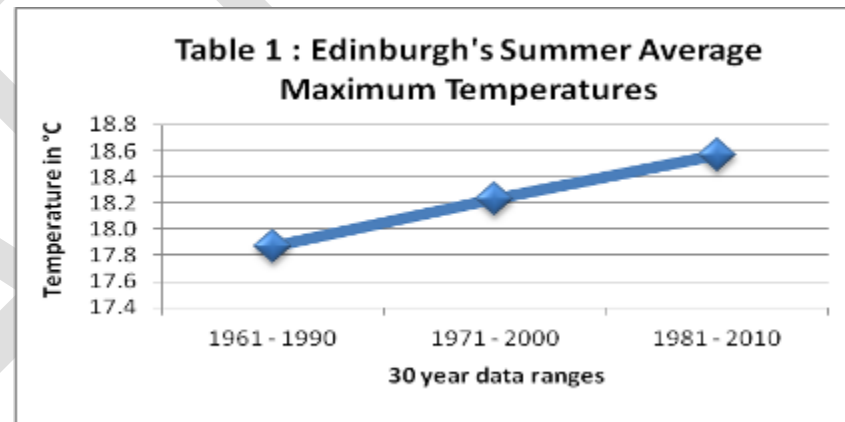
It is likely that the extreme weather events that Edinburgh is currently experiencing will become more frequent in the future.

Warmer, Drier Summers

Weather predictions for South East Scotland show a distinct warming trend. Summers will be warmer, up to 1.4 °C, and drier, with the potential for extended periods of drought.

Met Office data¹ shows a distinct warming trend for Edinburgh in line with climate change predictions. Table 1 shows a daytime temperature rise of 0.75 °C comparing 1961-1990 averages with those of the 1981 to 2010 period.

As well as warming, climate change trends predict drier summers for South East Scotland, with periods of intense rainfall shifting from summer towards autumn.



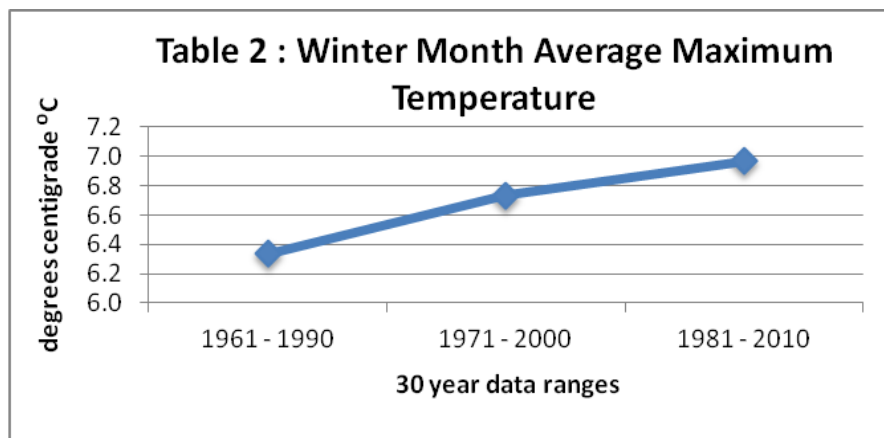
Milder, Wetter Winters

Edinburgh's winters are predicted to become milder. The winter temperature data for Edinburgh from 1961 to 2010 (Table 2) shows a clear rising trend that is consistent with climate change predictions.

Weather data suggests Edinburgh is already experiencing up to 4% wetter winters, with increased rainfall intensity in autumn and winter.

¹ [Met Office Climate Averages](#),

This trend towards wetter winters is expected to continue into the future. The wettest year on record at Edinburgh's Royal Botanic Gardens was 2008 with a total of 907.9mm (981.4mm in 12 months in 2007/08 or 141% of the average)².

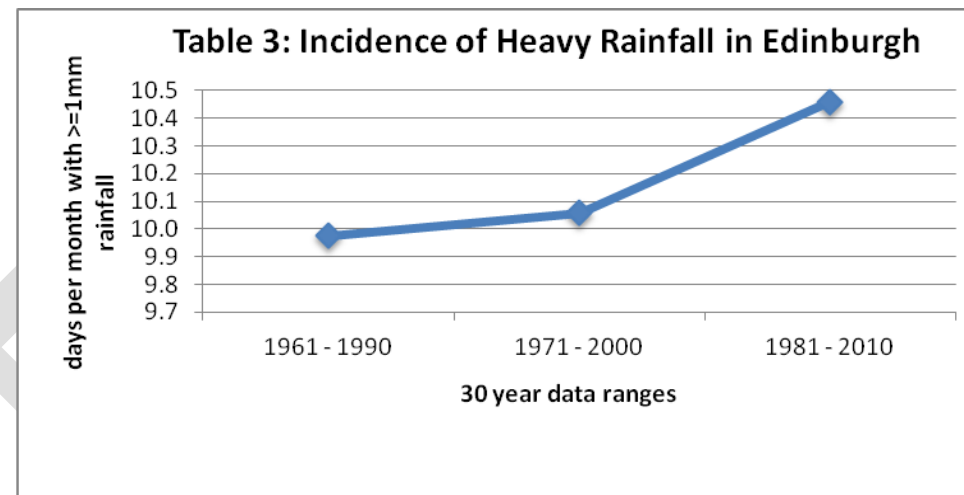


Extreme Rainfall

The incidence of heavy rain (days when the quantity that fell was equal to or greater than 1mm) in Edinburgh has grown by 5% comparing the period 1961-1990 with that of 1981-2010, as in Table 3.

Rainwater volumes have also increased in Edinburgh over the same period. On average an extra 6mm of rain per month fell in the more recent period in comparison with the earliest one. The implications of this include greater potential for flash floods, rivers bursting their banks and drainage systems being overwhelmed in the city.

² [Royal Botanic Gardens Edinburgh – Edinburgh Weather Station](#), webpage last updated 1 March 2012



Severe Weather Events

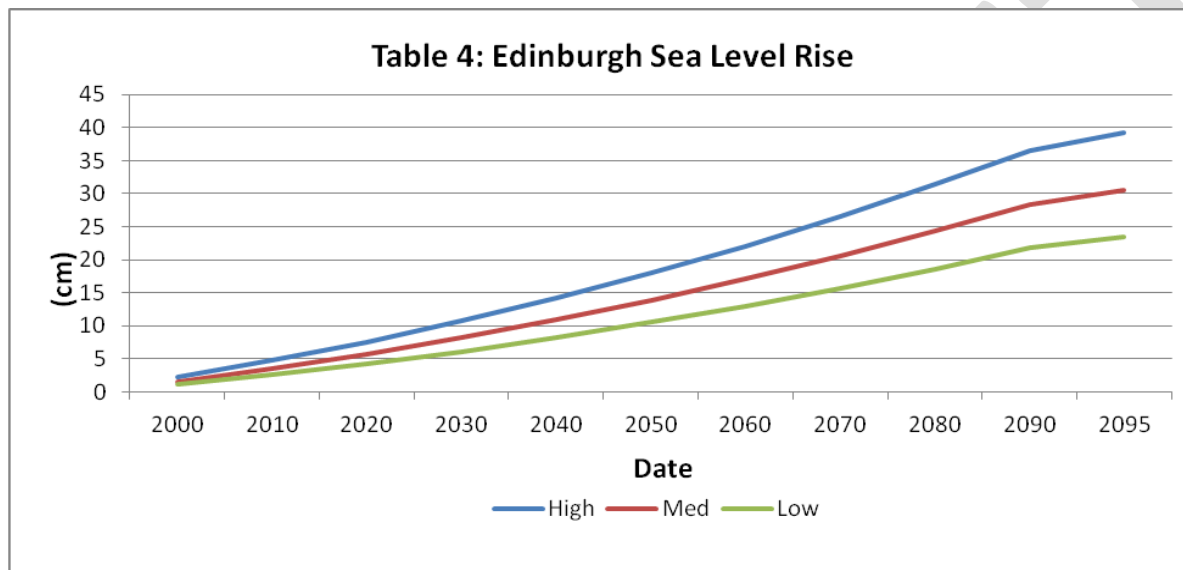
There have been high profile consequences of severe wind and storm events in Edinburgh in recent years. Edinburgh, in common with Scotland as a whole, is prone to severe gales in the winter months. The predicted trend is for a greater frequency of extreme events, including storms.

Rising Sea Levels

As global average temperatures increase, we will experience rises in sea level around the coast. Two major factors contribute to sea level rise. Firstly, as the sea warms it expands. This is called thermal expansion. Secondly, melting of land-based ice adds further water to the world's seas.

While Edinburgh has suffered from a number of river floods, coastal flooding has not been a significant issue up to now. However there are concerns that climate change could lead to more widespread

coastal flooding, resulting from a combination of rising sea levels, increased frequency of storm surges, and rougher sea conditions. Table 4 shows UKCP09 projections for future sea level rise around Edinburgh's coast, based on the three scenarios of future levels of greenhouse gas emissions³.



³ [UK Climate Projections – Sea Level Rise](#), updated 11 March 2011

EDINBURGH'S LOCAL CLIMATE IMPACT ASSESSMENT

In 2012, the City of Edinburgh Council participated in an Adaptation Scotland pilot [workbook for local authorities on climate change adaptation](#). Our Local Climate Impacts Profile (LCLIP) was updated as part of this process. The aim of a LCLIP is to help local authorities establish and prepare for the impacts of climate change and extreme weather events on the delivery of local authority services. The original LCLIP was compiled in 2008. The City of Edinburgh Council was one of four Scottish local authorities that took part in this Adaptation Scotland led project. The LCLIP now covers a 13 year period between 1997 and 2011.

Using existing regional research and recorded local weather events, the Council assessed the potential impact of climate change on its buildings, local infrastructure and the way it manages its services. The LCLIP provides an assessment of Edinburgh's vulnerability to extreme weather events.

Local authorities provide many services that will be affected by climate change. Climate change impacts – such as wetter winters, drier summers, increased flooding and extreme weather events – have implications for service areas including:

- emergency planning;
- waste collection and disposal;
- strategic and land-use planning;
- building control;
- estates management;
- protection and management of biodiversity and greenspaces;

- provision and management of leisure facilities and open spaces;
- events management
- transport infrastructure and fleet services;
- social services.

Weather Data

Relevant weather data from 1997-2011 was researched to verify severe weather events described in media reports and service information. Data was supplied by the Royal Botanic Garden Edinburgh weather station⁴, the Gogarburn Edinburgh weather station⁵ and the Met Office website⁶, and the online Weather Underground website⁷ and the Climatological Observers Link⁸ - an organisation for amateur meteorologists - were used as additional sources (though averages and records from these sites are not official values).

Correlation of media reports, service information and weather data enabled the assessment of the consequences of severe weather events for services.

⁴ www.rbge.org.uk/science/plants-and-climate-change/edinburgh-weather-station

⁵ http://www.tutiempo.net/en/Climate/EDINBURGH_GOGARBANK/31660.htm

⁶ www.metoffice.gov.uk/

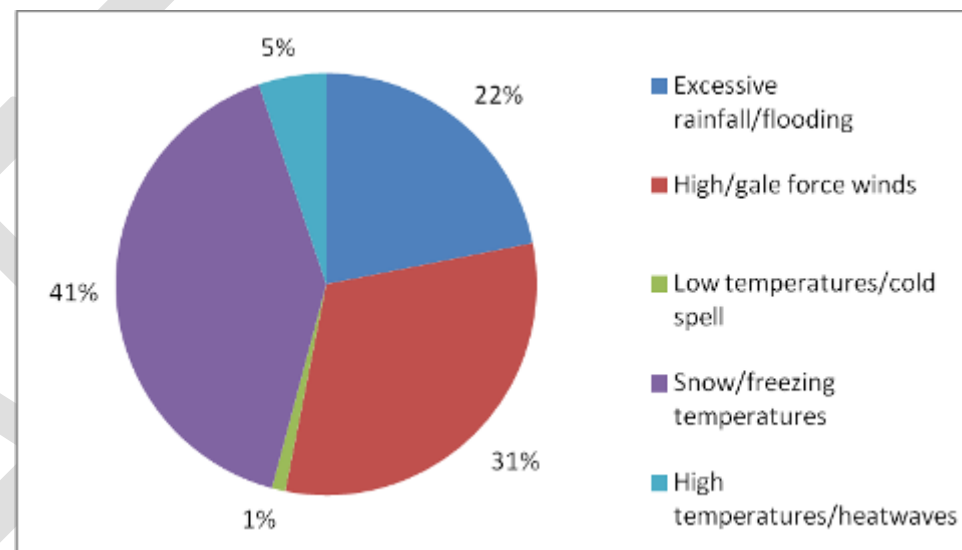
⁷ www.wunderground.com/history/

⁸ www.met.rdg.ac.uk/~brugge/col.html

Media Search

- 472 media references to weather events and impacts were identified and recorded in the period 1997 to 2011.
- Media reports reflected the study area's urban character and Edinburgh's role as a major tourist centre.
- Incidents of flooding, high winds and severe frost were the most regularly reported weather events with their associated impacts on infrastructure, property, transport movement, biodiversity and communities.
- Media reports not rated as highly relevant in identifying significant weather events included references to localised flooding, hot summer weather, warm weather and others that did not have an immediate consequence for services.
- Many media reports reiterated previously reported events and it was noted that there was increased reporting of weather events since the original LCLIP and a tendency in some media reports to sensationalise weather incidents. Some reports referred to weather warnings that did not materialise.
- A number of media reports referenced the perceived impact of "weather" (e.g. the hot summer of 2003, extended summer rainfall during 2007, the severe winter of 2011, the heatwave of September 2011 or short periods of torrential rain/downpours) on sporting, cultural and tourist events and visitor numbers.

Weather events identified by Edinburgh LCLIP media search 2007-2011



The original LCLIP media search showed the increasing prevalence of precipitation-related severe weather events, in the form of excessive rainfall/flooding and frost/ice/snow.

The second LCLIP (2008-2011) found a major increase in severe weather incidents and impacts on Council services from snow and freezing temperatures. This is due to the severity of the winters of 2008/09 and 2009/10.

Specific incidents of excessive rain and subsequent flooding have also risen from 15% in the original LCLIP to 33% in the second. Incidents of high winds and gales have remained the same at 19%.

Project Findings

The LCLIP found five types of weather event that impacted on the Council and the city:

- a warming trend;
- more frequent intense rainfall;
- extreme weather events;
- heavy snowfall and subsequent thawing
- other – including lightning strikes.

Over the first 10-year period (1997-2007) flooding and high winds were the most regularly reported weather events with their associated impacts on infrastructure, property and transport movement. From 2008-2011 (the period of the second LCLIP) incidents of intense rainfall, flooding, high winds and snow and thawing were the most regularly reported with associated impacts on infrastructure, property and transport movement. The severe winters of 2008/09 and 2009/10 in particular affected Council services. The Council's response to these extreme winter weather events was significant in terms of the resources deployed but, despite this, the city still experienced significant disruption. In response, a winter weather preparedness strategy and short-term measures were developed. These should reduce disruption caused by such severe weather events.

Other severe weather events had a more limited impact on Council services, principally because these services have already adapted or are planning to adapt. Impacts tended to result from infrastructure failure exacerbated by the weather. Emergency Planning arrangements were found to be effective for weather-related incidents both experienced to date and predicted.

1. Warming Trend

Weather data for South East Scotland shows a distinct warming trend⁹ with the largest temperature increase (up to 2°C) in winter months. Nine of the 10 hottest years on record have occurred since 2001, according to the Met Office's temperature data. However recent years have seen a spate of cold winters, with 2009-10 being recorded as the coldest in 31 years. This has caused major disruption to the city and to Council services.

1.1 Biodiversity

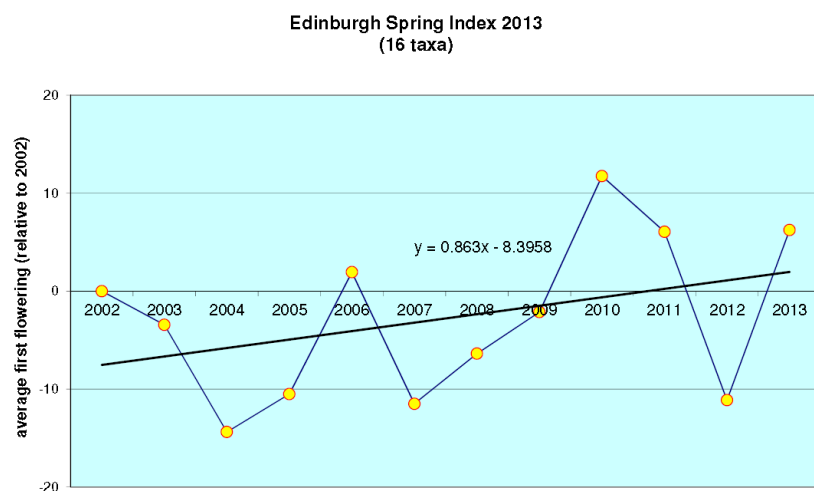
Climate change is having a direct impact on biodiversity in the UK. This is evident in the shift in timing of seasonal events such as budburst, flowering, egg laying and the arrival of migrant birds. Climate change is also acting as a further stress on some ecosystems already under pressure.

Nationally, a consistent warming trend is now associated with changes in the flowering and breeding patterns of wildlife. According to the [Woodland Trust's Nature Calendar](#), Britain's native trees are fruiting on average 18 days earlier than 10 years ago. Flowers are coming into bloom in gardens and the countryside earlier, birds and animals are breeding earlier and their distribution is changing. In general, levels of bioproductivity may be increasing although the breeding success of individual species has been variable in recent years.

The [Royal Botanic Gardens' 'Edinburgh Spring Index'](#) provides further evidence of earlier flowering dates of all taxa flowering

⁹ *State of Scotland's Environment 2006* SEPA, Part D – Environmental Challenges, Figure C4: Change in mean temperature...1961-2004

before the Spring Equinox, relative to 2013.



Climate change may be a contributory factor to the regular presence of kingfishers on the Water of Leith, and on other watercourses in Edinburgh, as the recent succession of mild winters will have supported recovery of the local population.



Climate change is thought to be partly responsible for other species extending their range into Edinburgh, such as the northward spread of the nuthatch. These insect-eating birds have recently bred in

the Lothians for the first time and there have been an increasing number of sightings in Edinburgh woodlands, parks and gardens.

Some effects of a slowly warming climate are becoming evident in the delivery of Council services. The [Edinburgh Local Biodiversity](#)

[Action Plan 2010-15](#) (LBAP) includes a new section and various actions on climate change mitigation and adaptation.

A practical example of this is the work the Council is doing to protect and preserve the honeybee. One fifth of honeybee hives died in the winter of 2008/09. The causes of the current rate of loss are thought to be a combination of factors including climate change.



The LBAP is implementing a series of actions to: provide more bee-friendly plant species and habitat features; increase our knowledge of the city's bee species through recording; and, raise awareness of the decline in bee populations.

As projected trends in temperature and rainfall become more evident in Edinburgh some form of intervention or active management may be necessary to maintain the city's current natural habitats and wild species and to accommodate new species moving into the area.

1.2 Pests

Figures on the number of requests for local authority pest control services have been published by Audit Scotland for 2003 to 2005 only. These show that the total number of requests increased by 50% over that two-year period in Edinburgh, compared with a 19% increase for Scotland. However, this is a very short time period to draw any strong conclusions. The large number of requests in 2003-04 may partly be a reflection of the very hot summer in 2003.

Where the Council's pest control service used to deal sequentially

with mice in the winter, ants in the spring, gulls in the early summer and wasps and bees in the summer they are now requested to deal with mice year-round, ants from January to September and gulls in the spring, with resulting pressures on staffing resources.

Recent warm summers have also led to a rise in Edinburgh of complaints about wasps with unusually large nests being formed due to the plentiful food supply of aphids and greenfly. Wasps are now the most frequently reported pests in Edinburgh, with requests exceeding those for mice in 2006-07. More conclusive evidence of trends for all pests will emerge as a longer data series builds up. This may also be the case for other pest species. The longer growing season also means that city buildings are more likely to have some degree of fungal growth on walls and plant growth in gutters. Wetter winters may increase damp problems in Council housing and other properties.

Pest control figures need to be interpreted with caution as the rising trend may be affected by reduced tolerance on the part of the public, rather than (or in addition to) real changes in the frequency of incidents. Other factors may also influence the number of requests for Council intervention – for example, revisions to charging policies or the use of private pest control contractors.

There was a peak in mice and rat complaints in 2005-06, which was echoed in higher requests for private pest control services. This may have been related to rates of house building and other development, which disturbs existing populations and stimulates breeding.

Because of the warmer winters, the growing season now starts on average three weeks earlier than it did in 1961 and extends two

weeks further into the autumn. The resulting increased bioproductivity has had significant impacts on pest control, grounds maintenance and management of green waste. The pattern, nature and severity of pest problems have meant a heavier workload for the Council's Pest Control service.

The Parks and Greenspace services were considering at the time of the initial LCLIP what adaptations would be required. These include how to go about replacing a tree stock that may come under increasing stress/disease and how to adapt maintenance regimes to the ever-lengthening growing season. One option that was under consideration was to naturalise a number of parks to reduce the need for regular and extensive mowing and provide habitats more suitable for species migration/conservation. This may free resources to extend grass cutting in those parks more suited to formal lawns.

1.3 Parks and Gardens



The extended growing season has resulted in increased green waste, affecting not only the green waste recycling service but also the parks maintenance teams who are responsible for routine tasks such as grass cutting. The Council through its Living Landscapes project is looking at ways to reduce green

waste and allow greenspaces to return to a more natural state through reduced grass cutting and maintenance.

If the current warming trend continues consideration will need to be given to adapting maintenance and watering regimes to suit longer, warmer, drier summers and to the choice of trees, shrubs and flowers planted in parks and greenspace across the city.

There are also implications for the city's biodiversity if a warming climate changes the current suitability of local habitats for wildlife and increases the occurrence of pests and diseases. The implications of climate change for pests and diseases in the city's parks and gardens are difficult to predict. This is because there is a fine balance between pests and disease-causing organisms and the trees, shrubs and flowers that they affect. The majority of insect pests affecting the city's gardens are likely to benefit from climate change as a result of increased summer activity and reduced winter mortality.

Climate change could have implications for the spread of well-known plant diseases such as Dutch Elm Disease. Warmer, wetter conditions could enable the beetles which carry the disease to complete more breeding cycles in a year. Until now, Edinburgh's relatively cool climate has been a factor helping to inhibit the spread of the disease. Similarly predicted warmer and wetter weather could help the spread of Acute Oak Decline and Ash Dieback, which is an example of how quickly a newly emerged disease can gain countrywide significance.

In addition, some insect pests that are currently present at low levels, or that are not considered a threat at this time, may become more prevalent. As the climate warms some pests may migrate into the city from more southerly parts of Britain.

Summer droughts and prolonged wet periods may adversely affect

the health of many trees and shrubs currently planted across the city. This will increase their vulnerability to disease.

Because the impact of climate change on some pests and diseases cannot be predicted it will be important to maintain a high level of vigilance to ensure the continuing health of the city's parks and gardens, particularly during periods of environmental stress.



1.4 Property

The longer growing season means that city buildings are more likely to have fungal and plant growth in gutters etc. This combines with more frequent instances of heavy rainfall to impact on building maintenance, particularly as regards historic buildings.

An increase in wet and dry weather cycles is going to accelerate stone decay. As the majority of buildings in central Edinburgh are stone, this would impact on the integrity of the historic urban fabric and could potentially pose a risk to passersby as well.

2. Extreme Rainfall and Flooding

Weather data suggests that Edinburgh is experiencing progressively drier summers and wetter winters, with increased rainfall intensity in autumn and winter. The period of most intense rainfall appears to be shifting from summer towards autumn. This trend toward drier summers and wetter winters is expected to continue into the future.

This is shown in the LCLIP, at least in relation to wetter winters and increased rainfall intensity in the autumn. However, instances of intense and prolonged summer rainfall have caused localised disruption and damage, with flooding resulting from a combination of surface water and surcharged drainage.

The wettest year on record at Edinburgh's Royal Botanic Gardens was 2008 with a total of 907.9mm (981.4mm in 12 months in 2007/08 or 141% of the average) and the wettest month has been August 2008 with 202.3mm; that is 326% of the average for August (230.6mm in a 31 day period in July/August 2008).¹⁰

Heavy rainfall has caused significant disruption to the city in recent years. The East of Scotland has seen an increase in average rainfall intensity by 7.6% on 1961 levels¹¹.

Extreme rainfall, often resulting in flooding from a combination of surface water and surcharged drainage, has led to localised disruption and damage. Localised flooding has an impact on infrastructure, property and transport movement, leading to road and rail closures, and damage to homes and businesses. Impacts tend to result from infrastructure failure exacerbated by the weather. The East of Scotland has seen an increase in average rainfall intensity (*i.e.* mm per day) by 7.6% on 1961 levels¹².

In April 2000 severe weather caused widespread flooding. Very wet

weather accompanied by strong north-easterly winds brought floods to north-east Scotland. This caused flooding throughout Eastern Scotland, and Edinburgh was one of the most severely affected areas. A total of 112mm of rain fell over 48 hours. The monthly average rainfall in Edinburgh for April is 42.2mm. River flows were the highest ever recorded on the Water of Leith and the Braid Burn.



The flooding affected some 750 residential and business properties in the Edinburgh area including Murrayfield Stadium, two residential care homes and a school. Lothian & Borders Fire and Rescue Service received over 500 calls - 296 within a six-hour period.

Firefighters evacuated more than 150 people from their homes, including nearly 100 elderly residents from nursing homes in the Gorgie and Peffermill areas of the city. Around 700 Council staff worked to reopen flooded roads, clear mud and debris from roads and pavements and respond to calls from residents. 8,000 sandbags were filled to minimise the damage. 2,500 people lost power when an electricity sub-station was engulfed by more than a foot of water. Several main roads throughout the city were closed, including an eight-mile stretch of the city bypass. Later in the same year, on 8 November, four houses were flooded and a flood alert was initiated resulting in emergency flood works.

The costs of flood damage at the time were estimated at £25 million. The immediate cost to the Council was estimated at just over £1 million for land drainage works and repairs to highways,

¹⁰ Royal Botanic Gardens Edinburgh – Edinburgh Weather Station - <http://www.rbge.org.uk/science/plants-and-climate-change/edinburgh-weather-station>, webpage last updated 1 March 2012

¹¹ *Handbook of Climate Trends* SNIFFER January 2006 – Precipitation related variables, Table 19: Changes in average rainfall intensity

¹² *Handbook of Climate Trends* SNIFFER January 2006 - Precipitation related variables, Table 19: Changes in average rainfall intensity

removing fallen trees and debris plus the evacuation of a care home. In 2001 the Council received Scottish Government funding of £150,792. This grant reimbursed the Council for the immediate costs of ensuring public safety after the two flooding incidents in 2000.

While major flooding events such as that experienced in April 2000 are rare, climate models predict more prolonged and intensive periods of rainfall. In 2006 the council published a flood risk strategy¹³ to plan ahead and the council's State of the Environment Audit 2008¹⁴ brings together a wide range of evidence on recent environmental trends.

2.1 Water of Leith and Braid Burn



Edinburgh has also suffered from riverine flooding in recent years. An estimated £25m worth of damage to around 600 homes and businesses was caused when the Water of Leith and the Braid Burn burst their banks in 2000.

Much of the burn's natural flood plain has been constrained by residential development. It had burst its banks five times in the last 16 years. One of the most recent example occurred in August 2008 leaving Old Dalkeith Road and Inch Park flooded, with localised flooding in residents' gardens.

After April 2000 the Council decided to progress two major flood prevention schemes along the Water of Leith and the Braid Burn. Both schemes are funded by the City of Edinburgh Council and the Scottish Government.

The Water of Leith Flood Prevention Scheme comprises a series of walls and embankments along the river banks to protect properties from flooding. There are other associated works such as landscaping, pumping stations and drainage. Upstream storage has been created. This has the benefit of reducing high flows during storms. As funding was not available to implement the Scheme in full, it was agreed to deliver it in phases. Phase 1 is largely complete. Proposals for Phase 2 are currently under review.

The Braid Burn Flood Prevention Scheme was completed in October 2010 and provides protection to approximately 900 properties. It comprises physical defences in the form of flood walls and embankments at vulnerable locations along the route. Two temporary flood storage reservoirs have been constructed at Inch Park and Peffermill. These will hold back water in the event of a flood and allow it to flow back into the burn as flood water levels fall. At Inch Park, more than £100,000 was spent on environmental improvements, including hundreds of trees and thousands of shrubs, with reed beds designed to create a habitat for waterfowl.

The Council has also identified unbuilt areas of land which fulfil an

¹³ *Flood Risk Strategy for the City*, City of Edinburgh Council Executive, 14 November 2006

¹⁴ *Edinburgh's Environment: State of the Environment Audit Baseline Report* The City of Edinburgh Council May 2008

important flood function and which should be allowed to flood in order to protect other, built-up areas from floodwater. These are shown on the [Edinburgh Local Development Plan](#) Proposals Map as areas important for flood management.

2.2 Balcarres Street

Since 2000, mainly short duration storms or periods of extensive rainfall have led to a number of localised flooding incidents, due to excess surface water and surcharged/choked sewers, drains and culverts. Flooding caused by blockage is more frequent in many locations than that caused by severe weather.¹⁵



Two of the most recent incidents took place in the Morningside area of the city in 2011. The flooding was a result of exceptional adverse weather conditions.

On 8 July there was severe flooding due to thunderstorms over Edinburgh. 36mm of rain was recorded in two hours at Bonaly, the seasonal average for July is 5.6mm. On 17 October the severe weather resulted in an intense downpour for about four hours. A maximum rainfall of 20 mm over a two hour period was recorded again at Bonaly.

The intensity of rainfall exceeded the amount the drainage systems

¹⁵ *Flood Assessment Reports*, City of Edinburgh Council, 2001, 2003, 2005, 2007

could be expected to take without above ground flooding. The significant localised flooding which occurred as a consequence was not caused by any defects in the drainage systems or faults in its maintenance. Business premises and homes were flooded, and flooding of the road led to damage to cars, waste bins and travel disruption. Surface water ran down through gardens, round houses and collected in basements and back gardens causing damage on Greenbank Road.



Surface water from a large area of Morningside runs downhill and collects at the low point in Balcarres Street. The layout and level of the buildings on the street has resulted in a development that is

vulnerable to flooding of this kind, and leaves limited options to improve the situation. The drainage system in place is known as a combined sewer which carries foul and storm water. The sewer system has had problems downstream and the only surface water outlet is the Jordan Burn culvert, which has limited capacity. The sewer is the property of Scottish Water.

Since it is not possible at present to prevent flooding in all circumstances, and since it is likely to be some time before a permanent improvement could be achieved, it was recommended that the Council provide flood defense equipment to help householders in Balcarres Street. The estimated cost at the time of supplying and installing temporary flood defense products and improving gullies was approximately £30,000 and was met from existing Flood Prevention Revenue and Roads Capital Budgets.

Specific short term actions include the procurement and installation of dismountable defences.

Any permanent solution is likely to involve significant investment and can only be developed through cooperation between the Council and Scottish Water under the process set out by the Flood Risk Management (Scotland) Act 2009. There is now a duty on both parties to work together to develop solutions and Flood Risk Management Plans. The Council has carried out a pluvial flood risk screening study which identifies which areas are at risk.

While major flooding events are rare, climate models predict more prolonged and intensive periods of rainfall. Local Flood Risk Management Districts are currently being established to produce a Flood Risk Management Plan for the Forth Estuary District. It is likely the Council will be the Lead Authority for the District and will be required to produce a Plan for the District, in co-operation with Scottish Water and the other authorities by December 2015. The Plan must show the measures which are required to deal with flooding from all sources.

The Council has already carried out modelling work which indicates the areas at risk of flooding from surface water. Scottish Water is due to start modelling work in all the major cities to develop measures to address sewer and surface water flooding. This will be carried out in conjunction with the Local Authorities, who may be expected to contribute to the costs. However it is recognised that it is not economically possible to prevent flooding of roads in all events, especially in areas like Balcarres Street where the urban area has expanded while still draining into old systems.

2.3 Coastal Flooding

Climate change could lead to more widespread coastal flooding, resulting from a combination of rising sea levels, increased frequency of storm surges, and rougher sea conditions. Research by the Scottish Environment Protection Agency (SEPA) indicates that areas of Leith are at risk from high sea levels and storms surges.

A severe storm surge in 1953 inundated many coastal areas of South-East England and the Netherlands with devastating consequences. This raised water levels by 2.97 metres at Kings Lynn, although in Scotland the uplift was considerably smaller – just 0.82 metres at Leith, for example. Nevertheless, climatic change is likely to generate more frequent and more severe storms of this type.

In late March 2010 the East of Scotland was hit by a storm comprising easterly gales, heavy rain and blizzards. A tidal surge coincided with the highest spring tides of the year. The Firth of Forth was worst affected, damage being caused to the coast of Edinburgh, Fife and East Lothian. In Edinburgh there was storm damage to coastal defences from Cramond through Portobello to Eastfield. Work to ensure damaged areas were made safe involved a significant response from a range of Council services, all met out of Council budgets. This work is not eligible for Central Government support under the Bellwin Scheme or at a level to be paid by the Council's Emergency Funds. £214,000 of the estimated cost was met by the Council's Services for Communities Department and £344,000 by City Development capital budgets. A number of infrastructure projects were delayed in order to accommodate the additional expenditure within the Coast Protection budget. An

estimated £23,000 worth of damage was caused to private property.

In early January 2014 SEPA issued a warning that high tides coupled with a storm surge would affect the Forth estuary and may affect low lying areas. While this did not materialize, it did result in some localised flooding.

Rising sea levels and storm surges will increase the risk of flooding in low-lying areas. Future climate scenarios predict sea level rise relative to the land in some areas; by 2080 the current estimates range from between 0 and 600 mm sea level rise, leading to increased risk of flooding around Scotland's coasts. Although Edinburgh has escaped significant coastal flooding, the risk cannot be ignored. Due consideration must be given to minimising the risk to existing and future developments in low-lying coastal areas – especially to the most vulnerable groups of people and to the most vulnerable land uses (e.g. essential public infrastructure). The effects of rising sea levels on coastal habitats and sites of natural and cultural interest also need to be taken into account.

Under the Coast Protection Act 1949 the Council has a duty to ensure coastal defences are inspected regularly and repair work is carried out as required. The Council has ownership of the coastal defences between Cramond and Newhaven and Seafield and Joppa. It identifies and carries out repairs to these sections of the coast, within available resources and funding. The type of coastal work carried out includes maintenance or repair works to damaged sea walls, land acquisition by compulsory purchase, prohibition of excavation or removal of any materials from the seashore and making contributions towards the costs of others carrying out coastal protection work. The Council also works closely with Arcus

to manage water levels in Leith Docks during high tides. The Water of Leith must be able to discharge enough flood water into the sea to prevent flooding occurring further upstream.

The cost to the Council of coastal defence essential repairs over the period 2008-2011 was estimated at £740,000. Repair and maintenance works are not eligible for grant assistance from the Scottish Government. However new works have to be promoted as a coast protection works scheme, and may be eligible for grant assistance.

The Council supports the Forth Estuary Forum's approach of pursuing an integrated approach to coastline management. This will entail the production of a Shoreline Management Plan by 2015, which will provide guidance on the maintenance of coastal defences and the control of development along the coast.

3. Extreme Weather Events

There have been a number of high profile impacts resulting from severe weather events in Edinburgh in recent years, including the cancellation of the Hogmanay celebrations, closure of the Winter Wonderland in Princes Street Gardens, damage to infrastructure and biodiversity, street closures due to falling masonry and trees, and loss of revenue to business. Edinburgh, in common with Scotland as a whole, is prone to severe gales in the winter months. Over recent years, some weather data gathered on the Forth Road Bridge indicates that high wind events have increased over the very short term¹⁶. Climate change trends predict a greater frequency of extreme weather events rather than a change or increase in the severity of strong or gale force winds.

In 2006 Edinburgh's Hogmanay Street Party was cancelled in the interests of public safety due to storm-force winds and heavy rain in the city centre. Wind gusts of 92mph were recorded. The total cost of the cancellation of the Street Party was met by £2 million worth of insurance cover – a learned outcome from the cancellation of the 2003-04 event due to similar adverse weather conditions.

Strong winds during December 2006 caused the cancellation or closure of some of Edinburgh's Christmas festivities. Edinburgh's Winter Festivals attract a local, national and international audience with an estimated economic impact of over £33 million. They are funded through a variety of sources including the Council's revenue budget, commercial sponsorship and income generation. The reported success of the 2007-08 Winter Festivals demonstrated that Edinburgh's Hogmanay recovered well following the cancellation of

¹⁶ *Edinburgh's Environment: State of the Environment Audit Baseline Report* The City of Edinburgh Council May 2008

the previous year's Street Party. Public and marketing confidence are of vital importance to the success of such high profile events indicating the need to plan for events that are weather resistant.

In April 2010, fallen trees caused road closures and traffic disruption while the debris was removed. Falling scaffolding and loose tiles led to the closure of an area of the High Street and the Royal Mile was closed after a 60ft tree fell on a car and masonry fell onto the street.



In May 2011, high winds caused the closure of Edinburgh bus station, the Forth Road Bridge, the Zoo and Botanic Gardens as wind gusts exceeded safety levels. Princes Street Gardens were closed due to safety concerns about falling branches.

The Forestry Service responded to over 350 emergency tree incidents involving hundreds of fallen and damaged trees. With the support of Roads Services, Ranger Services and neighbourhood task force teams, roads and pedestrian walkways were kept open and safe throughout this period. A major clear up phase was completed by the end of June.

In December 2011, high winds again led to the closure on safety grounds of Edinburgh Castle, the Forth Road Bridge, Edinburgh Zoo, the Botanic Gardens and Princes Street Gardens Winter Wonderland. Roads were closed because of falling debris and trees, there was further travel disruption and double decker buses were taken off the road. Fallen masonry led to the closure of a city centre street, cars and property were damaged by debris from roof

and chimney stacks, offices and schools were closed early and police advised against non-essential travel in the afternoon.

The Council's Shared Repairs Service provides an emergency service to deal with situations where there is a risk to public safety or public health. The Council can use its legal powers to issue a statutory notice and carry out the emergency repair. When particularly bad weather is forecast by the Met Office extra provisions are made.

4. Winter Weather Preparedness

Edinburgh experienced two bouts of particularly severe winter weather in 2009/10 and 2010/11 including the coldest average daily temperatures since 1947 and the highest number of days with snow lying since the winter of 1963. December 2010 was reported as the coldest since Met Office records began.



The severe weather emergency in December 2009 to January 2010 was considered to be exceptional in terms of volume of snow, low temperatures and overall duration. This severe weather was reported as the worst in decades. Prior to

the severe weather of 2009-10, the Council had a relatively stable response to winter weather conditions. The established gritting fleet and routes worked well and because there were few prolonged spells of severe weather, additional resources from outwith the Council were never considered.

This severe winter weather caused major disruption to the city and

to Council services. The Council's response to these conditions was very significant in terms of the resources deployed but, despite this, the city experienced significant disruption. The Council's response developed significantly over these two winters.

For 2009-10 a number of unprecedented steps were taken in order to augment the normal response. This included:

- Redeployment of further staff from non-essential work
- Use of those serving Community Service Orders
- Deployment of contractors on an emergency basis
- Provision of food parcels for vulnerable people
- Contact arrangements to keep in touch with vulnerable people
- Targeting of snow-clearance resources to schools, care homes and other important sites
- Use of 4x4 vehicles to enhance access for care and support services for vulnerable people

As a result of these additional measures there were typically 350 people deployed on snow clearing duties.

Following a report in May 2010, the Council invested in a further eight mini-tractors and secured five additional lorries capable of being converted for winter maintenance work. These measures significantly enhanced the fleet at minimal extra cost. Additionally, the Council's salt storage capacity was increased by 38% so that before the winter period began, the Council had some 7,215 tonnes of salt in storage.

A tailored "Severe Weather Emergency Plan" was developed and implemented in November 2010 following heavy snowfall. As a result the Council's response was more formally managed during

those early days than during the previous winter. Of particular significance was the speed with which private contractors were deployed – within 2 days of the first snowfall. The Council's response included all the measures listed above, augmented by:

- The number of people on snow-clearing duty increased from 350 to 650 largely due to enhanced use of private contractors, and the additional plant, vehicles and equipment.
- Military assistance was requested and provided for a short period in December 2010.
- Exceptional measures were taken to relieve measures in relation to refuse collection. These included permission to use garden waste containers for domestic waste, distribution of over 40 skips and large containers to supermarket car parks etc across the city and hand collection of refuse sacks in some hard-to-reach areas.
- Use of grit-dumps to maximise availability of grit in areas where permanent grit bins could not be reached or where demand was particularly high.
- The securing of additional salt supplies from the Scottish Government's strategic reserve.
- The communications plan was intensified with daily Member's Briefings throughout the period, supplemented by more detailed briefings from Neighbourhood Managers and significant usage of Twitter and other social media.

Lessons Learned

- This severe winter weather caused major disruption to the city and to Council services. The Council's response to these conditions was very significant in terms of the resources deployed but, despite this, the city experienced significant disruption. The Council's response developed very significantly

over these two winters. However some communities nevertheless experienced significant disruption.

- A key factor in carrying out any review of the Council's preparedness for severe winter weather is to assess the likelihood of similar events recurring in future years. This is impossible to predict at the moment. Met Office records show these two winters reversed a trend of nearly 10 years of milder winters.
- A "just-in-time" approach is not feasible if a trend of freezing winters were to develop. Financial resources were not the constraint limiting the Council's response, rather the scale of the response was constrained by the availability of plant, vehicles, equipment and manual labour. When Edinburgh experiences severe weather, it is highly likely that much of Scotland will be facing similar conditions (or much of the UK). In these circumstances, the supply of plant etc is quickly exhausted. There are also significant challenges in deploying a large manual labour force quickly – so this too needs to be planned in advance. Salt supply also needs to be taken into consideration.
- A Corporate Severe Weather Resilience Plan was developed. It details the Council's arrangements for responding to any form of severe weather emergency and to ensure the continued delivery of essential Council services during periods of severe weather and their aftermath.

5. Further Work

Edinburgh World Heritage, together with climate scientists and conservation experts, are working on a climate modeling tool for the whole city. This tool could be applied to other cities to assess risks and impacts on the built fabric, particularly in their historic centers, to help understand future climate impacts and develop an effective adaptation strategy.

KEY CLIMATE RISKS FOR EDINBURGH

Effective climate risk management requires that the likelihood and consequences of impacts are understood and assessed at the service delivery level within local authorities. The Council's [Local Climate Impacts Profile](#) is a step towards identifying potential threats. To further this process, a high level analysis of existing climate risks for Eastern Scotland has been conducted, based on the known climate trends outlined in this Framework and the existing service responsibilities of the Council. This should act as a precursor to more rigorous service-based risk assessment and will be vital in identifying and developing appropriate actions for responding to the climate risks. Following guidance in Adaptation Scotland's Adaptation Workbook for Local Authorities risk is determined by a climate change impact's likelihood and impact.

Likelihood

Likelihood	Score	Recurrent Impact
Rare	1	Unlikely to occur during next 25 years
Unlikely	2	May arise once in 10 to 15 years
Possible	3	May arise once in 10 years
Likely	4	May arise about once a year
Almost Certain	5	Could occur several times a year

Impact

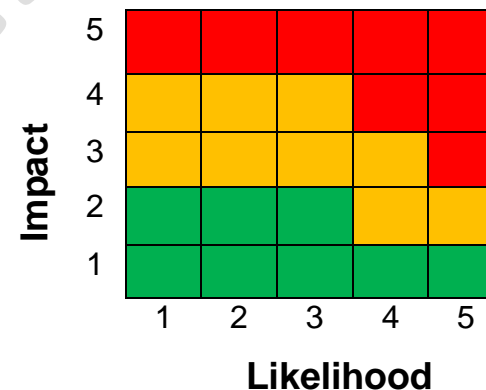
Impact	Score	Nature of Impact
Negligible	1	Appearance of threat but no actual impact on service provision
Minor	2	Isolated but noticeable examples of service decline. Minor environmental damage
Moderate	3	Service provision under severe pressure. Appreciable decline in service provision at community level. Isolated but significant

		instances of environmental damage that could be reversed. Small number of injuries
Major	4	Services seen to be in danger of failing completely with severe/widespread decline in service provision and quality of life. Severe loss of environmental amenity. Isolated instances of serious injuries
Catastrophic	5	Widespread service failure with services unable to cope with wide-scale impacts. Irrecoverable environmental damage. Large numbers of serious injuries or loss of life

Assessing risk

Once the risk has been scored it will fall within one of these areas, where, as an indicator:

- **red area** requires urgent attention
- **amber area** requires active management
- **green area** is acceptable, subject to monitoring



	Climate Change Impact	Likelihood x Impact	Risk	Climate Change Impact	Likelihood x Impact	Risk
Property and Housing	Warmer, Drier Summers			Milder, Wetter Winters		
	Increased energy consumption for cooling	5 x 2	Yellow	Building damage	5 x 2	Yellow
	Increased growth pest infestations and vermin	5 x 2	Yellow	Reduced heating demand	5 x 2	Yellow
	Increased 'heat island' effect	5 x 2	Yellow	Dampness/mould issues increase	5 x 2	Yellow
	Increased bioproductivity promotes growth of problem species e.g. buddleia	2 x 4	Yellow	Increased pest infestations and vermin	5 x 2	Yellow
	Increased water demand	5 x 1	Green			
	Damage to buildings/fittings due to subsidence & heave	2 x 2	Green			
	Severe Weather Events and Extreme Rainfall			Sea Level Rise		
	Building damage	5 x 4	Red	Damage to sea defenses	1 x 1	Green
	Increased vulnerability of key heritage & cultural assets to damage	5 x 4	Red	Flooding/damage to coastal property and possible loss of property value	1 x 1	Green
Increased insurance costs	5 x 4	Red	Increased vulnerability to storm surges	1 x 2	Green	
Increased incidence of inundation and flood damage	5 x 4	Red				
Land Use Planning	Warmer, Drier Summers			Severe Weather Events and Extreme Rainfall		
	Policy response to enable local wildlife to adapt better to climate change. Planning must make it easier for species to move through the landscape to new habitats	5 x 3	Red	Design guidance to ensure developments will be built to withstand increased rainfall, more intense rain storms & more frequent flooding, including from surface water	5 x 4	Red
	New building design requirements in response to excessive summer temperatures and increased 'heat island' effect	5 x 3	Red	Development and strategic planning responses to ensure increases in rainfall intensity will result in changes and improvements in fresh and waste water infrastructure	5 x 4	Red
	Enabling policies required to reduce pressure from increased tourism and recreational demand	5 x 3	Red	Measures such as flood & coastal defences and enhanced drainage systems will be required to reduce risk posed by flooding.	5 x 4	Red
	High development churn rates due to subsidence and heave	2 x 2	Green	Disruption to transport – minimise need to travel through better town planning	5 x 4	Red
	Sea Level Rise			Disruption of services – decentralise provision of energy and water supplies	5 x 4	Red
	New and existing developments close to coast may need to be adapted	5 x 2	Yellow	More flexibility in choice of building materials and designs may be required	5 x 3	Red
	Development Plans will need to reflect impact of long term sea level rise	5 x 2	Yellow			

	Climate Change Impact	Likelihood x impact	Risk	Climate Change Impact	Likelihood x Impact	Risk
Road Services & Transport	Warmer, Drier Summers			Milder Wetter Winters		
	Failure of essential road infrastructure e.g. melting tarmac	5 x 2	Yellow	Increased road deterioration	5 x 3	Red
	Extreme Weather Events and Extreme Rainfall			Failure of drainage infrastructure	5 x 3	Red
	Failure of drainage infrastructure	5 x 4	Red	Disruption to work programmes and operational issues caused by water logged ground conditions	5 x 3	Red
	Increased incidence of localised and widespread flooding	5 x 4	Red			
	Increase road deterioration	5 x 3	Red	Sea Level Rise		
	Disruption to work programmes and operational issues caused by waterlogged ground conditions	5 x 3	Red	Failure of coastal defences	3 x 2	Green
	Increased number of emergency call-outs	5 x 4	Red	Storm surge inundation	3 x 4	Yellow
	Significant increases in maintenance costs/requirements for new infrastructure	5 x 3	Red			
	Economic and reputational ramifications of major transport disruption to Edinburgh	5 x 2	Yellow			
Biodiversity & Greenspace	Warmer, Drier Summers			Milder, Wetter Winters		
	Trees, vegetation and grass in parks and open space dying during prolonged periods without rainfall	4 x 2	Green	Habitat changes	5 x 3	Red
	Deterioration in river and wetland environments	4 x 2	Green	Severe Weather Events and Extreme Rainfall		
	Reduced water quality	4 x 2	Green	Damage to vegetation and trees	5 x 4	Red
	Increased fire risk – grasslands and moorlands	4 x 2	Green	Mature trees liable to be blown down during storms with potential to cause damage or injury, road traffic accidents and road closures. This will be especially important if storm events occur during prolonged wet spells in summer months when broadleaf trees are in leaf.	5 x 4	Red
	Longer growing season	5 x 3	Red			
	Species and habitat stress	5 x 3	Red	Deterioration of public parks	3 x 4	Red
	Introduction of new species	5 x 3	Red	Increased soil erosion and land instability resulting in increased risk of landslides & accelerated coastal erosion	3 x 3	Yellow
Damage to tree roots – subsidence and heave	5 x 3	Red				
Deterioration in river and wetland environments	4 x 3	Yellow				

	Climate Change Impact	Likelihood x impact	Risk	Climate Change Impact	Likelihood x impact	Risk
Environmental and Community Health	Warmer, Drier Summers			Milder, Wetter Winters		
	Changes in incidence of vector borne diseases	5 x 4	Red	Increased risk of mould and fungal illness and associated respiratory problems	5 x 4	Red
	Increased risk of heat stroke, dehydration and respiratory problems	5 x 4	Red	Higher levels of air pollution when there is no wind	2 x 4	Red
	Severe Weather Events and Extreme Rainfall					
	Increased incidence of food poisoning	5 x 4	Red	Public health and safety risks increase	5 x 4	Red
	Reduced water quality – sea, river and standing water	5 x 4	Red	Disruption to essential community services for vulnerable individuals	5 x 4	Red
Increase in air particulates leads to worsening air quality	5 x 4	Red	Long- term mental health issues	5 x 1	Green	
Waste Services	Warmer, Drier Summers			Milder, Wetter Winters		
	Changes in incidence of vector borne diseases	5 x 4	Red	Increased pest infestations and vermin	5 x 2	Yellow
	Increased pest infestations and vermin	5 x 2	Yellow	Potential for leachate escape from landfills and contaminated land	2 x 1	Green
	Increased odour issues	5 x 2	Yellow			
	Increased bioproductivity promotes green waste volume	2 x 4	Green	Sea Level Rise		
	Severe Weather Events and Extreme Rainfall					
	Lost work days	5 x 4	Red	Loss of recycled materials	5 x 4	Red
Disruption to transport and supplies	5 x 4	Red	Increased insurance and repair costs	5 x 4	Red	
			Increased vulnerability to coastal landfills and contaminated land	1 x 1	Green	

Economy	Warmer, Drier Summers			Milder, Wetter Winters		
	Increased demand for outdoor events	5 x 3		Changes in demand for weather related goods/services	5 x 2	
	Additional staff heat and health risks	5 x 2		Severe Weather Events and Extreme Rainfall		
	Heat stress to service provision	5 x 2		Cancellation/disruption of events	5 x 4	
	Closure of water reliant recreational activities	5 x 2		Lost work days	5 x 4	
	Sea Level Rise			Disruption to transport and supplies	5 x 4	
	Loss of land and property values	5 x 2		Increased insurance and repair costs	5 x 4	
				Loss of land/property values	3 x 2	

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