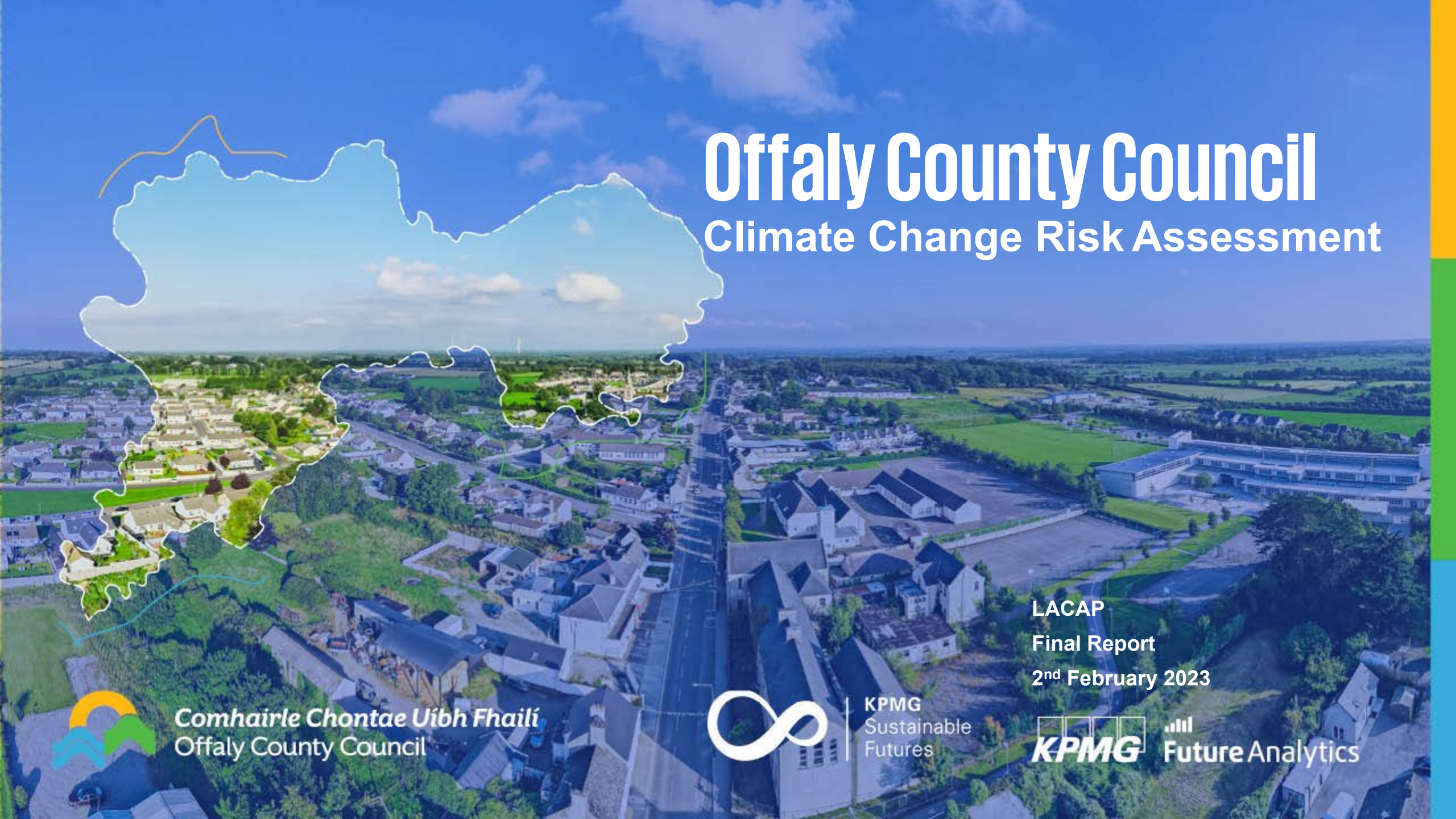
Offaly County Council

Climate Change Risk Assessment



LACAP

Final Report

2nd February 2023

Comhairle Chontae Uíbh Fhailí
Offaly County Council

KPMG Sustainable Futures

KPMG Future Analytics

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Executive Summary

Executive Summary

Context and Scope of this Report

Climate change poses a critical challenge for Offaly County Council. It will result in a wide range of impacts across Offaly, from damaging infrastructure such as roads and bridges, to detrimental impacts on biodiversity and restrictions on water supply. These bring substantial implications for Offaly County Council.

Internationally, national and local governments are increasingly compelled to take ambitious action to increase resilience to climate change within their organisations and their functional areas through adaptation and mitigation measures.

Ireland's Climate Action and Low Carbon Development (Amendment) Act, 2021 highlights the role of the Local Authority in meeting national emission reductions targets and achieving climate resilience. The Act stipulates that local authorities need to prepare a Local Authority Climate Action Plan (LACAP) that will drive local response to the challenges posed by climate change, translating the national climate policy to the local level.

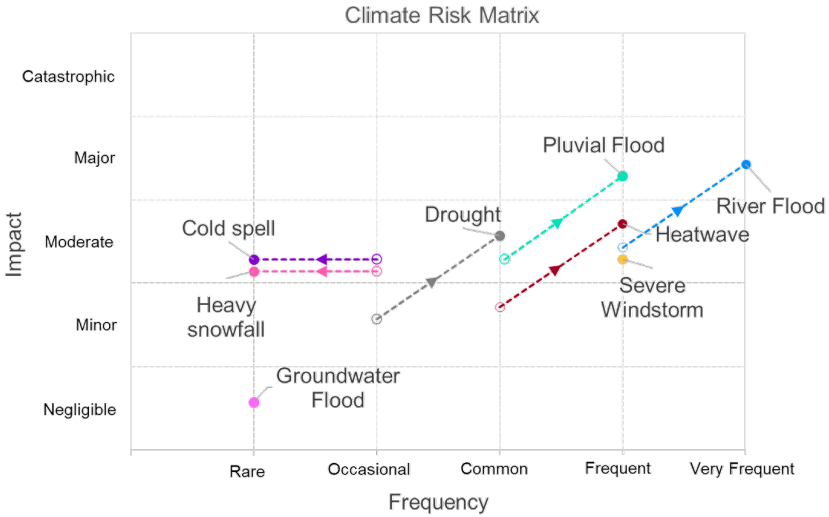
This report provides an assessment of Offaly's climate change risks and impacts on the delivery of services by Offaly County Council. The aim of the report is to provide the evidence base and inform the development of the LACAP for Offaly County Council.

Key Results and Findings

As illustrated in the climate risk matrix on the right the frequency and intensity of some hazards (e.g., river and pluvial flooding, heatwaves and drought) will increase while others will remain the same (e.g., severe windstorms). Some hazards are expected to decrease in frequency, such as cold spells and heavy snowfalls.

- Recent experiences of **cold spells and heavy snowfall** events (e.g. Storm Emma) demonstrated the wide range of impacts for County Offaly. These included, amongst others, disruption to public transport networks, power outages and a reduction in agricultural production. Projected increases in average temperature and decreases in the frequency of snowfall indicate a decrease in the frequency of cold spells, heavy snowfall, and their associated impacts.
- Recent **river and pluvial flooding** events in 2020 had a wide range of impacts for County Offaly, including inundation of residential properties, damage to recreational amenities, disruption of transport networks and inundation of farmland. Projected increases in the frequency of extreme precipitation events will result in increased surface water and riverine flood risk for Offaly.
- Offaly experienced both a **heatwave and drought** in 2018, with heatwaves recorded in 2021 and 2022. These events included, amongst others, disruption of public transport networks, the imposition of restrictions on water supply, and contributed to the development of uncontrolled fires (e.g. Slieve Bloom Mountains). Projected increases in the frequency of heatwaves and drought conditions will mean that events currently experienced on an infrequent basis will become more frequent. As the population ages, there will also be an increase in the number of vulnerable people exposed to heat-related risks.
- **Severe windstorms** are currently experienced on a frequent basis in Offaly and result in wide-ranging impacts, including damage to buildings and infrastructure, and disruptions to energy supply and transport networks across the county. Projections indicate no significant change to this frequency.

To increase resilience, Offaly County Council will need to proactively plan for and adapt to the **current and future climate change risks** identified through this report.



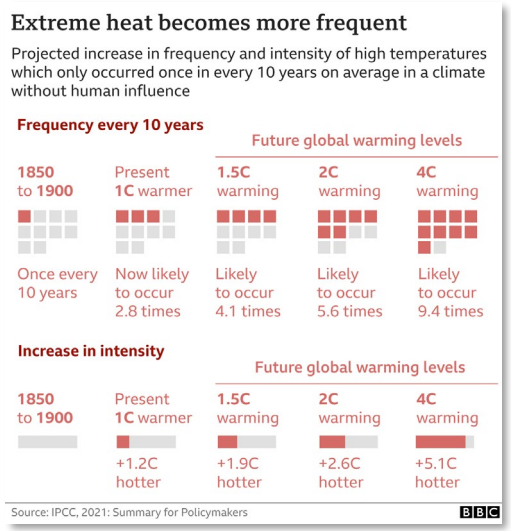
The risk matrix above shows the current and future level of risk associated with climate hazards for Offaly. The hollow marker showing the current level of risk and the solid marker the future level of risk. The dotted line shows the change between the current and future risk.

02

Introduction

Global Response to the Challenge of Climate Change

Global Climate Change Challenge



It is unequivocal that human influence has warmed the atmosphere, land and ocean since pre-industrial times, affecting many weather and climate extremes in every region across the globe. Each of the last four decades have been successively warmer than any decade preceding it since 1850.

Since 1990, the IPCC have published a series of assessment reports which provide a synthesis of the most up-to-date science and evidence of climate change. The most recent assessment report shows that the global average temperatures have increased by 1.1°C when compared with pre-industrial conditions (1850-1900).

Global trends

Climate relates to average weather over a period of time, which is typically measured over 20 or 30 years.

Local impacts

Weather relates to short term changes in atmospheric conditions and can change from minute-to-minute, day-to-day and season-to-season.

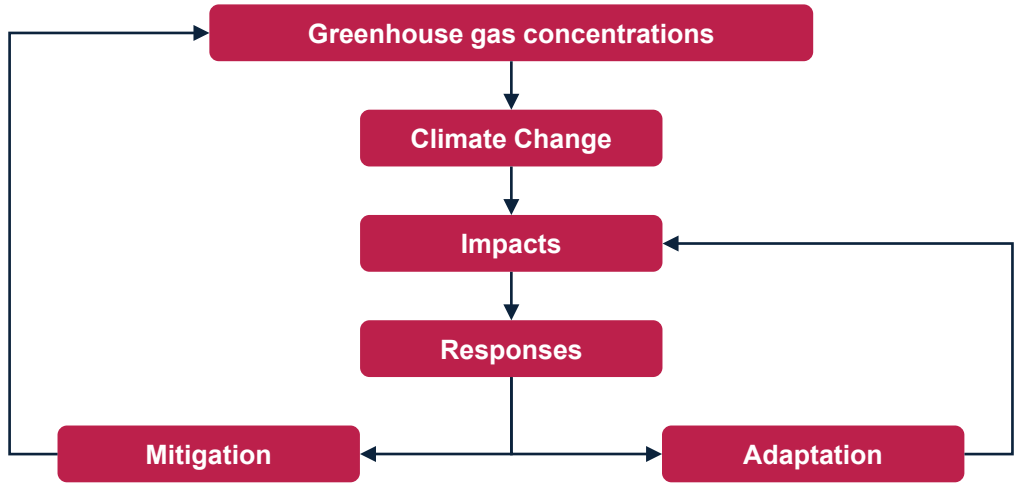
It is becoming apparent that **changes in global climate are being reflected in changes in the frequency and intensity of extreme weather events such as heatwaves, droughts and flooding.**

Global Climate Change Response Framework

In response to the challenges posed by climate change, two complementary approaches are being adopted.

Mitigation: Making the impacts of climate change less severe by preventing or reducing the emission of greenhouse gases (GHG) into the atmosphere. Mitigation is achieved either by reducing the sources of these gases (e.g. by increasing the share of renewable energies, or establishing a cleaner mobility system), or by enhancing the storage of these gases (e.g. by increasing the size of forests). In short, mitigation is a human intervention that reduces the sources of GHG emissions and/or enhances the sinks.

Adaptation: Anticipating the adverse effects of climate change and taking appropriate action to prevent or minimise the damage they can cause, or taking advantage of opportunities that may arise. Examples of adaptation measures include large-scale infrastructure changes, such as building defences to protect against sea-level rise, as well as behavioural shifts, such as individuals reducing their food waste. In essence, adaptation can be understood as the process of adjusting to the current and future effects of climate change.



Ireland's Challenge of Climate Change

Observed Impacts of Climate Change on Ireland

The mean annual observed temperature for Ireland (1900-2019) Source: Cámaro García and Dwyer, 2021)

According to the Environmental Protection Agency (EPA) Ireland's climate is changing in line with global trends, with a temperature increase of, on average, by 0.8 Celsius. Since the 1980s, each successive decade has been warmer than any preceding since 1850. In the mean time, the island has seen an increase in average annual national rainfall of approx. 5% in 1981-2010, compared to 1961-1990. Concurrently, the rate of global sea level rise for 2006/2015 is about 2.5 times the rate of 1901-1990.

- Surface air temperature has increased, on average, by 0.9 Celsius during the past 120 years.

- Yearly precipitation was, on average, 6% higher in the 30 years from 1989-2018 as compared to 1961-1990.
- 2006 to 2015 was shown to be the wettest in Ireland since records began.

- Due to limited analysis, no long-term wind trends have been observed.

- There has been a rise in sea level of approximately 2-3 mm per annum since 1990.
- Sea temperature at Malin Head has been, on average, 0.47 Celsius over the past years as compared to the period 1980 to 2001.

Projected Impacts of Climate Change on Ireland

Climate projections suggest that these observed impacts will continue and likely worsen into the future. It is expected that Ireland's climate will become warmer and drier out towards 2050, its sea levels will continue to increase at a faster rate and its extreme weather events will occur more frequently. Even if mitigative action is taken over the next 30 years, certain projected impacts are locked in for the foreseeable future as a result of past actions, and surface temperatures will increase globally until at least 2050, even under low emissions scenarios

- By 2050, average annual temperatures are expected to increase by 1-1.2 Celsius under an intermediate emissions scenario.
- Heatwave events are set to increase, with an expected extra 1-8 heatwave events between 2041 to 2060 under an intermediate emission scenario.

- Summer precipitation levels are expected to decrease by a maximum 0-11% under an intermediate emissions scenario.
- During winter and autumn months, there is expected to be an increase of 5-19% in the occurrence of heavy precipitation events.

- Projections indicate a small reduction in wind speed of between 1-2.7% under an intermediate emissions scenario.
- There is an expected easterly extension of severe windstorms across Ireland.

- The expected average global sea level rise by the year 2100, under an intermediate emissions scenario, is between 0.44-0.76 metres.
- Projections indicate that the Irish Sea could warm by a further 1.9 Celsius before the end of the 21st Century

Source: Local Authority Climate Action Plan Guidelines, pages 26-29.

National and Local Response

Paris Agreement, 2015

The Paris Agreement, adopted in 2015 provides an internationally accepted and legally binding global framework to addressing climate change challenges. It has two clearly defined goals aimed at supporting progressive and ambitious climate action to avoid dangerous climate change:

I. holding global average temperature increase to well below 2°C and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels (i.e. **mitigation**);

II. increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience (i.e. **adaptation**).

European Climate Law, 2021

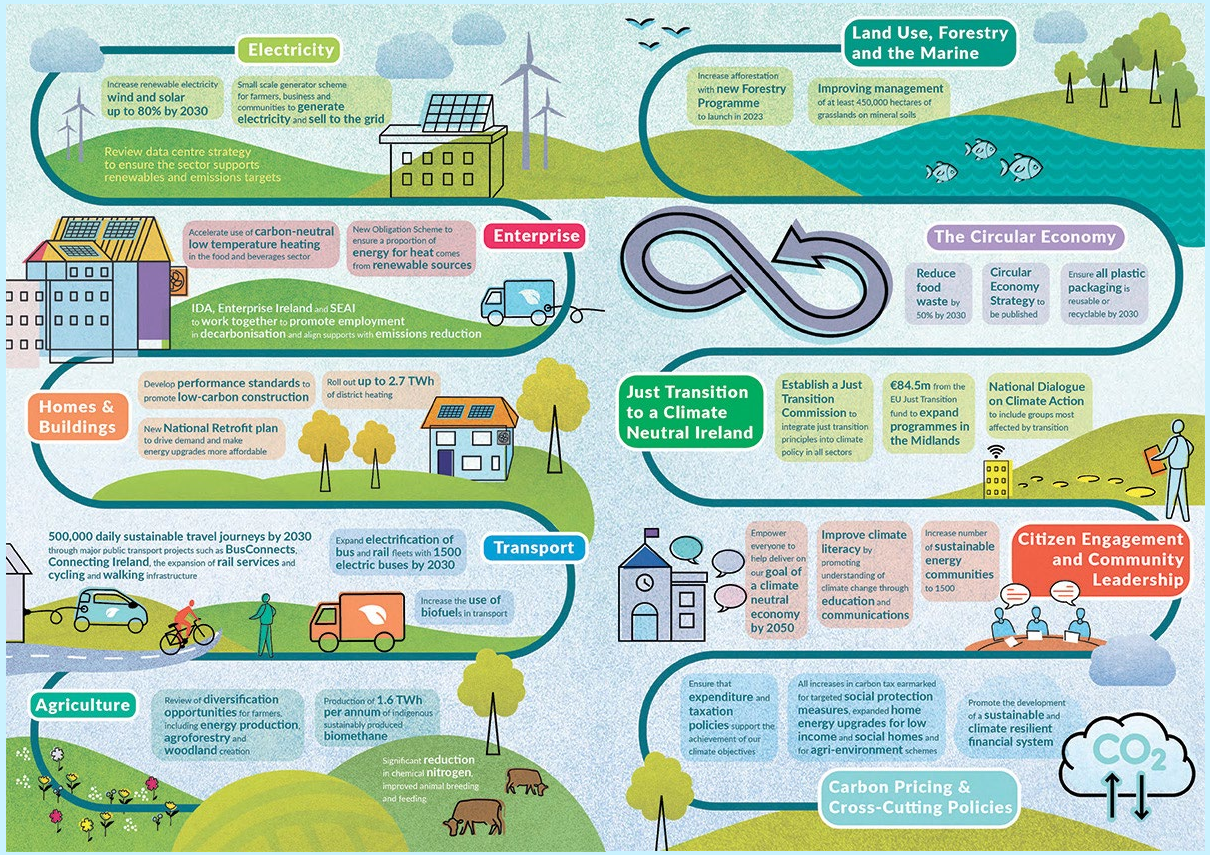
The EU adopted a legislative proposal for the European Climate Law in June 2021 to frame the climate neutrality objective by 2050 across the EU with an intermediate target of **reducing net greenhouse gas emissions by at least 55% by 2030**. The European Commission (EC) is clear in the commitment required by all Member States, and the use of all policy levers and instruments, to fight against the urgent challenge of climate change and to activate leadership efforts to reach climate neutrality by 2050.

Climate Action and Low Carbon Development (Amendment) Act, 2021

Climate policy in Ireland reflects the ambition of the EU and that required to confront the challenges of climate change. The Climate Action and Low Carbon Development (Amendment) Act, 2021 frames Ireland's legally binding climate ambition to delivering a **reduction in greenhouse gas emissions of 51% by 2030**, to achieve climate neutrality by the end of 2050.

Through progressive economy-wide carbon budgets, sectoral ceilings, a suite of strategies devised to promote a **combination of adaptation and mitigation measures**, and robust oversight and reporting arrangements, climate policy is working to scale up efforts across all of society and deliver a step change on ambitious and transformative climate action to 2030 and beyond to 2050.

Climate Action Plan 2021 - Infographic



Project Overview

Legislative context

Climate Policy in Ireland is aligned with the EU's ambitions to combat Climate Change. The Climate Action and Low Carbon Development (Amendment) Act 2021 enshrines the National Climate Objective to "pursue and achieve, by no later than the end of 2050, the transition to a climate resilient, biodiversity rich, environmentally sustainable and climate neutral economy."

The importance of place-based approaches and the role of the Local Authority is highlighted in the Act, which stipulates that "each local authority shall prepare and make a plan relating to a period of five years (in this section referred to as a 'local authority climate action plan') which shall specify the **mitigation measures** and the **adaptation measures** to be adopted by the local authority."

These plans will drive the mitigation and adaptation measures at the local level and see Local Authorities translate national climate policy to local circumstances and to support the delivery of the National Climate Objective at local and community levels.

Preparing local authorities' climate action plans

To support local authorities in meeting their legislative requirements, the Climate Action Regional Offices (CAROs) developed the draft Local Authority Climate Action Plan (LACAP) Guidelines.

These guidelines structure the development and implementation of climate action plans (CAPs) around a 4-step cycle, which is supported by four technical annexes[1]:

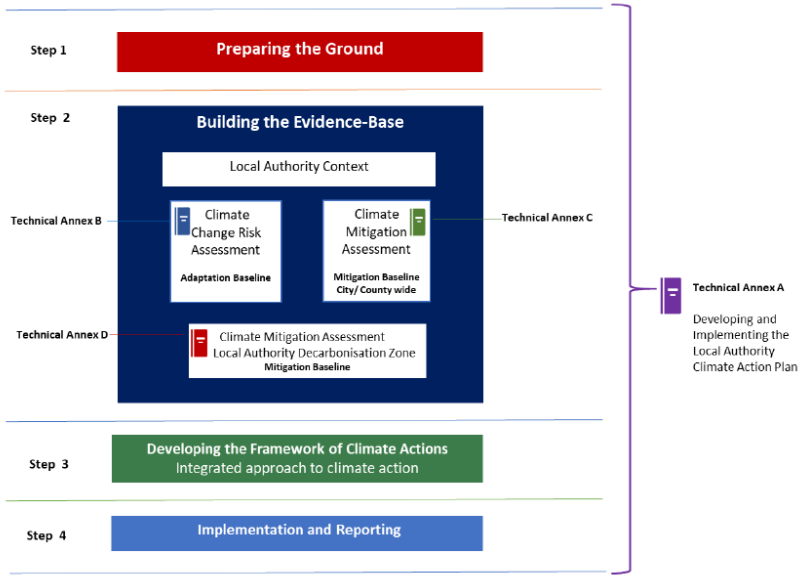


Figure 3: 4-step-cycle for development of the local authority climate action plan.

[1] *Source: Local Authority Climate Action Plan Guidelines, page 5.*

Scope of this report

Per Offaly County Council's request, the KPMG team is supporting the council in Step 2 to build the adaptation baseline and develop a climate change risk assessment (CCRA) following **Technical Annex B of the LACAP Guidelines** in order to understand the current and future risks posed by climate change to County Offaly and Offaly County Council.

03

Climate Change Risk Assessment (CCRA)

3.1 Introduction, Scope and Methodology

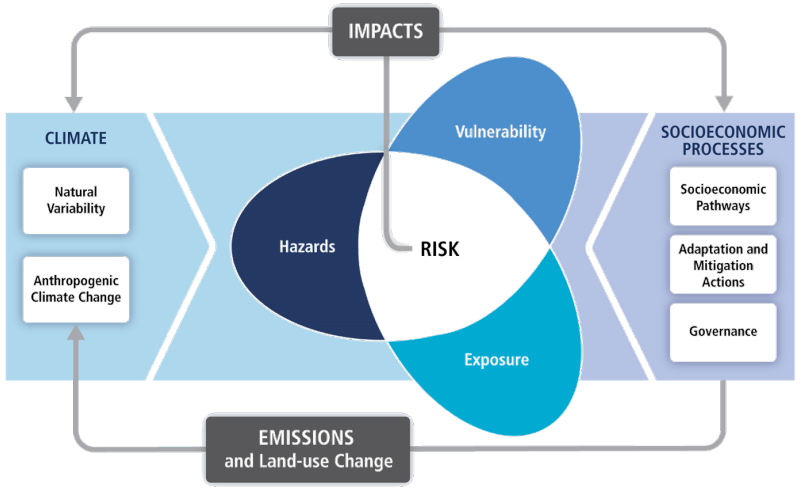
Understanding of Climate Change Risk Assessment

Purpose of Climate Change Risk Assessment

As detailed in the introduction to this report, the response to climate change entails both mitigation and adaptation actions. The aim of adaptation is to reduce the risks posed by climate change to County Offaly's environment, society and economy and increase resilience. In order to know how County Offaly needs to adapt to observed and projected changes to the climate, KPMG conducted a Climate Change Risk Assessment (CCRA).

Nature of Climate Change Risk Assessment

Conventional 'predict and act' approaches to risk assessment are challenged by the inherent uncertainty associated with climate change, the spatial and temporal dynamics of climate change, the amplification of risk through societal preferences and values and through the interaction of multiple risk factors. In assessing climate change risk we have adopted the risk assessment framework of the Intergovernmental Panel on Climate Change (IPCC). This framework identifies three key components of climate risk:hazards, exposures and vulnerabilities. Details of the framework are explained on the right.



Hazard: potential source of climate-related harm, i.e. damage or loss of property.

Exposure: presence of people, livelihoods, environmental services and resources, infrastructure, or economic and social or cultural assets in places that could be adversely affected.

Vulnerability: propensity / disposition to be adversely affected.

Risk: the potential for adverse consequences.

Anthropogenic Climate Change

Impact of human activity on climate; more specifically, the global warming caused by unnatural (human-induced) increase in the greenhouse effect, as concentrations of greenhouse gases increase.

Natural Variability

Natural variability refers to the variation in global climate caused by non-human activities such as long term shifts in weather patterns.

Adaptation & Mitigation Actions

Adaptation actions aim to reduce adverse climate impact and risks.

Mitigation actions refer to those that address the causes of anthropogenic climate change.

Governance

Looks at how governance factors, e.g. Institutions, transparency, policies, etc. contribute or hinder adaptation or mitigation measures.

Socio-economic pathways

Looks at how changes in socio-economic factors, e.g. wealth & inequality, demographics, access to technology, etc. impact contribute to mitigation and adaptation action.

Source: Local Auhtority Climate Action Plan Guidelines, Technical Annex B, Figure 1. (page 5)

Methodology of Climate Change Risk Assessment (CCRA)

Qualitative Assessment

This Climate Change Risk Assessment has been undertaken in accordance with Technical Annex B Climate Change Risk Assessment of the Local Authorities Climate Action Plan Guidelines and provides a qualitative assessment of climate risk for Offaly County Council.

A qualitative risk assessment provides the evidence base to identify potential climate risks through an impact and risk analysis on the assets and service delivery function of a local authority and its administrative area.

The Technical Annex B provides a stepped approach to carrying out a climate change risk assessment:

1. Assess climate impact baseline, identifying, assessing and characterising the climate and weather-related impacts already being experienced by the authority, and
2. Identify and assess potential future climate impacts and risks.

In assessing climate change risk, we employ climate information derived from *Nolan (2020)* and *Climate Ireland* for two climate scenarios, RCP4.5 and RCP 8.5 in our assessments.

- RCP4.5 represents an 'intermediate emissions' scenario with an average global warming of 1.4°C for the 2046-2065 period.
- RCP8.5 represents a 'very high emissions' scenario with an average global warming of 2°C for the 2046-2065 period.

The RCP8.5 scenario was used as it is the best match to the mid-century current and stated policies. It is also the 'worst-case' scenario which allows for a conservate risk assessment approach.

Qualitative

- **A qualitative assessment is based on available information and supports a screening of climate change related hazards and risks.**
- **This type of assessment helps to:**
  - **Prioritise systems that need further assessment risk;**
  - **Communicate identified risks to relevant stakeholders**
  - **Identify which stakeholders to engage in a semi-quantitative risk assessment; and**
  - **Provide a broad understanding of where adaptation actions could be required.**

Semi-quantitative

- **A semi-quantitative risk assessment uses nationally available data along with expert judgement to explore potential risks of prioritised decision areas, sectors, systems, etc. in further detail to understand the wider impact.**
- **This type of assessment helps to:**
  - **Identify climate change risks across relevant sectors of the organisation;**
  - **Identify any cross linkages of impacts**
  - **Identify the organisation's capacity to adapt; and**
  - **Generate a list of risks that should be prioritised**

Quantitative

- **A quantitative risk assessment uses site-specific data and expert knowledge to establish a detailed understanding of risks and identify the point in time in the future when the risk will pass the tolerable limit and an implementation of your planned action will be necessary.**
- **This type of assessment helps to:**
  - **Detail an estimation of rate of change (when the risk will cross the limit and need action); and**
  - **Identify the extent of impact (how badly it will affect the system).**

Methodology Overview

As detailed below, **Technical Annex B Climate Change Risk Assessment** provides for a proportionate and stepped approach for undertaking a Tier 1 Climate Change Risk Assessment. An assessment of the current climate hazards, exposure, vulnerabilities and impacts leads to the '**Current Climate Risks and Impacts**'. This is followed by an assessment of future climate risks and impacts, resulting in the '**Future Climate Risks and Impacts**'. The detailed steps for both current and future climate risk and impacts are discussed in further pages.

Step 1. Current Climate Risks and Impacts

- Develop Profile of Climate Hazards
- Characterise Climate Hazards Frequency
- Exposure, Vulnerability and Impacts (Physical, Social and Environmental)
- Impact Assessment (Service Delivery)
- Overall Impact on Offaly County Council (e.g., Asset Damage, Health and Wellbeing, Environment, Social, Financial, Reputation, Cultural Heritage and Cultural Premises).

Step 2. Future Climate Risks and Impacts

- Assess Future Changes in Climate Hazards Frequency and Intensity
- Assess Future Change in Exposure and Vulnerability
- Uncertainty Assessment
- Assess Emerging Hazards and Potential Future Climate Risks
- Overall Impact on Offaly County Council

Step 1: Assess Current Climate Risks and Impacts

In assessing current climate risks and impacts, developing an understanding of the range of climate and weather related events with current impacts for Offaly County Council is essential. To achieve this, a number of steps have been undertaken and as detailed below:

1.1

Develop Profile of Climate Hazards

The climate hazard profile provides an overview of climate and weather-related hazards to have impacted the Local Authority.

We have updated the climate hazard profile developed through the existing Offaly County Climate Adaptation Strategy (2019) in accordance with recent experiences of extreme weather and climate variability.

Section 3.2.1

1.2

Characterise Climate Hazards- Frequency

On the basis of the most up-to-date information on extreme weather events and observed climate changes for Ireland, the frequency of occurrence of the climate hazards identified through the climate hazard profile has been assessed according to the criteria provided through **Technical Annex B: Climate Change Risk Assessment**.

Section 3.2.1

1.3

Exposure, Vulnerability and Impacts

For each of the climate hazards identified through the climate hazard profile, an assessment of the local-scale impacts, exposure, and vulnerability has been performed based on reported impacts and in discussion with the local authority.

Section 3.2.2

1.4

Impact Assessment (Service Delivery)

The level of disruption to the delivery of services by the council has been assessed for each of the identified climate hazards following the criteria provided through **Technical Annex B: Climate Change Risk Assessment**.

Section 3.2.3

1.5

Overall Impact on Offaly County Council

The overall impact of the identified climate hazards on Assets, Health and Wellbeing, Environment, Reputation, Cultural Heritage and Cultural Premises and Social and Financial impacts has been assessed and a summary of current climate impacts has been provided through a current climate risk matrix.

Section 3.2.4

Step 2: Assess Future Climate Risks and Impacts

Building on the assessment of current climate impacts, assessing future climate risks and impacts is concerned with understanding and characterising how projected changes in the frequency and intensity of climate hazards may exacerbate existing climate impacts and risks faced by the Local Authority. To achieve this, a number of steps have been undertaken and as detailed below:

2.1

Assess Future Changes in Climate Hazards- Frequency and Intensity

The most up- to-date climate change projections have been employed to assess the changes in frequency and intensity of climate hazards identified through our assessment of current climate impacts.

Section 3.3.1

2.2

Assess Future Change in Exposure and Vulnerability

To identify and assess the potential future changes in exposure and vulnerability, projections of potential future changes in non-climatic factors (e.g. *County Development Plans, Regional Social and Economic Strategies*) have been examined. The assessment of the projected future impacts and risks and the rationale behind this have been provided.

Section 3.3.2

2.3

Assess Emerging Hazards and potential Future Climate Risks

In addition to those hazards and impacts identified through the current climate impact and risk assessment. Projected climate change may result in new or emerging risks. Emerging risks for County Offaly have been identified and considered as part of the CCRA.

Section 3.3.2

2.4

Overall Impact on Offaly County Council

Accounting for projected changes in hazard, exposure and vulnerability, the overall future impact on Asset, Health and Wellbeing, Environment, Reputation, Cultural Heritage and Cultural Premises and Social and Financial impacts is assessed and a summary of potential future climate impacts have been provided through a future climate risk matrix.

Section 3.3.3

2.5

Uncertainty Assessment

In assessing future climate risks, there will be uncertainty in how hazards, exposure, and vulnerability will change. The level of uncertainty in projected changes in climate hazards, exposure, and vulnerability is assessed.

Section 3.3.4

Data and Information Sources

As detailed below, a wide range of qualitative and quantitative and information was employed to inform the development of the CCRA for Offaly County Council. The Offaly Council Adaptation Strategy 2019-2024 was reviewed using a range of national and local data sources. Climate Ireland was employed to access data and information on projected changes in the frequency and intensity of climate hazards accessed while the National Planning Framework, Offaly County Council Development Plan 2021-2027 and the Regional Spatial & Economic Strategy for the Eastern and Midland Region were employed to assess future development patterns. In addition, a stakeholder workshop was held to garner further insights from Offaly County Council.

Report Section	Sources	
Introduction and scope	• Local Authority Climate Action Plan Guidelines, Technical Annex	
Step 1: Current Climate Risks and Impacts	• Environmental Protection Agency (EPA) • Catchments.ie (EPA) • Floodinfo.ie (Office of Public Works) • Climate Status Report 2020 (Cámaro García and Dwyer, 2021) • Data.gov.ie • Department of Transport • Department of Housing, Local Government and Heritage • Department of Transport, Sport and Tourism • National Directorate for Fire and Emergency Management • Teagasc • Iarnród Éireann • Sectoral Climate Change Adaptation Strategies (2018) • Stakeholder Workshop	• Met Éireann • RTE News • The Irish Times • The Irish Mirror • The Journal • The Farmers Journal • Farming Independent • Greennews • Offaly Live • Offaly Independent • Offaly Express • Westmeath Independent • Westmeath Edt.
Step 2: Future Climate Risks and Impacts	• Eastern and Midlands Climate Action Regional Office • High-resolution Climate Projections for Ireland – A Multi-model Ensemble Approach (Nolan and Flanagan, 2020) accessed via Climate Ireland • Offaly County Council Development Plan 2021-2027	• Regional Spatial & Economic Strategy for the Eastern and Midland Region

3.2 Current Climate Risks and Impacts

3.2.1 Profile of Climate Hazards (incl. Frequency)

Characteristics of County Offaly

Offaly County Council is a member of the Eastern and Midlands Climate Action Regional Office (CARO) and serves **82,688** people (2022 Census). Apart from the Slieve Bloom Mountains, the county is characterised by flat and undulating lands. Approximately one fifth of the county comprises peatlands and most of the remainder of the land is used for agriculture or forestry.

Physical & Environmental Characteristics

County Offaly is approximately 2,001km² making it the 18th largest of Ireland's thirty-two counties. Offaly is located in the centre of Ireland and is bounded by counties Meath, Kildare, Laois, Tipperary, Galway, Roscommon and Westmeath. The county is comprised of 3 municipal districts (including Birr MD, Edenderry MD and Tullamore MD) and has a strong rural based population.

Peatlands are a dominant part of the county's landscape and have traditionally been a significant asset in terms of both energy resources and employment. In recent years, peatlands act as a valuable amenity, including for tourism and educational purposes. Notable bogs include Lough Boora Discovery Park and the Clara and Mongan bogs.

In terms of landscape, Offaly is characterised by a comprehensive system of eskers (i.e. glacial formed sand and gravel ridges). These are mainly concentrated in the northwest and centre of the county with the most comprehensive and visually dominating being the Eiscir Riada which runs east to west (from Shannonbridge towards County Westmeath). Other significant landscape features include the River Shannon and its Callows which runs along the western county boundary, its tributary the River Brosna, and the Grand Canal which traverses the county from east to west. Important archaeological and historical landscapes include Clonmacnoise, Durrow and the extinct volcano Croghan Hill.

Socioeconomic Characteristics

County Offaly has a well-developed network of towns and villages and the county is well served by strategic road access and a rail line serving stations at Portarlington, Clara and Tullamore. Tullamore is the county's main town and the administrative centre and was, under the 2019 Regional Spatial and Economic Strategy, designated as a Key Town.

Offaly's location in the centre of Ireland means that the county is traversed by strategic transport routes. The county includes the M6 (Dublin to Galway) and the M7 (Dublin to Limerick) motorways, and key national secondary routes such as the (N52) Dundalk - Nenagh and the (N80) Enniscorthy-Moate routes. These routes and their on-going improvement make the county more accessible to ports such as Drogheda, Bellview and Rosslare and help attract inward investment. They are also fundamental in providing connections with other urban centres in the midlands.

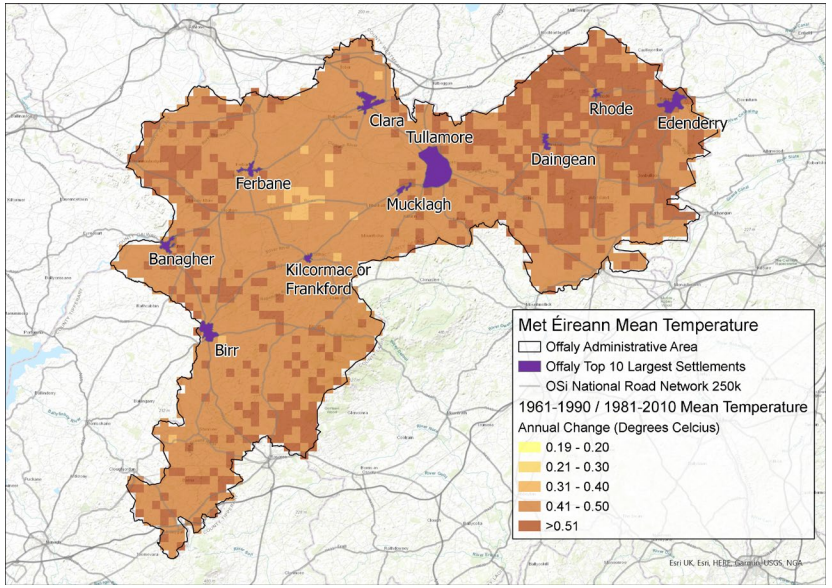
According to the CSO Statistical Yearbook, 63% of all commuters travelled by motor car compared to 11% on foot and 9% on Bus, Coach or Minibus. Offaly's higher-than-average car ownership rate (i.e. one car per 2.6 persons compared to the national average of 1 car per 3.4 persons).

According to Census 2016, 84.1% of the total Labour Force in Offaly was 'At Work'. Although this was below the State average of 87.1%, it compares well with the other Midland counties of Laois, Longford and Westmeath.

Tullamore, the county town, is nationally central and serves as a major employment hub for the Midlands, with Professional Services, Manufacturing and Engineering being its largest industries. An increasing cluster of medical-tech and biopharma companies are locating themselves in Tullamore; in proximity to the Midlands Regional Hospital, which is the major hospital for the region. Tullamore is also a growing hub for the Food and Drinks sector, with large employers like Tullamore Dew Distillery, Carroll Meats and Glenisk all located in the area. Professional services, scientific and technical activities, as well as various public service providers comprise the town's other key economic pillars, with traditional employment in peat production giving way to opportunities in the green economy. In the east of the county, the economy was traditionally dependent on agriculture and peat production, however given this area's proximity to the Dublin Metropolitan Area, a trend of commuting has emerged.

The county's Household Median Gross Income in 2016 was €41,271 and in 2021 the council provided 768 Housing Assistance Payments.

Observed Changes in Offaly's Climate



In line with global trends, the climate of Ireland and Offaly is changing, temperatures are increasing and patterns of precipitation are changing. These changes are projected to continue and intensify with a wide range of impacts for Offaly and Offaly County Council. A summary of key climate and weather-related changes already observed for County Offaly are detailed below. The Birr long-term weather station was used for historic baseline figures

Highlights of Observed Climate Change for Ireland and Offaly

Droughts

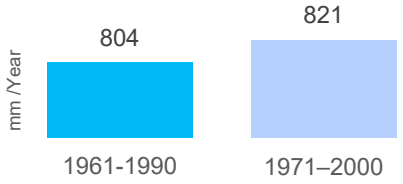
The longest running absolute drought in Offaly was recorded at Derrygreenagh weather station, lasting a total of 30 days with less than 0.2mm of rain

31.1°C

Highest temperature on record recorded on Jul 19th 2006 at Derrygreenagh

Rainfall

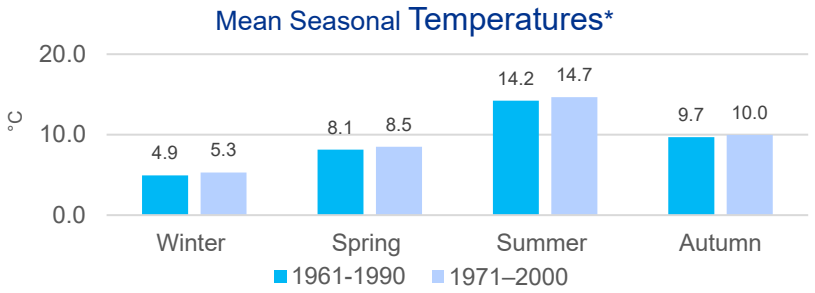
Average annual rainfall at Birr Increased by 2% for the most recent full period (1971-2000) compared to the 1961-1990 baseline of the station.*



0.5°C

Average temperature increase for the 1971-2010 baseline when compared to the 1961-1990 baseline.*

The 2018 July heatwave is the longest running heatwave experienced in Offaly since 1961, with temperatures remaining above 25 °C for 9 consecutive days**

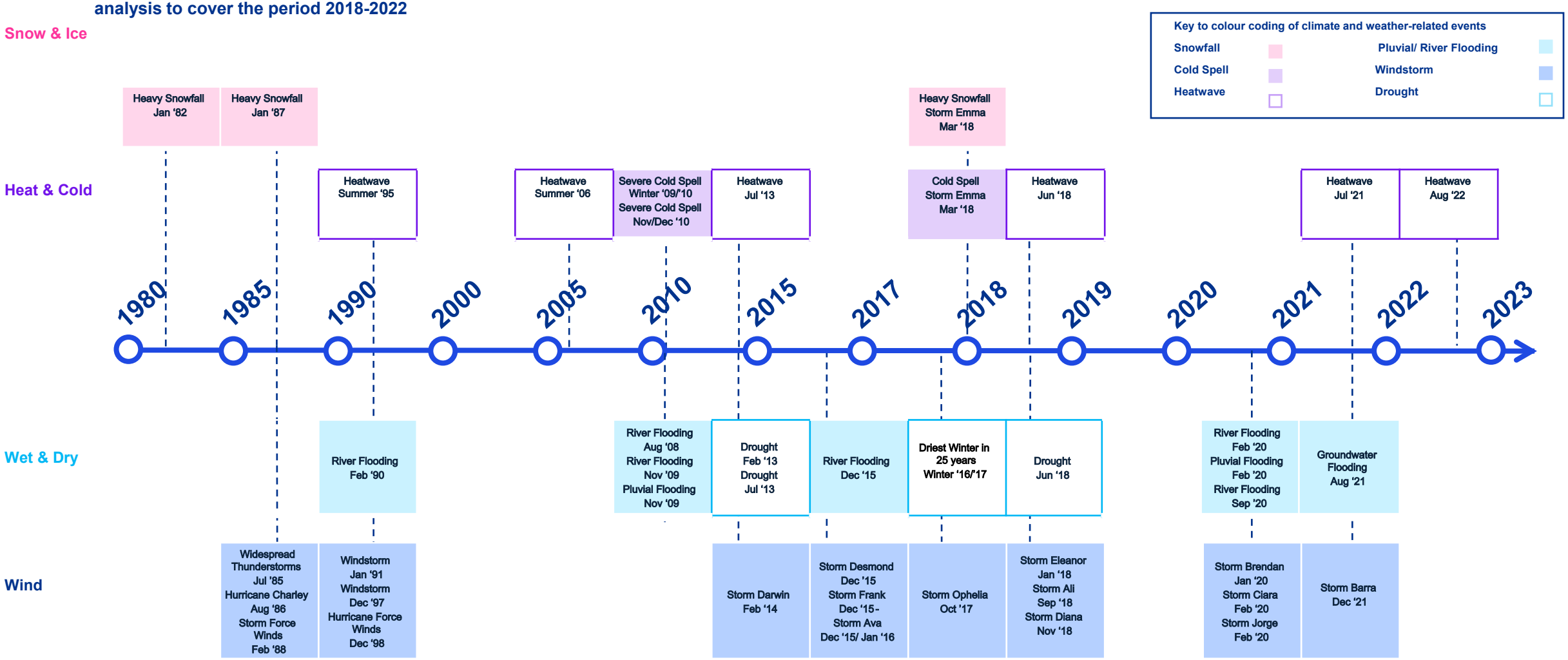


*Source: Met Éireann Long term weather station : Birr (Closed 2008)
**Source: Met Éireann weather station data: Derrygreenagh
***Source: interpolation from Long term Met Éireann mean temperature 1x1 Grid data
****Source:

With over 15 days of temperatures above 25 °C , Extremely dry conditions in 2018 provided for favourable ignition conditions and contributed to a wild fire at the Slieve Bloom mountains that required 6 days of effort by firefighters to combat.

Climate Hazard Profile

In addition to observed changes in Offaly's climate, we have identified significant climate and weather-related events to have impacted on County Offaly over the period 1982-2022. To do this, we have further developed the existing climate hazard profile developed through the existing Offaly County Council Adaptation Strategy (2018) and expanded the analysis to cover the period 2018-2022

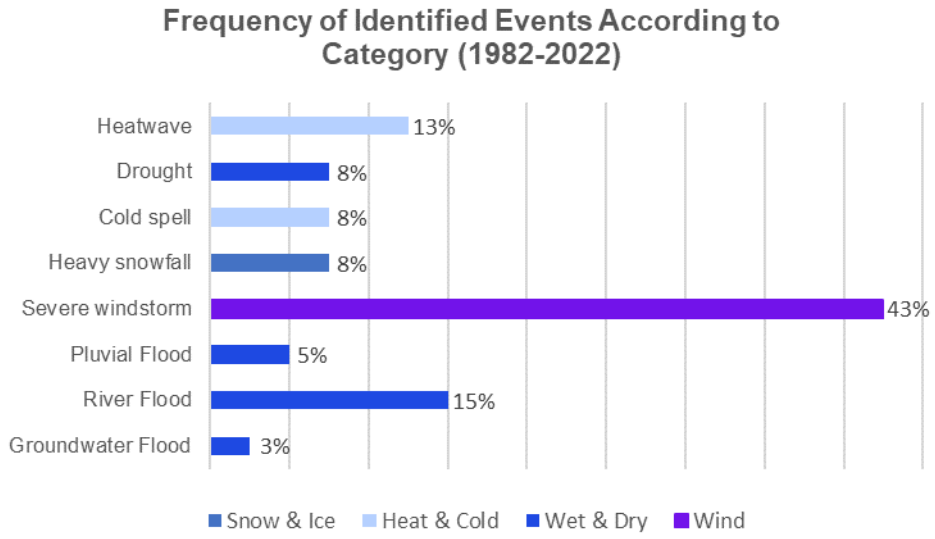


Frequency of Climate Hazards

For each of the climate hazards that have been identified through the climate hazard profile, an assessment of their frequency of occurrence has been conducted. Each hazard was assigned a frequency category according to Table 2 of the **Technical Annex B Climate Change Risk Assessment Guidelines** (top right).

Based on the climate hazard baseline, server windstorm events have impacted upon County Offaly most frequently over the period 1982-2022, with river flooding and heatwaves also affecting the County on a number of occasions. Flooding (pluvial and groundwater), cold spells and heavy snowfall events, have also impacted County Offaly, but less frequently.

The hazard frequency for each hazard is shown in the bottom right table, informed by past event occurrence and information received from Offaly County Council.



Frequency classification from Technical Annex B Climate Change Risk Assessment Guidelines

Frequency	Frequency Occurrence in a Year	Description
Very Frequent	> 100%	Occurs several times in a single year
Frequent	50 to 100%	Occurs once in a 1-to-2-year period
Common	10 to 50%	Occurs once in a 2-to-10 years period
Occasional	1 to 10%	Occurs once in a 10-to-100-year period
Rare	< 1%	Occurs once in over 100 years

Current hazard frequency for County Offaly, based upon analysis of past events and workshop feedback

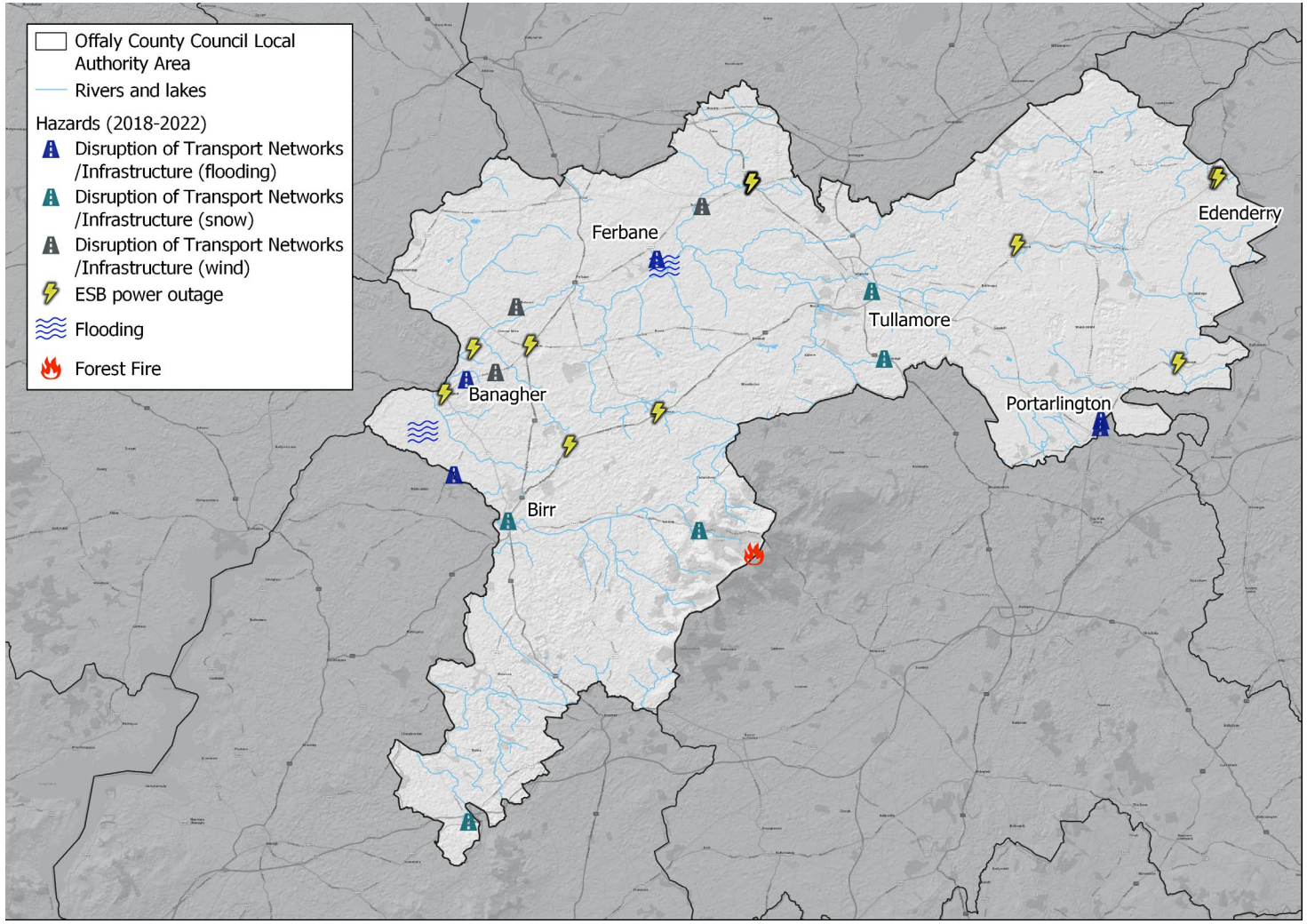
Hazard Type	Current Frequency
Heatwave	Common
Drought	Occasional
Cold Spell	Occasional
Heavy Snowfall	Occasional
Severe Windstorm	Frequent
Pluvial Flood	Common
River Flood	Frequent
Groundwater Flood	Rare

3.2.2 Exposure, Vulnerability and Impacts

Characterising Exposure, Vulnerability and Impacts of Climate Hazards

Employing and integrating information derived from previous events (sources of information are detailed on page 17), we have characterised the exposures, vulnerabilities, and impacts of the hazard events experienced in County Offaly. Below and to the right we provide an example of exposures and impacts of hazard events already experienced.

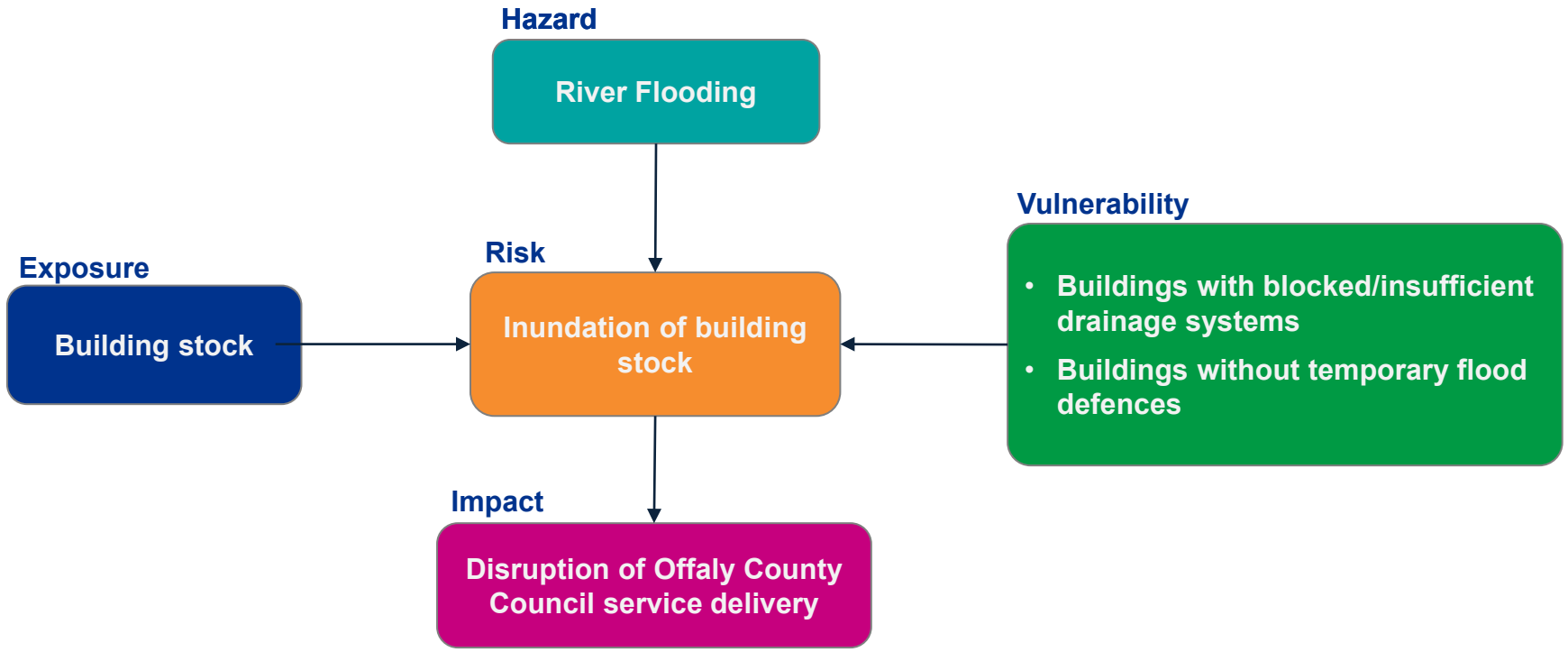
- In 2018, **Storm Ali** caused approximately 2,220 customers to lose power in Edenderry, 1,300 customers in Clara, 144 in Banagher, 45 in Fivealley and 40 in Bracknagh.
- Treefall associated with **Storm Eunice** in 2022 disrupted travel on roads in Ballycumber, between Cloghan and Belmont, and between Banagher and Cloghan.
- **Heavy snowfall** associated with Storm Emma in 2018 resulted in road closures and transport disruption across the county, particularly for roads around Birr and Tullamore.
- **High temperatures** in August 2022 affected rail lines in the county and led to a reduction in the speed limit for trains travelling between Portarlington and Tullamore.
- Heavy rainfall in 2018 led **fluvial flooding** as the Blackstick river flooded roads around Portarlington, including Botley Lane. Botley Lane flooded again in February 2020, as did the L7014-1, L2020-6 and R438 at Angler's Rest.
- **Groundwater flooding** of farmland around the Shannon Callows affected up to 200 farmers.
- High temperatures in 2021 leading to **26 wild fires** reported throughout the county. In 2018 combating a wildfire in the Slieve Bloom mountains required 6 days of effort by firefighters.



Climate Risk and Impacts

For County Offaly and for each of the identified climate hazards, we characterised the exposures, vulnerabilities, and impacts associated with the relevant hazard events. For example, below shows the three risk components for a river flooding hazard which would pose an inundation risk to Offaly County Council buildings. The buildings with insufficient drainage and with no temporary flood defences would be considered more vulnerable to this hazard. Consequently, if Offaly County Council buildings were to be flooded, one of the possible impacts would be the disruption of Offaly County Council's ability to deliver its services. This process was undertaken for each hazard and a range of exposures were identified along with their associated vulnerabilities.

The following pages summarise the exposures, vulnerabilities and impacts for the hazards that exist within the County Offaly region.



Impacts of climate hazards (1/4)

The table below shows the key impacts and exposures associated with each climate and weather-related hazard. Detailed information on exposure specific vulnerabilities (physical, social and environmental) are provided in the associated impacts and risks spreadsheet.

Hazard	Key Impacts	Key Exposures (and Key Vulnerabilities)
Heatwave	• Hot and uncomfortable working/living conditions • Increased demand on recreational areas • Damage to road surface, hazardous driving conditions and impact on road surface maintenance • Disruption of Public Transport Networks • Heat stress for animals and livestock resulting in the adoption of unsustainable mitigation measures • Increased demand on available water resources, leading to increasing pressure to share resources. • Detrimental impacts on freshwater quality and fish populations • Increase in the frequency of uncontrolled fire • Increased strain on natural biodiversity • Disruption of Recreational Activities	• Housing, buildings (incl. LA offices), care home/leisure centres/recreational facilities, outdoor workers (elderly, with limited access to water, shade and sunscreen) • Bathing Areas, Parks (with easy access to urban areas) • Local roads (surface-dressed roads, located in areas of high solar radiation) • National Railway Network (communities with limited transports network) • Pasture (farms with limited watering infrastructure, with a lack of shade) • Reservoirs/lakes • Emergency response services (areas of growing vegetation) • European/Irish designated sites (SPAs, SACs, Ramsar sites, NHAs) • Recreational Areas
Drought	• Decreased grass growth and increased supplementary feed requirements for cattle • Increased demand on available water resources, leading to increasing pressure to share resources • Reduced river flow • Increased degradation rates	• Pasture (in marginal areas of production) • Reservoirs/lakes/groundwater supplies (already depleted/under stress) • Biodiversity (water bodies, areas with diverse wildlife populations) • Cultural Heritage (wooden/decomposable material based assets)

Impacts of climate hazards (2/4)

The table below shows the key impacts and exposures associated with each climate and weather-related hazard. Detailed information on exposure specific vulnerabilities (physical, social and environmental) are provided in the associated impacts and risks spreadsheet.

Hazard	Key Impacts	Key Exposures (and Key Vulnerabilities)
Cold Spell	• Extreme cold results in increased requirement for heating and associated economic costs. • Cold conditions result in increased damage to vehicles • Disruption to road networks, including increases in costs associated with gritting fuel and overtime. • Disruption to public transport networks • Cold conditions leading to damage of road surfaces (i.e., freeze thaw) • Increase in the frequency of trips and falls. • Reduction in agricultural production • Difficulties in accessing land • Freeze thaw damage to critical infrastructure • Impacts on water resources • Increases in cold-related mortality and morbidity • Delay of infrastructure/development projects • Increased strain on natural biodiversity • Damage and disruption of electricity supply • Damage to built heritage	• Buildings (poorly insulated, with elderly residents, in isolated locations) • Public/private transport vehicles (exposed vehicles) • Transport network (untreated road surfaces, near isolated communities) • Public/staff (elderly populations, people with pre-existing conditions) • Road Network • Crops, livestock (cold-sensitive crops, areas with low solar radiation) • Land (marginal farms, areas of low solar radiation) • Water infrastructure/pipes (older pipes, in areas of freezing soil conditions) • Water resources (waterbodies in lower altitudes) • People at high risk of exposure to cold (people in insulated buildings, vulnerable communities) • Development projects (ongoing construction with loose materials) • European/Irish designated sites (SPAs, SACs, Ramsar sites, NHAs) • Homes/Businesses/Local Govt Office/Agricultural sites (without on-site electricity generation)
Heavy Snowfall	• Damage to buildings • Disruption of transport network • Heavy snowfall and freezing conditions impacting on livestock • Snow melt resulting in increased risk of flooding • Runoff from snow melt impacting on environmentally sensitive areas • Disruption to energy/electricity supply • Disruption to waste collection	• Buildings (vacant/flat roof properties, higher elevation, elderly residents), offices (incl. LA) (single story/flat roof, higher elevation, impervious surfaces) • Local Authority Offices • Public/Staff (communities with limited access, elderly and young populations) • Agricultural sites (livestock unprotected) (farms at higher elevations, marginal farms) • Natural Resources/Sensitive materials/Water Supply • Energy (energy infrastructure in need of maintenance, older infrastructure) • Waste collection routes (in terrain with a with higher propensity of snow drifts)

Impacts of climate hazards (3/4)

The table below shows the key impacts and exposures associated with each climate and weather-related hazard. Detailed information on exposure specific vulnerabilities (physical, social and environmental) are provided in the associated impacts and risks spreadsheet.

Hazard	Key Impacts	Key Exposures (and Key Vulnerabilities)
Severe Windstorm	• Direct wind damage to buildings and infrastructure • Wind damage to trees resulting in tree fall. • Wind damage to habitats and sensitive species • Disruption of wind energy generation • Disruption to Energy supply across the county • Disruption of communications infrastructure • Disruption of Transport Networks. • Closure of Parks and Public Buildings • Disruption to waste collection • Disruption to water quality monitoring	• Buildings, development sites (buildings w. rooftop equip., vulnerable populations, high-rise structures) • Trees • Habitats and sensitive species • Wind turbines (turbines with lower shut-down thresholds for high winds • Power supply (infrastructure in exposed locations, vulnerable populations, isolated communities) • Overhead communication lines • Road and Rail Network (in exposed locations) • Parks, public buildings (populations requiring essential council services, exposed, locations) • Waste collection routes (terrain with a with higher propensity of snow drifts) • Waterbodies (exposed waterbodies and waterbodies in need of water quality monitoring)
Pluvial Flood	• Direct rain and surface water damage to buildings and infrastructure • Damage to amenities and recreational areas • Pluvial Debris • Disruption to public transport networks. • Disruption to Transport Networks/Infrastructure. • Surface water (run-off) pollutants. • Impact on business and local economy.	• Buildings, Local Authority Offices, Heritage Sites (blocked drainage systems, high levels of impervious surfaces, etc) • Recreational Amenities (low-lying parks and other amenities, locate near water bodies such as lakes and rivers) • Stormwater Infrastructure • People • Road/Railways (low-lying roads with no alternative access routes and which allows for the pooling of water) • Public/ Staff (located in low-lying areas, near water bodies, limited surrounding drainage and low-quality signage) • Natural Resources/Sensitive materials (Enviro. sensitive areas, heavily fertilised agric. land close to water bodies) • Employers, Employees, Customers, Students (business in low-lying areas, lacking remote work/study options, etc.) • Wastewater treatment Infrastructure

Impacts of climate hazards (4/4)

The table below shows the key impacts and exposures associated with each climate and weather-related hazard. Detailed information on exposure specific vulnerabilities (physical, social and environmental) are provided in the associated impacts and risks spreadsheet.

Hazard	Key Impacts	Key Exposures (and Key Vulnerabilities)
River **Flood**	• Flood damage to buildings and infrastructure. • Damage to amenities and recreational areas • Fluvial debris • Disruption of Transport Networks/Infrastructure. • Surface water (run-off) pollutants. • Impact on business and local economy. • Damage/degradation to automobiles and public transport. • Potential Bridge Failure • Inundation of farmland	• Buildings, Local Authority Offices, Heritage Sites (blocked drainage, loc. on floodplains, vulnerable residents) • Recreational Amenities (low-lying parks, located near water bodies, parks and amenities in need of investment) • People, Stormwater Infrastructure • Road/Railways (low lying roads/railways, located near water bodies, limited drainage) • Public/ Staff (located in low-lying areas, near water bodies, limited surrounding drainage and low-quality signage) • Natural Resources/Sensitive materials (Env. Sensitive areas, networks with polluting vehicles, near waterbodies) • Employers, Employees, Customers, Students (located in at-risk areas, lack of access to early warning systems). • Council Fleets, Public Transport, Private vehicles (underground/low-lying carparks, fleets sensitive to submergence) • Bridges (older bridges, bridges in need of investment and maintenance) • Farmland situated on riverbanks (economically marginalised farmers, rivers susceptible to soil bank erosion, etc)
Groundwater Flood	• Inundation and damage to road infrastructure • Isolation of communities • Inundation of farmland	• National Road (Roads with limited drainage capacity) • Public/ Staff (located in low-lying areas, near water bodies, limited surrounding drainage and low-quality signage) • Farmland situated in areas of ground water flood risk

3.2.3 Impacts of Current Climate Risks (Service Delivery)

Summary of Service Level Impacts

Below we provide a summary of the impacts on the delivery of services of Offaly County Council as a result of the climate hazards identified within the climate hazard profile. This assessment was undertaken in accordance with the criteria provided through ***Technical Annex B: Climate Change Risk Assessment (see appendix 1)***, with each service delivery area assigned an impact category of either negligible, minor, moderate, major, or catastrophic. The following pages provide the detailed information that informed this assessment.

Key to colour coding of impact ratings

- Catastrophic
- Major
- Moderate
- Minor
- Negligible

Hazard	Business Services	Roads, footpaths, bridges: construction and maintenance	Building Stock	Community Infrastructure	Cultural Heritage	Stormwater / Sewerage	Wastewater	Water Supply	Water Quality	Biodiversity	Community Development	Emergency Response
Heatwave	Minor	Moderate	Minor	Minor	None	None	None	Moderate	Minor	Moderate	Minor	Moderate
Drought	None	None	None	None	Minor	None	Minor	Minor	Minor	Minor	Minor	Minor
Cold spell	Moderate	Moderate	Moderate	Moderate	Minor	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Heavy Snowfall	Moderate	Moderate	Moderate	Moderate	Minor	None	None	Minor	Minor	Minor	Moderate	Moderate
Severe windstorm	Moderate	Moderate	Moderate	Moderate	Moderate	None	Moderate	Moderate	Negligible	Moderate	Moderate	Moderate
Pluvial Flood	Minor	Moderate	Minor	Minor	Minor	Minor	Minor	Minor	Moderate	Moderate	Moderate	Minor
River Flood	Minor	Moderate	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Moderate	Moderate
Groundwater Flood	None	Minor	None	Minor	None	Minor	Minor	None	None	Minor	Moderate	Minor

Service Level Impacts (Heatwaves & Drought)

The impact of Heatwaves on the services areas provided by Offaly County Council was identified as moderate for Roads, Water Supply, Biodiversity, and Emergency Response, with services affected countywide. Heatwaves were identified as having a minor impact on Business Services, Building Stock, Community Infrastructure, Water Quality, and Community Development, with localised declines in service provision.

Drought was identified as putting the provision of Cultural Heritage, Water Supply, Water Quality, Biodiversity, Community Development, Emergency Response services in decline, with impacts occurring at a localised level.

Key to colour coding of impact ratings30.73

- Catastrophic
- Major
- Moderate
- Minor
- Negligible

	Heatwaves	Drought
Business Services	• Decreased staff productivity and increased staff and customer discomfort.	• None
Roads, footpaths, bridges, construction and maintenance	• Increased costs associated with repair of road surfaces across the county. • Increased health and safety risk for outdoor staff members across the county.	• None
Building Stock	• Increased requirement for cooling in council offices/buildings.	• None
Community Infrastructure	• Increased requirement for wate collection and traffic management at key recreational sites.	• None
Cultural Heritage	• None	• Localised degradation of cultural heritage sites due to drying out. • Increased requirements for monitoring and maintenance of cultural heritage sites.
Stormwater / Sewerage	• None	• None
Wastewater	• None	• Drought will have impact on wastewater treatment plant.
Water Supply	• Increased supply demand for water to cool infrastructure, communities, and livestock. • Implementation of water conservation measures (e.g., hosepipe bans).	• Increased requirement to support provision of water to communities suffering loss of water supply (e.g., Tankering).
Water Quality	• Reduced water flows impacting on water quality in local areas with increased requirement for monitoring and remediation.	• Reduced water flows impacting on water quality in local areas with increased requirement for monitoring and remediation.
Biodiversity	• Decreased ecosystem health across the county with potential for loss of priority habitats resulting in increased requirement for monitoring and remediation.	• Reduced water flows impacting on biodiversity with potential for loss of priority species and habitats necessitating increased monitoring and remediation.
Community Development	• Increased requirement for management at congested sites.	• Reduced grass growth causing increased supplementary feed requirement for cattle reducing farm incomes and the wider industry.
Emergency Response	• Increase in number of wildfire call-outs across the county. • Increase in number of call out to bathing areas throughout the county.	• Increase in number of uncontrolled fire call-outs at a localised level..
Crosscutting	• Health and Safety of Staff	

Service Level Impacts (Cold Spell & Heavy Snowfall)

The impact of Cold Spells on the service areas provided by Offaly County Council was identified as resulting in an appreciable decline in the provision of Business Services, Roads, Building Stock, Community Infrastructure, Stormwater/ Sewerage, Wastewater, Water Supply, Water Quality, Biodiversity, Community Development, and Emergency Response services, with impacts across the county and was identified as minor impact for Cultural Heritage.

In addition, the impact of Heavy Snowfall on the service areas provided by Offaly County Council was identified as moderate for Business Services, Roads, Building Stock, Community Infrastructure, Community Development and Emergency Response. Heavy Snowfall was also identified to have a localised and minor impact on Cultural Heritage, Water Supply, Water Quality, and Biodiversity services.

Key to colour coding of impact ratings

- Catastrophic
- Major
- Moderate
- Minor
- Negligible

	Cold Spell	Heavy Snowfall
Business Services	• Closure of business services across the County. • Health and safety risks for public and staff.	• Closure of business services across the County • Health and safety risks for public and staff
Roads, footpaths, bridges, construction and maintenance	• Increased costs associated with gritting and salting roads across the county. • Increased repair and maintenance costs.	• Transport disruption and road closures • Increased costs associated with gritting and salting roads and footpaths around the county.
Building Stock	• Increased energy costs for buildings countywide. • Increased health and safety risks for public and staff countywide.	• Increased energy costs for buildings county wide. • Increased health and safety risks for public and staff countywide.
Community Infrastructure	• Increased energy costs in community buildings across the county. • Increased health and safety risks for public and staff working in community buildings.	• Increased health and safety risks for public and staff. • Closure of services throughout communities across the county.
Cultural Heritage	• Increased energy costs for cultural heritage sites. • Increased health and safety risks for public and staff at community heritage sites.	• Increased health and safety risks for public and staff. • Localised closure of sites.
Stormwater / Sewerage	• Reduced capacity for drainage resulting in standing water due to post cold spell events. • Damage to stormwater infrastructure with increased requirement for maintenance and repair across the county.	• None
Wastewater	• Overland flows of pollutants due to post freezing events, causing contamination of water supplies necessitating increased monitoring and remediation. • Damage to wastewater infrastructure with increased requirement for maintenance and repair.	• None
Water Supply	• Countywide water supply issues due damaged water supply infrastructure (e.g., burst pipes). • Increased maintenance and repair costs of water service infrastructure across the county.	• Localised water supply issues due damaged water supply infrastructure (e.g., burst pipes). • Increased maintenance and repair costs of water service infrastructure.
Water Quality	• Reduction and disruption of water supplies across the county due to decreased water quality necessitating increased requirement on council to supply water to affected communities.	• Reduction and disruption of water supplies across the county due to decreased water quality necessitating increased requirement on council to supply water to affected communities.
Biodiversity	• Prolonged Cold Spells impacts species not protected from the frigid temperatures across the county, with increased monitoring and remediation required.	• Heavy Snowfall impacts species not protected from the frigid temperatures, with increased monitoring and remediation required at a localised level.
Community Development	• Increased instances of community isolation county wide. • Significant impact on the county's economy.	• Increased instances of community isolation county wide. • Significant impact on the county's economy.
Emergency Response	• Increased pressure on emergency response units across the county.	• Increased pressure on emergency response units across the county. • Increase in response times due to heavy snowfall on roads around the county.
Crosscutting	• Redeployment of staff	

Service Level Impacts (Severe Windstorm)

Severe Windstorms were identified as having a moderate impact on the provision of Business Services, Roads, Building Stock, Community Infrastructure, Cultural Heritage, Wastewater, Water Supply, Biodiversity, Community Development, and Emergency Response services provided by Offaly County Council, with severe pressure on services across the county. The impact of Severe Windstorms on Water Quality was also identified to have a negligible impact on the provision of Water Quality services.

Key to colour coding of impact ratings

- Catastrophic
- Major
- Moderate
- Minor
- Negligible

	Severe Windstorm
Business Services	• Widespread closure of business services • Health and safety risks for public and staff
Roads, footpaths, bridges, construction and maintenance	• Countywide transport disruption and road closures affecting the wider community and local authority operations • Increased clean-up and repair costs after an event •
Building Stock	• Closure of buildings and disruption of services as a result of direct damage to buildings and disruption of power
Community Infrastructure	• Disruption to delivery of community services across the county • Increased clean-up and repair costs after an event
Cultural Heritage	• Increased maintenance and repair costs due to storm damage to cultural heritage sites
Stormwater / Sewerage	• None
Wastewater	• Widespread increased drain maintenance costs for wastewater infrastructure.
Water Supply	• Water supply issues due to damaged water supply infrastructure.
Water Quality	• Adverse weather conditions cause disruptions to water quality monitoring.
Biodiversity	• High winds result in damage to habitats. • Increased cost to protect habitats from wind damage.
Community Development	• Increased power outages and damages to infrastructure result in an impact on community economies across the county.
Emergency Response	• Countywide increased pressure on emergency services. • Increase in response times due to heavy snowfall on roads around the county.
Crosscutting	• Staff redeployment

Service Level Impacts (Pluvial & River Flood)

Pluvial flooding was identified as having a minor and localised impact on the provision of Business Services, Building Stock, Community Infrastructure, Cultural Heritage, Stormwater/ Sewerage, Wastewater, Water Supply services by Offaly County Council and moderate impact on the provision of Biodiversity services. The impact of Pluvial Flooding was also identified to have a moderate impact on Roads, Water Quality, Biodiversity, Community Development services, with service provision under severe pressure across the county.

In addition, the impact of River Flooding on the provision of service areas provided by Offaly County Council was identified as moderate for Roads, Community Development, and Emergency Response, with services under severe pressure due to floods. River flooding was identified as having a minor and localised impact on the provision of Business Services, Building Stock, Community Infrastructure, Cultural Heritage, Stormwater/ Sewerage, Water Supply, Water Quality, and Biodiversity services.

Key to colour coding of impact ratings

- Catastrophic
- Major
- Moderate
- Minor
- Negligible

	Pluvial Flood	River Flood
Business Services	• Localised disruption and closure of local authority services.	• Localised disruption and closure of local authority services.
Roads, footpaths, bridges, construction and maintenance	• Widespread transport disruption and road closures. • Increased clean-up and repair costs after an event.	• Transport disruption and road closures. • Increased clean-up and repair costs after an event.
Building Stock	• Increased maintenance and repair costs. • Increased requirement for flood defence measures.	• Increased maintenance and repair costs. • Increased requirement for flood defence measures.
Community Infrastructure	• Closure of community infrastructure and services at a localised level. • Increased repair and maintenance costs.	• Localised closure of community infrastructure and services. • Increased repair and maintenance costs.
Cultural Heritage	• Damage to heritage sites due to pluvial flooding requiring repair work. • Increased maintenance and repair costs.	• Damage to heritage sites due to river flooding requiring repair work • Increased maintenance and repair costs.
Stormwater / Sewerage	• Reduced capacity for drainage resulting in standing water. • Damage to stormwater infrastructure at a localised level. • Increased maintenance and repair costs.	• Reduced capacity for drainage resulting in standing water. • Damage to stormwater infrastructure at a localised level . • Increased maintenance and repair costs.
Wastewater	• Damage to wastewater treatment plants. • Increased maintenance and repair costs.	• Damage to wastewater treatment plants. • Increased maintenance and repair costs.
Water Supply	• Water supply issues at a localised level requiring supplemental water provision (e.g., tankering). • Increased water treatment costs.	• Water supply issues at a localised level requiring supplemental water provision (e.g., tankering).
Water Quality	• Deterioration of water quality due to overland flow of pollutants resulting in water supply issues and environmental degradation and an increased requirement for monitoring and remediation.	• Deterioration of water quality due to overland flow of pollutants resulting in water supply issues and an increased requirement for monitoring and remediation.
Biodiversity	• Severe damage across the county to environmentally sensitive areas requiring monitoring and/or restoration work.	• Isolated and limited damage to environmentally sensitive areas requiring monitoring and/or restoration work.
Community Development	• Inhibited development of communities across the county. • Damage to buildings and travel disruptions impact on local economies.	• Inhibited development of communities at a countywide level. • Damage to buildings and travel disruptions impact on local economies across the county.
Emergency Response	• Localised increased pressure on emergency response.	• Widespread increased pressure on emergency response.
Crosscutting	• Staff redeployment	

Service Level Impacts (Groundwater Flood)

Groundwater flooding was identified as having a minor impact on the provision of Roads, Community Development, Biodiversity, and Emergency Response services. A moderate impact on the provision of Community Development services provided by Offaly County Council was identified, with severe pressure on services across the county.

Key to colour coding of impact ratings

- Catastrophic
- Major
- Moderate
- Minor
- Negligible

	Groundwater Flood
Business Services	• None
Roads, footpaths, bridges, construction and maintenance	• Localised transport disruption and road closures affecting the wider community and local authority operations • Increased clean-up and repair costs after an event
Building stock	• None
Community Infrastructure	• Closure of community infrastructure and services at a localised level. • Increased repair and maintenance costs.
Cultural Heritage	• None
Stormwater / Sewerage	• Reduced capacity for drainage resulting in standing water. • Damage to stormwater infrastructure at a localised level. • Increased maintenance and repair costs.
Wastewater	• Damage to wastewater treatment plants. • Increased maintenance and repair costs.
Water Supply	• None
Water Quality	• None
Biodiversity	• Isolated and limited damage to environmentally sensitive areas requiring monitoring and/or restoration work.
Community Development	• Inhibited development of communities at a countywide level. • Damage to buildings and travel disruptions impact on local economies.
Emergency Response	• Increased pressure on emergency response services.
Crosscutting	• Staff redeployment

3.2.4 Overall Impacts of Current Climate Risks

Impacts of Current Climate Risks on the Local Authority

Following on from characterising the frequency of the hazard, exposure, vulnerability, and the associated level of impact to the local authority, the overall impact on key risk areas of Offaly County Council was assessed according to the criteria provided through Technical Annex B: Climate Change Risk Assessment (catastrophic, major, moderate, minor and negligible) (see appendix 2). Below we provide a summary of impacts across the eight climate hazards identified. The following pages provide the information that informed this assessment.

Key to colour coding of impact ratings

- Catastrophic
- Major
- Moderate
- Minor
- Negligible

Hazard	Current Frequency	Assets	Health and Wellbeing	Environment	Social	Cultural Heritage	Financial	Reputational	Overall Impact Score
Heatwave	Common	Minor	Negligible	Moderate	Minor	Negligible	Minor	Negligible	1.7
Drought	Occasional	Negligible	Negligible	Moderate	Minor	Minor	Negligible	Negligible	1.6
Cold Spell	Occasional	Moderate	Moderate	Negligible	Moderate	Negligible	Moderate	Minor	2.3
Heavy Snowfall	Occasional	Minor	Moderate	Minor	Moderate	Negligible	Minor	Minor	2.1
Severe Windstorm	Frequent	Moderate	Minor	Minor	Minor	Minor	Moderate	Minor	2.3
Pluvial Flood	Common	Moderate	Minor	Minor	Minor	Negligible	Moderate	Moderate	2.3
River Flood	Frequent	Moderate	Minor	Minor	Moderate	Negligible	Moderate	Moderate	2.4
Groundwater Flood	Rare	Minor	None	Negligible	None	None	Negligible	None	0.6

Impacts of Current Climate Risks – Heatwaves & Drought

County Offaly has been exposed to heatwave events (defined as 5 consecutive days with temperatures >25 deg. C) over the period 1985-2022 with a wide range of impacts across the county. The most notable and costly impact relates to repair and maintenance of road surfaces and responding to uncontrolled fires. In addition, County Offaly has experienced drought conditions over the period as exemplified by the drought events in 2006 and July 2018.

Key to colour coding of impact ratings

- Catastrophic
- Major
- Moderate
- Minor
- Negligible

Hazard & Frequency	Exposure	Impact Description	Rating
 **Heatwave** **Common**	**Assets**	• High temperatures have resulted in localised damage to road surfaces (tar and chip) across the County. • High temperatures can damage or disrupt transport networks. High rail temperatures in August 2022 led to a reduction in the speed limit for trains travelling between Portarlington and Tullamore.	**Minor**
	Health and Well being	• High indoor temperatures have resulted in uncomfortable working conditions for staff and public and has had impacts on for heat sensitive equipment (e.g., Council laboratories). This has resulted in the increased requirement for active/mechanical cooling.	**Negligible**
	Environment	• Heat waves provide suitable conditions for the ignition of uncontrolled fires, with high temperatures in 2021 leading to 26 wild fires reported throughout the county. In 2018 combating a wildfire in the Slieve Bloom mountains required 6 days of effort by firefighters. • High water temperatures associated with heatwave events have also had significant impacts on freshwater and marine environments.	**Moderate**
	Social	• Heatwaves have resulted in congestion at key recreational areas with facilities (e.g., litter collection and parking) overwhelmed.	**Minor**
	Cultural Heritage	• Extreme temperatures are recognised as contributing to the increased weathering of cultural heritage sites.	**Negligible**
	Financial	• The financial implications of heatwaves are primarily associated with road maintenance and repair.	**Minor**
	Reputational	• Heatwaves have had a negligible reputational impact for Offaly County Council	**Negligible**
 **Drought** **Occasional**	**Assets**	• Drought conditions (e.g. Summer 2018) resulted in the imposition of restrictions on water supply on a national and county basis with implications for building operation.	**Negligible**
	Health and Well being	• Water restrictions, particularly in combination with extreme heat, have the potential to result in dehydration, this is particularly the case for vulnerable populations and outdoor workers.	**Negligible**
	Environment	• High temperatures and dry conditions, often compounded by high levels of ignition activity, have resulted in uncontrolled fires. In 2018 this led to 26 gorse fires throughout the county. In 2018 combating a wildfire in the Slieve Bloom mountains required 6 days of effort by firefighters.	**Moderate**
	Social	• Water restrictions can lead to inconvenience for local businesses and residents.	**Minor**
	Cultural Heritage	• Drought conditions results in damage to cultural heritage sites due to drying out of substrate.	**Minor**
	Financial	• The financial implications of drought are limited and restricted to responding to wildfire and supporting the provision of water (e.g., tankering).	**Negligible**
	Reputational	• The reputational impacts of drought conditions are limited and localised.	**Negligible**

Impacts of Current Climate Risks – Cold Spells & Heavy Snowfall

County Offaly has experienced significant extreme cold/cold spell and heavy snowfall events over the period 1985-2022 with significant events reported for 2018 (the 'Beast from the East') and January 2019. These events have wide ranging impacts across the County including disruption of transport routes, damage to buildings, and isolation of communities.

Key to colour coding of impact ratings

- Catastrophic
- Major
- Moderate
- Minor
- Negligible

Hazard & Frequency	Exposure	Impact Description	Rating
Cold spell Occasional	Assets	• Cold spells have resulted in road closure, transport disruption and increased maintenance and repair costs across the county. • Freeze thaw action has resulted in damage to critical infrastructure (E.g., water infrastructure) and building stock. • Extreme cold conditions in combination with snowfall have resulted in the widespread closure of business (incl. LA business services).	Moderate
	Health and Well being	• Extreme cold has resulted in treacherous conditions and increased incidence of slips and falls. • Exposure to extreme cold has had detrimental impacts for outdoor workers and vulnerable populations.	Moderate
	Environment	• Cold spells have led to decreased water availability and have detrimental impacts for biodiversity and habitats, resulting in a decrease of ecosystem health.	Negligible
	Social	• Road closures have resulted in social isolation for remote communities. • Elderly and vulnerable populations are required to stay in place resulting in isolation.	Moderate
	Cultural Heritage	• Freeze thaw has been identified as having detrimental impacted on the structural integrity of cultural heritage sites.	Negligible
	Financial	• The financial implications of cold spells are primarily associated with maintenance and repair costs for local and regional roads, buildings and assets, and can be significant.	Moderate
	Reputational	• Isolation of communities and council response (e.g., gritting) across the county receives media attention but with limited reputational impact for County Offaly.	Minor
Heavy snowfall Occasional	Assets	• Heavy snowfall has resulted in road closures and transport disruption as evidenced with the closure of roads across the county as a result of Storm Emma (2018), which led to closure of roads around Birr and Moneygall. • Accumulations of snowfall on roofs results in damage to buildings. Flooding post-heavy snowfall events results in the flooding of assets (e.g., roads and infrastructure).	Minor
	Health and Well being	• Extreme cold events have resulted in treacherous conditions and increased incidence of slips and falls amongst public and staff.	Moderate
	Environment	• Flooding post-heavy snowfall event results in overland flow of pollutants to habitats and ecosystems with detrimental effects.	Minor
	Social	• Road closures can result in significant social isolation for remote communities.	Moderate
	Cultural Heritage	• Accumulations of heavy snowfall can result in damage to cultural heritage sites.	Negligible
	Financial	• The financial implications of cold spells are primarily associated with maintenance and repair costs for local and regional roads, buildings and assets	Minor
	Reputational	• Isolation of communities and council response (e.g., gritting) across the county receives media attention but with limited reputational impact for the county.	Minor

Impacts of Current Climate Risks - Windstorms

County Offaly has been frequently exposed to wind storms over the period 1985-2022, notable examples being Storms Ali, Brendan and Barra. Impacts have been experienced across the county and relate to disruption of transport, electricity and communication networks. Severe windstorms also result in a range of environmental impacts

Key to colour coding of impact ratings

- Catastrophic
- Major
- Moderate
- Minor
- Negligible

Hazard & Frequency	Exposure	Impact Description	Rating
Severe windstorm Frequent	**Assets**	• Wind storms has caused direct damage to building stock and other assets. Storm Brendan in 2020 caused damage in Clara when a steel gate was blown into the road. • Wind storm damage to power and communication transmission infrastructure (e.g., tree fall on overhead lines) has resulted in disruption of communications and energy supply. In 2018, Storm Ali caused approximately 2,220 customers to lose power in Edenderry and 1,300 customers in Clara. Storm Brendan in February 2020 led to power outages for 1,200 homes in Clara. Storm Ciara led to a further 500 homes losing power. • Wind storms have caused disruption of transport routes as a result of treefall. Treefall associated with Storm Eunice in 2022 disrupted travel on roads in Ballycumber, between Cloghan and Belmont, and between Banagher and Cloghan	**Moderate**
	Health and Well being	• Wind storms posed a health and safety risk with potential for injury. Storm Ali in 2018 caused a tree to fall onto a driving car between Kilbeggan and Clara, with the driver suffering minor injuries. • Treacherous driving conditions caused by storms can pose a hazard. In December 2021 a woman suffered fatal injuries on the stretch of motorway near Ballywilliam in a collision involving a number of vehicles.	**Minor**
	Environment	• Wind storms have resulted in loss of trees and this is particularly the case for vulnerable tree species. • Wind storms prevent council staff from safely taking accurate water samples from lakes, hindering monitoring of water quality.	**Minor**
	Social	• Severe wind storms and disruption of transport and communication networks has resulted in isolation of communities. • Severe wind storms can lead to cancellation of significant events, such as Storm Ali in 2018 leading to the cancellation of the second day of the National Ploughing Championships.	**Minor**
	Cultural Heritage	• Severe wind storms can cause structural damage to cultural heritage sites.	**Minor**
	Financial	• The financial impacts of severe wind storm are associated with clean-up and repair cost.	**Moderate**
	Reputational	• Reputational damage as a result of wind storms is limited and associated with short term media reporting on council preparedness and response.	**Minor**

Impacts of Current Climate Risks - Pluvial and Fluvial Flooding

For County Offaly in the period 1985-2022, pluvial and fluvial flooding have occurred on a frequent basis. Areas of exposure to fluvial flooding are limited geographically but with the potential for frequent exposure for fluvial flooding. Notable flooding events including flooding of the N4 east of Offaly town in 2019 and 2020.

Key to colour coding of impact ratings

- Catastrophic
- Major
- Moderate
- Minor
- Negligible

Hazard & Frequency	Exposure	Impact Description	Rating
Pluvial flood **Frequent**	**Assets**	• Pluvial flooding has resulted in the temporary inundation of assets. • Pluvial flooding results in damage to road surfaces or disruption to transport networks. Heavy downpours in 2018 led to roads across the county being flooded and impassable, notable the Tyrellspass bog road, roads at Ballycommon old church, the Kilclonfert-Daingean road, and parts of the Croghan roads.	**Moderate**
	Health and Well being	• Heavy precipitation and floodwater leads to dangerous driving conditions for both council staff and public	**Minor**
	Environment	• Pluvial flooding has resulted in the overland flow of pollutants (nutrients, sediment and pesticides) with impacts on terrestrial and freshwater ecosystems. Improvements to runoff systems to prevent this have been undertaken on 10 local roads and 2 regional roads in the county. • Pluvial flooding can lead to issues with sewage systems, as evidenced in the Greenwood Park estate in Edenderry in 2020, where during periods of excess rainfall, raw sewage would overflow from the drainage system.	**Minor**
	Social	• Road closures can result in significant social isolation for communities.	**Minor**
	Cultural Heritage	• Pluvial flooding puts built heritage with stone cavities at risk of soakage and leakage.	**Negligible**
	Financial	• The financial implications of emergency response (e.g. pumping and emergency co-ordination, clean-up and repair) can be significant. • Increased budget pressure to adapt to impact of climate change, e.g. flood protection measures and upgrading of existing drainage systems.	**Moderate**
	Reputational	• Pluvial flooding issues are localised but can result in reputational damage to the council.	**Moderate**
River flood **Frequent**	**Assets**	• River flooding has resulted in the temporary inundation of buildings. River flooding in the Shannon harbour and Banagher areas in 2020 damaged local houses. Similarly, river flooding associated with Storm Jorge in 2020 led to the Erin's Rovers club grounds in Pullagh being flooded. • River flooding results in transport disruption and road closures. Heavy rainfall in 2018 led the Blackstick river to flood roads around Portarlington, including Botley Lane. Botley Lane flooded again in February 2020, as did the L7014-1, L2020-6 and R438 at Angler's Rest.	**Moderate**
	Health and Well being	• Heavy precipitation and floodwater leads to dangerous driving conditions for both council staff and public • Fluvial floods can carry debris which can lead to injury of residents and pedestrians	**Minor**
	Environment	• River flooding can result in the overland flow of pollutants (nutrients, sediment and pesticides) with impacts on terrestrial and freshwater ecosystems.	**Minor**
	Social	• Road closures can result in significant social isolation for communities • Inhibited development of communities as a result of frequent river flooding.	**Moderate**
	Cultural Heritage	• A number of the county's cultural heritage and archaeological sites are situated near river systems and are particularly exposed to river flooding.	**Negligible**
	Financial	• The financial implications of fluvial flooding are associated with Increased costs associated with preparedness (e.g., sandbags and demountable defences) emergency response (e.g. pumping and emergency co-ordination), clean-up and repair.	**Moderate**
	Reputational	• For areas that are subject to frequent inundation, there is the potential for localised reputational damage.	**Moderate**

Impacts of Current Climate Risks – Groundwater Flooding

For the period 1985-2022, groundwater flooding has occurred on a rare basis with limited impact.

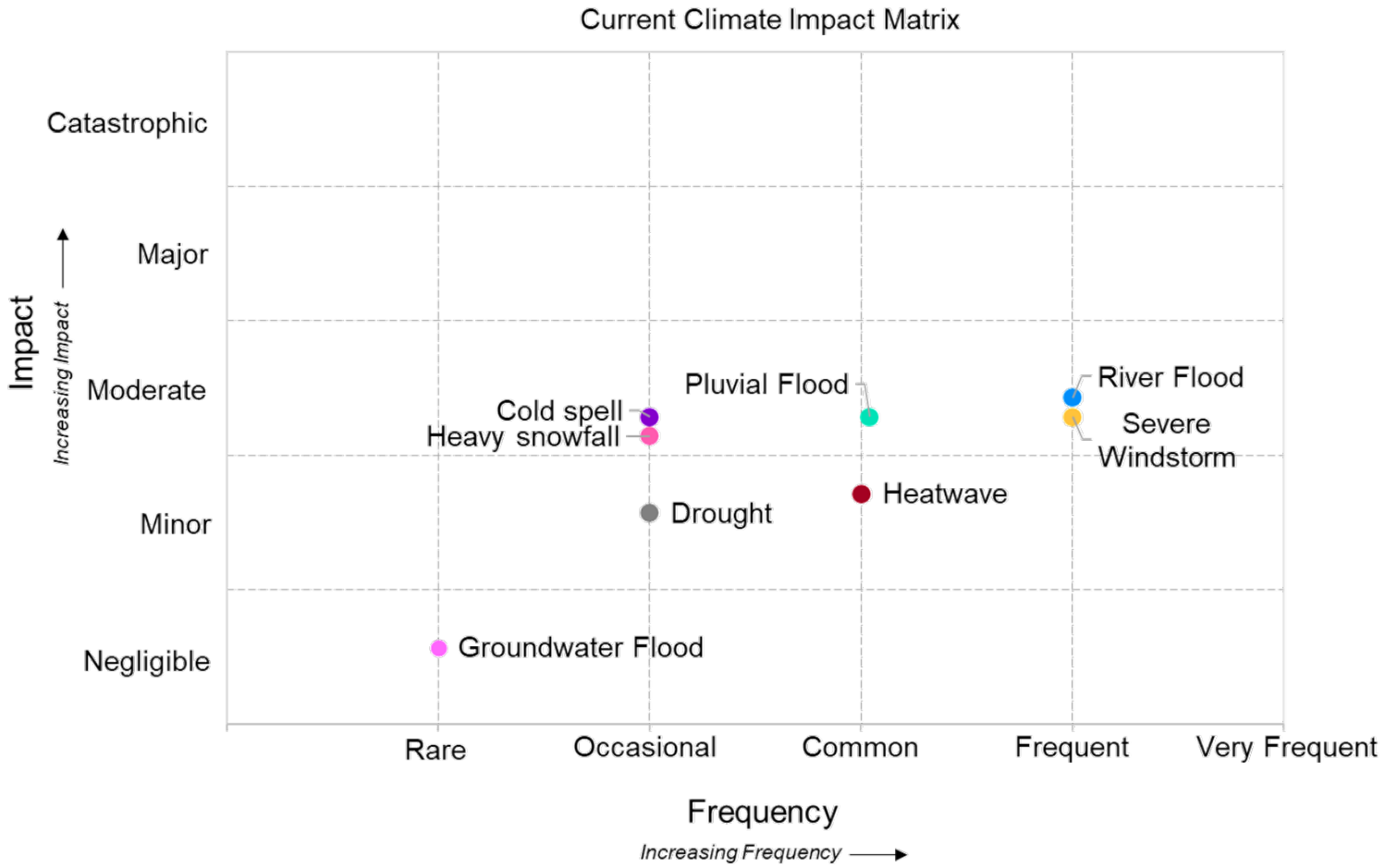
Key to colour coding of impact ratings

- Catastrophic
- Major
- Moderate
- Minor
- Negligible

Hazard & Frequency	Exposure	Impact description	Rating
Groundwater Flood Occasional	**Assets**	• Ground water flooding has resulted in repeated flooding of farmland. Up to 200 farmers in southwest Offaly were also affected by 2020 flooding in the Shannon Callows area between Meelick and Athlone	**Minor**
	Health and Well being	• None	**None**
	Environment	• Potential for detrimental environmental impacts	**Negligible**
	Social	• None	**None**
	Cultural Heritage	• None	**None**
	Financial	• Response but limited amounts	**Negligible**
	Reputational	• None	**None**

Current Climate Impact Matrix

Based on frequency of hazard occurrence and level of impact, we have developed a current climate impact matrix for Offaly County Council. Our assessment identified heatwaves, droughts, severe windstorms, cold spells, heavy snowfall, and river, pluvial, and groundwater flooding hazards have occurred within the region. River flooding and severe windstorms were assessed as being the hazards occurring most often and with a moderate impact on County Offaly.



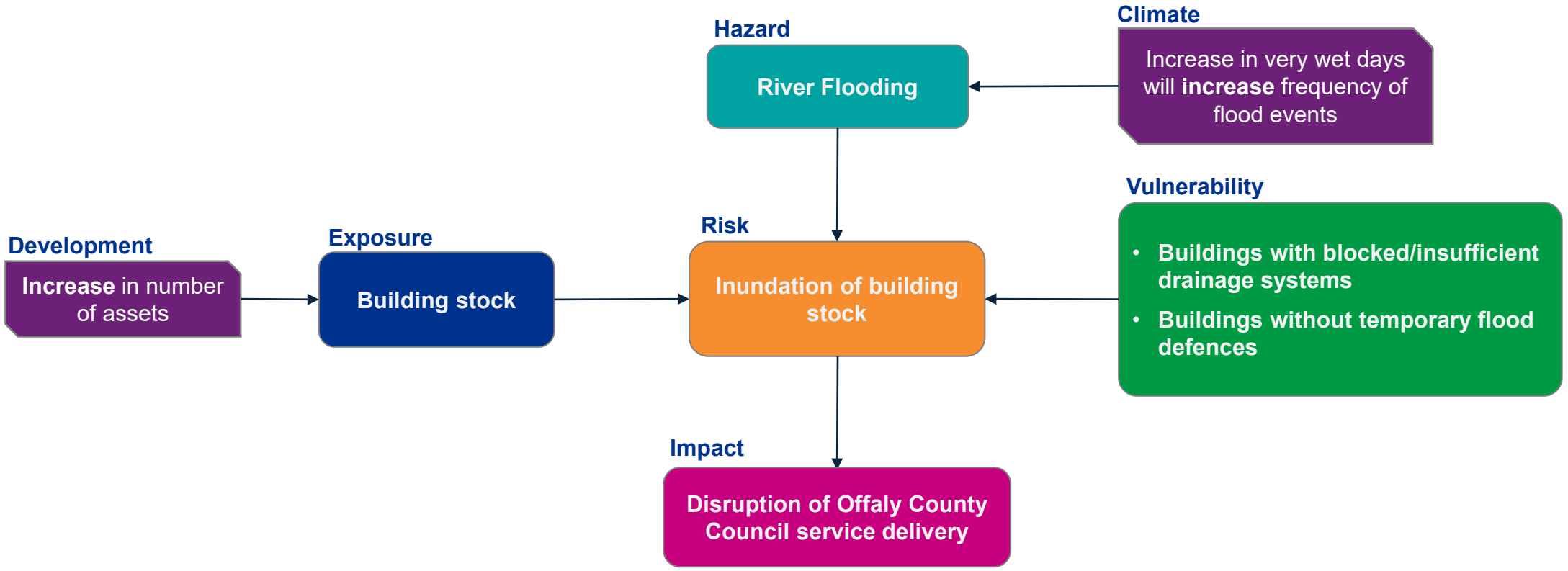
3.3 Future Climate Risks and Impacts

3.3.1 Future Changes in Climate Hazards

Future Climate Risk and Impact

Climate risks may increase, decrease, or emerge in the future due to a change in either the frequency and severity of climate hazards and/or changes in exposure and vulnerability. In the example below, the risk of inundation due to river flooding will increase due to an increase in the number of very wet days (> 30 mm precipitation) leading to an increase in the frequency of river flood events. Furthermore, there is likely to be an increased population in the region, possibly resulting in new buildings being constructed. This will potentially increase the number of assets exposed to river flooding. Therefore, due to changes in both the hazard and exposure, the risk of inundation of Offaly County Council buildings will increase in the future.

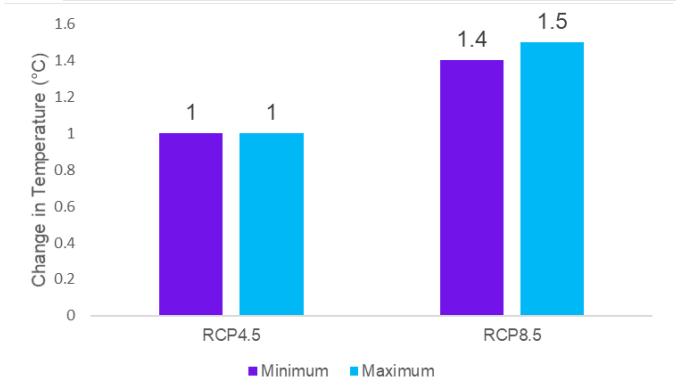
In the following sections, we provide an assessment of potential future changes in the climate of County Offaly by 2050 and its effects on the frequency of hazard occurrence. An assessment of the future changes in the population and development in the region by 2050 that could affect exposure and vulnerability was also undertaken. Finally, considering all three components, the future climate risk was assessed.



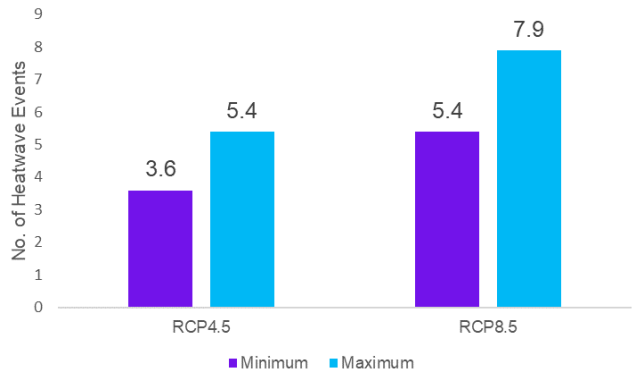
Climate Projections for County Offaly in 2050 (1/2)

Having identified and assessed the range of climate hazards already experienced by Offaly County Council, the projected changes in the frequency and intensity of climate hazards was assessed to understand how existing climate impacts and risks faced by Offaly County Council may be exacerbated.

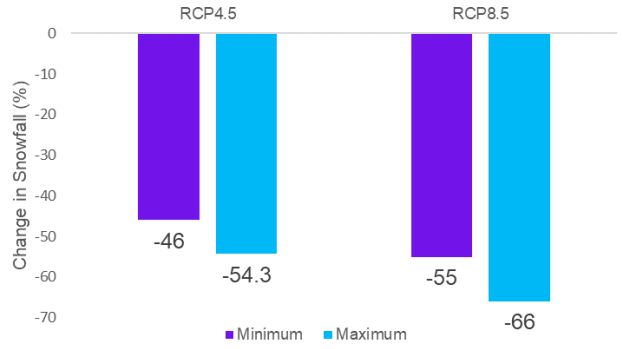
Hazard	Projected Change	Future Frequency
Heatwaves	• Projections indicate **an overall increase in average temperature** (bottom left) of between 1.1 and 1.5°C for County Offaly relative to the 1981-2000 period. • Under a high emission scenario, projections indicate that **heatwaves will become more frequent** (bottom middle) by mid-century.	Frequent
Droughts	• **Summer rainfall is expected to reduce** by between 6 and 10% in the future when compared with the baseline period of 1981 to 2000, in both the RCP4.5 and RCP8.5 scenario contributing to potential drought conditions.	Common
Cold Spell	• As a consequence of the increasing temperatures, **a decrease in the number of frost days and ice days** in the 2041-2060 future period when compared with the baseline period of 1981 to 2000, is projected for both the RCP4.5 and RCP8.5 scenario.	Rare
Heavy Snowfall	• The annual **snowfall** in the region is projected to decrease substantially by the middle of the century for the RCP4.5 and RCP8.5 scenarios (bottom right).	Rare
Severe Windstorms	• **Projections of storms are subject to a high level of uncertainty**. By mid century, projections indicate that average wind speed will remain similar to those currently experienced but an increase in more intense storms which are currently rare events is projected.	Frequent



The projected minimum and maximum **increase in the mean annual temperature** for the area of County Offaly for the period 2041-2060 compared to 1981-2000 for a medium (RCP4.5) and high (RCP8.5) emissions scenario *(Source: Nolan and Flanagan, 2020)*



The projected minimum and maximum **number of heatwaves** for the area of County Offaly for the period 2041-2060 compared to 1981-2000 for a medium (RCP4.5) and high (RCP8.5) emissions scenario *(Source: Nolan and Flanagan, 2020)*

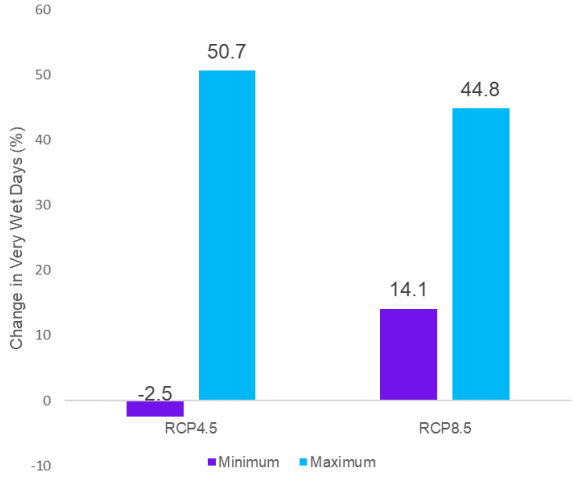


The projected minimum and maximum **reduction in snowfall (> 30 mm)** for the area of County Offaly for the period 2041-2060 compared to 1981-2000 for a medium (RCP4.5) and high (RCP8.5) emissions scenario *(Source: Nolan and Flanagan, 2020)*

Climate Projections for County Offaly in 2050 (2/2)

Having identified and assessed the range of climate hazards and impacts already experienced by Offaly County Council, the projected changes in the frequency and intensity of climate hazards (acute and chronic) were assessed to understand how existing climate impacts and risks faced by Offaly County Council may be exacerbated.

Hazard	Projected Change	Future Frequency
Pluvial Flooding **River Flooding** **Groundwater Flooding**	• Projections indicate an **increase in the frequency of heavy rainfall days** (days with precipitation >30mm) for County Offaly with some areas projected to see increase of up to 51% (bottom). This will likely result in an increased frequency of associated fluvial and pluvial flooding. • Projections of changes in groundwater flooding are currently not available, therefore there is **uncertainty in the change** in groundwater flooding frequency that can be expected.	Frequent Very Frequent Rare

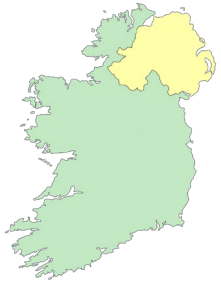


Projected **increase in very wet days (> 30 mm)** for the area of County Offaly for the period 2041-2060 compared to 1981-2000 for a medium (RCP4.5) and high (RCP8.5) emissions scenario *(Source: Nolan and Flanagan, 2020)*

3.3.2 Future Changes in Exposure and Vulnerability (incl. Emerging Risk)

Projected Changes in Exposure and Vulnerability

In the future, County Offaly will also change in terms of its population and developments. This will potentially affect the exposure and vulnerability of people and assets within the region. National, regional and local strategies that outlined expected and possible sociodemographic and infrastructure developments within County Offaly were reviewed to understand how exposure and vulnerability may change by 2050. A summary of the results of this review are shown below.



How is Ireland projected to change by 2040?

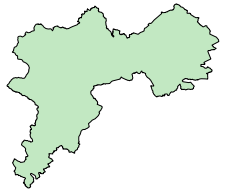
- Extra **1m population**, 500,000 in rural areas / regional centres
- Extra 660,000 jobs

- Extra **550,000 homes**
- 'Housing for All' promotes a 'town centre first' approach

Cross-Sectoral National Priorities:

- Infrastructure and Services
- Climate Change Adaptation & Mitigation
- Regeneration, Repopulation, Resilience

How is County Offaly projected to change?



- Population to increase from 78,000 in 2016 to **87,200 in 2027** (CDP)
- Tullamore **population to increase by c.4,400** between 2016 and 2027 (CDP)
- **3,998** new housing units required by 2028 (CDP)
- Offaly's total road network of **2,164 km**, consists of 57 km national roads, 392 km regional roads and 1,688 km local roads (CARO)

RSES Objectives: *"at least 30% of all new homes that are targeted in settlements with a population of at least 1,500..., within the existing built-up footprints."*

"… at least 30% of all new homes that are targeted in settlements [to be located] within their existing built-up footprint of the settlement, with a focus on infill/brownfield lands"

Offaly County Development Plan (2021-27)

Planning for adaptation

Flood Defence Schemes:

The Office of Public Works-Council projects includes: Tullamore Flood Relief Scheme (100 properties protected – status: scheme completed 2013). Rahan Flood Relief Scheme (est. aims to protect 4 properties at risk of flooding)

Key national road infrastructure projects include focus for council:

- N62 Crancreagh (Cloghan to Derrinlough) – minor works
- N62 Corr Hill
- N52 – Ballynacard East & West

Notable renewable energy initiatives include:

- 14 X Sustainable Energy Community (SEC) (e.g. Green Offaly Projects and Tullamore Live Green)
- Derrinlough Wind Farm proposal & consent (subject to conditions) granted in late 2021 & Leabeg, Mountlucas and Meenwaun Wind Farms
- Solar farms applications & approvals (e.g. Edenderry).

Planning for mitigation

Case Study in Urban Planning: Tullamore Town Centre Urban Regeneration & Development

€5.25m funding approved by the Urban Regeneration and Development Fund (URDF). €3m was approved under Call 1 followed by a subsequent €2.5m under Call 2.

- The project aims to facilitate compact and sustainable development in Tullamore town centre and supplements the Public Realm works carried out under the existing 'Call 1' project
- This includes the development of new street links, a civic space and a range of repair and restoration works. It also includes a masterplan which will be used to appraise the viability of the Tullamore Harbour Development.

Future Exposure and Vulnerability (1/2)

In addition to the changes in the frequency of hazard events, future risk is also driven by the changes in exposure and vulnerability of assets. In order to estimate the potential change in risk, a number of assumptions have been made in relation to the seven impact areas, which are outlined below.

Assets	• Due to the expected increase in County Offaly's population, there will be an **increase in the associated households and infrastructure,** resulting in an increase in the number of assets exposed to hazard events • Due to the expected increase in the frequency of heatwaves, **road assets will be more regularly exposed to melting,** and **drought** conditions will result in **shrinkage of peatland** and increased damage to roads as a result • Pluvial and river flooding events that were once considered extreme, will become more frequent. This will **increase damage in the areas already exposed to these hazards** and also expose new areas and therefore assets that were previously unaffected
Health and Wellbeing	• Due to the expected increase in the elderly population in County Offaly there will be **a greater number of vulnerable people who are more sensitive to hazards**, particularly heatwaves • Pluvial and river events that were once considered extreme, will become more frequent. Consequently, people will be more frequently exposed to flooding hazards, and higher flood levels which will mean **people previously unaffected by flooding may become exposed.** This could impact on both physical and mental health and wellbeing
Environment	• The potential increasing occurrence of heatwaves and drought conditions within County Offaly will mean **increased temperatures in water bodies and lower water levels** which can decrease water quality resulting in short and long term impacts on the environment • Due to the potential increased frequency of exposure to hazards in County Offaly, there could be an **increase in the impact on environmental assets** as the time/ability for the habitat/environment to recover is reduced • Pluvial and river flooding events that were once considered extreme, will become more frequent. Consequently, environmental assets will be more frequently exposed to flooding hazards, and higher flood levels will mean **environmental assets previously unaffected by flooding may become exposed-** resulting in short and long term damage to habitats/environment by these hazards

Future Exposure and Vulnerability (2/2)

In addition to the changes in the frequency of hazard events, future risk is also driven by the changes in exposure and vulnerability of assets. In order to estimate the potential change in risk, a number of assumptions have been made in relation to the seven impact areas, which are outlined below.

Social	• Due to the expected increase in the total and elderly population in County Offaly there will be an **increase in the number of people affected by social isolation during some hazard events** • In response to heatwaves, there will be an increased use of blue/green spaces by the public **putting increased pressure on local amenities** e.g. littering, traffic problems
Cultural Heritage	• Due to the potential increase in frequency of heatwave and drought events, **degradation rates will potentially increase resulting in an increase in the impact of cultural heritage assets** • Pluvial and river flooding events that were once considered extreme, will become more frequent. Consequently, **cultural heritage assets will be more frequently exposed to flooding hazards,** and higher flood levels will mean cultural heritage assets previously unaffected by flooding may become exposed resulting in short and long term damage to habitats/environment by these hazards
Financial	• Due to the potential increase in frequency of hazard events and exposure across County Offaly, there will be an **associated increase in the actions the local authority takes before, during, and after an event** • As a consequence, there will be an **increase in the costs associated with dealing with the events**, e.g. air conditioning, emergency service response, temporary and permanent flood defences, staff, training, and equipment purchase/maintenance
Reputational	• Due to the potential increase in frequency of hazard events and exposure across County Offaly during an event there will be an **increase in demand/pressure on services/resources** potentially reducing the level of service delivery and harming the reputation of the local authority • For hazards which are existing long-term issues in County Offaly, e.g. river flooding, if the response to the increased frequency and severity events is deemed insufficient by the public, this **may negatively impact on the reputation of the local authority**

Future Impacts

Taking into account the changes in exposure and vulnerability, the future change in impacts for each of the eight hazards was assessed. The potential future changes in impact are outlined below with the change in impact shown in bold.

Hazard	Assets		Health and Wellbeing		Environment		Social		Cultural Heritage		Financial		Reputational	
	Current	Future (2050)	Current	Future (2050)	Current	Future (2050)	Current	Future (2050)	Current	Future (2050)	Current	Future (2050)	Current	Future (2050)
Heatwave	**Minor**	**Moderate**	**Negligible**	**Minor**	**Moderate**	**Major**	**Minor**	**Moderate**	Negligible	Negligible	**Minor**	**Moderate**	**Negligible**	**Minor**
Drought	**Negligible**	**Minor**	**Negligible**	**Minor**	**Moderate**	**Major**	**Minor**	**Moderate**	**Minor**	**Moderate**	**Negligible**	**Minor**	**Negligible**	**Minor**
Cold Spell	Moderate	Moderate	Moderate	Moderate	Negligible	Negligible	Moderate	Moderate	Negligible	Negligible	Moderate	Moderate	Minor	Minor
Heavy Snowfall	Minor	Minor	Moderate	Moderate	Minor	Minor	Moderate	Moderate	Negligible	Negligible	Minor	Minor	Minor	Minor
Severe Windstorm	Moderate	Moderate	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Moderate	Moderate	Minor	Minor
Pluvial Flood	**Moderate**	**Major**	**Minor**	**Moderate**	**Minor**	**Moderate**	**Minor**	**Moderate**	**Negligible**	**Minor**	**Moderate**	**Major**	**Moderate**	**Major**
River Flood	**Moderate**	**Major**	**Minor**	**Moderate**	**Minor**	**Moderate**	**Moderate**	**Major**	**Negligible**	**Minor**	**Moderate**	**Major**	**Moderate**	**Major**
Groundwater Flood	Minor	Minor	None	None	Negligible	Negligible	None	None	None	None	Negligible	Negligible	None	None

3.3.3 Overall Future Impact on Offaly County Council

Climate Risks Matrix

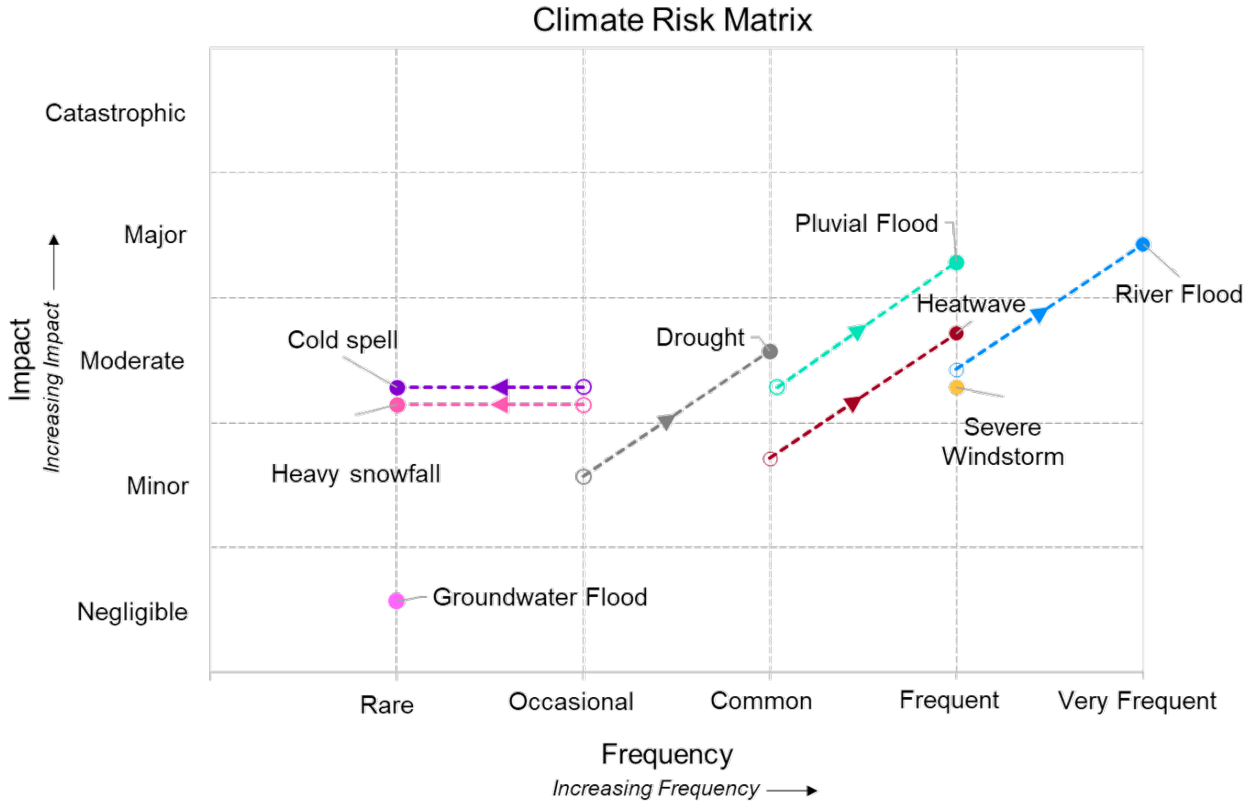
The future changes in the hazard, exposure, and vulnerability, combine to form an assessment of future risks across County Offaly. The risk matrix on the right shows the future change in risk with the hollow marker showing the current risk and the solid marker the future risk. The dotted line shows the change between the current and future risk.

The **risk** of existing hazards such as **river and pluvial flooding** is likely to **increase** in the future because of changes in both hazard frequency as a result of climate change and impact due to changes in exposure and vulnerability.

Heatwaves and droughts although already experienced in County Offaly, are expected to occur more frequently due to climate change and with a greater impact on County Offaly in the future. These hazards can be therefore be considered as **emerging risks** for the region.

Although the frequency and impact of **severe windstorms** is thought to be **unchanged in the future**, these events will remain a risk for County Offaly. The risk of **groundwater flooding** is also unchanged in the future, however, there is uncertainty associated with how climate change will impact the occurrence of this hazard.

The impact of **heavy snowfall and cold spells** on County Offaly remains constant, however, due to the potential decrease in hazard frequency, the overall risk of these hazards is likely to reduce in the future, resulting in less risk.



The risk matrix above shows the future changes in risk for the identified hazards within County Offaly. For each hazard there is a solid marker, which identifies the future risk, and a hollow marker showing the current risk. The dotted line in between these markers shows the change between the current and future risk.

3.3.4 Uncertainty Assessment

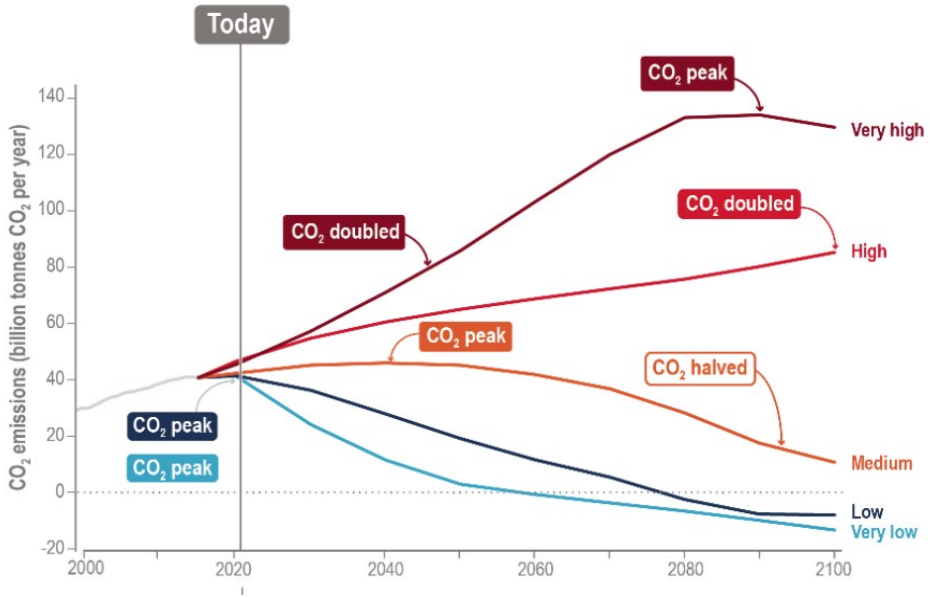
Uncertainty

In assessing future climate risks there are levels of uncertainty related to each of the three elements of risk, i.e., not only the magnitude and frequency of hazards but also the exposure and vulnerability to any given hazard.

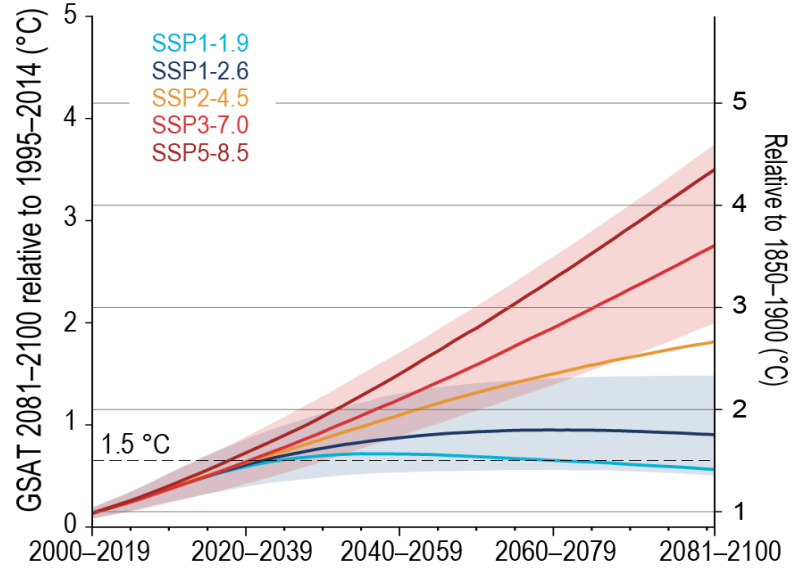
Different social and economic developments can lead to substantially different future emissions of carbon dioxide and other greenhouse gases (bottom left) resulting in uncertainty in what the future global climate will be. As an example of the possible future ranges in mean global surface temperature (bottom right) vary from below 1.5°C to over 4°C by 2100.

As a result of this uncertainty, climate projections include a range of scenarios, with SSP5-8.5 (AR6) or RCP8.5 (AR5) being the highest emission scenario and therefore the greatest change in future climate. When assessing climate risks with a qualitative approach, it is best practice to take a conservative or 'worst case scenario' to ensure that climate risks are not underestimated and dismissed as low or no risk. Climate risks identified within a qualitative risk assessment should be subsequently assessed using semi-quantitative or quantitative approaches to evaluate the risk in further detail.

Uncertainty also exists in relation to how County Offaly will develop into the future. Although, in the near-term there is relatively good understanding as a result of strategies, such as the Offaly County Development Plan 2021-2027, developments up to 2050 are less certain. A 'worst case scenario' approach has been taken here also, with the potential future impact being increased according to the indicative near-term trend and the assumption that adaptation actions are not implemented.



Annual emissions of CO_2 for the five core Shared Socio-economic Pathway (SSP) scenarios (very low: SSP1-1.9, low: SSP1-2.6, intermediate: SSP2-4.5, high: SSP3-7.0, very high: SSP5-8.5) (Source: IPCC AR6 Infographic TS.1).



Assessed projected change in mean global surface temperature for five future climate scenarios. Future global temperatures can vary from below 1.5°C to over 4°C by 2100 depending on the amount of future emissions (Source: IPCC AR6 Cross-Chapter Box TS.1, Figure 1).

3.4 Summary

Summary

This CCRA detailed within this report provides an assessment of County Offaly's climate change risks to support Offaly County Council's efforts to prepare its LACAP. The CCRA has been carried out in line with the Local Authority Climate Action Plan Guidelines, Technical Annex B, drafted by the Climate Action Regional Offices (CAROs). The key results are summarised below:

- Recent experiences of **cold spells and heavy snowfall** events (e.g. Storm Emma) demonstrated the wide range of impacts for County Offaly. These included, amongst others, disruption to public transport networks, power outages, and a reduction in agricultural production. Projected increases in average temperature and decreases in the frequency of snowfall indicate a decrease in the frequency of cold spells, heavy snowfall, and their associated impacts.

- Offaly experienced significant **river and pluvial flooding** events in 2020. These events demonstrated the wide range of impacts for County Offaly, including inundation of residential properties, damage to recreational amenities, disruption of transport networks, and inundation of farmland. Projected increases in the frequency of extreme precipitation events will result in increased surface water and riverine flood risk for Offaly.

- Offaly experienced both a **heatwave and drought** in 2018, with heatwaves recorded in 2021 and 2022. These events included, amongst others, disruption of public transport networks, the imposition of restrictions on water supply, and contributed to the development of uncontrolled fires (e.g., Slieve Bloom Mountains). Projected increases in the frequency of heatwaves and drought conditions will mean that events currently experienced on an infrequent basis will become more frequent. As the population ages, there will also be an increase in the number of vulnerable people exposed to heat-related risks.

- **Severe windstorms** are currently experienced on a frequent basis in Offaly and result in wide-ranging impacts, including damage to buildings and infrastructure, disruptions to energy supply and transport networks across the county. Projections indicate no significant change to this frequency for County Offaly.

To increase resilience, Offaly County Council will need to proactively plan for and adapt to the current and future climate change risks identified through this CCRA.

04
Appendices

Appendix 1 - Glossary

Biodiversity: The variability among living organisms from terrestrial, marine and other ecosystems. Biodiversity includes variability at the genetic, species and ecosystem levels

Climate: The long-term average weather for an area, usually taken over 30 years

Climate projection: A climate projection is the simulated response of the climate system to a scenario of future emission or concentration of greenhouse gases (GHGs) and aerosols, generally derived using climate models

Coastal erosion is the breaking down of land and removal of sediment and rocks by coastal processes. Factors affecting the rate of coastal erosion include sea level rise, strong wave action, and storms

Cold Spell: A sustained period of cold weather, where extreme low temperatures are recorded

Coastal Flooding: Coastal flooding occurs when sea levels along the coast or in estuaries exceed neighbouring land levels, or overcome coastal defences where these exist, or when waves overtop over the coast

Drought: A period of abnormally dry weather long enough to cause a serious hydrological imbalance

Exposure: The presence of people, livelihoods, species or ecosystems, environmental functions, services, and resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected

Extreme weather event: An extreme weather event is an event that is rare at a particular place and time of year

Fluvial flooding occurs when rivers and streams break their banks and water flows out onto the adjacent low-lying areas (the natural floodplains)

Groundwater flooding occurs when the water table rises above the land surface. It generally requires sustained rainfall over relatively longer duration than other forms of flooding, its location is discontinuous, and they can last for weeks or months

Appendix 1 - Glossary

Hazard: The potential occurrence of a natural or human-induced physical event or trend or physical impact that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems and environmental resources.

Heat wave: A period of abnormally and uncomfortably hot weather

Heavy Snowfall: A substantial prolonged snowfall event resulting in substantial accumulations of snow on the ground over a period of consecutive days.

Landslide describes a wide variety of processes that result in the downward and outward movement of materials under the force of gravity

Pluvial flooding occurs when the amount of rainfall exceeds the capacity of urban storm water drainage systems or the ground to absorb it

Representative Concentration Pathways (RCPs): Scenarios that include time series of emissions and concentrations of the full suite of greenhouse gases (GHGs) and aerosols and chemically active gases, as well as land use/land cover

RCP4.5 and RCP6.0: Two intermediate stabilization pathways in which radiative forcing is stabilized at approximately 4.5 W/m2 and 6.0 W/m2 after 2100 (the corresponding ECPs assuming constant concentrations after 2150)

RCP8.5 One high pathway for which radiative forcing reaches >8.5 W/m2 by 2100 and continues to rise for some amount of time (the corresponding ECP assuming constant emissions after 2100 and constant concentrations after 2250)

Risk: The potential, when the outcome is uncertain, for adverse consequences on something of value (lives, ecosystems, assets, services, etc.)

Severe Windstorm: A windstorm is a wind that can cause at least light damage to trees and buildings, typically exceeds 34 mph (55 km/h), and may or may not be accompanied by rain

Vulnerability: The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt

Appendix 2 – Service Area Descriptions

Acronym	Full form
Business Services	Corporate and customer facing services.
Roads, footpaths, bridges, construction and maintenance	Road and active travel, bridges, piers and harbours.
Building Stock	Local Authority buildings and social housing stock.
Community infrastructure	Recreation (incl. libraries and parks), tourism and economic development infrastructure.
Cultural Heritage	Arts and heritage protection.
Stormwater / Sewerage	Stormwater and sewerage infrastructure.
Wastewater	Foul and surface water sewers, water treatment plants and wastewater pumping stations.
Water Supply	Public water supply network (with Irish Water), public water treatment plant and pumping stations (with Irish Water) .
Water Quality	Water quality (rivers, lakes and marine).
Biodiversity	Biodiversity and habitat protection.
Community Development	Community development and co-ordination.
Emergency Response	Fire and water safety services, emergency response during severe weather response.

Appendix 3 – Acronyms

Acronym	Full form
CAPS	Climate Action Plans
CAROs	Climate Action Regional Offices
CCRA	Climate Change Risk Assessment
CDP	County Development Plan
CRA	Climate Risk Assessment
EPA	Environmental Protection Agency
EU	European Union
GHG	Greenhouse gases
IPCC	Intergovernmental Panel on Climate Change
LA	Local Authority
NHA	National Heritage Area
RCP	Representative Concentration Pathways
SACs	Special Area of Conservation
SPAs	Special Protection Areas
URDF	Urban Regeneration Development Fund
WTP	Water Treatment Plant

Appendix 4 – Description of the levels of impact due to disruption of Local Authority Services (Source: Technical Annex B: Climate Risk Assessment

Impact	Description	Level of Impact
Catastrophic	Widespread service failure with services unable to cope with wide-scale impacts	5
Major	Services seen to be in danger of failing completely with severe widespread decline in service provision	4
Moderate	Service provision under severe pressure. Appreciable decline in service provision at community level	3
Minor	Isolated but noticeable examples of service decline	2
Negligible	Appearance of threat but no actual impact on service provision	1

Appendix 5 – Characterisation of the magnitude of impact across various risk areas (Source: Technical Annex B: Climate Risk Assessment)

Risk Area	Negligible (Score; 1)	Minor (Score: 2)	Moderate (Score: 3)	Major (Score: 4)	Catastrophic (Score:5)
Asset Damage	Impact can be absorbed through normal activity	An adverse event that can be absorbed by taking business continuity action	A serious event that requires additional emergency business continuity actions	A critical event that requires extraordinary/ emergency business continuity actions	Disaster with the potential to lead to shutdown or collapse or loss of assets/ network
Health and Wellbeing	First aid case	Minor physical injury or mental health impact, medical treatment required	Serious physical or mental health impact, or lost work	Major or multiple injuries or mental health impact, permanent or physical disability	Single or multiple fatalities
Environment	No impact on baseline environment. Localised in the source area. No recovery required	Localised within site boundaries. Recovery measurable within one month of impact	Moderate harm with possible wider effect. Recovery in one year	Significant harm with local effect. Recovery longer than one year. Failure to comply with environmental regulations/ consent	Significant harm with widespread effect. Recovery longer than year. Limited prospect of full recovery
Social	No negative social impact.	Localised, temporary social impacts	Local, long-term impact on public opinion with adverse local media coverage	Failure to protect poor or vulnerable groups. National, long- term social impacts	Loss of social licence to operate. Community protests
Financial (for single extreme event or annual average impact)	x % IRR < 2% of turnover	x % IRR 2- 10% of turnover	x % of IRR 10-25% of turnover	x % IRR 25-50% of turnover	x % IRR > 50% of turnover
Reputation	Localised, temporary impact on public opinion	Localised, short-term impact on public opinion	Local, long-term impact on public opinion with adverse local media coverage	National, short-term impact on public opinion; negative media coverage	National, long-term impact with potential to affect stability of the government
Cultural Heritage	Insignificant impact	Short term impact. Possible recovery or repair	Serious damage with wider impact to tourism industry	Significant damage with national and international impact	Permanent loss with resulting impact on society