



# Galway County Council

## Climate Change Risk Assessment



LACAP  
Final Report  
4<sup>th</sup> Aug 2023



KPMG  
Sustainable  
Futures





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# Executive Summary



# Executive Summary

## Context and Scope of this Report

Climate change poses a critical challenge for Galway County Council. It will result in a wide range of impacts across County Galway, from damaging infrastructure such as roads and bridges, to biodiversity and restrictions on water supply. These bring substantial implications for Galway 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 climate change risks and impacts for County Galway and the implications of these for the delivery of services by Galway County Council. The aim of the report is to provide the evidence base to inform the development of the LACAP for Galway County Council.

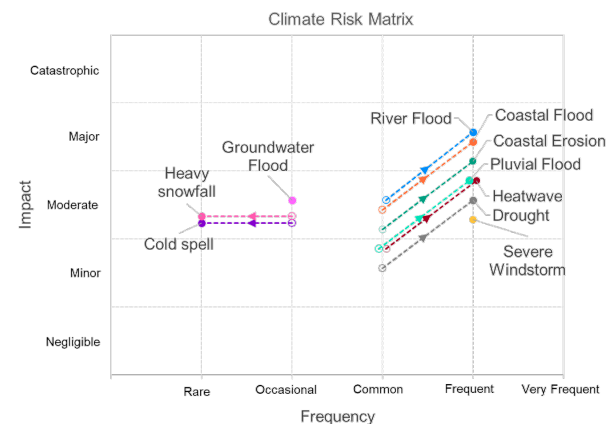
## Key Results and Findings

As illustrated in the climate risk matrix on the right, projections indicate the level of risk posed by some hazards (e.g. coastal erosion, coastal, river and pluvial flooding, heatwaves and drought) will increase while others will remain the same (e.g., severe windstorms and groundwater flooding). The level of risk associated with some hazards are expected to decrease, such as cold spells and heavy snowfalls.

- Recent experiences of **river and pluvial flooding** events in 2015/16, 2017 and 2020, resulted in damages to buildings, disruption of transport networks (e.g. L4519 and L4506), and impacts on business and local economy. Projected increases in the frequency of extreme precipitation events will result in increased level of surface water and riverine flood risk for County Galway.
- Coastal erosion and flooding** already pose a significant risk for County Galway and have resulted in temporary inundation of buildings (e.g. homes in Cave), damages to coastal habitats and heritage sites (e.g. 17<sup>th</sup> century church in Aughinish), and disruption of transport networks (e.g. N59). Rising sea levels will increase the rate of coastal erosion and frequency of coastal inundation, resulting in an increased coastal erosion and flood risk for County Galway.
- County Galway experienced both a **heatwave and drought** in 2018 and 2022, with heatwaves also recorded in 2021. These events resulted in damage to road surfaces (e.g. Connemara), increased demand on water resources, and increased frequency of uncontrolled fire (e.g. Curraghalline). Projected increases in the frequency of heatwaves and drought conditions will mean that events currently experienced on an infrequent basis will become more frequent.
- Severe windstorms** are currently experienced on a frequent basis in County Galway and result in wide-ranging impacts, including disruption to energy supply and transport networks (e.g. N59). Projections indicate no significant change to this frequency.
- Groundwater flooding** is currently experienced on an occasional basis in County Galway and results in significant impacts including disruption of transport, submergence of agricultural lands for extended periods and detrimental impacts on water quality. Projections indicate no change to this frequency.
- Recent experiences of **cold spells and heavy**

**snowfall** events in 2018 (e.g. Storm Emma) demonstrated the wide range of impacts for County Galway. These included, amongst others, road closures (e.g. N17 and R332), an increase in the frequency of trips and falls, disruption to public transport, power outage, impacts on water resources, and closure of business with impacts on the local economy. 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. .

To increase resilience, Galway 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 County Galway. 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

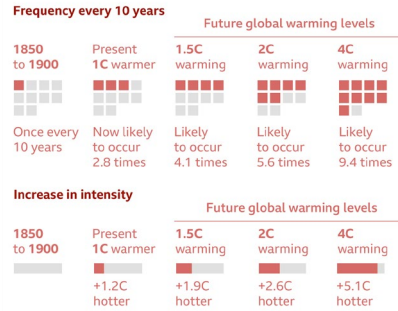
# Introduction

# Global Response to the Challenge of Climate Change

## Global Climate Change Challenge

### Extreme heat becomes more frequent

Projected increase in frequency and intensity of high temperatures which only occurred once in every 10 years on average in a climate without human influence



Source: IPCC, 2021: Summary for Policymakers

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 has been successively warmer than any decade that preceded it since instrumental records began in 1850.

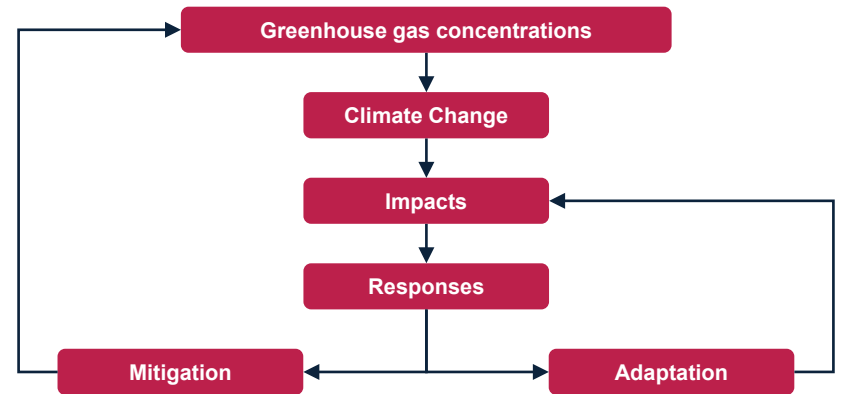
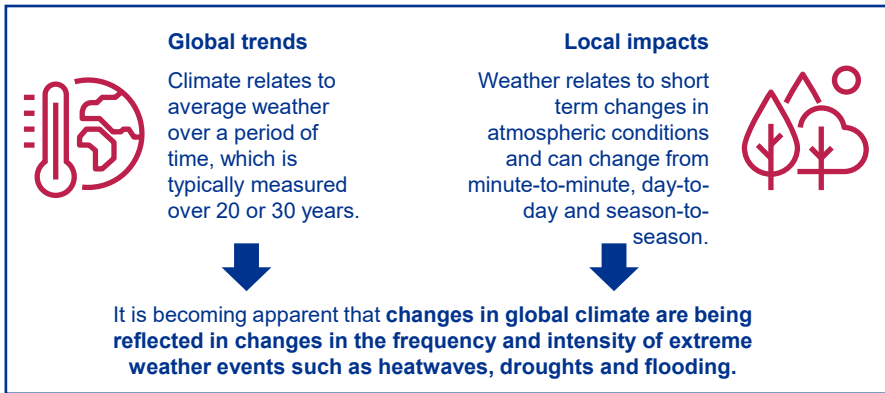
Since 1990, the Intergovernmental Panel on Climate Change (IPCC) have published a series of assessment reports which provide a synthesis of the most up-to-date science and evidence of climate change. The most recent assessment report shows that the global average temperature has increased by 1.1°C when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

## 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 (GHGs) 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 levels of afforestation). In short, mitigation is a human intervention that reduces the sources of GHG emissions and/or enhances GHG sinks.

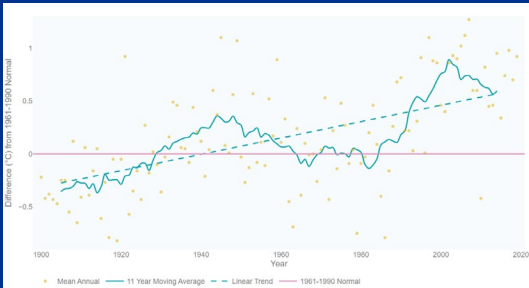
**Adaptation:** Anticipating the adverse impacts of climate change and taking appropriate action to prevent or minimise the damage they can cause, or taking advantage of opportunities that may arise. Examples of adaptation measures include large-scale infrastructure changes, such as building defences 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 an increase in annual average temperature of 0.9 °C between 1900 and 2018. Ireland has seen an increase in annual average rainfall of approx. 6% for the period 1989-2018 when compared to 1961-1990. Global sea level is rising at an increasing rate with the average global rate of sea level rise for the period 2006-2015 being about 2.5 times the rate for the period 1901-1990.



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



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



- Due to limited analysis, no long-term change in windiness have been observed.



- There has been a rise in sea level of approximately 2-3 mm per annum since 1990.
- Sea surface temperature at Malin Head has been, on average, 0.47 °C higher over the period 2009 to 2018 when compared to the average for the period 1981 to 2010.

## Projected Impacts of Climate Change on Ireland

Climate projections indicate that observed changes in Ireland's climate will continue and likely intensify into the future. It is expected that Ireland's climate will become warmer and drier, sea levels will continue to increase at a faster rate and that extreme weather events will occur more frequently. Even if mitigation actions are taken over the next 30 years, a level of projected changes are locked in for the foreseeable future as a result of historical GHG emissions. As a result, temperatures will continue to increase globally until at least 2050, even under low emissions scenarios.



- By 2050, average annual temperatures are expected to increase by up to 1.6°C under a high emissions scenario.

- The frequency and intensity of heatwave events are projected to increase.



- By 2050, Levels of summer precipitation are expected to decrease by up to 17% under a high emissions scenario.

- During winter and autumn months, there is expected to be an increase of up to 19% in the occurrence of heavy precipitation events.

- By 2050, Projections indicate a small reduction in overall wind speed (10m) by up to -3.3% under a high emissions scenario.



- Projections of severe windstorms show a high degree of uncertainty with some projections indicating an increase in very severe windstorms. However, more work is required to increase confidence in these projections.

- Global sea level is expected to continue to and by up to 1m by 2100.



- Projections indicate that the Irish Sea could warm by a further 1.9 °C 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 address 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

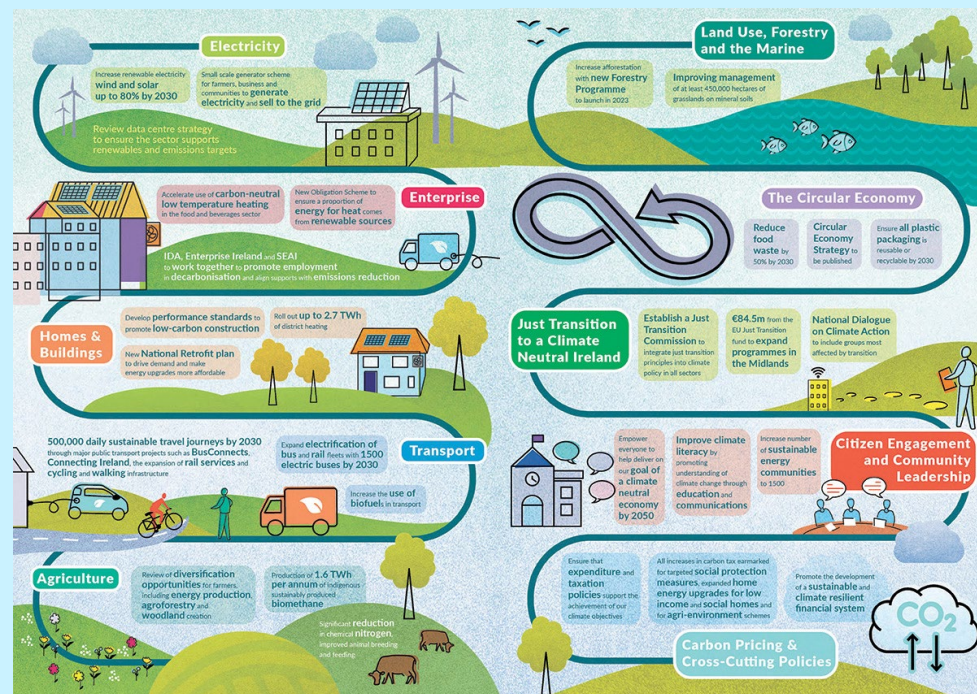
The EU adopted a legislative proposal for the European Climate Law in June 2021 to frame the climate neutrality objective by 2050 across the EU with an intermediate target of **reducing net greenhouse gas emissions by at least 55% by 2030**. The European Commission (EC) is clear in the commitment required 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**, and 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."

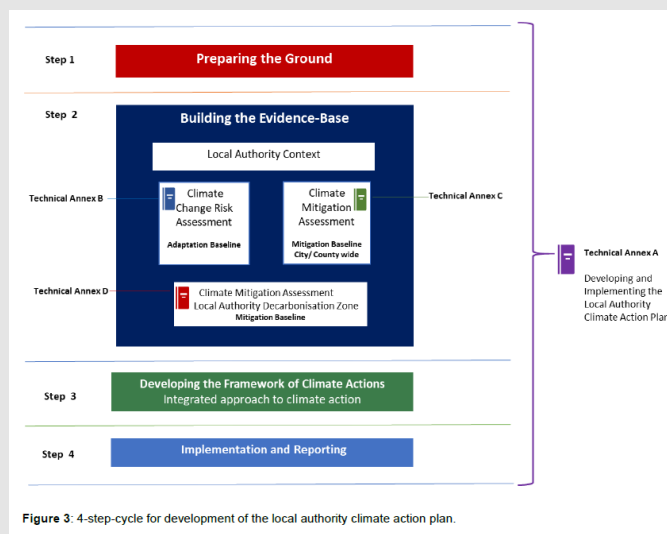
These plans will drive the mitigation and adaptation measures at the local level and see local authorities translate national climate policy to local circumstances and to support the delivery of the National Climate Objective at local and community levels.



## 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 LACAP around a 4-step cycle, which is supported by four technical annexes<sup>1</sup>:



<sup>1</sup> Source: *Local Authority Climate Action Plan Guidelines*, page 17.

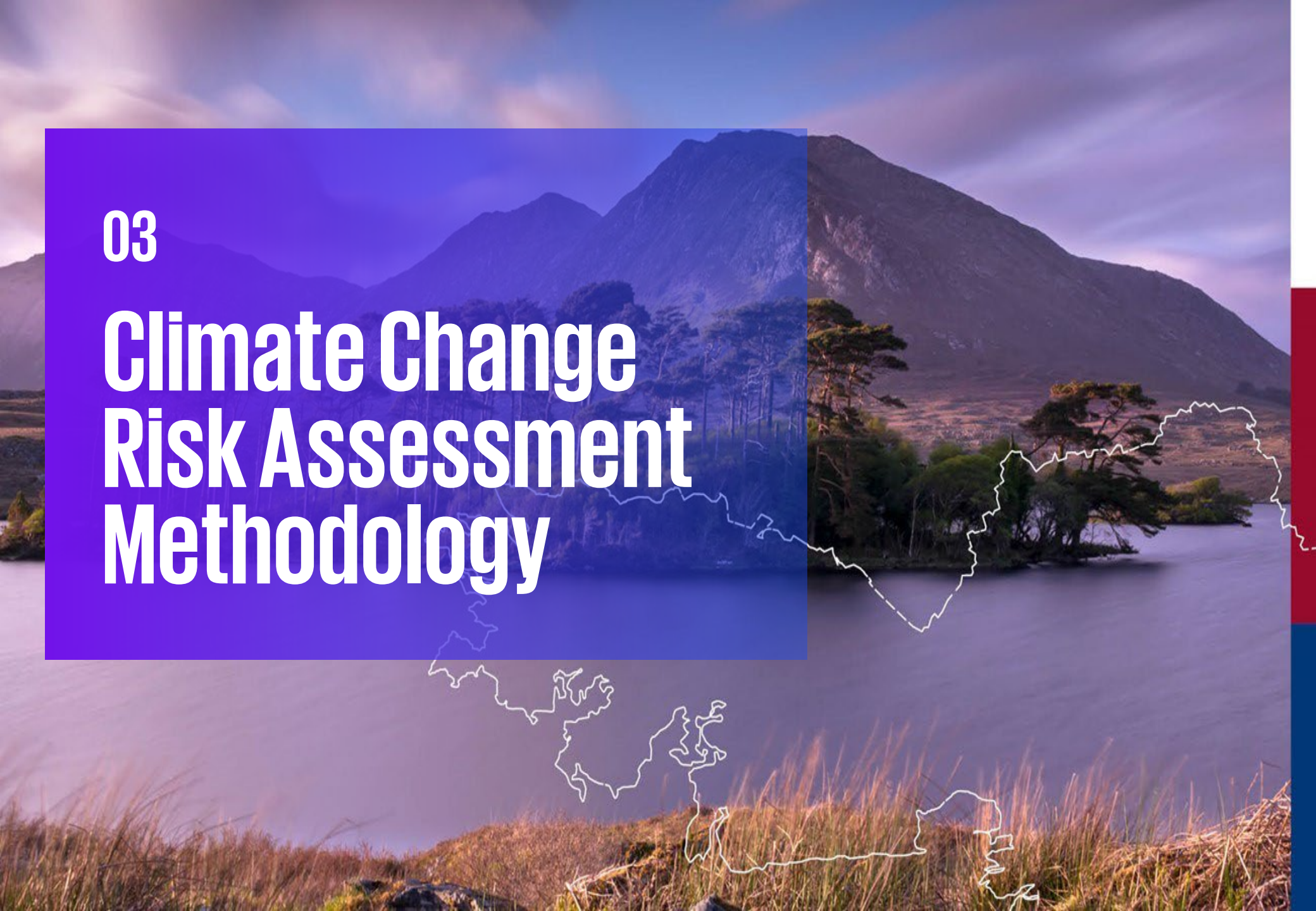


## Scope of this report

Per Galway 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 current and future risks posed by climate change for County Galway and the implications of these for Galway County Council.

03

# Climate Change Risk Assessment Methodology





# 3.1 Introduction, Scope and Methodology

# Understanding of Climate Change Risk Assessment

## Purpose of Climate Change Risk Assessment

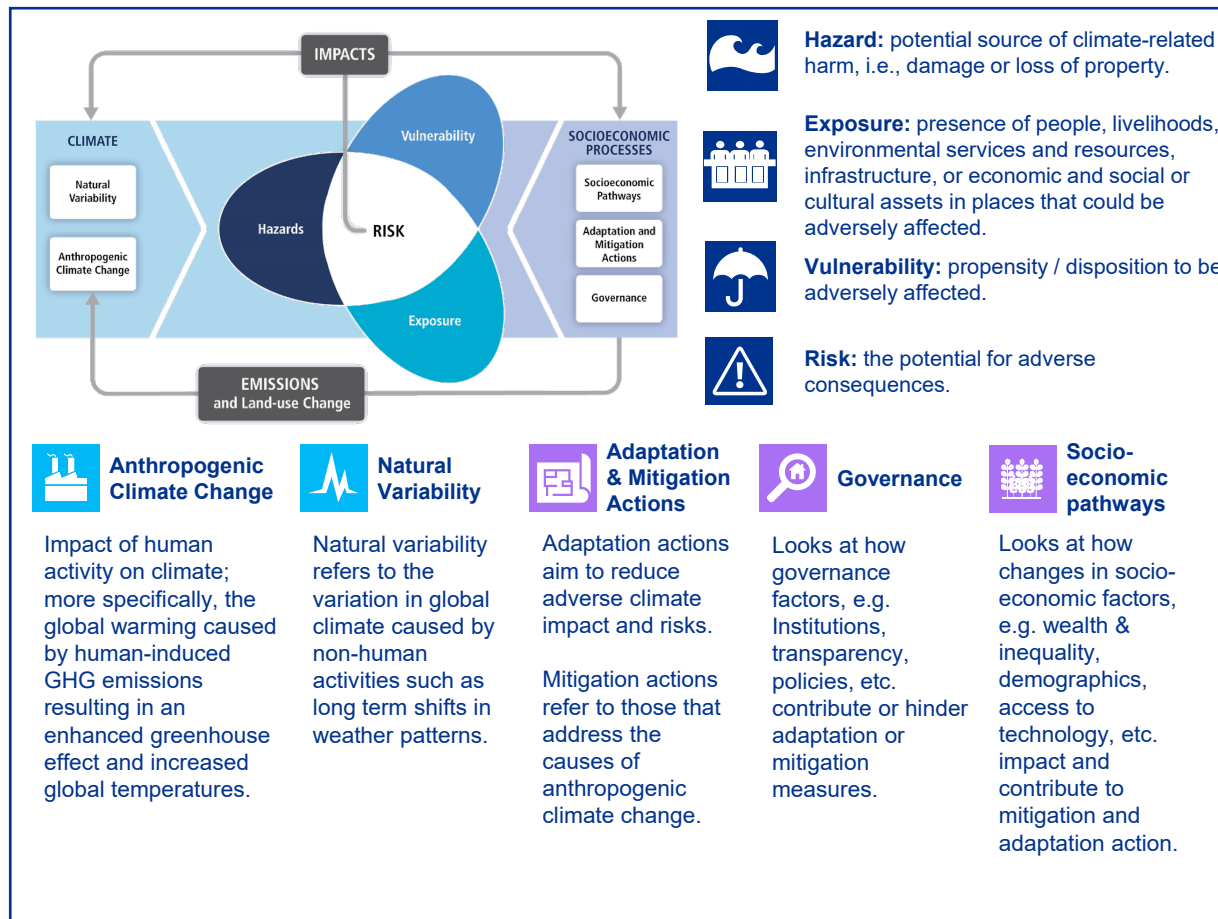
Responding to climate change impacts involves taking adaptation actions to reduce the adverse risks posed by current and projected climate change.

Climate change risk assessments identify the likelihood of future climate hazards and their potential impacts. This is fundamental for informing the prioritisation of climate action and investment in climate action.

## 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 for Galway County Council, the risk assessment framework of the Intergovernmental Panel on Climate Change (IPCC) has been adopted. This framework identifies three key components of climate risk: hazard, exposure and vulnerability. Details of the framework are provided to the right.



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



# Methodology 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 County Galway.

A qualitative risk assessment provides the evidence base to identify potential climate risks for the administrative area of Galway County Council and for the delivery of services by Galway County Council.

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

1. Assess the 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 and Flanagan (2020)* and *Climate Ireland* for two climate scenarios, RCP4.5 and RCP 8.5.

- 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 represents a 'worst-case' scenario which allows for a conservative risk assessment approach.

### Qualitative

- A qualitative assessment is developed based on readily available information and provides for a screening of climate change related hazards and risks.
- This type of assessment helps to:
  - Identify the full range of climate-related risks;
  - Communicate identified risks to relevant stakeholders;
  - Prioritise risks for further more detailed analysis; and
  - Provide a broad understanding of where adaptation actions could be required.

### Semi-quantitative

- A semi-quantitative risk assessment builds upon a qualitative screening assessment and provides a more detailed assessment of climate change risks. Semi-quantitative risk assessments use national and regional information and data along with expert judgement to explore potential risks in further detail.
- This type of assessment helps to:
  - Provide semi-quantitative risk analysis insights;
  - Identify on a spatial basis climate risk hotspots;
  - Identify where adaptation measures may be required.

### 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 when implementation of 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 for County Galway
- Impact Assessment (Service Delivery)
- Current Climate Risk Matrix

## Step 2. Future Climate Risks and Impacts

- Assess Future Changes in Climate Hazards Frequency and Intensity
- Assess Future Change in Exposure and Vulnerability
- Assess Emerging Hazards and Potential Future Climate Risks
- Future Climate Risk Matrix
- Uncertainty Assessment



# 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 currently County Galway and the consequence of these for Galway County Council is essential. To achieve this, a number of steps have been undertaken 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 County Galway.

We have updated the climate hazard profile developed through the existing Galway County Council 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 County Galway

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

### Current Climate Risk Matrix

The overall impact of the identified climate hazards has been assessed according to the following categories of exposure: Asset Damage, Health and Wellbeing, Environment, Social, Financial, Reputation and Cultural Heritage. 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 for County Galway. 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 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 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 Galway have been identified and considered as part of the CCRA.

Section 3.3.2

## 2.4

### Future Climate Risk Matrix

Accounting for projected changes in hazard, exposure and vulnerability, future climate risk has been assessed according to the following categories of exposure: Asset Damage, Health and Wellbeing, Environment, Social, Financial, Reputation and Cultural Heritage. A summary of potential future climate impacts is 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 Galway County Council. The Galway Council Adaptation Strategy 2019-2024 was reviewed and updated 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, Galway County Council Development Plan 2022-2028 and the Regional Spatial and Economic Strategy for the Northern and Western Region were employed to assess future development patterns. In addition, a stakeholder workshop was held to garner further insights from Galway County Council.

Report Section	Sources
Introduction and scope	<ul style="list-style-type: none"> <li>Local Authority Climate Action Plan Guidelines, Technical Annex</li> </ul>
Step 1: Current Climate Risks and Impacts	<ul style="list-style-type: none"> <li>Environmental Protection Agency (EPA)</li> <li>Catchments.ie (EPA)</li> <li>Climate Status Report 2020 (<a href="#">Cámaro García and Dwyer, 2021</a>)</li> <li>Floodinfo.ie (Office of Public Works)</li> <li>Data.gov.ie</li> <li>Transport for Ireland (TFI)</li> <li>Department of Transport</li> <li>Department of Housing, Local Government and Heritage</li> <li>Department of Culture Heritage &amp; the Gaeltacht</li> <li>Department of Transport, Sport and Tourism</li> <li>Teagasc</li> <li>An Taisce</li> <li>Inland Fisheries Ireland</li> <li>Local and National News Media, including newspapers, radio and local authority news feeds</li> <li>Galway County Council Website</li> <li>Galway County Council Adaptation Strategy 2019-2024</li> <li>Sectoral Climate Change Adaptation Strategies (2018)</li> <li>Stakeholder Workshop</li> <li>Inishbofin Inspection of Damaged Coastal Areas Preliminary Report, 2014</li> <li>European Flood Awareness System (EFAS)</li> <li>South Galway Flood Relief Feasibility Study, 2021</li> <li>Hydrologyireland.ie</li> <li>Met Éireann</li> </ul>
Step 2: Future Climate Risks and Impacts	<ul style="list-style-type: none"> <li>Galway County Council Development Plan 2022-2028</li> <li>High-resolution Climate Projections for Ireland – A Multi-model Ensemble Approach (<a href="#">Nolan and Flanagan, 2020</a>) accessed via Climate Ireland</li> <li>Regional Spatial &amp; Economic Strategy for the Northern and Western Regional Assembly</li> <li>Transport Infrastructure Ireland</li> </ul>

# 3.2

# Current Climate Risks and Impacts



# 3.2.1 Profile of Climate Hazards (incl. Frequency)

# Characteristics of County Galway

Galway County Council is a member of the Atlantic Seaboard North Climate Action Regional Office (CARO) which coordinates climate action undertaken by the five Local Authorities of Donegal, Sligo, Mayo, Galway County and Galway City. According to the Census 2022, the county council serves 192,995 people (2022 Census). The county is best known for its farmland plains in east, which extends towards the raised bog, lake and mountainous of Connemara landscape in the west and, beyond that, a rugged Atlantic coastline.

## Physical & Environmental Characteristics

Galway is approximately 6,099km<sup>2</sup>, making it the second largest county in Ireland. The county is bordered by counties Mayo, Clare, Roscommon, Offaly and Tipperary as well as natural boundaries such as Galway Bay to the west and the River Shannon and Lough Derg in the east.

The county boasts a wealth of natural capital, including 18 SPAs (including bays, loughs, islands, turloughs, callows, woods and marshes), along with a number of NHAs (mainly bog, marsh and esker habitats). This includes the 2,957 sq ha Connemara National Park in the west of the county. Fertile agricultural lands can be found in the county's east and a more varied limestone area in the south.

The County's inland waterways includes lakes, rivers, canals and streams, along with a Blueways network which connects with the city and neighbouring counties. With over 2000km of coastline (incl. its offshore islands), the county has a rich habitat of rocky and sandy shores, shingle beaches, and saltwater lagoons. Galway has 6 Blue Flag beaches and 3 coastline areas identified as Designated Shellfish Waters.

Galway is home to wealth of archaeological monuments, particularly around settlements such Tuam, Oranmore, Athenry, Oughterard, Gort and the islands.

## Socioeconomic Characteristics

As of the 2022 Census, Galway County has a population of 192,995 people which represented a 13,605 increase since the previous census in 2016. The county has experienced relatively steady population growth over recent years and has an almost equal gender breakdown. The Galway Gaeltacht and Islands covers extensive parts of the county and the county accounts for approximately 49.7% of the national Gaeltacht population (2016).

Galway county comprises of 5 municipal districts and the most populous town in the 2016 census was Tuam at 8,767 (the town was designated as a county Hub under the Regional Spatial and Economic Strategy (RSES). Other large towns include Ballinasloe, Loug hrea, Oranmore, Athenry, Gort, Clifden, Bearnna, Portu mna, Oughterard and Moycullen. Under the RSES strategy, Oranmore-Athenry has been identified as a strategic industrial corridor.

In terms of transport infrastructure, the N/M6 and N17/18 are the county's main access routes and there are approximately 771 kms of regional roads and 5,331kms of local roads in the county. The Western Rail Corridor serves stations from Limerick to Athenry while the county is accessible to neighboring international airports in

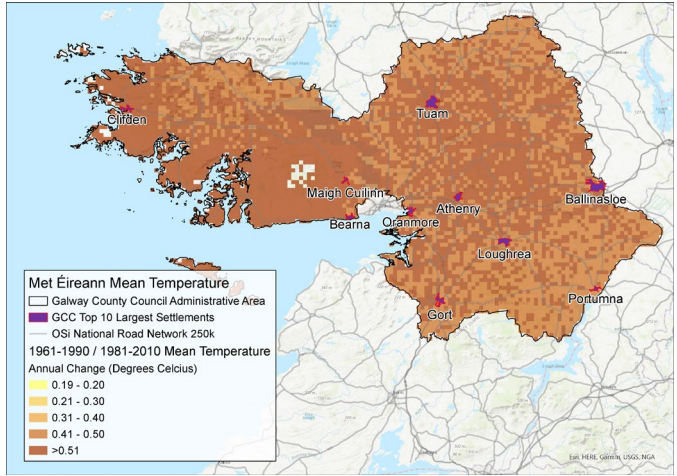
counties Mayo and Clare. Ros a' Mhíl is the main ferry port for the Aran Islands.

A predominantly rural county, over 78% of people in the county live in Galway's towns, villages and rural areas. Naturally, therefore, agriculture, horticultural and equine industries, as well as agri-food businesses, recreational, and tourism activities are significant areas of employment across the county.

According to the 2016 Census, the county's main industries of employment include Professional Services (26%), Commerce and Trade (19%), Manufacturing (16%) and Agriculture, forestry and fishing (7%). Other Industries including Public Administration, Building & Construction, Transport and Communications. Major employers across the county include Valeo manufacturing, Chanelle Pharma, and Natus Medical.

The county's Household Median Gross Income in 2016 was €44,352 and in 2021 the council provided 1,398 Housing Assistance Payments.

# Observed Changes in Galway's Climate



To assess changes in climatic conditions across County Galway, we have employed data from Met Éireann's network of meteorological and climatological stations. To establish a long-term climatology, a 30-year period of data is required. Due to no designated long-term weather stations being located in Galway, the Birr weather station was used due to its close proximity.

In line with global trends, the climate of Ireland and Galway is changing, temperatures are increasing and patterns of precipitation are changing. A summary of key climate and weather-related changes already observed for County Galway are detailed below.

## Highlights of Observed Climate Change for Ireland and County Galway

### Droughts



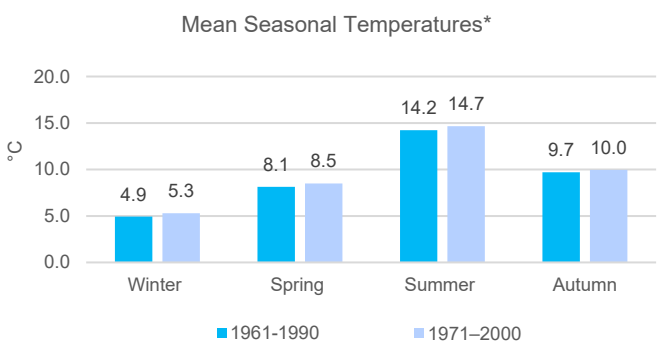
During the 2018 Drought, summer precipitation levels were 43% below average across all weather stations when compared to the 1961-1990 baseline\*\*

### Rainfall

Average annual rainfall increased by 14% for the most recent period (1981-2010) compared to their 1961-1990 baseline.\*\*

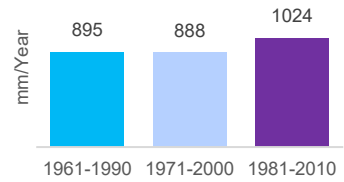
# 0.52°C

Average temperature increase for the period 1981-2010 when compared to the 1961-1990 baseline.\*\*\*



# 30.5°C

Highest temperature on record recorded on July 18<sup>th</sup> 2022 at Athenry



2020 was the wettest year on record across the county with average precipitation levels 105% above the 1961-1990 baseline

\*Source: Met Éireann Long term weather station : Clones (Closed in 2007)  
 \*\*Source: Met Éireann weather station data: Kiltormer, Milltown, Glenamaddy (Gortnagier), and Camdolla  
 \*\*\*Source: interpolation from Long term Met Éireann mean temperature 1x1 Grid data

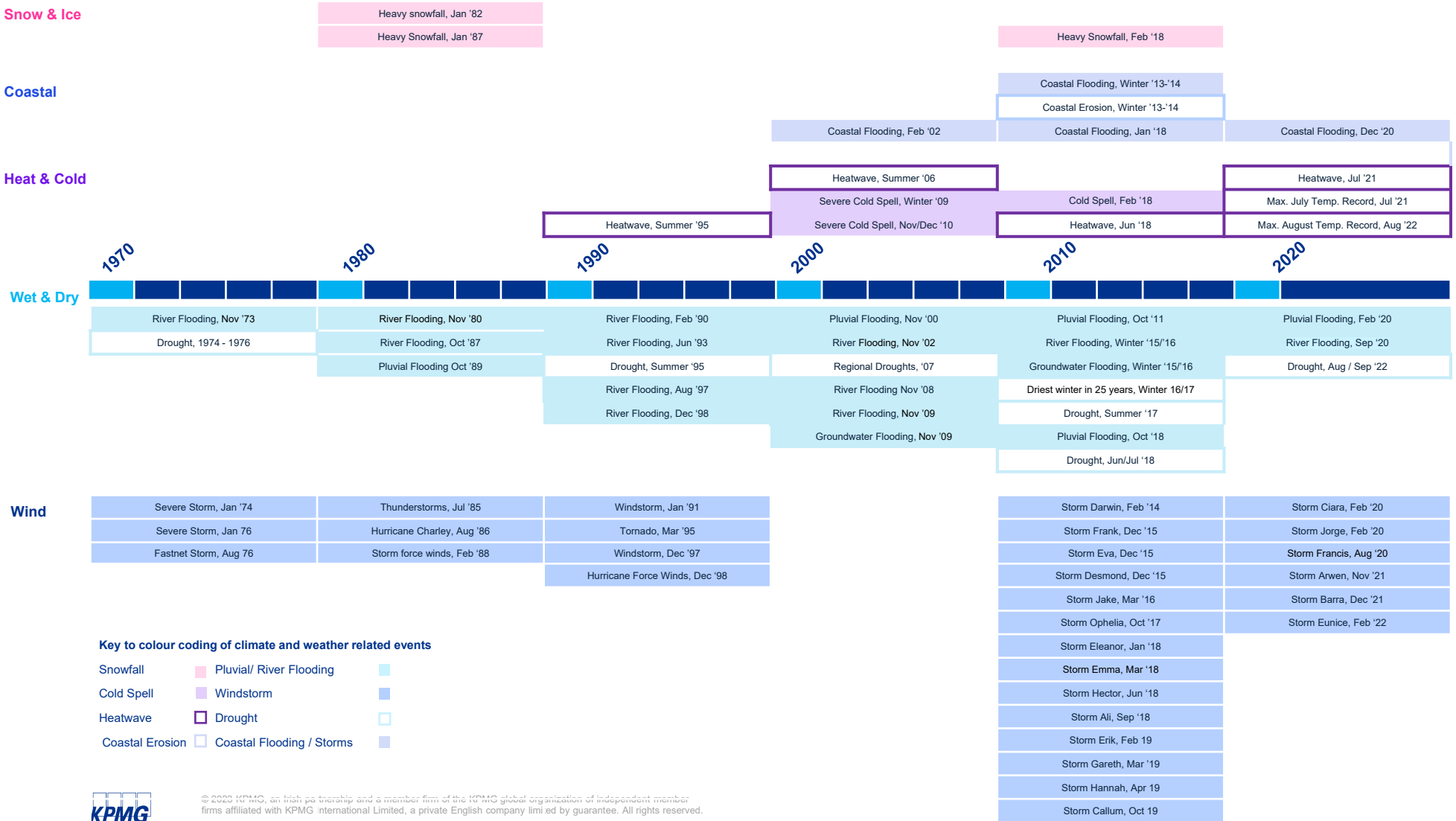


Groundwater flooding during Dec 2015/Jan 2016 in Gort inundated 24 km<sup>2</sup> of land, with agricultural land submerged for 6 months



# Climate Hazard Profile

In addition to observed changes in County Galway's climate, we have identified significant climate and weather-related events to have impacted on the county over the period 1973-2022. To do this, we have further developed the existing climate hazard profile developed through the existing Galway County Council Adaptation Strategy (2019) and expanded the analysis to cover the period 2018-2022.



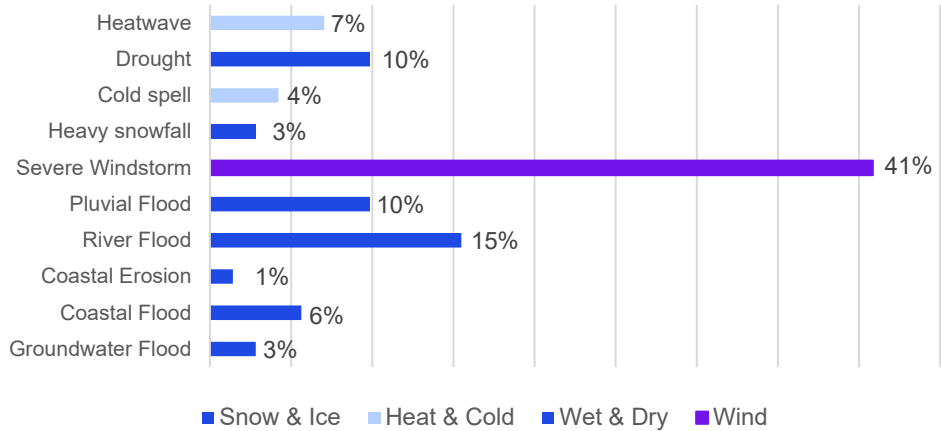
# Frequency of Climate Hazards

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, severe storm events have impacted upon County Galway most frequently over the period 1973-2022, with river and pluvial flooding, heatwaves and drought, coastal erosion and flooding also affecting the County on a number of occasions. Cold spell, heavy snowfall and groundwater flooding, have also impacted County Galway, but less frequently.

The hazard frequency for each hazard is shown in the bottom right table, informed by past event occurrence and in consultation with Galway County Council.

**Frequency of Identified Events According to Category (1973-2022)**



**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 Galway, based upon analysis of past events and workshop feedback**

Hazard Type	Current Frequency
Heatwave	Common
Drought	Common
Cold spell	Occasional
Heavy snowfall	Occasional
Severe windstorm	Frequent
Coastal Flood	Common
Coastal Erosion*	Common
Pluvial Flood	Common
River Flood	Common
Groundwater Flood	Occasional

\*Classification of frequency for coastal erosion recognises the chronic nature of the hazards rather than being based on discrete and significant erosion events.

# 3.2.2 Exposure, Vulnerability and Impacts for County Galway



# Exposure, Vulnerability and Impacts for County Galway

Key to colour coding of impact ratings
Catastrophic
Major
Moderate
Minor
Negligible

On the basis of identified exposures, vulnerabilities and impacts for County Galway, the impact of climate and weather-related hazards on key categories of exposure for County Galway was assessed according to the criteria provided through Technical Annex B: Climate Change Risk Assessment (catastrophic, major, moderate, minor and negligible) (Appendix 2). This assessment was undertaken on the basis of existing information on impacts and in consultation with Galway County Council.



Below we provide a summary of impacts across the key categories of exposure for the seven climate hazards identified. The following pages provides the information that informed this assessment with additional information provided in Appendix 3.

Hazard	Current Frequency	Assets	Health and Wellbeing	Environment	Social	Cultural Heritage	Financial	Reputational	Overall Impact Score
Heatwave	Common	Moderate	Minor	Minor	Negligible	Minor	Minor	Negligible	1.9
Drought	Common	Minor	Negligible	Moderate	Minor	Minor	Negligible	Negligible	1.6
Cold Spell	Occasional	Moderate	Minor	Minor	Minor	Minor	Moderate	Minor	2.3
Heavy Snowfall	Occasional	Moderate	Minor	Minor	Minor	Minor	Moderate	Minor	2.3
Severe Windstorm	Frequent	Moderate	Moderate	Minor	Minor	Minor	Minor	Minor	2.3
Coastal Flood	Common	Moderate	Moderate	Minor	Moderate	Minor	Minor	Minor	2.4
Coastal Erosion	Common	Minor	Negligible	Moderate	Minor	Moderate	Minor	Minor	2.1
Pluvial Flood	Common	Minor	Minor	Minor	Minor	Negligible	Minor	Minor	1.9
River Flood	Common	Moderate	Moderate	Moderate	Moderate	Minor	Minor	Minor	2.6
Groundwater Flood	Occasional	Moderate	Moderate	Minor	Moderate	Minor	Minor	Moderate	2.6

# Impacts of Current Climate Risks– Heatwaves & Drought

County Galway has been exposed to heatwave events (defined as 5 consecutive days with temperatures >25 deg. C) over the period 1973-2022 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 Galway has experienced drought conditions over the period as exemplified by the drought events in 2017, 2018 and 2022.

Key to colour coding of impact ratings
Catastrophic
Major
Moderate
Minor
Negligible

Hazard & Frequency	Exposure	Impact Description	Rating
 <p>Heatwave Common</p>	Assets	<ul style="list-style-type: none"> <li>High temperatures have resulted in damages to road surfaces (tar and chip) across the county. Tar melted on roads in Connemara in July 2021 due to extreme temperatures with remediation works carried out by Galway County Council.</li> <li>High temperatures have resulted in disruption to public transport networks. In August 2022 high rail temperatures led to delayed trains running between Galway and Dublin.</li> </ul>	Moderate
	Health and Well being	<ul style="list-style-type: none"> <li>High indoor temperatures have resulted in uncomfortable working conditions for staff and public with the potential for impacts on heat sensitive equipment (e.g., Council laboratories). This has resulted in increased requirement for active/mechanical cooling.</li> </ul>	Minor
	Environment	<ul style="list-style-type: none"> <li>Heat waves provide suitable conditions for the ignition of uncontrolled fires, with high temperatures in summer 2022 leading to gorse fires in Curraghline, forcing the N84 Headford Road to be temporarily closed. In July 2018, a forest fire near Killure destroyed over 15 acres of Coillte plantation and put nearby homes at risk. In 2022, extreme temperatures contributed to the ignition of uncontrolled fires with gorse fires reported at Spiddal, Killimordaly, Attymon and Lettermore.</li> <li>Increased sea surface temperatures can result in increased frequencies of jellyfish being observed on coasts. In July 2022 a number of sightings of the potentially hazardous Portuguese Man o' War were recorded in waters off Galway, notably off Silverstrand Beach.</li> </ul>	Minor
	Social Cultural Heritage	<ul style="list-style-type: none"> <li>Heatwaves have resulted in congestion at key recreational areas with facilities (e.g., litter collection and parking) overwhelmed.</li> </ul>	Negligible
	Financial	<ul style="list-style-type: none"> <li>The financial implications of heatwaves are primarily associated with emergency response (e.g. uncontrolled fire), road maintenance and repair.</li> </ul>	Minor
	Reputational	<ul style="list-style-type: none"> <li>Heatwaves, associated impacts and response have the potential for a localised and temporary impact on public opinion.</li> </ul>	Negligible
 <p>Drought Common</p>	Assets	<ul style="list-style-type: none"> <li>Drought conditions (e.g. Summer 2018) resulted in the imposition of restrictions on water supply on a national and county basis with potential implications for building operation. In August 2022, Irish Water experienced water shortages in five of Galway WTPs (Ballinasloe Town WTP, Mid Galway WTW, Carna Kilkieran WTP, Ahascragh WTP, Inis Oirr WTP, Tiernee WTP) and appealed to customers to conserve water.</li> </ul>	Minor
	Health and Well being	<ul style="list-style-type: none"> <li>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.</li> </ul>	Negligible
	Environment	<ul style="list-style-type: none"> <li>High temperatures and dry conditions, often compounded by high levels of ignition activity, have resulted in uncontrolled fires with high temperatures in summer 2022 leading to gorse fires in Curraghline, forcing the N84 Headford road to be temporarily closed. In July 2018, a forest fire near Killure destroyed over 15 acres of Coillte plantation and put nearby homes at risk.</li> </ul>	Moderate
	Social	<ul style="list-style-type: none"> <li>Water restrictions can lead to inconvenience and disruption for local businesses and residents.</li> </ul>	Minor
	Cultural Heritage	<ul style="list-style-type: none"> <li>Drought conditions results in damage to cultural heritage sites due to drying out of substrate.</li> </ul>	Minor
	Financial	<ul style="list-style-type: none"> <li>The financial implications of drought are limited and restricted to responding to wildfire and supporting the provision of water (e.g., tankering).</li> </ul>	Negligible
Reputational	<ul style="list-style-type: none"> <li>Droughts, associated impacts and response have the potential for a localised and temporary impact on public opinion.</li> </ul>	Negligible	

# Impacts of Current Climate Risks – Cold Spells & Heavy Snowfall

County Galway experience cold spells and heavy snowfall events on an occasional basis with significant county wide events reported in 2009,2010 and 2018. These events have wide ranging impacts across the County including disruption of transport routes, damage to buildings, and significant repair and maintenance costs.

Key to colour coding of impact ratings
Catastrophic
Major
Moderate
Minor
Negligible


Hazard & Frequency	Exposure	Impact Description	Rating
 Cold spell Occasional	<b>Assets</b>	<ul style="list-style-type: none"> <li>Cold spells have resulted in road closure, transport disruption and increased maintenance and repair costs across the county.</li> <li>During Storm Emma in 2018, County Galway was affected by water restrictions and supply losses as a result of freeze thaw damage to critical water infrastructure.</li> <li>Extreme cold conditions in combination with snowfall have resulted in the widespread closure of business (incl. LA business services) and damage to buildings.</li> </ul>	Moderate
	<b>Health and Well being</b>	<ul style="list-style-type: none"> <li>Extreme cold has resulted in treacherous conditions and increased incidence of slips and falls.</li> <li>Exposure to extreme cold has had detrimental impacts for outdoor workers and vulnerable populations.</li> </ul>	Minor
	<b>Environment</b>	<ul style="list-style-type: none"> <li>Extreme cold temperatures and decreased water availability and have detrimental impacts for biodiversity and habitats, resulting in a decrease of ecosystem health.</li> </ul>	Minor
	<b>Social</b>	<ul style="list-style-type: none"> <li>Road closures have resulted in social isolation for remote communities.</li> <li>Elderly and vulnerable populations are required to stay in place resulting in isolation.</li> </ul>	Minor
	<b>Cultural Heritage</b>	<ul style="list-style-type: none"> <li>Freeze thaw has been identified as having detrimental impact on the structural integrity of cultural heritage sites.</li> </ul>	Minor
	<b>Financial</b>	<ul style="list-style-type: none"> <li>The financial implications of cold spells are primarily associated with significant maintenance and repair costs for local and regional roads, buildings and assets.</li> </ul>	Moderate
	<b>Reputational</b>	<ul style="list-style-type: none"> <li>A perceived deficit in response (e.g., gritting) can receive short term media attention but with limited impact on public opinion.</li> </ul>	Minor
 Heavy snowfall Occasional	<b>Assets</b>	<ul style="list-style-type: none"> <li>Heavy snowfall has resulted in road closures and transport disruption. Heavy snowfall in February 2021 led to treacherous conditions around Tuam on the N17 and R332.</li> <li>Accumulations of snowfall on roofs results in damage to buildings. Snow melt results in the flooding of assets (e.g., roads and infrastructure).</li> <li>Heavy snowfall has damaged energy infrastructure and lead to power outages. In February 2021, approximately 2,000 homes in the Tuam were left without power as a result of damage to energy infrastructure.</li> </ul>	Moderate
	<b>Health and Well being</b>	<ul style="list-style-type: none"> <li>Extreme cold events have resulted in treacherous conditions and increased incidence of slips and falls amongst public and staff.</li> </ul>	Minor
	<b>Environment</b>	<ul style="list-style-type: none"> <li>Flooding post-heavy snowfall event results in overland flow of pollutants to habitats and ecosystems with detrimental effects.</li> </ul>	Minor
	<b>Social</b>	<ul style="list-style-type: none"> <li>Road closures can result in significant social isolation for remote communities.</li> </ul>	Minor
	<b>Cultural Heritage</b>	<ul style="list-style-type: none"> <li>Accumulations of heavy snowfall can result in damage to cultural heritage sites.</li> </ul>	Minor
	<b>Financial</b>	<ul style="list-style-type: none"> <li>The financial implications of cold spells are primarily associated with maintenance and repair costs for local and regional roads, buildings and assets.</li> </ul>	Moderate
	<b>Reputational</b>	<ul style="list-style-type: none"> <li>A perceived deficit in response (e.g., gritting) can receive short term media attention but with limited impact on public opinion.</li> </ul>	Minor



# Impacts of Current Climate Risks – Severe Windstorms

County Galway has been frequently exposed to wind storms over the period 1973-2022, notable examples being Storms Ali, Barra, Dennis and Gareth. Impacts have been experienced across the county and primarily relate to disruption of transport, electricity and communication networks. Severe windstorms also result in health and safety risks, e.g. associated with treefall.

Catastrophic
Major
Moderate
Minor
Negligible

Hazard & Frequency	Exposure	Impact Description	Rating
 <p>Severe windstorm Frequent</p>	Assets	<ul style="list-style-type: none"> <li>Windstorms has caused direct damage to building stock and other assets. Storm Ali in September 2018 forced residents of Renvyle to use a JCB to prevent the roof from blowing off the local post office.</li> <li>Windstorm damage to power and communication transmission infrastructure (e.g., tree fall on overhead lines) has resulted in disruption of communications and energy supply. Storm Barra in December 2021 caused power outages for over 1,200 properties, particularly in Clifden. Storm Dennis in February 2020 caused power outages for over 2,700 homes in Athenry, 900 homes around Gort, and 460 homes in Creagh, among other areas. Storm Gareth in March 2019 caused power outages for c.1,100 homes in Creagh and a further 600 in Clifden.</li> <li>Windstorms have caused disruption of transport routes as a result of treefall. Storm Barra in December 2021 led to cancellation of multiple Bus Eireann services and school transport routes. Treefall arising from Storm Ali in September 2018 caused the N59 to be temporarily closed.</li> </ul>	Moderate
	Health and Well being	<ul style="list-style-type: none"> <li>Windstorms posed a health and safety risk with potential for injury. In September 2018, the high winds of Storm Ali caused a caravan to blow off a cliff on Claddaghduff, causing one death. Storm Jorge in February 2020 caused a truck to overturn on the N59 in the Maam Valley.</li> </ul>	Moderate
	Environment	<ul style="list-style-type: none"> <li>Windstorms have resulted in treefall across County Galway, this is particularly for vulnerable tree species (i.e. trees already under stress).</li> <li>Windstorms prevent council staff from safely taking accurate water samples from lakes, hindering monitoring of water quality.</li> </ul>	Minor
	Social	<ul style="list-style-type: none"> <li>Severe windstorms and disruption of transport and communication networks has resulted in isolation of communities. As a result of Storm Eleanor in 2018, Eir saw 50 sites affected nationally. Three and Vodafone had 71 and 30 affected sites respectively.</li> </ul>	Minor
	Cultural Heritage	<ul style="list-style-type: none"> <li>Severe wind storms can cause structural damage to cultural heritage sites.</li> </ul>	Minor
	Financial	<ul style="list-style-type: none"> <li>The financial impacts of severe wind storm are associated with clean-up and repair cost.</li> </ul>	Minor
	Reputational	<ul style="list-style-type: none"> <li>Reputational damage as a result of wind storms is limited and associated with short term media reporting on preparedness and response.</li> </ul>	Minor

# Impacts of Current Climate Risks - Coastal Flooding and Erosion

Key to colour coding of impact ratings

Catastrophic

Major

Moderate

Minor

Negligible

County Galway has an extensive coastline of 689 km which is home to a variety of natural habitats, rugged coastline and scenic terrain and is frequently exposed to flooding. In addition, County Galway is also exposed to coastal erosion. Bearna Pier is one of the protected structure which is at high risk of coastal erosion.

Hazard & Frequency	Exposure	Impact Description	Rating
 <p><b>Coastal flood</b></p> <p>Common</p>	<b>Assets</b>	<ul style="list-style-type: none"> <li>Coastal flooding has resulted in direct damages to building stock. In December 2020 thirty homes in Cave, near Clarinbridge, were inundated and damaged due to tidal flooding.</li> <li>Coastal flooding can result in damage to road surfaces and footpaths, as was observed during coastal flooding of Barn, Furbo and Spiddal in January 2014. Coastal flooding associated with Storm Eleanor in January 2018 caused damage to the N59, which required emergency works to stabilise.</li> </ul>	Moderate
	<b>Health and Well being</b>	<ul style="list-style-type: none"> <li>Coastal flooding poses risks to health and well being of the public and staff working in exposed areas. Cars were swept away by flash flood in Oranmore during Storm Eleanor in 2018.</li> </ul>	Moderate
	<b>Environment</b>	<ul style="list-style-type: none"> <li>Coastal flooding has detrimental impacts on coastal ecosystems, causing an overall reduction in ecosystem health.</li> </ul>	Minor
	<b>Social</b>	<ul style="list-style-type: none"> <li>Closure of transport routes due to coastal flooding results in significant social isolation for remote communities. In 2020 the village of Cave, near Clarinbridge, was reported being isolated due to tidal waters restricting access. Similarly flooding arising from Storm Eleanor in 2018 caused a road at Tawnagh West in Kinvara to be impassable, isolating 9 families.</li> </ul>	Moderate
	<b>Cultural Heritage</b>	<ul style="list-style-type: none"> <li>Coastal flooding has the potential to cause structural damage to cultural heritage due to water ingress and submergence.</li> </ul>	Minor
	<b>Financial</b>	<ul style="list-style-type: none"> <li>Financial implications associated with coastal flooding relate to increased costs associated with emergency response (e.g. pumping and emergency co-ordination), clean-up and repair.</li> </ul>	Minor
	<b>Reputational</b>	<ul style="list-style-type: none"> <li>For those areas subject to inundation, there is a potential for a localised short term impact on public opinion.</li> </ul>	Minor
 <p><b>Coastal erosion</b></p> <p>Common</p>	<b>Assets</b>	<ul style="list-style-type: none"> <li>Assets and communities are currently at risk from coastal erosion. During the winter of 2013/2014, coastal erosion caused damage to 235m<sup>2</sup> of road surface on Inishbofin as well as damage to coastal and road side walls.</li> </ul>	Minor
	<b>Health and Well being</b>	<ul style="list-style-type: none"> <li>Coastal erosion results in the loss of land, impacting the health and wellbeing of the community affected.</li> <li>Damage to recreational amenities poses a health and safety risk to the members of the public.</li> </ul>	Negligible
	<b>Environment</b>	<ul style="list-style-type: none"> <li>Coastal erosion results in damage to coastal habitats including sites of biodiversity importance (e.g. dune systems).</li> </ul>	Moderate
	<b>Social</b>	<ul style="list-style-type: none"> <li>Road closures as a result of coastal erosion can result in significant social isolation for communities.</li> </ul>	Minor
	<b>Cultural Heritage</b>	<ul style="list-style-type: none"> <li>Coastal erosion has had significant impacts on cultural heritage sites and monuments along Galway's coastline. Since 2015 additional archaeological recording and excavation has been required on the north strand of Omey island, where an archaeological site featuring human remains is threatened by dune erosion. Many piers throughout the county, such as Bearna Pier, which are protected structure, are currently considered at high risk of coastal erosion. A 17<sup>th</sup> century church in Aughinish has been lost due to coastal erosion.</li> </ul>	Moderate
	<b>Financial</b>	<ul style="list-style-type: none"> <li>The financial implications of coastal erosion are primarily related to the development and maintenance of coastal defence works.</li> </ul>	Minor
	<b>Reputational</b>	<ul style="list-style-type: none"> <li>Coastal erosion issues are localised and are associated with short term media reporting on preparedness and response.</li> </ul>	Minor

# Impacts of Current Climate Risks - Pluvial and Fluvial Flooding

Key to colour coding of impact ratings

- Catastrophic
- Major
- Moderate
- Minor
- Negligible


For County Galway in the period 1973-2022, pluvial and fluvial flooding have occurred on a common basis. Galway County was impacted multiple times by fluvial flooding over the last two decades (e.g. 2002, 2008, 2009, 2015-16 and 2020) These events have wide impacts across the County including disruption of transport routes, damage to buildings, and environmental impacts. The most notable impacts of Pluvial flooding are direct damages to buildings and infrastructures and mobilisation of pollutants.

Hazard & Frequency	Exposure	Impact Description	Rating
 <p><b>Pluvial flood</b> Common</p>	<b>Assets</b>	<ul style="list-style-type: none"> <li>Pluvial flooding results in damage to road surfaces and disruption of transport networks. Storm Dennis in February 2020 led to the closure of the L4519 and the L4506. In addition, pluvial flooding has resulted in the temporary inundation of assets and infrastructure.</li> </ul>	Minor
	<b>Health and Well being</b>	<ul style="list-style-type: none"> <li>Heavy precipitation and floodwater leads to dangerous driving conditions for both council staff and public.</li> </ul>	Minor
	<b>Environment</b>	<ul style="list-style-type: none"> <li>Pluvial flooding has resulted in the overland flow of pollutants (nutrients, sediments and pesticides) with impacts on terrestrial and freshwater ecosystems.</li> <li>Pluvial flooding has the potential to cause landslides resulting in damage to local habitats.</li> </ul>	Minor
	<b>Social</b>	<ul style="list-style-type: none"> <li>Road closures as a result of pluvial flooding can result in significant social isolation for communities.</li> </ul>	Minor
	<b>Cultural Heritage</b>	<ul style="list-style-type: none"> <li>Pluvial flooding has the potential to inundate cultural heritage sites and puts built heritage with stone cavities at risk of soakage and leakage.</li> </ul>	Negligible
	<b>Financial</b>	<ul style="list-style-type: none"> <li>The financial implications of pluvial flooding is associated with emergency response (e.g. pumping and emergency co-ordination, clean-up and repair) while there is also increased budget pressure to adapt to impact of climate change, e.g. flood protection measures and upgrading of existing drainage systems.</li> </ul>	Minor
	<b>Reputational</b>	<ul style="list-style-type: none"> <li>Pluvial flooding issues are localised and can result in short term impacts on public opinion.</li> </ul>	Minor
 <p><b>River flood</b> Common</p>	<b>Assets</b>	<ul style="list-style-type: none"> <li>River flooding has resulted in the temporary inundation of buildings. Heavy rainfall caused the Owenglin river to burst its banks in September 2020, necessitating the evacuation of 17 properties and a holiday village in Clifden and forcing the closure of local schools.</li> <li>River flooding and fast flowing rivers can cause damage to bridges through hydrodynamic scour. In 2007, this led to a bridge in Leenane being swept away.</li> <li>River flooding results in transport disruption and road closures.</li> </ul>	Moderate
	<b>Health and Well being</b>	<ul style="list-style-type: none"> <li>Heavy precipitation and floodwater leads to dangerous driving conditions for both council staff and public.</li> <li>Fluvial floods can carry debris which can lead to injury of residents and pedestrians.</li> <li>Homes and schools were evacuated after flash floods in County Galway, during September 2020 when extreme levels of rainfall resulted in Owenglin river bursting its' banks.</li> </ul>	Moderate
	<b>Environment</b>	<ul style="list-style-type: none"> <li>River flooding can result in the overland flow of pollutants (nutrients, sediments and pesticides) with impacts on terrestrial and freshwater ecosystems.</li> </ul>	Moderate
	<b>Social</b>	<ul style="list-style-type: none"> <li>Road closures can result in significant social isolation for communities. During September 2020, flooding from Owenglin river caused temporary closure of parts of Clifden town.</li> <li>Inhibited development of communities as a result of frequent river flooding.</li> </ul>	Moderate
	<b>Cultural Heritage</b>	<ul style="list-style-type: none"> <li>A number of the county's cultural heritage and archaeological sites are situated near river systems and are particularly exposed to river flooding.</li> </ul>	Minor
	<b>Financial</b>	<ul style="list-style-type: none"> <li>The financial implications of fluvial flooding are associated with increased costs of preparedness (e.g., sandbags and demountable defences), emergency response (e.g. pumping and emergency co-ordination), clean-up and repair. There is also increased budget pressure to adapt to impact of climate change, e.g. flood protection measures and upgrading of existing drainage systems.</li> </ul>	Minor
	<b>Reputational</b>	<ul style="list-style-type: none"> <li>For areas that are subject to inundation, there is the potential for localised short term impact on public opinion.</li> </ul>	Minor

# Impacts of Current Climate Risks – Groundwater Flooding

For the period 1973-2022, groundwater flooding has occurred on occasional basis with significant county wide impacts (e.g. 2009 and 2015-16). 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
 <p><b>Groundwater Flood</b> Common</p>	<b>Assets</b>	<ul style="list-style-type: none"> <li>Groundwater flooding has resulted in the flooding of road infrastructure and transport disruption. The Gort groundwater flooding of winter 2015/2016 resulted in traffic diversions being required for up to four months. Heavy rainfall associated with Storm Ciara in February 2020 led to flooding around turloughs in the Gort area, rendering the L8527 at Cloonnearla, L8258 at Carrowbaun and the L2851 at Newhall being impassable for several days.</li> </ul>	Moderate
	<b>Health and Wellbeing</b>	<ul style="list-style-type: none"> <li>Groundwater flooding, where regular and repeated, has resulted in significant stress for those affected, such as in the Gort lowlands.</li> </ul>	Moderate
	<b>Environment</b>	<ul style="list-style-type: none"> <li>Flooding can result in the overland flow of pollutants (nutrients, sediments and pesticides) with impacts on terrestrial and freshwater ecosystems. During the floods of winter 2015/2016, pollutant plumes discharged from flooded farm sheds into groundwater flood plains and associated SACs.</li> </ul>	Minor
	<b>Social</b>	<ul style="list-style-type: none"> <li>Groundwater flooding has led to extensive hardship for residents and farmers in the Gort lowlands, with over 24 km<sup>2</sup> of farmland being inundated for 6 months, impacting on the livelihoods of locals.</li> <li>Road closures can result in significant social isolation for communities. Flooding in the Gort lowlands in winter 2015/2016 resulted in the isolation of numerous farms.</li> </ul>	Moderate
	<b>Cultural Heritage</b>	<ul style="list-style-type: none"> <li>Repeated groundwater flooding can impact protected structures or archaeological sites in proximity to turloughs.</li> </ul>	Minor
	<b>Financial</b>	<ul style="list-style-type: none"> <li>The financial implications of emergency response (e.g. pumping and emergency co-ordination, clean-up and repair) can be significant.</li> </ul>	Minor
	<b>Reputational</b>	<ul style="list-style-type: none"> <li>Groundwater flooding issues are observed county wide and can result long term impact on public opinion with adverse media coverage.</li> </ul>	Moderate



# 3.2.3 Impact Assessment (Service Delivery)

# Summary of Service Level Impacts

The impacts of climate change hazards on County Galway will have direct and indirect consequences for the delivery of services by Galway County Council before, during and after climate and weather-related event.

On the basis of reported information and in consultation with Galway County Council, an assessment of the impacts of identified climate change hazards and impacts on the delivery of services by Galway County Council was undertaken in accordance with the criteria provided through Technical Annex B: Climate Change Risk Assessment (Appendix 2), with each service delivery area assigned an impact category of either negligible, minor, moderate, major, or catastrophic.

Below we provide a summary of the impacts on the delivery of services of Galway 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	Internal LA Governance & Administration	Roads, Transportation & Critical Infrastructure Services	Built Environment & Asset Management Services	Community Development Services / Economic & Tourism Development Services	Arts, Culture & Heritage Services	Water Supply Services*	Environment Services (Protection & Enhancement)	Emergency Services & Response
Heatwave	Minor	Moderate	Minor	Moderate	Minor	Moderate	Moderate	Moderate
Drought	None	None	None	Moderate	Minor	Moderate	Minor	Minor
Cold spell	Minor	Moderate	Moderate	Moderate	Minor	Moderate	Moderate	Moderate
Heavy snowfall	Moderate	Moderate	Moderate	Minor	Minor	Minor	Moderate	Moderate
Severe windstorm	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Coastal Flood	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Coastal Erosion	None	Minor	None	Minor	Negligible	None	Minor	Minor
Pluvial Flood	Minor	Minor	Minor	Minor	Minor	Minor	Moderate	Minor
River Flood	Minor	Moderate	Moderate	Moderate	Minor	Minor	Minor	Moderate
Groundwater Flood	Minor	Moderate	Minor	Minor	Minor	None	None	Moderate

# Service Level Impacts (Heatwaves & Drought)

Heatwaves and drought result in a range of impacts for service provision by Galway County Council. The primary impacts relate to increased maintenance and repair requirements of road surfaces and increased pressure on emergency response as a result of the increased incidence of uncontrolled fire. Decreased levels of water supply due to drought conditions put increased pressure on LA staff working under the Service Level Agreement (SLA) with Irish water. In addition, high temperatures result in staff and public discomfort and an increased requirement for mechanical and passive cooling. Heatwaves and drought put additional pressure on community infrastructure such as parks.

Key to colour coding of impact ratings

Catastrophic
Major
Moderate 30.73
Minor
Negligible

	Heatwaves	Drought
<b>Internal LA Governance &amp; Administration</b>	<ul style="list-style-type: none"> <li>Increased staff and customer discomfort as a result of high indoor temperatures with potential for decreased productivity.</li> </ul>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Roads, Transportation &amp; Critical Infrastructure Services</b>	<ul style="list-style-type: none"> <li>Increased costs associated with repair of road surfaces across the county.</li> <li>Increased health and safety risk for outdoor staff members across the county.</li> </ul>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Built Environment &amp; Asset Management Services</b>	<ul style="list-style-type: none"> <li>Increased requirement for cooling in council offices/buildings.</li> </ul>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Arts, Culture &amp; Heritage Services</b>	<ul style="list-style-type: none"> <li>Increased requirements for monitoring and maintenance of cultural heritage sites.</li> <li>Increased staff and customer discomfort.</li> </ul>	<ul style="list-style-type: none"> <li>Widespread degradation of cultural heritage sites due to drying out.</li> <li>Increased requirements for monitoring and maintenance of cultural heritage sites.</li> </ul>
<b>Water Supply Services</b>	<ul style="list-style-type: none"> <li>Increased demand for water to cool infrastructure, communities, and livestock.</li> <li>Implementation of water conservation measures (e.g., hosepipe bans).</li> </ul>	<ul style="list-style-type: none"> <li>Increased requirement to support provision of water to communities suffering loss of water supply (e.g., Tankering).</li> </ul>
<b>Environment Services (Protection &amp; Enhancement)</b>	<ul style="list-style-type: none"> <li>Reduced water flows impacting on water quality in local areas with increased requirement for monitoring and remediation.</li> <li>Decreased ecosystem health across the county with potential for loss of priority habitats resulting in increased requirement for monitoring and remediation.</li> </ul>	<ul style="list-style-type: none"> <li>Reduced water flows impacting on water quality in local areas with increased requirement for monitoring and remediation.</li> <li>Reduced water flows impacting on biodiversity with potential for loss of priority species and habitats necessitating increased monitoring and remediation.</li> </ul>
<b>Community Development Services / Economic &amp; Tourism Development Services</b>	<ul style="list-style-type: none"> <li>Increased requirement for waste collection and traffic management at key recreational sites.</li> </ul>	<ul style="list-style-type: none"> <li>Reduced grass growth causing increased supplementary feed requirement for cattle reducing farm incomes and the wider industry.</li> </ul>
<b>Emergency Services &amp; Response</b>	<ul style="list-style-type: none"> <li>Increase in number of wildfire call-outs across the county.</li> <li>Increase in number of call out to bathing areas throughout the county.</li> </ul>	<ul style="list-style-type: none"> <li>Increase in number of localised uncontrolled fire call-outs.</li> </ul>
<b>Crosscutting</b>	<ul style="list-style-type: none"> <li>Health and Safety of Staff</li> </ul>	

# Service Level Impacts (Cold Spell & Heavy Snowfall)

Cold spells and heavy snowfall have significant impacts across County Galway with direct and indirect consequences for the delivery of services by Galway County Council. Impacts are related primarily to maintenance and repair of assets and infrastructure, closure of local authority offices and services, and increased demand on emergency response.

Key to colour coding of impact ratings

Catastrophic

Major

Moderate 30.73

Minor

Negligible

	Cold Spell	Heavy Snowfall
<b>Internal LA Governance &amp; Administration</b>	<ul style="list-style-type: none"> <li>Localised disruption and closure of business services..</li> <li>Increased health and safety risks for public and staff.</li> </ul>	<ul style="list-style-type: none"> <li>Disruption and closure of business services across the county</li> <li>Increased health and safety risks for public and staff.</li> </ul>
<b>Roads, Transportation &amp; Critical Infrastructure Services</b>	<ul style="list-style-type: none"> <li>Increased costs associated with gritting and salting roads across the county.</li> <li>Increased road repair and maintenance costs.</li> <li>Reduced capacity for drainage resulting in standing water due to post cold spell events.</li> <li>Damage to stormwater infrastructure with increased requirement for maintenance and repair across the county.</li> <li>Damage to wastewater infrastructure with increased requirement for maintenance and repair</li> </ul>	<ul style="list-style-type: none"> <li>Increased costs associated with gritting and salting roads and footpaths around the county.</li> <li>Increased road repair and maintenance costs.</li> </ul>
<b>Built Environment &amp; Asset Management Services</b>	<ul style="list-style-type: none"> <li>Increased energy costs for buildings county wide.</li> <li>Increased health and safety risks for public and staff county wide.</li> </ul>	<ul style="list-style-type: none"> <li>Increased energy costs for buildings county wide.</li> <li>Increased health and safety risks for public and staff county wide.</li> </ul>
<b>Community Development Services / Economic &amp; Tourism Development Services</b>	<ul style="list-style-type: none"> <li>Increased energy costs in community buildings across the county.</li> <li>Increased health and safety risks for public and staff working in community buildings.</li> <li>Increased instances of community isolation county wide.</li> </ul>	<ul style="list-style-type: none"> <li>Increased health and safety risks for public and staff.</li> <li>Closure of services throughout local communities.</li> <li>Increased instances of community isolation at a localised level.</li> </ul>
<b>Arts, Culture &amp; Heritage Services</b>	<ul style="list-style-type: none"> <li>Increased energy costs for cultural heritage sites.</li> <li>Increased health and safety risks for public and staff at community heritage sites.</li> </ul>	<ul style="list-style-type: none"> <li>Increased health and safety risks for public and staff.</li> <li>Localised closure of sites.</li> </ul>
<b>Water Supply Services</b>	<ul style="list-style-type: none"> <li>County wide water supply issues due damaged water supply infrastructure (e.g., burst pipes).</li> <li>Increased maintenance and repair costs of water service infrastructure across the county.</li> <li>Overland flows of pollutants due to post freezing events, causing contamination of water supplies necessitating increased monitoring and remediation.</li> </ul>	<ul style="list-style-type: none"> <li>Localised water supply issues due damaged water supply infrastructure (e.g., burst pipes).</li> <li>Increased maintenance and repair costs of water service infrastructure.</li> </ul>
<b>Environment Services (Protection &amp; Enhancement)</b>	<ul style="list-style-type: none"> <li>Overland flows of pollutants due to post freezing flood events resulting in decreased water quality necessitating increased requirement on council for monitoring.</li> <li>Prolonged cold spells impacting species not protected from the frigid temperatures in local communities requiring increased monitoring and remediation.</li> </ul>	<ul style="list-style-type: none"> <li>Overland flows of pollutants due to post freezing flood events resulting in decreased water quality necessitating increased requirement on council for monitoring.</li> <li>Heavy Snowfall impacts species not protected from the frigid temperatures, with increased monitoring and remediation required at a localised level.</li> </ul>
<b>Emergency Services &amp; Response</b>	<ul style="list-style-type: none"> <li>Increased pressure on emergency response units across the county.</li> <li>Increase in response times due to treacherous road conditions around the county.</li> </ul>	<ul style="list-style-type: none"> <li>Increased pressure on emergency response units across the county.</li> <li>Increase in response times due to heavy snowfall on roads around the county.</li> </ul>
<b>Crosscutting</b>	<ul style="list-style-type: none"> <li>Redeployment of staff</li> </ul>	



# Service Level Impacts (Severe Windstorm)

Severe windstorms can result in the closure and/or disruption of Galway County Council Offices and services. Primary impacts of severe windstorms are associated with disruption of services and infrastructure due to loss of power supply and communications, damage to local authority assets and infrastructure, increased pressure on emergency response and redeployment of staff to support clean-up following a severe windstorm event.

*Key to colour coding of impact ratings*

- Catastrophic
- Major
- Moderate 30.73
- Minor
- Negligible

	Severe Windstorm
<b>Internal LA Governance &amp; Administration</b>	<ul style="list-style-type: none"> <li>Widespread closure of business services.</li> <li>Increased health and safety risks for public and staff</li> </ul>
<b>Roads, Transportation &amp; Critical Infrastructure Services</b>	<ul style="list-style-type: none"> <li>Countywide transport disruption and road closures affecting the wider community and local authority operations</li> <li>Increased clean-up and repair costs after an event</li> <li>Increased drain maintenance costs on a county wide basis</li> <li>Disruption of critical infrastructure services (e.g. electricity) impacting on wastewater treatment</li> </ul>
<b>Built Environment &amp; Asset Management Services</b>	<ul style="list-style-type: none"> <li>Closure of buildings and disruption of services as a result of direct damage to buildings and disruption of power and communications</li> </ul>
<b>Community Development Services / Economic &amp; Tourism Development Services</b>	<ul style="list-style-type: none"> <li>Disruption to delivery of community services across the county</li> <li>Increased clean-up and repair costs after an event</li> <li>Increased power outages and damages to infrastructure result in an impact on local economy</li> </ul>
<b>Arts, Culture &amp; Heritage Services</b>	<ul style="list-style-type: none"> <li>Closure of sites and events</li> <li>Increased maintenance and repair costs due to storm damage to cultural heritage sites</li> </ul>
<b>Water Supply Services</b>	<ul style="list-style-type: none"> <li>Water supply issues due to damaged water supply infrastructure.</li> </ul>
<b>Environment Services (Protection &amp; Enhancement)</b>	<ul style="list-style-type: none"> <li>High winds result in damage to habitats</li> <li>Increased cost to protect habitats from wind damage</li> </ul>
<b>Emergency Services &amp; Response</b>	<ul style="list-style-type: none"> <li>Increased pressure on emergency service units across the county</li> </ul>
<b>Crosscutting</b>	<ul style="list-style-type: none"> <li>Staff redeployment</li> </ul>

# Service Level Impacts (Coastal Flood & Erosion)

Coastal flooding and erosion result in a range of impacts for service provision by Galway County Council. Impacts of coastal flooding are associated with clean-up and repair costs, damage to assets and infrastructure and damage to environmentally sensitive areas. The primary impacts of coastal erosion are associated with transport disruption and road closures, damages to community assets and infrastructure, and damages to coastal habitats.

	Coastal Flood	Coastal Erosion
<b>Internal LA Governance &amp; Administration</b>	<ul style="list-style-type: none"> <li>Temporary inundation of buildings in exposed areas resulting in closure of services.</li> </ul>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Roads, Transportation &amp; Critical Infrastructure Services</b>	<ul style="list-style-type: none"> <li>Transport disruption and road closures across the county.</li> <li>Increased clean-up and repair costs.</li> <li>Damage to stormwater systems with increased requirement for maintenance and repair.</li> <li>Damage to wastewater infrastructure with increased requirement for maintenance and repair.</li> </ul>	<ul style="list-style-type: none"> <li>Transport disruption and road closures across local areas.</li> <li>Increased clean-up and repair costs.</li> </ul>
<b>Built Environment &amp; Asset Management Services</b>	<ul style="list-style-type: none"> <li>Inundation of building stock.</li> </ul>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Community Development Services / Economic &amp; Tourism Development Services</b>	<ul style="list-style-type: none"> <li>Damage to community infrastructure such as parks and refuse collection points.</li> <li>Closure of community infrastructure and services.</li> <li>Increased repair and maintenance costs.</li> <li>Inhibited development of communities at risk of coastal flooding.</li> </ul>	<ul style="list-style-type: none"> <li>Damage to community infrastructure such as parks and refuse collection points.</li> <li>Increased repair and maintenance costs.</li> <li>Inhibited development of communities as a result of coastal erosion at a localised level.</li> <li>Building damage and travel disruptions impact on local economies.</li> </ul>
<b>Arts, Culture &amp; Heritage Services</b>	<ul style="list-style-type: none"> <li>Damage to heritage sites exposed to coastal flooding across the county.</li> <li>Increased health and safety risks.</li> <li>Increased maintenance and repair costs.</li> </ul>	<ul style="list-style-type: none"> <li>Potential for damage to heritage sites exposed to coastal erosion.</li> </ul>
<b>Water Supply Services</b>	<ul style="list-style-type: none"> <li>Damage to critical water supply infrastructure with increased requirement for maintenance and repair.</li> </ul>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Environment Services (Protection &amp; Enhancement)</b>	<ul style="list-style-type: none"> <li>Impact on the water status of high quality sites necessitating increased monitoring and remediation.</li> <li>Damage to coastal habitats resulting in a decrease of ecosystem health at a county wide level and an increased requirement for monitoring and remediation.</li> </ul>	<ul style="list-style-type: none"> <li>Localised damage to coastal habitats resulting in a decrease of ecosystem health and an increased requirement for monitoring and remediation.</li> </ul>
<b>Emergency Services &amp; Response</b>	<ul style="list-style-type: none"> <li>Increased pressure on emergency response units across the county.</li> </ul>	<ul style="list-style-type: none"> <li>Increased pressure on emergency response units at a community level</li> </ul>

Key to colour coding of impact ratings

Catastrophic

Major

Moderate 30.73

Minor

Negligible

# Service Level Impacts (Pluvial & River Flood)

Pluvial and river flooding have resulted in a wide range of impacts for Galway County Council. Impacts are primarily associated with clean-up and repair costs, water quality issues due to overland flows of pollutants into water courses, damage to environmentally sensitive areas, increased pressure on emergency response services and supporting communities during and following flood events.

	Pluvial Flood	River Flood
<ul style="list-style-type: none"> <li>Internal LA Governance &amp; Administration</li> </ul>	<ul style="list-style-type: none"> <li>Localised disruption and closure of local authority services.</li> </ul>	<ul style="list-style-type: none"> <li>Localised disruption and closure of local authority services.</li> </ul>
<ul style="list-style-type: none"> <li>Roads, Transportation &amp; Critical Infrastructure Services</li> </ul>	<ul style="list-style-type: none"> <li>Localised transport disruption and road closures.</li> <li>Increased clean-up and repair costs after an event.</li> <li>Reduced capacity for drainage resulting in standing water.</li> <li>Damage to stormwater infrastructure at a localised level.</li> <li>Damage to wastewater treatment plants.</li> </ul>	<ul style="list-style-type: none"> <li>Transport disruption and road closures.</li> <li>Increased clean-up and repair costs after an event.</li> <li>Reduced capacity for drainage resulting in standing water.</li> <li>Damage to stormwater infrastructure county wide.</li> </ul>
<ul style="list-style-type: none"> <li>Built Environment &amp; Asset Management Services</li> </ul>	<ul style="list-style-type: none"> <li>Damage to buildings and disruption of service at localised level.</li> <li>Increased maintenance and repair costs.</li> <li>Increased requirement for flood defence measures.</li> </ul>	<ul style="list-style-type: none"> <li>Damage to buildings and disruption of service across the county.</li> <li>Increased maintenance and repair costs.</li> <li>Increased requirement for flood defence measures.</li> </ul>
<ul style="list-style-type: none"> <li>Community Development Services / Economic &amp; Tourism Development Services</li> </ul>	<ul style="list-style-type: none"> <li>Closure of community infrastructure and services at a localised level.</li> <li>Increased repair and maintenance costs.</li> <li>Inhibited development of communities at a localised level.</li> <li>Damage to buildings and travel disruptions impact on local economies.</li> </ul>	<ul style="list-style-type: none"> <li>Closure of community infrastructure and services countywide.</li> <li>Increased repair and maintenance costs.</li> <li>Inhibited development of communities across the county.</li> <li>Damage to buildings and travel disruptions impact on local economies.</li> </ul>
<ul style="list-style-type: none"> <li>Arts, Culture &amp; Heritage Services</li> </ul>	<ul style="list-style-type: none"> <li>Damage to heritage sites due to pluvial flooding requiring repair work.</li> <li>Increased maintenance and repair costs.</li> </ul>	<ul style="list-style-type: none"> <li>Damage to heritage sites due to river flooding requiring repair work.</li> <li>Increased maintenance and repair costs.</li> </ul>
<ul style="list-style-type: none"> <li>Water Supply Services</li> </ul>	<ul style="list-style-type: none"> <li>Water supply issues at a localised level requiring supplemental water provision (e.g., tankering).</li> <li>Increased water treatment costs due to contamination by overland pollutant flows.</li> </ul>	<ul style="list-style-type: none"> <li>Water supply issues at a localised level requiring supplemental water provision (e.g., tankering).</li> <li>Increased water treatment costs due to contamination by overland pollutant flows</li> </ul>
<ul style="list-style-type: none"> <li>Environment Services</li> <li>(Protection &amp; Enhancement)</li> </ul>	<ul style="list-style-type: none"> <li>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.</li> <li>Severe damage across the county to environmentally sensitive areas requiring monitoring and/or restoration work.</li> </ul>	<ul style="list-style-type: none"> <li>Deterioration of water quality due to overland flow of pollutants resulting in water supply issues and an increased requirement for monitoring and remediation.</li> <li>Isolated and limited damage to environmentally sensitive areas requiring monitoring and/or restoration work.</li> </ul>
<ul style="list-style-type: none"> <li>Emergency Services &amp; Response</li> </ul>	<ul style="list-style-type: none"> <li>Localised increased pressure on emergency response.</li> </ul>	<ul style="list-style-type: none"> <li>Widespread increased pressure on emergency response.</li> </ul>
<ul style="list-style-type: none"> <li>Crosscutting</li> </ul>	<ul style="list-style-type: none"> <li>Staff redeployment</li> </ul>	

Key to colour coding of impact ratings
Catastrophic
Major
Moderate/30.73
Minor
Negligible

# Service Level Impacts (Groundwater Flooding)

Groundwater flooding result in a range of impacts for service delivery by Galway County Council. The impacts are primarily associated with repair of road surfaces, increased pressure on emergency response services and supporting communities during and following flood events.

*Key to colour coding of impact ratings*

- Catastrophic
- Major
- Moderate 30.73
- Minor
- Negligible

	Groundwater Flooding
<b>Internal LA Governance &amp; Administration</b>	<ul style="list-style-type: none"> <li>Localised disruption and closure of local authority services.</li> </ul>
<b>Roads, Transportation &amp; Critical Infrastructure Services</b>	<ul style="list-style-type: none"> <li>Transport disruption and road closures.</li> <li>Increased clean-up and repair costs after an event.</li> </ul>
<b>Built Environment &amp; Asset Management Services</b>	<ul style="list-style-type: none"> <li>Damage to buildings and disruption of services at the localised level.</li> <li>Increased maintenance and repair costs.</li> <li>Increased requirement for flood defence measures.</li> </ul>
<b>Community Development Services / Economic &amp; Tourism Development Services</b>	<ul style="list-style-type: none"> <li>Closure of community infrastructure and services at a localised level.</li> <li>Increased repair and maintenance costs.</li> <li>Inhibited development of communities at a localised level.</li> <li>Damage to buildings and travel disruptions with detrimental impacts for local economies.</li> </ul>
<b>Arts, Culture &amp; Heritage Services</b>	<ul style="list-style-type: none"> <li>Damage to heritage sites due to groundwater flooding requiring repair work.</li> <li>Increased maintenance and repair costs.</li> </ul>
<b>Water Supply Services</b>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Environment Services (Protection &amp; Enhancement)</b>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Emergency Services &amp; Response</b>	<ul style="list-style-type: none"> <li>Increased pressure on emergency response.</li> </ul>
<b>Crosscutting</b>	<ul style="list-style-type: none"> <li>Staff redeployment</li> </ul>



# 3.2.4 Current Climate Risk Matrix

# Current Climate Risk Matrix

Based on reported information and in consultation with Galway County Council, a current climate risk matrix for County Galway has been developed based on the frequency of hazard and the associated level of impact.

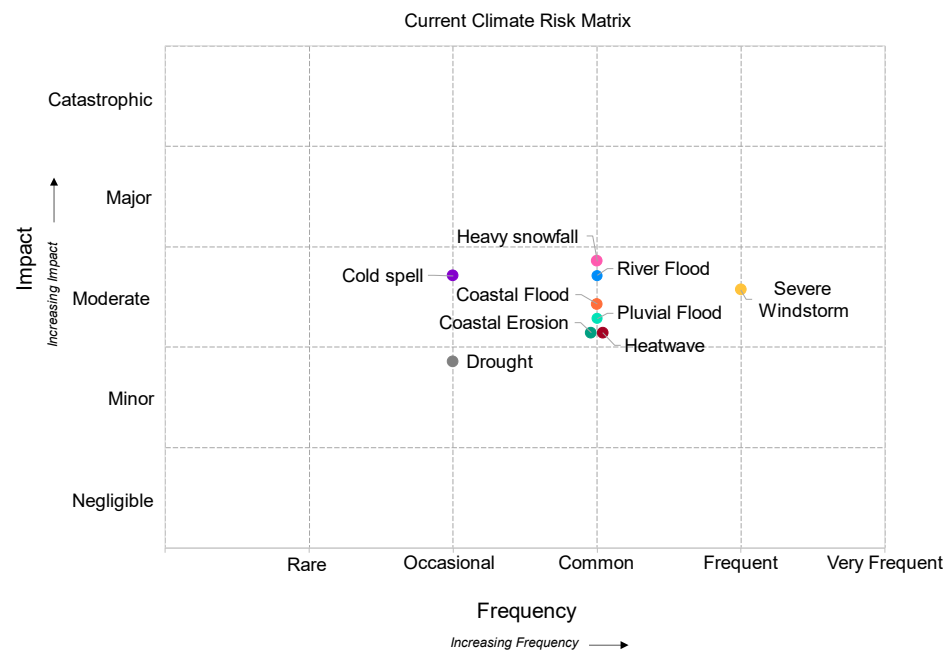
The assessment identified **severe windstorm** as posing the highest level of risk for County Galway with impacts primarily associated with disruption and damage to energy, communication and transport networks.

**River and coastal flooding** have been identified as posing a relatively high risk for County Galway with impacts experienced at the localised scale including damage to assets and infrastructure and potential for isolation of communities and vulnerable populations. **Pluvial flooding** is also considered a risk for County Galway with impacts associated with damages to road surfaces, disruption of transport networks and mobilisation of pollutants

**Coastal erosion** along the Galway coastline is ongoing, and has significant impacts on coastal assets and infrastructure and cultural heritage sites (e.g. 17<sup>th</sup> Century Church in Aughinish). **Heatwaves** occur on a common basis across County Galway; however, the overall impact is currently considered minor. The impacts of heatwaves are associated with an increase in the frequency of uncontrolled fire, damage to road surfaces and increased pressure on recreational sites.

**Groundwater flooding** is considered to occur on occasional basis in County Galway with impacts associated with disruption of road transport and community isolation. **Cold spells and heavy snowfall** also occur on an occasional basis across County Galway resulting in damages to critical energy, communication and water infrastructure while closure of transport infrastructure has the potential to result in isolation of remote communities..

During the current period, **droughts** have occurred on a common basis but with relatively minor impacts and are associated with increases in the frequency of uncontrolled fires and disruption of water supply.



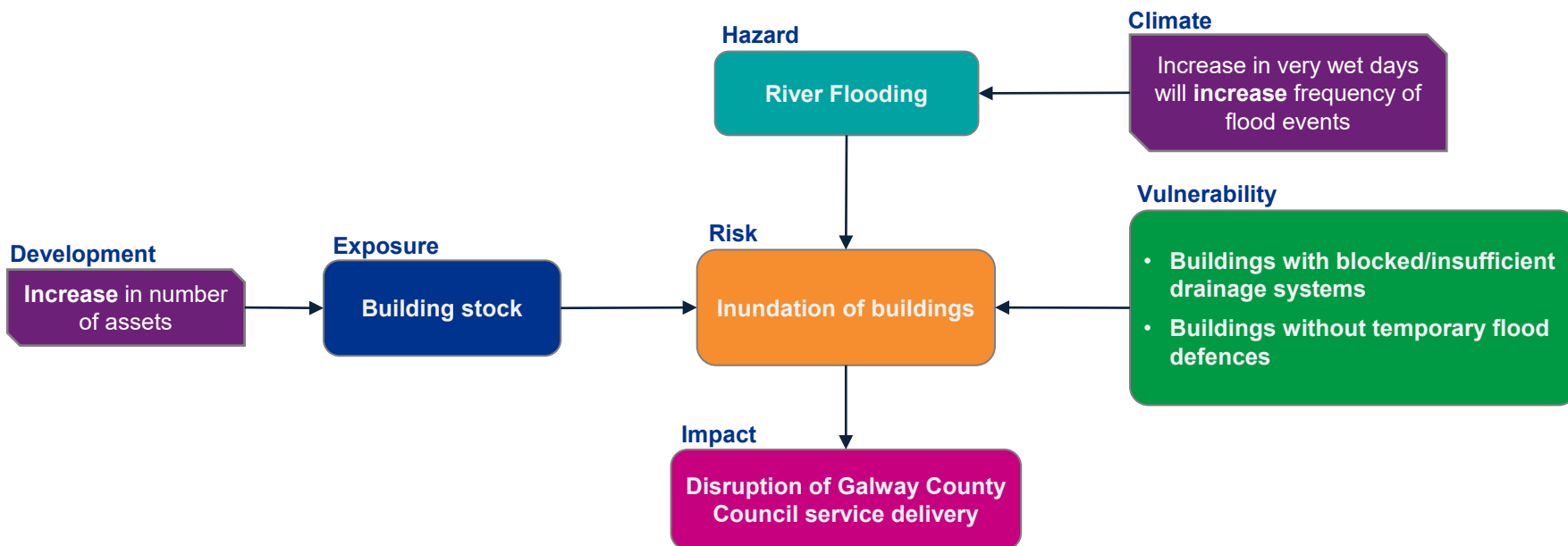
The risk matrix above shows the current risk for the identified hazards within County Galway.

# 3.3 Future Climate Risks and Impact Assessment

# 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 Galway 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 Galway 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.













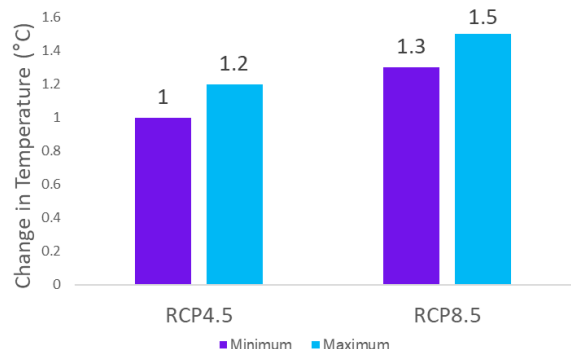


# 3.3.1 Future Changes in Climate Hazards

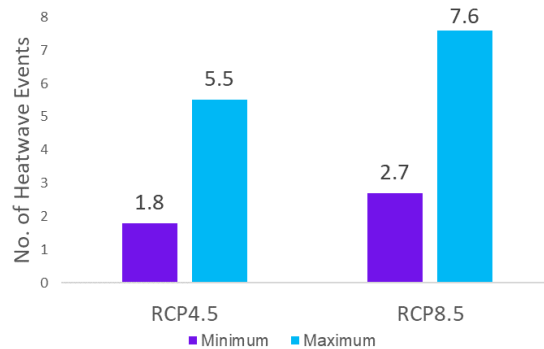
# Climate Projections for County Galway in 2050 (1/2)

Having identified and assessed the range of climate hazards already experienced by Galway 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 Galway County Council may be exacerbated. The information below summaries the climate projections for each hazard based on Nolan and Flanagan (2020).

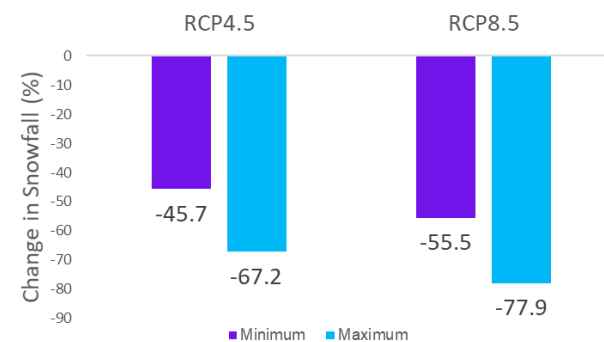
Hazard	Projected Change	Future Frequency
 <b>Heatwaves</b>	<ul style="list-style-type: none"> <li>Projections indicate <b>an overall increase in average temperature</b> (bottom left) of between 1.1 and 1.5°C for County Galway relative to the 1981-2000 period.</li> <li>Under a high emission scenario, projections indicate that <b>heatwaves will become more frequent</b> (bottom middle) by mid-century.</li> </ul>	Frequent 
 <b>Droughts</b>	<ul style="list-style-type: none"> <li><b>Summer rainfall is expected to reduce</b> by between 4 and 15% 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.</li> </ul>	Frequent 
 <b>Cold Spell</b>	<ul style="list-style-type: none"> <li>As a consequence of the increasing temperatures, <b>a decrease in the number of frost days and ice days</b> 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.</li> </ul>	Rare 
 <b>Heavy Snowfall</b>	<ul style="list-style-type: none"> <li>The annual <b>snowfall</b> in the region is projected to decrease substantially by the middle of the century for the RCP4.5 and RCP8.5 scenarios (bottom right).</li> </ul>	Rare 
 <b>Severe Windstorms</b>	<ul style="list-style-type: none"> <li><b>Projections of storms are subject to a high level of uncertainty.</b> By mid century, projections indicate that average wind speed will remain similar to those currently experienced. There is limited evidence of a potential increase in the frequency of more intense storms which are currently rare events. However, more research is needed to confirm this increase.</li> </ul>	Frequent 



The projected minimum and maximum **change in the mean annual temperature** for the area of County Galway 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 Galway 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)

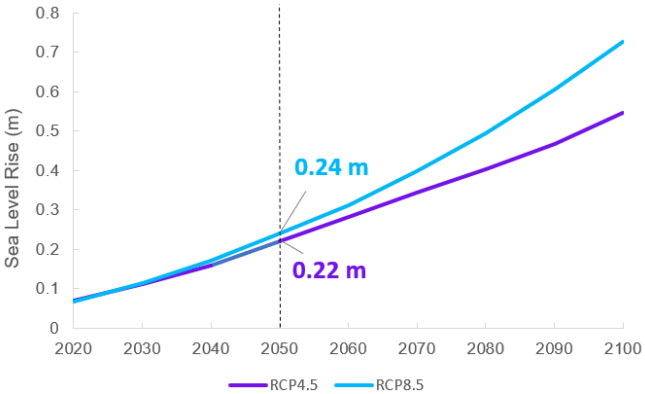


The projected minimum and maximum **change in snowfall** for the area of County Galway for the period 2041-2060 compared to 1981-2000 for a medium (RCP4.5) and high (RCP8.5) emissions scenario (Source: Nolan and Flanagan, 2020)

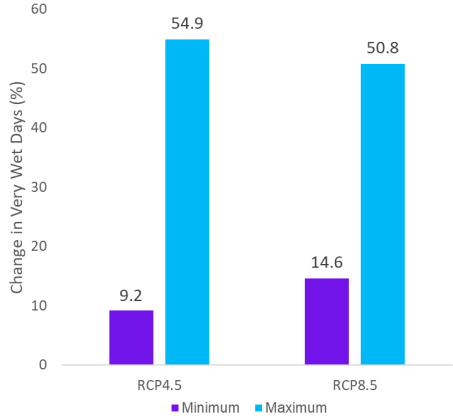
# Climate Projections for County Galway in 2050 (2/2)

Having identified and assessed the range of climate hazards and impacts already experienced by Galway 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 Galway County Council may be exacerbated. The information below summarizes the climate projections for each hazard based on Nolan and Flanagan (2020).

Hazard	Projected Change	Future Frequency
 Coastal Flooding	<ul style="list-style-type: none"> <li>Rising sea levels projections under a high emissions scenario indicate an increase of up to 0.24 m by 2050 which will <b>increase the frequency of coastal inundation</b> (bottom left).</li> </ul>	Frequent 
 Coastal Erosion	<ul style="list-style-type: none"> <li>A rising sea level is strongly linked with coastal erosion and <b>an increase in erosion rates and extent</b>.</li> </ul>	Frequent 
 Pluvial Flooding	<ul style="list-style-type: none"> <li>Projections indicate an <b>increase in the frequency of heavy rainfall days</b> (days with precipitation &gt;30mm) for County Galway with some areas projected to see increase of up to 55% (bottom right). This will likely result in an increased frequency of associated fluvial and pluvial flooding.</li> </ul>	Frequent 
 River Flooding	<ul style="list-style-type: none"> <li>Projections indicate an <b>increase in the frequency of heavy rainfall days</b> (days with precipitation &gt;30mm) for County Galway with some areas projected to see increase of up to 55% (bottom right). This will likely result in an increased frequency of associated fluvial and pluvial flooding.</li> </ul>	Frequent 
 Groundwater Flooding	<ul style="list-style-type: none"> <li>Projections of changes in groundwater flooding are currently not available, therefore there is <b>uncertainty in the change</b> in groundwater flooding frequency that can be expected.</li> </ul>	Occasional 



Projected **change in sea level** for a medium (RCP4.5) and high (RCP8.5) emissions scenario offshore of County Galway (Grid Reference: 53,-10) (Source: IPCC AR6 Sea-Level Rise Projections)



The projected minimum and maximum **change in very wet days (> 30 mm)** for the area of County Galway 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 Galway will also change in terms of its population and developments with implications for levels of exposure and vulnerability across the region. National, regional and local strategies that outlined expected and possible sociodemographic and infrastructure developments within County Galway 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 Galway projected to change?



- Population to increase from 179,390 in 2016 to **198,000 in 2028** (CDP)
- Galway Metropolitan Area **population to increase by 38%** between 2022 and 2028 (CDP)
- **10,738 new houses** required by 2028 (CDP)

**RPO 3.2b:** "(b) Deliver at least 40% of all new housing targeted in the Regional Growth Centres, within the existing built-up footprint."

**RPO 3.2c:** "Deliver 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."

## Planning for adaptation

### Flood Defence Schemes:

The Office of Public Works-Council projects include the Ballinasloe Flood Relief Scheme which aims to protect 309 properties (incl. 251 homes, 58 businesses)) from the River Suck.

### Key national road infrastructure projects include focus for council:

- N6 Galway City Ring Road
- N59 Oughterard to Maam Cross
- N59 Moycullen Bypass



### Notable renewable energy projects include:

- Approx. 30 X Sustainable Energy Community (SEC) (e.g. Aran Islands Energy Cooperative)
- Wind farms (e.g. SSE Galway Wind Park, produces renewable energy to power over 140k homes per annum)
- Solar farm at Ballymoneen (e.g. planned & conditionally approved)



## Planning for mitigation



## Case Study in Urban Planning: Tuam and Oranmore Projects

- **Tuam Regeneration Masterplan** (commissioned by the council in 2020) aims to: improve access, modernisation of the Market Square, develop the Station Quarter and an Arts Centre. The plan is part-funded under Project Ireland 2040 through the Rural Regeneration and Development Fund (RRDF).
- **Oranmore Railway Station** - the €9.28m. project aims to reduce the number of car journeys into the city, which will ultimately result in less traffic congestion and benefits to the environment. The project was funded by the Urban Regeneration and Development Fund (URDF) and also received match-funding from the Department of Transport.



# 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 categories of exposure, which are outlined below.

<p><b>Assets</b></p>	<ul style="list-style-type: none"> <li>• Due to the expected increase in County Galway’s population, there will be an <b>increase in the associated households and infrastructure</b> resulting in an increase in the number of assets exposed to hazard events</li> <li>• Due to the expected increase in the frequency of heatwaves, <b>road assets will be more regularly exposed to extreme temperatures</b> and <b>drought</b> conditions with the potential for increased damage to roads</li> <li>• Pluvial, river, and coastal flooding events that were once considered extreme, will become more frequent. This will <b>increase damage in the areas already exposed to these hazards</b> and also expose new areas and therefore assets that were previously unaffected</li> </ul>
<p><b>Health and Wellbeing</b></p>	<ul style="list-style-type: none"> <li>• Due to the expected increase in the elderly population in County Galway there will be a <b>greater number of vulnerable people who are more sensitive to hazards</b>, particularly heatwaves</li> <li>• 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 <b>people previously unaffected by flooding may become exposed</b>. This could impact on both physical and mental health and wellbeing</li> </ul>
<p><b>Environment</b></p>	<ul style="list-style-type: none"> <li>• The potential increasing occurrence of heatwaves and drought conditions within County Galway will mean <b>increased temperatures in water bodies and lower water levels</b> which can decrease water quality resulting in short and long term impacts on the environment</li> <li>• Due to the potential increased frequency of exposure to hazards in County Galway, there could be an <b>increase in the impact on environmental assets</b> as the time/ability for the habitat/environment to recover is reduced</li> <li>• 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 <b>environmental assets previously unaffected by flooding may become exposed</b>- resulting in short and long term damage to habitats/environment by these hazards</li> </ul>

# 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 categories of exposure, which are outlined below.

<p><b>Social</b></p>	<ul style="list-style-type: none"> <li>• Due to the expected increase in the total and elderly population in County Galway there will be an <b>increase in the number of people affected by social isolation during some hazard events</b></li> <li>• In response to heatwaves, there will be an increased use of blue/green spaces by the public <b>putting increased pressure on local amenities</b> e.g. littering, traffic problems</li> </ul>
<p><b>Cultural Heritage</b></p>	<ul style="list-style-type: none"> <li>• Due to the potential increase in frequency of heatwave and drought events, <b>degradation rates will potentially increase resulting in an increase in the impact on cultural heritage assets</b></li> <li>• Pluvial, river, and coastal flooding events that were once considered extreme, will become more frequent. Consequently, <b>cultural heritage assets will be more frequently exposed to flooding hazards</b>, and higher flood levels will mean cultural heritage assets previously unaffected by flooding may become exposed resulting in short and long term damage to cultural heritage assets by these hazards. .</li> </ul>
<p><b>Financial</b></p>	<ul style="list-style-type: none"> <li>• Due to the potential increase in frequency of hazard events and exposure across County Galway, there will be an <b>associated increase in the actions the local authority takes before, during, and after an event.</b></li> <li>• As a consequence, there will be an <b>increase in the costs associated with dealing with the events</b>, e.g. air conditioning, emergency service response, temporary and permanent flood defences, staff, training, and equipment purchase/maintenance</li> </ul>
<p><b>Reputational</b></p>	<ul style="list-style-type: none"> <li>• Due to the potential increase in frequency of hazard events and exposure across County Galway during an event there will be an <b>increase in demand/pressure on services/resources</b> potentially reducing the level of service delivery and harming the reputation of the local authority</li> <li>• For hazards which are existing long-term issues in County Galway, e.g. river flooding, if the response to the increased frequency and severity events is deemed insufficient by the public, this <b>may negatively impact on the reputation of the local authority</b></li> </ul>

# Future Impacts

Taking into account the changes in exposure and vulnerability, the future change in impacts for each of the ten 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	Moderate	<b>Major</b>	Minor	Moderate	Minor	Moderate	Negligible	Minor	Minor	Moderate	Minor	Moderate	Negligible	Minor
Drought	Minor	Moderate	Negligible	Minor	Moderate	<b>Major</b>	Minor	Moderate	Minor	Moderate	Negligible	Minor	Negligible	Minor
Cold spell	Moderate	Moderate	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Moderate	Moderate	Minor	Minor
Heavy snowfall	Moderate	Moderate	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Moderate	Moderate	Minor	Minor
Severe windstorm	Moderate	Moderate	Moderate	Moderate	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor
Coastal Flood	Moderate	<b>Major</b>	Moderate	<b>Major</b>	Minor	Moderate	Moderate	<b>Major</b>	Minor	Moderate	Minor	Moderate	Minor	Moderate
Coastal Erosion	Minor	Moderate	Negligible	Minor	Moderate	<b>Major</b>	Minor	Moderate	Moderate	<b>Major</b>	Minor	Moderate	Minor	Moderate
Pluvial Flood	Minor	Moderate	Minor	Moderate	Minor	Moderate	Minor	Moderate	Negligible	Minor	Minor	Moderate	Minor	Moderate
River Flood	Moderate	<b>Major</b>	Moderate	<b>Major</b>	Moderate	<b>Major</b>	Moderate	<b>Major</b>	Minor	Moderate	Minor	Moderate	Minor	Moderate
Groundwater Flood	Moderate	Moderate	Moderate	Moderate	Minor	Minor	Moderate	Moderate	Minor	Minor	Minor	Minor	Moderate	Moderate

# 3.3.3 Future Climate Risk Matrix

# Future Climate Risk Matrix

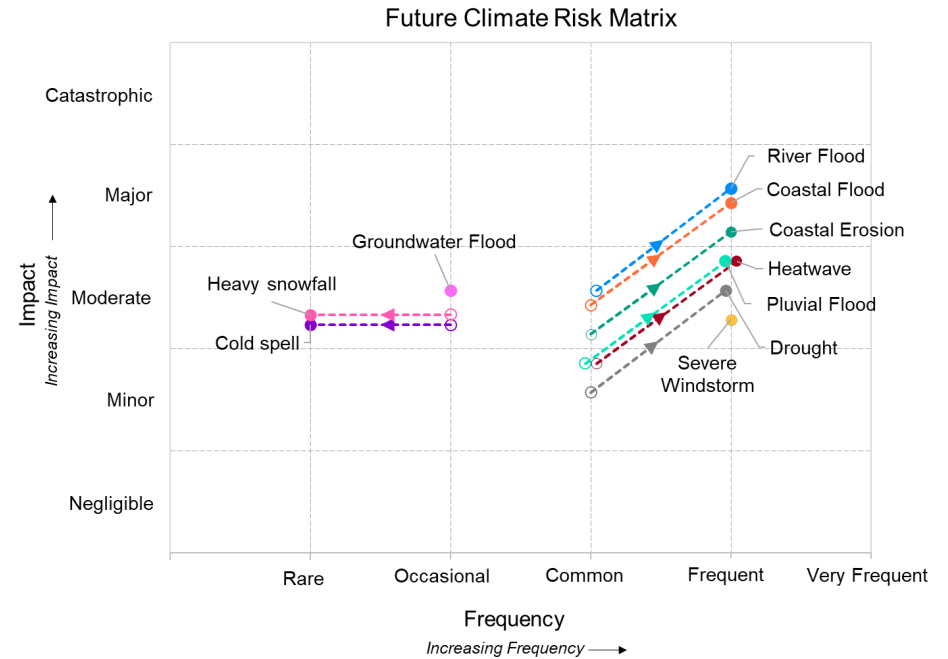
Projected changes in levels of hazard, exposure, and vulnerability for County Galway combine to form an assessment of future risks. The future climate risk matrix on the right shows projected change in risk with the hollow marker showing the current risk and the solid marker the future risk. The dotted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

The **risk** of existing hazards such as **river, pluvial, coastal flooding and erosion** is projected to **increase** in the future as a result of projected increases in the frequency of hazard events and also due to an increase in the areas, assets and populations exposed to these hazards.

**Droughts** and **heatwaves** although already experienced in County Galway, are expected to occur more frequently due to climate change and with a greater impact on County Galway in the future. The risk is exacerbated by not only projected changes in the frequency occurrence of drought and heatwaves but also as a result of projected increases in population and the proportion of population considered vulnerable (those aged 65 years and over). These hazards can therefore be considered as **emerging risks** for the region.

Although the frequency and impact of **severe windstorms and groundwater flooding** is thought to be **unchanged in the future**, these events will remain a risk for County Galway.

The impact of **heavy snowfall and cold spells** on County Galway remains constant, however, due to the potential decrease in hazard frequency, the overall risk of these hazards is projected 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 Galway. 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

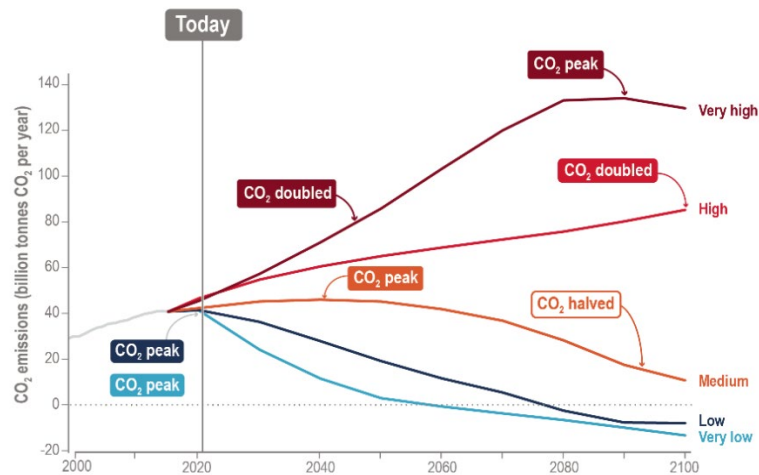
# Uncertainty

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.

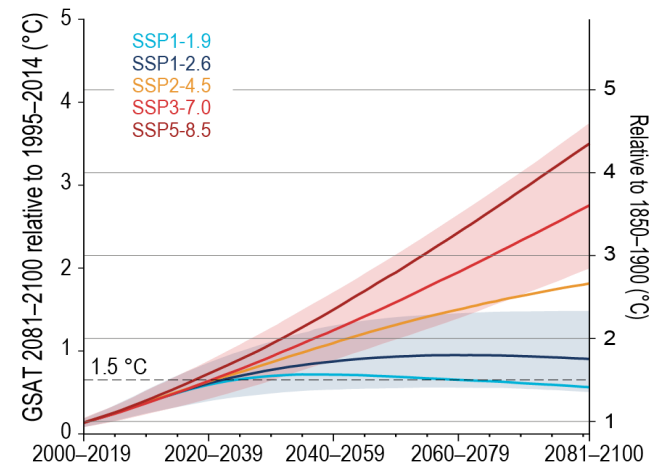
Different social and economic developments can lead to substantially different future emissions of carbon dioxide and other greenhouse gases (bottom left) resulting in uncertainty in what the future global climate will be. As an example of the possible future ranges in mean global surface temperature (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 Galway will develop into the future. Although, in the near-term there is relatively good understanding as a result of strategies, such as the Galway County Development Plan 2022-2028, 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<sub>2</sub> 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 and Recommendations

# Summary

This CCRA detailed within this report provides an assessment of Galway County’s climate change risks to support Galway 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, limitations and recommendations are summarised below:

## Key Results:

- 
  - Recent experiences of **river and pluvial flooding** events in 2015/16, 2017 and 2020, resulted in damages to buildings, disruption of transport networks (e.g. L4519 and L4506), and impacts on business and local economy. Projected increases in the frequency of extreme precipitation events will result in increased surface water and riverine flood risk for Galway County.
- 
  - **Coastal erosion and flooding pose a significant** risk for County Galway and have resulted in temporary inundation of buildings (e.g. homes in Cave), damages to coastal habitats and heritage sites (e.g. 17th century church in Aughinish), and disruption of transport networks (e.g. N59). Rising sea levels will increase the frequency of coastal inundation and rate of coastal erosion, resulting in an increased coastal flood and erosion risk for County Galway.
- 
  - County Galway experienced both a **heatwave and drought** in 2018 and 2022, with heatwaves also recorded in 2021. These events resulted in damage to road surfaces (e.g. Connemara), increased demand placed on water resources, and increased frequency of uncontrolled fire (e.g. Curraghline). Projected increases in the frequency of heatwaves and drought conditions will mean that events currently experienced on an infrequent basis will become more frequent.
- 
  - **Severe windstorms** are currently experienced on a frequent basis in County Galway and result in wide-ranging impacts, including disruption to energy supply and transport networks (e.g. N59). Projections indicate no significant change to this frequency.
- 
  - **Groundwater flooding** is currently experienced on an occasional basis in County Galway and result in significant impacts including disruption of transport, submergence of agricultural lands for extended periods and detrimental impacts on water quality. Projections indicate no change to this frequency.
- 
  - Recent experiences of **cold spells and heavy snowfall** events in 2018 (e.g. Storm Emma) demonstrated the wide range of impacts of these events for County Galway. These included, amongst others, road closures (e.g. N17 and R332), an increase in the frequency of trips and falls, disruption to public transport, power outages, impacts on water resources, and closure of business with impacts on the local economy. 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.

## Limitations and Key Recommendations:

- This report has been developed on the basis of the most-up-to-date climate projection data available for Ireland at the time of writing. This data focuses on changes in average climatic conditions for a high emissions scenario (RCP8.5). Where risks have been identified as part of this initial qualitative CCRA, further more detailed assessment should be undertaken as part of semi-quantitative and/or quantitative site specific CCRAs which employ the full range of projected changes in climate parameters (including extremes) and more up-to-date climate projection information where available.
- This report focuses on the direct risks posed by climate change for County Galway and the implications of these for Galway County Council. It is important to note that climate change will also pose indirect risks for County Galway as a result of changes in climate conditions at international and global scales. These include amongst others forced migration of populations, increase in vector-borne disease and disruption of supply chains.



04

# Appendices





# 4.1

# 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 of 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

# 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/m<sup>2</sup> and 6.0 W/m<sup>2</sup> after 2100 (the corresponding ECPs assuming constant concentrations after 2150)

**RCP8.5** One high pathway for which radiative forcing reaches >8.5 W/m<sup>2</sup> 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

# 4.2

# Appendix 2

# Service Area Descriptions

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



# 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

# Description of the levels of impact due to disruption of Local Authority Services (Source: Technical Annex B: Climate Change 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

# Characterisation of the magnitude of impact across various risk areas (Source: Technical Annex B: Climate Change Risk Assessment)

Risk Area	Negligible (Score; 1)	Minor (Score: 2)	Moderate (Score: 3)	Major (Score: 4)	Catastrophic (Score:5)
<b>Asset Damage</b>	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
<b>Health and Wellbeing</b>	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
<b>Environment</b>	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
<b>Social</b>	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
<b>Financial (for single extreme event or annual average impact)</b>	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
<b>Reputation</b>	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
<b>Cultural Heritage</b>	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

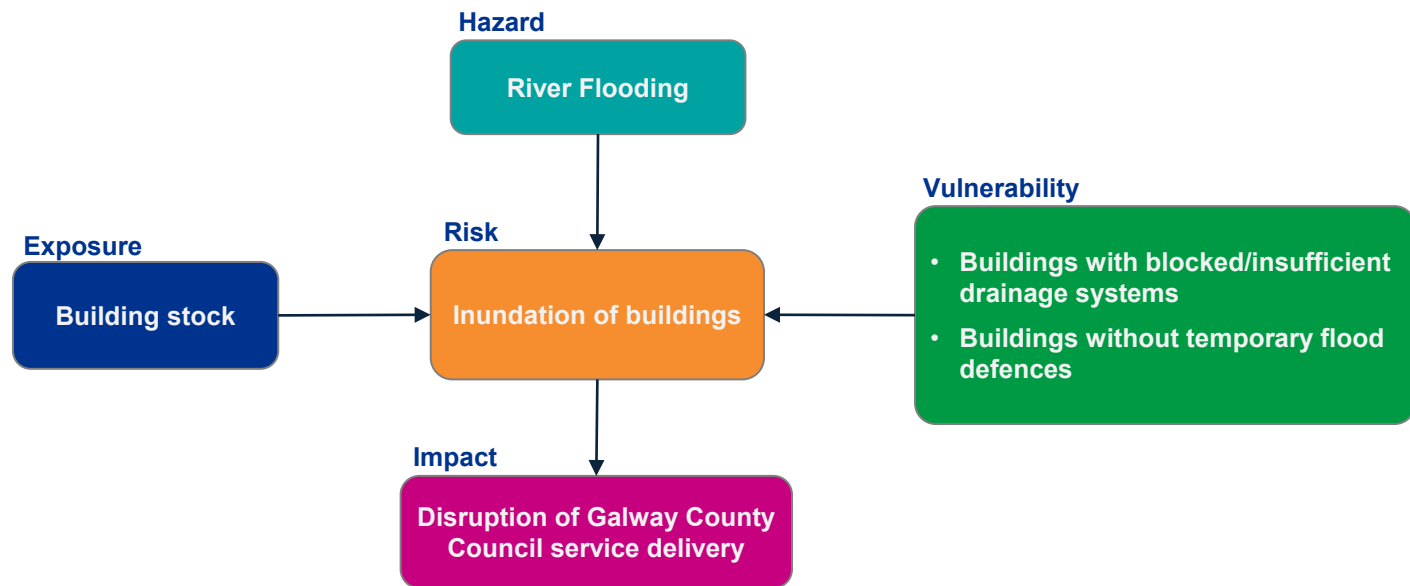
# 4.3

# Appendix 3

# Characterising Exposure, Vulnerability and Impacts of Climate Hazards

For County Galway 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 Galway County Council buildings. The buildings with insufficient drainage and with no temporary flood defences would be considered more vulnerable to this hazard. Consequently, if Galway County Council buildings were to be flooded, one of the possible impacts would be the disruption of Galway 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.

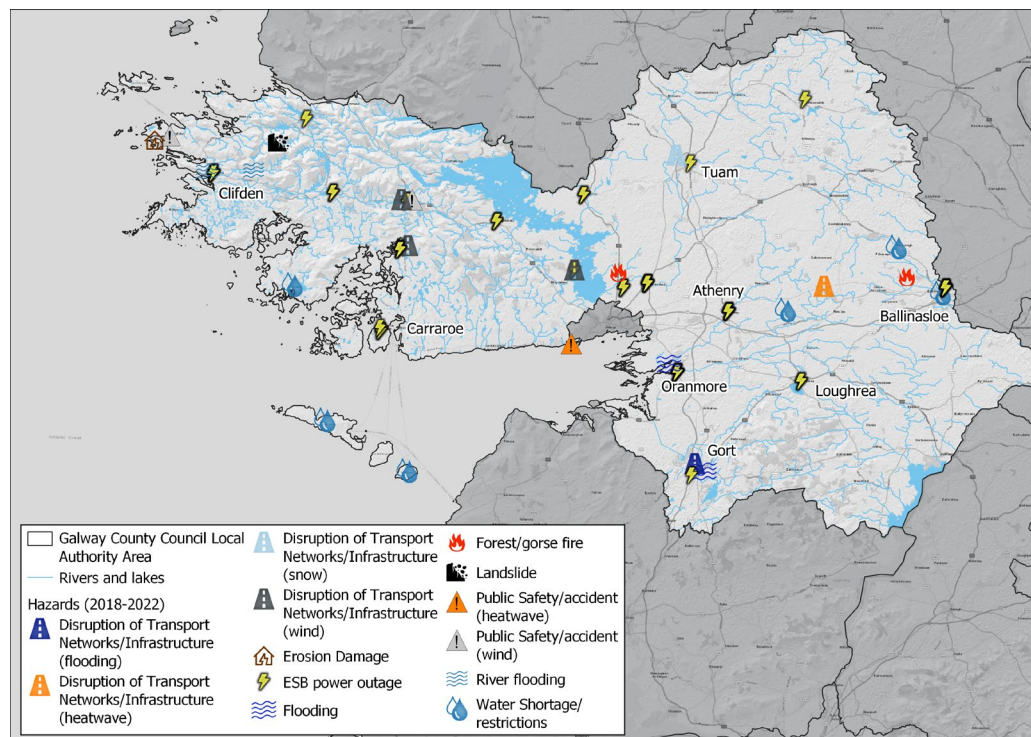
The following pages summarise the exposures, vulnerabilities and impacts for the hazards that exist within the County Galway region.



# Exposure, Vulnerability and Impacts of Climate Hazards

Employing and integrating information derived a wide range of sources, we have characterised the exposures, vulnerabilities, and impacts of the climate and weather-related hazards for County Galway. Below and to the right we provide an example of exposures and impacts of hazard events experienced between 2018 and 2022.

- **Storm Barra in December 2021** caused power outages for over 1,000 homes in Clifden, 182 homes around Screeb, and almost 500 homes in Carraroe.
- **Storm Dennis in February 2020** caused power outages for over 2,700 homes in Athenry, 900 homes around Gort, and 460 homes in Creagh, among other areas.
- **Heavy snowfall in February 2021** led to treacherous conditions around Tuam on the N17 and R332, and the loss of power to approximately 2,000 homes in the Tuam area.
- Heavy rainfall caused **the Owenglin river to burst its banks in September 2020**, necessitating the evacuation of 17 properties and a holiday village in Clifden and forcing the closure of local schools.
- **Groundwater flooding in winter 2015/2016** inundated over 25km<sup>2</sup> of farmland in the Gort area for 6 months, blocking roads and requiring detours. Pollutant plumes discharged from flooded farm sheds into groundwater floodwater plains and associated SACs. The Gort area has been subject to repeated flooding, including in **February 2020**.
- In July 2018, **high temperatures led to a significant wildfire** in a Coillte forest near Killure in East Galway and smouldered for more than 6 weeks over an area of approximately 15 acres, putting the homes of local residents at risk.





# Impacts of climate hazards (1/5)

The table below shows the key impacts and exposures associated with each climate and weather-related hazard. These hazards impacts both the public and the service delivery of Galway County Council. 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	<ul style="list-style-type: none"> <li>Hot and uncomfortable working/living conditions</li> <li>Increased demand on recreational areas</li> <li>Damage to road surface and hazardous driving conditions.</li> <li>Disruption of public transport networks</li> <li>Heat stress for animals and livestock resulting in the adoption of unsustainable mitigation measures</li> <li>Increased frequency of beach/swimming area closures</li> <li>Increased demand on available water resources, leading to increasing pressure to share resources.</li> <li>Detrimental impacts on freshwater quality and fish populations</li> <li>Disruption of recreational activities</li> <li>Increase in the frequency of uncontrolled fire</li> <li>Increased strain on natural biodiversity</li> </ul>	<ul style="list-style-type: none"> <li>Housing, buildings, care home/leisure centres/recreational facilities, outdoor workers (with limited access to water, shade and sunscreen)</li> <li>Beaches, Parks (with easy access to urban areas)</li> <li>Local roads (located in areas of high solar radiation)</li> <li>Public/staff (communities with limited transports network)</li> <li>Livestock (farms with limited watering infrastructure, with lack of shade)</li> <li>Beaches/Swimming areas (highly utilised beaches)</li> <li>Reservoirs/Lakes (Lakes already depleted/under stress)</li> <li>Fish populations (in sites with poor/eutrophic water quality)</li> <li>Recreational Areas (situated in areas of high solar radiation)</li> <li>European/Irish designated sites (SPAs, SACs, Ramsar sites, NHAs)</li> <li>Emergency response services (areas of growing vegetation)</li> </ul>
Drought	<ul style="list-style-type: none"> <li>Decreased grass growth and increased supplementary feed requirements for cattle</li> <li>Increased demand on available water resources, leading to increasing pressure to share resources</li> <li>Reduced river flow</li> <li>Increased degradation rates</li> </ul>	<ul style="list-style-type: none"> <li>Livestock (in marginal areas of production)</li> <li>Reservoirs/lakes/groundwater supplies (already depleted/under stress)</li> <li>Biodiversity (water bodies, areas with diverse wildlife populations)</li> <li>Cultural Heritage (wooden/decomposable material based assets)</li> </ul>

# Impacts of climate hazards (2/5)

The table below shows the key impacts and exposures associated with each climate and weather-related hazard. These hazards impacts both the public and the service delivery of Galway County Council. 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)
<b>Cold Spell</b>	<ul style="list-style-type: none"> <li>• Extreme cold results in increased requirement for heating and associated economic costs.</li> <li>• Cold conditions result in increased damage to vehicles</li> <li>• Disruption to road networks, including increases in costs associated with gritting fuel and overtime.</li> <li>• Disruption to public transport networks</li> <li>• Cold conditions leading to damage of road surfaces (i.e., freeze thaw)</li> <li>• Increase in the frequency of trips and falls.</li> <li>• Reduction in agricultural production</li> <li>• Difficulties in accessing land</li> <li>• Freeze thaw damage to critical infrastructure</li> <li>• Impacts on water resources</li> <li>• Increases in cold-related mortality and morbidity</li> <li>• Delay of infrastructure/development projects</li> <li>• Increased strain on natural biodiversity</li> <li>• Damage and disruption of electricity supply</li> <li>• Damage to built heritage</li> </ul>	<ul style="list-style-type: none"> <li>• Buildings (poorly insulated, with elderly residents, in isolated locations)</li> <li>• Public/private transport vehicles (exposed vehicles)</li> <li>• Transport network (road and rail) (untreated road surfaces, near isolated communities)</li> <li>• Public/staff (elderly populations, people with pre-existing conditions)</li> <li>• Crops, livestock (cold-sensitive crops, areas with low solar radiation)</li> <li>• Land (marginal farms, areas of low solar radiation)</li> <li>• Water infrastructure/pipes (older pipes, in areas of freezing soil conditions)</li> <li>• Water resources (waterbodies in lower altitudes)</li> <li>• People at high risk of exposure to cold (people in uninsulated buildings, vulnerable communities)</li> <li>• Development projects (ongoing construction with loose materials)</li> <li>• European/Irish designated sites (SPAs, SACs, Ramsar sites, NHAs)</li> <li>• Homes/Businesses/Local Govt Office (without on-site electricity generation)</li> <li>• Built heritage sites (structures which are more vulnerable to freeze-thaw action)</li> </ul>
<b>Heavy Snowfall</b>	<ul style="list-style-type: none"> <li>• Damage to buildings</li> <li>• Disruption of transport network and isolation of communities</li> <li>• Impact on business and local economy</li> <li>• Freezing conditions impacting on livestock</li> <li>• Snow melt resulting in increased risk of flooding</li> <li>• Disruption to energy/electricity supply</li> <li>• Runoff from snow melt impacting on environmentally sensitive areas</li> </ul>	<ul style="list-style-type: none"> <li>• Buildings (vacant/flat roof properties, higher elevation, with elderly residents), offices (incl. LA) (single story/flat roof, higher elevation, impervious surfaces)</li> <li>• Local Authority Offices</li> <li>• Public/Staff (communities with limited access, elderly and young populations)</li> <li>• Agricultural sites (livestock unprotected) (farms at higher elevations, marginal farms)</li> <li>• Energy (energy infrastructure in need of maintenance, older infrastructure)</li> <li>• Employers, Employees, Customers, Students (business in low-lying areas, lacking remote work/study options, etc.)</li> <li>• Natural Resources/Sensitive materials (Env. Sensitive areas, networks with polluting vehicles, near waterbodies)</li> <li>• Areas prone to flooding(areas prone to pooling of water, inadequate drainage)</li> <li>• Transport networks (in terrain with a with higher propensity of snow drifts, isolated roads)</li> </ul>

# Impacts of climate hazards (3/5)

The table below shows the key impacts and exposures associated with each climate and weather-related hazard. These hazards impacts both the public and the service delivery of Galway County Council. 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)
<b>Severe Windstorm</b>	<ul style="list-style-type: none"> <li>• Direct wind damage to buildings and infrastructure.</li> <li>• Disruption of communications infrastructure.</li> <li>• Wind damage to trees resulting in tree fall</li> <li>• Wind damage to habitats and sensitive species</li> <li>• Disruption of wind energy generation</li> <li>• Disruption to energy supply</li> <li>• Accessibility of islands communities</li> <li>• Disruption of transport networks.</li> <li>• Closure of parks and public buildings</li> <li>• Disruption to waste collection</li> <li>• Disruption to water quality monitoring</li> <li>• Treacherous conditions at coast and on land</li> <li>• Impact on national monuments and archaeological sites</li> </ul>	<ul style="list-style-type: none"> <li>• Buildings, development sites (buildings with rooftop equip., vulnerable populations, high-rise structures)</li> <li>• Overhead communication lines (situated in upland and exposed sites)</li> <li>• Trees (Forestry situated in upland and /or exposed areas)</li> <li>• Habitats and sensitive species (which are already under stress)</li> <li>• Wind turbines (turbines with lower shut-down thresholds for high winds)</li> <li>• Power supply (infrastructure in exposed locations, vulnerable populations, isolated communities)</li> <li>• Island communities (in exposed locations)</li> <li>• Road and Rail Network (in exposed locations)</li> <li>• Airports, Parks, public buildings (populations requiring essential council services, buildings in exposed locations)</li> <li>• Waste collection routes (terrain with a with higher propensity of snow drifts)</li> <li>• Waterbodies (exposed waterbodies and waterbodies in need of water quality monitoring)</li> <li>• Coastal and Uplands areas (areas in exposed locations)</li> <li>• National Monuments and Archaeological Sites (which are in exposed coastal locations)</li> </ul>
<b>Groundwater Flood</b>	<ul style="list-style-type: none"> <li>• Direct rain and surface water damage to buildings and infrastructure</li> <li>• Damage to amenities and recreational areas.</li> <li>• Physical and health danger to individuals.</li> <li>• Disruption of transport networks/infrastructure</li> <li>• Impact on business and local economy</li> <li>• Farmland inundation</li> </ul>	<ul style="list-style-type: none"> <li>• Buildings, Local Authority Offices, Heritage Sites (with blocked drainage, located on floodplains, vulnerable residents)</li> <li>• Recreational Amenities (low-lying parks, located near water bodies, parks and amenities in need of investment)</li> <li>• People (impact on mental health of local communities as a result of closure of river banks and parks which lack man-made/natural drainage- especially ones located near sources of debris)</li> <li>• National Road (Situated in areas with history of groundwater flooding)</li> <li>• Employers, Employees, Customers, Students (located in at-risk areas, lack of access to early warning systems).</li> <li>• Turloughs (Environmentally sensitive areas - terrestrial and aquatic)</li> </ul>

# Impacts of climate hazards (4/5)

The table below shows the key impacts and exposures associated with each climate and weather-related hazard. These hazards impacts both the public and the service delivery of Galway County Council. 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)
<b>Coastal Flood</b>	<ul style="list-style-type: none"> <li>• Temporary inundation of buildings</li> <li>• Deterioration of transport infrastructure</li> <li>• Closure/submergence of transport routes and impact on commuting, accessibility and travellers.</li> <li>• Flooding of agricultural areas.</li> <li>• Treacherous conditions at coast and on land</li> <li>• Damage to recreational amenities and facilities provided by the council.</li> <li>• Damage to coastal habitat</li> <li>• Accessibility of islands communities</li> <li>• Damage to critical water supply infrastructure</li> <li>• Damage to wastewater infrastructure.</li> </ul>	<ul style="list-style-type: none"> <li>• Housing Buildings (located in low lying coastal areas), Heritage Sites (sites in poor condition)</li> <li>• Coastal roads and rail infrastructure (roads, bridges and infrastructure not designed to withstand corrosive salt-water)</li> <li>• Agricultural areas (farms on a marginal income)</li> <li>• Coastal areas (coastal low-lying amenity areas exposed to storms)</li> <li>• Footpaths, Parks and recreational amenities (amenities situated in coastal areas)</li> <li>• Coastal Habitat (sites exposed to coastal storms)</li> <li>• Island Transport infrastructure (habitable island areas without safe harbours)</li> <li>• Water infrastructure/Pipes (Coastal flooding can cause corrosion to water supply infrastructure)</li> <li>• Wastewater Treatment Plants (areas served by Irish Water and Co Co.)</li> </ul>
<b>Coastal Erosion</b>	<ul style="list-style-type: none"> <li>• Deterioration of transport and subterranean infrastructure</li> <li>• Disruption and loss of transport infrastructure</li> <li>• Erosion of agricultural areas</li> <li>• Damage to recreational amenities</li> <li>• Damage to coastal habitat</li> <li>• Damage to heritage sites</li> </ul>	<ul style="list-style-type: none"> <li>• Coastal roads and rail infrastructure (roads used for commuting purposes and by isolated communities and students).</li> <li>• Public/Staff (located in low-lying areas, near water bodies, limited surrounding drainage and low-quality signage)</li> <li>• Agricultural Areas (farms on marginal income)</li> <li>• Recreational amenities (low-lying parks and other amenities, located near water bodies such as lakes and rivers)</li> <li>• Coastal Habitat (sites exposed to existing coastal erosion)</li> <li>• Heritage Sites (environmentally sensitive areas)</li> </ul>

# Impacts of climate hazards (5/5)

The table below shows the key impacts and exposures associated with each climate and weather-related hazard. These hazards impacts both the public and the service delivery of Galway County Council. 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)
<b>Pluvial Flood</b>	<ul style="list-style-type: none"> <li>• Direct rain and surface water damage to buildings and infrastructure</li> <li>• Damage to amenities and recreational areas</li> <li>• Pluvial debris</li> <li>• Disruption to transport networks/infrastructure</li> <li>• Disruption to public transport networks.</li> <li>• Surface water (run-off) pollutants.</li> <li>• Impact on business and local economy.</li> </ul>	<ul style="list-style-type: none"> <li>• Buildings, Local Authority Offices, Heritage Sites (blocked drainage systems, high levels of impervious surfaces, etc)</li> <li>• Recreational Amenities (low-lying parks and other amenities, located near water bodies such as lakes and rivers)</li> <li>• People (areas where there is a lot of un-reinforced waste management systems containing potential debris )</li> <li>• Stormwater Infrastructure (riversides and parks with reduced - especially ones located near sources of debris)</li> <li>• Road/Railways (low-lying roads with no alternative access routes and which allows for the pooling of water)</li> <li>• Public/ Staff (located in low-lying areas, near water bodies, limited surrounding drainage and low-quality signage)</li> <li>• Natural Resources/Sensitive materials (Enviro. sensitive areas, heavily fertilised agric. land close to water bodies)</li> <li>• Employers, Employees, Customers, Students (business in low-lying areas, lacking remote work/study options, etc.)</li> <li>• Wastewater Treatment Infrastructure</li> </ul>
<b>River Flood</b>	<ul style="list-style-type: none"> <li>• Flood damage to buildings and infrastructure.</li> <li>• Damage to amenities and recreational areas.</li> <li>• Disruption of transport networks/infrastructure.</li> <li>• Fluvial debris</li> <li>• Surface water (run-off) pollutants.</li> <li>• Impact on business and local economy.</li> <li>• Damage/degradation to automobiles and public transport.</li> <li>• Potential bridge failure</li> <li>• Inundation of farmland</li> </ul>	<ul style="list-style-type: none"> <li>• Buildings, Local Authority Offices, Heritage Sites (blocked drainage, loc. on floodplains, vulnerable residents)</li> <li>• Recreational Amenities (low-lying parks, located near water bodies, parks and amenities in need of investment)</li> <li>• People (located near river backs and parks which lack man-made/natural drainage- especially ones located near sources of debris), Stormwater Infrastructure</li> <li>• Road/Railways (low lying roads/railways, located near water bodies, limited drainage)</li> <li>• Public/ Staff (located in low-lying areas, near water bodies, limited surrounding drainage and low-quality signage)</li> <li>• Natural Resources/Sensitive materials (Env. Sensitive areas, networks with polluting vehicles, near waterbodies)</li> <li>• Employers, Employees, Customers, Students (located in at-risk areas, lack of access to early warning systems).</li> <li>• Council Fleets, Public Transport, Private vehicles (underground/low-lying carpark, fleets sensitive to submergence)</li> <li>• Bridges (older bridges, bridges in need of investment and maintenance)</li> <li>• Farmland situated on riverbanks (economically marginalised farmers, rivers susceptible to soil bank erosion, etc)</li> </ul>



The information contained herein is of a general nature and is not intended to address the circumstances of any particular individual or entity. Although we endeavour to provide accurate and timely information, there can be no guarantee that such information is accurate as of the date it is received or that it will continue to be accurate in the future. No one should act on such information without appropriate professional advice after a thorough examination of the particular situation.

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