CARLOW
COUNTY COUNCIL

Climate Change Adaptation Strategy 2019-2024

Acknowledgements

Foreword

Executive Summary

Adapting to climate change is a key challenge facing Governments and societies across the world. It is now clear that, even if the climate change mitigation measures undertaken to date are successful, climate change will not stop over the coming decades or possibly centuries. Adapting to its impacts is necessary to reduce vulnerability across all sectors of society and the natural environment.

For the first time, Carlow County Council have developed a Climate Change Adaptation Strategy as a collaborative response to the impact that climate change is having, and will continue to have, on the County of Carlow and its citizens.

This Climate Change Adaptation Strategy features a range of actions across nine key thematic areas - Local Adaptation Governance and Business Operations, Mobility, Community Health & Wellbeing, Infrastructure Built Environment & Landuse Development, Clean Energy, Economic Development, Natural Resources & Cultural Infrastructure, Water and Resource Management- that collectively address Carlow County Council's vision of fulfilling a leadership role in learning about and responding to the impacts of climate change, fully engaging with the risks and opportunities of a changing climate and building a resilient future for and together with, the communities of County Carlow.

In order for Carlow County Council to achieve its goal in reducing the negative impacts of climate change, this Climate Change Adaptation Strategy sets out the current climate change impacts which affect the internal departments of Carlow County Council through the development of adaptation baselines. It also examines the future impacts that climate change may have on these departments and then sets out a first iteration of actions that will be used to reduce the source and effects of these impacts.

The adaptation baseline has identified that the effects of climate change are already impacting Carlow County Council at a significant rate and are very likely to increase in their frequency and intensity.

With climate projections showing an increase in rainfall for winter, a decrease in rainfall for summer combined with an overall seasonal increase in average annual temperatures clearly highlight the need to reduce the impacts that climate change is having on the environment, the economy and the citizens Co. Carlow.

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1. Introduction

The phenomena of climate change has now become a forefront topic within the agenda of Local Authorities. Climate change refers to the significant change in climate measures, such as temperature, rainfall or wind, lasting for a long period of time. These changes in our climate can be caused by natural factors within the earth like volcanic eruptions and intensified solar activity. However, past scientific research has proven that the buildup of greenhouse gases (GHGs) in the atmosphere has predominately been caused by human activity. The build-up of these greenhouse gases are often caused by excessive emissions produced by activities carried out within sectors such as Transport, Energy, Waste and Agriculture. In a nutshell, these GHG's allow the sun to venture through the atmosphere in order to reach the earth, but then trap the outward energy from the heated surface of the earth like a blanket, and as a result of this, a warming effect is then present within the global atmosphere. 2017 witnessed a human-induced warming of approx 1° C above pre-industrial levels showing an increase of 0.2° C per decade (IPCC, 2018). As a result of reaching this consequential mark, January of 2018 saw the development and publication of Ireland's first statutory National Adaptation Framework (NAF). The NAF was developed to maintain and build on previous works carried out under the National Climate Change Adaptation Framework published in 2012. The NAF is a national strategy which aims to reduce the vulnerability of the country to the negative effects caused by climate change and to benefit from the positive impacts (National Adaptation Framework, 2018). Under the regulations set down in this publication, each Local Authority in Ireland is obliged to develop an individual Local Climate Change Adaptation Strategy as there is no uniform impact regime or adaptation response that can be managed centrally, and therefore, local understanding of, and sensitivity to change is key to getting adaptation right (Grey and O'Dwyer, 2018). This Climate Change Adaptation Strategy is the start of the process of adaptation planning in Carlow County Council and is the first step in increasing knowledge and understanding of our changing climate, growing resilience, and enabling effective responses to the threats posed by climate change.

In 2018, Carlow County Council selected a Climate Action Team. This team consists of senior management and staff members from Carlow County Council who will act as key personnel taking account of climate change and its impacts upon different sectoral departments of the Council. In response to this task Carlow County Council's Climate Action Team developed this Climate Change Adaption Strategy.

Carlow County Councils Adaptation Strategy forms part of the National Adaptation Framework (NAF) which was given statutory authority by the provisions of the Climate Action and Low Carbon Development Act 2015.

As the level of government closest to local communities and enterprise and as first responders in many emergencies, we here in Carlow County Council are uniquely placed to effect real positive change with respect to delivery of the national transition objective to low carbon and a climate resilience future.

The local authority adaptation strategy takes on the role as the primary instrument at local level to:

(i) Ensure a proper comprehension of the key risks and vulnerabilities of climate change

(ii) Bring forward the implementation of climate resilient actions in a planned and proactive manner

(iii) Ensure that climate adaptation considerations are mainstreamed into all plans and policies and integrated into all operations and functions of the local authority

This adaptation strategy serves Carlow County Council in its two capacities namely:

(i) As a business organisation or entity with an obligation towards customer service, a focus on effectiveness in business, improving efficiencies and maintaining staff welfare

(ii) In the delivery of services and functions across the administrative and geographical area of County Carlow

In accordance with the provisions of the Climate Action and Low Carbon Development Act 2015 this adaptation strategy is required to be adopted by members of Carlow County Council before the 30th September 2019.

1.1 The Challenge of Climate Change

Climate is described as the average weather prevailing in an area over a period of time. *Climate Change* is a significant change in weather patterns such as rainfall, temperature, and / or wind, which continue over an extended period of time (i.e. over decades or longer). The Earth's climate is constantly changing. Climatic fluctuations are known to occur from natural causes including the Earth's orbit and tilt, volcanic eruptions, variations in solar energy and other phenomena such as the El Nino effect[1]. However, in more recent times, there are growing concerns that natural fluctuations in climate are being overtaken by rapid human-related activities which are negatively influencing climate variability and giving rise to serious implications for the rate of global warming. Scientific evidence for warming of the climate system is unequivocal. According to the Intergovernmental Panel on Climate Change (IPCC) [2] warming of the climate system is attributable to human activities as a consequence of greenhouse gas emissions[3] from:

- Burning of fossil fuels such as oil, gas, peat, and coal resulting in carbon dioxide emissions,
- Agricultural activities that lead to methane and nitrous oxide emissions,
- Emissions from changes in land use such as urbanization, deforestation, reforestation and desertification.

Emissions from these activities are proven to impact the atmosphere by trapping the suns radiation and reflecting back to the earth giving rise to global warming. The term greenhouse effect has been coined to describe this occurrence. The effects of global warming are observed through reductions in snow and ice in polar regions, increase in global mean surface temperatures, rise in sea levels and changes in some climate extremes i.e. weather events. Scientists state these changes are occurring rapidly, are considerable, and will have consequences for this and future generations. Some impacts of global warming such as sea level rise and coastal flooding are already locked in and unavoidable.

[1] El Nino is a climate cycle in the Pacific Ocean with a global impact on weather patterns.
[2] The IPCC was created in 1988. One of its key objectives is to provide governments at all levels with scientific information that they can use to develop climate policies. IPCC reports are a key input into international climate change negotiations.
[3] Greenhouse Gases include: water vapour, carbon dioxide (CO2), methane CH4), nitrous oxide (N20) and industrial gasses: Hydrofuorocarbons HFCs), Perfluorocarbons (PFCs), Sulphur Hexaflouride (SF6), and Nitrogen Triflourise (NF3). Carbon Dioxide emissions in the atmosphere are the main greenhouse gas caused by human activity

The full impacts of current warming have not yet been seen, since ice sheets and oceans take many decades to fully react to higher temperatures.

Climate change is one of the most pressing global policy challenges facing governments needing immediate commitment to action.

1.2. The challenge for Ireland

There is evidence that Irelands climate is changing in line with global trends of climate change. Over the last few decades our climate has warmed, sea-levels have risen, rainfall patterns have changed, and we have been impacted by frequent, intense and more extreme weather events. Temperatures have increased by 0.8^0C since 1900 and sea level rises of about 3.5cm per decade have been observed since 1990. Climate change has diverse and wide-ranging impacts on Ireland's economic and natural resources including:

- More intense storms and rainfall events giving rise to disruption to society
- Increased river and coastal flooding
- Water shortages in summer
- Increased risk of new pests and diseases
- Adverse impacts on water quality
- Changes in the distribution and phenology of plant and animal species on land and in the oceans[4]

The impacts of climate change are felt more acutely at the local level. Nationally, climate projections for the next century indicate that the climate trends observed over the last century will continue and intensify over the coming decades i.e.:

- Increase in average temperatures across all seasons. Heat waves are expected to occur more frequently.

[4] EPA Research, A summary of the state of knowledge on Climate Change Impacts for Ireland, Report No. 223, 2014.

- Significant reductions are expected in average levels of spring and summer rainfall with a substantial increase in the frequency of heavy precipitation events in Winter and Autumn

- Decrease in wind speed and an increase in extreme wind speeds. The number of very intense storms is projected to increase over the North Atlantic region.

- Sea levels will continue to rise for all coastal areas. The south of Ireland will likely feel the impacts of these rises first. Sea surface temperatures are projected to continue warming for the coming decade.

This local authority adaptation strategy is set against the background of increasing risks associated with climate change and seeks to reduce and manage these risks at local level through a combination of mitigation and adaptation responses.

All local authorities including Carlow County Council provide a wide range of services, many of which are already and will increasingly be affected by climate change. It is most likely that we will continue to play a critical role in responding to the impacts of extreme weather events and other impacts that are likely to emerge over the coming decades through various implementation tools available as a local authority[5].

[5] Including: Spatial Planning, development consent, asset management and natural resource protection.

1.3. Methadology

Initiate
- Develop a climate action steering group
- Schedule internal adaptation team meetings
- Agree the scope of the plan

Research
- Research scientific resources i.e. Climateireland.ie, County Devlp Plan, Engineer Reports
- Legislative policy engagement
- Identify positive and negative impacts of climate change

Plan
- Agree on vision and targets for the plan
- Develop a baseline for the plan
- Develop a climate change risk assessment for the plan
- Develop actions and measures
- Engage with public community on guidelines to achieve best practice (Public Consultation)
- Undergo environmental assessments (AA/SEA)

Implement
- Integration of plan into council operations
- Introduction of action plan into other council documents

Report
- Set dates for regular and annual monitoring and reviews to observe the plans progression
- Report all findings back to climate action steering group and internal staff of Carlow County Council
- Review and update plan every 5 years and develop a new plan every 10 years

2. Policy and Adaptation

2.1 Adaptation Policy and Legislation

This Local Authority Climate Change Adaptation strategy is set within a policy framework at International, European and National level.

International:

The United Nations Framework Convention on Climate Change (UNFCCC) is an international environmental treaty adopted in May 1992. The frameworks objective is "to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system." The framework set non-binding limits on greenhouse gas emissions and contained no enforcement mechanisms. However, the framework outlined how specific international treaties may negotiate further action towards its key objective. **The Paris Agreement 2015** is a protocol set within the context of the UNFCC (ratified by Ireland on 4th November 2016) and it is aimed at:

- limiting global warming to less than 2^0C above pre-industrial level and pursue efforts to limit the temperature increase to 1.5^0C
- Increasing the ability to impact of climate change and foster climate resilience

The agreement states the need for Parties to formulate and implement National Adaption Plans.

EU

The 2013 EU Strategy on Adaptation to Climate Change encouraged all Member states to adopt comprehensive adaptation strategies. It sought for better informed decision making through the identification and addressing of gaps in knowledge about adaptation. The European Climate Adaptation Platform, Climate-ADAPT, was developed as a resource mechanism to help users' access and share information on adaptation.

The Global Covenant of Mayors for Climate and Energy is a voluntary, bottom up, approach for cities and local governments to combat Climate Change and move towards a low emission, resilient society. The Global Covenant of Mayors for Climate and Energy brought the Compact of Mayors and the EU Covenant of Mayors under one international body in January 2017 incorporating over 9,000 cities and local governments. Carlow County Council is working towards becoming a party to the Covenant of Mayors.

National Context

The 2012 National Climate Change Adaptation Framework (NCCAF) was Ireland's first step in developing a national policy on adaptation actions to combat the impacts of climate change.

The National Policy Position on Climate Action and Low Carbon Development 2014 restated the policy position of the NCCAF, 2012. Greenhouse gas mitigation and adaption to the impacts of climate change were to be addressed in parallel national plans under an evolving climate policy to 2050.

The Climate Action and Low Carbon Development Act 2015 was a landmark national milestone in the evolution of climate change policy in Ireland. It provides the statutory basis for the national transition objective laid out in the National Policy Position (as per above). Further to this, it made provision for and gave statutory authority to both the **National Mitigation Plan** (NMP), published in 2017 and the **National Adaptation Framework** (NAF) published in 2018. This Local adaptation Strategy forms part of the National Adaptation Framework.

The Local Authority Adaptation Strategy Development Guidelines 2018 provides guidance to Local Authorities to develop their own Climate Action Adaptation Strategy. In developing this adaptation strategy Carlow County Council has been consistent with these guidelines.

2.2. Environmental Assessment:

Screening Overview for SEA*:* Under the European Communities (Environmental Assessment of Certain Plans and Programmes) Regulations 2004 (S.I. 435 of 2004 as amended by S.I. 200 of 2011), all plans which are likely to have a significant effect on the environment must undergo screening to determine whether a Strategic Environmental Assessment (SEA) is required. "Screening" is the process for making a determination as to whether a particular plan, would be likely to have significant environmental effects, and would thus warrant SEA. This strategy has been screened for SEA and it is determined that full SEA is not required. The screening report accompanies this strategy.

Screening Overview for AA: Screening of this draft strategy has been undertaken in accordance with the requirements of Article 6(3) of the EU Habitats Directive (directive 92/43/EEC) to determine if the Climate Change Adaptation Strategy is likely to significantly affect Natura 2000 sites (i.e. Special Areas of Conservation (SAC) and Special Protection Areas (SPA)) within or surrounding the Strategy area. It is determined that stage 2 Natura Impact Report is not required. The draft screening report accompanies this Strategy

2.3. Mitigation & Adaptation

This Local Authority Climate Change Adaptation Strategy forms part of Ireland's national strategy for climate adaptation as set out in the National Adaptation Framework (NAF) which was produced under the provisions of the Climate Action and Low Carbon Development Act 2015.

It is tasked with mainstreaming climate change adaptation over time into all functions, operations and services of the Local Authority. It seeks to inform or 'climate proof' existing plans and policies produced and implemented by the Local Authority. This ensures a considered, consistent and coherent approach, facing head on the challenges of a changing climate. Crucially, it also helps in building resilience within the Local Authority organization itself as well as across all communities.

While there is strong emphasis on local authorities through the NAF to develop and implement adaptation measures and actions, mitigation measures and actions that seek to combat, reduce or eliminate the emissions of greenhouse gases are also hugely important. Local Authorities have a significant role to play in actively implementing mitigation actions through measures including the design and construction of flood defences, retrofitting of building stock, energy efficient projects, promoting sustainable energy communities and encouraging sustainable transport and landuse.

There are positive interactions between adaptation and mitigation measures. Employing both adaptation and mitigation measures represents a robust climate action response in addressing the challenges associated with climate change at local level. The actions set out in Chapter 6 of this strategy reflect both adaptation and mitigation measures as a considered, relevant and integrated approach to combating the effects of climate change in County Carlow

Mitigation

Mitigation refers to the efforts to reduce the emission of greenhouse gases and reduce the severity of future climate change impacts.

Adaptation

Climate Adaptation can be best described as planning proactively to take action and make adjustments to minimize or avoid the existing and anticipated impacts from climate change. The Intergovernmental Panel on Climate Change (IPCC), in 2014, defined climate adaptation as:

"The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects."

Climate adaptation aims to build climate resilient communities, to protect people, ecosystems, businesses, infrastructure and buildings from the negative impacts of climate change. As a Local Authority we play a pivotal role in planning for, and responding to, emergency situations. We are best placed to react faster and more effectively to local climate events given our close relationship with communities and extensive knowledge of the local, natural and built environment. This is demonstrated by our prompt and unrelenting emergency responses to varying and more frequent extreme weather events.

Our climate is changing and we as a Local Authority need to ensure that we adapt to climate change. It is crucial that climate change adaptation is mainstreamed into our decision-making processes and implemented proactively in the performance of our duties. In addition, the benefits and opportunities that may arise as a result of climate change must be capitalized upon in respect of cost savings and new ways to foster environmental sustainability.

3. Regional and Local Context

Carlow County Council is located within the Eastern and Midlands Climate Action Region (CARO) and is one of 17 Local Authorities in the region. Carlow County Council is located in the South East of Ireland and has a combined urban and rural population of 24,272 people. The River Barrow flows through the town and forms the historic boundary between counties Laois and Carlow.

The Eastern & Midland CARO is one of four regional climate action offices set up in 2018 in response to Action 8 of the 2018 National Adaptation Framework (NAF) – *Planning for a Climate Resilient Ireland*. The four CAROs have been established to drive climate action at both regional and local levels. In recognition of the significant obligation to develop and implement climate action measures, the four regional offices are mandated to co-ordinate engagement across the varying levels of government and help build on experience and expertise that exists in the area of climate change and climate action.

The composition of the four Climate Action Regions has been determined by the geographical and topographical characteristics, vulnerabilities and shared climate risks experienced across Local Authority areas. The climatic risks associated with the Eastern and Midlands Climate Action Region include Fluvial Flooding, Pluvial Flooding, Groundwater Flooding and Coastal Flooding.

The Eastern and Midlands CARO has assisted and supported Carlow County Council in the development of this Climate Change Adaptation Strategy.

Climate Action Region	Local Authority function area	Lead Authority
Midlands and Eastern	Carlow, Cavan, Kildare, Kilkenny, Laois, Leitrim, Longford, Louth, Meath, Monoghan, Offaly, Roscommon, Tipperary, Waterford, Westmeath, Wexford, Wicklow	**Kildare County Council**
Atlantic Seaboard North	Donegal, Sligo, Mayo, Galway City & County	**Mayo County Council**
Atlantic Seaboard South	Clare, Limerick, Kerry, Cork City & County.	**Cork County Council**
Dublin Metropolitan	South Dublin, Fingal, Dun-Laoghaire-Rathdown, Dublin City	**Dublin City Council**

Table 1, Shows an illustrative map and corresponding table providing information on the four CARO regions, constituent Local Authorities and their specific lead authorities

3.1 Profile of Eastern and Midland Climate Action Region

With 17 local authority areas, the Eastern and Midland region is the largest of the four Climate Action Regions in Ireland. The region, exclusive of the Dublin Metropolitan Area, occupies the eastern and central aspects of the country. The Region borders Northern Ireland to the north with counties Louth, Cavan, Monaghan and Leitrim. The River Shannon flanks the western aspect bounding along its course, counties Leitrim, Roscommon, Longford, Westmeath, Offaly and Tipperary. The Irish Sea bounds the region to the east. Counties Louth, Wicklow, Wexford and Waterford are located to the east and south east of the region all with extensive coastlines along the Irish Sea.

The region with its extensive pattern of settlement areas and rural areas, has a population of almost 1.8 million people accounting for 37.7% of the total population of the state[6] with 32,542 sq.km occupying 46.3% of the area of the state[7]. The region plays a significant role economically to the country hosting a range of sectors inclusive of multinationals, public service, private and small-medium enterprises. Agriculture remains the prevailing sectoral landuse in the region. There is a rich variety of landscapes and topographies across the region. A mostly flat low-lying landscape sweeps through the midland counties. Significant areas of raised bogs occupy this central location in the country extending towards the Curragh Plains in County Kildare. The Drumlin Belt across the northern aspect of the region, the Wicklow Mountains, Galtee Mountains and Slieve Bloom Mountains offer variation and punctuation in the landscape of the region. 21 prominent Rivers rise and flow (with tributaries) through the Region. The most prominent of these include the River Shannon, River Barrow, River Suir, River Nore, River Liffey and River Boyne. Counties Louth, Wicklow, Wexford and Waterford occupy coastal locations to the East and South East of this region while County Leitrim extends to occupy a distance of 4.6km along the Western coast of the Country.

The region offers an extensive and crucially important network of critical infrastructure. The road network in the region typically radiates from the metropolitan Dublin Region. The Rail Network is significant with the Dublin-Cork, Dublin-Limerick, Dublin-Waterford and Dublin-Galway/Mayo lines. Rosslare Europort in Wexford is a gateway to Wales and greater Europe through France. Electricity and communications infrastructure is widespread throughout the region. The Ireland's Ancient East proposition best represents the vast array of tourism products on offer in the region as a cultural and tourist destination.

[6] Total population of E&M Region is 1,796, 923 persons. The state population is 4,761,865 persons (CSO, 2016).
[7] Total area of state is 70,282 sq.km

3.2 County Specific Details

Figure 1, Map representing total area and boundaries of County Carlow (GoogleMaps,2018)

3.3 Landscape Character & Topography

The County of Carlow Is located inland within the South East of Ireland in the province of Leinster covering an area of approximately 897 Km^2. Carlow's landscape character is categorized into 4 primary landscape character areas; Backstairs and Mt. Leinster Uplands, Central Lowlands, River Slaney-East rolling farmland and The Rossmore Range (Killeshin Hills).

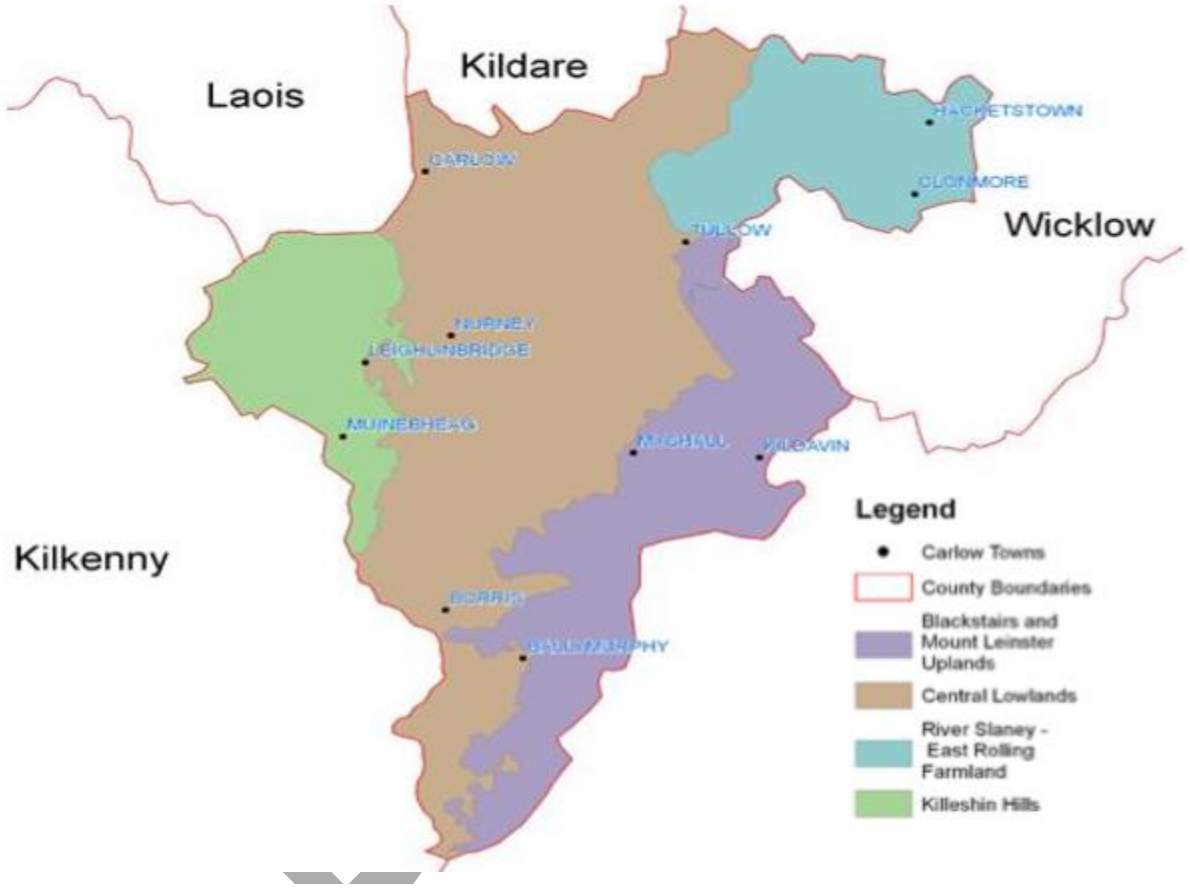

Figure 2, Map representing the different landscape character areas, boundaries and towns of Co. Carlow (Carlow County Landscape Character Assessment and Schedule of Protected Views,2015).

The topography present within the Central Lowlands is mostly limestone towards the West and granite towards the East. Till from the lower carboniferous limestone dominates the lowlands. Material found closer to the East of the lowlands contains till from granite. Glaciofluvial sands

and gravels are also present in high quantities along the River Barrow. Grey brown podzolic soils are mostly dominated in this zone but acid brown earths are also present in the granite till areas. As a result, soils present within this area are well drained and highly suited to arable and grassland farming.

The topography present within the River Slaney- East rolling Farmland Area mostly contains granite and is identified simply as rounded granite dome-shaped hills with interspersed rolling topography. Well drained brown earth and acidic soils, as well as drained gleys in partial areas make up this zones soil composition

The Rossmore Range (Killeshin Hills) contains mostly namurian shale and sandstone corresponding to the presence of the Castlecomer Plateau which is present along the north-west of the County. Poorly drained gley soils dominate the ridges of the plateau. Run-off is most pronounced at this location in addition to poor infiltration rates. Peat soils and Alluvial soils are also present within parts of the ridge.

The Blackstairs and Mount Leinster uplands mostly consists of granite, sandstone and ordovician schists. The upland areas of the Blackstairs Mountains consists of intact and cutover blanket bog whilst the lower areas consist of acid brown earths.

Breakdown of Land Use				
Land Use Type	**Mount Leinster-Blackstairs**	**Central Lowlands**	**River Slaney- East Rolling Farmland**	**Rossmore Range**
Agriculture	Low	High	High	High
Rural Housing	Low	Moderate	Low	Low
Urban Development	Low	Moderate	Moderate	Low
Forest Plantation	Moderate	Moderate	Moderate	Moderate
Tourism Related	High	High	High	High
Industrial Development	Low	Low	Low	Low
Extractive Industry	Low	Moderate	Moderate	Moderate
Wind Farming	Low	Moderate	Moderate	Moderate

Table 2, Represents the Breakdown of Land use within the four-character areas of Co. Carlow. Land use types are represented on the left-hand side of the table and the four -character areas are represented across the top of the table (Carlow County Landscape Character Assessment and Schedule of Protected Views, 2015).

The main waterbodies present within the County of Carlow are the River Barrow, Burren and Slaney. Carlow is the largest urban centre situated within the Barrow catchment and drains a total area of 3,025km². The River Barrow is the second largest river in Ireland which forms the boundary between Laois and Carlow measuring approx. 192km's in length. The River Greese and River Lerr are tributaries of the River Barrow which are renowned for their plentiful fish stocks. The River Burren, another tributary of the River Barrow begins at the North side of Mt. Leinster and flows Northwards towards Rathoe where it then turns Westwards towards the N80 and enters South of Carlow town where it drains into the River Barrow. The River Slaney, measures approx. 117km in length and also passes through Carlow where it flows through Tullow town. Rivers Derry and Dereen are both tributaries of the River Slaney. The River Derry rises in Hackettstown and flows under the Clonegal bridge where it becomes a border and establishes the divergent point of Co. Carlow to the West and Co. Wexford to the East. The River Dereeen rises in the Wicklow Mountains and flows Southwards passing through the towns of Hackettstown and Tullow. The Mountain and Dinin Rivers are also two prominent water bodies which flow close by to the town of Borris in Co. Carlow. River Status, Quality and Risk identification of all Co. Carlow's rivers can be identified on the GIS Map viewer provided by the EPA https://gis.epa.ie/EPAMaps/

Reservoirs	
Name	**Location**
The Moate	Rathvilly, Co. Carlow
Brownshill	Hackettstown, Co. Carlow
Raheenlea	Borris, Co. Carlow
Tullow Hill	Tullow, Co. Carlow
Eagle Hill	Hackettstown, Co. Carlow
Hackettstown	Hackettstown, Co. Carlow
Borris	Borris, Co. Carlow
Crows Grove	Kildavin, Co. Carlow
Ballon Hill	Ballon, Co. Carlow
Oak Park	Oak Park, Co. Carlow
Carrigduff	Bunclody, Co. Wexford

Table 3, Represents a list of current active reservoirs and their locations within the County of Carlow.

3.4 Population & Settlement Patterns

The population of Co. Carlow has witnessed significant population growth over recent years. The most recent census which took place in 2016 showed a total of 56,932 individuals living in Co. Carlow. Approx. 19,621 of these individuals were under 24 years of age and approx. 7,357 of these individuals were over 65 years of age. The development and extension of Carlow's third level institution- IT Carlow, has brought about extensive growth within the young adult age group to the area in addition to St. Patrick's, Carlow College. Carlow as it's County town is a critical element within the settlement structure of the County. In addition to Carlow town, Graiguecullen is located on the western side of the River Barrow which forms part of a wider urban area. This urban area is known as the Greater Carlow Graiguecullen Urban Area. Both Carlow town and Graiguecullen are two areas where a large number of individuals within Carlow reside. After Carlow town, Tullow and Muinebheag are the next major market towns in the County followed by a network of smaller towns and villages.

Settlement Hierarchy	
Urban Centre	Town
County Town	Carlow
District Town	Tullow, Muinebheag / Bagenalstown
Smaller Towns	Borris, Hacketstown, Rathvilly, Ballon, Leighlinbridge, Carrigduff
Villages	Tinryland, Bennekerry/Kernanstown, Palatine, Clonegal, Grange, Kildavin, Fenagh, Myshall, Rathoe, Ballinabrannagh/Raheendoran, Tinnahinch, Old Leighlin, Ballinkillen, Ardattin, Nurney, Ballymurphy, Clonmore, Rathoe Palatine Bennekerry Grange/Killerig Ballinabrannagh/ Raheendoran Bilboa Old Leighlin Graiguenalug/Nurney Fenagh Myshall Ardattin Ballinkillen Garryhill Clonmore Newtown Ticknock Glynn St. Mullins Rathanna Ballymurphy Drumphea

Table 4, Represents the Settlement Hierarchy and its components within Co. Carlow (Carlow County Development Plan 2015)

Housing Stock (County Carlow)	
Type of Accommodation	**Number (by persons per household)**
Detached	30,679
Semi-Detached	16,140
Terraced	6,433
Flat/Apartment in Purpose Built Block	1,668
Flat/Apartment in a Converted House/Commercial Building	406
Bed-sit	34
Caravan, Mobile or other Temporary Structure	138

Table 5, Represents Housing Stock details retrieved from Census 2016 data collection for Co. Carlow, including types of accommodation and number of persons per household (CSO, 2016)

4. Adaptation Baseline Assessment

4.1 Major Climate Event Timeline

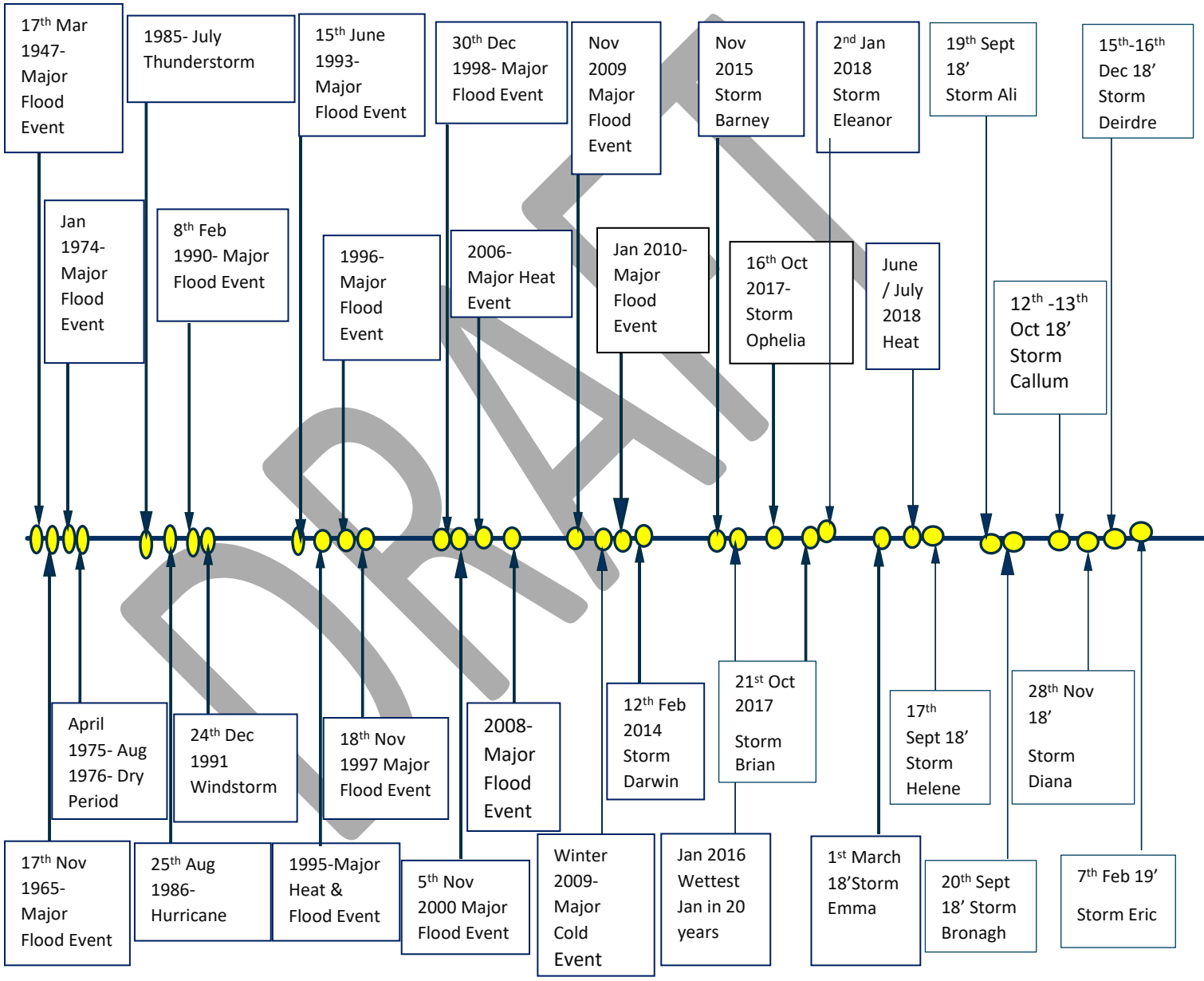

Figure 3, Represents a timeline of major climate events which affected Co. Carlow since 1974 to present (MetÉireann,2018; South Eastern CFRAM Study,2014; Carlow CoCo FEP,2010)

4.2 Climate Event information

The following table shows information in relation to the date, type and description of each climate event which occurred and caused an impact to the County of Carlow since 1947 to present. This information is displayed in conjunction with the major climate event timeline shown on the previous page.

Date of Event	Type of Event	Description of Event
17th March 1947	Flooding	Severe flooding followed a rapid thawing of snow and ice event in addition to heavy rainfall. Carlow town and Loughlinbridge were most affected and flood water remained for approx. four days. Centaur street experienced a depth of 1.35 m's of water on its street and peak flows within the River Barrow reached up to 240 m^3/s upstream of the Burren tributary and 260 m^3/s downstream of the tributary.
17th Nov 1965	Flooding	This flood event was caused by extreme rainfall. Carlow town, Loughlinbridge and Tullow areas were most affected when the River Barrow burst its banks resulting in some roads becoming impassable in addition to damaging approx. 60 properties.
11th & 12th Jan 1974	Flooding	Flooding and high gusts caused trees to fall blocking roads and destruction to a number of mobile homes.
April 1975-Aug 1976	Dry Period	Extreme dry period was experienced within the South East of Ireland between April 1975-Aug 1976, Carlow witnessed extreme hot conditions in August 1976
26th July 1985	Thunderstorm	Widespread thunderstorm. Weather recorder at Oakpark measured 22mm of rainfall in 15mins and 28mm of rainfall in 30 mins on the 26th of July 1985.
25th Aug 1986	Hurricane Charley	Hurricane Charley brought extremely high gusts and rainfall to the South-Eastern counties of Ireland. High precipitation and wind levels resulted mostly in flood damages within the Carlow region
Feb 1990	flooding	Co. Carlow experienced four days of flooding in mid-February 1990. The River Barrow broke its banks and passed through Kennedy Street. Peak flows of 182.5 m^3/s and 198.8 m^3/s were recorded in the River Barrow, upstream and downstream.
24th Dec 1991	Windstorm	Windstorm spread Countrywide mid Dec- early Jan 92' causing high levels of destruction countrywide
15th June 1993	Flooding	Heavy rain caused the Barrow to break its banks. Flood water enter Kennedy street measuring to a depth of 2ft. Peak flows occurred at 170 m^3/s and 187.5 m^3/s upstream and downstream of the River Barrow.
28th Jan 1995	Flooding	Heavy rain caused the River Barrow to break its banks. Centaur Street, Kennedy Street, John Street, Barrow Track, Pembroke Street, Burrin Street, John Street and Maryborough Street were worst affected in Carlow. The flood water reached a maximum depth of 1.15 m at John Street. Peak flows of 197.5 m^3/s and 215.9 m^3/s were recorded in the River Barrow, upstream and downstream
2nd Aug 1995	Heatwave	1995 was the warmest summer on record. On the 2nd of August 1995 temperatures at Oak Park, Co. Carlow reached 31.5° C
5th Jan 1996	flooding	Flooding on 5th of Jan caused Carlow town to become impassable
18th Nov 1997	flooding	Extensive flooding in the South-East of Ireland. River Slaney burst its banks and Tullow town experienced impacts to its infrastructure in addition to several damaged to agricultural crops and leaching of pollutants into waterways

30th Dec 1998	Flooding	Heavy rainfall caused the Burren to break its banks and Carlow town became flooded. Paupish Lane experienced major impacts with recorded depths of street flooding between 100 and 150 mm. Flood levels almost exceeded the lowest floor level in the area.
5th Nov 2000	Flooding	Centaur Street, Kennedy Street, John Street, Water Lane, Sleaty Street, Henry Street, Morris Lane, Barrow Track, and Seven Springs were the most affected areas. 28 residential properties and 15 commercial properties were flooded. 18 individuals had to be evacuated from six of these properties and one sewerage system pump was temporarily decommissioned. Roads were also closed for three days in Carlow town.
2006	Heatwave	Warmest summer on record since 1995. Summer rainfall totals were below normal especially in the South-East of Ireland. Third highest records on the Poulter Index
11th Jan 2008	Flooding	Cox's Lane, Barrow Track, Centaur Street, Kennedy Street, John Street, Henry Street, Maryborough Street, Pembroke, Montgomery Street, areas around the boathouse and Carlow Weir experienced high flood water levels causing damage to properties
June, July, Aug 2008	Flooding	Summer rainfall in Carlow in 2008 was above normal levels. Rainfall recorder located in Hackettstown measured 98.2 mm of rainfall in June, 170.9 mm in July and 138.5 mm in August giving a total of 407.6 mm of rain over 45 days. Centaur Street, Barrow Track, Maryborough Street, John Street, Cox's Lane, Pembroke and Kennedy Street were all affected
Nov 2009	Flooding	In November 2009 Carlow experienced severe flooding in many parts of the County due to the banks of the Barrow bursting. Flooding occurred in Carlow and Leighlinbridge from 19th to 26th November which followed a flood event in Oct. 33 residential properties were affected by the flooding, impacting approx. 200 people. Six shops, five public houses, three restaurants, one garage and one leisure facility were flooded. Centaur Street, John Street, Kennedy Street, Barrow Track, Maryborough Street, Sleaty Street, and Pembroke Street were worst affected in addition to Newacre on the Athy Road and North of Carlow town experiencing flood impacts. The sewage pumping stations at Maryborough Street, Carlow Castle and Pembroke were also inundated with surface water
Winter 2009/2010	Severe Cold Spell & Flooding	2009/10 was the coldest winter in almost 50 years. Oak Park recording station measured a total of 188mm of rainfall. Recording a temperature of -12°C on the 7th of Jan 2010. The most rainfall to occur in a day was 20.1mm of rain on the 4th of Feb. The mean temp. was 2.6°C, a total of 49 days of rain, 50 days of air frost and 6 days of gale gusts was experienced.
12th Feb 2014	Storm Darwin	Oakpark in Co. Carlow recorded the county's highest gust at 68kt on Feb 12th at 15:26pm with rainfall of 17.1mm. Throughout this storm period in Carlow, a max windspeed reached 89kt and max gust reached 126kt recorded at Oakpark. Considerable damage and destruction was experienced county-wide.
17th Nov 2015	Storm Barney	Gusts up to 78mph was recorded in the County of Carlow on the 17th of November. Impacts of wind and flooding was experienced in many towns within the County
Jan 2016	Wettest Jan in 20 years	Persistent rain, particularly through the first half of the winter, resulted in new records for both monthly and seasonal rainfall accumulations widely across Ireland. Storm Frank arrived forcing one family to evacuate their home in St. Mullins, Co. Carlow
16th Oct 2017	Storm Ophelia	At 12.26pm there was a wind elevation of 62m recorded in Oakpark in addition to strong gale forces up to 76km/hr and wind gusts of 117km/hr.
21st Oct 2017	Storm Brian	Aftermath of Storm Ophelia, Yellow wind warning was placed throughout the County
2nd Jan 2018	Storm Eleanor	Co. Carlow was issued an orange weather alert for the most of this storm. High gale force winds and gusts of up to 130km/r were experienced along the South-East. As a result of high winds and heavy rain, much destruction of property was experienced right across the South-East region of Ireland

1st-3rd March 2018	Storm Emma (Beast from the East)	Heavy snowfall and blizzard conditions were witnessed in Co. Carlow on the 1st,2nd and 3rd of March. A status orange followed by a status red alert was placed upon the County for parts of the storm and all schools and many businesses had to shut their doors throughout this extreme weather event as conditions were too treacherous to travel.
June/ July 2018	Heatwave	Oak Park weather station recorded an 11-day heatwave in late June, the longest heatwave in the last 20 years. Partial drought was experienced in Co. Carlow where only 0 .2mm of rain had fallen over a period of 38 days. Carlow held the record longest heatwave in the Country on the 5th of July with mercury soaring at Oak Tree station for 11 days straight since the 24th of June. A total of only 47.7mm of rain fell within June and July. This partial drought brought about extensive disruption to many farmers and their livestock in the area. As a result of lowered water tables, the implementation of a hose ban was brought into action in Co. Carlow at 8am on Friday, 6 July to midnight on Tuesday 31 July for all domestic public water supplies and commercial premises for non-commercial activities to save water supplies, however, with the continuous severity of hot conditions this ban was extended in Carlow until the 30th of Sept 2018.
17th Sept 2018	Storm Helene	Humid spell of wet & windy weather was experienced in Co. Carlow as the passing of former hurricane Helene which initiated in the Atlantic became a surge of tropical storms.
19th Sept 2018	Storm Ali	Brought about rainfall of up to 60mm in the South East of Ireland
20th Sept 2018	Storm Bronagh	Mean wind speeds between 65 and 80 km/h with gusts between 110 and 120 km/h in parts of the Country. Carlow was issued a status yellow alert
12th-13th Oct 2018	Storm Callum	Gales of up to 130km/h were experienced in parts of the Country and localized flooding. Carlow was issued a status yellow wind warning
28th Nov 2018	Storm Diana	Yellow wind warning in place for Co. Carlow, Power outages mostly affected Pollerton, Tullow and Hackettstown with over 100 ESB customers without power. Fairgreen shopping Centre also closed for a short period of time.
15th-16th Dec 2018	Storm Deirdre	Mean wind speeds in the South East reached 55-65km/hr & gusts up to 100 km/hr. Both the River Derry and Dereen in Carlow were flooded causing nearby areas to experience flood impacts
7th Feb 2019	Storm Eric	Yellow wind warning placed on Co. Carlow, Southwest-West winds of 50-65km/hr, mean windspeed and gusts of 80-110 Km/hr in Co. Carlow

Table 6, Shows information relating to all major climate events which caused impact(s) to Co. Carlow since 1947. (MetÉireann,2018; South Eastern CFRAM Study,2014; Carlow CoCo FEP,2010; CarlowWeather,2018)

4.3 Method of Assessing Current Adaptation Baseline

Consequence	Level	Description
Catastrophic	5	Widespread service failure with services unable to cope with wide-scale impacts. Irrecoverable environmental damage. Large numbers of serious injuries or loss of life
Major	4	Services seen to be in danger of failing completely with severe/widespread decline in service provision and quality of life. Severe loss of environmental amenity. Isolated instances of serious injuries
Moderate	3	Service provision under severe pressure. Appreciable decline in service provision at community level. Isolated but significant instances of environmental damage that could be reversed. Small number of injuries
Minor	2	Isolated but noticeable examples of service decline. Minor environmental damage
Negligible	1	Appearance of threat but no actual impact on service provision

Table 7, Shows method used to assess current adaptation baseline of Co. Carlow (CARO Guidelines,2018).

4.4 Baseline Assessment

Climate Hazard (Event):	Extreme Heat Event (2018)		
Meteorological/ Climatological Conditions:	Partial drought was experienced in Co. Carlow where only 0 .2mm of rain had fallen over a period of 38 days. Carlow held the record longest heatwave in the Country on the 5th of July with mercury soaring at Oakpark station for 11 days straight since the 24th of June. A total of only 47.7mm of rain fell within June and July in 2018		
Services/Functions	**Climate Hazard Impacts**	**Consequences**	**Level**
Business Operations/ Continuity			
Business efficiency, effectiveness and emergency response	• Increased frequency of fires at recreational parks due to increased pressure from recreational activities in addition, fires at homes and businesses where electrical devices and infrastructure may have been triggered by excessive heat • Increased frequency of gorse fires • Frequent delivery of emergency water supply	• Increased callout of fire services • Stretched emergency services in dealing with fires and tankering of water	
Business Operations	• Capitalising on opportunities arising from addressing the impacts of climate hazards.	• Positive	
Infrastructure & Built Environment			
Roads/footpaths, bridges, project construction and maintenance	• Deterioration of road surfaces due to prolonged exposure to high temperatures • Changes in rates of deterioration - faster rate of deterioration in areas subject to sustained high temperatures • Infrastructure collapse, significant damage • Compression and displacement of joint and surfaces of roadways and pathways • Impact on construction projects	• Nuisance • Risk to public safety • Financial implications for unscheduled maintenance, repair, upgrade, new construction, staff overtime costs. • Reduced economic efficiency of road network for commuting traffic and emergency transport routes disrupted. • Time delays and cost implications in delivery of infrastructure.	
Surface Water Drainage	• Reduced pressure on surface water drainage systems	• Reduce water flows	
Building Stock – LA Buildings and social housing stock	• Need for mechanical ventilation systems and cooling systems	• Service disruption • Cost of fuel (positive) • Pressure on housing staff to rectify reports issues.	
Community Infrastructure	• Deterioration of community infrastructure eg, playgrounds, public parks, swimming pools, public realm spaces from extreme hot conditions. • Reduced water for swimming pools, irrigation of open spaces, parks etc	•Cost of maintenance/upgrade •Loss of revenue locally/regionally – tourism. •Closure of community infrastructure – short term. •Injury, illness or potential loss of life.	

	• Risk to public safety in times of high temperatures for unsecured lakes, water spots,quarries	
Water & Sewage Services		
Water levels	• Changes in groundwater levels • Changes in mean and peak stream and river flows • Uncertain water availability • Reduction of surface and groundwater supplies • Reduced dry weather sewerage flows	• Disruption to communities • Negative Environmental consequences - draw on staff resources to investigate/rectify.
Wastewater	• Interruption to anaerobic processes within waste water treatment plants.	• Disruption to communities • Negative Environmental consequences - draw on staff resources to investigate/rectify.
Water Supply	• Increase in water demand and reduction in receiving water assimilative capacities during drought conditions • Reduced availability of water supply sources during • Increased potential for water contamination • Changes in availability of groundwater • Quality of water diminished	• Nuisance to householders. • Impact on economic development i.e businesses and tourism. • Additional demand on LA staff working under the SLA with Irish Water • Requirement for hose pipe bans and impacts on local communities including Local Authority parks and sports facilities • Water pollution issues relating to reduction in surface water flows
Water Quality	• Ground movement, in high temps, resulting in cracking of old wastewater pipe networks • Changes in species distribution and phenology of river systems • Low flows resulting in deterioration of water quality	• Increased pollution of surface water systems • Changes to surface water habitats • Spread of pathogens and other contaminants • Increased monitoring staff needed • Health Consequences with inadequate water quality
Natural Resources and Flood Management		
Biodiversity	• Shift in distribution of plant and animal species from heat and cold stress • Loss of bio-diversity • Increased species, habitat & crop losses • Alteration in vegetation composition & soil moisture, having a knock-on effect to organisms and microbial networks • Increased risk of disturbance to population and species leading to extinction • Reduced ecosystem resilience to stress • Increased ecosystem and species heat stress • Increased bog and sand dune fires	• Inability to meet objectives to protect and conserve important habitats. • Negative consequence on health and wellbeing of communities. • Stretched emergency services in dealing with bog fires, fires on sand dune areas. • Economic impact – reduced tourism. • Loss of habitats • Loss of Species • Loss of valuable Agricultural Crops • Development of invasive species Increase of monitoring staff

Weed/pest Management – Area Offices	• Changes in rate of coverage and spatial distribution of invasive species due to heat extremes	• Cost and staff resources required to manage and deal with invasive species.
Landuse and development policy		
Spatial Planning and landuse	• Early retirement of capital infrastructure • Inappropriate location of urban expansion areas • Increased uncertainty in long term landuse planning and infrastructure design i.e. location of future developments, suitability of infrastructure designs to cope with impacts of hot weather events.	• Impact on quality of life • Increased pressure on disaster management and response resources • Long term economic cost to area and to general public.
Community Health and Wellbeing		
Community Development	• Increase isolation and disconnect of communities through inaccessibility (bog, gorse, sandune, commonage fires) • Pressure on drinking water supplies	• Abandonment of vulnerable rural areas • Impact on local economies, reduced interest in settlement • Cost of repair, replacement of street surfaces, public realm • Disadvantaged communities • Loss of revenue locally/regionally- Tourism

Table 8, Shows an assessment of the heatwave which occurred in Co. Carlow within the Summer of 2018 (Climate Ireland, 2018 CarlowWeather,2018; MetÉireann, 2018)

Climate Hazard (Event):	Extreme Flood Event (2009)		
Meteorological/ Climatological Conditions:	Flooding occurred in Carlow and Leighlinbridge from 19th to 26th November 2009. 191.2 mm of rain fell within the month. There was a total of 26 rain days. However, the mean air temp was 1-1.5°C warmer than usual.		
Services/Functions	**Climate Hazard Impacts**	**Consequences**	**Level**
Business operations/ Continuity			
Business efficiency, effectiveness and emergency response	• Building Closures • Building damage, impacts on servers • Electricity supply affected • Risks to staff welfare, public safety, local business and tourism assets	• Service disruption to customers: motor tax, housing applications, scheduled meetings, arts/cultural events etc. • Inability to meet statutory deadlines eg. planning applications – financial/reputational consequences. • Resources stretched to deal with various impacts from extreme weather events above and beyond the performance of daily duties. • Increased pressure on emergency response and recovery operations. • Consequence to local/regional economies • Financial implications to local authority in clean-up operations, staff overtime, unable to perform normal duties. • Economic impacts – longer term consequence to local economy and local authority in terms of rate collection	
Infrastructure & Built Environment			
Roads/footpaths, bridges, project construction and maintenance	• Changes in rates of deterioration - faster rate of deterioration in areas subject to flooding • Direct and indirect impacts of flooding affects roadways and transport infrastructures • Infrastructure collapse, significant damage – sustained duration and frequency of extreme flooding. • Increased frequency of blocked roads due to flood waters • Impact on construction projects	• Nuisance • Increased maintenance costs of roadways Traffic and Transport disruptions • Risk to public safety • Financial implications for unscheduled maintenance, repair, upgrade, new construction, staff overtime costs. • Reduced economic efficiency of road network for commuting traffic and emergency transport routes disrupted. • Time delays and cost implications in delivery of infrastructure. • Increased insurance costs	
Surface Water Drainage	• Exceedance of drainage capacity – localised and larger scale flooding • Reduction in drainage capacity • Inflow/infiltration into wastewater networks • Increased discharges from drainage systems to groundwater	• Blocked roads, flooding/damage to roads properties/business – impact on insurance costs. • Operating challenges of waste water infrastructure – knock on effects for wider community	

		• Stretch on staff resources Financial implications for increased maintenance, repair
Building Stock – LA Buildings and social housing stock	• Damage and deterioration of housing stock • Closure of Local Authority buildings	• Cost of maintenance, safety implications to public, possible rehousing of tenants • Cost of fuel • Service disruption • Pressure on housing staff to rectify reports issues.
Flood defences & Coastal Infrastructure	• Exceedance of existing flood defences • Increased coastal erosion and inundation • Increased frequency or permanent inundation of coastal infrastructure & utilities i.e. water, sewerage, gas, communications, electricity, transportation routes • Increased erosion and/or exceedance of seawalls, jetties and other coastal defences • Damage to water pipe networks	• Loss of capital infrastructure – cost of replacement. • Damage/loss of properties/lands take – displacement or isolation of communities • Disruption to commuting traffic, and utilities – economic impact. • Increased cost to local authority – repair, replacement
Community Infrastructure	• Deterioration of community infrastructure eg, playgrounds, public parks, swimming pools, public realm spaces • Impacts on recreation amenities and tourism activities	• Cost of maintenance/upgrade • Loss of revenue locally/regionally – tourism • Closure of community infrastructure – short term • Injury, illness or potential loss of life.
Cultural/Heritage	• Damage to cultural and heritage assets and cultural landscapes	• Negative impact on tourism-economic consequence locally/regionally • Loss of assets of intrinsic historical importance
Water and Sewerage Services		
Stormwater /Sewerage	• Inundation of stormwater and sewerage infrastructure • Increased peak flows • Changes in floodplains • Reduced/unreliable power supply for pumping and treatment • Changes in mean and peak stream and river flows	• Disruption to communities • Negative Environmental consequences - draw on staff resources to investigate/rectify. • Local surface water flooding events**.**
Wastewater	• Inflow and infiltration to wastewater network • Exceedance of wastewater levels	• Disruption to communities • Negative Environmental consequences - draw on staff resources to investigate/rectify. • Local surface water flooding events. • Increased maintenance costs and monitoring staff overtime

Water Supply	• Flooding and inundation of wastewater treatment and water abstraction plants • Loss of power supply during intense rainfall events • Salinisation of surface water and groundwater supplies in coastal areas • Increased potential for water contamination • Quality of water diminished • Occasional risk of fire due to electrical powered systems within water supply operations	• Nuisance to householders. • Impact on economic development i.e businesses and tourism • Health consequences with inadequate water quality. • Health consequences with inadequate water quality. • Need for emergency response • Increased maintenance costs & monitoring staff overtime • Network disruptions due to loss of power supplies
Water Quality	• Increased flooding mobilising runoff from land, incl contaminants into surface waters • Changes in species distribution and phenology of river systems • Saline intrusion of waters	• Increased discharges from drainage systems to ground-waters • Increased pollution of surface water systems • Changes to surface water habitats • Health consequences with inadequate water quality • Spread of pathogens and other contaminants • Increased maintenance costs & monitoring staff overtime
Natural Resources and Flood Management		
Biodiversity	• Loss of bio-diversity • Reduced ecosystem resilience to stress • Damage to Agricultural land and crops • Alteration of natural environmental systems such as breeding, migration, dispersal and nutrient cycle • Loss of recreational and wetland functioning • Changes in species distribution and phenology of river systems • Changes in rate of coverage and spatial distribution of invasive species	• Inability to meet objectives to protect and conserve important habitats (WFD) • Negative consequence on health and wellbeing of communities. • Economic impact – reduced tourism. • Loss of priority habitats and species • Increased monitoring and maintenance costs • Increase of invasive species to the environment • Cost and staff resources required to manage and deal with invasive species
Landuse and development policy		
Spatial Planning and landuse	• Inappropriate location of urban expansion areas • Increased uncertainty in long term landuse planning and infrastructure	• Increased insurance costs • Increased pressure on disaster management and response resources

	design i.e. location of future developments, suitability of infrastructure designs to cope with impacts of extreme flood events. • Loss of private property and community assets due to extreme rainfall event • Early retirement of capital infrastructure	• Long term economic cost to area and to general public. • Impact on quality of life
Community Health & Wellbeing		
Community Development	• Increase isolation and disconnect of communities through inaccessibility • Break up of individual communities and social connectivity • Damage to properties, streetscapes and community assets • Contaminants to waterways and drinking water supplies • Land/property take at coastal areas	• Abandonment of vulnerable rural areas • Impact on local economies, reduced interest in settlement • Cost of repair, replacement of street surfaces, public realm • Disadvantaged communities • Inaccessibility of Community Service staff to vulnerable individuals in isolated areas.

Table 9, Shows an assessment of the flooding event which occurred in Co. Carlow in November 2009 (Climate Ireland,2018; CarlowWeather,2018; MetÉireann, 2018)

Climate Hazard (Event):	Extreme Cold Spell (2009/10)		
Meteorological/Climatological Conditions:	December 09'-Feb 10' was the Coldest winter for almost 50 years in Ireland. Oak Park recording station measured a total of 188mm of rainfall. The most rainfall to occur in a day was 20.1mm of rain on the 4th of Feb. A mean temperature of 2.6˚C, lowest temperature of -12.1° C, a total of 49 days of rain, 50 days of air frost and 6 days of gale gusts was recorded for Carlow at the monitoring station in Oak Park.		
Services/Functions	**Climate Hazard Impacts**	**Consequences**	**Level**
Business Operations/ Continuity			
Business efficiency, effectiveness and emergency response	• Building Closures due to freezing conditions • Building damage, impacts on servers • Risks to staff welfare, public safety, local business and tourism assets	• Service disruption to customers: motor tax, housing applications, scheduled meetings, arts/cultural events etc. • Inability to meet statutory deadlines eg. planning applications – financial/reputational consequences. • Resources stretched to deal with various impacts from extreme weather events above and beyond the performance of daily duties. • Increased pressure on emergency response and recovery operations. • Consequence to local/regional economies Financial implications to local authority in clean-up operations, staff overtime, unable to perform normal duties. • Economic impacts – longer term consequence to local economy and local authority in terms of rate collection. • Increased callout of emergency services • Increased pressure on response resources	
Infrastructure & Built Environment			
Roads/footpaths, bridges, project construction and maintenance	• Changes in rates of deterioration - faster rate of deterioration in areas subject to extreme cold conditions • Infrastructure collapse, significant damage due to sustained duration and frequency of extreme cold event • Increased risk of damage to roads and pavements due to the process of freeze-thaw action. • Severe cold conditions stress metal bridges & railway tracks. • Blocked roads • Increased risks of road accidents • Impact on construction projects	• Nuisance • Risk to public health and safety • Increased callout of emergency services • Increased pressure on response resources • Financial implications for unscheduled maintenance, repair, upgrade, new construction, staff overtime costs. • Reduced economic efficiency of road network for commuting traffic and emergency transport routes disrupted. • Time delays and cost implications in delivery of infrastructure. • Increased Insurance costs • Loss of capital infrastructure	
Surface Water Drainage	• Exceedance of drainage capacity due to melting snowfall – localised and larger scale flooding. • Damage to surface water drainage infrastructure	• Blocked roads, flooding/damage to roads properties/business – impact on insurance costs. • Operating challenges of waste water infrastructure – knock on effects for wider community. • Stretch on staff resources.	

		• Financial implications for increased maintenance, repair
Building Stock – LA Buildings and social housing stock	• Damage and deterioration of housing stock • Increased need for heat • Closure of Local Authority buildings	• Cost of maintenance, safety implications to public, possible rehousing of tenants • Cost of fuel (negative or positive) • Service disruption • Pressure on housing staff to rectify reports issues.
Community Infrastructure	• Deterioration of community infrastructure eg, playgrounds, public parks, swimming pools, public realm spaces • Impacts on recreation amenities and tourism activities	• Cost of maintenance/upgrade. • Loss of revenue locally/regionally – tourism. • Closure of community infrastructure – short term. Injury, illness or potential loss of life
Cultural/Heritage	• Damage to cultural and heritage assets and cultural landscapes	• Negative impact on tourism – economic consequence locally/regionally. • Loss of assets of intrinsic historical importance
Water and Sewerage Services		
Stormwater /sewerage	• Damage to stormwater and sewerage infrastructure due to freezing conditions • Changes in groundwater levels • Reduced/unreliable power supply for pumping and treatment due to freezing conditions • Changes in mean and peak stream and river flows • Uncertain water availability due to impacts of freezing conditions	• Disruption to communities • Negative Environmental consequences - draw on staff resources to investigate/rectify.
Wastewater	• Inflow and infiltration to wastewater network • Interruption to wastewater process	• Disruption to communities • Negative Environmental consequences - draw on staff resources to investigate/rectify
Water Supply	• Damage to infrastructure • Pipe breaks, blocked valves & restricted intake of water to supply systems due to process of freeze thaw action • Loss of power supply during intense freezing temperatures • Salinisation of surface water and groundwater supplies in coastal areas	• Nuisance to householders. • Impact on economic development i.e businesses and tourism. • Health consequences with inadequate water quality. • Additional demand on LA staff working under the SLA with Irish Water • Requirement for hose pipe bans and impacts on local communities including Local Authority parks and sports facilities • Network disruptions due to loss of power supplies
Water Quality	• Changes in species distribution and phenology of river systems	• Changes to surface water habitats • Water quality deteriorates due to increased amount of road salt in stormwater runoff.

		• Increased maintenance costs & monitoring staff overtime. • Disruption to communities
Natural Resources and Flood Management		
Biodiversity	• Shift in distribution of plant and animal species from heat to cold stress • Loss of bio-diversity • Reduced ecosystem resilience to stress • Increased risk of water pollution due to leakage of salt from roads & pavements into streams & rivers impacting plant & animal species • Increased risk of harm to crops as yield levels are reduced • Fish production is also affected due to severe cold temp of water- reducing fish stocks and providing a medium for growth & development of invasive species • Forests can become damaged from severe cold conditions resulting in release of carbon from trees	• Inability to meet objectives to protect and conserve important habitats. • Negative consequence on health and wellbeing of communities • Loss of priority habitats and species
Weed/pest Management – Area Offices	• Changes in rate of coverage and spatial distribution of invasive species due to extreme change of temperature	• Cost and staff resources required to manage and deal with invasive species
Landuse & Development Policy		
Spatial Planning and landuse	• Inappropriate location of urban expansion areas • Increased uncertainty in long term landuse planning and infrastructure design i.e. location of future developments, suitability of infrastructure designs to cope with impacts of weather events. • Loss of private property and community assets • Early retirement of capital infrastructure	• Increased insurance costs • Increased pressure on disaster management and response resources • Long term economic cost to area and to general public. • Impact on quality of life
Community Health and Wellbeing		
Community Development	• Increase isolation and disconnect of communities through inaccessibility • Damage to properties, streetscapes and community assets	• Abandonment of vulnerable rural areas • Impact on local economies, reduced interest in settlement

	• Pressure on drinking water supplies	• Cost of repair, replacement of street surfaces, public realm • Disadvantaged communities. • Cold temperatures and icy conditions prevent access to roads making it hard for members of the community services to liase with vulnerable people

*Table 10, An assessment of the severe cold spell which occurred in Co. Carlow throughout winter of 09/10 (*Climate Ireland, 2018; *CarlowWeather,2018; MetÉireann, 2018*)

5. Climate Risk Identification

5.1 Climate Projections & future Risk

Climate Hazard:	Heatwaves			
Observed & Projected Information	The Mean air temperature is expected to increase everywhere & for all seasons by 1-1.6˚C by mid-century therefore increasing the intensity of Heatwaves. The average temperature projections for Co. Carlow between 2021-2040 are as follows; • Summer: increase of 1.1˚C • Winter: increase of 0.7˚C • Spring: increase of 0.8˚C • Autumn: increase of 1.4˚C The Average temperature projections for Co. Carlow between 2041-2060 are as follows: • Summer: increase of 1.5˚C • Winter: increase of 1.1˚C • Spring: increase of 0.7˚C • Autumn: increase of 1.5˚C			
Operational Area	**Risk Statement**	**Timing of Risk**	**Projected change in of level of risk (2050)**	**Priority**
Business operations/continuity	More frequent and intense heatwaves will increase the risk of fires within Local Authorithy buildings and businesses impacting performance operations of daily tasks, exercising statutory duties and organising events.	**S/M/L**	**Increase**	**High**
Infrastructure & Built Environment	More frequent and intense hot weather events will undermine the integrity of critical infrastructure and the built environment giving rise to increased costs to repair, reinforce, or replace with potential for loss of these assets. Financial implications for unscheduled maintenance, repair, upgrade, new construction, disruption to services and staff overtime costs will become an issue	**S/M/L**	**Increase**	**High**
Water & Sewage Services	Heatwaves and/or sustained drought conditions will result in significant and serious impact to water supply and quality, which will increase the risk of impacting the ability of the Local Authorithy to meet requirements of WFD, communities and emergency response units in addition to causing service disruptions.	**S/M/L**	**Increase**	**High**

Natural Resources and Flood Management	Increase frequency of heat events will increase the risk of invasive species and impact the natural ecosystems causing an increase in demand for monitoring staff resources and increased risk of Local Authorithy unable to meet objectives to protect and conserve important habitats.	**M/L**	**Increase**	**Moderate**
Landuse and development policy	Increased frequency of hot weather will give rise to the uncertainty in long term landuse planning and infrastructure design to withstand such temperatures increasing pressure on planning and design staff as well as economy of Carlow County Council	**S/M/L**	**Increase**	**Moderate**
Community Health and Wellbeing	Higher temperatures and more hot days could result in heat exhaustion, risk of skin cancer and increased heat-related stress with vulnerable people within communities increasing the need for emergency response. Remote communities are particularly vulnerable	**S/M/L**	**Increase**	**High**

Table 11, An assessment of the climate risks associated with predictions of heatwaves in the future in Co. Carlow (Climate Ireland, 2018)

Climate Hazard:	Rainfall			
Observed and Projected Information:	Nationally, an increase in seasonality in precipitation can be expected with significant decreases projected for spring and summer and increases for Winter and Autumn. An increase in the occurrence of extreme rainfall events is also likely. The average precipitation projections for Co. Carlow for 2021-2040 are as follows: • Summer: 0 - 4% increase & -1- -2% decrease in some areas • Winter: 13-21% increase • Spring: 0-7% increase • Autumn: -1- -7% decrease The average precipitation projections for Co. Carlow for 2041-2060 are as follows: • Summer: -7- -14% decrease • Winter:1-5% increase • Spring:0-3 % increase & -1- -4% decrease in some areas • Autumn:0-1% increase & -1- -5% decrease in some areas			
Operational Area	**Risk Statement**	**Timing of Risk**	**Projected change in of level of risk (2050)**	**Priority**
Business operations/continuity	Increased frequency of flood events in Winter and Autumn periods will rise the demand for emergency services response for the placement of sandbags, use of vehicles to gain access to areas out of reach by other modes of transport and regular check-ins with vulnerable individuals of communities in isolated areas. In addition to general service disruption presenting difficulties for business continuity and the delivery of projects locally, as a consequence of staff being unable to travel to work.	S/M/L	Increase	High
Infrastructure & Built Environment	Extreme rainfall events could affect critical infrastructure such as roads, water, sewerage, storm water, housing and communications through flooding and inundation. Damage to critical infrastructure will impact the economic function of transport routes, will give rise to flooding impacts to properties and communities resulting in increased costs of clean up and maintenance, repair and insurance costs and a wider economic impact. More frequent and intense rainfall events will damage local authority buildings, housing stock, equipment and facilities (machinery yards, storage facilities etc) increased costs for maintenance, repair and replacement and increased demand on staff resources.	S/M/L	Increase	High
Water & Sewage Services	With a higher risk of flooding and inundation and more impactful storm surges, this will result in significant impacts on property, land and critical infrastructure affecting the economic viability of certain areas and increasing further the vulnerability of communities. Extreme rainfall events will increase the risk of impacting water quality and the ability of the Local Authority to meet the requirements of the WFD	S/M/L	Increase	High

Natural Resources and Flood Management	Extreme rainfall events will increase habitat flooding and leaching of nutrients and sediment into watercourses. This will result in changes to geomorphology and cause contamination of watercourses. Landscape may become more vulnerable, ecologically sensitive and may result in habitat loss Frequency of flooding will increase, as will the intensity and areas of flooding. This will mean that areas previously not subject to flooding will be at risk Changes in Rainfall will also impact native species, encourage diseases, weeds, pests and invasive species which will need to be managed appropriately.	S/M/L	Increase	High
Landuse and development policy	Increase in extreme rainfall events will shorten the lifespan of many infrastructural developments, causing a loss of capital infrastructure and increasing insurance costs	S/M/L	Increase	High
Community Health and Wellbeing	Extreme rainfall events will increase the risk of property damage within communities and contaminate community water supplies which will result in loss of popular tourist areas (economic impact) and will increase clean-up, maintenance and monitoring staff costs.	S/M/L	Increase	High

Table 12, An assessment of the climate risks associated with predictions of Flooding in the future in Co. Carlow (Climate Ireland ,2018)

Climate Hazard:	Severe Cold Spells			
Observed and Projected Information:	In general, the number of frost days has decreased significantly at all monitoring stations across Ireland. In winter all stations which record a change, display a decrease in cold wave duration, related to the general increase in winter temperatures (Epa,2007). Due to the variability of the atmospheric and oceanic circulation, occasional below-average or, in rare cases, record cold temperatures, are expected to occur even when the global mean temperature is increasing. The number of cold months generally increases from low to high latitudes. Seasonally, Northern Hemisphere high-latitude continents are projected to experience the largest number of cold months in winter and spring, despite a maximum of warming in winter. Cold months as defined against 20th century climate are still expected to occur in the future, although gradually more seldom. In rare cases, even individual record cold months are likely to occur, this being not inconsistent with projections of continued global warming (Räisänen and Ylhäisi, 2011). One of the biggest factors exacerbating this extreme cold event is due to the configuration of the Jet Stream around the earth. As the Artic continues to warm, it enables the jet stream to meander at a wider dimension into regions it would never have before bringing with it warm and artic conditions. As a result of this movement, different regions around the planet are experiencing absurd extreme weather events (Heart, 2018).			
Operational Area	**Risk Statement**	**Timing of Risk**	**Projected change in of level of risk (2050)**	**Priority**
Business operations/continuity	The occurrence of intense extreme cold events will see higher risk of service disruptions presenting difficulties for business continuity and the delivery of projects locally, as a consequence of staff being unable to travel to work. Intense extreme cold events will result in closure of local authority offices impacting performance of normal daily tasks, exercising statutory duties and organising events. This will interrupt work flows and efficiencies, disrupt scheduled events and increase staff costs in dealing with extreme events. General decrease in the number of frost days and cold periods should reduce pressure on emergency response throughout the year. Winter and Spring are projected to experience coldest conditions. Occasional cold events are projected for the future, therefore emergency services must expect the unexpected.	S/M/L	Decrease	Moderate
Infrastructure & Built Environment	Intense cold events will undermine the integrity of critical infrastructure and lead to an increase in costs to repair, reinforce, or replace with potential for loss of these assets. Intense cold events will damage Local Authority buildings, housing stock, equipment and facilities (machinery yards, storage facilities etc) giving rise to increased costs for maintenance, repair and	S/M/L	Decrease	Moderate

	replacement and increased demand on staff resources. Damage to critical infrastructure will impact the economic function of transport routes, will give rise to flooding impacts to properties and communities resulting in increased costs of clean up and maintenance, repair and insurance costs and a wider economic impact. Concaving and cracking of road surfaces may occur due to soil moisture changes and cold spells in winter & spring Decrease in frost and cold days may reduce minor accidents and personal and motor insurance costs			
Water & Sewage Services	Decreased frost days and cold days, reduced risk of burst pipes and associated water leakage (damage), but may also make pipes more fragile infrastructure may be subjected to brittle breaks due to the adverse impact of climate extremes therefore increasing costs of maintenance staff and repairs	M/L	Decrease	Moderate
Natural Resources and Flood Management	Cold events will cause severe impact to growth and development of crops and species resulting in a loss of biodiversity	S/M/L	Decrease	Moderate
Landuse and development policy	Extreme cold temperatures will have an impact on infrastructural developments, increasing the risk of early retirement and as a result increasing maintenance, repair costs and need for new design developments	S/M/L	Decrease	Moderate
Community Health and Wellbeing	Cold temperatures will result in significant impacts on property, land and critical infrastructure affecting the economic viability of certain areas and increasing further the vulnerability of communities	S/M/L	Decrease	Moderate

Table 13, An assessment of the climate risks associated with climate predictions of Severe Cold Spells in the future in Co. Carlow (Climate Ireland, 2018)

6. Adaptation Goals, Objectives & Actions

Our Vision

Carlow County Council will fulfil a leadership role in learning about and responding to the impacts of climate change, be fully engaged with the risks and opportunities of a changing climate and build a resilient future for and together with, the communities of County Carlow"

6.1 Thematic Areas and High-Level Goals

This Adaptation Strategy is based around nine Thematic Areas that are developed further as High-Levels Goals. These goals identify the desired outcomes anticipated through the effective implementation of the Climate Change Adaptation Strategy. They are supported by specific objectives and adaptation actions to achieve their desired outcomes.

Theme 1- Local Adaptation Governance and Business Operations **Goal:** Climate Change adaptation considerations are mainstreamed and integrated successfully into all functions and activities of the local authority ensuring operational protocols, procedures and policies implement an appropriate response in addressing the diversity of impacts associated with climate change
Theme 2- Infrastructure & Built Environment **Goal:** Increased capacity for climate resilient structural infrastructure is centered around the effective management of climate risk, informed investment decisions and positive contribution towards a low carbon society
Theme 3- Landuse & Development **Goal:** Sustainable policies and measures are devised influencing positive behavioural changes, supporting climate adaptation actions and endorsing approaches for successful transition to low carbon and climate resilient society.
Theme 4- Drainage & Flood Management **Goal:** Great understanding of risks and consequences of flooding and successful management of a co-ordinated approach to drainage and flooding
Theme 5- Natural Resources & Cultural Infrastructure **Goal:** Fostering meaningful approaches to protecting natural and key cultural assets through an appreciation for the adaptive capacity of the natural environment to absorb the impacts of climate change.
Theme 6- Community Health & Wellbeing **Goal:** Empowered and cohesive communities with strong understanding of climate risks, increased resilience to impacts of climate change with capacity to champion climate action at local level
Theme 7- Mobility **Goal:** Sustain transport networks throughout impacts of climate change and develop more sustainable adaptation methods of mobility
Theme 8- Economic Development **Goal:** Protect the economy of Carlow County Council and communities acknowledging the benefits which can be gained from adjusting to a 'Green Economy'

Theme 9- Resource Management **Goal:** Promote awareness on importance of resource management and explore actions on becoming more efficient within the workplace and community

Table 14, Shows the nine thematic areas and goals used within this Climate Change Adaptation Strategy

6.2 Aims of High-Level Goals

Through its nine Thematic Areas and High-Level goals, the Local Authority Climate Change Adaptation Strategy is designed to guide a planned and coherent response to the effects of climate change. However, four principle aims (guiding principles) thread through and underpin these goals:

1. **Mainstream Adaptation**: That climate change adaptation is a core consideration and is mainstreamed in all functions and activities across the local authority. In addition, ensure that local authority is well placed to benefit from economic development opportunities that may emerge due to a commitment to proactive climate change adaptation and community resilience.

2. **Informed decision making**: That effective and informed decision making is based on reliable and robust evidence base of the key impacts, risks and vulnerabilities of the area. This will support long term financial planning, effective management of risks and help to prioritise actions.

3. **Building Resilience**: That the needs of vulnerable communities are prioritised and addressed, encourage awareness to reduce and adapt to anticipated impacts of climate change and promote a sustainable and robust action response.

4. **Capitalising on Opportunities**: Projected changes in climate may result in additional benefits and opportunities for the local area and these should be explored and capitalised upon to maximise the use of resources and influence positive behavioural changes.

6.3 Adaptation Actions

Local Adaptation Governance and Business Operations		
Adaptation Goal Climate Change adaptation considerations are mainstreamed and integrated successfully into all functions and activities of the local authority ensuring operational protocols, procedures and policies implement an appropriate response in addressing the diversity of impacts associated with climate change		
Adaptation Objectives: Objective 1: Increase understanding of the operational risks posed by current and projected climate hazards by all members of Carlow County Council staff; Objective 2: Increase capacity for climate adaptation planning across all service areas; Objective 3: Mainstream climate adaptation considerations across all operations and procedures; Objective 4: Implement an appropriate response in addressing diversity of climate change impacts.		
Adaptation Actions:	**Operational Area**	**Time Frame S/M/L**
LAGBO 1- Establish a steering group with representatives from across key functions of Local Authority to ensure the successful implementation of the actions of this strategy and to report on progress.	Senior Management Team	S
LAGBO 2- Mainstream climate action policy as an integral consideration in the objectives of the corporate plan encompassing the delivery of functions and services across the administrative area	Corporate Services	S
LAGBO 3- Undertake and implement a Business Continuity Plan to identify and address specifically, the impacts associated with extreme weather events on the varying functions/services of the local authority including: • Preparing for critical services disruptions, • Mitigating/Minimising the impact of service disruption and, Improving the capacity/ability to recover	Building Facilities	S
LAGBO 4- Develop a 'Monitoring & Review' system to allow for an appropriate response in addressing the diversity of climate change impacts.	Climate Action Steering Group	S-L
LAGBO 5- Liaise, collaborate and work in partnership with the sectors identified in the NAF, subject to funding, in the delivery of the Government approved sectoral adaptation actions, where they relate and are relevant to the functions and activities of the council at local level/in local communities.	Climate Action Steering Group	S

Infrastructure & Built Environment		
Adaptation Goal Increased capacity for climate resilient structural infrastructure is centered around the effective management of climate risk, informed investment decisions and positive contribution towards a low carbon society		
Adaptation Objectives: Objective 1: To ensure and increase the resilience of infrastructural assets and inform investment decisions Objective 2: To work towards the objective for a low carbon society Objective 3: Identify feasible adaptation/maintenance actions to maintain resilience despite climate change impacts Objective 4: Implement sustainable cost effective and adaptation/maintenance measures drawing on risk register outputs.		
Adaptation Actions:	**Operational Area**	**Time Frame S/M/L**
IBE-1 Apply a robust risk assessment and management framework to Local Authority owned buildings and properties to identify and protect against the key vulnerabilities to the impacts of climate change and mitigate against service disruption	Building facilities	S
IBE-2 Integrate climate considerations into the design, planning and construction of all roads, footpaths, bridges, public realm and other construction projects. Make provision to incorporate green infrastructure as a mechanism for carbon offset	Road Design, Area Offices, NTA	S/M/L
IBE-3 Undertake a Risk Assessment of road infrastructure in the area to identify the severity of climate change risks on their function and condition. The risk assessment should provide for an understanding and quantification of risks posed. The findings should be integrated into decision making processes, road infrastructure programmes and investment strategies.	Road section, NTA, local communities	M
IBE-4 Move towards near-zero-energy in council newbuild buildings, in line with EU policy	Building facilities, Planning, Housing	M/L

Landuse and Development		
Adaptation Goal Sustainable policies and measures are devised influencing positive behavioural changes, supporting climate adaptation actions and endorsing approaches for successful transition to low carbon and climate resilient society		
Adaptation Objectives: Objective 1: To Integrate climate action considerations into landuse planning policy and influence positive behaviour		
Adaptation Actions:	**Operational Area**	**Time Frame**
LD-1 Identify and integrate climate change as a critical consideration and guiding principle informing core strategy of the County Development Plan.	Planning section	S
LD-2 Identify funding opportunities provided by SEAI and OPW for retrofit/renovation of public buildings	Housing/Planning/Finance	S/M/L
LD-3 Integrate and promote climate-smart building and urban design performance outcomes in development standards through the development management process.	Planning Section, Housing section, Project Office	S-L
LD-4 Promote the integrated planning, design and delivery of green infrastructure (including urban greening) through appropriate provisions in planning policies, development standards, infrastructural, public realm and community projects. .	Planning, Community Development, Tourism, Economic Development, Project Office, Area offices, Heritage, Parks, Housing.	S-L
LD-5 Research and incorporate, in the content of the County Development Plan, measures in accordance with section 10 (n) of the Planning and Development Acts 2000 (as amended) for: **(***n*) the promotion of sustainable settlement and transportation strategies in urban and rural areas including the promotion of measures to— (i) reduce energy demand in response to the likelihood of increases in energy and other costs due to long-term decline in non-renewable resources, (ii) reduce anthropogenic greenhouse gas emissions, and (iii) address the necessity of adaptation to climate change; in particular, having regard to location, layout and design of new development;	Planning Section in consultation with external agencies and key stakeholders including E&M CARO.	S
LD-6 Encourage development proposals to maximize energy efficiency through siting, layout, design or which incorporate best practice in energy technologies, conservation and implementation of smart technology	Planning/Housing	M/L
LD-7 Develop criteria to climate proof all future council led developments against the negative impacts of severe weather events	Building facilities, Planning, Housing	S-L
LD-8 To encourage where feasible and practical, the provision of photovoltaic solar panels in new residential developments for electricity generation/storage and/or water heating purposes.	Housing/Planning	S/M/L

Drainage & Flood Management		
Adaptation Goal Great understanding of risks and consequences of flooding and successful management of a co-ordinated approach to drainage and flooding		
Adaptation Objectives: Objective 1: To mitigate and manage the risk and impact of flooding through a variety of measures Objective 2: Investigate where possible, if improvements can be made on water infrastructure to reduce leakage and increase water supply within developments of Carlow County Council Objective 3: Liaise with relevant bodies (in respect of flood management and planning) to support in the development of sustainable actions and measures		
Adaptation Actions:	**Operational Area**	**Time Frame**
DFM-1 Undertake a surface water management plan for the assessment and management of flood risks with the aim of reducing the adverse consequences of flooding, to prioritise projects to reduce surface water flood risk and provide for detailed mapping of areas prone to surface water and groundwater flood risk	Water Services, Area Offices	S
DFM-2 Stipulate the requirement for the design and specification of urban stormwater drainage systems for new development to take account of the potential future impact of climate change.	Planning section	M/L
DFM-3 Incorporate the requirement for Sustainable Urban Drainage Systems where appropriate in local authority projects and private development sites.	Project Office, Planning Section	S-L
DFM-4 Incorporate considerations of the impact of climate change into proposals submitted under the Minor Works Programme to ensure that measures proposed are adaptable to future changes.	Project Office, OPW	S-L
DFM-5 Ensure that potential future flood information is obtained/generated by way of a Flood Risk Assessment (FRA) and used to inform suitable adaptation requirements within the Development Management process in line with the Guidelines for Planning Authorities on Flood Risk Management (DoECLG & OPW, 2009).	Planning Section	S-L
DFM-6 Review of infrastructure to identify assets at risk from flooding/extreme rainfall to inform low-cost 'minor works' flood relief schemes	Water Services/Planning	S/M

Natural Resources & Cultural Infrastructure		
Adaptation Goal Fostering meaningful approaches to protecting natural and key cultural assets through an appreciation for the adaptive capacity of the natural environment to absorb the impacts of climate change		
Adaptation Objectives: Objective 1: To provide for enhancement of natural environment to work positively towards climate action. Objective 2: To promote effective bio-diversity management and enhance protection of natural habitats and landscapes Objective 3: To protect Heritage and Cultural Infrastructure Objective 4: Promote awareness about the importance of protecting natural resources at present and for the future		
Adaptation Actions:	**Operational Area**	**Time Frame**
NRCI- 1 Review Biodiversity Plans / habitat conservation strategies, plans and projects to ensure that: • all risks from adverse climate change have been identified; • future changes are assessed, and measures employed to address issues identified • carbon capture within habitats is considered.	Environment, NPWS	S-L
NRCI-2 Support and resource the implementation of the National Biodiversity Action Plan 2017-2021 in full	Environment	S-L
NRCI-3 Map and identify sites where invasive species are detected and develop a programme to manage invasive species appropriately.	Environment	S
NRCI-4 Liase with the NPWS to identify vulnerable ecosystems and species that through enhanced landscape connectivity would be less impacted by climate change.	Environment	S
NRCI-5 Design and implement a citizen engagement and awareness campaign within schools and communities on climate change and biodiversity conservation to capture case studies, tell stories and engage citizens in data collection and monitoring	Environment/Community	S
NRCI-6 Identify green spaces and wildlife refuges in Co. Carlow with local communities to provide habitats for species under threat from climate change and to connect people to biodiversity.	Planning/Environment/ Community	S
NRCI-7 Support the implementation of the Biodiversity Pollinator Plan in communities in Carlow	Environment/Planning	S
NRCI-8 Develop a strategy to undertake and implement an active Tree Planting programme in the context of climate adaptation in conjunction with an awareness campaign that informs of the benefits to communities in improving air quality, offsetting carbon emissions, promoting biodiversity, limiting flood risk, reducing urban heat, as well as aesthetic value.	Environment, Community Development, Project Office, Planning	S
NRCI-9 Develop a Green Infrastructural Strategy which promotes biodiversity and its role in adaptation to climate change by strengthening habitat networks, reducing habitat fragmentation and providing opportunities for species to migrate	Environment	S/M/L

NRCI-10 Integrate natural borders/buffers to be included as an integral component of the design of greenways/blueways, tracks and trails and amenity areas to promote natural enhancement.	Design Office, Roads Section, Bio-diversity	M/L
NRCI-11 Through the development management process, promote habitat resilience and greenspaces through tree planting, biodiversity improvements, strategic projects (linking green networks), active travel projects (greenways, blueways), creating new greenspaces, and preventing fragmentation of habitat networks.	Environment Planning/Transport	M/L
NRCI-12 Research, map and consider nature-based solutions for use as local carbon sequestration and potential low-cost win-win climate change adaptation and mitigation solutions and include in Green Infrastructure strategy	Bio-diversity, Planning Section, stakeholders	S-L
NRCI-13 Undertake a risk assessment of the Heritage and Cultural Assets in the county to assess the vulnerability and the risk to the historical environment from the impacts of climate change and to help build resilience to these important assets.	Heritage Officer, Heritage Council, Dept.	M
NRCI-14 Conduct educational seminars within schools and communities about the importance of conserving natural resources	Environment/Community	S-L
NRCI-15 Liase with external important relevant bodies like; Coilte, Teagasc, National Parks and Wildlife Service, Central Fisheries Board &The Department of Environment, Heritage and Local Government to understand how Carlow County Council can support and improve resilience efforts.	Environment/Planning	S
NRCI-16 Continuous monitoring to ensure policy legislation standards are met and external stresses are reduced e.g. pollution	Environment	S-L

Community Health and Wellbeing		
Adaptation Goal Empowered and cohesive communities with strong understanding of climate risks, increased resilience to impacts of climate change with capacity to champion climate action at local level		
Adaptation Objectives: Objective 1: To build capacity and resilience within communities Objective 2: Engage with Carlow communities in relation to guidance on how to reduce the impacts of Climate Change within their homes and communities Objective 3: Prioritize communities who are currently and projected to be most vulnerable to the adverse impacts of Climate Change		
Adaptation Actions:	**Operational Area**	**Time Frame**
CHW-1 Through public participation network raise awareness of the impacts of climate change and ways for communities to increase response and resilience to these impacts.	PPN, Community Development	S
CHW-2 Assess communities across the county in the context of their vulnerability to the impacts of climate change. Identify vulnerable communities and the risks to the community.	Area Offices, Community Development	S

CHW-3 For identified vulnerable communities, develop and implement a programme to enhance their capacity to respond to and recover from extreme weather events with specific aims to: • help the vulnerable community to develop a stronger facilitating role for mitigating risks • provide advice on the risk of extreme events affecting their locality • Devise mitigating actions to enhance preparedness • provide support to develop appropriate resilience arrangements to enable response and recovery	Area Offices, Community Development, Community	M
CHW-4 Increase the provision of education and awareness guidelines to Communities in Co. Carlow on the importance of Climate Adaptation for the future health and wellbeing of all community members.	Environment	S-L

Mobility		
Adaptation Goal To maintain transport network integrity in the face of climate change impacts		
Adaptation Objectives: Objective 1: Identify vulnerable transport infrastructure; Objective 2: Identify feasible adaptation/maintenance actions to maintain resilience despite climate change impacts; Objective 3: Implement sustainable cost effective and adaptation/maintenance measures drawing on risk register outputs.		
Adaptation Actions:	**Operational Area**	**Time Frame**
M-1 Develop a scheme to pilot low carbon alternative vehicles for use by Carlow County Council in relation to business travel.	Transport/corporate	M/L
M-2 To identify and seek to implement a strategic, coherent and high-quality cycle and walking network across the county that is integrated with public transport and interconnected with cultural, recreational, retail, educational and employment destinations and attractions	Transport	M/L
M-3 To support the provision of a long-distance walking/cycling route which links Carlow to neighboring county greenways.	Transport	S/M/L
M-4 Promote Cycle-to-Work Scheme to Carlow County Council staff to help reduce carbon emissions	Transport	S

M-5 Develop a programme to retrofit charging points and include as a criteria in devolvement standards of the County Development Plan for new charging points on private sites	Transport	M/L
M-6 Promote car clubs and car sharing schemes for the county council staff	Transport	S/M
M-7 Support the promotion of incentives to encourage low emissions vehicles within county Carlow through mechanisms such as parking bye-laws	Transport	M/L
M-8 Investigate the feasibility to introducing bike rental hubs at appropriate locations throughout the county	Transport	M/L
M-9 Liaise and collaborate with bus companies to identify deficiencies in bus infrastructure and examine ways of improving the infrastructure and awareness to promote bus usage	Transport	M/L
M-10 Undertake a Risk Assessment of all road infrastructure in the area to identify the severity of climate change risks on their function and condition. The risk assessment should provide for an understanding and quantification of risks posed by extreme heat/drought, cold and rainfall events. The findings should be integrated into decision making processes, road infrastructure programmes, design and planning for new roads, project budgets and investment.	Transport	M/L
M-11 Provide and champion world car free day initiative	Transport/ Environment	S/M/L
M-12 Look to increase and integrate pedestrian only zones	Transport/Planning	M/L
M-13 Develop programmes and policies in the County Development Plan to have appropriate modern ICT, including open access fibre connections in all new developments and a multiplicity of carrier neutral ducting installed during significant public infrastructure works such as roads, water and sewerage, where feasible	Transport/Planning/IT	M/L
M-21Engage with IT to Introduce online web seminars to broadcast meetings, workshops etc. to reduce travelling.	IT/Transport	S/M/L

Economic Development		
Adaptation Goal **Develop a more sustainable green economy within Carlow County Council and within businesses around the County**		
Adaptation Objectives: Objective 1: Identify current businesses in Co. Carlow that are benefitting financially from green economy, assess their productivity and profit made Objective 2: Examine other businesses in the county which could also potentially benefit from a green economy Objective 3: Educate the general public on benefits available from a sustainable green economy		
Adaptation Actions:	**Operational Area**	**Time Frame**
ED-1 Showcase businesses in County Carlow that are making money from green economy	Economic & Enterprise Team	S/M
ED-2 Review potential EU funding streams to understand whether climate strategy might place Carlow County Council in stronger position to apply for certain funding	Economic & Enterprise Team	S/M/L
ED-3 Promotion of local jobs and local workspace to reduce the amount of commuting outside the county	Economic & Enterprise Team	M/L
ED-4 Provide support to local businesses in recognizing opportunities for innovation, increasing resilience and saving money	Economic & Enterprise Team	S/M/L

Resource Management		
Adaptation Goal To Manage resources more sustainably, reduce emission levels through reuse, recycling and generating energy, moving towards a circular economy.		
Adaptation Objectives: Objective 1: Promote the importance of disposal of waste into segregated waste streams Objective 2: Improve and promote new recycling initiatives within Carlow County Council Objective 3: Engage with relevant stakeholders and members of the community on the importance of waste management at a local scale Objective 4: Promote the use of clean energy and decreasing the consumption of fossil fuels to reduce the negative impacts of climate change		
Adaptation Actions:	**Operational Area**	**Time Frame**
RM-1 Develop robust polices in the County Development Plan to: •Encourage and support the provision of a separate collection of source segregated waste throughout the county; •Encourage the development of waste infrastructure and associated developments in appropriate locations; and •Encourage the recycling of construction and demolition waste and the reuse of aggregate and other materials in future construction projects •Encourage high quality sustainable waste recovery and disposal infrastructure/technology including composting (anaerobic digester) plants for managing organic solid waste at appropriate locations.	Environment	S-L
RM-2 To co-operate with relevant stakeholders to implement proposals which discourage illegal or improper disposal of waste and promote the diversion of recyclable items from the waste streams including 'bottle return and refund' schemes.	Environment	M/L
RM-3 To identify suitable sites for additional recycling centres and bring bank facilities	Environment	S/M
RM-4 To seek the effective engagement of local communities in County Carlow to promote their role in recycling waste and tackling the problems of illegal dumping within the county through liaising with the Environmental Awareness Officer.	Environment/Community	S
RM-5 To promote and facilitate communities to become involved in environmental awareness activities and community-based recycling initiatives or environmental management initiatives that will lead to local sustainable waste management practices.	Environment/Community	S
RM-6 Engage with staff of Powerstown Civic Amenity Site to see what actions or measures can be taken to improve sustainable efficiency of facilities at site	Environment	S/M
RM-7 To continue to promote and encourage the education and awareness on all issues associated with waste management at school, household, enterprise and community level. This will include the promotion of waste reduction by encouraging the minimization, re-use, recycling and recovery of waste within the county	Environment/community	S/M/L
RM-8 Explore opportunities to move towards a circular economy	Environment	S/M/L
RM-9 Seek opportunities to introduce rainwater harvesting within Council buildings & social housing	Water Services/Planning	S/M/L

RM-10 To promote water conservation through the use of low-flush toilets in Council buildings & social housing	Planning	S
RM-11 To seek to secure a water resources Management Plan for County Carlow	Water Services	S/M
RM-12 To liaise, support and work with Irish Water in the development and upgrade of the water supply systems so as to ensure that County Carlow has an adequate, sustainable and economic supply of suitable quality piped water for all users.	Water services	S/M/L
RM-13 To continue to support Irish Water's Water Conservation Programme to conserve valuable resources by reducing leakage	Water Services	S/M/L
RM-14 To support the recording and monitoring of renewable energy potential in the county in partnership with other stakeholders including SEAI.	Environment	S/M/L
RM-15 Create a climate adaptation and energy master plan for Co. Carlow	Multi-departmental	M
RM-16 Collaboration with the County Development Plan on integrating climate adaptation and energy actions on the new *Carlow Development Plan 2020-2026*	Planning	S
RM-17 Develop a feasibility study and gap analysis of development of ISO 50001 compliant energy management system	Transport	S
RM-18 Annual Monitoring & Reporting to SEAI on energy and carbon use. Publishing Display Energy Certificates for public buildings	Environment	S
RM-19 Publish Climate Action and Energy Review annually	Environment	S
RM-20 Identify sites for trialing renewable energy projects to reduce the need for "Grey adaptation" measures	Planning/Environment	S
RM-21 Commission a feasibility study on district heating systems for Urban Regeneration projects	Planning	L
RM-22 Develop a programme to investigate all council owned and operated buildings to ensure they are Climate Adapted and Energy efficient	Multi- Departmental	S
RM-23 Develop a Public Lighting Upgrade Plan	Roads/Planning	S
RM-24 Liase with external stakeholders on research and project proposals for grant funding (CARO/Third level institutes)	Multi-Departmental	S
RM-25 Develop research and funding opportunities for climate adaptation, renewable and energy efficiency projects	Multi-Departmental	S
RM-26 Engage with students on climate change through CPD programme/Engineers Week/Science Week	Environment/Transport	S
RM-27 Provide citizens with energy awareness material in public buildings. Also providing the Home Energy Saving Kits in CCC's public libraries to monitor CO_2 related emissions and how to reduce.	Environment	S
RM-28 Provide County Council tenants with climate adaptation awareness materials at home, particularly at time of taking up new tenancy.	Housing	S
RM-29 Raise awareness of SEAI community energy projects within Carlow County Council, engage with and support communities in the development of energy projects.	Environment/Community	S/M/L
RM-30 Continued staff energy awareness in all council buildings	LA	S
RM-31 Explore potential for renewable energy/ micro generation at council facilities. Including Powerstown Civic Amenity Site.	Environment	M/L

RM-32 Develop and support the Resource Efficient Action Plan in 2019 (REAP)	Environment	M/L
RM-33 Investigate land management opportunities for water attenuation in council owned land	Environment/Water/ Planning	S-M
RM-34 Observe ground water and surface water measures at Powerstown landfill to ensure rainfall levels don't impact containments	Water Services/ Environment	S
RM-35 Increased collaboration between water team and engineering team	Water Services	S/M/L

7. Implementation, Monitoring & Evaluation

All adaptation measures and operational procedures will be implemented, and roles and responsibilities which are assigned will be made aware to the internal staff of Carlow County Council. Policies and institutions available to assist the Local Authority adaptation efforts will also be utilized throughout the process of implementation.

The Local Adaptation Strategy will also inform development plans and other statutory plans of Co. Carlow's Local Authority. Where adaptation measures arising from the strategy are incorporated into a plan, the decision of undergoing an AA or SEA process will be decided amongst the adaptation team. An AA or SEA process will provide a natural mechanism to highlight and assess these actions and their possible impacts on the environment.

The Adaptation strategy will be monitored on a continuous regular basis by assigned internal staff members of Carlow County Council. A schedule will be set to monitor and review the strategy on both a regular and annual full-scale basis. The strategy will encompass a period of approximately 35 years. A new strategy will be drafted every 10 years, with a 5-year review point to determine the strategy's continued relevance and performance against adaptation objectives.

After each 5-year review point a progress report will be developed and reported to the internal staff of Carlow County Council.

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