Rialtas na hÉireann
Government of Ireland

Health

Climate Change Sectoral Adaptation Plan

2019-2024

Prepared under the
National Adaptation Framework

Prepared by the Department of Health
www.gov.ie/health

Health

Climate Change Sectoral Adaptation Plan

2019-2024

Contents

Foreword

Climate change is one of the greatest challenges facing us all and it is clear we need to step up our response to this growing issue.

The window of opportunity is closing and it is essential we take adequate steps now to respond to this challenge.

As Minister of Health, I am aware that climate change is having a tangible impact on the health and wellbeing of people across the country.

We have seen the damage caused by winter storms in recent years and the effects this has had on our health service.

However, there are likely to be further impacts on our people. The fair skin of many Irish people makes us particularly vulnerable to UV damage and the risk of skin cancer.

We can also expect climate change to aggravate the existing negative health effects of air pollution on some of our most vulnerable people, including people with chronic conditions.

For patients and people using our health and social care services, or professionals working in them, there are a multitude of existing daily pressures and service challenges to face. Climate change adaptation may seem like something distant or non-urgent.

But without decisive adaptation action, climate change will have profound impacts for the health and wellbeing of our people, for the smooth delivery of our health and social care services, and for our critical infrastructure.

Crucially, the health effects of climate change will be felt the most by our most vulnerable citizens, including the elderly, children, those with pre-existing medical conditions, the urban poor, farmers and coastal populations.

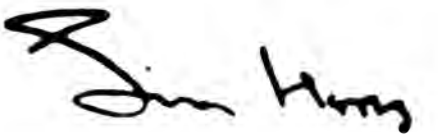
Action to adapt to climate change must be taken up across the health sector: in our service planning, in our emergency response preparations and in day-to-day operations at different levels in our health and social care services.

An important focus of our climate change adaptation will be on promoting the health of our population in order to prevent illness. I am pleased to see the alignment of this Plan with the efforts of Healthy Ireland and our recently-launched National Skin Cancer Prevention Plan.

Our climate change adaptation efforts will also be very much in line with the focus of our Sláintecare programme of reform - to provide the majority of care at home or closer to home. A good example, submitted during the public consultation for this Plan, is that hospitals quickly become overcrowded during and especially shortly after climate emergencies – so stronger support for community healthcare teams will help to manage some acute and chronic medical conditions within the home.

Finally, I would like to acknowledge the work of the doctors and officials in the joint Department-HSE team that developed and drafted this Plan.

I see this Climate Change Adaptation Plan, the first for the health sector, as the start of an important conversation that must continue.



Simon Harris, T.D.
Minister for Health

Executive Summary

"Climate change is the biggest global health threat of the 21st century."

The Lancet, 2018

Climate change is a globally pervasive phenomenon that represents a significant threat to human health. Models and simulations, including those by Met Éireann and the Irish Centre for High End Computing, project Ireland's future climate as less dependable and less stable, with more frequent and intense weather events. Projections show an average increase in temperature of about 1.5 degrees by mid-century, with increases of up to 2 degrees in summer days and up to 3 degrees in winter nights. We can expect wetter winters (especially in the West) with more frequent heavy precipitation events, and drier summers (especially in the South East).

Even as we move towards being a low-carbon and environmentally sustainable country by 2050, some changes are still likely to occur. This is because the climate system is slow to react, and some changes are already locked in.

Therefore, effective adaptation planning and action is imperative to protect the health and wellbeing of people in Ireland, the smooth delivery of our health and social care services, and our critical infrastructure.

Development of a Plan for Ireland's Health Sector, 2019–2024

This Plan, the first Climate Change Adaptation Plan for the health sector, is one of twelve sectoral adaptation plans developed under the *National Climate Change Adaptation Framework (2018)* and the *Climate Action and Low Carbon Development Act 2015*. The chapter structure of this Plan closely follows the planning steps set out in the *Sectoral Planning Guidelines for Climate Change Adaptation (2018)*.

The Plan sets out the main climate change-related risks and vulnerabilities we expect to face in the health sector in the next five years and beyond and proposes concrete measures we can take to help reduce our vulnerabilities.

The Plan was developed in a collaborative way:

- a sectoral adaptation team with relevant expertise from the Department of Health and the Health Service Executive (HSE) was established to develop and draft this Plan, using the Sectoral Planning Guidelines;
- the views and input of relevant stakeholders were gathered at a consultation event and at other meetings;
- broader input was received as part of a public consultation exercise; and
- input from other Government sectors was proactively sought, because many health-related risks of climate change originate in other sectors and because health impact is a cross-cutting feature of climate change action.

The Plan is based on evidence:

- two separate reviews of national and international literature have been conducted on the scientific evidence relating to the health impacts of climate change;
- additional information was considered relating to past climate events, including learning from Ireland's emergency response to severe weather events over recent years; and
- the sectoral adaptation team held workshops to conduct the core, detailed risk assessment of the health sector impacts of climate change.

The Plan is informed by international literature, including Public Health England (2014), which identified three main categories of adaptation actions to address the main climate scenarios and vulnerabilities in the health sector, as follows:

- **population health and wellbeing**: Ireland's healthcare system will need to prevent avoidable illness where possible, paying particular attention to vulnerable population groups, and to be prepared for different volumes and patterns of healthcare demand;
- health and social care **service continuity** during acute events: effective emergency planning and preparedness will be essential to ensure operational continuity and service delivery during severe weather events; and
- **infrastructure resilience** to severe weather: the system infrastructure (buildings, communications, emergency service vehicles, models of care) together with the supply chain (fuel, food,medical supplies) will need to be made more resilient to more frequent severe weather events and other impacts of climate change.

Adaptation to climate change presents a complex methodological challenge. It calls for decisions to be taken with potentially very long-term consequences on the basis of incomplete knowledge and/or uncertain information about future changes.

Appropriately, climate change adaptation planning and action is an iterative process. The present Plan will evolve during the coming years as our understanding improves, as the evidence base on climate impacts increases, and as ad ditional appropriate actions are considered to manage health sector risks and impacts.

Six climate scenarios with profound health implications

During the development of this Plan, six main climate scenarios with the most profound health implications were identified. Two of the six scenarios relate to slow onset climate-mediated effects over time (UV radiation and air pollution) while four scenarios concern acute, severe weather events (windstorms, extreme heat and heatwaves, high precipitation and flooding, and extreme cold snaps). Measures to ensure population health and wellbeing are relevant to all six climate scenarios, while actions to ensure service continuity and infrastructure resilience are more relevant for severe weather events.

An inclusive Climate Change Oversight Group for the health sector will drive and oversee implementation of the Plan; will closely collaborate with relevant stakeholders in the health sector; and will monitor and review progress, including any unintended consequences that may arise.

UV / Sun Exposure

Climate change may result in increased exposure to ultraviolet radiation from higher levels of ambient UVR and by people spending more time outdoors in warmer weather. Irish people with fair skin are particularly vulnerable to UV damage and are at a higher risk of skin cancer. Currently over 11,000 cases of skin cancer are diagnosed each year – this is projected to more than double by 2045 (National Cancer Registry [NCR], 2017).

Air pollution

Climate change is expected to see weather-driven increases in air pollutants such as ozone, particulate matter (PM) and aeroallergens. In 2014 an estimated 1,050 premature deaths occurred in Ireland secondary to particulate matter (European Environment Agency [EEA], 2017). The most vulnerable people include older adults, individuals with chronic illnesses, children and those living in deprived communities.

Windstorms

The most immediate and visible climate change-related risks to Ireland come in the form of extreme weather events such as Storm Ophelia in 2017. The number of deaths directly attributable to such events to date are low, not least because of the effective national adaptation action of the population following advice to stay at home. The full impact of widespread disruption, including to outpatient services, hospital procedures and discharges, is not currently measured or assessed.

Heat / Heatwaves

Extreme heat and heatwaves are projected to increase in frequency, the effects of which will be amplified by our significantly increasing elderly population and rising numbers of people living with chronic disease. 70,000 premature deaths were attributed to the particularly extreme heatwave across Europe in 2003 (Rey *et al.*, 2007). A recent study attributed 294 excess deaths to heatwaves in Ireland over the last three decades (Pascal *et al.*, 2013).

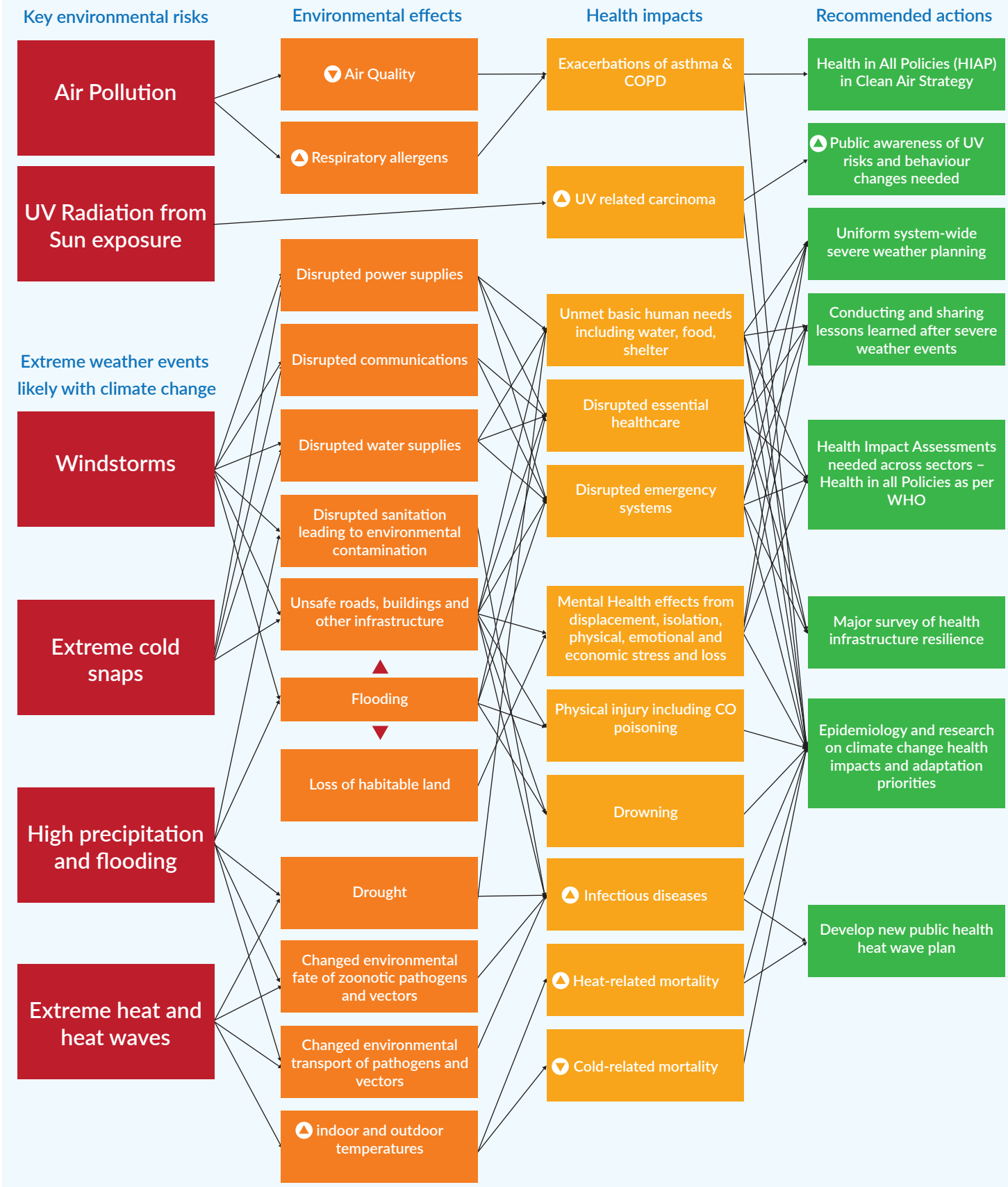
High Precipitation / Flooding

Increasingly frequent heavy rainfall events for winter/ autumn are projected to occur by mid-century, along with a 0.8 metre rise in coastal sea levels by the end of the century (DCCAE, 2018a). Flooding has both direct health impacts, through drownings or injury, and indirect effects, including mental health impacts. The most vulnerable include the elderly, children, pregnant women, people with disabilities, farmers, tourists

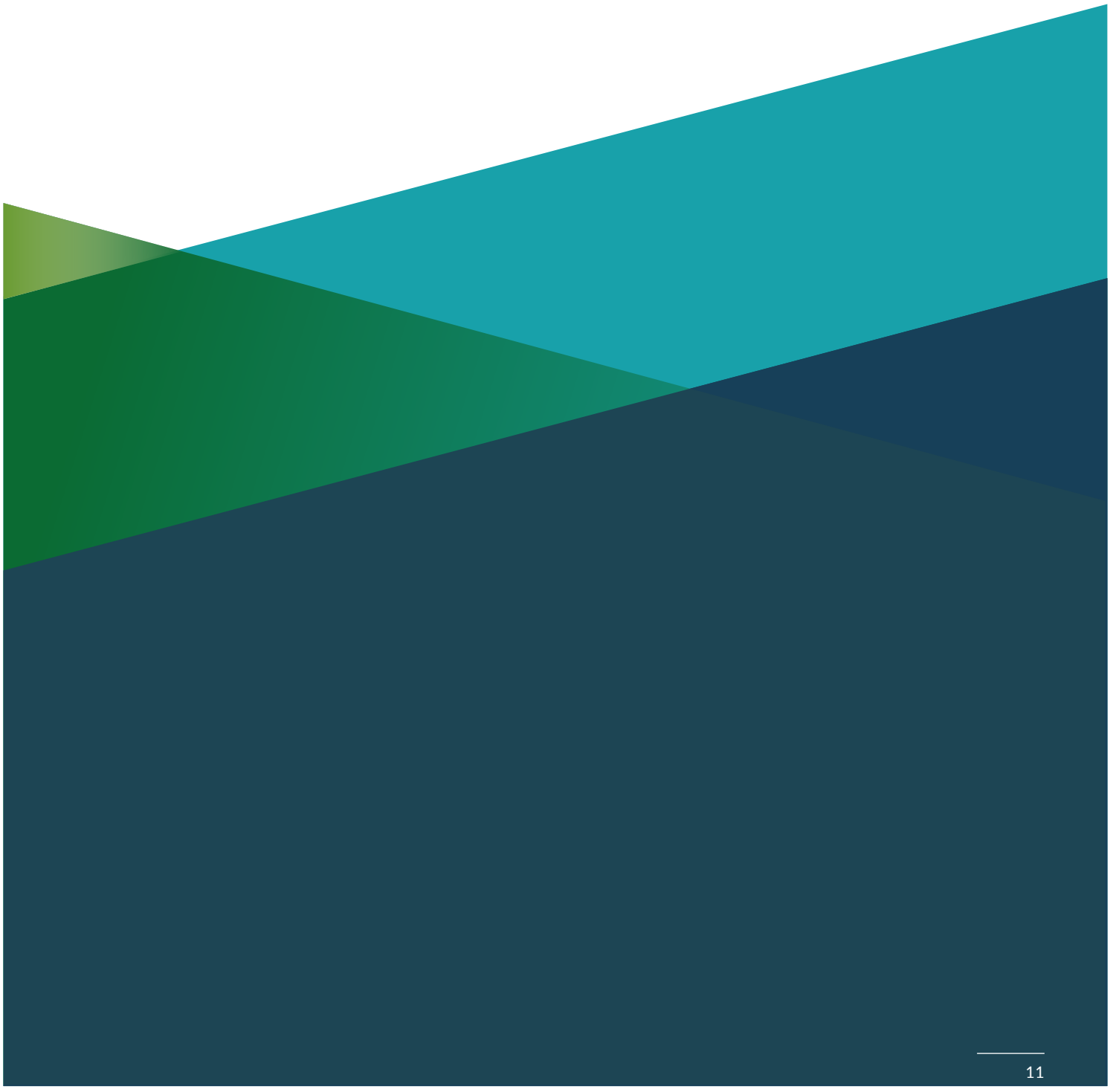
Extreme cold snaps

The island of Ireland has the highest levels of excess winter deaths in Europe with up to 2,800 excess deaths every winter (excess winter deaths are the number of deaths that take place during winter months compared with the rest of the year) (McAvoy, 2007). While climate change projections see generally warmer winters that may reduce the risk of cold-related illness, significant health impacts will continue from extreme cold snaps and more frequent heavy precipitation events during winter, including snow, sleet or hail.

Major predicted climate risks and health impacts



Chapter 1
Introduction



"Climate change is one of the greatest challenges of our time. Climate change will affect, in profoundly adverse ways, some of the most fundamental determinants of health: food, air, water. In the face of this challenge, we need champions throughout the world who will work to put protecting human health at the centre of the climate change agenda".

Dr. Margaret Chan, Director-General, World Health Organization (2006–2017)

Mandate and vision

This is the first Climate Change Adaptation Plan for the health sector.

This Plan is one of twelve sectoral adaptation plans developed under the *National Adaptation Framework (2018)* and the *Climate Action and Low Carbon Development Act 2015*. The Plan was developed using the *Sectoral Planning Guidelines for Climate Change Adaptation (2018)*.

Action to address climate change is generally categorised as either mitigation or adaptation, although there can be overlap between the two. This Plan is primarily concerned with adaptation for the health sector.

> *Adaptation is defined as a change in natural or human systems in response to the impacts of climate change. These changes moderate harm or exploit beneficial opportunities and can be in response to actual or expected impacts* (Department of Communications, Climate Action and Environment [DCCAE], 2018).
>
> *In contrast, mitigation is defined as action to reduce the likelihood of an event occurring or reduce the impact if it does occur. This can include reducing the causes of climate change (for example emissions of greenhouse gases) as well as reducing future risks associated with climate change* (DCCAE, 2018).

The **vision** of this adaptation plan is **reduced climate vulnerability across the health sector**. This will involve protecting people's health and wellbeing to prevent avoidable illness, and increasing the resilience of our health and social care services and our critical infrastructure to severe weather events and other negative effects of climate change.

The Plan identifies the main climate change-related impacts and risks we expect to face in the health sector in the years 2019 – 2024, and beyond. The Plan focuses on adaptation responses and identifies concrete measures we can take to build resilience and to reduce our vulnerabilities.

This adaptation plan will apply to:

- the Department of Health;
- agencies of the Department of Health including the Health Service Executive (HSE);
- all relevant external organisations which provide services on behalf of the HSE; and
- non-HSE health sector services, including General Practice, private hospitals and nursing homes.

Our approach to climate change in the health sector needs to be urgent, dynamic and collaborative. The process of developing this Plan has been a good start, bringing together relevant doctors and officials in the Department and the HSE, and gaining valuable input from stakeholders and from the public at large.

A new Climate Change Oversight Group for the health sector, led by the Department of Health, will be inclusive and decisive in its approach. Some of the priority practical actions in the next five years, set out in Chapter 4, will include:

- clear, whole-of-organisation leadership demonstrated by the Department of Health and by the HSE;
- collaboration with all relevant stakeholders;
- development of a new public health heat-wave plan;
- step-change in public awareness and behaviour given serious risks from exposure to UV;
- conducting and widely sharing lessons learned after each severe weather event, as standard;
- applying a Health In All Policies approach. The Department of Health supports the introduction of public health impact assessment for proposed legislation in relevant policy areas such as planning and climate;
- priority focus on research and data in order to develop a better understanding of the health impacts of climate change; and
- a major survey of health infrastructure resilience to severe weather events to be conducted.

Health context and the case for adaptation

The health sector already features a multitude of existing pressures and service challenges, together with emerging strategic challenges such as demographic pressures from our ageing population.

Climate change adaptation may not appear to be the most urgent or immediate issue for patients and people using our health and social care services, or for professionals working in them. However, evidence and projections show that, without decisive adaptation action, climate change will have profound impacts for the health and wellbeing of people in Ireland, for the smooth delivery of our health and social care services, and for our critical infrastructure.

Climate change will increase demands on our health and social care services. Although all of the population will be exposed to climate change, health effects will be felt most by our most vulnerable citizens. These include the elderly, children, those with pre-existing medical conditions, the urban poor, farmers and coastal populations.

In particular, research has found that age, pre-existing medical conditions and social deprivation are all found to increase vulnerability to climate change impacts (Paavola, 2017). Some concrete examples include:

- children have the highest prevalence of asthma, so may be more vulnerable to aeroallergens;
- elderly people have difficulty thermo-regulating so are more vulnerable to temperature extremes;
- migrants without functional English language may have difficulty following health advice during emergencies; while
- people with respiratory and cardiac diseases are more likely to have a worsening of their health due to air pollution.

Possible measures to address health and social inequalities relating to climate change include health education and public preparedness measures that take account of different levels of exposure, sensitivity and adaptive capacity of different groups (Paavola, 2017). It is imperative that efforts to reduce the impact of climate change do not increase health inequalities.

It is important to acknowledge adaptation actions already underway in the health sector. This Plan references diverse adaptation work in areas such as business continuity planning, emergency preparedness for severe weather events, infrastructure resilience, skin cancer prevention, and vector-borne and waterborne disease surveillance and prevention programmes. Implementation of this Plan offers the opportunity to draw together and build upon this valuable existing work.

It is also important to note that there are a number of health benefits projected to occur as a result of climate change, for example warmer weather may reduce the risk of cold-related illness and death and may potentially improve mental health and wellbeing and increase physical activity levels.

Mainstreaming climate change adaptation

Successful adaptation planning and action for the health sector require climate change considerations to be mainstreamed into existing health strategies and programmes, and incorporation of health as a cross-cutting issue in other sectors, as many of the health threats posed by climate change are inherently linked to threats posed in other sectors. Without effective coordination, adaptation may take an isolated and fragmented approach, and increase the chances of unintended policy consequences.

Health in All Policies is an approach to improving the health of all people by incorporating health considerations into collaborative decision-making across sectors and policy areas. Health in All Policies, discussed further in Section 4.3, highlights the fact that the determinants of health (a complex range of social, cultural, economic and environmental factors that affect health) are influenced by actions in other Government sectors, as well as by other factors in society.

Health in All Policies and other intersectoral strategies present opportunities to drive health-relevant climate change action across government. The intersectoral approach requires the use of validated tools and support mechanisms, including Health Impact Assessment; cross-sectoral action teams; mechanisms for early warning and action across agencies; and ensuring that population health is firmly on the agenda in all sectors.

A good example of the Health in All Policies approach is provided by Healthy Ireland, the national programme to improve health and wellbeing. Healthy Ireland highlights a number of cross-sectoral objectives and opportunities of relevance both to climate change and reducing health inequalities: improving active travel, availability of good quality open and green spaces, improving the food environment in local areas, and energy efficiency of housing.[1] There are opportunities to build climate resilience through established networks and processes such as Health and Wellbeing County Plans, community groups, and existing emergency planning and business continuity plans.

The *Sustainable Development Goals National Implementation Plan 2018–2020* also offers a relevant whole-of-government mechanism through which to address resilience in multiple ways that are of relevance to Ireland's goal of successful climate change adaptation.[2]

1 Information on Healthy Ireland is available on www.gov.ie.
2 The 17 Sustainable Development Goals (SDGs) focus on policy areas such as poverty, economic development, protection of the environment, and access to health and education services.

It seems likely that framing climate change as a public health matter can help to increase public engagement with the issue (Myers, 2012). While awareness of the need for adaptation remains poor, with correspondingly low levels of willingness to engage (Climate Change Advisory Council, 2019), discussing climate change in terms of public health issues may make impacts more personally relevant for people. This can be particularly resonant in supporting pro-environmental behaviour among a younger audience (Stevenson and Peterson, 2016).

Both adaptation and mitigation actions can contribute towards achieving other policy objectives (termed co-benefits). Health co-benefits can arise through several pathways. A common example given is that active travel policies can reduce illness and deaths associated with respiratory and cardiovascular conditions by reducing vehicular emissions. The Climate Change Oversight Group will need to consider how best to ensure that health sector adaptation and mitigation initiatives are integrated, and how to advance mitigation planning and action.

Limitations – more research, better data

Developing the evidence base to better inform policy-making and concrete adaptation measures is a prominent theme throughout this Plan (see Section 4.2). For example, the availability of more quantitative data on health impacts relating to UV and air pollution, compared with data on other climate stimuli, influenced the priority accorded to these health impacts.

Furthermore, while the present Plan focuses mainly on the coming five years, future plans will need to consider longer time horizons and a wider range of possible climate change impacts. Such a focus will be established early in the implementation phase, during the envisaged stakeholder consultation with the research community.

Adaptation planning is an iterative process. Climate change adaptation in the health sector will evolve over time as the evidence base and our understanding of the effects of climate change improves. The present Plan will be refined and strengthened as new information and research become available.

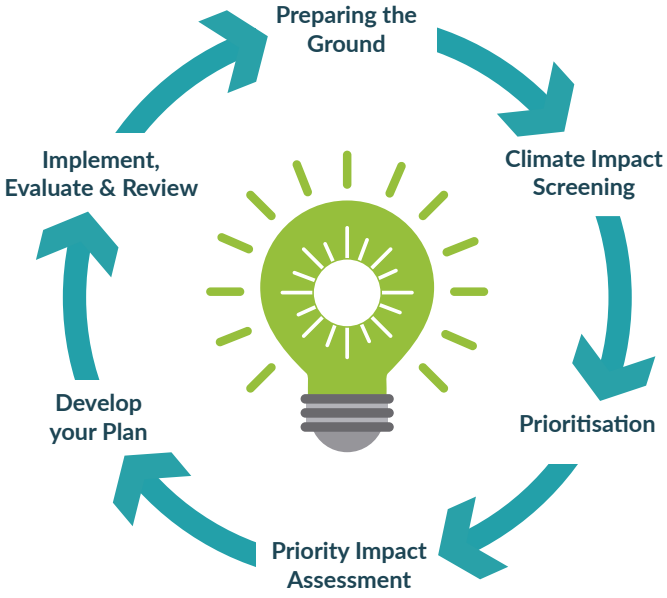
Development of this Plan

This Plan was developed collaboratively and is based on national and international evidence and data.

Table 1: Meetings of the Sectoral Adaptation Team

Date	Event
May 2019	Department of Health preparatory meetings
27 May 2019	Sectoral Adaptation Team initial meeting
6 June 2019	Stakeholder consultation forum
26 June 2019	Risk Workshop 1 – Sectoral Adaptation Team
5 July 2019	Risk Workshop 2 – Sectoral Adaptation Team
25 July – 25 Aug 2019	Public consultation
16 August 2019	Sectoral Adaptation Team meeting
27 August 2019	Meeting with the Department of Public Expenditure and Reform
4 September 2019	Sectoral Adaptation Team meeting
9 Sept 2019	Sectoral Adaptation Team + (Adaptation Action focus)

The team followed the six-step planning cycle set out in the *Sectoral Planning Guidelines for Climate Change Adaptation (2018)*. The structure of this Plan largely corresponds to the steps in that planning cycle.[3]



3 Along with the health sector, the other eleven sectors which have produced adaptation plans are: seafood; agriculture; forestry (led by the Department of Agriculture, Food and the Marine); biodiversity; built and archaeological heritage (Department of Culture, Heritage and the Gaeltacht); transport infrastructure (Department of Transport, Tourism and Sport); electricity and gas networks; communications networks (Department of Communications, Climate Action and Environment); flood risk management (Office of Public Works); water quality; water services infrastructure (Department of Housing, Planning and Local Government).

Table 2: Climate change adaption planning process

Climate Change Adaptation Plan – Health	Six-step adaptation planning cycle
Chapter 1 - Introduction	Step 1 – Preparing the Ground
Chapter 2 – Scene-setting: climate change, health and Ireland	Step 2 – Climate Impact Screening
Chapter 3 – Prioritisation	Step 3 – Prioritisation
	Step 4 – Priority Impact Assessment
Chapter 4 – Adaptation Action	Step 5 – Develop Your Plan
Chapter 5 – Implementation and Review	Step 6 – Implement, Evaluate and Review

Chapter 1: Introduction (Preparing the Ground)

The Plan was developed by a sectoral adaptation team with relevant experience from the Department of Health and the HSE. Team membership and meetings are outlined in Appendix II.

The planning process included stakeholder engagement, a public consultation exercise, and proactive engagement from other government sectors (because so many health impacts can originate elsewhere).

Chapter 2: Scene-setting: climate change, health and Ireland (Climate Impact Screening)

Chapter 2 gives a summary of Ireland's baseline health status, identifies vulnerable groups and identifies trends already projected to affect demand for services during the longer-term climate risk period. The chapter gives an overview of Ireland's climate, predicted climate changes for the country and their potential impacts on health.

Chapter 2 draws on two reviews of national and international literature that were conducted on the scientific evidence relating to the health impacts of climate change: the first literature review, *Climate change adaptation in the health sector – a scoping document*, is being made available in conjunction with the present Plan; the second was published in June 2019 by the Department of Health as the research paper Health Impacts of Climate Change and the *Health Benefits of Climate Change Action: A Review of the Literature*.

Chapter 3: Prioritisation (Prioritisation and Priority Impact Assessment)

Chapter 3 describes the process by which climate change-related health impacts were prioritised and assessed.

The views of relevant stakeholders were gathered at a consultation forum held on 6 June 2019 at the Department of Health. Along with overview presentations and plenary discussion, representatives of 16 organisations participated in three breakout sessions: on population health; on emergency management / business continuity; and on vulnerability assessment.

The core, detailed risk assessment of the health impacts of climate change was conducted during two workshops held by the sectoral adaptation team in June and July 2019. Risk assessment and scoring (impact and likelihood scales) were informed by the approach in the Major Emergency Management framework (see Appendix V). The public health risk assessment considered the likelihood of each

climate scenario or event based on observed and projected climate change, as well as the magnitude of the potential health impact, informed by the particular health vulnerabilities in Ireland relating to our geography, environmental influences on health, and health behaviours. The risks posed were examined separately from the perspectives of health of the population, service continuity and infrastructure resilience:

- **population health and wellbeing:** Ireland's healthcare system will need to prevent avoidable illness where possible and, where not, be prepared for different volumes and patterns of demand;
- **health service continuity** during acute events: effective emergency planning and business continuity planning, preparedness and response will be essential to ensure operational continuity and service delivery during severe weather events;
- **infrastructure resilience** to severe weather: the system infrastructure (buildings, communications, emergency service vehicles, models of care) together with the supply chain (fuel, food, medical supplies) will need to be made more resilient to more frequent severe weather events and other impacts of climate change.

Six priority climate stimuli or events of most concern, with the most profound health implications, were identified as part of this process. Two of the six scenarios relate to slow onset climate-mediated effects over time (UV radiation and air pollution) while four scenarios concern acute, severe weather events (windstorms, extreme heat and heatwaves, high precipitation and flooding, and extreme cold snaps).

A public consultation exercise in July – August 2019 invited views from members of the public on whether these six priorities accurately represented the highest priority risks for the health sector; what other vulnerabilities should be included; and welcomed suggestions for concrete and cost-effective adaptation actions. 38 submissions were received from individuals and organisations. The exercise was successful in broadening the net to gather valuable input from those with particular interest or expertise, and several ideas and proposals from the public consultation feature in this Plan.

Chapter 4: Adaptation Action (Develop Your Plan)

Chapter 4 features a table with priority adaptation planning and actions to be undertaken in the next five years and beyond. The list is not exhaustive. Actions are grouped under five action areas (or broad goals), each of which contain specific actions (or objectives):

Table 3: Action Areas

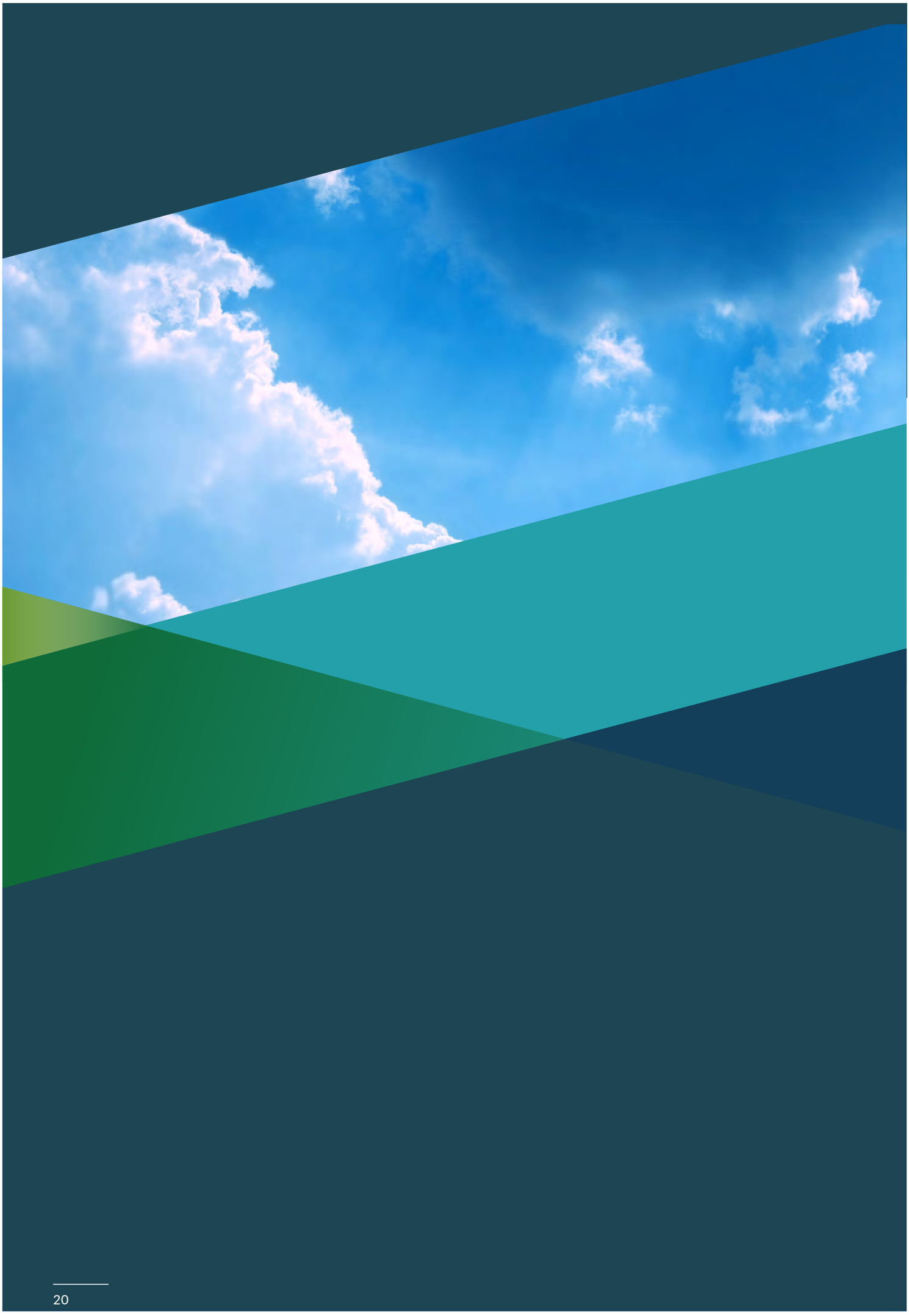
Action Area (Goal)	
1	Leadership and oversight
2	Severe weather events
3	UV radiation
4	Air pollution
5	Monitoring, research, evaluation

The importance of leadership and oversight to ensure that planning translates into effective adaptation action was identified both during the stakeholder consultation and it also features in the international literature. Severe weather event-related planning, preparation, emergency response and reviews are grouped into one area. Measures relating to two slow onset effects of climate change each have their own action area: UV radiation and air pollution. Steps to ensure monitoring, research and evaluation of the Plan comprise the final area. Given their importance, there are sections at the end of Chapter 4 on research and data, and on intersectoral collaboration.

The present Plan benefited from the learning arising from adaptation planning in health sectors in other countries (as identified in the international literature), as well as from insights from adaptation planning in other sectors in Ireland. Members of the sectoral adaptation team also brought rich experience and insights from their own areas of expertise that informed the group's deliberations, for example lessons learned from Ireland's emergency response to severe weather events over the last number of years.

Chapter 5: Implementation and Review (Implement, Evaluate and Review)

Chapter 5 describes the implementation and review arrangements, expanding on and adding nuance to the provisions in the final action area of the Adaptation Actions Table in Chapter 4. A Climate Change Oversight Group will drive and oversee implementation of the Plan; will closely collaborate with relevant stakeholders within and outside the health sector; and will monitor and review progress, including any unintended consequences that may arise.



Chapter 2
Scene-setting: Climate change, health and Ireland

This chapter begins with an overview of Ireland's baseline health status, our climate and predicted climate changes for Ireland. A literature review entitled *Climate change adaptation in the health sector – a scoping document* (Department of Health, 2019a), published alongside this Plan, informs much of the material in this chapter. The review specifically focused on the potential health effects of predicted climate change for Ireland. These are grouped into the health impacts of temperature changes (heatwaves, UV radiation, air quality, vector-borne disease, and food security and safety), the health impacts of drought and flooding, and the health impacts of storms, together with discussion of mental health impacts and risks to our health services.

2.1. Health in Ireland, climate in Ireland

2.1.1 Health of the population

Building health and health service climate resilience requires understanding the current state of health and healthcare, and recognising the importance of maintaining and improving effective services.

Ireland's population in 2019 is estimated to be approximately 4.92 million. The population is growing across all regions and age groups, with the most significant growth seen in the older age groups. Assuming moderate changes in migration and fertility rates, the total population is projected to reach 5.64 million by 2038, by which time more than one in five people is expected to be aged 65 years or older. The dependency ratio in Ireland - the number of people in Ireland aged less than 15 or over 64, as a percentage of those aged 15-64 - is projected to increase from about 53% in 2018 to 57% in 2038.

Some of the high-level measures of the health of the population that indicate the quality of Irish health services include:

- overall, life expectancy continues to increase for women and men;
- while the principal causes of death in the Irish population in 2018 were malignant cancers (29.6%), circulatory diseases (28.7%) and respiratory diseases (13.4%), age standardised death rates for major causes of death are decreasing, and survival rates for common cancers are increasing;
- infant mortality rate (IMR) in Ireland is about 3/1000 live births and is lower than the EU 28 average. This measure indicates the quality of the child health services including childhood vaccination; and
- maternal mortality rate is an indicator of the quality of the antenatal and obstetric services in a country. The maternal mortality rate is 6.5/100,000 and as such is considered very low, for example less than the UK (8.8/100,000) or the US (26.7/100,000).

However, there are also major challenges for the future in sustaining health, and for the planning and provision of health services. These include increasing health inequalities, with the gap in life-expectancy increasing between higher and lower socio-economic groups, and population ageing in conjunction with lifestyle-related health threats. These and other strategic challenges such as climate change render it imperative for health planning to include:

- prevention of avoidable illness, which should also minimise the demand for services;
- extension of the analysis of cost-effectiveness of existing services;
- monitoring and evaluation of the quality of services; and

- integrated planning, to minimise gaps, and prevent unnecessary duplication of services, an area currently being addressed as part of the Sláintecare programme of reform.

2.1.2 Climate in Ireland

The island of Ireland consists of a large central lowland of limestone with a relief of hills and several coastal mountains and is situated in the north-west of Europe. Influenced by the Gulf Stream, and with the prevailing south-westerly winds, the climate of Ireland is temperate. Observed changes in Ireland's climate over the last century are in line with global and regional trends associated with human-induced climate change: temperatures have increased, precipitation patterns have changed, and sea levels have risen. These changes are expected to continue and to intensify in the future.

The most striking effect can be seen in the increased temperature. Temperatures have risen by 0.7°C between 1890-2008 and most significantly by 0.4°C between 1980-2008, with knock-on effects on Ireland's natural environment, changing the growing season and increasing the number of disease-causing organisms that thrive in warmer temperatures.

An increase in the frequency and impact of storms has also been recorded in the last few decades. Ireland's location means that it is frequently exposed to storms from the North Atlantic, particularly in winter. Weather characteristics that typify storms include high wind speed, and high precipitation falling as rain, freezing rain, hail or snow. As an island we are particularly vulnerable to increasing sea levels with coastal regions facing flooding (coastal areas also typically experience higher wind speeds than inland areas). Sea level measurements from 1993 to 2015 suggest a rise of 1-2mm per year around the western and southern coasts of Ireland, and 2-3mm per year on the east coast. Census 2016 figures established that 1.9 million people (40% of the Irish population) reside within 5km of the coast and, of this figure, 40,000 of these live less than 100 metres from the nearest coastline. 62.7% of the population live in urban areas (some of whom are at risk from urban heat effect). These data highlight the potential for increasing vulnerability of the population to climate change.

2.1.3 Climate change projections for Ireland

New global climate model simulations provide an update on the expected changes in the Earth's climate over the 21st century. Ireland's Met Eireann and the Irish Centre for High-End Computing (ICHEC) have contributed to the development of the EC-Earth Model and the running of simulations, as described by Gleeson, McGrath and Treanor (2013) and Nolan (2015). Data from these, and other global models relevant to Ireland, have been used in updating the projections for future Irish climate and some of the key results are as follows:

- winters are expected to become wetter (especially in the West), with increases of up to 14% in precipitation by mid-century; summers will become drier (especially in the South East), with up to 20% reduction in precipitation;
- heavy precipitation events during winter are likely to increase by up to 20%;
- the energy content of the wind during winter months is predicted to increase by up to 8% and decrease by up to 14% during summer months; and
- warmer winters and summers by about 1.5 degrees in mean temperatures by mid-century – warming extremes are likely to be an increase of up to 2 degrees in summer days and up to 3 degrees in winter nights.

In summary, climate change in Ireland is likely to lead to more severe weather events (including storms, heatwaves and extreme cold snaps), precipitation changes with resultant flooding and drought, and sea level rise. Apart from individual changes as above, combinations of changes are likely to occur: heatwaves and drought, perhaps followed by flooding; or storms with high winds and heavy rainfall and storm surges affecting coastal regions.

2.2. Effect of climate change on human health

The most basic needs for human health are air, water, food and shelter (O'Brien and Wolf, 2010). These needs are directly influenced by the quality of the environment into which people are born and in which they live, work and age (Wall, Derham and O'Mahony, 2016). The link between climate and disease has long been recognised, although our understanding of the relationship between climate and health has deepened as more research has emerged to inform the fields of environmental health, global climate modelling and how the social, cultural and political landscapes influence our environment and our health (Bell and Greenberg, 2018).

While climate change impacts humans directly through alterations in the frequency and severity of weather patterns, the role of climate on health extends beyond this, as climate change influences most systems that are essential for supporting life (Bell and Greenberg, 2018). Consideration of the extent and breadth of this influence, against the backdrop of the unpredictable nature of extreme weather events, highlights the potential vulnerability of society to the risks of climate change, and the need for cross-sectoral linkages in adaptation planning for public health (discussed further in Chapter 4).

Climate change has been heralded as "the biggest global health threat of the 21st century" with the World Health Organization (WHO) estimating that there will be an additional 250,000 deaths per year from 2030 to 2050, likely secondary to malnourishment, diarrhoea, malaria and heat exposure (Costello *et al.*, 2009; Neira, 2014). The Health Protection Agency (UK) has predicted a 70% increase in premature deaths secondary to heatwaves in the coming decade (2020 and beyond) (Vardoulakis and Heaviside, 2012). Although all populations will be affected by climate change, vulnerable populations such as the elderly, children, and those with chronic illnesses will be disproportionately affected (Senior, 2015; Crowley, 2016). The extent of an individual's vulnerability to climate change will depend on their socio-demographic characteristics, their social infrastructure, access to resources such as health services and their level of exposure to climate change (WHO Europe, 2017a). Understanding exposure pathways and how to interrupt them is key to developing effective prevention and adaptation measures.

2.3. Health implications of climate change in Ireland

2.3.1 Health impacts of temperature changes

Mean temperatures in Ireland have increased by an average of 0.07°C per decade since 1900 (Dwyer, 2012). Ireland has seen an increase in the number of warm days while the number of cold days has concomitantly decreased (Nolan *et al.*, 2013). National projections for 2050 and beyond indicate that an increase in mean annual temperatures (1-1.6°C) is projected and that all seasons could potentially become warmer (Gleeson, McGrath and Treanor, 2013; Nolan, 2015). Furthermore, an increase in the frequency of heatwaves has been projected (Desmond, O'Brien and McGovern, 2017).

Heatwaves

While warmer weather may reduce the risk of cold-related morbidity and may potentially improve wellbeing and physical activity levels, recent weather events across Europe and further afield have demonstrated the capacity that extreme heat can have on population health (DOH, 2017; RTE, 2018; Rey *et al*., 2007; Dear and Wang, 2015). The health effects of extreme heat include rashes, cramps, dehydration, heat exhaustion and heat stroke whilst also aggravating pre-existing health conditions including cardiovascular, respiratory, cerebrovascular and neurological disorders (Kenny *et al*., 2010; Lowe, Ebi and Forsberg, 2011; Public Health England [PHE], 2014). Moreover, there appears to be a higher level of healthcare service utilisation during periods of extreme heat (Scalley *et al*., 2015; Smith *et al*., 2016).

Heat waves are responsible for excess deaths every year: 70,000 premature deaths were attributed to a heatwave across Europe in 2003 while extreme heat was associated with 7,400 deaths in the United States (US) from 1999 to 2010 (Rey *et al*., 2007). An Irish study attributed 294 excess deaths to heatwaves in Ireland over three decades, with most of the deaths in the 1980s (Pascal *et al*., 2013). It is likely that the burden of mortality caused by heat waves will be disproportionately carried by more vulnerable groups within the population such as the elderly, children and those with chronic diseases (PHE, 2014; Ciscar *et al*., 2014; WHO Europe, 2008).

City dwellers are exposed to higher heat stress and are at greater risk of ill health due to extreme heat events because of urban heat islands and other effects (Stone *et al*., 2010; Uejio *et al*., 2011). The findings of the Urb-ADAPT research project, which aims to identify the impact of climate change on Dublin city and towns within the greater Dublin region, will inform future health sector policy in this regard. The project aims to identify risks to the population living in that area and future risks posed to it by the changing climate covering two key strands, water and heat (Urb-ADAPT, 2016).

Given Ireland's ageing population, and the expected commensurate rise in numbers of those living with chronic diseases, it is possible that extreme heat secondary to climate change could place a significant additional burden on healthcare services in Ireland.

Increased exposure to ultraviolet radiation

Ultraviolet (UV) radiation is the main risk factor responsible for skin cancers. Climate change may result in the Irish population having increased exposure to ultraviolet radiation (UVR), due to higher levels of ambient UVR as well as due to changes in human behaviour (e.g. more time spent outdoors in the warmer weather, variation in the measures taken to protect oneself from UVR) (Bharath and Turner, 2009; Thomas, Swaminathan and Lucas, 2012). Caucasian populations are the most vulnerable to skin cancers, particularly those of Celtic descent (Thomas, Swaminathan and Lucas, 2012; WHO, 2003).

In Ireland, skin cancer is the most common form of cancer. With over 11,000 cases diagnosed each year it accounts for over one-third of all cancers diagnosed annually. It is generally classified into two groups: melanoma and non-melanoma skin cancer. Over 1,000 people are diagnosed with melanoma annually in Ireland. Although it is not the most frequently diagnosed skin cancer, it is most associated with significant ill-health, is much more likely to spread to other parts of the body and can be fatal. Non-melanoma skin cancer accounts for over 10,000 cases per year. This skin cancer is much more common but is less aggressive, slowly progressing over months or years. Intermittent or recreational UVR exposure on the one hand and chronic sun exposure on the other are the main risk factors for different types of non-melanoma skin cancer (NCR, 2017).

The number of people being diagnosed with skin cancer in Ireland is rising rapidly. Between 2015 and 2045, it is predicted that the number of cases of melanoma per year among males will increase to 1,678 (+207%) and for females to 1,400 (+140%). The number of people diagnosed with non-melanoma skin cancer over the same time period is predicted to increase to 16,623 (+177%) for males and 13,503 (+189%) for females (NCR, 2019). Significantly, these projections are based on past trends and do not take into account additional risks such as climate change. Future research should address this.

A priority action of the *National Skin Cancer Prevention Plan (2019-2022)* is to increase national awareness of skin cancer prevention and improve adoption of skin cancer preventative behaviours.

Air quality

Climate change is expected to aggravate existing health risks from poor air quality due to weather-driven increases in air pollutants such as ozone and particulate matter (WHO Europe, 2013). Particulate matter is the mix of various solid and liquid particles found in the air, many of which can be hazardous, including dust, soot, smoke, pollen and liquid particles. Exposure to particulate matter is associated with increased all-cause and cardiovascular illness and death, respiratory disease in childhood and adverse birth outcomes (WHO Europe, 2013). Exposure to ozone is also associated with cardiovascular and respiratory illness and death (WHO Europe, 2013).

In Ireland, according to current estimates, there are 1,180 premature deaths per year due to poor air quality (Environmental Protection Agency [EPA], 2019). Within the EU, it is estimated that long-term exposure to the concentrations of PM2.5 (particles with a diameter ≤ 2.5 microns) and ozone recorded in 2014 were responsible for 399,000 and 13,600 premature deaths, respectively (European Environment Agency [EEA], 2017).

Older adults, individuals with chronic disease and children are particularly vulnerable to the health impacts of poor air quality (Crimmins *et al.*, 2016). Moreover, UK evidence highlights that deprived communities are more likely to be situated near busy roads and are more likely to experience adverse health impacts from air pollution (Department for Environment, Food and Rural Affairs, 2017), indicating the potential for links between geographical location and health inequalities.

Wildfires and the burning of stubble contribute to poor air quality and pose a health hazard. With climate change there has been an increase in wildfires, here in Ireland and across Europe as a whole. The *Draft Agriculture, Forest and Seafood Climate Change Adaptation Plan* addresses wildfire risk, which has been identified as a priority impact with consequences for air quality, and for animal and human health.

Aeroallergens such as pollens from trees and moulds have the potential to trigger an allergic response when inhaled by a vulnerable individual. An increase in aeroallergen levels can be linked to aggravation of respiratory diseases such as asthma and may lead to an increase in health service utilisation (Guilbert, 2018). Climate change may increase aeroallergen levels through higher temperatures, a prolongation of the pollen season and an increase in indoor growth of mould and fungus secondary to increased precipitation and flooding (Crowley, 2016).

There are approximately 450,000 people with doctor-diagnosed asthma in Ireland and there are indications that the prevalence is rising (DOH, 2018). The age-sex standardised rate of hospitalisation was 45 per 100,000 population in 2017 against a backdrop of a consistent increase in the rate over the preceding three years from 41 per 100,000 population in 2014 to 46 per 100,000 population in 2016 (DOH, 2018; DOH, 2017). In 2011, the HSE reported that approximately 20,000 Emergency Department attendances and 50,000 out of hours GP consultations were due to asthma (HSE, 2011).

Chronic obstructive pulmonary disease (COPD) is another prevalent respiratory disease in Ireland with an estimated 500,000 people aged over 40 years living with the disease (DOH, 2018). Ireland's rate of hospitalisation for COPD is significantly higher than the OECD average (370 per 100,000 of the population compared with 190 per 100,000), although Ireland's hospitalisation rate has been falling in recent years (DOH, 2018).

Cardiovascular disease continues to account for a large proportion of illness and death in Ireland, and by the year 2020 it is projected that the number of Irish adults living with a diagnosis of coronary heart disease will exceed 103,000 (DOH, 2018; Institute of Public Health [IPH], 2012). While it must be acknowledged that these chronic diseases are multifactorial in origin, it is apparent that they already represent a significant burden on the acute health services in Ireland. It is possible that climate change may contribute further to this burden, especially because of the worsening air pollution risk.

Climate change is also likely to influence several aspects of indoor environmental quality. Examples include more frequent periods of high indoor temperatures and associated heat stress, driven by more frequent outdoor heat waves; changes in indoor air pollutant levels driven by changes in outdoor air pollution; and increased indoor dampness and mould problems as a consequence of having more frequent severe storms. Indoor environmental quality will be affected, positively or negatively, by changes in building designs and operational practices implemented to mitigate and adapt to climate change.

The magnitude of the changes in indoor environmental quality will depend on the extent of climate change and on the climate change mitigation and adaption measures that are implemented. In Ireland, the HSE provides advice on building regulations to the EPA, the Department of Housing, Planning and Local Government, and the Department of Communications, Climate Action and Environment. The HSE has highlighted the need to consider radon prevention as well as ventilation in relation to volatile organic compounds and other indoor hazards while making buildings more air-tight.

In general, a decrease in pollutant emissions would reduce the negative effect of climate change, leading to an improvement in projected air quality. Actions to cut air pollution bring major co-benefits, providing added justification for policies to cut greenhouse gas emissions. For example, reduction of greenhouse gases and associated pollutants from industrial sources would give rise to co-benefits of decreased exposures to outdoor air pollution and reduced risks of cardiovascular disease, chronic and acute respiratory illnesses, lung cancer, and preterm birth.

Significant causes of air pollution in Ireland are particulate matter from domestic burning of solid fuels and nitrogen dioxide from vehicle emissions in urban areas. One solution is to move towards cleaner ways of domestic heating and the EPA notes that movement towards cleaner modes of home heating will have a subsequent improvement on air quality. Other measures include improving the energy efficiency of our buildings and implementing the transport options outlined in the Government's *Climate Action Plan 2019*.

Increases in active travel and reductions in pollution due to modifications to the built environment, including improved access to public transport, would have important co-benefits of increased physical activity; reduced obesity; reduced disease burden; health service costs averted; improved mental health; reduced exposure to air pollution; increased local access to essential services, including food stores; and enhanced safety (Smith, 2014).

Changes in vector-borne diseases

Climate change may affect the exposure, and therefore level of risk, to health from vector-borne diseases in a number of ways: through changes in the geographic distribution of the transmission cycles; changes in the numbers of pathogens and vectors; evolutionary changes of pathogens with the potential for a subsequent increase in transmissibility to humans and increased capacity to cause disease; and changes in the level of exposure of individuals to vector-borne diseases secondary to changes in human behaviour as a result of climate change (Berry *et al.*, 2014).

A review examining the projected effects of climate change on vector-borne disease incidence in Europe suggests a higher risk of West Nile Fever associated with milder winters, drier spring and summer seasons, and wetter autumn seasons (Semenza and Menne, 2009). Warmer weather is also associated with an increase in the length of the transmission season for dengue fever, with an increase in humidity also having the potential to impact on the geographic footprint of dengue vectors (Semenza and Menne, 2009). 10 cases of dengue were notified in Ireland during 2017 (this corresponds to a crude incidence rate (CIR) of 0.2 per 100,000 population). While the potential for indigenous malaria transmission in Europe secondary to climate change is recognised, it is likely that the highly developed socio-economic and healthcare sectors in European countries would limit its re-emergence.

A risk assessment of the potential emergence or re-emergence of indigenous vector-borne disease in Ireland that was undertaken by the HSE's Health Protection Surveillance Centre (HPSC) in 2016 recognised the impact of climate change on potentially increasing vector density for malaria, and the ongoing surveillance and treatment of imported cases is identified as likely to be effective in reducing the risk of indigenous transmission (HPSC, 2016).

With regard to ticks, projected temperature rises in Europe may alter their seasonal activity whilst also increasing the geographic areas of potential disease transmission (Gray *et al.*, 2009). Furthermore, changes in vegetation to favour ticks' habitats also have the potential to impact on their abundance (Gray *et al.*, 2009). Indeed, changes in tick distribution secondary to climatic changes have already been described in parts of Europe (Pettersson *et al.*, 2014).

In Ireland, warmer winters have the potential to support increased numbers and increased levels of activity of ticks, whilst also potentially extending their lifespan. While a combination of warmer summers with reduced rainfall may have an adverse effect on tick survival, the availability of an appropriate habitat will support continued tick activity and a projected increase in forest cover will also support the survival of host animals (Cullen, 2010).

This may have implications for the incidence of Lyme disease. Lyme disease is an infection transmitted to humans by bites from ticks infected with the bacteria. In 2017 in Ireland twelve cases of Lyme neuroborreliosis were notified, corresponding to a crude incidence rate (CIR) of 0.3 per 100,000 population.

Antimicrobial Resistance (AMR)

A recent study presented at the 29th European Congress of Clinical Microbiology & Infectious Diseases (ECCMID) has identified an association between climate change and antibiotic resistance (where antibiotics no longer work on bacteria they used to kill). The possibility that AMR and climate change might be linked first gained attention when it was noticed that AMR increased with rising temperatures in the US.

Recent research has investigated whether this was also the case in Europe, with its diverse range in healthcare systems. The authors found strong associations of carbapenem-resistant *Klebsiella pneumoniae* (CRKP), multi-resistant *Escherichia coli* (MREC) and methicillin-resistant *Staphylococcus aureus* (MRSA) with warm season change in mean temperature. These temperature changes had a higher contribution to MRSA variance than outpatient antimicrobial drug use. Additionally, a rise in carbapenem-resistant *Pseudomonas aeruginosa* (CRPA) was significantly associated with the warm season change in temperature. Further research is required in this area.

Food security and food safety

A literature-based review has assessed the potential effects of climate change on food safety and public health for people on the island of Ireland (Safefood, 2014). This review highlighted issues for further research and monitoring, such as: the impact of climate change on mycotoxin contamination of cereal grains; the impact of wetter soils and weather on crop quality; the impact of climatic changes on prevalence of harmful algal blooms and the implications to aquaculture food safety; and the impact of the increase in the disease burden on some agricultural livestock. Administration of veterinary medicines to food animals is likely to increase, contributing to the current problem of antimicrobial resistance.

Reductions in potable water supply due to increases in evaporation rates, population increases, and related increased contamination events will lead to agriculture having to use more "raw" water as potable water becomes a more expensive commodity. This may lead to a more frequent threats to food safety.

Climate change will also influence food and nutrition-related health outcomes indirectly via changing prices of and access to food and energy (Paavola, 2017). Food shortages have been predicted as a result of changes in both volume and quality of food production. Food insecurity will more likely be experienced by the most vulnerable groups, further exacerbating health inequalities in Ireland. There is a chance that basic nutritional needs will not be met due to the expense of good quality food, resulting in a higher consumption of highly processed food, which carries extensive health risks. There will be a need to strengthen existing structures and policies to regulate food production, monitor food quality and safety, and respond to nutritional and safety issues that arise (Lake *et al.*, 2012).

2.3.2 Health impacts of drought and flooding

Precipitation

Ireland has experienced an increase in the average annual national rainfall of approximately 60mm during the time period 1981-2010 when compared with the time period 1961-1990, with the largest increases observed in the west of Ireland (DCCAE, 2018). Projected changes for Ireland would see an increased risk of drought on foot of significant projected reductions in average levels of spring, summer and annual rainfall, together with an increased risk of flooding because of a notable projected increase in the frequency of heavy rainfall events for winter and autumn possible by mid-century (DCCAE, 2018).

Drought

Water scarcity presents significant threats to public health, business and industry and agriculture (WHO Europe, 2008; Berry *et al.*, 2014; Vins *et al.*, 2015). This has been highlighted in the *Draft Climate Change Sectoral Adaptation Plan for Water Quality and Water Services Infrastructure*. A reduction in precipitation can lead to less dilution of contaminated waters, altered waterborne disease patterns and water contamination which may result in increased incidence rates of gastroenteritis (Haines *et al.*, 2006; WHO Europe, 2008). Further compounding the situation, hand hygiene may become compromised

during water shortages leading to increased rates of gastroenteric and respiratory diseases due to a real or perceived lack of available water (U.S. Department of Health and Human Services [HHS], 2010).

The use of contaminated raw or recycled water to irrigate crops during times of water shortages can contaminate foods, and also increase the risk of foodborne outbreaks of illness. Furthermore, a lack of rainfall may impact negatively on crop yields leading to a loss of income for farmers, food shortages and increased food costs. Such weather-related events have been shown to impact negatively on mental health (US HHS, 2010).

Finally, drought-like conditions may lead to the contamination of surface waters or other waters used for recreational purposes, such as bathing, with a potential increased risk of contracting waterborne infections (WHO Europe, 2008; US HHS, 2010). Climate change against a backdrop of expected population growth may also put greater pressure on water availability and increase the risk of water scarcity (Vins *et al*., 2015). Children, the elderly population, individuals with weakened immune systems, individuals whose livelihoods are sensitive to extreme weather conditions, and individuals with private wells may be particularly vulnerable to drought conditions (US HHS, 2010; Vins *et al*., 2015, Murti *et al*., 2016).

Droughts can have significant impacts on health and wellbeing. The European Drought Impact Report Inventory indicates that the most commonly cited impact category during droughts has been the agriculture and livestock category, followed by public water supply, energy and industry, wildfires, water quality, freshwater ecosystems and human health and public safety (Stahl *et al*., 2012). In Ireland, past droughts have caused notable agricultural and water resource challenges (Noone, 2018).

Flooding

The Intergovernmental Panel on Climate Change (IPCC) projects an increase in the frequency of heavy precipitation events across Europe in the coming decades, and it is considered very likely that the projected rise in sea levels will contribute to increases in extreme high-water levels in coastal regions (IPCC, 2014). While sea levels have not been accurately measured in Ireland, UK data have shown a sea level rise of 1.7cm every decade since 1916, and Irish sea levels are expected to rise in all coastal areas by up to 0.8 metres by the year 2100 (DCCAE, 2018).

Flooding has affected 50 of the 53 countries in the WHO European Region over the past ten years (WHO Europe, 2017b). The potential health effects of flooding can be divided into direct health effects from flood waters such as drowning and injury, and indirect health effects including impacts arising from damage to infrastructure. Population groups most vulnerable to the health effects of floods include the elderly, children, pregnant women, people with disabilities, tourists, members of ethnic minority groups and people who are homeless (WHO Europe, 2017b).

Observational studies indicate that the greatest contributors to flood-related deaths include drowning, myocardial infarctions, hypothermia and trauma, including road traumas (WHO Europe, 2008). There is a lack of certainty regarding the long-term health effects of flooding (Vardoulakis and Heaviside, 2012; WHO Europe, 2008). Flood-related injuries may occur due to direct contact with flood waters or during the clean-up phase following a flood (WHO Europe, 2017b; Jakubicka *et al*., 2010). It is likely that such injuries are under-reported in the literature. The occurrence of death and prevalence of injury secondary to flooding in Ireland is unknown.

An increase in zoonotic diseases – diseases that pass from an animal or insect to a human - such as leptospirosis in the aftermath of heavy flooding has been observed in European countries in recent decades, and this risk could also potentially increase with a warmer climate (Jakubicka *et al*., 2010).

The integrity of private wells may become compromised due to flood damage and this could potentially lead to an increase in waterborne illness (Centers for Disease Control and Prevention [CDC], 2016). In Ireland, it is estimated that approximately 720,000 people obtain their drinking water from a private supply and that there are in excess of 100,000 private boreholes, dug wells and springs in use (Engineers Ireland, 2018; EPA, 2017). Serious verotoxigenic E. coli (VTEC) outbreaks have been consistently associated with private wells in Ireland (HPSC, 2009; 2015; 2017). The storms that occurred during the winter of 2015/2016 resulted in a notable rise in the number of boil water notices issued due to cryptosporidium contamination secondary to inadequate water treatment infrastructure (Wall, Derham and O'Mahony, 2016). Research is underway to examine the links between flooding and the incidence of outbreaks of waterborne infectious diseases in Ireland (Hynds, 2018).

There is also a risk to human health from chemical contamination of water due to displacement of chemicals during a flood, with overloaded sewers, storm water floods and landfill sites identified as potential sources of chemical contamination (Vardoulakis and Heaviside, 2012). While it is likely that such sources of contamination would be diluted in flood water, it is suggested that improvements in environmental investigation following a flood event should be considered. The Department of Housing, Planning and Local Government incorporated public health expertise in the development of their *Draft Climate Change Sectoral Adaptation Plan for Water Quality and Water Services Infrastructure*, and the public health risks of microbiological and chemical contamination have been highlighted. Effective ongoing public health engagement will be required, and this may have resource implications.

The effect of flooding on mental health is well documented in the literature. The impact of the loss of personal belongings, displacement and potential loss of livelihood can impact negatively on both short- and long-term mental health (Vardoulakis and Heaviside, 2012; Menne and Murray, 2013).

Carbon monoxide poisoning secondary to the indoor use of generators or other equipment to pump out waters or to dry the interior of houses in the aftermath of a flood is also recognised as a significant public health hazard (Waite, Murray and Baker, 2014; Saulnie, Ribacke and von Schreeb, 2017).

Flooding can cause damage to healthcare infrastructure and limit access to healthcare services (Meusel and Kirch, 2005). Loss of paper-based notes, a loss in electrical power and interrupted access to electronic records and laboratory systems have occurred secondary to flooding (Vardoulakis and Heaviside, 2012; Paterson, Wright and Harris, 2018). In situations where infrastructure is disrupted, patients who are routinely cared for in the community may require admission to hospital due to an inability to provide the service in the community or due to a disruption in the provision of the service aggravating a pre-existing medical condition (Menne and Murray, 2013). In Ireland, flooding at Letterkenny General Hospital in July 2014 caused significant disruption to the infrastructure and healthcare service provision to the region (Treanor, 2014). While there were no direct injuries, the media reported that the hospital lost 40% of its capacity, elective surgeries and outpatient clinics were cancelled, and medical records were damaged, which may have had indirect health impacts.

2.3.3 Health impacts of storms

Wind speed and storms

The increasing risk of extreme weather events such as windstorms are of particular concern in Europe (WHO Europe, 2011). The direct and indirect impacts of windstorms in terms of injuries and deaths have been demonstrated in Europe and further afield (Goldman *et al*., 2014; Baxter, Lee and Spence, 2001; Kovats and Allen, 2008). In Ireland, data on injuries and deaths attributable to windstorm events are not formally measured. However, information on deaths during extreme events is often available in media reports. For example, Storm Ophelia was implicated in the deaths of three people, caused significant disruption in road infrastructure and public services, and resulted in power outages in over 300,000 homes across the country (Logue *et al.*, 2017). Disruptions in the provision of outpatient services, hospital procedures and discharges secondary to the storm were also reported (HSE, 2017). More detail on Storm Ophelia is included in a case study in Chapter 3.

The impact of such extreme weather events on human health could potentially be reduced by a better understanding of their past and projected patterns, which would facilitate appropriate emergency planning, the introduction of adaptation and mitigation measures, and public education campaigns (Goldman *et al.*, 2014).

2.3.4 Mental health impacts

Mental health effects of climate change can be considered as a cross-cutting issue. While the specific attribution of mental health outcomes to climate change remains challenging, the psychological effects are increasingly recognised. As noted above, mental health consequences can arise from exposure to extreme events, as well as from population displacement, increased poverty and from other causes. Acute mental health effects include post-traumatic stress disorder, anxiety, substance abuse and depression. Chronic effects include higher rates of aggression, violence and hopelessness (EASAC, 2019).

2.3.5 Risks to health services

We can expect that the projected increase in the frequency and severity of extreme weather events may place additional demands on the health service in two ways (National Health Service [NHS], 2015):

- a change in health service usage patterns and
- threats to the health service infrastructure.

Health risks associated with climate change, such as injuries, heat stress and outbreaks of infectious disease secondary to extreme weather events, are projected to increase in frequency and severity leading to potential sudden and overwhelming levels of demand on health services (WHO Europe, 2008). Media reports during the heatwave in Ireland in 2018 suggest that healthcare facilities are not suitably equipped to deal with extreme weather events, and this may impact negatively on the health of patients as such events become more frequent and severe (Bray, 2018; Ní Aodha, 2018).

The ageing population is likely to further compound this risk (NHS, 2015; Central Statistics Office [CSO], 2018). Aside from the potential change in the levels and patterns of service utilisation, it is possible that the healthcare system will need to adapt to changing health needs secondary to climate change such as changing infectious disease epidemiology (NHS, 2015; Menne and Murray, 2013; CDC, 2005; Baker and Lee, 2008; Hames and Vardoulakis, 2012). The aforementioned points have significant implications for workforce planning, capacity and education and training needs within the health sector.

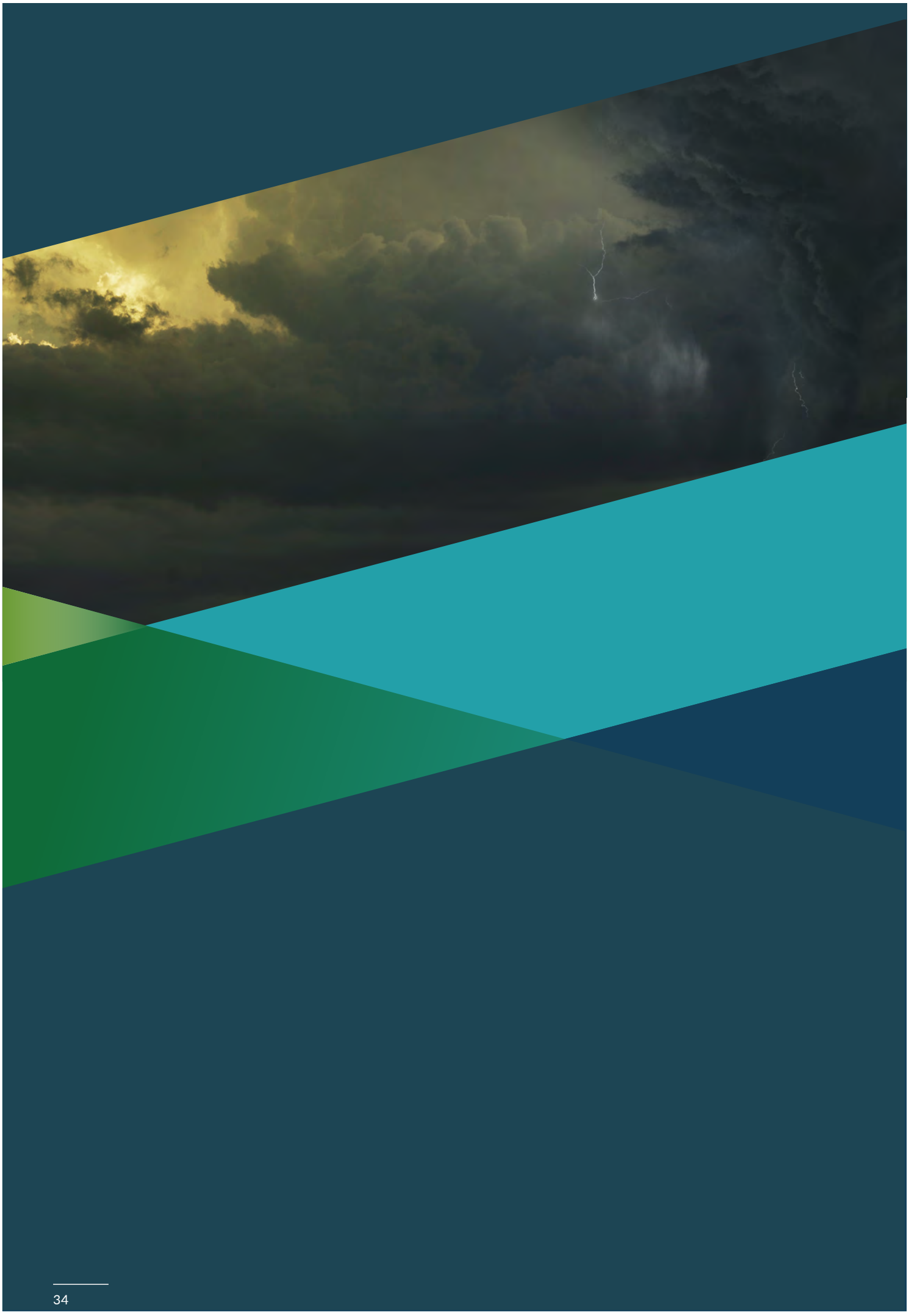
It is anticipated that the EU will likely continue to be a major receiving area for climate refugees due to increasing population displacement and migration resulting from longer term environmental change and its effects: heat, sea level rise, extreme weather events and exacerbation of food and water security problems. Therefore, it is likely that Ireland will in the future receive increasing numbers of migrants and climate refugees. The health risks associated with forced migration include undernutrition; food- and water-borne illnesses; diseases related to overcrowding such as measles, meningitis, and acute respiratory infections; sexually transmitted diseases; increased maternal mortality; and mental health disorders (McMichael, Barnett and McMichael, 2012). The European Academies' Science Advisory Council (2019) recommends that these challenges be countered by a sustainable and comprehensive approach to screening and vaccination of migrants (European Centre for Disease Prevention and Control [ECDC], 2018) and integration of everyone into strengthened national health systems, which must be climate-resilient and migrant-inclusive (Schwerdtle *et al.* 2018).

Consequences of disruption in critical infrastructure might include difficulties in transporting staff into work in the aftermath of an extreme weather event such as flooding, disruption of the operation of emergency services, and supply disruption and challenges in the safe storage of medications and other necessary supplies. Impacts of an extreme event such as flooding on a healthcare facility could require the evacuation of patients and diverting of emergency response vehicles. Rapid recovery of vital hospital infrastructure to restore continuity of essential services for patients would be a priority. (NHS, 2015; Hames and Vardoulakis, 2012).

Desmond, O'Brien and McGovern (2017) point to a lack of data on the vulnerability of Ireland's state-owned critical infrastructure and call for attention to be given to this area. A recent guideline from the Office of Emergency Planning (OEP) *Strategic Emergency Management Guideline 3 - Critical Infrastructure Resilience* offers guidance to Government Departments and Agencies, and public and private operators of essential services, on how to identify what critical infrastructure (CI) is, how to evaluate/quantify the criticality of the disruption or destruction of that CI and provides a framework of measures to improve resilience of CI. It adopts a risk-based approach that is focused on the impact of the loss of services to Irish society, rather than on the losses incurred by the owner or operator of that service. The HSE has committed to developing a draft report reviewing:

1. infrastructure criticality for hospitals, laboratories, the National Ambulance Service and IT infrastructure critical to the business of the HSE and
2. the steps to be taken to improve the resilience of the identified critical infrastructure.

Data on the impact of extreme weather events such as flooding or extreme temperatures on Irish healthcare facilities are not currently measured, so are not collected in a systematic way. This issue will need to be addressed during implementation of this Plan.



Chapter 3
Prioritisation

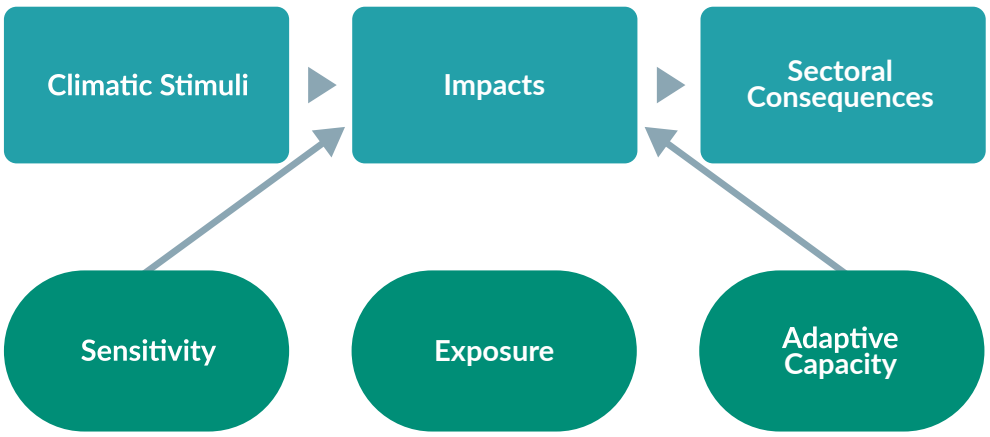
This chapter describes the process by which climate change-related health impacts were prioritised and assessed. The sectoral adaptation team comprising relevant expertise from the Department of Health and the HSE led the planning process, which was underpinned by an evidence-based approach and conducted in a collaborative way.

3.1 Climate Impact Screening

Two reviews of national and international literature were conducted on the scientific evidence relating to the health impacts of climate change. The first, *Climate Change Adaptation in the Health Sector – a Scoping Document* (DOH, 2019a), is being published with this Plan; the second was published in June 2019 as the research paper *Health Impacts of Climate Change and the Health Benefits of Climate Change Action: A Review of the Literature* (DOH, 2019b). Additional information was adduced from consideration by the sectoral adaptation team of past climate events, for example lessons learned from Ireland's emergency response to severe weather events over the last number of years.

The literature reviews, stakeholder consultation and the experience of sectoral adaptation team members between them identified a range of potentially serious sectoral impacts. To help focus discussions on vulnerability, the sectoral adaptation team followed the approach taken in health sector adaptation plans from other jurisdictions, including guidance from Public Health England, and concentrated on three key considerations: population health, health service or business continuity during extreme weather events, and critical infrastructure resilience.

Sectoral impact chains were defined to capture the inter-relationships between climate stimuli and sectoral consequences, with a particular focus on existing adaptative capacity. Impact chains as set out in the sectoral planning guidelines work as follows:



Impact chains were presented to stakeholders at the consultation forum. They were subsequently worked up in more detail following the identification of six priority climate stimuli / scenarios, and helped with framing adaptation options. A comprehensive list of impact chains is included in Appendix I. Some sample examples are given below that illustrate the importance, in the health sector, of population health, business continuity and infrastructure resilience.

Table 4: Impact Chains (sample examples)

Climate stimuli: High Temperature including heatwaves				
Sensitivity	**Exposure**	**Impacts**	**Sectoral Consequence**	**Adaptive Capacity**
Population of Ireland, visitors etc	All settings	Indoor and outdoor temperatures	Risk of increased morbidity and mortality	Shading, indoor temperature control, building regulations, preventing urban heat island effects.
Population of Ireland, visitors etc	All settings	Worsening Air pollution	Already > 1000 premature deaths per year (EEA), danger of increasing risk	HIAP, health advice, public education, etc
Population of Ireland, visitors etc	Outdoors	Worsening UV exposure	Worsening skin cancer risks - already many thousand per year	Skin cancer presentation plan, environmental planning to produce better shade etc

Climate stimuli: Windstorms				
Sensitivity	**Exposure**	**Impacts**	**Sectoral Consequence**	**Adaptive Capacity**
Residents especially dependant residents	Private houses/ domestic settings	Disrupted communications	Isolation, loss of potential to request assistance	Business continuity arrangements for neighbour visit, PHN visit etc.
Public, patients, staff	Healthcare facilities	Flooding	Destruction of critical infrastructure, resulting in service failure	Prevention of flooding through flood risk assessment and mitigation

Climate stimuli: Rising Sea Level				
Sensitivity	**Exposure**	**Impacts**	**Sectoral Consequence**	**Adaptive Capacity**
Residents especially dependant residents	Private houses/ domestic settings	Erosion	Destruction of property, displacement, mental health effects	Planning guidelines, Health in All Policies

Climate stimuli: Changes in Precipitation				
Sensitivity	**Exposure**	**Impacts**	**Sectoral Consequence**	**Adaptive Capacity**
Residents especially dependant residents	Private houses/ domestic settings	Flooding	Destruction of property, displacement, mental health effects, carbon monoxide poisoning during clean-up	Prevention of flooding through flood risk assessment and mitigation
Residents especially dependant residents	Private houses/ domestic settings	Flooding	Destruction of property, displacement, mental health effects	Prevention of flooding through flood risk assessment and mitigation

3.2 Developing Priorities

Stakeholder consultation: Early stakeholder consultation during the planning process gave those with expertise from across the sector an opportunity to input from the beginning. A stakeholder consultation forum on 6 June 2019 at the Department of Health saw 16 national and local organisations participate and heard a series of overview presentations, followed by breakout sessions and a concluding plenary discussion.

Stakeholders were asked to identify and prioritise key climate change-related health risks over the next five-year period, options for concrete action that could address risks and concerns, and information and data gaps that needed to be addressed urgently.

Some of the main qualitative points to emerge at the stakeholder consultation forum included: the need to integrate climate change considerations more fully into Sláintecare (particularly population health planning), Healthy Ireland and other relevant programmes; the need to integrate climate change-related elements into service planning, with a particular focus on vulnerable groups including the frail elderly; more focus on mental health, including mental health of farmers; the need to strengthen emergency management and business continuity, including through dedicated channels of communication, consistent messaging and encouragement of self-resilience during severe weather events; and better identification and use of existing data resources including the EPA's State of Knowledge on Climate Change Impacts, UCC's Climate Risk Project and the Urb-Adapt project.

Further detail on the stakeholder consultation forum is available in Appendix III.

Risk assessment: The core, detailed risk assessment of the health impacts of climate change was conducted during two workshops held by the sectoral adaptation team in June and July 2019.

Risk assessment and scoring (likelihood and impact) drew on the approach used in the Major Emergency Management Framework (see Appendix V for further details).

The risk assessment involved considering the likelihood of each stimulus or climate event - heat, cold, floods, air quality and so on - happening in the period 2019 – 2024, based on observed and projected climate change (see Section 2.1). Assessment of the magnitude of the potential health impact was informed by the literature reviews and international learning, the understanding gained through collaboration with stakeholders, and the professional judgement and experience of members of the sectoral adaptation team expressed in the risk workshops.

Special attention was paid to particular health vulnerabilities in Ireland, related to our geography, environmental influences on health, and health behaviour.

Using impact chains, and acknowledging existing adaptive capacity, the potential effects of a given stimulus on the sector were examined separately from the perspectives of population health, service continuity and infrastructure resilience:

- **population health and wellbeing:** Ireland's healthcare system will need to prevent avoidable illness where possible and, where not, be prepared for different volumes and patterns of demand;
- **health service continuity** during acute events: effective emergency planning and business continuity planning, preparedness and response will be essential to ensure operational continuity and service delivery during severe weather events;
- **infrastructure resilience to severe weather:** the system infrastructure (buildings, communications, emergency service vehicles, models of care) together with the supply chain (fuel, food, medical supplies) will need to be made more resilient to more frequent severe weather events and other impacts of climate change.

Six priority climate stimuli with the most profound health implications were identified as part of this process. Four of the priority scenarios relate to acute, severe weather events and two relate to slow onset climate-mediated changes.

Table 5: Risk Assessment

Climate Scenario	Category	Likelihood 1-5 (over the next 5 years)	Impact 1-5	Total Score
UV/Sun Exposure	Slow onset	5	5	25
Air Quality/Aeroallergens	Slow onset	5	5	25
Windstorms	Acute	5	4	20
Heat/Heatwaves	Acute	4	4	16
High Precipitation/Flooding	Acute	4	4	16
Extreme Cold Snaps	Acute	3	3	9

Public consultation: A public consultation exercise was then run from 25 July to 25 August 2019, with the views of the public sought on:

(i) whether these six stimuli / climate events represented the highest priority risks for the health sector;

(ii) what other vulnerabilities should be covered by this Plan, and why; and

(iii) suggestions for concrete and cost-effective adaptation actions for the health sector were invited.

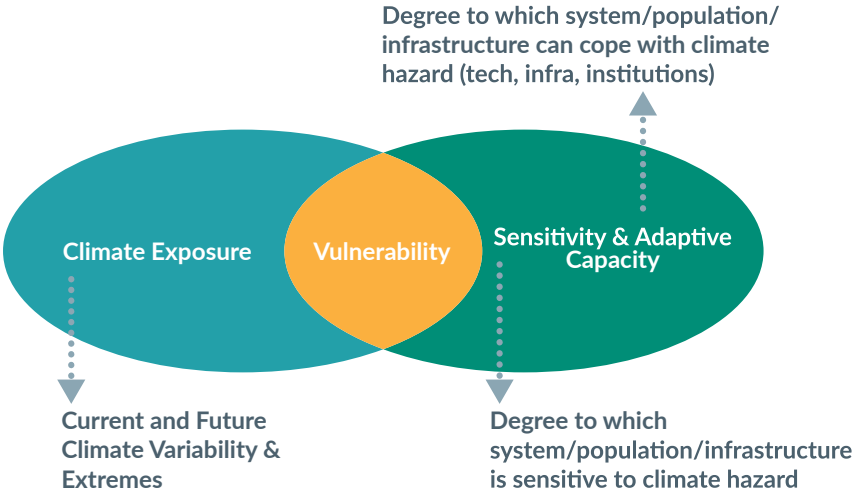
38 submissions were received from individuals and organisations. The exercise was successful in broadening the net to gather valuable input from those with particular interest or expertise, and several ideas and proposals from the public consultation feature in this final Plan.

More detail on the public consultation exercise is set out in Appendix IV and all of the submissions received are available on the website of the Department of Health.

Some of the main themes that emerged from the public consultation were: the uncertainties associated with climate change predictions; potential increasing health inequalities as a result of climate change; mental health issues arising as a result of severe weather events; and the importance of accurate information systems and specific research relating to health and climate change. Many submissions discussed the co-benefits to health as a result of mitigation actions in other sectors for example active transport, and the environmental impact of the health sector - while important, these issues lie outside the remit of this Plan.

Following climate impact screening, the input of stakeholders and of the public more broadly, and a series of deliberations amongst the sectoral adaptation team, a more in-depth understanding of vulnerabilities emerged which informed the identification and assessment of adaptation options presented in Chapter 4.

3.3 Climate scenarios – Priority Impacts



3.3.1 UV / Sun exposure

Climate change may result in Irish people having increased exposure to ultraviolet radiation (UVR) due to higher levels of ambient UVR as well as due to changes in human behaviour including more time spent outdoors in the warmer weather. As most Irish people have fair skin, we are particularly vulnerable to UV damage and at a higher risk of skin cancer. The potential magnitude of climate change compounding this pre-existing vulnerability makes UV a pressing concern that has already arrived. Skin cancer is the most common form of cancer in Ireland and it is increasing rapidly. Currently over 11,000 cases of skin cancer are diagnosed each year, including over 1,000 people diagnosed with melanoma – this is double the number of 10 years ago and is projected to more than double again by 2045 (NCR, 2017).

3.3.2 Air pollution

Older adults, individuals with chronic disease, children and those in deprived communities living near busy roads are particularly vulnerable to the health impacts of poor air quality. Climate change is expected to aggravate existing health risks through weather-driven increases in air pollutants such as ozone and particulate matter. The current magnitude of premature mortality from air pollution and the potential of climate change to exacerbate this makes this scenario a very serious risk. In Ireland, it is estimated that 1,050 premature deaths occurred in 2014 secondary to PM2.5 and 20 premature deaths occurred secondary to ozone (European Environment Agency [EEA], 2017). Climate change impacts on aeroallergens such as the earlier onset in the pollen season in the northern hemisphere - by about 15 days over the last three decades - which is likely to have had an impact on the patterns of allergenic disease caused by pollen.

3.3.3 Windstorms

Immediate and visible climate change-related risks to Ireland are in the form of extreme weather events. We have experience of events in the recent past such as Storm Ophelia in 2017 when three people died, there was significant disruption in road infrastructure and power, and in the health service there was widespread disruption to outpatient services, hospital procedures and discharges. While deaths directly attributable to such events may be low (not least because of the effective national adaptation action of the population following advice to stay at home), the extent of injuries or illness and the health impacts of rescheduling elective procedures are not currently measured or assessed.

Case Study 1

Storm Ophelia, 2017

On 16 October 2017, the "extra-tropical" Storm Ophelia made landfall over Ireland, resulting in observed wind speeds of up to 156 km/h. A nationwide Severe Weather Warning was issued by Met Éireann. Such a warning is only used in circumstances where the weather conditions are deemed severe enough to endanger life, and is an injunction to the public to take action to protect themselves and their properties (Met Éireann, 2017).

Storm Ophelia 16th October 2017	Impacts
Heavy rainfall. **Flooding.** **High winds.** **Power outages.** **Infrastructure damage.**	• Three deaths. • Fallen trees that were with full leaf. • Fallen electricity poles and electric cables left 300,000 households, 385,000 premises in total without power. • Affected other infrastructure and services, such as water treatment and wastewater systems. • The National Emergency Coordination Group convened after a nationwide red weather warning was issued. Schools and colleges closed, HSE appointments, Bus Éireann services, postal services and court sittings were cancelled. • Widespread road closures and flight cancellations. • In Cork city the storm knocked more than 500 trees, part of one of the stands in Turner's Cross stadium collapsed and in Douglas the roof of the Community School's sports hall was ripped off. • In Kerry hundreds of mature trees were felled and flooding caused in a number of locations also blocked roads. • In Galway city, coastal defences were completely breached along the Salthill promenade, causing extensive flooding. • Limerick city suffered some flooding and water surges, driven by offshore winds in the Shannon Estuary. • Dublin avoided the worst of Ophelia but the fire brigade in the capital still responded to more than 70 major tree falls. Counties in the north-west and midlands also suffered some major disruption with wide-spread road closures and thousands of homes left without power.

3.3.4 Heat / Heatwaves

While warmer weather may reduce the risk of cold-related illness and may potentially improve wellbeing and physical activity levels, extreme heat and heatwaves are also projected to increase in frequency. Extreme heat can cause heat exhaustion and heat stroke as well as aggravate pre-existing health conditions such as cardiovascular, respiratory and neurological disorders. Significant increases in Ireland's elderly population and a projected rise in the numbers living with chronic disease will amplify the health impact of more frequent extreme heat, which will place additional burdens on healthcare services. Most significantly, heat waves are responsible for excess deaths every year. 70,000 premature deaths were attributed to the particularly extreme heatwave across Europe in 2003 (Rey *et al.*, 2007). A recent study attributed 294 excess deaths to heatwaves In Ireland over three decades, with most of the deaths in the 1980s (Pascal *et al.*,2013).

3.3.5 High precipitation / Flooding

Ireland has experienced an increase in annual national rainfall (60mm) in recent decades, especially in the west of Ireland. Climate change projections foresee a possible notable increase in the frequency of heavy rainfall events for winter and autumn by mid-century. At the same time, sea levels are expected to rise in all coastal areas by up to 0.8 metres by the year 2100 (DCCAE, 2018a).

Flooding has direct health impacts, through drowning or injury. Over 1,000 people in Europe are estimated to have lost their lives due to flooding in a recent ten-year period by drowning, heart attacks, hypothermia and trauma (Jonkman and Kelman, 2005). There are also indirect health effects from flooding including impacts arising from damage to infrastructure; injuries during the clean-up phase following a flood (such as carbon monoxide poisoning from generators or other pumping equipment); risks from chemical contamination of water due to overloaded sewers, storm water floods and landfill sites; and possible negative impacts on short- and long-term mental health from the loss of personal belongings, the potential loss of livelihood or from displacement.

There has been an observed increase in water vector-borne diseases such as leptospirosis in the aftermath of heavy flooding in European countries in recent decades. While outbreaks of infectious disease due to flooding is rare, private wells compromised by flood damage potentially could lead to an increase in water-borne illness. Vero toxigenic E. Coli (VTEC) outbreaks have consistently been associated with private wells in Ireland, where approximately 720,000 people obtain their drinking water from a private supply (Engineers Ireland, 2018).

Flooding can also cause damage to healthcare infrastructure, a loss in electrical power, and can limit access to healthcare services. An example is the flooding at Letterkenny General Hospital in July 2014 where the hospital lost a reported 40% of its capacity causing significant disruption to healthcare service provision to the region, cancellation of surgeries and damage to medical records.

3.3.6 Extreme cold snaps

The island of Ireland has the highest levels of excess winter deaths in Europe with up to 2,800 excess deaths every winter (excess winter deaths are the number of deaths that take place during winter months compared with the rest of the year) (McAvoy, 2007). While climate change projections see an increase in temperature and generally warmer winters that may reduce the risk of cold-related illness, significant health impacts and risks will continue from extreme cold snaps and more frequent heavy precipitation events during winter (including snow, sleet or hail).

Evidence links sharp drops in temperature with higher rates of death and cardiovascular disease, while pneumonia, hypothermia and respiratory difficulties are among the other health impacts of severe winter weather. Older adults and people living in poorer communities are far more likely to be hospitalised due to the effects of cold weather. Winter 2018 saw some of the greatest snowfalls since 1982, together with extreme cold and blizzard-like conditions from Storm Emma coming from the Atlantic and the 'Beast from the East'. Met Éireann issued its first-ever Status Red warning for snow nationwide, with snowfalls leading to severe disruption for a prolonged period.

Case Study 2

Storm Emma, 2008

One of the most significant snowfall events of recent years affected Ireland in late February and early March 2018. From 27 February to 4 of March, temperatures plummeted, with bitterly cold easterly winds and widespread snowfall across the country (Met Éireann, 2018).

Storm Emma (2018)	Impacts
Low temperatures. **Heavy snowfall.** **Strong winds caused drifting, blizzard conditions.** **Extremely high waves in the Irish Sea.**	**Travel** • Air transport was severely disrupted with over 70,000 air passengers stranded due to flight cancellations and air-ports closures. • Some remote locations were cut off for a number of days due to the heavy snow and drifting making roads impassable. • Many colleges, schools and businesses shut down. • Public transport nationwide including bus, rail and Luas came to a standstill due to widespread cancellations to services. • Many ferry services were cancelled. **Power outages and water** • ESB said over 100,000 homes and businesses lost power. • More than 10,000 customers were without telephone, broadband and mobile services. • 18,000 people without water across the country. **Disruption to other services** • Fire crews had to assist ambulances in getting to some calls while other crews had to dig themselves out. • Fire service and civil defence personnel assisted key workers in the HSE, hospitals and wider community to get to work in extremely difficult conditions. • There were closures to sports and leisure centres, public libraries, community centres, swimming pools and other facilities. • Some coastal flooding in towns along the East and South coasts was reported during high tides. **Farming** • Some farmers, especially the Southeast and East, suffered significant losses. A number of sheds collapsed due to the weight of the snow leading to the loss of livestock and machinery. • There were fodder shortages and food shortages as farmers struggled to get supplies to supermarkets. • Growers in the soft fruit and nursery stock sectors were also badly hit by the heavy snowfall with tunnels and glass houses collapsing.

Chapter 4
Adaptation Action

This chapter identifies some priority health adaptation actions to be implemented over the coming five-year period. It is not an exhaustive list. The actions aim to protect public health, to promote workforce and organisation preparedness, and to ensure infrastructure resilience.

The actions have been derived through a process of stakeholder consultation, public consultation, literature review, learning from adaptation plans from other Irish sectors and from health sectors abroad, and from deliberations held by the sectoral adaptation team.

The new Climate Change Oversight Group for the health sector, led by the Department of Health, will adopt an inclusive and dynamic approach to implementation of this plan.

This plan will be reviewed and evolve in future iterations as the evidence base on climate impacts develops, and our understanding of public health adaptation requirements improves.

4.1 Actions

Action Area 1: Leadership and Oversight

Ref:	Adaptation Actions	Owner / Coordinator	Deliverable/ Timeline
1.1	A structured, dynamic and inclusive approach to climate change action in the health sector driven by a **new Climate Change Oversight Group**. Group to be chaired at senior level, feature full participation of research and other relevant organisations, and meet every 4 to 6 months (as the group decides).	Department of Health / HSE	Group meets as soon as possible
1.2	Clear, whole-of-organisation **leadership** demonstrated by the Department of Health and by the HSE, including: specific responsibilities outlined by relevant divisions; future proofing health investment including major infrastructure projects to prevent costly mal-adaptation; and climate change risks to feature in organisational risk registers. All organisations to which this plan applies to identify a person with lead responsibility for climate change action. Health sector bodies state-funded or grant-aided to reflect on and embed relevant adaptation actions within their strategic and operational planning.	Department of Health / HSE / HSE Agencies	Clear roles outlined by Q1 2020
1.3	To help ensure that a **Health in All Policies** approach is applied, identify, review and mobilise relevant cross-sectoral mechanisms (see Section 4.3 below). Department of Health to support the introduction, in relevant intersectoral policy areas such as planning and climate, of health and wellbeing impacts as required categories of impact assessment for Memorandums for Government and Regulatory Impact Assessments for proposed legislation. Department of Health to provide advice to other Departments on Health Impact Assessment. This would have resource implications for Departments. Continued strong public health participation in National Adaptation Steering Committee and Government Task Force on Emergency Planning.	Department of Health (Healthy Ireland) / HSE / all relevant Government Departments	Ongoing

1.4	Priority focus on **research and data** in order to develop a better understanding of the health impacts of climate change in Ireland (see Section 4.2 below). Deeper collaboration with research organisations and academic institutions to encourage investigation of relevant health impacts. Convene early stakeholder consultation with relevant research organisations to ensure a shared focus on common sectoral priorities and to address research gaps.	EPA and other identified research bodies	2020 and ongoing
1.5	Ensure effective health service **planning** for climate resilience. This includes planning for possible changes in volume and pattern of healthcare demand specifically due to climate-related impacts (such as vector-borne diseases dengue, malaria and Lyme; mental health needs; and increased migration). Special attention to vulnerable population groups. Improve mechanisms for Public Health Risk Assessments and Public Health Medical Advice – both in planning and during acute events.	Department of Health / HSE / Agencies	Ongoing
1.6	The new Climate Change Oversight Group to identify and build collaborative relationships with key **stakeholders** to guide implementation of this health sector adaptation plan: • conduct a sectoral stakeholder analysis; • hold an early stakeholder consultation to focus on practical actions; • multi-level engagement for example with Climate Action Regional Offices (CAROs); and • identify arrangements for ongoing engagement with key stakeholder groups and ways to ensure integration of their work.	Department of Health / HSE / Agencies / NGOs	2020 and ongoing

Action Area 2: Severe weather events

Ref:	Adaptation Actions	Owner / Coordinator	Deliverable/ Timeline
2.1	Development of a new public **health heat wave plan**. Seek to ensure **more uniform planning** system-wide for severe weather. Incorporation of severe weather planning into corporate and local level planning: • employ the HSE severe weather checklist and guidance document; • incorporate climate change adaptation risks into risk registers; • support a Be Summer Ready initiative; and • strong collaboration between the HSE and OPW on flood risks.	Department of Health / HSE / Inter-agency groups	2020
2.2	Conduct a **major survey of health infrastructure resilience** to severe weather events: wind events, heat waves, flooding, extreme cold snaps. Survey and identify necessary equipment to mitigate the impact of severe weather events, in order to develop smart procurement practices. The report required by the Strategic Emergency Management Guideline on Critical Infrastructure Resilience to take into account the six priority climate stimuli / events identified in this Plan. HSE Estates to participate in all relevant national fora to guarantee application of appropriate national standards in development of health infrastructure.	HSE Estates / DoH	Commence Q1 2020 Report Q1 2022 Draft Feb 2020
2.3	Identify and put in place appropriate **business continuity** measures to ensure continuity of service provision during severe weather events: • as a priority, identify service users who are vulnerable in severe weather events; and • during severe weather events, continue to work with the Government Task Force and other Departments to develop effective public safety messaging.	Department of Health / HSE National, Regional and Local / GTF/ OEP	Q3 2020 and ongoing
2.4	As standard, conduct and **widely share lessons learned** (effectiveness of actions, cost, new risks) following each severe weather event. Regularly review international best practice following international severe weather events.	Department of Health / HSE/ Agencies	After each severe event

Action Area 3: UV

Ref:	Adaptation Actions	Owner / Coordinator	Deliverable/ Timeline
3.1	Full implementation of the recently launched **National Skin Cancer Prevention Plan** that includes multiple actions pertinent to climate change. • ensure Health in All Policies approach to identify and help protect high risk groups; and • increase public awareness of risks from exposure to UV.	Department of Health / HSE	2019-2022
3.2	Continue **UV-related cancer registration and epidemiology** and expand based on emerging climate change requirements.	HSE / National Cancer Registry Ireland	Ongoing
3.3	As part of the **infrastructure survey** (Action 2.2 above), review the current and emerging building infrastructure and its potential associations with climate-sensitive UV health impacts in the indoor and outdoor architectural environment.	Cross-sectoral	Commence 2020 and report 2022

Action Area 4: Air Pollution

Ref:	Adaptation Actions	Owner / Coordinator	Deliverable/ Timeline
4.1	Build and refine **Irish-specific climate change epidemiology** relating to air pollution and identify risk groups. Recommend an increase in the number of ambient air quality monitoring stations. Develop tools for surveillance and monitoring of the effectiveness of health adaptation measures.	HSE / Research community/ EPA	Commence 2020
4.2	Improve **public education** for vulnerable populations (asthma, COPD) on the use of the EPA's Air Quality Index for Health, on the causes of air pollution and aeroallergens, and on what they can do to reduce exposure. Assess public health risk and provide public health medical advice during pollution events.	HSE/ EPA / and others	Commence end Q1 2021
4.3	Advocate the adoption of policies in all sectors to reduce emissions that negatively impact on air quality and public health. Continue public health advocacy and **Health in All Policies** in relevant government sectors that impact air quality, for example transport. Ensure public health input into Clean Air Strategy (Department of Communications, Climate Action and Environment).	Healthy Ireland / Cross-Government	Ongoing

Action Area 5: Monitoring, research and evaluation

Ref:	Adaptation Actions	Owner / Coordinator	Deliverable/ Timeline
5.1	Climate Change Oversight Group (CCOG) early work to include: • early identification of resources for effective implementation; • agree **performance indicators** / outcome measures and develop a monitoring framework (in line with statutory requirements); and • identify data requirements to support and monitor implementation of the plan.	Climate Change Oversight Group / Govt Task Force on Emergency Management	Ongoing
5.2	Identify and progress **research agenda** to develop a better understanding of health impacts of climate change and support on-going climate change planning and action (see Section 4.2 below). Collaborate closely with relevant academic institutions to encourage investigation of relevant health impacts and priorities. Prioritise research on vulnerable groups and their sensitivity, adaptive capacity and exposure to climate change. Assess future climate impact on the health sector using longer time horizons, which will involve a wider range of plausible climate change outcomes being considered.	Department of Health / HSE / EPA / Health Research Board / Universities	Ongoing
5.3	**Research** to determine a baseline for awareness and behaviours that relate to Action Areas 1-4 above, inform communications strategies, and measure the impact of engagement through a subsequent survey. Communications strategy to increase awareness, improve health literacy, and promote behavioural change that relate to Action Areas 1-4 above.	Climate Change Oversight Group	Commence Q3 2020
5.4	**Review plan** after 3 years (or more frequently if appropriate).	Climate Change Oversight Group	Minimum 3 yearly

4.2 Research and Data

Developing the evidence base to better inform policy-making and concrete adaptation measures is a prominent theme throughout this Plan. This section expands on Actions 1.4 and 5.2 in the table above, which are intended to collaboratively advance the research agenda with research community stakeholders in order to better inform policy. Improving the evidence base will require timely access to climatic and environmental data and infectious disease surveillance data that are collected by a variety of sources. Existing potential data sources are referenced in the tables below.

Basic and applied research on the relation between climate change and health - both infectious and non-communicable diseases - will be needed, in addition to research on the effectiveness, cost and economic implications of climate change and health interventions. There will also be a requirement for research to track adaptation, in order to define what health adaptation looks like in practice, reveal insights that can be taken up across sectors, and ensure policy-orientated learning (Austin, 2016).

The WHO defines epidemiology as the study of the distribution and determinants of health-related states or events (including disease), and the application of this study to the control of diseases and other health problems. In terms of climate change, this means the distribution of health-related states and events (including disease) associated with climate change, in order to prevent or minimise adverse climate change-related health outcomes, and to maximise positive health outcomes. Epidemiological information will be necessary in many ways, for example, in setting a baseline regarding the distribution of climate sensitive health status, monitoring changes in such health status and effectiveness of adaptation actions, and using the data to inform external stakeholders in relation to Health in All Policies.

The epidemiological tasks include:

1. For each potential health impact, a health data analysis process to measure baseline and monitor changes to be developed:
    - Identify relevant data where currently available, noting that very few data will be collected and categorised for this purpose at present;
    - Identify important data gaps;
    - Set up processes to address gaps;
    - Data systems will generally need to be on-going rather than once-off;
    - Attribution methodology may need to be developed for most health impacts taking into account exposure pathways to health outcomes.
2. Comprehensively describe the risk factors and diseases likely to be associated or attributable to climate change in Ireland.

In Ireland there are multiple organisations mandated to analyse and report on data that may be helpful. It is good practice to consider the use of routine data already available before expending resources on collecting new data. For example, there may be opportunities to use existing longitudinal data on population health to investigate how climate change affects the most vulnerable populations. Potential useful data sources include those outlined in Tables 6 and 7.

Table 6: Existing data sources for climate change health determinants

Determinants	Data sources
Air quality	EPA Air Quality Data
Water quality	EPA Drinking and Bathing Water Quality, Irish Water
Aeroallergens	Met Eireann
Flooding	OPW
UV Index	Met Eireann
Weather warnings and other environmental information	Met Eireann
Historical weather data	Met Eireann
Drought	Met Eireann
Power outages	ESB Networks
Sanitation disruptions	Irish Water

Table 7: Existing data sources for climate change health impacts

Health impacts	Data Sources
Injury and loss of life associated with extreme weather events	HIPE Central Statistics Office
Mental ill-health associated with weather events	Mental health services
Foodborne, waterborne and vector-borne disease	Health Protection Surveillance Centre
Melanoma and non-melanoma skin cancers	National Cancer Registry of Ireland
Heat-wave and cold-related related illness and mortality	HIPE - though limited codes for these events Central Statistics Office (CSO Environment)
Adverse effects of respiratory allergens on those with respiratory diseases	National Clinical Programme for Asthma, National Clinical Programme for COPD
Variety of data	Institute of Public Health
Fatal road deaths	Road Safety Authority - accidents may be weather related but not analysed to consider this at present

It should be noted that there are large uncertainties associated with climate change projections and the contribution from climate change to health risks such as those associated with UV radiation, ground level ozone, and new or emerging disease-causing pathogens. A further challenge is to improve understanding of the extent to which taking health co-benefits into account can offset the costs of greenhouse gas mitigation strategies. More research, particularly in the Irish context, is needed urgently in these areas. Additionally, there will be a need for capacity development in terms of increasing the accessibility of climate data.

There is potential for the Department of Health and other Government departments to work closely with research organisations that they fund (for example the EPA and the Health Research Board) and with academic institutions to encourage investigation of relevant health adaptation priorities. There is also potential to work with industry bodies to encourage and advise on research into climate impacts (Mullan, 2013).

4.3 Intersectoral collaboration

The determinants of health - the range of social, cultural, economic and environmental factors that affect health - are influenced by measures that are often managed by other Government sectors. Health in All Policies approaches highlight this fact, and seek to ensure that health is an integral part of all relevant policy areas, including environment, economic and social policies.

Successful climate change adaptation planning and action for the health sector require incorporation of health as a cross-cutting issue in other sectors, as many of the health threats posed by climate change are inherently linked to threats posed in other sectors. Health in All Policies or intersectoral working presents opportunities to drive health-relevant climate change action across government.

The *National Climate Change Adaptation Framework (2018)* establishes adaptation as a strategy to build resilience in the face of climate change, however a climate resilient Ireland is not possible without sustainable development, and the latter necessarily informs development of the policy framework for action on climate change.

Ireland's *Sustainable Development Goals National Implementation Plan 2018-2020* is our national, whole-of-government response to the 2030 Agenda for Sustainable Development. The SDGs make clear the links between climate change and sustainable development, and they address resilience in multiple ways that are of relevance to Ireland's goal of successful climate change adaptation (Shine, 2018). Goal 13 on climate change addresses resilience directly. Target 13.1 is to "strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries". Resilience is also part of Goal 9 on building resilient infrastructure and of Goal 11 on inclusive, safe, resilient and sustainable cities. Goal 3 is to ensure healthy lives and promote well-being for all at all ages, which comes directly within the remit of the Department of Health.

The Minister for Communications, Climate Action and Environment is responsible for promoting and overseeing the implementation of the SDGs, and all Ministers retain responsibility for implementing the individual SDGs relating to their functions. This provides opportunities to align climate policy with the SDGs (Climate Change Advisory Council, 2019).

Healthy Ireland, the national Government framework for action to improve the health and well-being, focuses on prevention and keeping people healthy for longer. Together with Sláintecare, Healthy Ireland's associated policies form the central response of the Department of Health to the SDGs (especially Goal 3).

In line with the Health in All Policies approach, Healthy Ireland has cultivated relationships and partnerships with other Government Departments, Local Authorities, the sports, education, research, business, voluntary and community sectors in order to progress effective cross-sectoral implementation. Action to build climate resilience can readily be embedded within these established networks and processes.

The following examples illustrate the Health in All Policies approach currently being advanced by Healthy Ireland. The examples demonstrate the co-benefits for health that can arise from climate mitigation action in other sectors, and the inherent links between mitigation and adaptation action.

Example 1: Built environment

The effects of the built environment on health, wellbeing and facilitation of physical activity have been noted in a number of current Government policies. Furthermore, the WHO notes that cities are major contributors to climate change and have a key role in mitigation strategies which also promote health, such as the promotion of safe, active transport. Support for the principles of Healthy Ireland are included in more recent Government policies such as the *National Planning Framework* and *National Sports Policy 2018–2027*.

Get Ireland Active – the National Physical Activity Plan for Ireland (NPAP) was launched in 2016, under the aegis of the Healthy Ireland Framework. The NPAP recognizes the various benefits of walking and cycling, for transport and for recreational purposes, and notes that both built and natural environments can impact on physical activity levels. A cross sectoral group, meeting quarterly, oversees implementation of this Plan.

A Stakeholder Forum on the built environment in November 2018, attended by 125 delegates, brought together those with responsibility for planning and developing public spaces, and those who have expertise regarding the impacts of the built environment on health and wellbeing, sport and physical activity.

Example 2: Active transport

An increase in public and active travel, in line with decarbonisation objectives, will have positive co-benefits for public health. Active Transport is primarily under the remit of the Department of Transport, Tourism and Sport.

Healthy Ireland, largely through the National Physical Activity Plan for Ireland, has a significant role in measures that are intended to impact positively on active transport levels (walking and cycling also have benefits in terms of climate change mitigation and environmental sustainability). These include:

- funding projects that support walking and cycling at local and national levels from the Healthy Ireland Fund (€5m in 2017, 2018 and 2019);
- the HSE supports local authorities and Sport Ireland in providing significant additional funding to Local Sports Partnerships (LSPs), which in turn provide local supports for walking, cycling and other measures intended to raise population activity levels. Examples include the Men on the Move and Women on Wheels programmes in addition to community walking programmes;
- continued expansion of community walking groups under a new Get Ireland Walking (GIW) Strategy, supported by the Healthy Ireland Fund; and
- cycling received additional support from the Healthy Ireland and Dormant Accounts Fund in 2017 and 2018, enabling the commencement of work required to establish a 'Get Ireland Cycling' initiative using a multi-agency approach similar to that used for Get Ireland Walking.

Example 3: Warmth and Wellbeing Pilot Scheme

The Warmth and Wellbeing pilot scheme is a priority cross-departmental project which commenced in 2016. Under the scheme, adults aged over 55 who are in receipt of the Fuel Allowance and are living with a chronic respiratory condition such as COPD or asthma are eligible to apply for a free home energy efficiency improvement (retrofit). Damp homes and air quality are regarded as key contributing factors to both of these respiratory conditions. By retrofitting homes, the Warmth and Wellbeing scheme aims to improve their internal air temperature and air quality, producing an improved quality of life for residents, reducing their energy bills and reducing impact on the health service through less frequent doctor/hospital visits. Retrofitting existing housing and raising the standards of new housing supports adaption to weather extremes as well as mitigation of the effects of climate change by reducing energy consumption.

As of mid-August 2019, 1,618 individuals who have qualified for the pilot scheme following an assessment by the HSE have been referred onto the Sustainable Energy Authority of Ireland for works to commence. A health impact evaluation of the scheme is currently being conducted by the London School of Hygiene and Tropical Medicine, in conjunction with the HSE. The Department of Health's Health and Wellbeing Programme and the HSE are supporting this project, which is being led by the Department of Communications, Climate Action and Environment and is a key action in the Strategy to Combat Energy Poverty.

Chapter 5
Implementation and Review

Leadership / governance arrangements

A new Climate Change Oversight Group for the health sector will:

- agree on performance indicators and develop a monitoring framework;
- provide public updates on progress in implementing this Adaptation Plan;
- participate in the National Adaptation Steering Committee and other cross-government fora and use these fora to keep other sectors informed on progress and realise cross-benefits that exist between plans.

The Climate Change Oversight Group will be inclusive in composition, will be chaired at senior level by the Department of Health, and will be convened as early as possible. The Group will support the development of clear governance arrangements with explicit roles, responsibilities, reporting and resources within the Department, HSE and other relevant organisations for the implementation of the Plan.

Implementation

This Adaptation Plan will be rolled out to the health sector as part of a programme of engagement with the HSE and other health agencies throughout Ireland. The Adaptation Plan will be incorporated into Corporate plans and Service plans throughout the health sector, including in the areas of risk assessment and emergency planning.

The success of this Plan will depend in large part on its adoption by the Department's stakeholders. Given the large number of stakeholders in the health sector involved and affected by the Plan, the Climate Change Oversight Group will identify arrangements for ongoing engagement with key stakeholder groups and ways to ensure integration of their work. There will be early stakeholder consultation focused on practical actions to support implementation of the Plan.

Implementation will mean that many key stakeholders will become action owners. Regular reports from the action owners identified in the table in Chapter 4 will form part of the monitoring and review programme. Close monitoring and review of progress should help to avoid unintended consequences.

Broader communication and engagement, not only across the health sector but across all sectors with climate change-related health risks, upholding the Health in All Policies approach, will be crucial to the successful implementation of this Plan.

Review

The *Sectoral Planning Guidelines for Climate Change Adaptation (2018)* recommend that adaptation plans be reviewed every 3-5 years. It can be expected that new priorities will arise or emerge as learning from future weather events and new data and research findings become available. This Plan will be reviewed and updated after 3 years (or sooner, if appropriate).

References

Austin, S. *et al.* (2016) 'Public health adaptation to climate change in OECD countries', *International Journal of Environmental Research and Public Health*, 13(9), pp. 889-909.

Baker, C. and Lee, B. (2008) 'Guidance on windstorms for the public health workforce', in: Murray, V., O'Connell, E. and Keshishian, C. (eds.) *Chemical hazards and poisons report*. London: Health Protection Agency, pp. 49-52.

Baxter, P.J., Lee, B.E. and Spence, R.J. (2001) 'Windstorms and climate change', in Department of Health Editorial Group (eds.). *Health effects of climate change in the UK*. London: Department of Health, pp. 134-152.

Bell, M. and Greenberg, MR. (2018) 'Climate change and human health: links between history, policy and science', *American Journal of Public Health*, 108 (Suppl 2), pp. S54-S55.

Berry, P. *et al.* (2014) 'Human health', in Warren, F.J. and Lemmen, D.S. (eds.) *Canada in a changing climate: sector perspectives on impacts and adaptation*. Ottawa: Government of Canada.

Bharath, A.K. and Turner, R.J. (2009) 'Impact of climate change on skin cancer', *Journal of the Royal Society of Medicine*, 102(6), pp. 215-218.

Bray, A. (2018) 'We're all suffering' - nurse who endured 42C temperatures in hospital room slams conditions', *Irish Independent*, 24 June. Available at: https://www.independent.ie/irish-news/heatwave/were-all-suffering-nurse-who-endured-42c-temperatures-in-hospital-room-slams-conditions-37065504.html. (24 June 2018)

Centers for Disease Prevention and Control (2005) 'Epidemiological assessment of the impacts of four hurricanes - Florida, 2004', *MMWR Morbidity and Mortality Weekly Report*, 54(28), pp. 693-697.

Centers for Disease Control and Prevention *et al.* (2010) '*When every drop counts: protecting public health during drought conditions - a guide for public health professionals*'. Atlanta: U.S. Department of Health and Human Services, 2010.

Centers for Disease Control and Prevention (2016) '*Water, sanitation and hygiene (WASH)-related emergencies and outbreaks*'. Atlanta: CDC. Available at: https://www.cdc.gov/healthywater/emergency/drinking/private-drinking-wells.html [Accessed 13 August 2018].

Central Statistics Office (2018) *Population and labour force projections*. Cork: CSO. Available at: https://www.cso.ie/en/statistics/population/populationandlabourforceprojections/ [Accessed 8 August 2018].

Ciscar, J.C. *et al.* (2014) *Climate impacts in Europe: the JRC PESETA II Project*. JRC Scientific and Policy Reports, EUR 26586EN. Brussels: European Commission.

Climate Change Advisory Council (2019) *Annual Review 2019*. Dublin: Climate Change Advisory Council.

Committee on the Future of Healthcare (2017) *Sláintecare report*. Dublin: Houses of the Oireachtas. Available at: https://uat.gov.ie/en/publication/1265e9-slaintecare-publications/#the-slaintecare-report. [Accessed 4 October 2019].

Costello, A. *et al.* (2009) 'Managing the health effects of climate change: Lancet and University College London Institute for Global Health Commission', *Lancet*, 373, pp. 1693-733.

Crimmins, A.J. *et al.* (2016) *The impacts of climate change on human health in the United States: a scientific assessment*. Washington: U.S. Global Change Research Programme.

Crowley, R.A. and Health and Public Policy Committee of the American College of Physicians (2016) 'Climate change and health: a position paper of the American College of Physicians', *Annals of Internal Medicine*, 164(9), pp. 608-610.

Cullen, E. (2010) 'Lyme disease and climate change', *Irish Medical Journal*, 103(4), pp. 101-102.

Dear, K. and Wang, Z. (2015) 'Climate and health: mortality attributable to heat and cold', *Lancet*, 386, pp. 320-2.

Department for Environment, Food and Rural Affairs (2017) *Air quality: a briefing for Directors of Public Health*. London: DEFRA.

Department of Communications, Climate Action and Environment (2018) *National adaptation framework: planning for a climate resilient Ireland*. Dublin: DCCAE.

Department of Communications, Climate Action and Environment (2018) *Sectoral planning guidelines for climate change adaptation*. Dublin: DCCAE.

Department of Communications, Climate Action and Environment (2019) *Climate action plan 2019*. Dublin: DCCAE.

Department of Health (2019a) *Climate change adaptation in the health sector – a scoping document*. Dublin: DOH.

Department of Health (2019b) *Health Impacts of Climate Change and the Health Benefits of Climate Change Action: A Review of the Literature*. Dublin: DOH.

Department of Health (2019c) *National Skin Cancer Prevention Plan (2019-2022).* Dublin: DOH.

Desmond, M., O'Brien, P. and McGovern, F. (2017) *A summary of the state of knowledge on climate change impacts for Ireland*. EPA Report No. 223. Wexford: EPA.

Doran, K.M. *et al.* (2016) 'Emergency department visits for homelessness or inadequate housing in New York City before and after Hurricane Sandy', *Journal of Urban Health*, 93, pp. 331–44.

Dwyer, N. (2012) *The status of Ireland's climate*. EPA report no. 26. Wexford: EPA.

European Centre for Disease Prevention and Control (ECDC) (2018) *Public health guidance on screening and vaccination for infectious diseases in newly arrived migrants within the EU/EEA*. Available at: https://ecdc.europa.eu (Accessed 5 December 2018).

Engineers Ireland (2018) *The state of Ireland 2018: a review of infrastructure in Ireland*. Dublin: Engineers Ireland.

Environmental Protection Agency (2017) *Have you checked your well water supply?* Wexford: EPA.

Environmental Protection Agency (2019) *Air Quality in Ireland 2018*. Wexford: EPA.

European Academies' Science Advisory Council (2019) *The imperative of climate action to protect human health in Europe: opportunities for adaptation to reduce the impacts, and for mitigation to capitalise on the benefits of decarbonisation*. Halle: German National Academy of Sciences Leopoldina.

European Centre for Disease Control and Prevention (2012) *Second meeting of the ECDC expert group on climate change*. Stockholm: ECDC.

European Environment Agency (2017) *Air quality in Europe – 2017 report*. Luxembourg: Publications Office of the European Union.

Gleeson, E., McGrath, R. and Treanor, M. (eds.) (2013) *Ireland's climate: the road ahead*. Dublin: Met Éireann. Available at: http://www.met.ie/publications/.

Goldman, A. *et al*. (2014) 'The health impacts of windstorms: a systematic literature review', *Public Health*, 128(1), pp. 3-28.

Gray, J.S. *et al.* (2009) 'Effects of climate change on ticks and tick-borne diseases in Europe', *Interdisciplinary Perspectives on Infectious Diseases*. Available at: https://www.hindawi.com/journals/ipid/2009/593232/ [Accessed 3 September 2019].

Guilbert, A. *et al.* (2018) 'Relationships between aeroallergen levels and hospital admissions for asthma in the Brussels-Capital Region: a daily time series analysis', *Environmental Health*, 17(1). 10.1186/s12940-018-0378-x.

Haines, A. *et al.* (2006) 'Climate change and human health: impacts, vulnerability and public health', *Public Health*, 120(7), pp. 585-596.

Hames D, Vardoulakis S. (2012) *Health sector report. Climate change risk assessment for the Health Sector*. London, England: Department for Environment, Food and Rural Affairs; 2012.

Health Protection Surveillance Centre (2009) *HPSC annual epidemiological report 2008*. Dublin: HPSC.

Health Protection Surveillance Centre (2015) *HPSC annual epidemiological report 2014*. Dublin: HPSC.

Health Protection Surveillance Centre (2016) *Ranking of likelihood of re-emergence of selected vector-borne diseases in Ireland*. Dublin: HPSC.

Health Protection Surveillance Centre (2017) *HPSC annual epidemiological report 2016*. Dublin: HPSC.

Health Service Executive (2011) *Asthma in Ireland*. Available at: https://www.hse.ie/eng/about/who/cspd/ncps/asthma/asthma-ireland/. (Accessed August 9 2018).

Health Service Executive (2017) *Storm Ophelia: health service update*. Available at: https://www.hse.ie/eng/services/news/newsfeatures/health-services-updates-red-weather-alert/. (Accessed 22 August 2018).

Healthcare System Adaptation Report Working Group (2015) *Adaptation report for the healthcare system 2015*. London: NHS.

Hynds, P.D. *et al.* (2018) *Putting the "socio" in socio-hydro(geo)logy via existing psychological models: health-related flood risk perception in the Republic of Ireland*. Dublin: UCD. Available at: https://www.researchgate.net/publication/323336792_Putting_the_socio_in_socio-hydrogeology_via_existing_psychological_models_Health-related_flood_risk_perception_in_the_Republic_of_Ireland. [Accessed 13 August 2018].

Institute of Public Health (2012) *Coronary heart disease briefing*. Dublin: IPH.

Intergovernmental Panel on Climate Change (2014) *Climate change 2014: synthesis report*. Geneva: IPCC.

Jakubicka, T. *et al.* (2010) *Health impacts of floods in Europe: data gaps and information needs from a spatial perspective*. Brussels: Centre for Research on the Epidemiology of Disasters.

Jonkman, S.N. and Kelman, I. An analysis of the causes and circumstances of flood disaster deaths. Disasters 2005:29(1):75-97.

Kenny, G.P. *et al.* (2010) Heat stress in older individuals and patients with common chronic diseases. *Canadian Medical Association Journal*, 182(10), pp. 1053-1060.

Kovats, S. and Allen, M. (2008) 'Flooding, windstorms and climate change', in Kovats, S. (ed) *Health effects of climate change in the UK: an update of the Department of Health report 2001/2002*. London: Department of Health.

Lake, I.R. (2012) 'Climate change and food security: health impacts in developed countries', *Environmental Health Perspectives*, 120(11), pp. 1520-6.

Large Urban Area Adaptation (Urb-ADAPT) research project. Available at: https://urbadapt.com/about/ (Accessed 27 September 2019).

Logue, P. *et al.* (2017) 'Hurricane Ophelia: three dead and 295,000 without power as storm enters final hours', *Irish Times*, 16 October. Available at: https://www.irishtimes.com/news/environment/hurricane-ophelia-three-dead-and-295-000-without-power-as-storm-enters-final-hours-1.3257434. (16 October 2017)

Lowe, D., Ebi, K.L. and Forsberg, B. (2011) 'Heatwave early warning systems and adaptation advice to reduce human health consequences of heatwaves', *International Journal of Environmental Research and Public Health*, 8(12), pp. 4623-4648.

McAvoy H. (2007) All-Ireland Policy Paper on Fuel Poverty and Health. Dublin, Institute of Public Health in Ireland.

McMichael, C., Barnett, J. and McMichael, A.J. (2012) 'An ill wind? Climate change, migration, and health', *Environmental Health Perspectives*, 120(5), pp. 646-54.

Menne, B. and Murray, V. (eds.) (2013) *Floods in the WHO European Region: health effects and their prevention*. Copenhagen: WHO Regional Office for Europe.

Meusel, D. and Kirch, W. (2005) 'Lessons to be learned from the 2002 floods in Dresden, Germany', in Kirch, W., Menne, B. and Bertollini, R. (eds.) *Extreme Weather Events and Public Health Responses*. Berlin: Springer.

Mullan, M. *et al.* (2013) *National adaptation planning: lessons from OECD Countries*. OECD Environment Working Papers, No. 54. Paris: OECD Publishing.

Murti, M. *et al.* (2016) 'Impact of the 2012 extreme drought conditions on private well owners in the United States, a qualitative analysis', *BMC Public Health*, 16. 10.1186/s12889-016-3039-4.

Myers, T.A. *et al.* (2012) 'A public health frame arouses hopeful emotions about climate change', *Climatic Change*, 113: 1105.

National Cancer Registry Ireland (2017) *Cancer trends no. 34: skin cancer*. Cork: NCRI.

National Cancer Registry Ireland (2019) *Cancer incidence projections for Ireland 2020-2045*. Cork: NCRI.

National Patient Safety Office (2017) *National Healthcare Quality Reporting System*: *annual report 2017*. Dublin: Department of Health.

National Patient Safety Office (2018) *National Healthcare Quality Reporting System*: *annual report 2018*. Dublin: Department of Health.

Neira, M. (2014) *Climate change: an opportunity for public health*. Available at: http://www.who.int/mediacentre/commentaries/climate-change/en/. (Accessed 8 August 2018).

Ní Aodha, G. (2018) 'Many Irish maternity hospitals don't have air con. Here's how they've been coping in the heatwave', *Thejournal.ie*, 7 July. Available at: http://www.thejournal.ie/maternity-hospitals-heatwave-4114266-Jul2018/. (7 July 2018).

Nolan, P. *et al.* (2013) 'Climate change: impacts on Irish temperatures', in Gleeson, E., McGrath, R. and Treanor, M. (eds.) *Ireland's Climate: the Road Ahead*. Dublin: Met Éireann.

Nolan, P. (2015) *Ensemble of regional climate model projections for Ireland*. EPA Report No. 159. Wexford: EPA.

Noone, S. *et al.* (2018) 'A 250-year drought catalogue for the island of Ireland', *European Geoscience Union (EGU) General Assembly 2017*. Vienna, Austria, 8-13 April. Maynooth: ICARUS, Maynooth University.

O'Brien, K. and Wolf, J. (2010) 'A values-based approach to vulnerability and adaptation to climate change', *Environmental Policy & Governance*, 1(2), pp. 232-242.

Paavola, J. (2017) 'Health impacts of climate change and health and social inequalities in the UK', *Environmental Health*, 16(Suppl 1), pp. 62-76. 10.1186/s12940-017-0328-z.

Pascal, M. *et al.* (2013) 'Heatwaves and mortality in Ireland, planning for the future', *Irish Geography*, 46(3), pp. 203-211.

Paterson, D.L., Wright, H. and Harris, P.N.A. (2018) 'Health risks of flood disasters', *Clinical Infectious Diseases*, [online] Available at: https://academic.oup.com/cid/advance-article/doi/10.1093/cid/ciy227/4945455 [Accessed 14 August 2018].

Pettersson J.H.O. *et al.* (2014) 'Prevalence of tick-borne encephalitis virus in Ixodes ricinus ticks in northern Europe with particular reference to Southern Sweden', *Parasites & Vectors*, 7. 10.1186/1756-3305-7-102.

Public Health England (2014) *Heatwave plan for England: supporting vulnerable people before and during a heatwave – advice for health and social care professionals*. London: PHE.

Public Health England, Sustainable Development Unit (2014) *Adaptation to climate change: planning guidance for health and social care organisations*. Cambridge: SDU.

Raidió Teilifís Éireann (2018) 'Greek fire death toll rises to 91', *RTE*, 6 August. Available at: https://www.rte.ie/news/world/2018/0806/983413-greece-fire/. (6 August 2018).

Rey G. *et al.* (2007) 'The impact of major heat waves on all-cause and cause specific mortality in France from 1971 to 2003', *International Archives of Occupational and Environmental Health*, 80, pp. 615-26.

SafeFood (2014) *Climate Change Ireland: The potential impacts of climate change on food safety from an island of Ireland perspective*. Available at: https://www.safefood.eu/SafeFood/media/SafeFoodLibrary/Documents/Publications/Research%20Reports/Climate-Change-Impact-on-Food-Safety_.pdf (Accessed 9 October 2019)

Saulnier, D.D., Ribacke, K.B. and von Schreeb, J. (2017) 'No calm after the storm: a systematic review of human health following flood and storm disasters', *Prehospital and Disaster Medicine*, 32(5), pp. 568-579.

Scalley, B.D. *et al.* (2015) 'Responding to heatwave intensity: excess heat factor is a superior predictor of health service utilisation and a trigger for heatwave plans', *Australian and New Zealand Journal of Public Health*, 39(6), pp. 582-587.

Schwerdtle P., Bowen K. and McMichael C. (2018) 'The health impacts of climate-related migration', *BMC Medicine*, 16(1). 10.1186/s12916-017-0981-7.

Semenza, J.C. and Menne, B. (2009) 'Climate change and infectious diseases in Europe', *The Lancet. Infectious diseases*, 9(6), pp. 365-75.

Senior, T. (2015) 'Climate change and the SEP drive', *British Journal of General Practice*, 65(631). 10.3399/bjgp15X683773.

Shine, T. (2018) Research 252: Climate Resilient Ireland. Wexford: EPA.

Smith, S. *et al.* (2016) 'Estimating the burden of heat illness in England during the 2013 summer heatwave using syndromic surveillance', *Journal of Epidemiology and Community Health*, 70(5), pp. 459-465.

Smith, K.R. *et al.* (2014) 'Human health: impacts, adaptation, and co-benefits', in Field, C.B *et al.* (eds.) *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge: Cambridge University Press, pp. 709-754.

Stahl, K. *et al.* (2012) *A European drought impact report inventory (EDII): design and test for selected recent droughts in Europe*. Frieburg: European Commission.

Stevenson, K. and Peterson, N. (2016) 'Motivating action through fostering climate change hope and concern and avoiding despair among adolescents', *Sustainability*, 8(1). 10.3390/su8010006.

Stone, B., Hess, J.J. and Frumkin, H. (2010) 'Urban form and extreme heat events: are sprawling cities more vulnerable to climate change than compact cities?', *Environmental Health Perspectives*, 118(10), pp. 1425-1428.

Thomas, P., Swaminathan, A. and Lucas, R.M. (2012) 'Climate change and health with an emphasis on interactions with ultraviolet radiation: a review', *Global Change Biology*, 18(8), pp. 2392-2405.

Treanor, M. (2014) 'Crisis of Letterkenny flooding continues', *INMO News* 26 July. Available at: https://www.inmo.ie/Article/PrintArticle/10973. (26 July 2014).

Uejio, C.K. *et al.* (2011) 'Intra-urban societal vulnerability to extreme heat: the role of heat exposure and the built environment, socioeconomics, and neighborhood stability', *Health & Place*, 17(2), 498-507.

United Nations Framework Convention on Climate Change (2019) *The Paris Agreement*. Available at: https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement (Accessed 23 April 2019).

Vardoulakis, S. and Heaviside, C. (eds.) (2012) *Health effects of climate change in the UK 2012: current evidence, recommendations and research gaps*. London: Health Protection Agency.

Vins, H. *et al.* (2015) 'The mental health outcomes of drought: a systematic review and causal process diagram', *International Journal of Environmental Research and Public Health*, 12(10), pp. 13251–13275.

Waite, T., Murray, V. and Baker, D. (2014) 'Carbon monoxide poisoning and flooding: changes in risk before, during and after flooding require appropriate public health interventions', *PLOS Currents Disasters*, Jul 3. 10.1371/currents.dis.2b2eb9e15f9b98278493880358448 7f1.

Wall, B., Derham, J. and O'Mahony, T. (2016) *Ireland's environment – an assessment 2016*. Wexford: EPA.

WHO (2003) *Climate change and human health – risks and responses: summary*. Geneva: WHO.

WHO Europe (2008) *Protecting health in Europe from climate change*. Copenhagen: WHO Regional Office for Europe.

WHO Europe (2011) *Climate change, extreme weather events and public health - meeting report*. Copenhagen: WHO Regional Office for Europe.

WHO Europe (2013) *Review of evidence on health aspects of air pollution - REVIHAAP Project: technical report*. Copenhagen: WHO Regional Office for Europe.

WHO Europe (2017a) *Protecting health in Europe from Climate Change: 2017 update*. Copenhagen: WHO Regional Office for Europe.

WHO Europe (2017b) *Flooding: managing health risks in the WHO European Region*. Copenhagen: WHO Regional Office for Europe.

Appendices

Appendix I: Impact Chain Assessment

Impact chains were presented to stakeholders at the consultation forum. They were subsequently worked up in more detail following the identification of six priority climate stimuli / scenarios, and helped with framing adaptation options.

Table 8: Impact Chains

Climate stimuli	Sensitivity	Exposure
Changes in climate variability (away from the mean) (e.g. periods of increased temperatures) and in the frequency and magnitude of extremes that are relevant for a climate impact	Sensitivity (Susceptibility or fragility) describes the extent to which a system (economic sector / population group) reacts to changes in climate stimuli. The effect may be direct (e.g. change in crop yield in response to a change in the mean, range or variability of temperature) or indirect (e.g. damages caused by an increase in coastal flooding due to sea level rise)	Exposure refers to the presence of a system / infrastructure / population potentially impacted upon by the climatic stimuli in the area of investigation
Impacts	**Sectoral Consequence**	**Adaptive Capacity**
Impacts refer to the observed or potential impact (biophysical and socio-economic) of the climate stimuli on the system taking into account sensitivity, exposure and adaptive capacity	Sectoral Consequence results from a climate impact on a system/infrastructure/ population and accounting for adaptive capacity	Adaptive Capacity refers to the possibility for a system to adapt to climate change through measures to reduce adverse impacts or exploit new opportunities. There are a wide range of factors which contribute to or reflect adaptive capacity, and these include resource availability (human, technological and financial), information and skills, and institutional capacity

Climate stimuli: Extreme cold snaps				
Sensitivity	**Exposure**	**Impacts**	**Sectoral Consequence**	**Adaptive Capacity**
Population of Ireland, visitors etc	Outdoors	Disruptions and unsafe roads, and other infrastructure	Risks of injuries, disrupted access to healthcare, etc	Winter ready, health alerts, public health risk assessment and advice

Climate stimuli: Windstorms				
Sensitivity	**Exposure**	**Impacts**	**Sectoral Consequence**	**Adaptive Capacity**
Residents especially dependant residents	Private houses/ domestic settings	Disrupted power supply	Loss of residential heating and lighting	Preparation to use alternative power e.g. battery light; precooked food; warm food / drink in flask
Residents especially dependant residents	Private houses/ domestic settings	Disrupted communications	Isolation, loss of potential to request assistance	Prior arrangement for neighbour visit, PHN visit etc
Residents especially dependant residents	Private houses/ domestic settings	Disrupted treated water supply, through power loss, flooding etc	Risk to hydration, personal and environmental hygiene, food safety	Anticipation of risk and storage of treated water for short to medium term
"Hospital in the home" patients	Private houses/ domestic settings	Disruptions	Loss of safe care, e.g. oxygen supply, home dialysis	Prioritisation of return of supplies or timely provision of essential healthcare in hospital
Inpatients	Hospitals, RCFs	Disrupted power supply	Loss of heating and lighting	Emergency generator with sufficient alternative fuel to last through power outage. Prioritisation of power return

Inpatients	Hospitals, RCFs	Disrupted communications	Loss of linkages with network hospitals, other services e.g. Ambulance services	Multiple back-up communications systems
Inpatients	Hospitals, RCFs	Disrupted treated water supply, through power loss, flooding etc	Risk to hydration, personal and environmental hygiene, food safety	Priority client status and sufficient short term storage in cooperation with IW
Residents especially dependant residents	Private houses/ domestic settings	Disrupted sanitation leading to environmental contamination	Risk of spread of infection	Public health risk assessment and hygiene advice
Patients	Unsafe roads	Disrupted access to healthcare	Risk of delayed or missed essential assessment and treatment	Maximising the transport capacity of the national ambulance services
Public, patients, staff	Outdoors	Falling trees, flying objects	Injuries, deaths	Stay at home, pre-plan care
Public, patients, staff	Healthcare facilities	Flooding	Destruction of critical infrastructure, resulting in service failure	Prevention of flooding through flood risk assessment and mitigation
Residents especially dependant residents	Private houses/ domestic settings	Flooding	Drowning	Alerts/warning advice
Residents especially dependant residents	Private houses/ domestic settings	Flooding	Destruction of property, displacement, mental health effects	Prevention of flooding through flood risk assessment and mitigation

Climate stimuli: Rising Sea Level				
Sensitivity	**Exposure**	**Impacts**	**Sectoral Consequence**	**Adaptive Capacity**
Residents especially dependant residents	Private houses/ domestic settings	Flooding	Destruction of property, displacement, mental health effects	Prevention of flooding through flood risk assessment and mitigation
Residents especially dependant residents	Private houses/ domestic settings	Erosion	Destruction of property, displacement, mental health effects	Environmental planning, HIAP

Climate stimuli: Changes in Precipitation				
Sensitivity	**Exposure**	**Impacts**	**Sectoral Consequence**	**Adaptive Capacity**
Residents especially dependant residents	Private houses/ domestic settings	Disrupted sanitation leading to environmental contamination	Risk of spread of infection	Wastewater management
Public, patients, staff	Healthcare facilities	Disrupted sanitation leading to environmental contamination	Risk of spread of infection	Wastewater management
Public	Outdoors	Disrupted sanitation leading to environmental contamination	Risk of spread of infection and anti-microbial resistance	Wastewater management
Residents especially dependant residents	Private houses/ domestic settings	Flooding	Drowning	Alerts/warning advice

Residents especially dependent residents	Private houses/ domestic settings	Flooding	Destruction of property, displacement, mental health effects, carbon monoxide poisoning during clean-up	Prevention of flooding through flood risk assessment and mitigation
Residents especially dependent residents	Private houses/ domestic settings	Flooding	Destruction of property, displacement, mental health effects	Prevention of flooding through flood risk assessment and mitigation
Residents especially dependent residents	Private houses/ domestic settings	Drought	Risk to hydration, personal and environmental hygiene, food safety	Public health risk assessment, hydration and hygiene advice
Public, patients, staff	Healthcare facilities	Drought	Risk to hydration, personal and environmental hygiene, food safety	Risk to hydration, personal and environmental hygiene, cooking
"Hospital in the home" patients	Private houses/ domestic settings	Drought	Risk to hydration, personal and environmental hygiene, food safety as well as potential risk to essential healthcare	Provision of alternative supplies, readmission
Population of Ireland, visitors etc	Private untreated water supplies, visitors to hotels and other facilities with inadequately treated private water, additional challenges for treatment for all water supplies (assumptions about pathogen survival may need to be revised)	Changed environmental fate of pathogens	Increased risk of foodborne and waterborne infection, spread of anti-microbial resistance	Improved drinking water infrastructure for all, reduction of environmental pollution

Climate stimuli: High Temperature including heatwaves				
Sensitivity	**Exposure**	**Impacts**	**Sectoral Consequence**	**Adaptive Capacity**
Population of Ireland, visitors etc	Outdoors	Increased vector survival	Increased risk of vectorborne infection	Vector and vectorborne disease surveillance, investigation and control
Population of Ireland, visitors etc	All settings	Drought	Risk to hydration, personal and environmental hygiene, food safety as well as potential risk to essential healthcare	Public health risk assessment, hydration and hygiene advice
Population of Ireland, visitors etc	All settings	Changed environmental fate of pathogens	Increased risk of foodborne and waterborne infection, spread of anti-microbial resistance	Improved drinking water infrastructure for all, reduction of environmental pollution
Population of Ireland, visitors etc	All settings	Changed environmental transport of pathogens	Increased risk of foodborne and waterborne infection, spread of anti-microbial resistance	Improved drinking water infrastructure for all, reduction of environmental pollution
Population of Ireland, visitors etc	All settings	Indoor and outdoor temperatures	Risk of increased morbidity and mortality	Shading, indoor temperature control, building regulations
Population of Ireland, visitors etc	All settings	Increased aeroallergen levels/duration	Risk of acute exacerbations of asthma, COPD	Health advice on prevention including risk monitoring, and timely treatment
Population of Ireland, visitors etc	All settings	Worsening Air pollution	Already > 1000 premature deaths per year (EEA), risk of worsening risk	HIAP, health advice, public education, etc
Population of Ireland, visitors etc	Outdoors	Worsening UV exposure	Worsening skin cancer risks - already many thousand per year	Skin cancer presentation plan, environmental planning to produce better shade etc

Appendix II: Sectoral Adaptation Team Members and Team Meetings

Table 9: Sectoral Adaptation Team Members

Name	Department/Organisation	Division/Unit
Dr. Colette Bonner	Department of Health	Deputy Chief Medical Officer
Gerry Canavan	Department of Health	Corporate Services
Mark Fagan	Health Service Executive	Assistant National Director Finance
Dr. Ina Kelly	Health Service Executive	Consultant in Public Health Medicine/Medical Officer of Health
Lee Lyons	Department of Health	Policy and Strategy Division
Aodán Mac an Mhíle	Department of Health	Capital / Infrastructure Unit
Trish Markham	Health Service Executive	National Office for Emergency Management
Robert Mooney	Department of Health	Press & Communications Office - Expertise in Climate Change research
Colm Ó Conaill (Chair)	Department of Health	Policy and Strategy Division
Emma O'Donoghue	Department of Health	Health and Wellbeing Unit
Daniel Shine	Department of Health	Health Protection Unit
Peter Smyth	Health Service Executive	Assistant National Director Estates
Michael Quirey	Health Service Executive	National Health Sustainability Office – HSE Estates

Table 10: Sectoral Adaptation Team Meetings

Date	Event
May 2019	Department of Health preparatory meetings
27 May 2019	Sectoral Adaptation Team initial meeting
6 June 2019	Stakeholder consultation forum
26 June 2019	Risk Workshop 1 – Sectoral Adaptation Team
5 July 2019	Risk Workshop 2 – Sectoral Adaptation Team
25 July – 25 Aug 2019	Public consultation
16 August 2019	Sectoral Adaptation Team meeting
27 August 2019	Meeting with the Department of Public Expenditure and Reform
4 September 2019	Sectoral Adaptation Team meeting
9 Sept 2019	Sectoral Adaptation Team + (Adaptation Action focus)

Appendix III: Stakeholder Consultation Forum, June 2019

The views of relevant stakeholders were gathered at a consultation forum held on 6 June 2019 in the Department of Health. Representatives of 16 organisations participated in three breakout sessions: on population health; on emergency management / business continuity; and on vulnerability assessment. Stakeholders were asked to identify and prioritise key climate change-related health risks over the next five years, options for concrete action that could address some of those risks and concerns, and information and data gaps that needed to be addressed urgently.

Some of the main qualitative points to emerge at the stakeholder consultation forum included: the need to integrate climate change considerations more fully into Sláintecare (particularly population health planning), Healthy Ireland and other relevant programmes; the need to integrate climate change-related elements into service planning, with a particular focus on vulnerable groups including the frail elderly; more focus on mental health, including mental health of farmers; the need to strengthen emergency management and business continuity, including through dedicated channels of communication, consistent messaging and encouragement of self-resilience during severe weather events; and better identification and use of existing data resources including the EPA's State of Knowledge on Climate Change Impacts, UCC's Climate Risk Project and Urban Adapt.

Agenda

Series of Presentations

- The Policy context, *John O'Neill, Department of Communications, Climate Action & Environment*
- Sectoral Planning for Climate Change Adaptation, *Barry O'Dwyer, UCC*
- Producing a Plan – Reflections, Sectoral Adaptation Plan Consultation Process, *Sean O'Leary, Climate Change Advisory Council Secretariat*
- Health Sector Adaptation, *Dr Ina Kelly, HSE Public Health*

3 parallel breakout sessions

Each thematic session to prioritise concrete options and actions for the 5-year plan

1. **Vulnerability Assessment**
2. **Emergency Management/Business Continuity**
3. **Health of the Population**

.

Plenary discussion

- Leadership was identified as a key component with regards to climate change adaptation. Integrated planning amongst all stakeholders will be essential to the plan's success.
- Vulnerability must be assessed through the following:

  1. Infrastructure

  2. Services

  3. Taking a more academic view to producing concrete actions
- There were a number of top priorities identified during the discussion, these included:

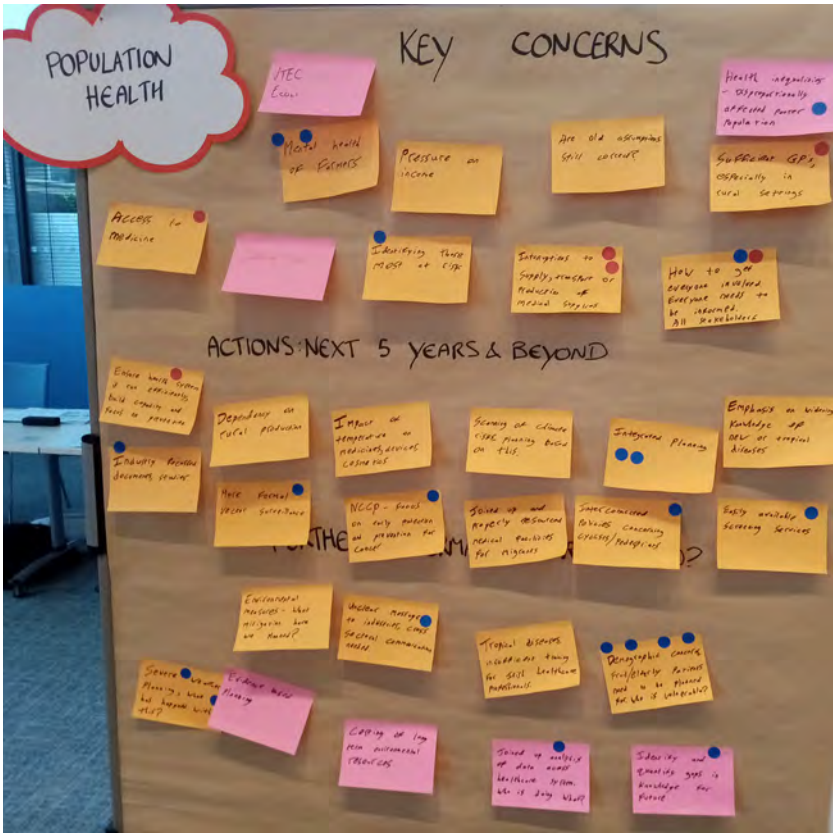
Communications

- A consistent message across all sectors
- Creating a dedicated channel for all communications
- Creating public awareness and maintaining a positive message
- Citizen engagement

Collaborative Planning

- Aligning the plan to/working with the implementation of Sláintecare
- Development of a key risk register
- This should take place during the development stage of plans/testing
- Cross-sector input and buy-in is essential
- Future planning with regards to finances, data gathering, contingencies around severe weather events
- Horizon scanning

Topic 1: Population Health



Key Concerns:

- Mental Health of farmers
- Interruptions to supply, transport or production of medical supplies
- How to get people involved. We are all stakeholders.

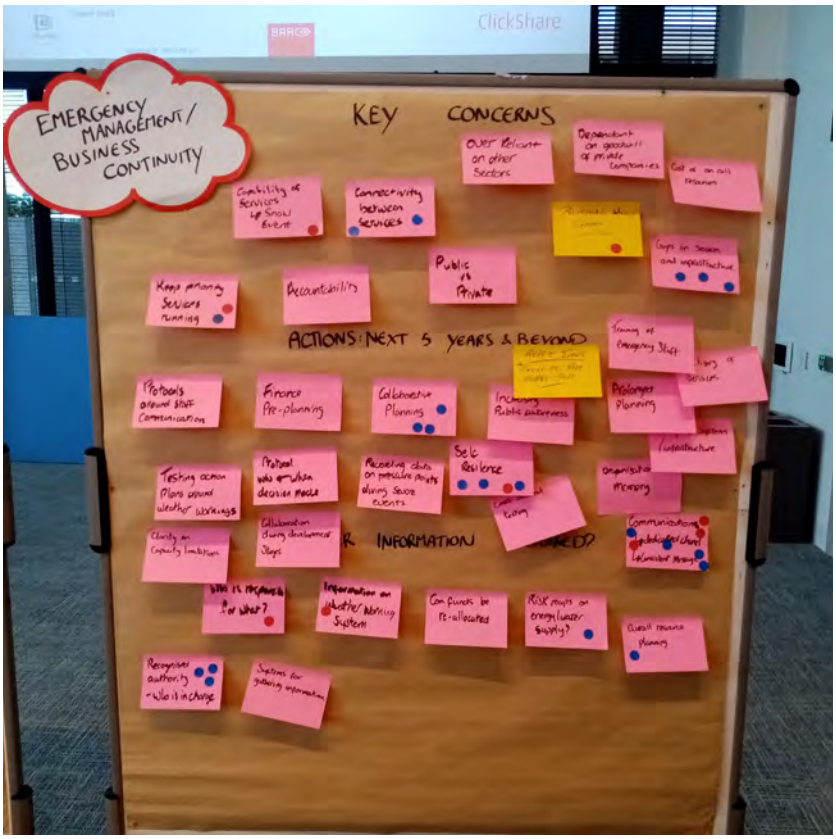
Actions: Next five-years and beyond

- Integrated planning across all healthcare sectors
- Ensure health system is run efficiently, build capacity and focus on prevention
- Industry focused studies

Further Information required:

- Demographic concerns, frail/elderly patients need to be planned for. Who is vulnerable to what?
- Severe weather planning, what progress has been made on this?
- Identify and quantify existing gaps in knowledge

Topic 2: Emergency Management/Business Continuity



Key Concerns:

- Gaps in services and infrastructure
- Keep priority services running
- Connectivity between services

Actions: Next five years and beyond

- Communications – consistent message and dedicated channel through which it is sent
- Self-resilience
- Collaborative planning

Further information required:

- Recognised authority – who is in charge
- Clarity on roles – who is responsible for each aspect
- Greater information on weather warning systems

Topic 3: Vulnerability assessment

Key Concerns

- Lack of leadership on climate change may compromise integrated planning
- Newly emerging diseases are combined with changing volumes and patterns of infectious diseases
- Infrastructure is at risk from flooding

Actions: Next 5 years and beyond

- We must ensure that climate change becomes a mainstream aspect of planning
- Health needs assessment, particularly around vulnerable populations
- Health proofing of adaptation plans for other sectors and vice versa, this should become a formal process

Further information required:

- Available data needs to be reclassified and adapted to monitor and evaluate risks from climate change, e.g. increased incidence of Legionnaire's disease.

Table 11: Stakeholder Consultative Forum, 6 June 2019, List of Participants

Name	Organisation
1. Dr. Colette Bonner	Department of Health (Deputy Chief Medical Officer)
2. Paul Brosnan	Department of Health (Health and Wellbeing unit)
3. Heather Burns	Department of Health (Office of the CMO)
4. Abigail Chanther	Department of Health (Older People's Projects unit)
5. Adam Dempsey	Department of Health (International & Research Policy unit)
6. Jacqui Donnelly	Department of Culture, Heritage & the Gaeltacht
7. Louis Duffy	Climate Action Regional Office
8. Mark Fagan	Health Service Executive (Finance)
9. Raymond Fenton	Health Service Executive (CHO 7)
10. Jason Flanagan	Irish Centre for High-End Computing
11. Brian Gillespie	Medical Health Council
12. Martin Hehir	Department of Housing, Planning and Local Government (Water Advisory)
13. Chloe Kearns	Department of Health (Sláintecare Programme Implementation Office)
14. Ina Kelly	Health Service Executive
15. Keith Lambkin	Met Éireann
16. Robert Leonard	Department of Agriculture, Food and the Marine
17. Jennifer Lyons	Department of Health (Corporate Services)
18. Lee Lyons	Department of Health (Policy and Strategy Division)
19. Aodán Mac an Mhíle	Department of Health (Finance unit)
20. Trish Markham	Health Service Executive (EM)
21. Keith McCarthy	Public Health Agency (Hermitage Medical Clinic)
22. Deirdre McCaughey	Department of Health (Eligibility unit)
23. Mary Mockler	Pharmaceutical Society of Ireland
24. Robert Mooney	Department of Health (Press & Communications unit)
25. Liam Morris	Department of Health (Acutes Care Division)
26. Colm Ó Conaill	Department of Health (Policy and Strategy Division)
27. Brian O'Connell	Health Service Executive (Estates)
28. Maurice O'Donnell	Department of Health (Minister's Office)
29. Emma O'Donoghue	Department of Health (Health and Wellbeing unit)
30. Barry O'Dwyer	University College Cork
31. Sean O'Leary	Climate Change Advisory Council (Secretariat)
32. John O'Neill	Department of Communications, Climate Action and Environment (Climate Adaptation, Soils, GMOs and Chemicals
33. Michael Quirey	Health Service Executive (NHSO)
34. Aaron Rafter	Department of Health (Health Systems and Structures unit)
35. Niamh Richardson	Department of Health (Disability Services unit)
36. Winnie Ryan	Department of Health (Acutes Care Division)
37. Wolfram Schulter	Office of Public Works
38. Damien Scully	Health Products Regulatory Authority
39. Daniel Shine	Department of Health (Health Protection unit)
40. Andrew Sulley	Health Service Executive
41. Eimear Walshe	Department of Health (Disability Appeals Office)
42. Damien Wyse	Department of Agriculture, Food and the Marine

Appendix IV: Public Consultation, July – August 2019

A public consultation exercise was run from 25 July to 25 August 2019, with the views of the public sought on (i) whether the six climate scenarios / impacts identified represented the highest priority risks for the health sector; (ii) what other vulnerabilities should be covered by the plan, and why; and (iii) suggestions for concrete and cost-effective adaptation actions for the health sector were invited.

38 submissions were received from individuals and organisations (listed below chronologically, by receipt). The exercise was successful in broadening the net to gather valuable input from those with particular interest or expertise, and several ideas and proposals from the public consultation feature in this final plan.

Table 12: Public Consultation Submissions

Name	Organisation
1. Eoin McMahon	Individual Submission
2. Raymond Ryan	Fingal Transport Strategic Policy Committee
3. Conall Boland	Individual Submission
4. Ronan Gilroy	Individual Submission
5. Pat Goodman	Individual Submission
6. Elaine Campbell	Individual Submission
7. Wolfram Schulter	Office of Public Works
8. Maria Talbot	Department of Agriculture, Food and the Marine
9. Craig Skerrit	Royal Irish Academy
10. Emily Kavanagh	Irish Water
11. Melanie O'Driscoll	Individual Submission
12. David Byrne	COPE Galway
13. Aoife Sugrue	CARO
14. Lucia Campones	Individual Submission
15. Erich Steyaert	Irish Cancer Society
16. Siobhan Creaton	Faculty of Public Health Medicine
17. Benjamin Hendriksen	AONTAS
18. Chris Macey	Irish Heart Foundation
19. Vanessa Hetherington	IMO
20. Dr Ina Kelly	Public Health Medicine Environment and Health Group
21. Teresa Curtin	Irish College of GPs
22. Eoin	Extinction Rebellion Wexford
23. Shane Conneely	Chambers Ireland
24. Kevin Balanda	Institute of Public Health
25. Dr Sean Owens	Plant Based Doctors Ireland
26. Leonard Lades	Individual Submission
27. Joan Swift	Cyclist.ie
28. Aisling Kett	Individual Submission

29. Eoin O'Neill	Individual Submission
30. Ann Marie Crosse	Individual Submission
31. John Brick	PP Ltd
32. Jonathan Derham	Environmental Protection Agency
33. Justin Fleming	Individual Submission
34. Cormac McElhinney	The Food Safety Authority of Ireland
35. Malvina Walsh & Claire Allcutt	Baby Feeding Law Group Ireland
36. Aileen Kitching	HSE Social Inclusion
37. Sadhbh Lee	Irish Doctors for the Environment
38. Ciaran Finlay	National Disability Authority

Some of the main issues highlighted in the submissions were:

- Mental Health especially in relation to farmers/flooding
- Health Inequalities
- Food safety /security /nutrient value / food waste
- Displaces populations / inward migration
- Data / Climate epidemiology
- Indoor Air Quality
- Heatwave Plan
- Resilience of infrastructure and health services.

Appendix V: Risk Matrix

Risk Assessment Stages

The impact and likelihood criteria as outlined in the tables below are used to position all the identified hazards on the risk matrix.

Table 13: Classification of likelihood

Ranking	Classification	Likelihood
1	Extremely Unlikely	May occur only in exceptional circumstances; Once in every 500 or more years.
2	Very Unlikely	Is not expected to occur; and / or recorded incidents or anecdotal evidence; and / or very few incidents in associated organisations, facilities or communicates; and / or little opportunity, reason or means to occur; May occur once every 100-500 years.
3	Unlikely	May occur at some time; and / or few, infrequent, random recorded incidents or little anecdotal evidence; some incidents associated or comparable organisations worldwide; some opportunity, reason or means to occur; may occur once per 10-100 years.
4	Likely	Likely to or may occur; regular recorded incidents and strong anecdotal evidence and will probably occur once pre 1-10 years.
5	Very Likely	Very likely to occur; high level of recorded incidents and / or strong anecdotal evidence. Will probably occur more than once a year.

Source: A Framework for Major Emergency Management, M.E.M. Project Team 2010

Table 14: Classification of Impact

Ranking	Classification	Impact	Description
1	Minor	Life, Health, Welfare Environment Infrastructure Social	Small number of people affected; no fatalities and small number of minor injuries with first-aid treatment No contamination, localised effects <0.5M Euros Minor localised disruption to community services or infrastructure (<6 hours).
2	Limited	Life, Health, Welfare Environment Infrastructure Social	Single fatality; limited number of people affected; a few serious injuries with hospitalisation and medical treatment required. Local displacement of a small number of people for 6-24 hours. Personal support satisfied through local arrangements. Simple contamination, localised effects of short duration 0.5-3M Euros Normal Community functioning with some inconvenience
3	Serious	Life, Health, Welfare Environment Infrastructure Social	Significant number of people in affected area impacted with multiple fatalities (<5), multiple serious or extensive injuries (20), significant hospitalisation Large number of people displace for 6-24 hours or possibly beyond; up to 500 evacuated. External resources required for personal support. Simple contamination, widespread effect or extended duration 3-10M Euros Normal community functioning with some inconvenience.

Ranking	Classification	Impact	Description
4	Very serious	Life, Health, Welfare	5 to 50 fatalities, up to 100 serious injuries, up to 2000 evacuated
		Environment	Heavy contamination, localised effects or extended duration
		Infrastructure	10-25M Euros
		Social	Community functioning poorly, minimal services available
5	Catastrophic	Life, Health, Welfare	Large numbers of people impacted with significant numbers of fatalities (>50), injuries in the hundreds, more than 2000 evacuated.
		Environment	Very heavy contamination, widespread effects of extended duration.
		Infrastructure	>25M Euros
		Social	Serious damage to infrastructure causing significant disruption to, or loss of, key services for prolonged period. Community unable to function without significant support.

Source: A Framework for Major Emergency Management, M.E.M. Project Team 2010

Rialtas na hÉireann
Government of Ireland