Appendix 13-2: Climate Change Risk Assessment

Appendix 13-2 Climate Change Risk Assessment

13A.1 Introduction

1.1.1 Appendix 13-2: Climate Change Risk Assessment (CCRA) of Chapter 13: Climate (Environmental Impact Assessment Report (EIAR) Volume 2) presents the findings of the assessment that was carried out to identify and assess the direct and indirect significant climate effects of the Proposed Order, with regard to climate change risk and resilience.

1.1.2 CCRA was undertaken by Joana Cerejeira BSc, MRes, a Principal Sustainability Consultant in AECOM's Carbon and ESG team, with over eight years' experience in the climate change and sustainability space. Joana specialises in climate and carbon in infrastructure and has undertaken numerous CCRAs and associated work across various sectors in Ireland and the UK.

1.1.3 Chapter 13: Climate (EIAR Volume 2) and its appendices were reviewed by Ian Davies BSc (Hons), a Technical Director in AECOM's Carbon and ESG team, with over 20 years' experience in the provision of environmental sustainability assessment, specialising in greenhouse gas (GHG) and CCRAs. These include recent Dublin Airport applications for the proposed Dublin Airport Underpass and for the proposed NRRA, and for the expansion of London Luton Airport.

1.1.4 The EIA Directive 2014/52/EU[1] describes the importance of considering climate change and GHG emissions when carrying out Environmental Impact Assessments (EIAs): *"Climate change will continue to cause damage to the environment and compromise economic development. In this regard, it is appropriate to assess the impact of projects on climate (e.g., GHG emissions) and their vulnerability to climate change"*.

1.1.5 In line with the Institute of Sustainability and Environmental Professionals (ISEP) formerly known as IEMA[2] and the EU Commission guidance[3,4], consideration is given to the following aspects of climate change in this appendix:

- CCRA – the resilience of the Proposed Order to projected climate change impacts.
- Lifecycle GHG impact assessment – quantifying the GHG emissions arising from the Proposed Order over its lifetime. Further detail on the assessment undertaken for the Proposed Order can be found in Chapter 13: Climate (EIAR Volume 2) and Appendix 13-1: Climate Change – GHG Assessment (EIAR Volume 4).
- In-combination climate change impact (ICCI) assessment – the combined impact of the Proposed Order and future climate change on receptors in the surrounding environment. Further detail on the ICCI assessment for the Proposed Order can be found in Appendix 13-4: ICCI (EIAR Volume 4).

[1] European Union (EU), Directive 2014/52/EU of the European Parliament and of the Council, 2014 https://www.legislation.gov.uk/eudr/2014/52/contents
[2] Institute of Environmental Management and Assessment
[3] ISEP, Environmental Impact Assessment Guide to: Climate Change Resilience and Adaptation, 2020, https://www.iaia.org/pdf/wab/ISEP%20Guidance%20Documents%20EIA%20Climate%20Change%20Resilience%20and%20Adaptation.pdf
[4] ISEP, Environmental Impact Assessment Guide to: Assessing Greenhouse Gas Emissions and Evaluating their Significance – 2.1 Edition, 2026, https://www.isepglobal.org/resources/blogs/2026/april/defining-significance-in-a-net-zero-era-the-next-step-for-greenhouse-gas-emissions-assessment-in-environmental-impact-assessment/

1.1.6 The assessment scope outlined above also covers the climate assessment scope described in the Environmental Protection Agency's (EPA) guidelines (hereafter referred to as the 'EPA Guidelines')[5], i.e., assessment of GHG emissions and a review of the resilience of the Proposed Order to climate change.

1.1.7 This appendix presents the methodology and outcomes from undertaking the CCRA for the Proposed Order, with the comprehensive Climate Change Risk Register that was completed during this CCRA detailed in Appendix 13-3: Climate Change Risk Register (EIAR Volume 4). The following subsections of this appendix will present the methodology and findings from the CCRA.

13A.2 Legislation, Policy & Guidance

2.1.1 Chapter 13: Climate (EIAR Volume 2) sets out the climate legislation and policy used in this assessment.

Guidance

EU Commission Notice (2021/C 373/01)

2.1.2 The EU Commission Guidance (2021/C 373/01)[6] provides technical guidance on the climate proofing of infrastructure covering the period 2021-2027. 'Climate proofing' is defined within the guidance notice as *"a process that integrates climate change mitigation and adaptation measures into the development of infrastructure projects"*.

2.1.3 Climate change mitigation (i.e., GHG emissions reduction) and adaptation (i.e., adapting to projected changes in climate) form the two pillars of climate proofing described within the guidance notice.

13A.3 Assessment Methodology

Overall Approach & Assumptions

3.1.1 The methodology for the CCRA has been developed in line with appropriate industry guidance for assessing climate change resilience and adaptation, including ISEP, and in accordance with the EU Commission Notice (2021/C 373/01) Technical guidance[15]. Following desk-based research to obtain qualitative and quantitative baseline climate data and future climate change projections data, a risk assessment was undertaken to identify potential physical climate risks that could pose a threat to the Proposed Order which represents ongoing operations at Dublin Airport.

3.1.2 As climate risks are principally associated with the exposure and vulnerability of physical assets, infrastructure, workers and airport users to climate hazards, rather than changes in operational activity levels, the assessment has been based on the existing airport environment and its ongoing operation. This approach provides an appropriate basis for assessing the resilience of Dublin Airport to future climate change and identifying adaptation measures required to manage potential climate-related risks over the lifetime of the Proposed Order.

3.1.3 The increase in passenger throughput associated with the Proposed Order has not been assessed in isolation within the CCRA. This is because climate risks must be considered in the context of the physical assets, infrastructure, airport users and embedded adaptation and resilience measures that form part of the operation of Dublin Airport as a whole. It is not possible to meaningfully isolate climate hazards or associated climate risks solely in relation to the passenger uplift arising from the Proposed Order, as the relevant receptors and mitigation measures are the same to both the Proposed Order and the wider airport operation.

3.1.4 Furthermore, the nature, likelihood and consequence of physical climate risks, together with the adaptation and resilience measures required to manage those risks, are not anticipated to differ as a result of variations

[5] EPA, Guidelines on the Information to be Contained in Environmental Impact Assessment Reports, 2022, https://www.epa.ie/publications/monitoring--assessment/assessment/EIAR_Guidelines_2022_Web.pdf
[6] EU, Commission Notice — Technical guidance on the climate proofing of infrastructure in the period 2021-2027 (2021/C 373/01), 2021, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021XC0916%2803%29

in annual passenger numbers. Climate risks are principally influenced by the exposure, sensitivity and vulnerability of airport assets, infrastructure and operations to climate hazards, rather than the volume of passengers using the airport.

3.1.5 Accordingly, the assessment considers the ongoing operation of Dublin Airport as a whole, including the increase in passenger numbers facilitated by the Proposed Order. References to "Dublin Airport" throughout this chapter therefore represent the operational environment assessed within the Climate Change Risk Assessment, encompassing both existing airport operations and those associated with the Proposed Order.

3.1.6 The CCRA includes all infrastructure and assets associated with the operation of the Dublin Airport, as well as human receptors. As per the Task Force on Climate-related Financial Disclosures (TCFD)[7] guidelines this assessment looks at the resilience against both gradual climate change, i.e., chronic climate-related hazards and the risks associated with an increased frequency of severe weather events, i.e., acute events.

Climate Change Context & Uncertainty

3.1.7 The Intergovernmental Panel on Climate Change (IPCC) has confirmed in its Assessment Reports[8] that the anthropogenic influence on the climate system is clear and growing, with impacts observed across all continents and oceans. Human activities have increased the concentration of CO_2 in our atmosphere, with observed levels of global atmospheric CO_2 rising from their pre-industrial levels of 280 parts per million (ppm) up to 426.90ppm as of May 2024[9]. Given CO_2 is a GHG that absorbs and radiates heat, these increases have resulted in the warming of the Earth's atmosphere.

3.1.8 According to an ongoing temperature analysis by NASA, Earth’s temperature has risen by an average of 0.06°C per decade since 1850, with the rate of warming since 1982 occurring three times as fast at 0.20°C per decade[10]. The ten warmest years in historical record have all occurred since 2015, with 2023 being the warmest year since global records began in 1850[11].

3.1.9 Globally, climate change is creating a more unpredictable and potentially turbulent environment for infrastructure and the communities it serves, through the prevalence of increased extreme heat days, more frequent and intense extreme weather events, extended periods of drought, and rising sea levels[18].

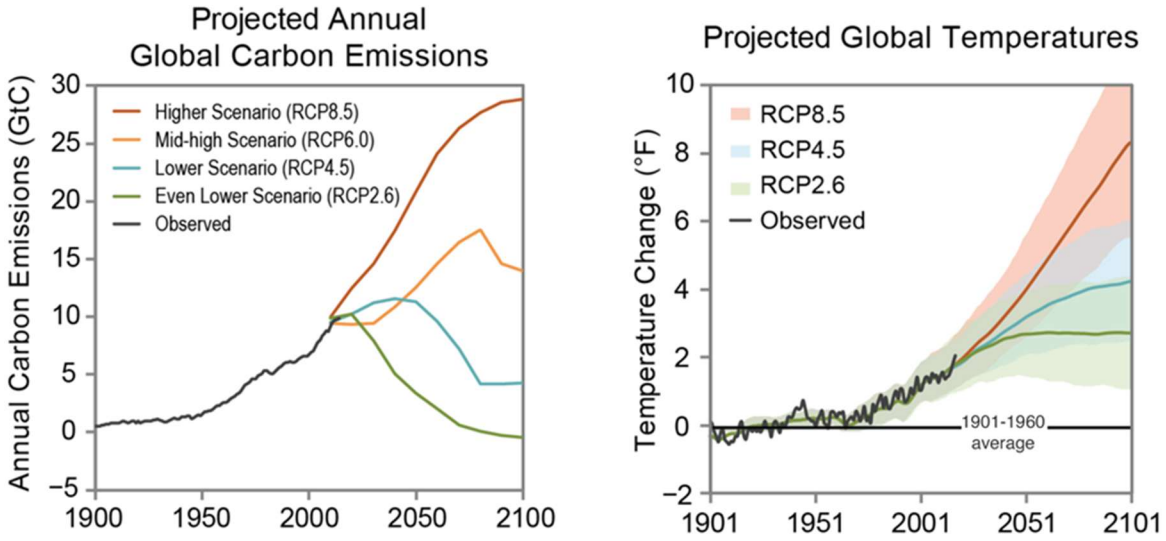
3.1.10 In order to understand how the global climate may change in the future, the IPCC's fifth Assessment Report (AR5) developed Representative Concentration Pathways (RCPs) that describe four different 21st Century pathways of GHG emissions depending on the level of mitigation action undertaken between now and then[17]. The RCPs are based on global research and existing literature and comprise a stringent mitigation pathway (RCP2.6), two intermediate scenarios (RCP4.5 and RCP6.0) and a high emissions scenario (RCP8.5) Plate 13A-1 shows the emission trajectories and projected global temperatures up to 2100 in terms of the IPCC's RCPs. These emission pathways are used for developing climate change projections which can then be used by policymakers, scientists, and other professionals to estimate and plan for climate risks and impacts.

3.1.11 However, it should be noted that the IPCC's sixth Assessment Report used the Shared Socio-economic Pathways (SSPs) and not the RCPs12, however due to the projection data for Ireland being based on the

[7] Task Force on Climate-related Financial Disclosures, Recommendations of the Task Force on Climate-related Financial Disclosures, 2017, https://assets.bbhub.io/company/sites/60/2021/10/FINAL-2017-TCFD-Report.pdf
[8] IPCC, Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, 2014, https://www.ipcc.ch/site/assets/uploads/2018/02/SYR_AR5_FINAL_full.pdf
[9] NOAA, Global Monitoring Laboratory, 2024, https://gml.noaa.gov/ccgg/trends/
[10] NOAA, Climate change: Global Temperature, 2023, https://www.climate.gov/news-features/understanding-climate/climate-change-global-temperature#:~:text=According%20to%20NOAA's%202020%20Annual,more%20than%20twice%20that%20rate
[11] Both SSSPs and RCPs represent a range of possible future climate change scenarios. SSPs primarily focus on describing different global futures based on socioeconomic factors, such as population growth, economic development, and technological advancements
[12] Both SSSPs and RCPs represent a range of possible future climate change scenarios. SSPs primarily focus on describing different global futures based on socioeconomic factors, such as population growth, economic development, and technological advancements. RCPs, on the other hand, focus specifically on GHG concentration trajectories in the atmosphere. They are used to represent different levels of radiative forcing, which is a measure of the imbalance between incoming and outgoing energy in the Earth's atmosphere.

RCP scenarios, those were used in this CCRA[13]. Plate 13A-1 illustrates the RCP scenarios and their timelines[14].

Plate 13A-1:Annual Global Historical Temperature with Projected Annual Global Carbon Emissions (left) and Projected Global Temperatures (right)



3.1.12 It is important to understand when using climate change projections, that they contain inherent uncertainty. This uncertainty is the result of limitations of available measurements and challenges in evaluating causation in complex and multi-component processes. Uncertainty in climate change projections is derived from multiple sources including:

- Uncertainty in how GHG emissions will change over time due to key unknowns in the drivers of this change; such drivers include economic and population growth, lifestyle and behavioural changes, associated changes in energy use and land use, technology, and climate policy
- Variable confidence levels in how well the climate models predict different climate variables; for example, climate models perform less well in their simulation of large-scale precipitation patterns than for surface temperature

[13] Carbon Brief, How 'Shared Socioeconomic Pathways' Explore Future Climate Change, 2018, https://www.carbonbrief.org/explainer-how-shared-socioeconomic-pathways-explore-future-climate-change/
[14] U.S. Climate Science Special Report, Highlights of the Findings of the U.S. Global Change Research Program Climate Science Special Report, 2017, https://science2017.globalchange.gov/chapter/executive-summary/

3.1.13 For these reasons, it is best practice to use a range of projection scenarios when considering how the climate may change in the future. As a result, two RCP scenarios were used in this CCRA as they will provide decision-makers with a more holistic understanding of the range of potential climate futures possible, which is essential when understanding risk and developing appropriate adaptation measures. The chosen RCP scenarios will be elaborated on further in Section 13A.3 and Section 13A.4.

Risk Assessment Methodology

3.1.14 The risk framework used for this assessment and the descriptors of likelihood and consequence were derived from the EU Technical guidance on climate proofing[16]. The likelihood analysis, consequences analysis and risk matrix are provided in Table 13A-1, Table 13A-2 and Table 13A-3 respectively. It should be noted that only risks rated 'high' or 'extreme' were classed as being significant and risks rated 'low' and 'medium' were classed as not significant in this CCRA.

Following the identification of a climate risk, and taking any identified planned controls into account, a climate risk will then be rated based on the likelihood of it occurring, using the Likelihood Analysis in Table 13A-1, and then should it occur what the consequence level would be based on Table 13A-2. Once likelihood of occurrence and consequence are assigned then using the Risk Matrix in

3.1.15 Table 13A-3 a risk rating will be allocated.

3.1.16 The initial risk ratings therefore take account of the existing and planned controls identified in the Climate Change Risk Register (Appendix 13-3). Residual risk ratings additionally consider the potential reduction in risk associated with further adaptation measures identified through the CCRA. Where these further measures have not yet been implemented, the residual ratings represent the anticipated risk following their implementation.

Table 13A-1: Likelihood Analysis

Term	Qualitative	Quantitative
Rare	Highly unlikely to occur	5%
Unlikely	Unlikely to occur	20%
Moderate	As likely to occur as not	50%
Likely	Likely to occur	80%
Almost certain	Very likely to occur	95%

Table 13A-2: Consequences Analysis

Risk areas	Insignificant	Minor	Moderate	Major	Catastrophic
Asset damage / Engineering / Operational	Impact can be absorbed through normal activity	An adverse event that can be absorbed by taking business continuity actions	A serious event that requires additional emergency business continuity actions	A critical event that requires extraordinary / emergency business continuity actions	Disaster with the potential to lead to shut down or collapse or loss of the asset / network
Safety and Health	First aid case	Minor injury, medical treatment	Serious injury or lost work	Major or multiple injuries, permanent	Single or multiple fatalities

Risk areas	Insignificant	Minor	Moderate	Major	Catastrophic
				injury, or disability	
Environment	No impact on baseline environment. Localised in the source area. No recovery required	Localised within site boundaries. Recovery measurable within one month of impact	Moderate harm with possible wider effect. Recovery in one year	Significant harm with local effect. Recovery longer than one year. Failure to comply with environmental regulations / consent	Significant harm with widespread effect. Recovery longer than one year. Limited prospect of full recovery
Social	No negative social impact	Localised, temporary social impacts	Localised, long-term social impacts	Failure to protect poor or vulnerable groups (1). National, long-term social impacts	Loss of social licence to operate. Community protests
Financial (for single extreme event or annual average impact)	x % IRR (***) < 2 % of turnover	x % IRR 2-10 % of Turnover	x % IRR 10-25 % of turnover	x % IRR 25-50 % of turnover	x % IRR > 50 % of Turnover
Reputation	Localised, temporary impact on public opinion	Localised, short-term impact on public opinion	Local, long-term impact on public opinion with adverse local media coverage	National, short- term impact on public opinion; negative national media coverage	National, long-term impact with potential to affect the stability of the Government
Cultural Heritage and cultural premises	Insignificant impact	Short term impact. Recovery or repair.	Serious damage with wider impact to tourism industry	Significant damage with national and international impact	Permanent loss with resulting impact on society

(1) Including groups that depend on natural resources for their income/livelihoods and cultural heritage (even if not considered poor) and groups considered poor and vulnerable (and often that have less capacity to adapt) as well as persons with disabilities and older persons.

(***) Internal Rate of Return (IRR).

Table 13A-3: Risk Matrix

		Consequence				
		Insignificant	**Minor**	**Moderate**	**Major**	**Catastrophic**
Likelihood	**Rare**	Low	Low	Medium	High	Extreme
	Unlikely	Low	Low	Medium	High	Extreme
	Moderate	Low	Medium	High	Extreme	Extreme
	Likely	Medium	High	High	Extreme	Extreme
	Almost certain	High	High	Extreme	Extreme	Extreme

13A.4 Current State of Environment

4.1.1 This section outlines the current and historic climate conditions and extreme weather events experienced in the local area of Dublin Airport site, as well as at a more regional level.

Climate Baseline Data

4.1.2 This section outlines the historic climate baseline data used for undertaking the CCRA. The subsequent section outlines the climate projection data gathered, the justification for the chosen future time period and the RCP scenarios used in this CCRA.

4.1.3 For the purposes of this CCRA, the baseline conditions were based upon historic qualitative and quantitative climate data, that was obtained from Met Éireann[15]. The quantitative data used was sourced from Met Éireann's Dublin Airport Weather Station, due to it being located within the boundary of Dublin Airport, as well as its data availability for the required climate variables and baseline period 1981-2010. Table 13A-6 displays the historic climate data, alongside the projection data.

4.1.4 To effectively conduct a CCRA and establish past and current climate and extreme weather events experienced in the area it is important to use not just historic data from the baseline period but also more recent qualitative data on the climate conditions and extreme weather events that were experienced in the location of the Dublin Airport Site.

Past Extreme Weather Events

4.1.5 The following past extreme weather events were identified:

- Wettest summer season: Dublin Airport recorded it wettest summer since 2008, with 318.0mm of rainfall falling during the summer months of 2023
- Storm Betty (August 2023): Dublin Airport recorded its highest gust for August since 1988, with 47 knots (87km/h) being recorded early on Saturday 19 August 2023
- Highest recorded temperature: 29ºC recorded in July 2022
- Highest daily rainfall recorded in the last 10 years was 84mm in August 2014

[15] Met Éireann, Historic Data-Dublin Airport Weather Station, 2026, https://www.met.ie/climate/available-data/historical-data

- Lowest recorded temperature: The temperature reached below -11ºC on two consecutive days in December 2010
- Flood Event (August 2008): Over a 24hr period 76.2mm of rainfall was recorded at Dublin Airport, this downpour of rain resulted in parts of the M3 (20km away) being severely flooded and parts of the road had to be closed
- Storm Éowyn (January 2025): major wind disruption causing widespread flight cancellations at Dublin Airport
- Severe flooding affecting access routes to Dublin Airport (February 2026): heavy rainfall caused flooding on roads leading to the airport and transport disruption.

4.1.6 The following factors were taken into account when identifying and assessing climate risks predicted to impact Dublin Airport: the baseline climate data results in Table 13A-6, the qualitative data on past extreme weather events and the location of Dublin Airport. In addition to the above considerations, the types of assets and infrastructure associated with Dublin Airport were also taken into account when undertaking the CCRA. The following chronic and acute variables were deemed relevant based on the above factors:

- Temperature related: changing air temperature, temperature variability, heat stress
- Wind related: changing wind patterns, increase in storm events
- Water related: changing precipitation patterns, sea level rise, heavy precipitation, fluvial flooding, coastal flooding, pluvial flooding and groundwater flooding

Future Receiving Environment

4.1.7 This section highlights the predicted climate trends that are expected to be experienced across the Island of Ireland, as well as those at a more local level to Dublin Airport. Table 13A-4 and Table 13A-5 present the qualitative findings for projected climate trends in Ireland, while Table 13A-6 shows the quantitative climate change projection data for Dublin Airport.

Climate Change Projection Data

4.1.8 In understanding how the climate is expected to change in the future it is important to consider broad, qualitative trends as well as location specific, quantitative projection data. This section will expand on the general climate conditions predicted to impact the island of Ireland, as well as those climate trends that are expected to impact the specific location of Dublin Airport .

Qualitative Projections

4.1.9 Future trends for key climate variables in Ireland are summarised in Table 13A-4, based on information from Climate Ireland[16] which highlights the observed and projected changes in the climate for Ireland. Accounting for the wider climate conditions predicted to impact Ireland allows for a broader examination of the overall climate hazards and extreme weather events that are increasing in frequency and intensity across Ireland to be taken into account when assessing the hazards expected to impact Dublin Airport in the future.

Table 13A-4: Key Messages - Climate Change Projection Ireland

Climate variable	Key trend	Key message
Surface air temperature	Average surface air temperatures are expected to increase everywhere and across all seasons.	An increase in the intensity and duration of heatwaves is expected.

[16] Climate Ireland, Essential Climate Information, 2026, https://www.climateireland.ie/#!/tools/climateInformation/essentialClimateInformation

Climate variable	Key trend	Key message
Precipitation	An increase in seasonality in precipitation can be expected with significant decreases projected for spring and summer and increases for winter.	An increase in the occurrence of extreme rainfall events is likely.
Hydrology	Increasing seasonality in hydrological regimes can be expected with decreased summer and increased winter flows likely.	Flood risk is expected to increase across Ireland while increases in the frequency of drought conditions is also expected.
Windspeed	An increase in the intensity of extreme windstorms is expected.	Projections indicate a decrease in wind speeds for summer and increases for winter.
Sea level rise	Sea levels are expected to increase for all Irish coastal areas.	Projected changes in sea level will magnify the impacts of changing storm surge and wave patterns in coastal areas.
Waves and Surges	A decrease in mean and extreme wave heights are expected by the end of the century.	The magnitude and intensity of storm wave heights are expected to increase.

4.1.10 Storms and associated high wind speeds are a major natural hazard risk for many countries across Europe. For example, Ireland has been severely affected by an exceptional number of storms over the last 10 years, causing serious coastal damage and widespread, persistent flooding[17]. Future projections show an increase in the number of very intense winter storms over Ireland from the middle of the century. It should be noted that because extreme storms are rare events, storm projections should be considered with a level of caution[18].

4.1.11 The number of very intense storms is projected to increase over the North Atlantic region in the future (2041-2070), under RCP 8.5. Projections suggest that the winter track of these storms may extend further south and over Ireland more often. Under RCP 4.5, the projections of future intense storm tracks have a similar, but weaker signal[32].

4.1.12 As the planet continues to warm, areas with warmer temperatures and moist conditions are expected to experience an increase in lightning. The British Isles, including Ireland, is one of the regions predicted to experience an increase in lightning, with lightning expected to double during July and August[19].

4.1.13 Met Éireann's report 'Ireland's Climate Averages 1991-2020'[20] gives a comparison of the two 29-year time periods 1961-1990 and 1991-2020. Based on the recommendations from the World Meteorological Organization, it is best practice for the reference periods for climate averages to be updated every 10 years, with reference periods lasting 30 years. This report outlines the climate averages for the period 1991-2020 for a range of parameters including air temperature, precipitation, sunshine and wind, in addition to giving a comparison against the previous reference period 1961-1990. By comparing the two reference periods and the observed trends it gives us an indication into the climate trends that can be expected in the next 30-year reference period and reinforces the quantitative trends that are displayed in Table 13A-6. Table 13A-5 below

[17] Met Éireann, Major Weather Events, 2026, https://www.met.ie/climate/major-weather-events
[18] EPA, Ensemble of Regional Climate Model Projections for Ireland, 2015, https://www.epa.ie/publications/research/climate-change/EPA-159_Ensemble-of-regional-climate-model-projections-for-Ireland.pdf
[19] Abdullah Kahraman *et al.*, Contrasting Future Lightning Stories Across Europe, 2022, https://iopscience.iop.org/article/10.1088/1748-9326/ac9b78/pdf
[20] Curley, M., Coonan, B., Ruth, C.E. and Ryan, C., Ireland's Climate Averages 1991-2020 – Climatological Note No. 22. (Met Éireann), 2023, https://edepositireland.ie/handle/2262/108693

outlines some of the key climate trends that were observed in this reference period compared to those reported in 1961-1990.

Table 13A-5: Observed Changes in Ireland's Climate Averages between 1991-2020 and 1961-1990

Climate Variable	Observed Change
Annual Mean Temperature	Comparing the 1991-2020 annual mean air temperature for Ireland with that of the 1961-1990 period, there has been an increase of approximately 0.7°C.
Seasonal Mean Temperature	Mean air temperature has increased in all seasons. Spring shows the highest increase of approximately 0.8°C.
Annual Rainfall	Annual average rainfall has increased by approximately 7% between the periods 1961-1990 and 1991-2020. Almost all regions have observed an increase in annual average rainfall between the two 30-year periods.
Seasonal Rainfall	All seasons show a percentage increase in average rainfall amounts between the periods 1961-1990 and 1991-2020, although it should be noted that there were large regional variations. Summer rainfall had the greatest increase at 12%, with July experiencing the biggest variability of 22% between the two periods. Winter rainfall has increased by 7% between the two 30-year periods.
Number of Rain Days	There has been an increase in the average annual number of rain days, wet days and very wet days observed between the 1961-1990 and 1991-2020 periods. At a seasonal level winter, summer and autumn show an increase in the number of rain days, wet days and very wet days.

Quantitative Projections

4.1.14 The quantitative climate change projection data for Dublin Airport are presented in Table 13A-6, alongside the historic climate baseline data foshr the area. The historic time period is 1981-2010, and the projection period is 2041-2070, these two time periods were chosen based on data availability.

4.1.15 As aforementioned, two RCP scenarios were used, to provide a more conclusive assessment of the potential GHG emissions that could arise if global mitigation measures are or are not implemented. The chosen RCP scenarios used in this assessment were RCP 4.5 and RCP 8.5, as the former is an intermediate emissions scenario, and the latter is a high emissions scenario. Accounting for this range of emissions allows for a wider range of possible climate risks to be accounted for across the varying emission trajectories. Table 13A-6 states the climate change projection data for the time period 2041-2070 under both RCP 4.5 and RCP 8.5.

4.1.16 Some key projected trends to note, as displayed in Table 13A-6, are an expected increase in all temperature climate variables, an increase in the number of wet and very wet days, a decrease in summer rainfall, and an increase in the frequency and intensity of storms.

Table 13A-6: Climate Change Baseline and Projection Data for Dublin Airport

Climate Variable	Baseline (1981-2010) Dublin Airport *Weather Station*	Climate change projection		Projected Trend	Source
		Moderate scenario RCP4.5 (2041-2070)	Extreme scenario RCP8.5 (*2041-2070*)		
Temperature					
Mean annual maximum daily temperature (°C)	13.3	1.1 14.4	1.6 14.9	↑	2
Mean annual minimum daily temperature (°C)	6.2	1.4 7.6	1.8 8.0	↑	2
Mean summer maximum daily temp (°C)	18.7	1.1 19.8	1.6 20.3	↑	2
Mean winter minimum daily temp (°C)	2.5	1.1 3.6	1.6 4.1	↑	2
Highest temperature for baseline period (°C)	28.7	-	-	-	1
Lowest temperature for baseline period (°C)	-12.2	-	-	-	1
Rainfall					
Mean annual rainfall levels (mm)	758.0	7.9% *817.9*	10.5% *837.8*	↑	2
Mean summer rainfall (mm)	196.7	-2.8% *191.2*	-5.8% *185.3*	↓	2
Mean winter rainfall (mm)	205.0	8.20% *221.8*	17% *239.7*	↑	2
Wettest month on average (mm)	Oct	-	-	-	1
Driest month on average (mm)	Feb	-	-	-	1
Highest daily rainfall (mm) for baseline period	92.6	-	-	-	1
Other					
Heatwaves	n/a	An increase in the intensity and duration of heatwaves is expected.		↑	2
Mean wind speed (knot)	10.3	Projections from Climate Ireland suggest an increase in the intensity of extreme windstorms is expected. Projections indicate a decrease in wind speeds for summer and increase for winter. Projections indicate a decrease in the numbers of less intense storms for Ireland with an increase in more intense storms which are rare events. However, due to a limited number of studies, these projections should be considered with a high level of caution.		↑↓	2

Climate Variable	Baseline (1981-2010) Dublin Airport *Weather Station*	Climate change projection		Projected Trend	Source
		Moderate scenario RCP4.5 (2041-2070)	Extreme scenario RCP8.5 (*2041-2070*)		
Storms	n/a	Storm surges, particularly in combination with extreme waves, pose an increasing risk to Ireland. However, projections of changes in storminess and extreme wave heights are uncertain. Significant wave heights (the highest third of all waves) are projected to decrease around Ireland during the remainder of the century. However, the future behaviour of extreme waves around Irish coasts is considerably less certain, with studies showing everything from decreases to increases in wave heights. Expected surge levels for events of a 20 to 30-year return period are likely to increase by up to 9cm by 2100.		↑	2
Storms (Lightning)	n/a	As the planet continues to warm, areas with warmer temperatures and moist conditions are expected to experience an increase in lightning. It is predicted that the British Isles (Ireland) are expected to experience double the amount of lightning in July and August by 2100.		↑	3
Sea level rise (m) *	n/a	0.15 to 0.28	0.15 to 0.29	↑	4
References: **1** Met Eireann Historical Data (https://www.met.ie/climate/available-data/historical-data) **2** Climate Ireland (https://www.climateireland.ie/#!/tools/climateDataExplorer) **3** Abdullah Kahraman et al 2022 Environ. -'Contrasting future lightning stories across Europe' (https://iopscience.iop.org/article/10.1088/1748-9326/ac9b78/pdf) **4** IPCC AR6 Sea Level Projection Tool (https://sealevel.nasa.gov/ipcc-ar6-sea-level-projection-tool)					

13A.5 Environmental Design & Management

Operational Mitigation Measures

5.1.1 A number of operational planned control measures were captured while undertaking this CCRA. Some such measures included:

- In compliance with the airport drainage policy, the airport surface water drainage systems have been designed to include a climate uplift factor applied to rainfall depths and intensities
- Taxiway surfaces and runways were built to comply with industry standards. They were built based on design standards intended to withstand far higher temperatures to be able to cope with aircraft braking
- Building layouts and designs considered ways to maximise daylight and natural ventilation

13A.6 Assessment of Effects & Significance

6.1.1 This section of the report outlines the main climate risks and hazards that were identified during the CCRA. A full breakdown and additional information on each specific climate risk can be found in Appendix 13-3: Climate Change Risk Register (EIAR Volume 4).

6.1.2 The initial risk profile presents the climate risks that were identified at the time of the CCRA, and without any action being taken, in the form of adaptation measures, these climate risks would negatively impact Dublin Airport. Following this section, Section 13A.7 presents a summary of some of the recommended adaptation measures that if implemented would reduce the risks posed by the identified climate risks to Dublin Airport.

13A.7 Initial Risk Profile

7.1.1 Using the climate change projection data gathered in Section 13A.4, a series of climate risks were identified for climate hazards deemed to be relevant to Dublin Airport with the Proposed Order in operation.

7.1.2 For each climate risk identified, the asset components impacted were noted and the planned or embedded controls listed, some of which are detailed in Section 13A.5. In this instance, embedded or planned controls represent measures at Dublin Airport that work to mitigate climate risk. With this information, an initial assessment of climate change risk was undertaken based on an analysis of likelihood and consequence.

7.1.3 Each identified climate risk was rated using the risk framework presented in Section 13A.3. Climate risks were first assessed to determine their likelihood of occurrence, and then should they occur the level of consequence this would have on the Dublin Airport.

7.1.4 There was a total of 16 risks identified. Table 13A-7 highlights the initial risk profile for the Dublin Airport, under both RCP scenarios. There was a total of four climate risks which fell under the 'significant' category for the RCP 4.5 scenario and six risks rated as significant under RCP 8.5. Further details on each individual climate risk can be found in Appendix 13-3: Climate Change Risk Register (EIAR Volume 4).

Table 13A-7: Initial Risk Profile for Dublin Airport

Risk rating	Moderate emissions scenario RCP 4.5 2041 - 2060	High emissions scenario RCP 8.5 2041 - 2060
Low	6	6
Medium	6	4
High	4	5
Extreme	0	1

13A.8 Mitigation & Monitoring

8.1.1 This section outlines a number of recommended adaptation measures that will help increase the Dublin Airport's resilience to the identified climate risks and subsequently reduce the impact of these climate risks. For a full list and detailed information on all the recommended adaptation measures, against each climate risk, please refer to Appendix 13-3: Climate Change Risk Register (EIAR Volume 4).

8.1.2 When addressing climate risks, it is vital that not only adaptation measures be implemented and integrated into Dublin Airport, but also that monitoring measures are established so that contingency plans and measures can be put in place in the lead up to expected extreme weather events.

8.1.3 It is recommended that a 'Weather Monitoring' procedure be developed and put in place. Having this system in place will act as an early warning system that will allow for adaptation measures and contingency plans to be initiated, in advance of the expected poor weather conditions. Monitoring weather forecasts is one of the most effective procedures which address all the climate risks identified during the CCRA, as by having advance warning on expected poor weather conditions and extreme weather events, the appropriate actions can be planned and taken prior to the weather impacting Dublin Airport.

Overarching Adaptation Measures Identified

8.1.4 There were three overarching climate risk variables that were deemed to be a risk. These are; flooding (fluvial, pluvial and ground water), strong winds during storm events, and extreme temperatures, both hot and cold.

Flooding

8.1.5 To reduce the risk from flooding, a number of adaptation measures were proposed which build upon the existing flood mitigation measures currently in operation across Dublin Airport. It is recommended that water pumps should be installed beside areas with critical infrastructure, as doing so will increase the surface drainage capacity.

8.1.6 In addition, it is recommended that consideration is given to developing and introducing a drainage maintenance and operation plan, that'll help to monitor the drainage system and keep it blockage free.

Storms (Wind)

8.1.7 Areas that are near to or include vegetation or trees should be regularly monitored, and vegetation pruned where necessary, to avoid damage or potential debris causing disruption to work.

Extreme Temperatures

8.1.8 There are a number of existing procedures in place at Dublin Airport to address ice and snow conditions, and it is recommended that these procedures be reviewed and updated to ensure they are still adequate and sufficient.

8.1.9 In advance of expected periods of extreme heat check all Heating, Ventilation, and Air Conditioning (HVAC) system are working correctly and assess if further temporary fans need to be dispersed in indoor areas.

13A.9 Residual Effects & Conclusions

9.1.1 This section outlines the residual effects and risk rating, based on the understanding that the recommended adaptation measures, or similar, are implemented. Should these additional measures not be implemented, then the risk rating will remain unchanged.

Residual Risk Rating

9.1.2 The residual climate change risks have been considered taking account of the existing design, operational and management controls in place at Dublin Airport, together with opportunities for further adaptation identified through the CCRA.

9.1.3 Existing controls form part of the airport's ongoing operational and environmental management arrangements and are reflected in the assessment of climate risk. Additional adaptation measures identified through the CCRA represent opportunities to further improve the airport's resilience to future climate conditions and may be progressed through daa's wider asset management, maintenance and infrastructure investment programmes, as appropriate.

9.1.4 These wider adaptation measures are not proposed as mitigation specific to the Proposed Order. Where the residual risk ratings presented in Table 13A-8 assume the implementation of further adaptation measures, those ratings should be interpreted as conditional upon their implementation. In the absence of those measures, the corresponding initial risk ratings would continue to apply

Table 13A-8: Residual Risk Rating

Risk rating	Moderate emissions scenario RCP 4.5 2041 - 2060	High emissions scenario RCP 8.5 2041 - 2060
Low	11	11
Medium	5	5
High	0	0

Extreme	0	0

13A.10 Conclusion

10.1.1 Following the undertaking of the CCRA, 16 climate risks were identified, with the overarching climate risks relating to flooding, changing temperatures and storm events. The initial risk rating took into account any existing embedded controls, as those climate risks which did not have embedded controls were generally rated higher than those which did.

10.1.2 The initial risk rating categorised four climate risks as 'significant' under RCP 4.5, and six under RCP 8.5. However, Table 13A-8 shows that following the implementation of the recommended adaptation measures there are no risks rated as high or extreme, and therefore none categorised as 'significant' under both RCP scenarios. The implementation of the identified adaptation and monitoring measures would further reduce the risks associated with future climate change, supporting the continued resilience of Dublin Airport.