MORGAN AND MORECAMBE OFFSHORE WIND FARMS: TRANSMISSION ASSETS

Environmental Statement

Volume 4, Annex 1.2: Climate change risk assessment

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Glossary

Term	Meaning
Commitment	This term is used interchangeably with mitigation and enhancement measures. The purpose of commitments is to avoid, prevent, reduce or, if possible, offset significant adverse environmental effects. Primary and tertiary commitments are taken into account and embedded within the assessment set out in this Environmental Statement. Secondary commitments are incorporated to reduce effects to environmentally acceptable levels following initial assessment.
Morgan and Morecambe Offshore Wind Farms: Transmission Assets	The offshore export cables, landfall, and onshore infrastructure for the Morgan Offshore Wind Project and the Morecambe Offshore Windfarm. This includes the offshore export cables, landfall site, onshore export cables, onshore substations, 400 kV grid connection cables and associated grid connection infrastructure such as circuit breaker compounds. Also referred to in this report as the Transmission Assets, for ease of reading.
Offshore export cables	The cables which would bring electricity from the Generation Assets to the landfall.
Offshore export cable corridor	The corridor within which the offshore export cables will be located.
Onshore export cables	The cables which would bring electricity from the landfall to the onshore substations.
Onshore export cable corridor	The corridor within which the onshore export cables will be located.
Onshore substations	The onshore substations will include a substation for the Morgan Offshore Wind Project: Transmission Assets and a substation for the Morecambe Offshore Windfarm: Transmission Assets. These will each comprise a compound containing the electrical components for transforming the power supplied from the generation assets to 400 kV and to adjust the power quality and power factor, as required to meet the UK Grid Code for supply to the National Grid.
Substation	Part of an electrical transmission and distribution system. Substations transform voltage from high to low, or the reverse by means of electrical transformers.
Transmission Assets	See Morgan and Morecambe Offshore Wind Farms: Transmission Assets (above).
Transmission Assets Order Limits	The area within which all components of the Transmission Assets will be located, including areas required on a temporary basis during construction and/or decommissioning (such as construction compounds).

Acronyms

Acronym	Meaning
BEIS	The former Department for Business, Energy & Industrial Strategy
CCRA	Climate Change Risk Assessment
CoT	Commitment
EIA	Environmental Impact Assessment
GHG	Greenhouse Gas
IEMA	Institute of Environmental Management and Assessment
IPCC	Intergovernmental Panel on Climate Change
MOHC	Met Office Hadley Centre
NPS	National Policy Statement
RCP	Representative concentration pathway
UKCP18	United Kingdom Climate Projections 2018
UN	United Nations

Units

Unit	Description
°C	Degrees Celsius
km^2	Kilometres Squared
kn	Knots
m/s	Metres Per Second (Speed)
%	Percentage

1 Climate change risk assessment

1.1 Introduction

1.1.1.1 This document forms Annex 1.2 of the Environmental Statement (ES) prepared for the Morgan and Morecambe Offshore Wind Farms: Transmission Assets (hereafter referred to as the Transmission Assets).

1.1.1.2 This Climate Change Risk Assessment (CCRA) technical report assesses the potential adverse effects on the Transmission Assets from climate change, in line with the UK's guidance on climate change risk assessments.

1.2 Summary

1.2.1.1 For the purpose of the CCRA, the assessment of risk has been divided between (a) onshore and (b) offshore and intertidal elements of the Transmission Assets, see Volume 1, Chapter 3: Project Description of the ES for full detail. In summary, these comprise:

- Onshore infrastructure elements:
  - onshore substations;
  - onshore export cables;
  - 400 kV grid connection cables;
  - transition joint bays;
  - link boxes;
  - crossings and trenchless techniques (including works between the transition joint bays within Blackpool Airport to Queensway (B5261) and the River Ribble Crossing).
- Offshore (and intertidal) permanent infrastructure elements:
  - offshore export cables; and
  - landfall (trenchless installation and transition joint bays).

1.2.1.2 The offshore elements of the Transmission Assets are located in the Irish Sea, with the onshore and intertidal elements located within the administrative areas of Fylde Council, Blackpool Council, South Ribble Borough Council and Preston City Council (and Lancashire County Council at the County level).

1.3 Methodology

1.3.1.1 The scope of the CCRA is defined in accordance with the Climate Change Committees recommendations. This report considers the climate-related physical risks on the Transmission Assets and identifies the current and anticipated risks throughout its 35-year lifetime. This technical report evaluates the processes utilised for managing the risks through four key stages.

1. An assessment of the baseline climate to understand present-day vulnerability and assess current climate-related risks, opportunities, and levels of adaptation.
2. An assessment of future climate projections to understand the future vulnerability.
3. Identify the vulnerability of the Transmission Assets to climate change (including the identification of hazards and receptors) and undertake an assessment of the likelihood and severity of potential impacts and effects, respectively.
4. Identify adaptation and mitigation commitments.

1.4 Policy context

1.4.1 National Policy Statements

1.4.1.1 There are currently six energy National Policy Statements (NPSs), three of which contain policy relevant to offshore wind development and the Transmission Assets, specifically:

- Overarching NPS for Energy (NPS EN-1) which sets out the UK Government's policy for the delivery of major energy infrastructure (Department for Energy Security & Net Zero 2023a);
- NPS for Renewable Energy Infrastructure (NPS EN-3) (Department for Energy Security & Net Zero 2023b); and
- NPS for Electricity Networks Infrastructure (NPS EN-5) (Department for Energy Security & Net Zero 2023c).

1.4.1.2 NPS EN-1 sets out how the energy sector can help deliver the Government's climate change objectives by clearly setting out the need for new low carbon energy infrastructure to contribute to climate change mitigation. It requires applicants to consider the impacts of climate change, taking account of projected impacts of climate change. Where energy infrastructure has safety critical elements (e.g., substations), the applicant should apply a credible maximum climate change scenario.

1.4.1.3 NPS EN-3 states that while offshore wind farms will not be affected by flooding, it should be demonstrated that any necessary onshore infrastructure (such as cabling and onshore substations) will be appropriately resilient to climate-change induced weather phenomena.

1.4.1.4 NPS EN-5 highlights that the vulnerability of the development to flood risk, wind and storm events, heightened temperatures, and subsidence resulting from climate change should be considered, in addition to the design of resilience measures.

1.4.1.5 A detailed review and compliance check for each of the above-described NPSs is included within Volume 4, Chapter 1: Climate change of the ES.

1.4.2 The Paris Agreement

1.4.2.1 The Paris Agreement came into force on 4 November 2016 and has been adopted by 196 parties, including the United Kingdom. The overarching aim of the agreement is to set long term goals to guide nations in substantially reducing global greenhouse gas emissions to limit the global temperature increase to 2 degrees Celsius (°C), while pursuing efforts to limit the increase to 1.5 °C (UN, 2015).

1.4.3 Climate Change Act 2008

1.4.3.1 The Climate Change Act 2008 sets a target for the year 2050 for the reduction of targeted greenhouse gas emissions to net zero, whilst providing for a system of carbon budgeting. The Committee on Climate Change was also established under the Act, alongside the requirement for the UK Government to publish a CCRA every five years to assess the risks for the UK from the current and predicted impacts of climate change.

1.5 Baseline climate

1.5.1.1 To understand the impact of climate change on the Transmission Assets, the baseline environment must be considered. The offshore elements of the Transmission Assets are located within the Irish Sea Region, with the onshore elements located in west Lancashire, between Blackpool and Penwortham, which, therefore, necessitates the consideration of both the offshore climate in addition to the onshore baseline environment.

1.5.1.2 Baseline onshore climate conditions have been sourced from Met Office observed data from Blackpool, Squires Gate climate station. The observational data from Squires Gate climate station has been collected and averaged over 30 years from 1981 to 2010 and reviewed alongside regional observational data averaged over the same period (Met Office, 2020).

1.5.1.3 Baseline offshore climatic conditions have been sourced from observational data collated within the UK Offshore Energy Strategic Environmental Assessment which covers the period from 1981 to 2020 (Department for Business, Energy and Industrial Strategy (BEIS), 2022) and Intergovernmental Panel on Climate Change's (IPCC) Sixth Assessment Reporting of the physical science which covers the period from 1901-2018 for the relevant parameters (IPCC, 2021).

1.5.2 Onshore baseline

1.5.2.1 North West England experiences a temperate climate, with annual average maximum and minimum temperatures of 13.11 °C and 6.66 °C recorded at the Squires Gate climate station respectively (Met Office, 2020). During the 1981 to 2010 baseline period, average maximum temperatures reached 19.62 °C in July, and minimum temperatures fell to an average of 1.67 °C in February. This is consistent with regional climate patterns for North West England and North Wales. In the summer months, regional temperatures often fall between 19.09 °C and 9.07 °C; in the winter months, regional temperatures range between 6.42 °C and 0.94 °C. In recent years, temperature fluctuations have resulted in extreme high temperatures above 30 °C in the summer months.

1.5.2.2 Precipitation recorded at the Squires Gate climate station is lower than that reported for the regional annual total of 1,304.55 mm, at 882.68 mm a year. However, regional precipitation in North Wales and North West England exceeds the UK annual average, which totals 1,142.04 mm. Therefore, North West England can be considered as a region that is exposed to high rainfall in comparison to the rest of the UK.

1.5.2.3 Regional annual average wind speeds in North West England and North Wales regions are marginally higher than the annual average for the UK, equalling 9.52 knots (kn), and 9.38 kn, respectively. Moreover, as the selected onshore elements of the Transmission Assets are adjacent to the Irish Sea coastline, it can be predicted that the area will be susceptible to higher wind speeds throughout the year due to its coastal location.

1.5.3 Offshore baseline

1.5.3.1 Mean air temperatures range from lows of 7 °C in January to 14 °C in July, with surface air temperatures exceeding sea surface temperatures during the spring and summer months and falling below sea surface temperatures during the autumn and winter months (BEIS, 2022).

1.5.3.2 Precipitation generally falls 18 days per month during the winter, and 10 to 15 days per month during the summer. Rainfall intensity and duration varies greatly from day to day (BEIS, 2022).

1.5.3.3 Higher wind speeds can be expected offshore and in intertidal areas in comparison with the onshore elements of the Transmission Assets Order Limits due to the lack of obstructions (both man-made and natural) in open water. Wind conditions are generally westerly and south westerly throughout the year. During the winter, winds occasionally exceed 14 metres per second (m/s) (with 20% probability) in the Irish Sea to the east of the Isle of Man. During the summer, the chance of these higher wind speeds drops to 2% (BEIS, 2022).

1.5.3.4 Mean sea level is a crucial element of climate change-related risks for wind farms – global mean sea level rose by 0.2 m between 1901 and 2018, and continues to rise (IPCC, 2021). Land adjacent to the coast and estuaries within Lancashire has been identified as vulnerable to coastal flooding, despite the protection of current sea and tidal defences (Environment Agency, 2022).

1.6 Climate change projections

1.6.1.1 Climate change has been identified as a process that is already taking place in the UK, in both academic research and in all prior legislation and policy referenced in this annex (**section 1.4**) and Volume 4, Chapter 1: Climate change of the ES. The risks associated with rising temperatures, more frequent extreme weather patterns and rising sea levels are further Investigated within this section.

1.6.2 Onshore climate projections

1.6.2.1 The Met Office Hadley Centre (MOHC) publishes both probabilistic climate change projections and downscaled global circulation model outputs for the UK at various spatial scales. This is called the UK Climate Projections 2018 (UKCP18) dataset, first published in November 2018 and at v2.9.0 (MOHC, 2023) at the time of writing. The projections are based on Representative Concentration Pathway (RCP) scenarios used by the IPCC. The RCP scenarios (four scenarios presented in the IPCC fifth Assessment report which are included within the UKCP18 database) describe different climatic futures, all of which are considered possible depending on the volume of Greenhouse Gases (GHGs) emitted. These provide the basis for future assessments of climate change and possible response strategies, thereby giving a low-high range in potential global GHG reduction initiatives and resulting rate of climatic effects over a given period.

1.6.2.2 The probabilistic projections published at a 25 km grid cell scale are considered the most useful for this assessment when considering the onshore elements of the Transmission Assets, being designed to show a range of projection values that reflect uncertainty in modelled outcomes. The CP18 Overview Report (MOHC, 2018a) and supporting factsheets (MOHC, 2018b) for the wider regional and UK context have also been drawn upon.

1.6.2.3 At the end of the operational lifetime of the Generation Assets, the Transmission Assets will be decommissioned. The operational lifetime of the Generation Assets is currently considered to be 35 years. As the seabed leases for the wind farms are for up to 60 years it is anticipated that one re-powering of the Generation Assets may be sought during the lease duration in line with the regulations, requirements, guidance and best practice relevant at that time. In this case, new consents are likely to be required for the Generation Assets, and the consenting requirements for the Transmission Assets would also be reviewed as part of that process alongside legislation and guidance in existence at that time. For the purposes of this assessment, the Transmission Assets are expected to have an initial 35-year operating lifetime and become fully operational by 2030, but as a key piece of energy infrastructure could also operate in the longer term (and the design life of the Transmission Assets would support this). Therefore, climate projections for the mid- and late century have been considered: average conditions during 2040 to 2069 and 2070 to 2099.

1.6.2.4 Over the past decade, annual average temperature and precipitation have gradually increased when compared to preceding observational data baseline periods. These variations are likely to amplify over this century, with the anthropogenic climatic changes expected to become increasingly apparent (MOHC, 2018a).

1.6.2.5 **Table 1.1** and **Table 1.2** show potential onshore climatic changes from the UKCP18 probabilistic dataset (averaged over the 2040 to 2069 and 2070 to 2099 time periods) relative to the 1981 to 2010 baseline for the two 25 km grid squares local to the onshore elements of the Transmission Assets, as shown within **Figure 1.1**. The majority of the onshore elements of the Transmission Assets Order Limits lie within the western grid cell, with the remaining area located within the south west portion of the east grid cell. Data for both grid cells are presented below.

1.6.2.6 The data presented here is for the emissions pathway RCP8.5, which is a high-emissions scenario assuming 'business as usual' growth globally with little additional mitigation. This is a conservative (maximum design scenario) approach for the assessment.

1.6.2.7 In summary, the data within **Table 1.1** and **Table 1.2** shows that across both grid cells there is likely to be increased intensity in seasonal precipitation trends: precipitation is predicted to increase during both the wettest season and during the driest season. Temperatures are anticipated to increase across the year, both during the coldest and hottest seasons. These trends will continue and amplify towards the latter half of the century.

1.6.2.8 The greatest difference between the two grid cells is in the driest month. Precipitation during the driest month increases in the western cell and decreases in the eastern cell. This trend accelerates towards the latter half of the century. It is understood that this difference arises due to a change in the driest month when compared to the baseline (i.e., a change from April to May within the west cell, resulting in an apparent projected increase in precipitation in the baseline driest month, April). Given the driest season remains consistent across both grid cells, and that the vast majority of the onshore elements of the Transmission Assets lie within one cell, the differences between the cells with regards to the driest month are not of consequence to the assessment of climate risk in this assessment.

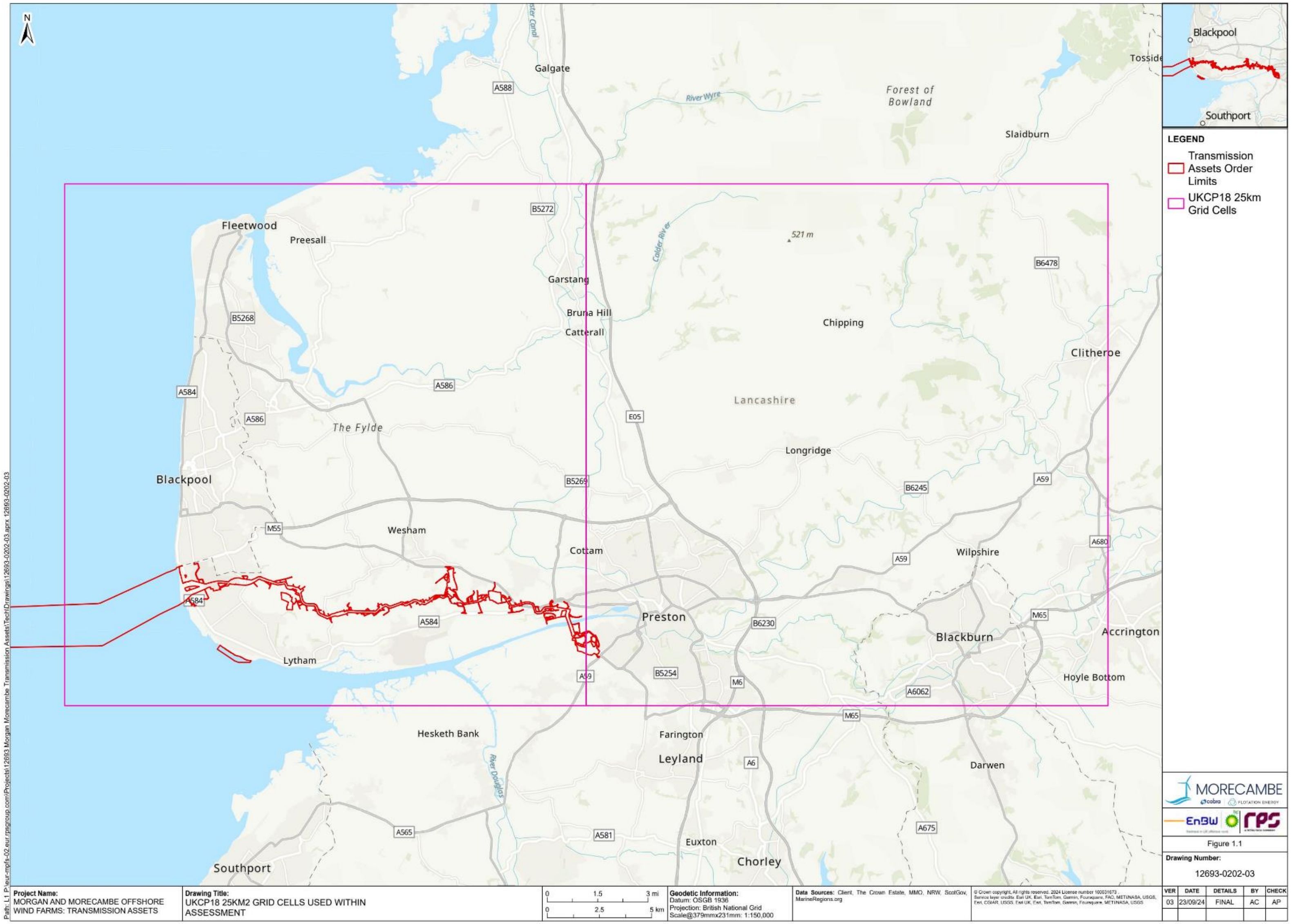

Figure 1.1: UKCP18 25 km² grid cells used within the assessment

Table 1.1: Climate parameter projections 2040 to2069

Parameter†	Units	West 25 km cell (GR 337500 437500)			East 25 km cell (GR 362500 437500)		
		10th percentile	Median value	90th percentile	10th percentile	Median value	90th percentile
Precipitation – annual average	%	-4.85	1.73	8.82	-5.08	1.12	7.76
Precipitation – driest season	%	-9.87	2.94	16.16	-11.78	1.23	14.38
Precipitation – wettest season	%	-9.30	4.60	20.19	-9.05	4.02	18.55
Precipitation – driest month	%	-20.16	0.48	22.76	-23.62	-0.93	21.26
Precipitation – wettest month	%	-17.01	8.27	38.39	-18.59	6.95	36.37
Temperature – annual average	ºC	0.75	1.59	2.47	0.76	1.62	2.53
Temperature – hottest season average	ºC	0.69	1.87	3.12	0.73	1.96	3.27
Temperature – hottest season maximum	ºC	0.48	1.92	3.43	0.55	2.05	3.64
Temperature – coldest season average	ºC	0.38	1.43	2.54	0.38	1.45	2.58
Temperature – coldest season minimum	ºC	0.33	1.60	2.97	0.33	1.60	2.98
Temperature – hottest month average	ºC	0.40	2.00	3.66	0.45	2.12	3.85
Temperature – hottest month maximum	ºC	0.05	2.06	4.14	0.13	2.24	4.42
Temperature – coldest month average	ºC	0.26	1.59	3.05	0.28	1.63	3.10
Temperature – coldest month minimum	ºC	0.16	1.69	3.47	0.20	1.71	3.50

† daily mean, maximum or minimum, as applicable, averaged over time period specified
n.b. 10th and 90th percentile and median values for scenario RCP8.5.

Table 1.2: Climate parameter projections 2070 to 2099

Parameter†	Units	West 25 km cell (GR 337500 437500)			East 25 km cell (GR 362500 437500)		
		10th percentile	Median value	90th percentile	10th percentile	Median value	90th percentile
Precipitation – annual average	%	-6.12	3.68	14.01	-6.57	2.64	12.23
Precipitation – driest season	%	-14.11	3.28	22.79	-16.16	1.34	20.56
Precipitation – wettest season	%	-10.51	10.43	35.54	-10.37	9.09	32.22
Precipitation – driest month	%	-28.99	0.55	33.59	-35.73	-7.87	19.74
Precipitation – wettest month	%	-14.10	25.28	71.44	-16.44	22.72	67.26
Temperature – annual average	ºC	1.75	3.14	4.66	1.79	3.22	4.78
Temperature – hottest season average	ºC	1.85	4.02	6.24	1.95	4.19	6.52
Temperature – hottest season maximum	ºC	1.67	4.34	7.00	1.78	4.59	7.42
Temperature – coldest season average	ºC	0.88	2.62	4.49	0.92	2.68	4.59
Temperature – coldest season minimum	ºC	0.82	2.88	5.23	0.86	2.92	5.28
Temperature – hottest month average	ºC	1.72	4.61	7.59	1.80	4.84	7.97
Temperature – hottest month maximum	ºC	1.51	5.04	8.69	1.62	5.37	9.24
Temperature – coldest month average	ºC	0.65	2.97	5.44	0.71	3.05	5.54
Temperature – coldest month minimum	ºC	0.54	3.13	6.17	0.60	3.20	6.23

† daily mean, maximum or minimum, as applicable, averaged over time period specified
n.b. 10th and 90th percentile and median values for scenario RCP8.5.

1.6.2.9 No clear trend for change in wind speed during this time period is shown in the regional projections data. Probabilistic projections do not provide wind speed data. Trends in windstorm numbers are difficult to detect, due to their natural year-to-year variation. Projections indicate that winter windstorms will increase slightly in number and intensity over the UK (i.e. more winter storms), however there is limited confidence in this projection due to differing results from climate models (Met Office, 2024).

1.6.3 Offshore climate projections

1.6.3.1 Probabilistic local climate projections consistent with those referenced above and used to illustrate future possible onshore climate trends are not available for offshore regions. As such, the results of marine climate projections as set out within the UKCP18 Marine Report (Palmer *et al*. 2018) and interrogated within the UK Climate Risk Independent Assessment (CCRA3), Chapter 4: Infrastructure (Jaroszweski *et al.* 2021) have been used to examine future trends for wind speed, wave height and sea levels. The projections are based on RCP8.5, with data largely available for the end of the 21st century. Whilst this is outside of the initial lifetime of the Transmission Assets, these projections display climate trends that will begin to be felt throughout this century.

1.6.3.2 It is virtually certain that sea surface temperatures will continue to increase in the 21st century, with global mean sea surface temperatures predicted to increase by approximately 2.9 °C by 2100 under RCP8.5. It is anticipated that the north Atlantic will warm at a slower rate in comparison to other oceans (IPCC, 2021).

1.6.3.3 The average wave height is predicted to decrease around much of the UK at a factor of about 10% to 20% over the 21st century, with average wave heights in the Irish Sea decreasing by approximately 0.1m. However, maximum wave heights in the Irish Sea are anticipated to increase, with projections showing a change in elevation of the height of maximum waves of up to 2m to the end of the century (Jaroszweski *et al*. 2021).

1.6.3.4 Given the close relationship between wave heights and wind speeds, average changes in wind speed are predicted to follow similar patterns to those predicted for average wave height, with a reduction in average wind speeds projected for the west and south west of Ireland. Changes in maximum wind speeds associated with storm surges vary regionally, with changes in the order of +/- 1.5 m/s. However, there is little consensus between models regarding the extent and pattern of such winds in relation to climate change (Palmer *et al*. 2018). As such, conservatively an increase in maximum wind speed should be anticipated.

1.6.3.5 Global mean sea level will continue to rise throughout the 21st century, a change that is projected within all future climate change scenarios. Under RCP8.5, the UK can expect to see sea level rise of approximately 1m by 2100. This change is regionally variable, with a lesser impact anticipated in the north of the UK. The North Wales coastline can expect to see a mean sea level rise of approximately 0.6 m by 2100 (Palmer *et al*. 2018).

1.7 Climate risk and resilience scoping

1.7.1.1 Based on the information available for the Transmission Assets, an initial screening exercise identified the relevant climate change risks on the Transmission Assets based on information sourced from the UK Climate Independent Assessment (CCRA3) which are presented in **Table 1.4**.

1.7.1.2 Given the variability in the nature of the potential effects of climate change on the development, receptors have been identified on a risk-specific basis, whereby all receptors relate to the continued safe and effective operation of the Transmission Assets. In line with the Institute for Environmental Management and Assessment (IEMA) (2020) guidance, the vulnerability and susceptibility have been considered in determining the severity of risk.

1.7.1.3 A high-level assessment of such risks has been undertaken, considering the hazard, the potential severity of the effect on the development and its users, the probability of that effect, and the level of influence the development design can have on the risk. The severity of effect score considers the potential consequences of the hazard and the sensitivity of the receptor(s) affected. Each element of the risk assessment has been scored on a scale of one to three, representing low, medium or high; the scores are then summed to give a combined risk score. **Table 1.3** defines each of these terms. A combined risk score of five or more when considering the factors in **Table 1.4** has been defined as an impact that would be a significant adverse/beneficial effect on the Transmission Assets.

1.7.1.4 The assessment of effects has taken into account design considerations in determining the combined risk score. As detailed in **paragraph 1.7.1.3**, a score of 5 or more is assessed as a significant effect which is presented in the 'significant effect' column. Should an effect be significant, further measures are presented where relevant to reduce the residual effect to negligible and not significant in EIA terms.

Table 1.3: Severity, probability and influence factor definitions

Factor	Score definitions
Severity: the magnitude and likely consequences of the impact should it occur.	**1 =** unlikely or low impact: for example, low-cost and easily repaired property damage; small changes in occupiers' behaviour.
	2 = moderate impacts with greater disruption and/or costs.
	3 = severe impact, e.g. risk to individual life or public health, widespread property damage or disruption to business.
Probability: reflects both the range of possibility of climatic parameter changes illustrated in CP18 projections and the probability that the possible changes would cause the impact being considered.	**1 =** unlikely or low probability of impact; impact would occur only at the extremes of possible change illustrated in projections.
	2 = moderate probability of impact, plausible in the central range of possible change illustrated in projections.
	3 = high probability of impact, likely even with the smaller changes illustrated as possible in the projections.
Influence: the degree to which design of the proposed development can affect the severity or probability of impacts.	**1 =** no or minimal potential to influence, outside control of developer, e.g. reliance on national measures or individuals' attitudes/actions; or hypothetical measures would be impracticable.
	2 = moderate potential to influence, e.g. a mixture of design and user behaviour or local and national factors; measures may have higher costs or practicability challenges.
	3 = strong potential to influence through measures that are within the control of the developer and straightforward to implement.

1.7.1.5 **Table 1.4** shows the climate change risks to the Transmission Assets that have been identified prior to any design considerations and the risk scores assigned, following the approach set out in **Table 1.3**. Appropriate design principles have been identified as necessary to accordingly reduce the risk to an acceptable level and not significant level of effect.

Table 1.4: Risk scores for the Transmission Assets

Risk	Infrastructure element	Potential consequences	DCO Document and/or Commitment (CoT)	Design considerations	Severity	Probability	Influence	Significant?
Operation and maintenance								
Onshore								
Increases in average and extreme temperatures, both in winter and summer.	• Onshore substations	• Consistently heightened temperatures could lead to efficiency losses due to overheating, or the failure of electrical equipment within the onshore substations.	• Outline Design Principles document (document reference J3).	• The onshore substations will include plant located either externally or within buildings. The design will account for a range of temperature conditions and include standard safety measures, including monitoring, to prevent overheating.	1	1	2	No
	• Access roads	• Increased extreme temperatures may lead to permanent deformation of asphalt and increased risk of rutting in access roads.	• Outline Design Principles document (document reference J3).	• Monitoring of road surface quality, with maintenance works performed as required.	1	2	1	No

Risk	Infrastructure element	Potential consequences	DCO Document and/or Commitment (CoT)	Design considerations	Severity	Probability	Influence	Significant?
Changes to rainfall patterns, leading to increased annual precipitation.	• Onshore substations and export cables	• Damage to onshore substations and associated electrical equipment, including onshore export cables resulting in disruption to operations and power export.	• Outline Design Principles document (document reference J3) and Volume 1, Chapter 3: Project description of the ES.	• Buildings to be designed in line with durability quality standards and guidance. • Onshore cabling to be buried at a typical trench depth of 1.8 m.	1	1	2	No
Increased frequency of flood events resulting from increased precipitation intensity.	• Onshore substations and export cables	• Damage to onshore substations and associated electrical equipment, including onshore export cables resulting in disruption to operations and power export.	• Volume 3, Chapter 2: Hydrology and flood risk of the ES.	• Onshore flood risk and mitigation is assessed in Volume 3, Chapter 2: Hydrology and flood risk of the ES. This chapter takes into account increases in rainfall rate due to climate change, ensuring drainage design is able to accommodate increasing volumes of surface water runoff associated with the effects of climate change. • The onshore elements of the Transmission Assets Order Limits contain areas of medium flood risk and high fluvial flood risk, primarily associated with the River Ribble, and smaller areas of high, medium and low fluvial flood risk associated with some of the smaller watercourses.				

Risk	Infrastructure element	Potential consequences	DCO Document and/or Commitment (CoT)	Design considerations	Severity	Probability	Influence	Significant?
Increased frequency and intensity of extreme weather i.e., storms.	• Onshore substations and export cables	• Extreme storm events, including cold weather events, may cause structural damage to the onshore substations and associated electrical equipment, including export cables, through increased loading and ice accretion, resulting in disruption to operations and power export.	• Outline Design Principles document (document reference J3) and Volume 1, Chapter 3: Project description of the ES.	• Buildings to be designed in line with durability quality standards and guidance. • Onshore cabling to be buried at a typical trench depth of 1.8 m.	1	1	2	No

Risk	Infrastructure element	Potential consequences	DCO Document and/or Commitment (CoT)	Design considerations	Severity	Probability	Influence	Significant?
Increased wind speeds and changes to wind patterns.	• Onshore substations	• Substation buildings and infrastructure may be subject to physical damage from extreme wind forces. • Increased wind speeds may increase occurrence and incursion of coastal spray inland, resulting in salt build up on electrical infrastructure associated with the onshore substations.	• Outline Design Principles document (document reference J3) and Volume 1, Chapter 3: Project description of the ES.	• Buildings to be designed in line with durability quality standards and guidance. • Onshore cabling to be buried at a typical trench depth of 1.8 m.	1	1	1	No

Risk	Infrastructure element	Potential consequences	DCO Document and/or Commitment (CoT)	Design considerations	Severity	Probability	Influence	Significant?
Increase in mean sea level resulting in coastal flooding.	• Onshore export cables and associated cable crossings using trenchless techniques (detailed in the Onshore Crossing Schedule).	• May result in the increased frequency of coastal flooding, which may damage the associated electrical equipment and infrastructure, including export cables and associated onshore cable crossings, resulting in disruption to operations.	• Volume 3, Chapter 2: Hydrology and flood risk of the ES.	• Onshore flood risk and mitigation is assessed in Volume 3, Chapter 2: Hydrology and flood risk of the ES. This chapter takes into account increases in rainfall rate due to climate change, ensuring drainage design is able to accommodate increasing volumes of surface water runoff associated with the effects of climate change.				

Risk	Infrastructure element	Potential consequences	DCO Document and/or Commitment (CoT)	Design considerations	Severity	Probability	Influence	Significant?
Earth movements and subsidence resulting from phases of drought and heavy rainfall.	• Onshore export cables, joint bays, and associated cable crossings using trenchless techniques (detailed in the Onshore Crossing Schedule).	• Damage to joint bays, onshore export cables and associated onshore cable crossings, leading to disruption in operations.	• Volume 1, Chapter 3: Project description of the ES.	• All onshore export cable trenches to be backfilled with subsoil and topsoil to match pre-existing conditions. • Onshore cabling to be buried at a typical trench depth of 1.8 m.	1	1	1	No
Offshore (and intertidal)								
Increase in sea surface temperatures and ocean acidification.	• Offshore export cables	• Increased temperatures and ocean acidification may lead to accelerated corrosion of submerged structures, including offshore export cables.	• Outline Design Principles document (document reference J3).	• Design to be in line with existing standards at the time, including appropriate anti-corrosion protective coatings where appropriate.	1	1	2	No

Risk	Infrastructure element	Potential consequences	DCO Document and/or Commitment (CoT)	Design considerations	Severity	Probability	Influence	Significant?
Changes in the tidal range.	• Offshore export cables	• Degradation to undersea cabling due to scour from sediment transfer. Failure at cable joints may also result.	• Outline Offshore Cable Specification and Installation Plan (CSIP)) (document reference J15) CoT49.	• Development of, and adherence to, a Construction Method Statement(s) (CMSs) which includes an Offshore Cable Specification and Installation Plan (CSIP).	1	1	1	No

Risk	Infrastructure element	Potential consequences	DCO Document and/or Commitment (CoT)	Design considerations	Severity	Probability	Influence	Significant?
Increased frequency and intensity of extreme weather i.e. storms.	• Offshore export cables	• Degradation to undersea cabling due to scour from sediment transfer. Failure at cable joints may also result.	• Outline Offshore Cable Specification and Installation Plan (CSIP)) (document reference J15) CoT49.	• Development of, and adherence to, a Construction Method Statement(s) (CMSs) which includes an Offshore Cable Specification and Installation Plan (CSIP)CMSs will likely include: • details of cable installation and methodology, including commitment to cable burial wherever possible; and • details of cable protection and the deposition of material arising from drilling, dredging, and/or sandwave clearance.	1	1	1	No

Risk	Infrastructure element	Potential consequences	DCO Document and/or Commitment (CoT)	Design considerations	Severity	Probability	Influence	Significant?
Decommissioning								
Onshore								
Increases in average and extreme temperatures, both in winter and summer.	• n/a	• Worker health impacts due to heat stroke during extreme temperature days.	• CoT36	• An Onshore Decommissioning Plan will be developed prior to decommissioning. The Onshore Decommissioning Plan(s) will be in line with the latest relevant available guidance Decommissioning activities will be undertaken in line with the Onshore Decommissioning Plan and appropriate health and safety guidance in place at that time.	1	1	2	No

Risk	Infrastructure element	Potential consequences	DCO Document and/or Commitment (CoT)	Design considerations	Severity	Probability	Influence	Significant?
Increased frequency of flood events resulting from increased precipitation intensity.	• n/a	• The onshore substations (including drainage infrastructure) will be fully removed and the site reinstated to its original condition, the risk of flooding may increase to pre-development levels. This may pose a risk to the health of workers on site should a flood event occur during decommissioning activities.	• CoT36 and Volume 3, Chapter 2: Hydrology and flood risk of the ES.	• Onshore flood risk and mitigation is assessed in Volume 3, Chapter 2: Hydrology and flood risk of the ES. This chapter takes into account increases in rainfall rate due to climate change, ensuring drainage design is able to accommodate increasing volumes of surface water runoff associated with the effects of climate change. • Decommissioning activities will be undertaken in line with the Onshore Decommissioning Plan and appropriate health and safety guidance in place at that time, including consideration of extreme weather events.				

Risk	Infrastructure element	Potential consequences	DCO Document and/or Commitment (CoT)	Design considerations	Severity	Probability	Influence	Significant?
Increased frequency and intensity of extreme weather i.e., storms.	• n/a	• Worker health impacts and injuries.	• CoT36	• As above, decommissioning activities will be undertaken in line with the Onshore Decommissioning Plan and appropriate health and safety guidance in place at that time, including consideration of extreme weather events.	1	1	1	No
Increased wind speeds and changes to wind patterns.	• n/a	• Worker health impacts and injuries.	• CoT36	• As above, decommissioning activities will be undertaken in line with the Onshore Decommissioning Plan and appropriate health and safety guidance in place at that time.	1	1	1	No

1.8 Conclusion

1.8.1.1 This technical report assesses the potential adverse effects on the Transmission Assets from climate change through the consideration of climate-related current and anticipated physical risks throughout its 35-year lifetime.

1.8.1.2 Consistently heightened temperatures, changes to rainfall patterns, and increased frequency of extreme events such as floods and storms could lead to efficiency losses due to overheating, the failure of electrical equipment or damage to infrastructure which would result in an increase in operation and maintenance activities.

1.8.1.3 The most significant risk from climate change to the Transmission Assets is likely to arise from flooding. This is assessed separately in detail in Volume 3, Chapter 2: Hydrology and flood risk of the ES and appropriate flood management and resilience measures have been taken into account. No further consideration is presented in this assessment.

1.8.1.4 The risk assessment considers in its scoring the level of influence the design of the operation and maintenance and decommissioning activities can have upon the remaining risks, in addition to its severity and probability.

1.8.1.5 When considering the proposed design considerations against each of the risks identified, detailed within the above **Table 1.4**, the potential risk posed to the Transmission Assets would be reduced to an acceptable and not significant level in EIA terms.

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