Appendix: Climate Change

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Climate Change

Technical Note

South East England

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INTRODUCTION

1 This technical note describes a future climate scenario for South East England which has been developed by Trium using the future climate projections data published by the Met Office (UKCP18) in November 2018. UKCP18 projections consider the climate effects arising from a series of 'Representative Concentration Pathways' (RCP) emissions scenarios (described further below).

2 The purpose of this technical note is to present projection data for the future climate and to provide guidance to the EIA technical team on how to consider whether the effects of the Proposed Development (defined under the current climate conditions) may alter under the future climate scenario. In the context of the future climate condition, consideration needs to be given to:

- The change in the magnitude of impact of the Proposed Development;
- Receptor vulnerability to changes in climate;
- Vulnerability of the Proposed Development to climate change; and
- Resilience of the Proposed Development to climate change.

Climate Projections

3 UKCP18 gives probabilistic projections[1] for a number of atmospheric variables, with different temporal and spatial averaging, for several future time periods, under four different future RCP emissions scenarios.

4 In general, the longer the lifetime of a development, the greater the uncertainty about the impact of climate change over time. Uncertainty is dealt with by presenting projections which are probabilistic in nature, and which give the probability of different climate outcomes.

5 To make use of the probabilistic projections, an emissions scenario and percentile outcome (i.e. the likelihood of the change in climate occurring) needs to be identified.

6 The emissions scenario and probabilistic projection are detailed within this document and have been used by all technical disciplines contributing to the Environmental Impact Assessment (EIA), to ensure consistency in approach.

Emission Scenarios

7 The RCP emission scenarios represent four distinct Representative Concentration Pathways (RCP2.6, RCP4.5, RCP6.0 and RCP8.5) available in the UKCP18 climate projections. These are named according to the concentration of greenhouse gas modelled to occur in the atmosphere in 2100. The RCPs have been developed for long-term and near-term climate modelling and provide time-dependant projections of atmospheric greenhouse gas concentrations. These pathways were developed based on a literature review of current climate modelling research and have been chosen to represent the full range of climate outcomes presented within the literature.

8 The emission scenarios represent assumptions in terms of climate policy, land use and technological development, with RCP2.6 representing the 'optimum' emission scenario (i.e. measures aimed at achieving the maximum reduction in GHG emissions).

9 RCP 8.5 is the most conservative, highest emission, and highest-impact scenario. It assumes that technological development will slow and that there will be little to no decarbonisation of world power from new technology. It also assumes that no further climate mitigation or regulations to reduce climate change or air pollution will be implemented.

10 More information on the RCPs can be found in the UKCP18 Guidance: Representative Concentration Pathways[2].

Adopted Emissions Scenario: RCP8.5

11 RCP8.5 has been used in the climate projections presented in this technical note as it represents a suitably conservative emissions scenario with regards to climate policy, land use, and technological development. This is in accordance with the Institute of Environmental Management and Assessment's (IEMA's) Climate Change Resilience and Adaptation guidance[3].

12 The use of RCP8.5 is also in accordance with "*the National Policy Statement on National Networks, which states that developments should use the UKCP09 high emissions scenario at the 50% probability level*"[3]. RCP8.5 is the UKCP18 high emissions scenario and therefore has been identified as the most reasonable conservative emissions scenario for identifying future climate change projections in EIA.

13 The IEMA guidance recommends the use of RCP8.5 against a baseline period of 1980-2000 unless strong justification can be provided otherwise.

14 In line with the IEMA guidance, the climate projection data provided in this technical note are produced using RCP8.5 against the 1980-2000 baseline at the 50% probability level (or percentile).

[1] *Probabilistic projections give a range of possible climate change outcomes and their relative likelihoods i.e. unlikely, likely or very likely ranging across 10th to 90th percentiles.*

[2] *UKCP18 Guidance: Representative Concentration Pathways*
https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp18-guidance---representative-concentration-pathways.pdf

[3] *Institute of Environmental Management and Assessment, (2020); Environmental Impact Assessment Guide to: Climate Change Resilience and Adaptation.*

APPROACH TO ASSESSMENT

15 These steps provide a guide to assessing climate change within the EIA. More information and guidance can be found in references listed in Appendix A.

Step 1: Define the Future Climate Condition

16 Firstly, identify the climate variables that are relevant to the assessment. So, for example, the variables of relevance might be 'rainfall' or 'temperature'.

17 The next stage is to determine how these variables change under the future climate scenario based on the information presented in *'The Future Climate Condition in South East England for EIA'*, later in this technical note. This data present the 50th percentile for each climate variable projection, which represents the highest likelihood of occurrence. This aligns with the IEMA recommended approach.

18 This technical note provides data for 20 year timeslices from 2020 to 2099, to identify trends in projected climate change. The future climate condition should be based on the timeslice that is applicable for the lifetime of the Proposed Development.

19 This stage defines the future climate condition that is relevant to your assessment.

Step 2: Define Receptor Sensitivity to Climate Change

20 Receptors that have been identified for inclusion within the technical assessment in the ES need to be considered for their sensitivity to climate change, i.e., how the effects on these receptors as a result of the Proposed Development change due to the projected future climate conditions.

21 In ascribing the sensitivity of a receptor in relation to potential climate change effects, the following factors must be considered, as well as the value or importance of the receptor:

- **Susceptibility** of the receptor (e.g. ability to be affected by a change); and
- **Vulnerability** of the receptor (e.g. potential exposure to a change).

22 The susceptibility of the receptor can be determined using the following scale:

- **High susceptibility** - the receptor has no ability to withstand/not be substantially altered by the projected changes to the existing/prevailing climatic factors (e.g. lose much of its original function and form).
- **Moderate susceptibility** - the receptor has some limited ability to withstand/not be altered by the projected changes to the existing/prevailing climatic conditions (e.g. retain elements of its original function and form).
- **Low susceptibility** - the receptor has the ability to withstand/not be altered much by the projected changes to the existing/prevailing climatic factors (e.g. retain much of its original function and form).

23 The vulnerability of a receptor can be defined using the following scale:

- **High vulnerability** - the receptor is directly dependent on existing/prevailing climatic factors, and reliant on these specific existing climate conditions continuing in the future; or only able to tolerate a very limited variation in climate conditions.
- **Moderate vulnerability** - the receptor is dependent on some climatic factors, but able to tolerate a range of conditions.
- **Low vulnerability** - climatic factors have little influence on the receptor.

24 It is the responsibility of the technical specialist for each topic within the ES to reach a reasoned conclusion on sensitivity, based on a combination of the susceptibility and vulnerability of a receptor, in addition to its value/importance.

25 As an example, a high-value receptor that has very little resilience to changes in climatic conditions should be considered more likely to have a higher sensitivity than a high-value receptor that is very resilient to changes in climatic conditions.

Step 3: Identifying and Determining Magnitude of Impact

26 The magnitude of the impact is the degree of a change from the relevant baseline conditions. Magnitude is based on a combination of **probability** and **consequence**.

27 The **probability** of a climate change related effect occurring has already been determined based on RCP8.5, as set out in **paragraphs 11** to **14**.

28 The **consequence** of the impact reflects the geographical extent of the impact or the number of receptors affected (e.g. scale), the complexity of the impact, degree of harm to those affected and duration, frequency and reversibility of the impact.

29 A combination of probability and consequence should be used to reach a reasoned conclusion on the magnitude of the impact. It is likely that if the probability and/or consequence of the impact is high then the magnitude of the effect would also be high.

30 It is the responsibility of the technical specialist for each topic within the ES to apply professional judgement to assign magnitude to an impact as a result of the projected climate change. This judgement should be clearly outlined and supported by evaluation and evidence.

Step 4: Significance Assessment

31 Once the sensitivity and magnitude have been determined, these should be combined to reach an overall judgement on the significance of the likely environmental effect.

32 Again, it is the responsibility of the technical specialist to apply professional judgement on the significance of the effect.

Step 5: Identify any Mitigation Needed

33 If any adverse significant effects are identified (as a result of the impact of climate change), appropriate mitigation will need to be identified.

34 When considering the adoption of mitigation, consideration should be given to when the mitigation might be most usefully implemented over the duration of the scheme.

35 The key considerations in developing mitigation should include:

- Favouring flexible mitigation options over options which are locked and cannot be modified in future (adaptive management);
- Allowing for safety margins in developing mitigation designs to ensure resilience of the project or proposed mitigation to climate change; and
- Identifying who (which party) will be responsible for delivering the mitigation measure (e.g. designer, contractor, developer).

36 Mitigation measures should identify appropriate resilience and adaptive management measures.

37 Resilience measures include design features (e.g. the implementation of sustainable drainage systems) and construction materials (e.g. materials resistant to increases in temperature), to provide an appropriate resilience to changes in the existing climatic conditions, as well as occurrences of extreme weather.

38 Adaptive management measures account for the anticipated changes in the future climate. Consideration should be given as to whether there are opportunities to introduce mitigation measures later into the project when they are required, instead of including them from the outset when they're not required. These measures could be secured through a commitment to prepare a management plan / strategy (or equivalent) which would periodically review the need for such measures and their integration into the scheme when required.

39 Where mitigation is proposed, the effectiveness of the measures against the predicted future climate conditions should be presented, with reference to the resulting magnitude of impact and the resulting residual effect and its significance (as per the standard ES technical assessments).

40 These results should be presented in a statement to clarify whether or not the projected future climate change is anticipated to alter the findings of the assessment as already presented for the Proposed Development under the current climate conditions.

THE FUTURE CLIMATE CONDITION IN SOUTH EAST ENGLAND FOR EIA

41 The future climate projections for South East England, based on RCP8.5, are presented and described below for the climatic variables:

- Temperature;
- Precipitation; and
- Wind speed.

42 When assessing the effects of climate change in a technical ES chapter, the data presented in the proceeding tables should be used by the technical specialist as the basis for their assessment.

Temperature

43 **Table 1** presents the projected air temperature data for South East England up until 2099, in 20 year timeslices, from 2020. In line with the Met Office predictions[4], the data present future summers to be hotter and winters to be warmer, with the annual temperature steadily increasing.

44 Depending on the lifetime of the Proposed Development, different timeslices will need to be considered. When developing adaptive mitigation measures, consideration should be given to the appropriate time to implement these measures based on the temperature increase at each timeslice.

45 The data are presented for the Annual Mean, Summer Maximum, and Winter Minimum temperature for each timeslice. It is the responsibility of the technical specialist to select the most relevant and appropriate data for their technical discipline.

Table 1 Air Temperature Anomaly at 1.5m Above Ground Level (ºC) Relative to Baseline

Timeslice	Predicted Change from Baseline (ºC)		
	Annual Mean	Summer Max	Winter Min
	50th Percentile	50th Percentile	50th Percentile
2020-2039	1.05	1.50	0.91
2040-2059	1.87	2.77	1.65
2060-2079	2.96	4.28	2.53
2080-2099	4.29	6.43	3.60

Precipitation

46 **Table 2** presents the predicted percentage change in precipitation levels relative to the 1980-2000 baseline. In line with the Met Office predictions[5], the data present future Summers to be drier and Winters to be wetter. The data also predict that annual precipitation will reduce marginally up to 2099.

47 Depending on the lifetime of the Proposed Development, different timeslices will need to be considered. When developing adaptive mitigation measures, consideration should be given to the appropriate time to implement these measures based on the precipitation change at each timeslice.

[4] *Met Office Hadley Centre, 2018. 'UKCP18 Factsheet: Temperature'* https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp18-fact-sheet-temperature.pdf
[5] *Met Office Hadley Centre, 2018. 'UKCP18 Factsheet: Precipitation'* https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp18-factsheet-precipitation.pdf

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48 The data are presented for the seasonal extremes of Winter and Summer, as well as an Annual projection for each timeslice. It is the responsibility of the technical specialist to select the most relevant and appropriate data for their technical discipline.

Table 2 Precipitation Rate Anomaly (%) Relative to Baseline

Timeslice	Predicted Change from Baseline (%)		
	Annual	Summer	Winter
	50th Percentile	50th Percentile	50th Percentile
2020-2039	1.39	-9.46	8.20
2040-2059	-0.10	-21.50	13.11
2060-2079	-0.04	-30.00	20.04
2080-2099	-0.83	-41.21	27.00

Wind Speed

49 UKCP18 probabilistic data for wind is not available, nor any RCP8.5 data for wind through alternative projections. For this reason, UKCP09 wind data has been reviewed for the A1B scenario, as it is comparable to RCP8.5. This data indicates that there is currently no clear trend in the speed and frequency of winds that would make a meaningful difference to assessments. The predicted small changes to the average wind speeds and frequency remain substantially less than the typical year-to-year variability. It is considered that applying a 'worst-case' factor would introduce an unhelpful and unrealistic level of conservatism into the results, and hence wind speed is not a factor taken into account when considering the future climate condition.

Appendix A: Policy and Guidance

Policy and Guidance

- EU Guidance on Integrating Climate Change and Biodiversity into the Environmental Impact Assessment (2013)[6]
- IEMA Environmental Impact Assessment Guide to Climate Change Resilience and Adaptation (2020)[7]
- UK Climate Change Risk Assessment Evidence Report (2017)[8]
- 2017 EIA Regulations (as amended)[9]

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[6] *European Union, 2013. Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessments*
[7] *Institute of Environmental Management and Assessment, (2020); Environmental Impact Assessment Guide to: Climate Change Resilience and Adaptation.*
[8] *HM Government, 2017. UK Climate Change Risk Assessment 2017*
[9] *Her Majesty's Stationery Office (HMSO) 2017. The Town and Country Planning (Environmental Impact Assessment) (England) Regulations 2017 (amended in 2018 and 2020).*