OXFORDSHIRE
STRATEGIC RAIL FREIGHT INTERCHANGE

Preliminary Environmental Information (Work in Progress) Report (PEIR)

Draft Environmental Statement

Chapter 15: Climate Change

On behalf of
Oxfordshire Railfreight Limited

Prepared by BWB Consulting Limited
May 2022

CONTENTS

APPENDICES

15.1 INTRODUCTION

15.1.1 This draft chapter presents the preliminary work undertaken as part of the ongoing preparation of the Environmental Statement (ES) to assess the potential effects of climate change on the Proposed Development and the effects of the Proposed Development on climate change.

15.1.2 Scientific evidence links greenhouse gas (GHG) emissions associated with human activity to global warming, global warming being an increase in the global mean surface temperature which is triggering changes to the global climate system. The resultant impact of climate change is evident through sea level rises and increasing occurrence of extreme weather events.

15.1.3 The purpose of this chapter ultimately will be to present an assessment of:

- Climate Change Resilience - The vulnerability of the Proposed Development to the potential impacts of climate change in particular impacts from extreme weather and long-term climate change during construction and operation (Climate Change Resilience Assessment); and
- A GHG Emissions Assessment - The potential effects of the Proposed Development by virtue of the magnitude and mitigation of GHGs emitted during construction and operation.

15.1.4 Being 'preliminary', this draft chapter includes details of the scope and methodology of the above assessments which will be undertaken and presented in the final draft ES chapter (at the 'Stage 2' consultation process).

15.1.5 The assessments will be undertaken in accordance with Climate Change Guidance produced by the Institute of Environmental Management and Assessment (IEMA), as well as adhering to Climate Guidance produced by Highways England[1].

15.1.6 A separate Energy and Sustainability Strategy will be prepared and submitted as part of the final ES and will capture a range of measures intended to play a direct role in mitigating and minimising the effects of the scheme on climate change. That Strategy will evolve as the emerging proposals evolve over the coming months.

Competence

15.1.7 This report has been prepared by BWB Consulting Ltd ('BWB'); Matt Wilby (Full Member of the Institute of Environmental Management and Assessment) and approved by Chris Miller-Jones. Matt has over 10 years of experience in the built environment sector, specialising in the environmental appraisal of construction and

[1] Highways England (2021) 'Design Manual for Roads and Bridges – LA 114 Climate'. Available from: https://standardsforhighways.co.uk/dmrb/search/d1ec82f3-834b-4d5f-89c6-d7d7d299dce0

operational effects on large scale projects both nationally and internationally and including the effects of climate change over the last 5 years. Chris has nearly 25 years of industrial and commercial experience in sustainable design and construction sustainable design and construction. Both Matt and Chris are experienced in climate change policy in addition to BWB's experience in whole life GHG emission assessments for planning applications.

15.2 ASSESSMENT SCOPE AND METHODOLOGY

Introduction

15.2.1 The focus of this draft chapter is on providing sufficient information on the likely significant effects of the proposals, so as to facilitate and inform the consultation process.

15.2.2 The likely significant environmental effects to be considered within this Climate Change chapter are as follows:

- The resilience of the Proposed Development to climate change;
- The influence of the Proposed Development on climate change; and
- The in-combination climate change impacts assessment.

15.2.3 The scope and methodologies for the vulnerability of the Proposed Development to climate change and the influence of the Proposed Development on climate change will be addressed in separate subsections in the remainder of this section.

Consultation

15.2.4 An application for an EIA Scoping Opinion was submitted to the Secretary of State in June 2021. A Scoping Opinion from the Planning Inspectorate, on behalf of the Secretary of State, was returned in July 2021.

15.2.5 In relation to the resilience of the Proposed Development to climate change, tt was stated within the Scoping Opinion that "*the ES should include an assessment of the resilience of the Scheme to climate change, including how the Scheme design would be adapted to take account of the projected impacts of climate change (for both construction and operation). This should draw on the Water Environment topic chapter and Flood Risk Assessment*".

15.2.6 In relation to the GHG Assessment for the Proposed Development, the Scoping Report proposed to address GHG emissions with a focused quantitative and qualitative approach, proportionate to that equating to outline planning stage without detailed design or end-user information available at this stage. The assessment would draw on recognised climate change projections, existing guidance, emerging

good practice, as well as relevant information presented in other chapters of this ES and additional documents which form part of the Development Consent Order (DCO) application.

15.2.7 A quantitative appraisal of direct emissions associated with vehicle movements during the construction phase was proposed. This would draw on using applicable traffic data and DEFRAs Emission Factors Toolkit (EFT) v 9.0 (2VC), which is deemed suitable for large scale and high-level applications. Energy forecasts will draw on relevant application documents including the Energy and Sustainability Strategy and Design and Access Statement, which will be submitted as part of the DCO application.

15.2.8 Scenarios of current and future baselines will be built on the changing travel patterns and modal shift for operational circumstances. Baseline transport data to be used in the assessment will be based on the latest model as detailed in **Chapter 3 – Transport**. The transport model reports on travel patterns by mode (road and rail) associated with the Proposed Development. Transport efficiency improvements over time will also be considered. The impact that the Proposed Development has on freight will be assessed separately.

15.2.9 In relation to GHG emissions during the construction phase, the Scoping Opinion stated that "*Despite the indicative nature of the Proposed Development, the ES should nevertheless provide an approximate worst-case estimate of the GHGs arising from the construction of the scheme (materials quantity, energy and water demand, waste generation) and assess the significance*".

15.2.10 In relation to GHG emissions during the operational phase, the Scoping Opinion stated that as well as assessing vehicular GHG emissions and the modal shift from road to rail freight, "*the ES should provide an assessment of GHG emissions arising from operational energy and water use and waste generation*".

Resilience of the Proposed Development to Climate Change

Introduction

15.2.11 The assessment of the resilience of the Proposed Development to climate change will consider the impacts of a changing climate and extreme weather events on the Proposed Development. The assessment will follow best practice procedures for a Climate Change Resilience Assessment as set out by IEMA[2], the steps of which are included as **Table 1** in **Appendix 15.1**.

15.2.12 The Climate Change Resilience Assessment will use the UK Meteorological Office ('Met Office') published historical regional weather data and data from relevant

[2] IEMA (2020) Environmental Impact Assessment Guide to Climate Change Resilience and Adaptation

websites to establish the current climate within the region in which the Proposed Development will be located.

15.2.13 Information on climate trends and projections at the regional and local scale (where available) will also be utilised. Climate trends and projections are published by the Met Office through the UK Climate Projections website and provide the most up to date assessment of how the climate of the UK may change over this century.

15.2.14 The study area for the Climate Change Resilience Assessment will comprise the Order Limits of the DCO application, known as 'the Application Site'. The study area does not extend beyond the Application Site as a Resilience Assessment only considers the resilience of infrastructure associated with the Proposed Development.

Baseline Data Collection

15.2.15 The baseline data collected and presented in this draft chapter were sourced through desktop research, as well as information from other chapters within this ES.

15.2.16 Data included in this draft chapter has been collected from the following sources:

- Historical regional weather data published by the Met Office;
- UK Climate Projections (2018) (UKCP18)[3] – UK climate change projections, which were made in 2018, used to define the future baseline against which the resilience of the Proposed Development to climate change is assessed;
- UK Climate Projections (2009) (UKCP09)[4] –previous UK climate projections used where data from UKCP18 is unavailable;
- Centre for Environmental Data Analysis (CEDA)[5] – for observed climate data;
- Assessments offered in respect of, Chapter 6 – Ecology including Arboriculture, Chapter 9 – Water Environment (including Flood-Risk, Drainage & Water Quality) and Chapter 11: Ground Conditions within the ES will all be utilised to better understand the vulnerability of the Proposed Development to climate change.

15.2.17 Taken together, it is considered that the data sources provide a robust indication of the prevailing baseline situation relevant to the assessment reported within this chapter.

15.2.18 IEMA's 'Climate Change Resilience and Adaptation' guidance (IEMA, 2020[2]) for making a development resilient to, and adaptable against, climate change stresses that climate change should be an integrated consideration within the EIA. By its very

[3] Met Office (2018) 'UK Climate Projections (UKCP)'. Available from: https://www.metoffice.gov.uk/research/approach/collaboration/ukcp
[4] CEDA Catalogue (2009) 'UK Climate Projections 2009 (UKCP09)'. Available from: https://catalogue.ceda.ac.uk/uuid/077fd790439c44b99962552af8d37a22
[5] CEDA Catalogue 'UK Climate Projections 2018 (UKCP18)'. Available from: https://catalogue.ceda.ac.uk/uuid/c700e47ca45d4c43b213fe879863d589?jump=related-docs-anchor

nature, climate change spans a range of topics and therefore elements of this topic are considered throughout this ES and other planning documents.

15.2.19 The Proposed Development might take in the order of 5 years to construct. In lieu of specific guidance, the variability of the climate in the last 30 years has been taken into account when judging its resilience to climate change during the construction phase. It is considered that this 30-year timescale will identify recent extreme short-term weather events, as recommended by IEMA 2020[2] (pg. 16). Therefore, this assessment will recommend climate change-related mitigation measures based on these recent conditions during the construction phase if necessary.

15.2.20 During the operational stage, the long-term impacts of climate change, as predicted in the UKCP18, will be used to judge the resilience of the Proposed Development, which accords with IEMA (2020[2]) guidance (pg. 16). Climate change-related mitigation measures for the operational phase will be based on these long-term projections.

Identifying Sensitive Receptors

15.2.21 Receptors are defined as the physical or biological resource or user group that would be affected by a project. Baseline studies have informed the identification of potential environmental receptors. Some receptors will be more sensitive to certain climatic effects or changes than others.

15.2.22 Sensitive receptors specific to this assessment will be identified through examination of:

- the Parameters Plan for the Proposed Development;
- review of other Chapters within the ES;
- other documents which will be submitted as part of the DCO application; and
- professional judgement.

15.2.23 The potential impacts of climate change on the Proposed Development are also being considered in other Chapters of the emerging (draft) ES. In particular, it is expected to be most relevant to potential impacts with regard to the following topics:

- **Chapter 6: Ecology including Arboriculture**: Receptors that are likely to experience impacts are changes in habitats (seasonality and resilience), birds (in terms of future assemblage, seasonality breeding and feeding) and bats (in terms of seasonality and feeding);
- **Chapter 9: Water Environment (including Flood-Risk, Drainage & Water Quality):** Recommended 'Contingency Allowances' for Climate Change are guided by the Environment Agency. Considerations include fluvial flooding, groundwater, surface water runoff generation and overland flow, including flood risk receptors (people, property and infrastructure that may be at risk

from any flooding, including the Proposed Development, any off-site properties and existing sewers); and

- **Chapter 11: Ground Conditions:** Continuing declines in soil moisture and changes in season temperatures can increase the need for irrigation and increases stress upon foundations, affecting the stability of structures. Other impacts include erosion and stability of rock formations, which can be accelerated by extreme climate events, such as intense rain, drought, heat waves and storms.

15.2.24 Sensitive receptors which will be considered within the assessment of the vulnerability of the Proposed Development to climate change comprise the infrastructure within the Application Site boundary shown in the application drawings. These receptors are likely to include:

- Substructure;
- Infrastructure / Building Structures;
- Roads and bridges;
- Landscaping;
- Pedestrian and Cycle Ways; and
- Rail Infrastructure.

15.2.25 **Appendix 15.2** lists the climate variables, including extreme weather events which will be considered in this assessment (indicated with a tick in the table), as well as the likely sensitive receptors. Blank cells indicate variables that will not be considered further in the assessment due to geography and/or the context of the Proposed Development. World Bank prescribed best practice; Australian guidance, '*Standards Australia Climate Change Adaptation for settlements and infrastructure – a risk-based approach*'[6] has been applied in lieu of any UK and European guidance to assess the vulnerability of the elements of the Proposed Development, along with professional judgement.

Assumptions and Limitations

15.2.26 The assumptions and limitations which apply to this assessment are outlined in **Table 15.1**. For each assumption or limitation, an explanation of the possible effect of the assumption has been provided, as well as a description of any corrective actions that have been taken to adjust for any limitations. These assumptions are considered reasonable and are not likely to impact on the outcome of the assessment.

[6] Standards Australia (2013) 'Climate change adaptation for settlements and infrastructure - A risk based approach' Available from: https://infostore.saiglobal.com/en-gb/standards/as-5334-2013-119943_saig_as_as_251367/

Table 15.1: Climate Change Resilience Assessment Assumptions and Limitations

Assumption / Limitation	Consequence	Resolution
The assessment is based on a qualitative assessment and professional judgement.	The assessment undertaken provides a broad indication of the potential impacts of climate change on the Proposed Development.	An approach has been developed and will be applied in this assessment based on existing best practice.
There is currently no agreed methodology that should be applied for assessing the vulnerability of major schemes, including road infrastructure, under the EIA regulations.	The assessment has not been undertaken in line with specific standards.	An approach has been developed and will be applied in this assessment based on existing best practice guidance.
The UKCP18 projections have been used to infer future changes in a range of climate variables that may affect the vulnerability of the Proposed Development to climate change. At the time of writing, these represent the most up-to-date representation of future climate in the UK.	The UKCP18 data currently available does not provide data from extreme precipitation, drought, snow and ice, extreme temperature, solar radiation, wind or relative humidity. Data for these aspects has been taken from UKCP09. There are inherent uncertainties associated with climate projections and they are not predictions of the future. It is possible that future climate will differ from the baseline climate against which the resilience of the Proposed Development has been assessed depending on global emissions over the next century.	A 'high' emissions scenario (Representative Concentration Pathways (RCP) 8.5[7]) using the 2080s timeslice (2070-2099 – the longest temporal scale available through UKCP18) has been used to develop the baseline against which resilience will be assessed. This is consistent with the precautionary principle (i.e. 'worst case' scenario).
Analysis of climate projections is based on selected observational data available at the time of assessment.	Future climate projections, which may be more accurate, could not be accounted for within this assessment.	Any future decision-making based on this analysis should consider the range of literature, evidence and research available at that time and any changes to this.
The determination of resilience will be undertaken under the assumption that industry design standards will be adhered to where detailed information is unavailable.	Industry design standards may not have been updated to account for climate resilience.	To be applied, as applicable, as the design, construction and operation of the Proposed Development develops.

[7] A Representative Concentration Pathway is a GHG concentration (not emissions) trajectory adopted by the Intergovernmental Panel on Climate Change (IPCC).

Determining the Significance of Impacts

Vulnerability and Sensitivity of Receptors

15.2.27 The assessment will not only identify the Proposed Development's potentially sensitive receptors to climate change, but also determine each receptor's sensitivity to these changes.

15.2.28 A receptor's susceptibility is its ability to be affected by a change. In this sense, it is the opposite of resilience. Criteria based on the EIMA guidance for determining a receptor's susceptibility is included within **Table 2** of **Appendix 15.1**.

15.2.29 A receptor's vulnerability is a measure of its potential exposure to the changing climate. Criteria for determining a receptor's susceptibility is included within **Table 3** of **Appendix 15.1**.

15.2.30 The assessment of the significance of potential effects on the Proposed Development will apply a risk-based methodology for identifying potential climate impacts and assessing their severity, as recommended by IEMA[2] (pg. 27), and can be summarised into the following steps:

- Identifying potential climate change risks to a project;
- Assessing these risks (potentially prioritising to identify the most severe); and
- Formulating any additional mitigation actions to reduce the impact of the identified risks, if necessary.

15.2.31 Any assessment of risk to the Proposed Development includes assessing the likelihood (or probability) and magnitude (or severity) of the impacts identified. The Likelihood of an event and the Severity (or 'magnitude') of the event have been qualitatively assessed using the descriptions in **Tables 4** and **5** of **Appendix 15.1**. The determination of the likelihood and magnitude have been based on professional judgement and emerging best practice (IEMA, 2020[2] pg.27).

15.2.32 Assessment of the magnitude of impacts to receptors will take into account factors including:

- the acceptability of any disruption in use if the Proposed Development fails;
- its capital value if it had to be replaced;
- its impact on neighbours;
- the resilience of the Proposed Development element or receptor; and
- whether there are dependencies between the receptor and any interconnected network of nationally important assets on the Proposed Development

15.2.33 The significance of the potential impacts of climate change on receptors is determined by combining the likelihood and consequence ratings, as shown in **Table 6** of **Appendix 15.1**.

15.2.34 The above approach will be used to assess the likely significant environmental effects for the construction and operation of the Proposed Development.

15.2.35 The significance of the potential impacts of climate change on receptors is determined by combining the likelihood and consequence ratings in **Tables 4** and **5**, respectively, as shown in **Table 6** of **Appendix 15.1**. Therefore, as per IEMA guidance[2], the significance of potential impacts are as follows:

- Significant; or
- Not significant.

15.2.36 In accordance with best practice, short-term effects are considered to be those associated with the construction of the Proposed Development and long-term effects are those associated with the completed and operational Proposed Development.

Applying Mitigation

15.2.37 Suitable mitigation measures to address adverse effects on the ability of resources and receptors to adapt to climate change will beconsidered by other topic specialists and chapter authors contributing to the ES. For example, for in-combination climate change impacts relating to flood risk, climate change projections based on current Environment Agency guidance will be used in the relevant flood risk assessment as part of the assessment of drainage and flood-risk issues, and appropriate mitigation and design responses proposed.

15.2.38 These measures will be embedded into the design of the Proposed Development and would increase its resilience to climate change. Following the identification of any residual impacts, additional mitigation measures might also be recommended to further increase the Proposed Development's resilience to climate change.

Influence of the Proposed Development on Climate Change

Introduction

15.2.39 The assessment of the influence of the Proposed Development on climate change relates to the effects of GHG emissions relating to the Proposed Development which would contribute to climate change. The assessment follows best practice procedures

for an assessment of GHG emissions, the steps of which are set-out in Figure 1 of IEMA's 2022 guidance[8] and included as **Appendix 15.3**.

15.2.40 The Proposed Development will be assessed within the context of the UK's evolving carbon agenda as set-out in **Section 3 - Policy Context**.

Study Area

15.2.41 The study area for the GHG Assessment considers the emissions of GHGs arising from the construction and operation of the Proposed Development within the Application Site. This covers both construction and operational emissions as summarised in the list below:

- For construction emissions, the physical scope extends to the extraction and sourcing of materials nationally and internationally, as well as construction processes within the Site. Transportation of waste, and transport of workers to the Application Site also take place outside the Application Site boundary; and
- For the operational phase, emissions arise from the energy, waste arisings and water consumed within the Main Site. However, many of the upstream emissions associated with these (e.g. energy for electricity generation and potable water treatment) are outside the physical boundary of the Main Site.

Identifying Sensitive Receptors

15.2.42 The local, regional, national and global environment within which GHG emissions are emitted are considered the sensitive receptors within the assessment.

Sources of GHG emissions

15.2.43 The GHG Assessment will not be restricted by geographical area but instead assesses any increase (or decrease) in emissions as a result of the Proposed Development. The sources of GHG emissions therefore comprise 'direct'[9] and 'indirect'[10] sources which comprise the following:

- Primary Sources:
  - Emissions relating to on-site construction activities (such as plant use on-site);
  - Operational emissions from site maintenance activities;

[8] IEMA (2022) Environmental Impact Assessment Guide to Assessing Greenhouse Gas Emissions and Evaluating their Significance. Available from: https://www.iema.net/preview-document/assessing-greenhouse-gas-emissions-and-evaluating-their-significance
[9] Direct GHG emissions are emissions from sources that are owned or controlled by the reporting entity (i.e. the Applicant).
[10] Indirect GHG emissions are emissions that are a consequence of the activities of the reporting entity, but occur at sources owned or controlled by another entity.

- Operational end user traffic – a comparison has been made between GHG emissions between the 'Do-minimum' (without the Proposed Development) and 'Do-something' (with the Proposed Development) scenarios provided by a GHG assessment based on data from the traffic model and guidance from the Department of Transport[11];

- Secondary Sources:
  - Construction and operational emissions relating to the manufacturing, transport and disposal of materials, which may be some distance from the location of the Proposed Development (for example, emissions associated with the manufacture of cement and steel).

15.2.44 The activities which are likely to contribute the majority GHG emissions that are to be assessed are summarised in **Table 15.2**.

Table 15.2: Summary of Significant GHG Emissions Sources

GHG Emissions Sources	Description
Occupiers (Transport)	User behaviour during the operational phase, including heavy duty vehicles (HDV's) associated with general operation/functionality.
Transport	Employee commuting and other vehicular trips that start or end within the Main Site.
Construction (qualitative)	Direct sources of GHG emissions associated with vehicle and plant movements and function.

15.2.45 The GHG emissions sources which will be included and excluded from the GHG Assessment are shown in **Table 15.3** below. This table also indicates the phase of the Proposed Development that each activity relates to, as well as the stage at which each included activity will be assessed. Whilst it is recognised that the infrastructure provided within the Main Site (i.e. rail infrastructure and pedestrian/cycleways) can lock-in positive or negative user behaviour during the operational phase, the GHG emissions are influenced by a number of factors beyond design decisions that cannot be quantified at this early stage of the Proposed Development. Where feasible, qualitative appraisals will be provided.

[11] Department for Transport (2019) 'TAG unit A3 environmental impact appraisal'. Available from: https://www.gov.uk/government/publications/tag-unit-a3-environmental-impact-appraisal

Table 15.3: GHG Emissions Sources Included in / Excluded from the GHG Assessment

GHG Emissions Sources	Description	Included?	Stage of Assessment
Construction Phase			
Direct GHG (Energy)	Construction energy – On-site fuel combustion (e.g. construction plant)	X	ES
Indirect GHG (Construction)	Embodied carbon associated with construction (materials, construction process, in-use building component maintenance and eventual demolition)	X	ES
Solid Waste	Waste arising during construction	X	ES
Water	Water demand associated with construction works	X	ES
Operational Phase			
Natural Capital	Green and blue infrastructure (e.g. soft landscaping, water bodies, sustainable drainage features)	**X**	N/A
Direct GHG (Energy and vehicles)	Operational energy – On-site fuel combustion (e.g. gas, biomass, solar provisions, vehicular emission)	✓	ES
Indirect GHG (Energy)	Operational energy – Off-site generation (e.g. Grid electricity, heat and steam).	**X**	N/A
Water	Water demand associated with the non-domestic buildings	✓	ES
Solid Waste	Waste arising from building occupants and visitors (non-domestic buildings and different housing typologies)	✓	ES

Baseline/Comparative Data Collection

15.2.46 Baseline data for the assessment of the influence of the Proposed Development on climate change will be collected from the following sources. This will help establish a current GHG baseline to assess the Proposed Development against:

- UK Local and regional CO_2 emissions – data tables[12]; and
- The traffic model for the Proposed Development, which is being developed as part of **Chapter 3 – Transport**, and will be used to calculate total construction and operational phase GHG emissions; and
- The Energy and Sustainability Strategy, which will be an appendix to the final version of this chapter.

15.2.47 24-hour annual average daily traffic (AADT) flows for Light Duty Vehicle ('LDV') and Heavy Duty Vehicles ('HDV') will be provided by the transport consultants for the following scenarios:

- Baseline year without the Proposed Development;
- Future Year 'Do-minimum' (without the Proposed development); and
- Future Year 'Do-something' (with the completed Proposed Development).

15.2.48 Traffic data assumptions for the three scenarios above will be set out. Fleet composition data will be used with assumptions made about HDV/LDV splits and trip rates expected under construction and operational scenarios. In the absence of pre-defined distances for commuter vehicles ('LDV'), the most recent UK average journey distance as defined by the National Travel Survey[13] (8.4 miles/13.1 km) will be applied. The roads will be classified as "England (not London)" as applicable.

15.2.49 As publicly available timetabling does not account for rail freight, rail-based emissions assumptions for the GHG Assessment are therefore to be calculated on the assumptions as set-out and verified by the transport consultant, ADC Infrastructure.

15.2.50 During operations, rail freight is expected to increase over time to a total of up to 12 trains (24 two-way movements) per day ultimately, but this will increase gradually over time as seen at other SRFIs. Based on industry standards it would expected that Class 66 and 70 (both diesel) trains will comprise the majority of this fleet, with some (up to 2) Class 768 (bimodal diesel electric) trains facilitating delivery. Both the Class 66 and 70 are diesel-electric freight locomotives, with two-stroke diesel noted as the prime mover. Final assumptions about rail rolling stock will be agreed with the Rail consultant and/or prospective rail terminal operator.

15.2.51 The assessment will have regard to the average weight of a freight train, albeit this varies depending on the load and number of cars in the train, as well as to the average length (i.e. distance) of a singular rail freight haul using data from the Department for Transport and/or Network Rail.

[12] Department for Business, Energy and Industrial Strategy (2021) 'UK local authority and regional carbon dioxide emissions national statistics: 2005 to 2019'. Available from: https://data.gov.uk/dataset/723c243d-2f1a-4d27-8b61-cdb93e5b10ff/uk-local-authority-and-regional-carbon-dioxide-emissions-national-statistics-2005-to-2019

[13] Department for Transport (2019) 'National Travel Survey England'. Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/906276/national-travel-survey-2019.pdf

Determining Significance

15.2.52 In the absence of any significance criteria or a defined threshold, it might be considered that all carbon emissions are significant, and beneficial effects only arise if there is a net loss in carbon and emissions. As per the IEMA guidance (2022)[14] referred to above, when evaluating significance, in the context of the global challenges being faced all new GHG emissions contribute to a negative environmental effect; however, some developments will replace existing development that have higher GHG profiles. The significance of a development's emissions should therefore be based on its net impact, which may be positive or negative. EIA should ensure an assessment addresses the occurrence of GHG emissions by taking mitigating action and minimising the net impacts.

15.2.53 Whilst there is no single preferred method to evaluate significance given this topic is emerging within EIA, the approach to determining the significance of effects has applied IEMA guidance[15], standard industry practice and professional judgment. Therefore, the effects have been defined and compared against UK Carbon Budget Targets, which are shown in **Table 15.4**. 2036 is proposed as the assessment year on the basis that the Proposed Development would be fully operational (i.e. fully occupied) and established.

Table 15.4: Significance Criteria for GHG Emissions

Effect Significance	Description of Criteria (Emissions from Road Traffic (CO_2))
Negligible	Emissions are equal to the emissions predicted in the 2036 'Do Minimum' baseline.
Minor	An increase in emissions predicted in the 2036 'Do Minimum' scenario, but less than 1% of total emissions from the relevant 5-year UK carbon budget and with a commitment to reasonable and deliverable measures to seek to reduce these emissions in accordance with relevant policy and guidance.
Moderate	An increase in emissions predicted in the 2036 'Do Minimum' scenario, but less than 1% of total emissions from the relevant 5-year UK carbon budget and without a commitment to reasonable and deliverable measures to seek to reduce these emissions, in accordance with relevant policy and guidance.
Major	An increase in emissions predicted in the 2036 'Do Minimum' scenario, that results in GHG emissions representing greater than 1% of total emissions from the relevant 5-year UK carbon budget in which they arise.

[14] IEMA (2022) Environmental Impact Assessment Guide to Assessing Greenhouse Gas Emissions and Evaluating their Significance. Available from: https://www.iema.net/preview-document/assessing-greenhouse-gas-emissions-and-evaluating-their-significance
[15] As at footnote 14 above.

Assumptions and Limitations

15.2.54 The assumptions and limitations which apply to this assessment are outlined in **Table 15.5**. For each assumption or limitation, an explanation of the possible effect of the assumption has been provided as well as a description of any corrective actions that have been taken to adjust for any limitations. These assumptions are considered reasonable and are not likely to impact on the outcome of the assessment.

Table 15.5: GHG Assessment Assumptions and Limitations

Assumption / Limitation	Consequence	Resolution
There is currently no specific guidance or carbon emissions threshold, which, if exceeded, is considered significant.	The assessment has not been undertaken in line with specific guidelines or standards.	Professional judgement based on experience and knowledge of similar schemes and current guidance as identified have been used to make the assessment.
Data on the anticipated transportation distance for materials brought to site and wastes taken from site are not available and have been based on average journey distances as defined by the National Travel Survey[16].	The transportation distances are considered reasonable based on professional judgement. Any changes to the distances could be considered to materially affect the chapter outcomes.	The transportation distances have been used to complete the Highways England Carbon Tool to calculate construction phase GHG emissions.
The future traffic levels for the assessment of the Proposed Development are based upon an assessment year of 2036. An operational period of 60 years has been assumed for the assessment of GHG emissions.	N/A	To model the GHG emissions, the assessment has taken into account the proportions of the vehicle types, fuel type, forecast fuel consumption parameters and emission factors for the 2036 assessment year.
The most accurate way to calculate emissions from rail freight is to use direct measurements of fuel used – it is frequently not available. Given that limitation the most commonly used metric in rail freight is tonne km.	Fuel usage in rail freight will vary significantly across different locomotives and other factors such as the gradient of the route and weight / length of the freight train. Therefore, it is recommended that where possible operators try to measure or estimate	To estimate the effects of GHG emissions from freight, the assessment has taken into account the average savings as defined from the total number of trains expected per day using annual statistical data released for freight trains in the United Kingdom. Freight train data has been normalised to show the average CO_2e emission per net tonne kilometre of freight moved.

[16] Department for Transport (2019); National Travel Survey England. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/906276/national-travel-survey-2019.pdf

	fuel use more directly, and use this as the basis of their emissions calculation[17]. This information is not available for the extent of the rail network and as the type and quantity of freight is yet to be defined and variable, it has not been directly assessed.	

Assessing In-combination Effects

15.2.55 The in-combination climate change impacts assessment relates to the combined effect of the impacts of the Proposed Development and potential climate change impacts on the receiving environment.

15.2.56 In line with IEMA guidance (IEMA, 2022), the combined effect of the impacts of the Proposed Development and potential climate change impacts on the receiving environment are referred to as 'in-combination impacts' and 'in-combination effects'.

15.3 POLICY CONTEXT

International Legislation and Policy

15.3.1 The international and legislative framework for the consideration of climate change and GHG emissions established the basis for the approach to the assessment methodology. The legislative background is briefly set out below, along with the approach to the legislative requirements though policy.

Paris Agreement

15.3.2 The Paris Agreement[18] sets out a global framework to avoid dangerous climate change by limiting global warming to well below 2 degrees Celsius (°C) and pursuing efforts to limit it to 1.5°C. It also aims to strengthen country's ability to deal with the impacts of climate change and support them in their efforts. This Agreement is the first-ever universal, legally binding global climate change agreement, adopted at the Paris climate conference ('COP21') in December 2015.

[17] Multiple Contributors: 'Guidance on measuring and reporting Greenhouse Gas (GHG) emissions from freight transport operations'. Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/218574/ghg-freight-guide.pdf

[18] United Nations Climate Change (2015): 'The Paris Agreement'. Available from: https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

Directive 2014/52/EU on the Assessment of the Effects of Certain Public and Private Projects on the Environment (the EIA Directive)

15.3.3 European Directive 2014/52/EU[19] on the assessment of the effects of certain public and private projects on the environment provides the overarching legislative framework for assessing the significance of impacts and effects from the schemes on the environment.

15.3.4 Article 3 of the EIA Directive requires EIA's to identify, describe and assess the direct and indirect significant effects of a project on climate. Furthermore, Annex IV stipulates that the information to be included within the ES should include "*the impact of the project on climate (for example the nature and magnitude of GHG emissions) and the vulnerability of the project to climate change*".

15.3.5 Although the UK is officially no longer a member of the European Union as of 31 January 2020, Directive 2014/52/EU was fully transposed into UK law in the Infrastructure Planning (Environmental Impact Assessment Regulations) which came into force in the UK on the 16 May 2017[20]. The Directive requires: "*A description of the likely significant effects of the project on climate (for example the nature and magnitude of GHG emissions) and the vulnerability of the project to climate change*".

National Legislation and Policy

Department for Transport's National Policy Statement for National Networks (NPS)

15.3.6 UK Government policy for nationally significant infrastructure rail and road projects within England, and the need that underpins this, is set out in the National Policy Statement (NPS) for National Networks 2014[21].

15.3.7 A key driver identified for the national rail network is to provide for the transport of freight across the country, and to and from ports, in order to help meet environmental goals and improve quality of life.

15.3.8 Paragraph 2.35 states that "*Rail transport has a crucial role to play in delivering significant reductions in pollution and congestion. Tonne for tonne, rail freight produces 70% less CO2 than road freight, up to fifteen times lower NOx emissions and nearly 90% lower PM10 emissions. It also has de-congestion benefits –*

[19] European Parliament and Council (2014) 'Directive 2014/52/EU of the European Parliament and of the Council amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment'. Available from: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32014L0052
[20] The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017. Available at: http://www.legislation.gov.uk/uksi/2017/572/contents/made
[21] Department for Transport (2014); 'National Policy Statement for National Networks', Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/387222/npsnn-print.pdf

depending on its load, each freight train can remove between 43 and 77 HGVs from the road".

Climate Change Adaptation

15.3.9 The NPS also sets out UK Government policy on climate change mitigation and adaptation, and in particular how applicants should take climate change effects into account when developing infrastructure.

15.3.10 Because of the impacts of climate change, "*Adaptation is therefore necessary to deal with the potential impacts of these changes that are already happening. New development should be planned to avoid increased vulnerability to the range of impacts arising from climate change*" (Paragraph 4.38).

15.3.11 The NPS specifies the following within Paragraphs 4.41 – 4.44 to ensure a robust approach to climate change adaptation:

- "*Where transport infrastructure has safety-critical elements and the design life of the asset is 60 years or greater, the applicant should apply the UK Climate Projections 2009 (UKCP09) high emissions scenario (high impact, low likelihood) against the 2080 projections at the 50% probability level*";
- "*The applicant should take into account the potential impacts of climate change using the latest UK Climate Projections available at the time and ensure any environment statement that is prepared identifies appropriate mitigation or adaptation measures. This should cover the estimated lifetime of the new infrastructure. Should a new set of UK Climate Projections become available after the preparation of any environment statement, the Examining Authority should consider whether they need to request additional information from the applicant*";
- "*The applicant should demonstrate that there are no critical features of the design of new national networks infrastructure which may be seriously affected by more radical changes to the climate beyond that projected in the latest set of UK climate projections. Any potential critical features should be assessed taking account of the latest credible scientific evidence*…"; and
- "*Any adaptation measures should be based on the latest set of UK Climate Projections, the Government's national Climate Change Risk Assessment and consultation with statutory consultation bodies. Any adaptation measures must themselves also be assessed as part of any environmental impact assessment and included in the environment statement, which should set out how and where such measures are proposed to be secured*".

15.3.12 Paragraph 4.47 of the NPS also states that climate change adaptation measures should not cause "*an adverse effect on other aspects of the project and/or surrounding environment*".

UK Climate Change Act

15.3.13 The Climate Change Act 2008[22] established a legal requirement for an 80% reduction in the GHG emissions of the UK economy by 2050 in comparison to a 1990 baseline. The Act also created the Committee on Climate Change, with a responsibility for:

- Setting five-year carbon budgets and covering successive periods of emissions reduction to 2050;
- Advising and scrutinising the UK Government's associated climate change adaptation programmes; and
- Producing a national adaptation plan for the UK Government to implement.

15.3.14 In 2019, the target was revised to achieve 100% reduction (net zero) GHG emissions by 2050.

15.3.15 In December 2020, the UK announced plans to reduce GHG emissions by at least 68% by 2030 in comparison to a 1990 baseline[23]. This replaced the previous target of a 53% reduction by 2030.

The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017

15.3.16 Schedule 4, Clause 5(f) of the Regulations notes information should be included in the ES on the likely significant effects of the Proposed Development on the environment resulting from the impact of the project on climate (for example the nature and magnitude of greenhouse gas emissions) and the vulnerability of the project to climate change.

National Planning Policy Framework

15.3.17 The Revised National Planning Policy Framework[24] ('NPPF') (July, 2021) sets out the core planning principle of "*moving to a low carbon economy*": Chapter 9: Promoting Sustainable Transport, encourages the pursuit of *"…opportunities to promote walking, cycling and public transport*" and states that "*Significant development should be focused on locations which are or can be made sustainable, through limiting the need to travel and offering a genuine choice of transport modes*" (Paragraphs 104 and 105).

[22] HM Treasury (2008) Climate Change Act 2008. Available at: http://www.legislation.gov.uk/ukpga/2008/27/introduction
[23] Department for Business, Energy & Industrial Strategy (2020) 'UK sets ambitious new climate target ahead of UN Summit'. Available at: https://www.gov.uk/government/news/uk-sets-ambitious-new-climate-target-ahead-of-un-summit
[24] Ministry of Housing, Communities and Local Government (2021) 'National Planning Policy Framework'. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1005759/NPPF_July_2021.pdf

15.3.18 In accordance with NPPF Chapter 14: 'Meeting the challenge of climate change, flooding and coastal change'; "*the planning system should support the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change. It should help to: shape places in ways that contribute to radical reductions in GHG emissions, minimise vulnerability and improve resilience; encourage the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy and associated infrastructure*" (Paragraph 152).

Building Regulations

15.3.19 An update to Approved Document Part L2A '*Conservation of Fuel and Power in new buildings other than dwellings*'[25] was released in December 2021. These Regulations determine the energy efficiency and carbon emission standards required by new buildings. Part L addresses controls for:

- insulation values of buildings elements;
- the allowable area of windows, doors and other opening;
- the air permeability of the structure;
- the heating efficiency of boilers;
- hot water storage and lighting;
- mechanical ventilation and air conditioning systems;
- space heating controls;
- airtightness testing of larger buildings;
- solar emission; and
- requirements for Carbon Index ratings.

County and Local Policy

Oxfordshire County Council

15.3.20 Oxfordshire County Council (OCC) declared a climate emergency in April 2019 and created a Climate Action Framework[26] in October 2020 to tackle the issue. As part of this Framework, OCC plan to be operate at net zero carbon by 2030.

[25] HM Government (updated 2021) 'The Building Regulations 2010 Conservation of fuel and power Approved Document L Volume 2: Buildings other than dwellings' Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1045921/ADL2.pdf

[26] Oxfordshire County Council (2020) 'Climate Action at Oxfordshire County Council'. Available from: https://www.oxfordshire.gov.uk/sites/default/files/file/environment-and-planning/ClimateActionAtOCC.pdf

Oxfordshire Plan Consultation Document

15.3.21 The Oxfordshire Plan Consultation Document[27] was created in July 2021 with a view to the Plan being adopted in October 2022, albeit the updated plan preparation programme remains unconfirmed. The Plan states that "*Climate change is central to each of the Oxfordshire Plan themes and policies, as to properly address climate change, a coherent, joined-up approach encompassing development standards, transport and infrastructure and healthy ecosystems is required*" (Paragraph 61).

15.3.22 Four policies are being considered in relation to climate change within the consultation document.

15.3.23 Within **Policy option 01 - Sustainable Design and Construction**, the plan states that "*It is essential that the Oxfordshire Plan takes steps to mitigate the impact of new development by reducing its carbon footprint*" (Paragraph 78). According to this policy option:

- OCC will set out "*sustainable design and construction requirements to be applied to major residential and non-residential developments within Oxfordshire*;
- *Buildings should be designed to be resilient to the effects of a changing climate including overheating*; and
- *New buildings should be designed to be durable but flexible and adaptable to changing needs over time*" (pgs 34 -35).

15.3.24 Within **Policy option 02 – Energy**, the plan states that "*Developments would be required to maximise energy efficiency whilst integrating renewable and smart energy technologies in order to minimise energy demand. Installation and integration of these technologies should be delivered at the development stage to avoid more costly retrofitting after completion*" (pg. 39).

15.3.25 Within **Policy option 03 - Water Efficiency**, the plan "*would seek to require the most ambitious minimum water efficiency standards possible for new development...For non-residential development, this would include exploring the potential to set minimum water efficiency standards for some uses*" (pg. 43).

15.3.26 Within **Policy option 04 - Flood Risk**, the plan states that development should "take account of both its impact on flood risk and the potential impacts of flood risk on the development and its future occupiers/users" (pg. 45).

[27] Oxfordshire County Council (2021) 'Oxfordshire Plan – Regulation 18 (Part 2) Consultation Document'. Available from: https://oxfordshireplan.org/wp-content/uploads/2021/12/OX2050-PLAN-FULL-TEXT-V30-23-July-2021-with-para-nos.pdf

Cherwell District Council

15.3.27 Cherwell District Council (CDC) declared a climate emergency in July 2019[28] and pledged to make the district carbon neutral by 2030.

The Cherwell Local Plan 2011 – 2031

15.3.28 The Cherwell Local Plan 2011 – 2031, which was adopted in July 2015, sets out policies for the district.

15.3.29 According to **Policy ESD 1: Mitigating and Adapting to Climate Change** of this Plan, "*Measures will be taken to mitigate the impact of development within the District on climate change. Strategic aims of this policy which are relevant to this assessment include:*

- *Delivering development that seeks to reduce the need to travel and which encourages sustainable travel options including walking, cycling and public transport to reduce dependence on private cars*;
- *Designing developments to reduce carbon emissions and use resources more efficiently, including water*; and
- *Promoting the use of decentralised and renewable or low carbon energy where appropriate*" (pgs. 85 – 86).

15.3.30 The policy goes on to say that "*The incorporation of suitable adaptation measures in new development to ensure that development is more resilient to climate change impacts will include consideration of the following:*

- *Taking into account the known physical and environmental constraints when identifying locations for development*;
- *Demonstration of design approaches that are resilient to climate change impacts including the use of passive solar design for heating and cooling*;
- *Minimising the risk of flooding and making use of sustainable drainage methods*, and
- *Reducing the effects of development on the microclimate (through the provision of green infrastructure including open space and water, planting, and green roofs)*" (pg. 86).

15.3.31 According to **Policy ESD 2: Energy Hierarchy and Allowable Solutions** of this Plan, "*In seeking to achieve carbon emissions reductions, we will promote an 'energy hierarchy' as follows:*

[28] Cherwell District Council (2019) 'Summary of the Decisions taken at the meeting of Council held on 22 July 2019'. Available from: http://modgov.cherwell.gov.uk/documents/g3238/Decisions%20Monday%2022-Jul-2019%2018.30%20Council.pdf?T=2

- *Reducing energy use, in particular by the use of sustainable design and construction measures*;
- *Supplying energy efficiently and giving priority to decentralised energy supply*;
- *Making use of renewable energy*; and
- *Making use of allowable solutions*" (pg. 87).

15.3.32 According to **Policy ESD 3: Sustainable Construction** of this Plan, "*All new non-residential development will be expected to meet at least BREEAM 'Very Good' with immediate effect, subject to review over the plan period to ensure the target remains relevant. The demonstration of the achievement of this standard should be set out in the Energy Statement*" (pg. 88).

15.3.33 According to **Policy ESD 4: Decentralised Energy Systems** of this Plan, "*The use of decentralised energy systems, providing either heating (District Heating (DH)) or heating and power (Combined Heat and Power (CHP)) will be encouraged in all new developments. A feasibility assessment for DH/CHP, including consideration of biomass fuelled CHP, will be required for…all applications for non-domestic developments above 1000m2 floorspace*" (pg. 91).

15.3.34 According to **Policy ESD 5: Renewable Energy** of this Plan, "*Planning applications involving renewable energy development will be encouraged provided that there is no unacceptable adverse impact, including cumulative impact, on the following issues, which are considered to be of particular local significance in Cherwell:*

- *Landscape and biodiversity including designations, protected habitats and species, and Conservation Target Areas*;
- *Visual impacts on local landscapes*;
- *The historic environment including designated and non designated assets and their settings*;
- *The Green Belt, particularly visual impacts on openness*;
- *Aviation activities*;
- *Highways and access issues*, and
- *Residential amenity*" (pg. 93).

15.3.35 Furthermore, "*A feasibility assessment of the potential for significant on site renewable energy provision (above any provision required to meet national building standards) will be required for…all applications for non-domestic developments above 1000m^2 floorspace*" (pg. 93).

15.3.36 According to **Policy ESD 6: Sustainable Flood Risk Management** of this Plan, "*Development will only be permitted in areas of flood risk when there are no reasonably available sites in areas of lower flood risk and the benefits of the development outweigh the risks from flooding*" (pg. 95).

15.3.37 According to **Policy ESD 7: Sustainable Drainage Systems (SuDS)** of this Plan, "*All development will be required to use sustainable drainage systems (SuDS) for the management of surface water run-off*" (pg. 98).

Cherwell Local Plan Review

15.3.38 CDC have undertaken consultation since 2020 in relation to a review of the Local Plan[29]. Meeting the challenge of climate change was one of the three key themes of this Local Plan review.

15.3.39 The key objectives associated with meeting the challenge of climate change were:

- "*Promote net zero carbon new developments, with high sustainable construction standards, and low embodied carbon to ensure new developments deliver the highest viable energy efficiency, including the use of decentralised energy*;
- *Support a local zero- carbon energy system that reduces Cherwell's reliance on global fossil fuels and prioritises community energy*;
- *Deliver developments that minimise and are resilient to the impacts of climate change, including extreme weather events such as flooding, drought and heatwaves*;
- *Protect and maximise opportunities for biodiversity net gain and the enhancement of Cherwell's natural capital, and minimising pollution across the whole of Cherwell*;
- *Secure new green and blue infrastructure provision to improve sustainable connectivity, improve habitat connectivity to mitigate climate change impacts on biodiversity, and mitigate against the effects of development on the microclimate*;
- *Protect, conserve and enhance 'natural capital' assets such as soils, woodlands, hedges and ponds in order to capture and store carbon*;
- *Prioritise active travel and increase the attraction of and opportunities for public transport, ensuring high standards of connectivity and accessibility to services for all. Reduce dependency on the private car as a mode of travel, facilitating the creation of a zero-carbon transport network*;
- *Support the efficient use of our local resources (particularly water efficiency)*;
- *Recognise the contribution the historic environment can make to climate change mitigation through the reuse and recycling of existing buildings which retains embodied carbon and diminishes carbon emissions through the demolition and construction of new buildings*; and

[29] Cherwell District Council (2021) 'Cherwell Local Plan Review - Planning for Cherwell Community Involvement Paper 2: Developing our Options'. Available from: https://www.cherwell.gov.uk/info/83/local-plans/729/planning-for-cherwell---local-plan-review/3

- *Ensure a whole building approach is used for climate change mitigation measures for historic buildings, that allows for the unique circumstances of the historic building to be taken into account*" (pg. 26).

15.4 BASELINE CONDITIONS

Regional Climatic Conditions ('Do Nothing' Scenario)

15.4.1 Data from the Met Office[30] was used to build a profile of regional climatic conditions. As the Site is located to the north of Oxford and the Met Office considers it to be located within the English Midlands, as shown in **Figure 15.1**.

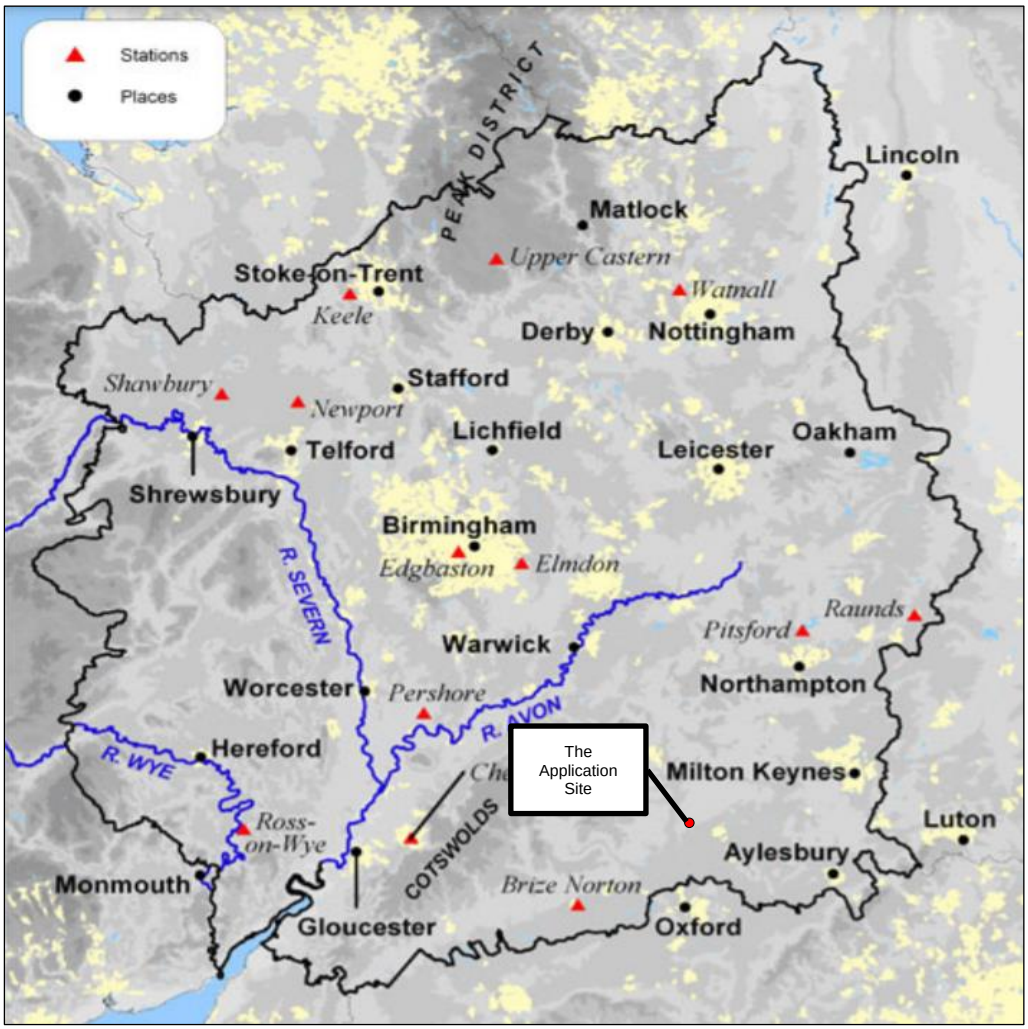

Figure 15.1: English Midlands
Source: Met Office[30]

[30] Met Office (no date) 'Midlands: climate'. Available from: https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/uk-past-events/regional-climates/midlands_-climate---met-office.pdf

15.4.2 The Midlands lie at the geographic heart of England. As such, it has a climate that is essentially transitional between northern and southern England regarding temperature and between Wales and eastern England regarding rainfall.

15.4.3 Mean annual temperatures over the region vary from around 8°C to just over 10°C. Temperature shows both a seasonal and a diurnal variation. Minimum temperatures usually occur around sunrise and maximum temperatures are normally 2 or 3 hours after midday. Since the Midlands region is at some distance from the sea, with its moderating effects on temperature, the annual range is more pronounced than in most parts of the UK. January is the coldest month, with mean daily minimum temperatures varying from just below 0°C to about 1.5°C, whilst July is the warmest month, with mean daily maximum temperatures exceeding 22°C in the south and east Midlands. Temperatures have been recorded as low as -26.1°C in Shropshire in January 1982 during snow cover, and as high as 38.5°C in Kent in August 2003.

15.4.4 The average number of days with air frost in the Midlands varies from about 40 – 60 days per year, whilst ground frost occurs on average on about 100 - 125 days per year.

15.4.5 The number of hours of bright sunshine is controlled by the length of day and by cloudiness. The day is shortest in December and longest in June and so in general December is the dullest month and June or July the sunniest. Average annual sunshine durations over the Midlands range between 1,400 – 1,600 hours per year.

15.4.6 Rainfall tends to be associated with Atlantic depressions or with convection. Rainfall is generally well-distributed through the year but most rainfall occurs in autumn and winter. The number of days of rainfall of more than 1mm is lower in the east and south, with 30 - 35 days in winter and 20 - 25 days in summer being typical. Periods of prolonged rainfall can lead to widespread flooding, especially in winter and early spring when soils are usually near saturation.

15.4.7 Thunderstorms are most likely to occur from May to September, reaching their peak in July and August. High intensity rainfall is often associated with summer showers and thunderstorms, with rates of 100 mm/hr or more being possible for short periods.

15.4.8 Over most of the area, snowfall is normally confined to the months from November to April, except in upland areas where it can occur beyond these months. On average, the number of days with snow falling is about 20 per winter in the lower lying areas.

15.4.9 The Midlands area is one of the more sheltered parts of the UK, the windiest areas being in western and northern Britain, closer to the Atlantic. Mean wind speeds and gusts are strongest and most frequent in the winter half of the year, especially from December to February. The range of directions between south and north-west accounts for the majority of occasions and the strongest winds nearly always blow from this range of directions. The strongest reported gusts in the Midlands (70 – 80

knots) occurred in 1976. The UK has the highest frequency of reported tornadoes per unit area in the world, although they are nowhere near as intense as other parts of the world. A tornado with estimated 110 knot winds damaged over 420 homes in Birmingham in 2005.

Local Climatic Conditions

15.4.10 Average climate conditions between 1991 - 2020 at Oxford Weather station from the Met Office[31], the closest weather station to the Main Site, are shown in **Appendix 15.4**. The table in **Appendix 15.4** shows that average maximum and minimum temperatures are lowest between November and February, whilst average maximum and minimum temperatures are highest between June and September. Most frost occurs between December and February. The average amount of sunshine hours is lowest between November and January and highest between May and August.

15.4.11 Rainfall is relatively evenly distributed throughout the year, with the highest averages in October and November. There is also little difference during the year between the number of days of rainfall above 1mm a month, with the highest averages between October and January.

15.4.12 On average, wind speeds are stronger in winter months than in summer months.

15.4.13 A Local Climate Impacts Profile undertaken for the Cherwell area, which considered extreme weather events between 2003 – 2008, identified that "*flooding was by far the most significant extreme weather event, with significant flooding occurring 6 times in a 5 year period, 2 of the events being serious and widespread*" (p.84 Cherwell Local Plan 2011 – 2031).

15.4.14 Interpolated data based on the weather stations at the following four locations[32] were used to ascertain temperature, rainfall and wind conditions in the vicinity of the Main Site during 2021:

- Oxford (Kidlington) / Shipton on Cherwell;
- Benson;
- Brize Norton; and
- High Wycombe / Sands.

[31] Met Office (no date) 'UK climate averages, Oxford'. Available from: https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-averages/gcpn7mp10
[32] Meteostat (updated February 2022) 'Bicester'. Available from: https://meteostat.net/en/place/48AERK?t=2021-01-01/2021-12-31

Temperature

15.4.15 The average temperature in 2021 was 10.5°C. The highest temperature recorded was 30°C in July and the lowest temperature recorded was -3°C in January. Average, minimum and maximum temperatures for 2021 are shown in **Figure 18.2**.

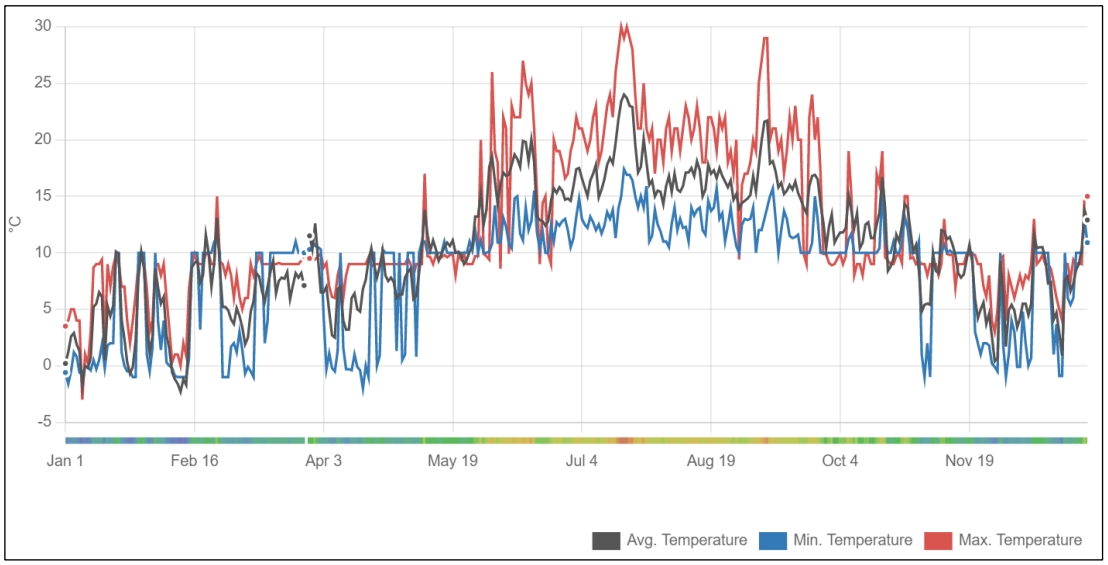

Figure 18.2: Average, Minimum and Maximum Temperatures in the Vicinity of the Main Site for 2021
Source: meteostat.net

Rainfall

15.4.16 The total amount of precipitation in 2021 was 801.1 mm. The most rainfall in one day was 36.1 mm on June 18th. The months with the highest number of rainy days were January, May and June, whilst October had the highest number of days with over 10 mm of rain.

Wind

15.4.17 Wind speeds were higher on average in spring and winter months in 2021. The highest average wind speed was 37.4 km/h recorded on November 27th, whilst the strongest gust was 66.7 km/h recorded on March 11th.

15.4.18 Interpolated data based on the weather stations at the following four locations[33] were used to ascertain average cloud, daylight hours and humidity conditions in the vicinity of the Site based on a statistical analysis of historical hourly weather reports and model reconstructions from 1 January 1980 to 31 December 2016:

- Benson;

[33] Weatherspark (no date) 'Climate and Average Weather Year Round in Bicester'. Available from: https://weatherspark.com/y/41712/Average-Weather-in-Bicester-United-Kingdom-Year-Round

- Brize Norton;
- Luton Airport; and
- Birmingham Airport.

Cloud Cover

15.4.19 The clearer part of the year generally begins at the start of April and lasts until mid October. The cloudiest month of the year is December, during which the sky is overcast or mostly cloudy 74% of the time on average.

Daylight Hours

15.4.20 The length of the day varies extremely over the course of the year. The maximum amount of daylight hours occurs on June 21st when there is 16 hours, 43 minutes of daylight. The minimum amount of daylight hours occurs on December 21st when there is 7 hours, 46 minutes of daylight.

Humidity

15.4.21 Humidity is based on the dew point, as it determines whether perspiration will evaporate from the skin, thereby cooling the body. The perceived humidity level in in the vicinity of the Site does not vary significantly over the course of the year, remaining a virtually constant 0% throughout.

GHG Emissions

National Emissions

15.4.22 According to UK greenhouse gas emissions national statistics[34], net territorial emissions in the UK of the basket of seven greenhouse gases covered by the Kyoto Protocol were estimated to be 454.8 million tonnes carbon dioxide (CO_2) equivalent ($MtCO_2e$), a decrease of 2.8% compared to the 2018 figure of 468.1 million tonnes and 43.8% lower than they were in 1990. CO_2 made up around 80% of the 2019 total.

15.4.23 The transport sector consists of emissions from road transport, railways, domestic aviation, shipping, fishing and aircraft support vehicles. It is estimated to have been responsible for around 27% of GHG emissions in the UK in 2019, almost entirely through carbon dioxide emissions. The main source of emissions from this sector is the use of petrol and diesel in road transport. Transport emissions fell by 2% between 2018 and 2019, despite an increase in road traffic. This is due to vehicle fuel efficiency and the increased uptake of hybrid and electric vehicles. Between 1990 and 2019,

[34] Department for Business, Energy & Industrial Strategy (2021) 'Final UK greenhouse gas emissions national statistics: 1990 to 2019'. Available from: https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-to-2019

there has been relatively little overall change in the level of GHG emissions from the transport sector.

Local, Regional and National Emissions Comparison

15.4.24 A summary of local, regional and national GHG emissions in 2019 in kilotonnes of carbon equivalent ($ktCO_2e/yr$) are shown in **Table 15.7**. Figures are taken from data produced by the Department for Business, Energy and Industrial Strategy in 2021[35], which was the latest data release at the time of writing. It should be noted that this data considers Oxfordshire to be located within the South East of England, rather than the English Midlands. **Figure 15.3** below illustrates the South East of England region and the approximate location of the Application Site.

Table 15.7: Local, regional and national GHG emissions in 2019

Emissions Source	Cherwell	Oxfordshire	South East of England	England
A. Industry Electricity	33.5	155.6	1,532.9	10,988.3
B. Industry Gas	62.3	124.4	912.5	10,648.5
C. Industry 'Other Fuels'	98.8	257.4	1,836.1	12,591.0
D. Large Industrial Installations	11.1	18.8	631.3	20,221.6
E. Agriculture	17.7	78.2	477.9	3,736.3
Industry Total	*223.3*	*634.5*	*5,390.7*	*58,195.8*
F. Commercial Electricity	51.7	251.9	2,423.3	15,160.6
G. Commercial Gas	34.8	158.5	1,561.5	11,089.4
H. Commercial 'Other Fuels'	1.9	6.3	51.0	273.2
Commercial Total	*88.4*	*416.6*	*4,035.8*	*26,523.2*
I. Road Transport (A roads)	214.6	760.4	6,966.8	40,273.5
J. Road Transport (Motorways)	286.1	442.4	5,382.8	24,380.5
K. Road Transport (Minor roads)	98.2	423.9	5,708.7	35,888.4
L. Diesel Railways	25.5	63.7	252.1	1,505.6
M. Transport Other	14.4	99.6	339.8	2,139.0
Transport Total	638.8	1,790.0	18,650.1	104,187.0

[35] Department for Business, Energy and Industrial Strategy (2021) 'UK local authority and regional carbon dioxide emissions national statistics: 2005 to 2019'. Available from: https://data.gov.uk/dataset/723c243d-2f1a-4d27-8b61-cdb93e5b10ff/uk-local-authority-and-regional-carbon-dioxide-emissions-national-statistics-2005-to-2019

Grand Total	**1,184.1**	**2,841.1**	**28,076.6**	**188,906.0**
Population ('000s, mid-year estimate)	150.5	691.7	9,180.1	55,287.0
Per Capita Emissions	7.9	4.1	3.1	3.4
Area (km^2)	588.7	2,605.9	19,400.1	132,929.1
Emissions per km^2 (kt)	2.0	1.1	1.4	1.4

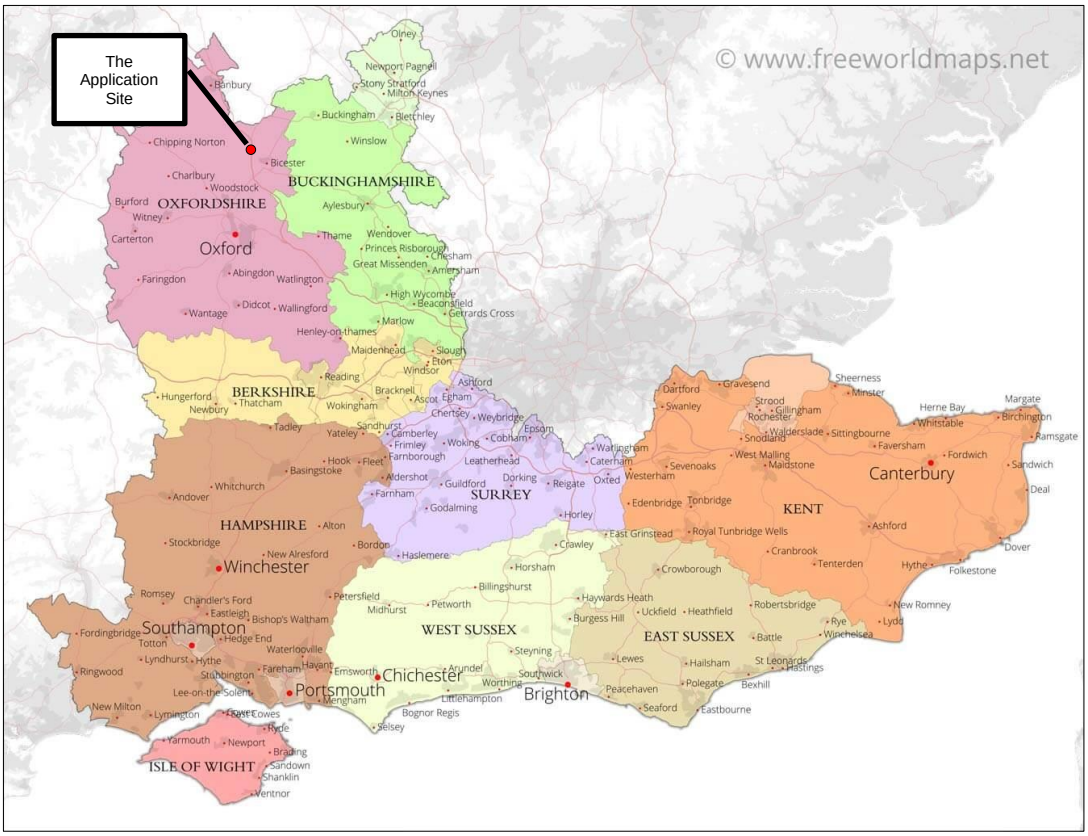

Figure 18.3: South East of England and Approximate Location of the Application Site
Source: Freeworldmaps.net

Network Emissions

Road

15.4.25 This section, and the assessment, will be completed once the transport modelling data has been produced (from the ongoing Transport Assessment process).

Rail

15.4.26 The total volume of rail freight moved in Q2 of 2021-22 was 4.28 billion net tonne kilometres, an increase of 10.0% compared with 2020-21 Q2 and 0.7% higher than Q2 of 2019-20. This signifies that the amount of freight moved has recovered to pre-

Covid19 pandemic levels. Domestic intermodal (transporting of goods to and from GB ports makes up the majority of this category) had the largest share of freight moved during Q2 of 2021-22 at 39.4%. This increased by 0.6% compared to 2020-21 Q2. Due to high levels of demand for aggregates from house building and infrastructure work, construction volumes increased by 20.5% compared with 2020-21 Q2 and by 9.2% compared with 2019-20 Q2[36].

15.4.27 The average GHG of singular fright journey is estimated to be approximately 45 metric tonnes of CO_2e, albeit will be informed by final assumptions and data regarding average train/load weights, and journey distances. The potential impact of freight on GHG emissions due to the Proposed Development will be assessed within the finalised version of this ES chapter.

Future Baseline

15.4.28 As the world warms, the UK is generally likely to have hotter, drier summers and warmer, wetter winters. Extreme weather events such as heatwaves and heavy downpours could become more frequent and more intense. Summer rain is likely to become less frequent but could be heavier. Without regular rainfall, the ground has a harder time absorbing water when it finally does come, leading to a greater risk of flash flooding.

15.4.29 The following future climatic conditions are predicted for the area in the vicinity of the Application Site based on extensive weather measurement records collected by the Met Office and reported in the UKCP18[37]. These predictions are based on a 4°C rise in global average temperatures associated with RCP 8.5, which is considered to be the worst-case global scenario with the greatest concentration of GHGs in the atmosphere.

Temperature

15.4.30 Met Office data suggests that the region within which the Application Site is located will experience hotter summers and warmer winters, with more extreme temperature events (heatwaves). If global temperatures rise by 4°C, the hottest day in summer could be approximately 41.2°C, compared to the hottest summer day of the last 30 years, which was 35.3°C. The same global temperature increase would see a rise in the warmest winter day from 18.5°C to 19.9°C. It would also see a rise in the number of 'summer days', which is defined as any day with a maximum temperature above 25°C, from 4 to 17 days.

[36] Office of National Statistics (2021) 'Freight rail usage and performance 2021-22 Quarter 2'. Available from: https://dataportal.orr.gov.uk/media/2040/freight-rail-usage-and-performance-2021-22-q2.pdf
[37] British Broadcasting Corporation (2021) 'What will climate change look like near me?'. Available from: https://www.bbc.co.uk/news/resources/idt-d6338d9f-8789-4bc2-b6d7-3691c0e7d138

Rainfall

15.4.31 If global average temperatures rise by 4°C, the average number of 'rainy days' per month during the summer would decrease to 6 from 9 days. The average number of rainy days during the winter would be approximately the same as it is now, which is 11 days. The number of days will vary from year-to-year, but rainy days in a warmer future could be wetter than today with total rainfall expected to rise.

15.4.32 A 4°C rise in global average temperatures is not expected to change the maximum amount of rainfall in one day during the summer. However, the maximum amount of rainfall in one day during the winter would likely increase from 35mm to 46mm. Summer rains may also become heavier in many places, although total rainfall is expected to decline.

Wind

15.4.33 Projections show an increase in near surface wind speeds over the UK for the second half of the 21st century for the winter season when more significant impacts of wind are experienced. This is accompanied by an increase in frequency of winter storms.

Potential Impacts on Sensitive Receptors

15.4.34 The vulnerability of the Proposed Development to climate change depends on the level of exposure of the receptors to changes in different climate variables. In the short-term, extreme weather events are not expected to deviate greatly from those discussed in the current climatic baseline earlier in this section of the chapter. However, over the long term, the climate we experience will be increasingly influenced by levels of GHG emissions and these events are likely to be more extreme.

15.4.35 The sensitivity of each receptor is determined through professional judgement and **Table 15.8** details the outcomes.

Table 15.8: Determination of the Sensitivity of Receptors

Receptor	Susceptibility	Vulnerability	Sensitivity
Substructure	Low	Low	Low
Infrastructure / Building Structures	Moderate	Moderate	Moderate
Roads	Moderate	Moderate	Moderate
Bridge	Low	Low	Low
Landscaping	Low	Moderate	Moderate
Pedestrian and Cycle Ways	Moderate	Moderate	Moderate
Rail Infrastructure	Moderate	Moderate	Moderate

GHG Emissions

15.4.36 The future baseline for GHG emissions in the future are those predicted within RCP 8.5.

15.4.37 According to the IPCC, under RCP 8.5 CO_2 concentrations – a worst case set of assumptions as described above in paragraph 18.4.29 above - in the atmosphere are predicted to be approximately 900 parts per million (ppm) by 2100 compared to approximately 380 ppm in 2005. This increase in concentrations would result in a global mean surface temperature of approximate 4°C relative to mean temperatures between 1986 – 2005[38].

15.5 ASSESSMENT OF LIKELY EFFECTS

15.6 MITIGATION AND RESIDUAL EFFECTS

15.7 CUMULATIVE EFFECTS

15.8 SUMMARY AND CONCLUSIONS

The remaining sections of this Chapter, including the results of the assessment of likely effects, will be progressed as other elements of the ES progress. A full draft will be prepared and available as part of the Stage 2 consultation process.

[38] IPCC (2021) 'Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report'. Available from: https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Citation.pdf