CHAPTER 13: CLIMATE CHANGE RESILIENCE AND MITIGATION

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13.0 CLIMATE CHANGE RESILIENCE AND MITIGATION

13.1 Introduction

13.1.1 A changing climate has the potential to fundamentally affect the world around us and the way we live. The Climate Change Act (2008) set up a framework for the UK to achieve its long-term goals of reducing greenhouse gases and develop a climate change adaption programme. The EIA Regulations seek to account for climate and require a description of 'the impact of the project on climate', and 'the vulnerability of the project to climate change' Schedule 4, paragraph 5(f).

13.1.2 The chapter considers:

- Climate change mitigation (i.e. acknowledge that all greenhouse gas emissions (GHGs) play a part cumulatively in climate change and identifying ways in which these can be reduced);
- Climate change resilience (i.e. the measures the Proposed Development will use to adapt to the manifestations of a changing climate).

13.2 Scope of Assessment

13.2.1 This chapter of the ES assesses the likely significant climatic effects of the Proposed Development in terms of climate change and is supported by **Volume 4**, **Appendix I: Climate Change.**

13.2.2 The Institute of Environmental Management and Assessment (IEMA) has developed a framework for assessing greenhouse gas emissions and climate adaptation and assessing their significance. This is outlined in **Section 13.3.**

13.2.3 To reflect this guidance this chapter is structured differently from the rest of ES Volume 2 and as a result this chapter assesses two distinct elements; the assessment of greenhouse gas (GHG) emissions expected to be generated by the Proposed Development during both construction and operation and the effect on global climate, and climate change adaptation. This assesses the effect of climate change on the Proposed Development, for example the ability of the design to adapt to the changing conditions climate change will bring about.

13.2.4 Each section outlines the assessment methodology; the baseline conditions currently existing at the Site and in the surrounding area; the likely significant environmental effects; the mitigation measures required to prevent, reduce or offset any significant adverse effects; the likely residual effects after these measures have been employed; and the cumulative effects associated with the Proposed Development in combination with other developments.

13.2.5 'Intra-project effects' which are the combined effects of individual topic impacts on a particular sensitive receptor are considered in **Volume 2 Chapter 14: Effect Interactions**.

13.3 Key Legislation, Policy and Guidance Considerations

13.3.1 The climate change assessment has been undertaken within the context of relevant planning policies, guidance documents and legislative instruments. These are summarised below.

Legislation

Climate Change Act 2008

13.3.2 The Climate Change Act 2008[1] sets up a framework for the UK to achieve its long-term goals of reducing greenhouse gas emissions by 34% over the 1990 baseline by 2020 and by 100% by 2050 (2050 Target Amendment) Order 2019 and to ensure steps are taken towards adapting to the impact of climate change. The Act introduces a system of carbon budgeting which constrains the total amount of emissions in a given time period and sets out a procedure for assessing the risks of the impact of climate change for the UK, and a requirement on the Government to develop an adaptation programme.

13.3.3 The Act introduced new powers and duties on climate change adaptation and mitigation. For adaptation it established a:

- UK-wide Climate Change Risk Assessment that must take place every five years;
- National Adaptation Programme which must be put in place and reviewed every five years to address the most pressing climate change risks;
- Government power to require 'bodies with functions of a public nature' and 'statutory undertakers' - for example, water and energy utilities - to report on how they have assessed the risks of climate change to their work, and their response.
- Adaptation Sub-Committee of the independent Committee on Climate Change (CCC) in order to oversee progress on the national programme and advise on the risk assessment; and
- Legally Binding ‘net zero’ target by 2050.

The UK Climate Change Risk Assessment 2017

13.3.4 The Government and its Adaptation Sub-Committee published the second UK Climate Change Risk Assessment (CCRA)[2] in January 2017, the five years after the first in 2012. The CCRA has drawn upon the evidence base for a range of potential impacts of climate change in a UK context.

13.3.5 In order to assess climate risks in a consistent way, and to facilitate action being focused on the most pressing risks, the Adaptation Sub-Committee took a three-step approach to assess the urgency of additional action for each climate risk and opportunity:

- Considering the magnitude of the risk now and in the future;

[1] HMSO (2008): Climate Change Act 2008 (2050 Target Amendment) Order 2019

[2] HM Government (2017): UK Climate Change Risk Assessment 2017 (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/584281/uk-climate-change-risk-assess-2017.pdf)

- Taking into account policies and adaption plans already in place to manage the risks; and
- Considering the potential benefits of further action.

13.3.6 The Adaptation Sub-Committee's full Evidence Report comprises an overarching Synthesis Report, which summarises the conclusions of eight technical chapters and highlights priority risks across different sectors where additional action is recommended in the next five years.

13.3.7 **Figure 13-1** shows the 'urgency scores' for 56 individual risks and opportunities identified in the Evidence Report.

13.3.8 Of particular relevance to the Proposed Development are those relating to 'people and the built environment', which are considered later in this chapter.

Figure 13-1: Findings of the CCRA Evidence Report

The National Planning Policy Framework

13.3.9 The NPPF 2021[3] describes ways in which the challenge of climate change can be met. It states that *"new development should be planned for in ways that:*

a) "avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure; and

b) can help to reduce greenhouse gas emissions, such as through its location, orientation and design. Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards."

13.3.10 To help increase the use and supply of renewable and low carbon energy and heat, plans should:

a) "provide a positive strategy for energy from these sources, that maximises the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts);

b) consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and

c) identify opportunities for development to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for co-locating potential heat customers and suppliers".

13.3.11 The NPPF was revised in July 2021, placing a greater impetus on sustainable development. Section 2 'Achieving Sustainable Development' paragraph 11 reads:

d) "all plans should promote a sustainable pattern of development that seeks to: meet the development needs of their area; align growth and infrastructure; improve the environment; mitigate climate change (including by making effective use of land in urban areas) and adapt to its effects".

Planning Practice Guidance

13.3.12 Planning Practice Guidance (PPG)[4] supports the NPPF. Climate change PPG states:

"In addition to supporting the delivery of appropriately sited green energy, effective spatial planning is an important part of a successful response to climate change as it can influence the emission of greenhouse gases. In doing so, local planning authorities should ensure that protecting the local environment is properly considered alongside the broader issues of protecting the global environment. Planning can also help increase resilience to climate change impact through the location, mix and design of development."

Local Planning Policy

Reading Borough Council Local Plan

[3] National Planning Policy Framework, July 2021

[4] Ministry of Housing, Communities & Local Government, Climate Change Planning Practice Guidance, https://www.gov.uk/guidance/climate-change, site accessed 10 September 2018

13.3.13 The Reading Borough Council (RBC) Local Plan[5] contains the following objective policies:

13.3.14 Policy CC2 Sustainable Design and Construction:

"Proposals for new development, including the construction of new buildings and the redevelopment and refurbishment of existing building stock, will be acceptable where the design of buildings and site layouts use energy, water, minerals, materials and other natural resources appropriately, efficiently and with care and take account of the effects of climate change:

- *All major non-residential developments or conversions to residential are required to meet the most up-to-date BREEAM 'Excellent' standards, where possible"*

13.3.15 Policy CC3 Adaptation to Climate Change:

"All developments will demonstrate how they have been designed to incorporate measures to adapt to climate change. The following measures shall be incorporated into development:

- *Wherever possible, new buildings shall be orientated to maximise the opportunities for both natural heating and ventilation and reducing exposure to wind and other elements;*
- *Proposals involving both new and existing buildings shall demonstrate how they have been designed to maximise resistance and resilience to climate change for example by including measures such as solar shading, thermal mass, heating and ventilation of the building and appropriately coloured materials in areas exposed to direct sunlight, green and brown roofs, green walls, etc;*
- *Use of trees and other planting, where appropriate as part of a landscape scheme, to provide shading of amenity areas, buildings and streets and to help to connect habitat, designed with native plants that are carefully selected, managed and adaptable to meet the predicted changed climatic conditions; and*
- *All development shall minimise the impact of surface water runoff from the development in the design of the drainage system, and where possible incorporate mitigation and resilience measures for any increases in river flooding levels as a result of climate change."*

13.3.16 Policy CC4 Decentralised Energy:

"Any development of more than 20 dwellings and/ or non-residential development of over 1,000 sq m shall consider the inclusion of decentralised energy provision, within the site, unless it can be demonstrated that the scheme is not suitable, feasible or viable for this form of energy provision.

Where there is existing decentralised energy provision present within the vicinity of an application site, further developments of 10 dwellings or more or non-residential development of 1,000 sq m or more will be expected to link into the existing decentralised energy network or demonstrate why this is not feasible."

[5] Reading Borough Council (2019) Local Plan

13.3.17 Policy CC5 Waste Minimisation and Storage:

"Development should demonstrate measures to minimise the generation of waste in the construction, use and life of buildings and promote more sustainable approaches to waste management, including the reuse and recycling of construction waste and the promotion of layouts and designs that provide adequate, well-designed space to facilitate waste storage, reuse, recycling and composting".

13.3.18 Policy EN14 Trees, Hedges and Woodlands

"New development shall make provision for tree retention and planting within the application site, particularly on the street frontage, or off-site in appropriate situations, to improve the level of tree coverage within the Borough, to maintain and enhance the character and appearance of the area in which a site is located, to provide for biodiversity and to contribute to measures to reduce carbon and adapt to climate change. Measures must be in place to ensure that these trees are adequately maintained."

13.3.19 Policy EN15 Air Quality

"Development should have regard to the need to improve air quality and reduce the effects of poor air quality."

13.3.20 Policy EN16 Pollution and Water Resources

"Development will only be permitted where it would not be damaging to the environment and sensitive receptors through land, noise or light pollution; where it would result in no deterioration in, or ideally enhance, ground and surface water quality; and where adequate water resources, sewerage and wastewater treatment infrastructure will be in place to support the proposed development prior to occupation."

13.3.21 Policy EN18 Flooding and Sustainable Drainage Systems

"Development will be directed to areas at lowest risk of flooding in the first instance, following the Sequential and Exceptions Test set out in the NPPF, and taking into account the effects of climate change. It will consider flooding from all sources, including fluvial, surface water, groundwater and sewer flooding. Where development in areas at risk of flooding is necessary, it will not reduce the capacity of the flood plain to store floodwater, impede the flow of floodwater or in any way increase the risks to life and property arising from flooding. Wherever possible, development should be designed to reduce flood risk, both on and off-site."

13.3.22 Policy H5 Standards for New Housing

"*New build housing should be built to the following standards, unless it can be clearly demonstrated that this would render a development unviable:*

- *All new build housing will be built to the higher water efficiency standard under Regulation 36(3) of the Building Regulations*
- *All major new-build residential development should be designed to achieve zero carbon homes*

- *All other new build housing will achieve at a minimum a 19% improvement in the dwelling emission rate over the target emission rate, as defined in the 2013 Building Regulations."*

13.3.23 Policy TR1 Achieving the Transport Strategy

"Planning permission will not be granted for major development proposals unless there is a commitment to implement measures to promote and improve sustainable transport facilities, such as through provision to encourage walking, cycling and the use of public transport; and through agreed travel plans, safe routes to local facilities and services, including schools and parks, and similar measures.

All development proposals should make appropriate provision for works and contributions to ensure an adequate level of accessibility and safety by all modes of transport from all parts of a development, particularly by public transport, walking and cycling, in accordance with any agreed transport assessment submitted as part of the application."

13.3.24 Policy TR4 Cycle Routes and Facilities

"Developments will be expected to make full use of opportunities to improve access for cyclists to, from and within the development and to integrate cycling through the provision of new facilities. Development of new facilities for cycling, such as cycle hire points and cycle parking, will be acceptable."

13.3.25 Policy TR5 Car and Cycle Parking and Electric Vehicle Charging

"Development should provide car parking and cycle parking that is appropriate to the accessibility of locations within the Borough to sustainable transport facilities, particularly public transport.

Development should make the following provision for electric vehicle charging points:

- *All new houses with dedicated off-street parking should provide charging points;*
- *Within communal car parks for residential or non-residential developments of at least 10 spaces, 10% of spaces should provide an active charging point."*

Reading Borough Council Climate Change Strategy

13.3.26 The RBC Climate Change Strategy[6] sets out a framework for achieving Reading's vision to make low carbon living the norm by 2050. The two broad objectives that they are seeking to address are to *"Develop a low carbon Reading"* and *"Prepare for a changing climate".*

13.3.27 The RBC Climate Strategy contains the following strategic priorities that the Council is aiming to achieve:

13.3.28 Energy Supply:

- *"Reduce electricity consumption within the commercial and public sectors (T1SP1);*

[6] Reading's Climate Change Strategy 2013 – 2020 (2013) Reading Climate Change Partnership

- *Introduce smart meters and energy storage solutions in Reading (T1SP2);*
- *Develop heat supply networks to deliver low carbon heat in Reading (T1SP3);*
- *Increase the amount of energy generated locally using renewable technologies (T1SP4)."*

13.3.29 Low Carbon Development:

- *"Buildings in Reading to be built to high standards of energy efficiency incorporating on-site renewable energy where possible (T2SP1);*
- *Minimise the 'embodied carbon' incorporated in construction projects (T2SP5)".*

13.3.30 Transport:

- *"Reduce energy use and 'embodied energy' in transport infrastructure (T5SP2);*
- *Manage transport infrastructure and services to prepare for climate change (T5SP3);*
- *Encourage non-car travel for all sectors of the population, through targeted advice, incentives and enforcement (T5SP4);*
- *Reduce the air pollution from vehicles (T5SP5)".*

13.3.31 Purchasing, Supply and Consumption:

- *"Reduce waste by supporting the re-use and repair of products and materials (T6SP5)*
- *Increase recycling rates (T6SP6)".*

Reading Borough Council's Climate Emergency Declaration

13.3.32 RBC declared a climate emergency on 26th February 2019 with the aim of ensuring Reading is carbon neutral by 2030. The Declaration highlights the strategies and actions the Council will take going forward:

- Launching the new Climate Change Strategy in April 2020 replacing the original Climate Strategy "Reading Means Business on Climate Change";
- The zero carbon and BREEAM 'Excellent' standard requirements within the new Local Plan;
- The Carbon Plan 2020-2025;
- Reading Climate Emergency Strategy 2020-2025;
- The Reading Community Energy Society; and
- The Council's sustainable transport programmes.

Other Relevant Policy, Standards and Guidance

The Fifth Carbon Budget

13.3.33 This document, produced by the Committee on Climate Change (CCC), reports on UK carbon budgets by sector, and reductions that need to be achieved for the UK to meet its target of 100% by 2050. It includes historical and projected GHG emissions and reports how the UK's power network is expected to be decarbonised.

UK Greenhouse Gas Statistics

13.3.34 The Department for Business, Energy and Industrial Strategy (formerly the Department of Energy and Climate Change) reports on energy and emissions projections by source, and reports on GHG emissions from a geographical perspective[7]. This allows a review of trends over the period 2005-2015 for a particular Local Authority to be undertaken.

13.3.35 They have also published conversion factors for GHG reporting[8].

WebTAG Data Book

13.3.36 The Department for Transport produces transport analysis guidance (TAG)[9] (Ref. 16.8) on how the UK's modal mix (diesel, petrol, electric) will change over time, as well as carbon dioxide emissions for different transportation modes (and projections for future efficiency).

One Click LCA Software

13.3.37 One Click LCA (Life cycle assessment) Software developed by Bionova Ltd[10] has been used to calculate the environmental impacts, in the form of tonnes of carbon dioxide equivalent (tonnes CO_2e) from the embodied carbon in the construction of the Proposed Development. Life Cycle Assessment is a scientific methodology used to calculate the environmental impacts, including carbon footprint, of a product, service, or process. It is possible to calculate the LCA of a building to find out how it will affect the environment through its whole existence, from extraction of raw materials to construction phase, use, and finally demolition and disposal[11].

Technical Standards and Guidance

IEMA Environmental Impact Assessment Guide to Climate Change Resilience and Adaption

13.3.38 The Institute of Environmental Management & Assessment (IEMA) has developed a framework for considering climate change resilience and adaption within the EIA process in line with the 2014 European Union Directive[12]. The guide is designed to ensure that both climate change resilience and adaption is incorporated in any future developments in the UK.

13.3.39 This guide was updated in June 2020 and is considered further in **Section 13.10.**

[7] Department for Business, Energy & Industrial Strategy (2017): UK local authority and regional carbon dioxide emissions national statistics: 2005-2015 (https://www.gov.uk/government/collections/uk-local-authority-and-regional-carbon-dioxide-emissions-national-statistics)

[8] Department for Business, Energy & Industrial Strategy (2017): Greenhouse gas reporting: conversion factors 2017

[9] Department for Transport (2017): WebTAG Transport Analysis Guidance data book, December 2017

[10] One Click LCA, Bionova Ltd 2018.

[11] One Click LCA, 10 essential facts about building life cycle assessment, site accessed 27/03/2020

[12] IEMA (2020) Environmental Impact Assessment Guide to Climate Change Resilience and Adaption

IEMA Environmental Impact Assessment Guide to: Assessing Greenhouse Gas Emissions and Evaluating their Significance

13.3.40 The approach to assessing the potential impact of the Proposed Development on climate change will follow the Institute of Environmental Management and Assessment (IEMA) guidance 'Assessing Greenhouse Gas Emissions and Evaluating Their Significance' (2017)[13]. This guidance describes how a proportionate assessment of a development's potential impact on climate can be achieved and how to communicate the results in terms of a notional percentage contribution relative to a carbon budget, accounting for achievable mitigation.

13.4 Consultation

13.4.1 A Scoping Report **(Volume 4, Appendix A1)** was submitted to Reading Council on the 11th February 2020 with a formal request for an EIA Scoping Opinion in accordance with Regulation 15 of the EIA Regulations. As part of this process, the key statutory and non-statutory consultees were consulted to review the proposed methodology and criteria for assessment. The Council subsequently issued its Scoping Opinion on the 15th April 2020 commenting on the proposed scope and methodology of the topics for assessment within the EIA. A copy of the Scoping Opinion is provided in **Volume 4**, **Appendix A2**.

13.4.2 The climate change assessment was undertaken in accordance with the EIA Scoping Report and with regard to comments received by Reading Council in its Scoping Opinion for air quality. A summary of the key points raised in the Scoping Opinion relevant to climate change are presented in **Table 13-1,** including a response as to where the comments have been addressed within this chapter.

Table 13-1 Reading Council Scoping Opinion Comments and Response

Scoping Opinion Topic /Section	Summary of Comment	Location within the ES where comments are addressed
Climate Change	The loss of the mature trees found on the Site should be addressed.	Scoping comment addressed in **Section 13.8.**

13.4.3 The outline Energy and Sustainability Report for the Proposed Development was completed in May 2020.

13.4.4 Following objections to the previous application for the scheme, including comments associated with the carbon and climate change scope and the publication of the Reading Climate Emergency Strategy 2020-25, it is proposed that the revised scheme will comprise the following amendments:

- U-values – enhanced U values for the roofs and windows on the proposed dwellings;
- PV Provision – It is proposed for roof mounted PV arrays to be provided to each of the homes - with an equivalent area of 40% of the ground floor area of each home.

[13] IEMA (2017) Environmental Impact Assessment Guide to: Assessing Greenhouse Gas Emissions and Evaluating their Significance

- The updated strategy will result in an 85% reduction in CO_2 emissions over a Part L compliance baseline for the proposed homes, with a net 60 tCO2 per annum liable for an offset payment to comply with Reading Policy H5.

13.4.5 Further information can be found in the Energy and Sustainability Report, which is being submitted as a standalone document to support the planning application.

13.5 Assessment Methodology – Climate Change Mitigation

13.5.1 The methodology applied to the climate change mitigation assessment follows the IEMA guidance[13]. The significance criteria used for this assessment was determined using expert judgement.

13.5.2 The goal and scope of undertaking this assessment is to:

- Identify the existing sources of GHG currently at the site, and consider how these may change under a 'do-minimum' scenario;
- Identify the likely sources of GHG emissions arising from the construction, operation and decommissioning of the proposed development, and quantify them as far as practical; and
- Consider measures in which different alternatives (such as development type, construction methodology, operating mechanisms, and end of life uses) can demonstrably reduce GHGs.

Determination of Baseline

13.5.3 The baseline GHG emissions will be calculated from existing activities at the Site using the same GHG quantification methodology as defined in the 'Methodology for Assessment' section below.

13.5.4 Considering known trends and policy support for reducing GHG emissions, it is considered that in the case of a 'do nothing' scenario at an already developed site, there would be reductions in emissions over the next 20 years or so resulting from aspects such as electric vehicles replacing petrol/diesel, smart technology helping to reduce demand, and decarbonising the National Grid.

Methodology for Assessment

13.5.5 This assessment adopts a project lifecycle approach to identify 'hot spots' of GHG emissions (i.e. the lifecycle stage(s) and emission sources likely to generate the largest amount of GHG emissions – see **Table 13-2**), and correspondingly enables priority areas for mitigation to be identified. This approach is consistent with the principles set out in IEMA guidance, as stated in **Section 13.3**.

13.5.6 Where data was available, GHG emissions arising from transport have been quantified using a calculation-based methodology as per the following equation as stated in the DEFRA 2017 emissions factor guidance.[14]

[14] DEFRA (2017): Emissions Factors Web Link: https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2019

Activity data x GHG emissions factor = GHG emissions value

13.5.7 Key data to calculate emissions include:

- Waste produced from enabling works and construction activities;
- Embodied emissions within construction materials;
- Transport of construction materials;
- Number of construction workers predicted and an assumed daily travel commute distance;
- Regulated and unregulated operational emissions;
- Fuel used by the plant and machinery predicted for the construction activities; and
- Reuse and disposal of materials.

13.5.8 The key anticipated sources of GHG emissions by lifecycle are outlined in **Table 13-2.**

Table 13-2 Key Anticipated GHG Emissions Sources and Sinks

Lifecycle Stage	Activity	Primary GHG emission sources/sinks
Pre – construction stage	• Enabling and remediation works.	• Construction materials. • Vehicles travelling from and to the Site. • Fuel use for generators on Site. • Tree planting (sink).
Product stage	• Raw material extraction and manufacturing of products required to build the Proposed Development. • Transport of materials. • Selection of trees for planting.	• Embodied carbon in construction materials. • Vehicle use. • Tree planting (sink).
Construction process stage	• On-site and off-site construction activity. • Transport of construction materials and construction workers. • Vehicle movements on-site. • Disposal and transport of waste generated. • Loss and replanting of trees	• Plant and vehicle use. • Disposal and transport of CDM waste. • Tree loss (removal of sink) and waste generation from vegetation • Tree planting (sink).
Operation stage	• Building energy consumption. • Maintenance. • Vehicle trips. • Landscaping management	• Transport of building users. • Maintenance equipment. • Replacement materials. • Tree growth and maturation (sink).
Decommissioning	• Removal and or renewal of the Proposed Development.	• Reuse and or disposal of materials.

Study Boundaries

13.5.9 The geographical scope includes the red-line boundary of the Proposed Development. However, some of the GHG emissions associated with the Proposed Development occur beyond the boundary of the Site, for example embodied GHG emissions from materials used and GHG emissions from transport of materials and people associated with the Site.

13.5.10 The impact from GHG emissions is a national and global issue, therefore the potential impact of the associated GHG emissions of the Proposed Development will be assessed by comparing these against the UK's carbon budgets.

Significance Criteria

13.5.11 As stated in the IEMA Guidance[13] *"GHG emissions have a combined environmental effect that is approaching a scientifically defined environmental limit, as such any GHG emissions or reductions from a project might be considered to be significant*". It goes on to explain that there is no single preferred method to evaluate significance, but the greater the project's carbon budget (i.e. magnitude of change), the greater its significance. Unlike other EIA topics, sensitivity is only considered for a single receptor (i.e. the whole planet), and therefore it is the magnitude that drives significance. It is therefore practical to base the assessment on professional judgement, and in a qualitative and comparative manner.

13.5.12 Therefore, the following are descriptions of different levels of effect assessed (all compared to the baseline GHG emissions):

- Major beneficial – A substantial reduction of GHG emissions;
- Moderate beneficial – A notable reduction of GHG emissions;
- Minor beneficial – A slight reduction of GHG emissions;
- Negligible – An imperceptible change in GHG emissions;
- Minor adverse – A slight increase of GHG emissions;
- Moderate adverse – A notable increase in GHG emissions; and
- Major adverse – A substantial increase in GHG emissions

13.5.13 To assess the impact of the emissions from the Proposed Development, the relevant UK carbon budget has been used. The UK carbon budgets are in place to restrict the amount of GHG emissions the UK can legally emit in a five-year period.

13.5.14 The appropriate UK national carbon budget during the construction programme of the Proposed Development is the 3rd carbon budget for 2018-2022, and the 4th carbon budget (2023-2027).

13.5.15 The operational phase of the Proposed Development will be compared to all of the available carbon budgets within the design life of the development. These include the 3rd carbon budget for 2018-2022, the 4th carbon budget for 2023-2027, and the 5th carbon budget for 2028-2032.

13.5.16 **Table 13-3** shows the current and future UK carbon budgets up to 2032, which highlights a decline in the amount of GHG emissions that the UK can legally emit going into the

future. This means that any source of emissions contributing to the UK's carbon inventory is going to have an increased impact on the UK carbon budgets in the future.

Table 13-3 Relevant Carbon Budgets for the Assessment

Carbon budget	Total budget ($MtCO_2e$)
3rd (2018-2022)	2,544
4th (2023-2027)	1,950
5th (2028-2032)	1,725

Assumptions and Limitations

13.5.17 The carbon sequestration capabilities of trees are influenced by a range parameters including the density, volume and moisture content of the hard wood, all of which vary depending on factors such as the tree species, age and size. This leads to the variation seen across the available research and data. The trees due to be planted will be done so at the earliest stage feasible in order to bring them to maturity and effectiveness as swiftly as possible. Though there may be less carbon sequestration than originally stated, there are still many uncertainties involved but this will not change the category of effect.

13.5.18 The regulated energy CO2 emission values have been taken from the Energy and Sustainability Report submitted in support of the planning application.

13.5.19 The CO_2 emissions calculation has been based on data obtained that is specific to the project, such as the site location, construction activities, material quantities and types, operational energy etc. Where particular information was not able to be specified at this stage, assumptions and omissions have been clearly stated. For construction materials, generic materials have been used in the assessment in the absence of EPDs and specific details of the materials.

13.5.20 The Defra Emissions Factor Toolkit[15] adopted for the construction and operational traffic assessment utilises the total number of vehicle movements, with assumptions being made with respect to size and assuming a standard fuel type. It has also been assumed a 50 km total round trip for both deliveries of construction materials and that there would be transport of waste away from the Site.

13.6 Climate Change Mitigation – Baseline Assessment

13.6.1 In order to understand trends in GHG emissions within RBC, a review of emissions from common sources (transport, domestic and industrial/commercial) in recent years has been carried out. Data has been taken from the UK Local Authority and regional carbon dioxide emissions national statistics[16]. **Table 13.4** shows the carbon dioxide emissions per capita within the RBC between 2005 and 2017, showing a decreasing trend over time.

[15] Defra Emissions Factor Toolkit https://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html

[16] UK Local Authority and regional carbon dioxide emissions national statistics: 2005 to 2018

Table 13-4: GHG emissions within Reading

Year	Industry and Commercial Total	Domestic Total	Transport Total	Grand Total	Population ('000s, mid-year estimate)	Per Capita Emissions (t)
2005	493.9	344.3	158.1	994.5	146.9	6.8
2006	486.7	336.5	151.4	972.4	148.3	6.6
2007	447.9	330.6	152.9	929.2	149.7	6.2
2008	460.7	331.7	147.5	937.6	151.5	6.2
2009	393.2	294.7	143.9	829.5	152.3	5.4
2010	396.8	310.6	140.7	845.6	154.3	5.5
2011	331.7	275.4	139.4	744.0	155.3	4.8
2012	363.3	300.5	137.4	798.5	156.8	5.1
2013	341.7	292.4	135.4	766.6	158.6	4.8
2014	290.6	247.6	135.4	670.7	160.3	4.2
2015	260.3	237.0	137.9	632.2	161.7	3.9
2016	226.5	225.5	138.5	587.5	162.7	3.6
2017	207.6	208.2	137.0	549.7	163.1	3.4
2018	200.2	207.9	131.0	535.8	163.2	3.3

13.6.2 When considering carbon dioxide emissions reductions alongside population growth, it can be concluded that there is a pattern of per capita emissions reduction and therefore it is expected that this trend will continue.

Site Emissions

13.6.3 The baseline conditions at the Site prior to the construction of the Proposed Development are described in detail in **Volume 2, Chapter 2: The Site**. The Site is current vacant as the Golf Club has recently been relocated. Therefore, for the purposes of the assessment a zero emissions baseline is assumed. The Site includes many trees that absorb carbon

dioxide during the daytime, and whilst this would have a small effect to provide a conservative assessment the net emissions from the Site are considered to be negligible.

13.6.4 The ES considers a range of 'reasonable alternatives' (**Volume 2, Chapter 4: Design Evolution and Alternatives Considered**) in terms of a do-nothing scenario and different layouts and uses. It is considered that the location and specification of the Proposed Development is sustainable, for reasons set out in the supporting Energy and Sustainability Report.

Future Baseline

13.6.5 Considering known trends and policy support for reducing GHG emissions, it is considered that in the case of a 'do-minimum' scenario at an already developed site, there would be reductions in emissions over the next 20 years resulting from aspects such as electric vehicles replacing petrol/diesel, smart technology helping to reduce demand, and decarbonising the National Grid.

13.6.6 However as the Site is no longer operating as a golf club any emission would be considered to be zero, while the vegetation on the Site would continue to absorb carbon to a similar extent.

13.7 Climate Change Mitigation - Identification and Description of Changes Likely to Generate Effect

Construction Phase Emissions

13.7.1 GHG emissions can arise through embodied carbon within the fabric of building materials, the transportation of materials and staff to and from the Site, and the running of the construction plant and facilities.

13.7.2 Soil disturbance during the construction phase will result in GHG emissions, however, within the wider context of the project emissions, they are not expected to be material. Based on professional judgement, the value will be less than 5% of the total emissions of the project, so in accordance with the IEMA guidance (2017) cut off rules, they have been excluded from this assessment as they will not significantly change the quantification of construction phase emissions.

13.7.3 Carbon dioxide equivalent (CO_2e) is a term describing greenhouse gases in a common unit. For any quantity and type of greenhouse gas CO_2e signifies the amount of CO_2 which would have the equivalent global warming impact.

Operational Phase Emissions

13.7.4 During the operational life of the Proposed Development there is a large potential for GHG emissions to arise from:

- Energy use associated with uses regulated under Part L of the Building Regulations 2013 (with 2016 amendments) (i.e. lighting, hot water, pumps/fans, space heating, cooling);
- Energy use associated with direct unregulated usage that is not covered by the Building Regulations (i.e. cooking, appliances and communal lighting);

- Indirect emissions through the use of different transport modes; and
- Indirect emissions through the provision of servicing, and waste disposal.

13.8 Assessment of Likely Significant Effect

Construction Phase (Emissions)

Construction Materials

Embedded Mitigation Measures

13.8.1 Due to the outline nature of the Proposed Development, there is limited detail available at this stage to fully define the GHG measures proposed. However, further potential mitigation is set out below that will be considered in due course.

Additional Mitigation Measures

13.8.2 Given the nature of the application, there are reasonable opportunities to review the materials prior to construction to identify opportunities for replacing a material with one with a lower embedded carbon (for instance sourcing only recycled metals and using cement with a higher fly ash content), or less material overall (such as thinner slabs, frames and piles).

13.8.3 However, care must be taken to:

- Consider the need to adapt to climate change (see later in this chapter);
- Balance this with the opportunities to minimise carbon emissions associated with the operation; and
- Consider the circular economy, with respect to safeguarding opportunities for the reuse or better recycling of a building material or component.

13.8.4 Although it is not clear how effective this mitigation would be at this stage, there will be opportunities to reduce the embodied carbon, and these could be considered at an appropriate design stage.

13.8.5 Furthermore, as part of the asset management procedures, when certain building components reach the end of their useful life, consideration should be given to the embodied carbon of the replacement components.

Tree Planting and Removal

Embedded Mitigation Measures

13.8.6 The evolution of the design attempted to reduce the number of trees that need to be removed and identified an adjacent area that is proposed for compensatory tree planting.

13.8.7 The Proposed Development will be removing 112 mostly mature trees from around the Site but will be replacing these on a 1:1.75 ratio and will therefore be replanting 196 new trees on the Site, as stated in **Chapter 5: Proposed Development and Construction Overview** and the **Arboriculture Report** submitted with this Application. The replacement of mature trees with younger specimens is likely to marginally reduce the carbon

sequestration from photosynthetic processes, as well as produce substantial quantities of wood and other vegetation (for which the end uses are not yet known), leading to a shorter-term increase in carbon emissions during this stage.

13.8.8 Although younger trees sequester less carbon than mature trees, they will be planted as early as reasonably practical and will continue absorbing carbon over their lifetime, absorbing more than would have been the case with only those 112 trees lost.

13.8.9 It is proposed that 196 new trees will be planted on Site as part of the Proposed Development, increasing the number of trees from the baseline. Further information can be found in the **Arboriculture Report / DAS** submitted in support of the Application.

Additional Mitigation Measures

13.8.10 In addition, the Applicant is committing to planting approximately 1,000 new native trees at Cucumber Wood to the north of the Site early in the programme, to help to offset this and lead to a longer-term net reduction in carbon from trees. Cucumber Wood has been chosen through consultation with relevant stakeholders. Furthermore, there is insufficient space at the Site to provide this level of planting.

13.8.11 The Applicant will be required to follow Local Plan Policy EN14, which requires measures to be in place to ensure trees are adequately maintained.

Anticipated Effects

13.8.12 The embodied carbon associated with the building materials for the Proposed Development was quantified using estimated quantities of specific materials (e.g. reinforced concrete) and applying this information to the carbon LCA tool.

13.8.13 The total embodied carbon in the building's materials is approximately 4,451 tonnes of carbon dioxide equivalent (TCO_2e).

13.8.14 A detailed balance of carbon from trees is not practical as there are many being affected (removed and introduced). However, whilst there are likely to be **minor adverse** effects in the shorter term, Woodland Trust guidance states that a young wood with mixed native species can lock up 400+ tonnes of carbon per hectare of land[17]. Given that the direct replacement trees and increase of trees on site from the baseline, as well as the 1,000 further trees roughly equates to one hectare of land, we can assume that the Proposed Development will offset approximately 400 tonnes of carbon, which will be a **minor beneficial** effect in the longer term.

13.8.15 The removal of the mature trees is likely to lead to a potential emission, either from carbon or potentially methane as they decompose. At this stage is it not technically feasible to confirm what will become of them, although it potentially could involve being repurposed for other timber-based uses or used in habitat creation. It is also possible that they could be burnt to generate energy. It can be confirmed that they will not be allowed to be burnt on-site or without proper consideration of them as a valuable resource.

Construction Traffic

[17] Woodland trust – How trees fight climate change (woodlandtrust.org.uk/trees-woods-and-wildlife/British-trees/how-trees-fight-climate-change/) website accessed on 25/05/2020.

Embedded Mitigation Measures

13.8.16 Careful management of construction traffic emissions could reduce the effects, as could sourcing products from local businesses to reduce transportation distances. Workers will be strongly encouraged to use active/public transport and appropriate measures will be set out in a **Construction Traffic Management Plan**.

Anticipated Effects

13.8.17 The total carbon emissions associated with transporting the materials to and from the site was calculated by using the latest version of the Defra Emissions Factor Toolkit[15] (v.10.1). This toolkit allows to calculate emissions up to 2030. The calculations are provided in **Volume 4, Appendix I**.

13.8.18 The quantity emitted will correlate with the construction traffic profile, with more being produced during peaks in construction activity. Overall, approximately 2.45 TCO_2e would be produced, which is considered **minor adverse** at a local level and **negligible** at a higher spatial level.

Construction Plant

Embedded Mitigation Measures

13.8.19 At this stage of the planning process, there is little detailed information with regards to specific plant and site office requirements. Until such a point where a construction contractor has been appointed this is not something that can be meaningfully estimated.

Anticipated Effects

13.8.20 Site enabling, demolition, excavation and construction activities require a substantial amount of fuel/energy to run the machinery and plant. The activities are expected to include excavation and piling, substructure and superstructure construction, internal fit out and external landscaping. The plant used is likely to include piling rigs, excavators, diggers, concrete pumps, generators, etc. In addition to that list, there is also other direct energy usage through site offices and welfare facilities, lighting, security equipment, etc, all of which use energy.

13.8.21 Over the course of the programme, a substantial amount of carbon would be generated, which could be **minor adverse** in a local context.

Operational Phase (Emissions)

Regulated Uses

Embedded Mitigation Measures

13.8.22 The mitigation is outlined in the Proposed Development's Energy and Sustainability Report which follows the same energy hierarchy set out in the London Plan, which is considered best practice, with the aim of promoting an energy efficient and low carbon approach which minimises carbon usage now and in the future. The energy hierarchy aims to: 1 Be Lean: use less energy, 2 Be Clean: supply energy efficiently and 3 Be Green: use renewable energy.

13.8.23 The 'Be Lean' approach will be utilised by ensuring highly efficient building fabrics, mechanical ventilation with heat recovery, maximisation of daylighting and consequently passive solar heating and energy requirements. The 'Be Clean' approach will incorporate measures such as the use of air source heat pumps (ASHPs) in order to meet the thermal energy loads of the houses and apartments. ASHPs are considered to be the most appropriate form of renewable energy technology for the Proposed Development and will be installed on site, complying with Policy E12 of the Reading Climate Emergency Strategy 2020-2025.

13.8.24 The 'Be Green' approach has been implemented in the form of Low or Zero Carbon technology. It is proposed for roof mounted photovoltaic (PV) installations to be provided to each of the homes, with an equivalent area of 40% of the ground floor area of each home. Further information can be found in the Energy and Sustainability Report.

13.8.25 It is proposed for the dwelling U values to be as set out in **Table 13.5** below, this includes enhancement to the proposed U value for the roofs and windows on the proposed dwellings.

Table 13-5: Proposed U Values of Design Elements for the Proposed Development

Design Element	Proposed U Value
External Walls	0.18W/m^{2}K
Floor	0.13W/m^{2}K
Roof	0.11W/m^{2}K
Windows	1.2W/m^{2}K
Doors	1.0W/m^{2}K
Air Permeability	3.0W/m^{2}K

13.8.26 These proposed updates to U values and the provision of roof mounted PV arrays to the homes align with the strategy for the scheme with the UK government roadmap to decarbonising homes set out in the Future Homes Standard, and RBC's aspirations to maximise the reduction in GHG emissions achievable on site.

13.8.27 The combination of Be Lean, Be Clean and Be Green measures results in a CO_2 emissions **reduction of 85%** over a Part L compliance baseline, exceeding the mandatory 35%. The anticipated regulated CO_2 emissions for domestic buildings is 60 TCO_2 per annum. This represents a total CO_2 emissions reduction of 338 TCO_2 per annum from the Part L baseline. This meets the requirements of RBC Local Plan.

13.8.28 A net of 60 TCO_2e per annum will also be liable for an offset payment of £108,750 to comply with RBC Local Plan Policy H5.

13.8.29 It should also be noted that, over time, electricity from the National Grid will become further decarbonised as more becomes generated from non-fossil fuel sources.

Anticipated Effects

13.8.30 The Proposed Development must meet carbon emission limits specified in Part L of the Building Regulations 2013 (with 2016 amendments). This has been calculated for the Proposed Development through the Energy and Sustainability Report submitted in support of the Application.

13.8.31 If the Proposed Development was designed to be compliant with the Part L 2013 of the Buildings Regulations (with 2016 amendments), with the above mitigation measures implemented, the carbon emissions associated with regulated uses would be 60 TCO_2e per year.

13.8.32 In the context of the Government's target to reduce CO_2 emissions by at least 100% of 1990 levels by 2050, this would represent a **negligible to minor adverse** effect, which is (borderline) **significant.**

Unregulated Uses

Embedded Mitigation Measures

13.8.33 No details on how reduction of these emissions would be achieved are available at this stage. However, they could include using white goods with good energy ratings.

13.8.34 As described above, grid electricity will continue becoming decarbonised over the lifespan of the Proposed Development, reducing the CO_2 emissions from its operation.

Anticipated Effects

13.8.35 Unregulated energy includes small power electricity use (computers, plug in devices) and catering energy consumption. Currently, unregulated energy is not included within the Part L assessments due to the difficulty in accurately predicting the likely consumption. Whilst it is considered that unregulated energy could form a significant part of overall energy consumption and CO_2 emissions it is considered **negligible** in the context of the Proposed Development as a whole.

Operational Traffic

Embedded Mitigation Measures

13.8.36 The Transport Assessment for the Proposed Development has embedded mitigation measures in place such as providing a 3 m wide cycleway for access to local facilities and also the encouragement of walking and cycling within the Site itself. A Residential Travel Plan will be implemented.

Anticipated Effects

13.8.37 The breakdown of trips generated by the Proposed Development, including the different modes is provided in **Volume 4, Appendix I**.

13.8.38 In total, the operational emissions arising from transport are considered to be approximately 313.52 TCO_2 for the total 100-tear lifespan of the Proposed Development. This is considered to be **minor adverse** (and not significant), although reductions could still be achieved as described above.

Other Emissions

Embedded Mitigation Measures

13.8.39 With respect to operational waste management, the Proposed Development will be designed to allow for appropriate levels of waste storage to separate waste streams from the various proposed uses, enable recycling and less frequent collections (when circumstances allow). This would facilitate improved waste management to move towards policy targets and reduce associated GHG emissions to overall **negligible** levels (not significant).

Anticipated Effects

13.8.40 Other operational phase emissions are expected to arise from servicing vehicles (considered as part of the operational traffic), the disposal, recycling and re-use of waste, the indirect emissions associated with street lighting and other infrastructure (including water and wastewater).

End of Life Phase Emissions

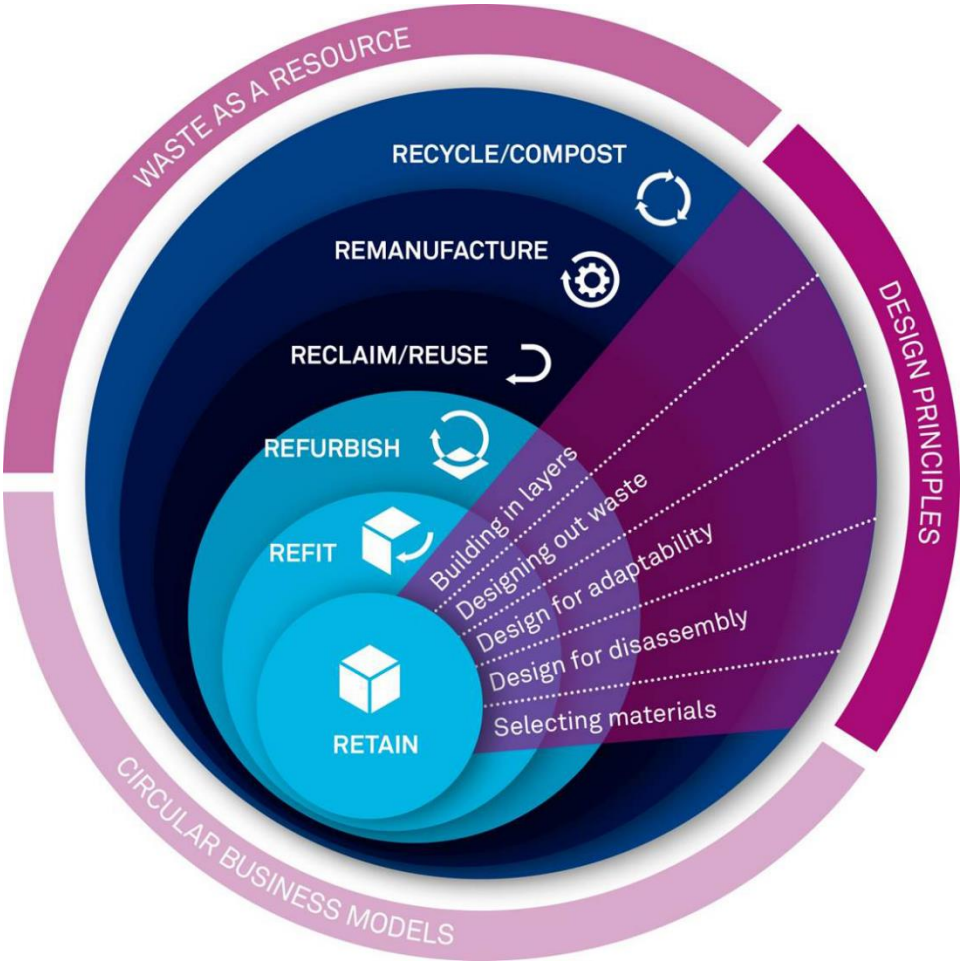
Additional Mitigation Measures

13.8.41 No mitigation measures can be confirmed at this stage. Based upon current best practice, the mitigation principles set out above (relating to the construction and operation phases) will be followed to reduce emissions. However, at this point in the future there are likely to be very different circumstances, such as the availability of new low carbon building materials and better energy efficiency.

13.8.42 However, the key element that can and should be considered at this stage to reduce emissions is the incorporation of ‘circular economy’ principles.

13.8.43 **Figure 13-2** shows how the concept of a circular economy works, with consideration needing to be given to how design principles (e.g. selection of materials, designing for adaptability, etc) can be used, and how waste should be seen as a resource with a preference to retain and refit buildings being preferred over recycling building materials.

Figure 13-2 Circular Economy Principles[18]



Anticipated Effects

13.8.44 Once the Proposed Development reaches the end of its design life, it is anticipated that it will be replaced by new buildings or uses. Any trees planted are expected to be fully mature/veteran and be sequestering carbon effectively by that time.

13.8.45 This replacement is likely to result in some substantial GHG emissions, due to both the demolition and construction activities (included embodied carbon within the new building materials) and future operational activities.

13.8.46 As this is such a long time in the future and subject to many uncertainties, a quantification of this has not been undertaken, however it is considered that the effect with no mitigation could be **moderate-minor adverse**, and significant (especially considering the criticality of further mitigating climate change by that stage).

[18] Source: https://academy.rics.org/info/images/Circular.png

13.9 Climate Change Mitigation – Cumulative Effects

13.9.1 The cumulative schemes identified will all lead to GHG emissions in similar ways to those described earlier in this chapter (e.g. from embodied carbon, construction plant and traffic, operation, and eventual decommissioning/deconstruction).

13.9.2 It is not reasonable or practical to accurately quantify the emissions for each committed development. However, assessing the development qualitatively based on a broad assumption that by their nature these projects are expected to be major developments of a similar scale to the Proposed Development a conservative estimate could be made by multiplying the quantified emissions by the number of committed developments identified in the surrounding area and adjusted to accommodate the scale of the developments.

13.9.3 Applying this qualitatively to the significance criteria presented above, this would be considered a notable/substantial increase in terms of emissions pertaining to the construction phase, and therefore moderate to major adverse cumulatively.

13.9.4 However, it is anticipated that operational local per capita emissions will reduce as the committed developments come forward (continuing the trend shown in **Table 13-4)** as together these projects will lead to a more energy efficient building stock. This is expected to be at least a **minor beneficial** effect in the longer term.

13.10 Climate Change Adaption - Assessment Methodology

Approach

13.10.1 IEMA's guidance 'Climate Change Resilience and Adaption' (2020)[12] presents a methodology for the consideration of climate change resilience and adaption in the EIA process, which has been followed in this assessment.

13.10.2 The main steps are to:

0. Pre-EIA Stage: How has climate resilience and adaptation been embedded in the design;
1. Scoping Climate Change Adaptation into the EIA;
2. Defining the Future Baseline;
3. Identifying Climate Change Vulnerability;
4. Identifying and Determining Magnitude of Effects;
5. Significance Assessment;
6. Develop Mitigation Measures; and
7. Post-EIA Stage: monitoring and Adaptive Management.

13.10.3 The 2020 IEMA guidance introduces a new significance aspect which should be considered in a climate change assessment. 'In-Combination' climate impacts should be assessed in that consideration should be given to the likely significant environmental effects and their associated magnitude of effect identified within the other topics being assessed as part of the ES.

Climate Change Projections – Defining the Future Baseline

13.10.4 UK Climate Projections from the 2018 Meteorological Office modelling (UKCP18) was reviewed in order to establish an appropriate future baseline. Due to the inherent uncertainty in future climate, and the vast data sets underpinning the modelling, the 'UKCP18 Factsheet: Derived Projections'[19] was used as it provided an accessible and clear summary.

13.10.5 Using a future assessment timeframe of 2081-2100 (representing a period when the Proposed Development is expected to still be in operation), over land the projected general trends of climate changes are similar to UKCP09 (the climate projections from the 2009 climate model, which has now been superseded), with a move towards warmer, wetter winters and hotter, drier summers. However, natural variations mean that some cold winters, some dry winters, some cool summers and some wet summers will still occur. All figures below are relative to present day (1981-2000), and as the Proposed Development is located in Reading, it is appropriate to consider the South East of England as the appropriate geographical location.

13.10.6 At 2°C of global mean warming:

- For temperature:
    - the largest warming in the UK will be in the South East where summer temperatures may increase another 3 to 4°C;
    - median warming will be at least 1 to 2°C throughout the year across the whole of the UK;
    - winter cool days will warm by 1 to 1.5°C across the country, whilst temperatures on warmer winter days increase by less than 1°C; and
    - in summer both hot and cool days warm by 1.5 to 2°C across England.
- For precipitation:
    - changes are uncertain, but suggest slightly wetter winters and drier summers, with summer drying more in the South.

13.10.7 At 4°C of global warming, changes compared to present day have a similar spatial pattern to those at 2°C but larger:

- For temperature:
    - all seasons warm, but summers warmer than winters;
    - summer temperatures rise by another 4 to 5°C in the south of England and 3 to 4°C elsewhere in the country;
    - hot summer days warm by 4.5 to 5°C compared to present day, across much of Southern England, possibly exceeding 5°C in some locations;

[19]Met Office (2018): UKCP19 Fact Sheet Derived Projections
https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp18-fact-sheet-derived-projections.pdf

- cooler summer days warm by 4 to 4.5°C across England and up to 5°C in the south east;
- cool winter days warm by 2.5 to 3°C across the country; and
- warm winter days warm by 2.5 to 3°C in England.

- For precipitation:
  - median winter precipitation increases by up to 20% across most of the country;
  - median summer precipitation decreases most in the south with median reductions of up to 20 to 30% across much of the England;
  - dry summer days decrease in precipitation by up to 50% in summer across much of southern England.

13.10.8 Changes in climate is explained under the baseline section but overall warmer, wetter/drier climatic conditions combined with more extreme weather events can lead to a number of effects. These can be considered in terms of the risk they pose to the Proposed Development and its occupiers directly, or they can have an in-combination effect with other impacts anticipated as part of the ES.

Outline Climate Change Adaption Plan

Introduction

13.10.9 This section considers how the inherent uncertainty of climate change predictions can be managed so as to allow for appropriate adaption in the future to reflect the realities of changing climate.

13.10.10 The IEMA Guidance recommends that a project's ability to adapt to climate change should:

- consider the whole life of the project;
- have a 'win-win' outcome that can provide benefits under multiple scenarios, and that can bring economic, social and environmental benefits;
- favour flexible future options (including building appropriate safety margins), rather than being too prescriptive and specific over options that can be modified in the future;
- delay details of project elements that are subject to the greatest risk and uncertainty from climate change until later in the programme when more should be known; and
- follow a hierarchy, whereby avoid, control or manage risk is preferred, enhancement (e.g. to improve the functionality over a project's lifespan), and compensate (e.g. by providing a measure to offset a climate change impact it exacerbates).

13.10.11 The procedure that should be followed is as follows:

- conceptualise the issues through the assessment across the EIA, and identify the greatest potential impacts and receptors most at risk;
- manage uncertainty by setting goals/objectives, and action trigger levels, developing a monitoring plan for reviewing updated climate predictions, and define roles, responsibilities and funding streams;
- implement the plan and monitor/analyse results over the life or the Proposed Development; and
- review the plan, collate data received, update the plan as necessary, including the need for additional or different mitigation.

Identifying Receptors' Sensitivity to Climate Change and Assessing Generic Impacts

13.10.12 **Table 13.6** considers the receptors associated with the topics scoped into the ES, and, using professional judgement, identifies any risks to these receptors or sensitivity to climate change. Given the long-term nature of the changes, a more generic receptor description is provided. Other typical EIA topics such as wind microclimate will also be sensitive to climate change but have not been assessed in this ES and therefore excluded from **Table 13.6**.

Table 13-6 How Climate Change Affects the ES Assessments

ES Chapter	Sensitive Receptor	Potential effect of climate change	Relative Sensitivity/Risk
6: Socio Economics	Users of amenity space/play space	Unable to use the amenity space due to hot/cold/wet weather Space is flooded	High
	Users of healthcare facilities	Increased use due to overheating/new diseases Casualties caused by extreme weather event, civil unrest	Medium High
7: Traffic and Transport and access	Pedestrians and cyclists	There will be more walking and cycling, although they will be sensitive to extreme weather	Medium
	Users of public transport	More overheating and less comfort, potentially less reliability	Medium

ES Chapter	Sensitive Receptor	Potential effect of climate change	Relative Sensitivity/Risk
9: Noise and Vibration	New and existing residents	Hotter temperatures may result in windows being left open for longer Electric vehicles would lead to traffic noise decreasing (although wetter conditions could counteract this) Cooling/ventilation plant may be installed to run for longer	Low (as other options are likely to be available) Medium
10: Flood risk and existing residents	New and existing residents	Changes in the flood zone caused by changes upstream or at the site itself Increased run off causing downstream flooding Blockage of groundwater migration, resulting in groundwater flooding Local sewage and water supplies threatened (including drought/inundation) Contamination of the surrounding water environment	High High Medium High Low
11: Ecology	Introduced biodiversity and habitats	The planting may not be resistant to extremes of temperature and moisture causing it to die or become stunted.	Medium
12: Archaeology	Buried archaeological resources	Changes to ground moisture and stability.	Low (unless deposits known about and left in-situ)

ES Chapter	Sensitive Receptor	Potential effect of climate change	Relative Sensitivity/Risk
Volume 3: Landscape and Visual Impact	Introduced biodiversity/greenspace and tree planting	The planting may not be resistant to extremes of temperature and moisture causing it to die or become stunted.	Medium

13.10.13 As shown in **Table 13.6** there is a potential for climate change to affect some, but not all, topics in this ES. It is possible that new significant effects could occur that would be otherwise negligible under current climate conditions. However, the following section provides a set of measures that can form an outline Climate Change Adaptation Plan, in order to demonstrate how the effects could be mitigated in the future.

13.11 Measures for Adapting to Climate Change

13.11.1 A Climate Change Adaption Plan could be produced (at a future design stage) as a measure to mitigate against the effects of climate change on generic receptors as described above. This could include, but not limited to, the following options:

- The fit-out of the tenanted spaces will be the responsibility of each tenant. Tenants could install highly efficient systems wherever possible, and meet the performance stipulations within the Non-Domestic Building Services Compliance Guide.
- The units could benefit from energy monitoring devices which would allow building managers to instantaneously view the energy requirements associated with maintaining appropriate internal conditions. It is anticipated that this will be linked to the incoming electricity and heat supply, and provide data upon which occupiers can better manage their specific needs.
- Heating systems could be provided with zonal, programmable thermostatic controls linked to a master control panel which will allow occupants to control each zone independently for maximum flexibility. Hot water could be separately programmable.
- Water consumption in the development will be minimised by the specification of highly efficient water installations. This will limit water consumption in apartments to 105 litres per person per day. Further consideration of rainwater/greywater harvesting should be given, including the future adaptability to collect this in greater quantities.
- The Flood Risk Assessment and Drainage Strategy, as well as the proposed finished floor levels have taken climate change into account and therefore the high risk to these receptors is being managed.
- External spaces could be planted with a range of species, including native and drought resistant spaces.

- Passive provision could be allowed for to install additional solar shading over public amenity space, car parks, etc.

Cumulative Climate Change Effects

13.11.2 The potential effects from climate change identified in could affect all of the cumulative schemes, and there is clearly a need for a co-ordinated approach to both mitigating and adapting to climate change. There is strategic guidance and ever-stronger policies in the form of the NPPF and the Local Planning Policy (as described earlier in this chapter).

13.11.3 It is considered that with all new major development needing to carefully consider climate change adaptation and be designed accordingly, there will be an overall positive cumulative effect.

13.12 Residual Effects

13.12.1 **Table 13.7** Provides a summary of the residual effects associated with climate change mitigation (carbon and GHG emissions).

Table 13-7 Significant Residual Effects

Description of Effect	Potential impact including significance	Mitigation	Residual Effect including significance
Construction and Decommissioning			
Embedded carbon in building materials (across project lifespan)	Minor adverse (negligible)	Consider the use of lower embedded carbon materials.	Minor adverse (not significant)
Carbon emissions from construction traffic	Minor adverse (not significant)	Consider using more efficient vehicles and sourcing products locally.	Minor adverse (not significant)
Carbon emissions from construction plant	Minor adverse (significant)	Consider using more efficient plant.	Minor adverse (not significant)
Carbon emissions from tree planting and removal	Minor adverse (not significant)	Replacement and compensatory planting (net 1,000 extra trees).	Minor beneficial (not significant) (over the long-term)
Completed Development			
Operational regulated energy use	Minor adverse (significant)	The use of energy efficiency principles set out in the Energy and Sustainability Report.	Negligible-Minor adverse (not significant)

		Proposed U values significantly exceed the minimum standards required by the current version of Part L of the Building Regulations. Roof mounted PV arrays to each of the homes. Carbon offset payment of £108,750.	
Operational unregulated energy use	Negligible (not significant)	Consider using more efficient equipment.	Negligible (not significant)
Operational traffic emissions	Minor adverse (not significant)	Encourage greater use of public and active travel modes.	Negligible (not significant)
End of Life			
End of life carbon costs (wastage)	Moderate-Minor adverse (significant)	Consider adopting circular economy principles.	Moderate-Minor adverse (significant)

13.12.2 It should be noted that the IEMA Guidance[13] states: "*in the absence of any significance criteria or a defined threshold, it might be considered that all GHG emissions are significant and an EIA should ensure the project addresses their occurrence by taking mitigating action*". In this respect, whilst it is acknowledged that all emissions from the Proposed Development will contribute to the overall significant effect of climate change, it is considered that the project has and will adopt an appropriate and reasonable level of mitigation and the residual effects should therefore be considered not significant for the purposes of this EIA.

13.12.3 With respect to climate change resilience, assuming the appropriate level of adaptation measures (which cannot be confirmed at this stage), the effects described in this ES are expected to remain valid throughout the lifetime of the Proposed Development.

13.13 Summary and Conclusions

13.13.1 This chapter has considered both how the Proposed Development can mitigate its effect on climate change by reducing carbon/GHG emissions throughout its life cycle, and how it can be affected by (and adapt to) a changing climate over its life cycle.

Summary of Baseline

13.13.2 Baseline GHG emissions are mainly expected to arise from transportation to and from the Site by customers, staff and servicing, emissions from any operational buildings and emissions associated with management and disposal of vegetation. The Site includes many trees that absorb carbon dioxide during the daytime, and so the net emissions from the Site are likely to be negligible.

Summary of Mitigation and Residual Effects

13.13.3 A range of embedded mitigation measures have been incorporated in the Proposed Development to minimise carbon emissions, appropriate to the scale and opportunities associated with the project. The residual impacts as seen in **Table 13.7** and with the suggested mitigation measures implemented considered not significant.

13.13.4 Risk from climate change, and opportunities to adapt have been identified, although there is no specific policy need to do so. These measures can be considered by the Applicant and future tenants and adopted as their individual circumstances require.

Table 13-8 Summary of Residual Effects of Greenhouse Gases on Global Climate (Climate Change Mitigation)

Receptor/ Affected Group	Value or Sensitivity (Significance of Receptor)	Activity or Impact	Embedded Design Mitigation	Magnitude/Spatial Extent/Duration/ Likelihood of Occurrence	Significance of Effect	Additional Mitigation	Residual Magnitude of Impact	Significance of Residual Effect
Construction								
Global Climate	High	Building materials, construction traffic emissions, construction plant emissions, tree planting and removal.	Replacement tree planting	High Direct Local and Global Short and Long term Likely	Moderate-Minor	Construction Environmental Management Plan (CEMP). Consider using lower embedded carbon materials Fuel efficient vehicles Locally sourced products (circular economy) Efficient plant Compensatory tree planting (1,000 trees in Cucumber Wood).	Negligible (if additional mitigation implemented) Moderate-Minor (otherwise)	Negligible (if additional mitigation implemented) Minor Adverse (otherwise)
Operation								
Global Climate	High	Regulated/ Unregulated energy use, vehicles associated with the Proposed Development	Energy and Sustainability Report, Residential Travel Plan	High Direct Local and Global Short and Long term Likely	Minor Adverse	De-carbonisation of grid electricity, take up of electrical vehicles	Minor Adverse	Minor Adverse (not significant)