15 Climate Change

Part 1: Climate Change Mitigation

Introduction

15.1 This chapter of the ES assesses the likely significant effects of the Development on the environment in respect of climate change.

15.2 The chapter has been prepared by Stantec, Institute of Environmental Management and Assessment (IEMA) EIA Quality Mark registrants. A statement of expertise is included at Appendix 1.2.

15.3 This part of the chapter should be read in conjunction with the following appendices which have been used to inform the assessment:

- Appendix 15.1: Relevant Policies, Legislation and Guidance;
- Appendix 15.2: Average Annual Daily Traffic Flows;
- Appendix 15.3: Whole Lifecyle Carbon (WLC) Assessment; and
- Appendix 15.4: Sustainability and Energy Statement.

15.4 This chapter is split into two main parts:

- Climate Change Mitigation (Greenhouse Gas (GHG) Emissions); and
- Climate Change Resilience (assessing the vulnerability of the Development to climate change).

Policy Context

15.5 Further policies, legislation, and guidance relevant to the chapter is included in Appendix 15.1.

National Legislation

15.6 This chapter assesses the effects of the Development in relation to climate change, in line with the requirements of the 2017 EIA Regulations (as amended):

> *"The EIA must identify, describe and assess in an appropriate manner, in light of each individual case, the direct and indirect significant effects of the proposed development on climate.[1]"*
>
> *"A description of the likely significant effects of the development on the environment resulting from, inter alia: (f) 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"[2].*

Climate Change Act 2008[i]

15.7 The Climate Change Act (2008) sets a legally binding target for reducing GHG emissions, in particular carbon dioxide (CO_2), by at least 80% (from 1990 levels) by the year 2050 in the United Kingdom (UK). The 2050 Target Amendment Order 2019 amended this to increase the target for reducing GHG emissions by 100% from the 1990 baseline ('net zero') in GHGs by 2050.

[1] S.I. 2017 No. 571: Part 1; 4(2)(C)

[2] S.I. 2017 No. 571: Schedule 4; 5(f)

15.8 In setting these targets, the Act established the Climate Change Committee (CCC), which is responsible for setting binding interim targets for the Government over five-year periods.

15.9 The government's plans for achieving the emissions reductions it has committed to, including actions and incremental five-year milestones, are set-out in the UK Carbon Plan which includes an interim target of 34% reduction in CO_2 emissions on 1990 levels by the year 2029[ii].

National Planning Policy Framework and Planning Practice Guidance

15.10 The National Planning Policy Framework (NPPF)[iii], which was revised in September 2023, requires developments to *"take a proactive approach to mitigating and adapting to climate change. "*Section 14 of the NPPF (Meeting the challenge of climate change, flooding and coastal change) emphasises the planning system's pivotal role in sustainable development through *"minimising vulnerability and improve resilience to the impacts of climate change".* Paragraph 153 of the NPPF states:

> *"Plans should take a proactive approach to mitigating and adapting to climate change, taking into account the long-term implications for flood risk, coastal change, water supply, biodiversity and landscapes, and the risk of overheating from rising temperatures. Policies should support appropriate measures to ensure the future resilience of communities and infrastructure to climate change impacts, such as providing space for physical protection measures, or making provision for the possible future relocation of vulnerable development and infrastructure."*

15.11 National Planning Practice Guidance (PPG)[iv] was published in June 2014 and recognises that the planning system can *"increase resilience to climate change impact through the location, mix and design of development".* The guidance advises how to identify suitable mitigation and adaptation measures in the planning process to address the impacts of climate change.

15.12 The PPG on climate change (Paragraph 007) also recognises that every area will have different challenges and opportunities for reducing carbon emissions from new development such as homes, businesses, energy, transport and agricultural related development:

- Robust evaluation of future emissions will require consideration of different emission sources, likely trends taking into account requirements set in national legislation, and a range of development scenarios;
- The distribution of new development and the potential for servicing sites through sustainable transport solutions, are particularly important considerations that affect transport emissions; and
- Different sectors may have different options for mitigation. For example, measures for reducing emissions in agricultural related development include anaerobic digestion, improve slurry and manure storage and improvements to buildings. In more energy intensive sectors, energy efficiency and generation of renewable energy can make a significant contribution to emissions reduction.

Local Planning Policy

Barnsley Local Plan 2019-2033[v]

15.13 The Barnsley Metropolitan Borough Council (BMBC) Local Plan was adopted in January 2019 and provides the overarching framework of spatial policies and principles to support development in the local area. The Local Plan contains specific reference to Climate Change and includes policies which interface with Climate Change. Policies particularly relevant to this chapter are summarised below:

Policy CC1: Climate Change: BMBC will seek to reduce the causes of and adapt to the future impacts of climate change by:

- "Giving preference to development of previously developed land in sustainable locations;

- Promoting the reduction of greenhouse gas emissions through sustainable design and construction techniques;
- Locating and designing development to reduce the risk of flooding; Promoting the use of Sustainable Drainage Systems (SuDS);
- Promoting and supporting the delivery of renewable and low carbon energy; and
- Promoting investment in Green Infrastructure to promote and encourage biodiversity gain."

Policy CC2: Sustainable Design and Construction: "Development will be expected to minimise resource and energy consumption through the inclusion of sustainable design and construction features, where this is technically feasible and viable.

All non-residential development will be expected, to achieve a minimum standard of BREEAM 'Very Good' (or any future national equivalent). This should be supported by preliminary assessments at planning application stage."

Policy RE1: Low Carbon and Renewable Energy: "All developments will be expected to seek to incorporate initially appropriate design measures, and thereafter decentralised, renewable or low carbon energy sources in order to reduce carbon dioxide emissions and should at least achieve the appropriate carbon compliance targets as defined in the Building Regulations."

15.14 In September 2019, BMBC declared a 'Climate Emergency' for the Borough[vi], requiring urgent action. The Declaration acknowledge the need to reduce the Borough's carbon emissions, setting a target 'Zero 45' where the Borough will become net zero carbon by 2045. The declaration prioritises measures relating to topics such as energy efficiency, resource efficiency, sustainable transport, renewables and decentralised heating.

Supplementary Planning Document (SPD): Sustainable Construction and Climate Change Adaptation (Adopted July 2023)[vii]

15.15 As outlined above, the BMBC Local Plan contains a number of climate change related policies. The SPD provides further guidance on what is expected of development in relation to the following policies:

- Policy SD1 Presumption in favour of Sustainable Development;
- Policy CC1 Climate Change;
- Policy CC2 Sustainable Design and Construction;
- Policy CC3 Flood Risk;
- Policy CC4 Sustainable Drainage Systems (SuDS);
- Policy CC5 Water Resource Management; and
- Policy RE1 Low Carbon and Renewable Energy.

15.16 The SPD outlines that a WLC assessment will be required with full or hybrid applications or assessment of approval of reserved matters for all major developments (10 dwellings or above and 1000m^2 or above for commercial developments. The WLC assessment will be expected to follow the model set out in the RICS professional statement 'Whole Life Carbon Assessment for the Built Environment'[viii].

15.17 This Climate Change chapter will therefore be supported by a WLC assessment, which is submitted as part of the ES (Appendix 15.3).

Technical Guidance

Building Regulations

15.18 The Buildings Regulations, specifically Approved Document Part L; 'Conservation of Fuel and Power', determine the energy efficiency and carbon emission standards required by new buildings. Part L was updated on the 15th June 2022[ix]. Part L addresses controls for:

- Insulation values of buildings elements;
- The allowable area of windows, doors and other openings;
- The air permeability of the structure;
- The heating efficiency of heating systems;
- Hot water storage and lighting;
- Mechanical ventilation and air conditioning systems;
- Space heating controls;
- Airtightness testing of larger buildings; and
- Requirements for Carbon Index ratings.

Future Buildings Standardx

15.19 In 2021, the Government released the second stage of a two part consultation on proposed changes to Part L (conservation of fuel and power) of the Building Regulations under the document: 'The Future Buildings Standard: 2021 Consultation on changes to Part L (conservation of fuel and power) and Part F (ventilation) of the Building Regulations for non-domestic buildings and dwellings; and overheating in new residential buildings'.

15.20 The goal of the Future Buildings Standard is to provide a pathway to highly efficient non-domestic buildings which are zero carbon ready, better for the environment and fit for the future. It is recognised that from 2025 the Future Buildings Standard will deliver buildings which require no further energy efficiency retrofit work, and are therefore anticipated for them to become zero-carbon as the electricity grid continues to decarbonise. The consultation response stated that the government intends to start a full technical consultation on the Future Buildings Standard in 2023-24.

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

15.21 In February 2022, IEMA published this guidance (referred to hereafter to as IEMA GHG Guidance), to assist practitioners with addressing GHG emissions assessment and mitigation in EIA. The guidance indicates that a 'good practice' approach is advocated where GHG emissions are always considered and reported but at varying degrees of detail depending on the project.

15.22 The IEMA GHG guidance places a much more prominent role for mitigation within the EIA. It is no longer an element to be considered towards the later stages of the EIA process. Instead, mitigation should be considered from the outset and throughout the projects' lifetime.

15.23 The IEMA GHG guidance sets out there are a number of different assessment methods available for measuring and quantifying the GHG emissions associated with the built environment, ranging from general guidance to standards for the use of an EIA. The IEMA GHG guidance recognises that: *"qualitative assessments are acceptable, for example: where data is unavailable or where mitigation measures are agreed early on in the design phase with design and engineering teams".*

15.24 The IEMA GHG guidance outlines that an EIA must give proportionate consideration to whether and how a development will contribute to the 2050 net zero target. Therefore, the crux of significance is not whether a project emits GHG emissions, nor even the magnitude of GHG emissions, but whether it contributes to reducing GHG emissions relative to a comparable baseline, consistent with a trajectory towards net zero by 2050.

UK Greenhouse Gas Statistics

15.25 The Department for Business, Energy & Industrial Strategy (BEIS)[xii] (now the Department for Energy Security and Net Zero (DESNZ)) reports on energy and emissions projections by source and reports on local and regional GHG emissions. This has allowed the collection of baseline data for the period 2005-2021 for the BMBC, as well as regionally and nationally.

UK Carbon Budgets

15.26 Carbon Budgets are five-year statutory cap on total GHGs, introduced under the Climate Change Act. As previously discussed, the Climate Change Act originally enshrined an 80% reduction in GHGs by 2050 until it was amended to a 100% reduction in 2019. Therefore, the first five carbon budgets (with the fifth budget running from 2028-2032) are aligned to the 80% reduction. The most recent sixth carbon budget is aligned to the new objective of achieving a 100% reduction in GHGs and covers the period from 2033-2037. As the anticipated year of project completion is 2026, the 4th carbon budget (2023-2027) has been utilised in this ES chapter to provide contextualisation for emissions.

15.27 The relevant UK Carbon Budget will be utilised for the contextualisation of how the Development's emissions are likely to contribute, positively or negatively, towards a pathway to Net-Zero by 2050. As previously stated, the IEMA GHG Guidance outlines that the crux of significance is not whether a project emits GHG emissions, nor even the magnitude of GHG emissions, but whether it contributes to reducing GHG emissions relative to a comparable baseline, consistent with a trajectory towards net zero by 2050; therefore, the UK Carbon Budgets will not be used in order to determine significance of effects. They will provide contextualisation to aid professional judgement of significance, supported by the IEMA GHG Guidance.

Assessment Methodology

General Approach

15.28 'Climate' is generally understood to mean the weather conditions prevailing over a long period of time and climate change refers to changes in recorded long term climate trends. As a topic for the assessment within EIA, climate change is relatively new. Guidance is evolving and there is no prescribed way in which climate change should be incorporated into an ES. However, guidance has been prepared by IEMA, discussed further below, which sets out the two main approaches that can be taken to determine a project's climate change impact. Part 1, assessed in this section is summarised below:

- **Part 1:** The direct and indirect influence of the Development on climate change (climate change mitigation).

15.29 The first part of the assessment considers the upfront and in-use effects of the Development on climate change. The London Energy Transformation Initiative (LETI)[xiii] defines emissions within the whole lifecycle as follows:

- Upfront Carbon: Carbon emissions from the construction phase including, construction vehicles, raw material supply, manufacturing and the installation process; and

- In-use Carbon: Carbon emissions from the operational use of the Development including: Operational regulated energy, use, maintenance, repair, replacement, and refurbishment.

15.30 This chapter provides a quantitative, assumptions – based assessment of the effects of the following sources:

- Upfront carbon emissions from construction vehicles;
- In-use carbon emissions from operational regulated energy usage; and
- Carbon emissions from operational transport usage (not included in the Whole Lifecycle carbon process).

15.31 This chapter will derive quantitative values of CO_2 emissions from sources outlined above that have been calculated from the Part L 2021 Building Regulations[xiv] baseline.

15.32 As the Development is a hybrid application, some detailed information is not yet available. Therefore, some elements of upfront and in-use carbon listed above in paragraph 15.29, for example, raw material supply, manufacturing and the installation process have been scoped out of this ES Chapter. The planning application is supported by a WLC assessment (detailed in paragraphs 15.43-44) (Appendix 15.3), which provides an assessment of modules A1-A3[3] and A5[4] from the whole lifecycle process which have been scoped out of this ES Chapter. The Sustainability and Energy Statement (Appendix 15.4) has also assessed the carbon emissions arising from the construction of the road, which is being submitted in full. Furthermore, lifecycle modules B1-B5[5] and the end-of-life phase[6] (C1-C4) have been scoped out of this ES Chapter.

Scope of Assessment

15.33 This part of the Climate Change Chapter assesses the effects of the Development on climate change by:

- Establishing the existing baseline conditions (2022 – when the baseline traffic data was recorded);
- Determining future baseline conditions;
- Assessing the likely significant effects of the Development on the established baseline and future conditions;
- Identification of mitigation measures; and
- Assessment of residual effects.

Consultation

15.34 Climate change has been scoped into this ES by the request of BMBC in the Scoping Opinion (Appendix 2.2) received on the 25th November 2022. BMBC requested climate change be scoped into the ES by virtue of significant environmental effects, without mitigation, being likely due to the scale of the Development on greenfield land.

15.35 BMBC also requested a climate change chapter be accompanied by a WLC assessment, this is provided in Appendix 15.3.

Temporal Scope

[3] Module A1, A2 and A3 may be declared as one aggregated module A1-A3. All stages include the provision of all materials, products, and energy, as well as waste processing up to the end-of-waste state or disposal of final residues during the product stage. The assessment takes only the building and its parts into account, but not furniture or appliances, for example.

[4] Stages A4 and A5 include all impacts and aspects related to any losses during this construction process stage (i.e. production, transport, and waste processing and disposal of the lost products and materials). A5 is related to installation into the building.

[5] B1: Use or application of the installed product; B2: Maintenance; B3: Repair; B4: Replacement; and B5: Refurbishment.

[6] It covers deconstruction and demolition (C1), transport (C2), waste processing for reuse, recovery or recycling (C3) and disposal (C4), until the site is cleared, level and ready for further use.

15.36 The assessment assumes a Development completion year of 2026, (see Chapter 5 Construction Methodology and Phasing for information). The data available to allow an assessment of GHG emissions from vehicle movements associated with the Development is limited to the modelling scenarios assessed in the Transport Assessment (TA) and ES Chapter 13 Transport. Therefore, this chapter is aligned with Chapter 13 Transport, Chapter 14 Air Quality and Chapter 12 Noise in assessing vehicular emissions from 2026 (refer to Chapter 5 Construction Methodology & Phasing for indicative phasing and construction information).

Spatial Scope

15.37 The data available to allow an assessment of GHG emissions from vehicle movements associated with the Development is limited to the study area of the TA and the same traffic data has been used as for the Noise and Air Quality assessments within this ES. This study area involves a modelling area covering 27 road links surrounding the Site. The study area links, provided by the projects Transport Consultant are included in Appendix 15.2.

15.38 Notwithstanding, the traffic flow data provided (Appendix 15.2) includes a trip generation summary, which shows the operational Average Annual Daily Traffic (AADT) movements from the Development in isolation. This figure has therefore been utilised in the Emissions Factors Toolkit (EFT) V11.0 assessment, in order to calculate GHG emissions arising from the Development operations alone, as opposed to accounting for an uplift in road traffic emissions from 27 road links surrounding the Development.

15.39 Given that climate change is a global issue, a qualitative assessment of the Development's effects is also made at the global scale.

Determining Significance

15.40 There is currently no industry – wide agreed threshold of carbon emissions which, if exceeded, can be defined as significant or potentially significant. The IEMA GHG guidance acknowledges that all emissions could lead to cumulatively significant effects.

15.41 The IEMA GHG guidance notes that the cumulative impact of carbon emissions arising from global human activity is considered major however, the contribution from individual developments, such as the Development assessed in this ES, could be considered negligible/ minor in the context of the UK's emissions. This is because, in isolation, the quantity of carbon emissions from an individual development is likely to have limited potential to significantly increase atmospheric carbon emissions towards global environmental targets.

15.42 The IEMA GHG guidance states that the significance of the impact of GHG emissions should be determined by considering whether a project contributes to reducing GHG emissions relative to a comparable baseline, consistent with a trajectory towards net zero by 2050. The trajectory towards net zero is mandated within the relevant carbon budget through which the specific activity falls.

Assessing Whole Life Carbon Emissions

15.43 Following a lifecycle analysis approach complies with BS EN 15978[xv] in determining the processes taken into consideration for environmental assessment across the whole project lifecycle. WLC emissions are the carbon emissions resulting from the materials, construction and the use of a building over its entire life, including its demolition and disposal. A WLC assessment provides a true picture of a building's carbon impact on the environment.

15.44 The WLC assessment (Appendix 15.3) is submitted as part of the ES. The WLC assessment includes measures to reduce demand-side energy requirements for the Development. In order to measure the level at which these demand-reduction measures are effective, a baseline energy demand has been calculated.

Assessing Operational Vehicle Greenhouse Gas Emissions

15.45 The assessment of carbon emissions and the evaluation of their significance is set out in IEMA GHG guidance. The receptor for the assessment is the global atmosphere; the impacts of GHG emissions, in terms of their contribution to climate change, are global and cumulative in nature, with every tonne contributing to impacts on natural and human systems. The potential impacts of the Development, therefore, contribute to this global issue.

15.46 The climate change impact is assessed as the difference between the carbon emissions associated with the baseline and that associated with the fully completed Development. The study area for carbon emissions assessment is defined by the Site boundary, as stated in 15.38, the Development trip generation summary provided in Appendix 15.2 has been utilised for assessing operational vehicle emissions, as this shows the operational vehicle movements from the Development alone. Therefore, the GHG figure provided for operational vehicle emissions is as a result of the Development, as opposed to accounting for GHG emissions from vehicular movements across all 27 road links assessed in the TA.

15.47 The baseline conditions of the Site were based on the trip rates and existing published data sets (Appendix 15.2). The baseline for the Site is defined as the current carbon emissions arising from vehicles in the study area. In terms of transport-related emissions, whilst forecasting can be carried out to project potential increases in traffic flows, and, by inference, the impact on CO_2 levels, the impact of technological changes is harder to infer. This includes the introduction and uptake of electric vehicles. Hence, the assessment in this broadly assumes negligible impacts in terms of electric vehicles, other than assumptions which are inherent in the Emissions Factors Toolkit (EFT V11.0)[xvi] utilised for the assessment.

15.48 It is recognised that whilst GHGs are released in the production of electricity to power electric vehicles, this is not to an extent considered significant to affect the assessment results. The EFT uses data sets on fleet growth assumptions which were current before the COVID-19 outbreak in the UK. As a result, default fleet outputs from the EFT do not reflect short or longer term impacts on emissions in 2020 and beyond resulting from behavioural change during the national or local lockdowns. Therefore, the assessments use best practice assumptions, but still represent a worst-case assumption of climate change impacts.

Traffic flow data

15.49 24-hour, Average Annual Daily Traffic (AADT) flows (Appendix 15.2) were provided by the Transport consultant for the following scenarios:

- 2022 Base;
- ‘Do-minimum’ (2026) (Baseline + growth + committed developments); and
- ‘Do-something’ (2026) (Baseline + growth + committed developments + the Development).

15.50 Fleet composition was provided utilising the baseline split of Heavy Goods Vehicles (HGV) and Light Duty Vehicles (LDV) for each of the 27 road links assessed as part of the Study Area for this assessment, which was informed from the data available from the TA modelling.

15.51 In the absence of pre-defined road link speed limits within Appendix 15.2, an assumption of 40kph (approximately 24mph) has been used in the EFT assessment. This speed has been chosen as a high-level estimate to reflect the speed limits within the Study Area.

15.52 In the absence of pre-defined distances for vehicles, the most recent UK average journey distance is defined by the National Travel Survey[xvii] provided by the Department for Transport as 9.2km (5.7 miles). This is considered to be a conservative over-estimate of the distance travelled on each individual road link, however, is utilised as a constant factor across all of the scenarios assessed.

Vehicle Emissions Factors

15.53 Assumptions of the inputs used in the carbon modelling are provided in Table 15.1 and details provided at Appendix 15.2. This includes the percentage of HGV vehicles per road link.

Table 15.1: Traffic Data Assumptions

Variable	2022 Base	2026 'Do-minimum'	2026 'Do-something'
24 hour Average Annual Daily Traffic (AADT) of the Development*	329,205	361,249	394,565
Link Length	9.2km		
Road Type	England – Not London		
Average Vehicle Speed**	40kph		
* Trips are two way ** based on the posted speed limit of the road link			

15.54 The fleet comparison for the operational phase was taken from the baseline fleet projection and predicted changes in fleet composition due to the Development. The road type utilised was 'England – Not London' to reflect the location of the Site. The assessment presents a worst-case scenario as it does not consider the use of public transport, including a potential reduction in vehicular trips. The breakdown of emissions for conventional vehicle types includes conventional vehicle categories and does allow for, with some degree of uncertainty, the likely phasing of alternative (electric) vehicles as previously discussed.

Operational Energy Use

15.55 There is currently limited information on the design specifications of the warehouses to be provided as part of the Development as the application is being submitted as a hybrid application, with the warehousing in outline. The assessment of operational energy has therefore provided a high-level estimate of energy GHG emissions based on the Target Emission Rates (TER) for a Part L 2021 Building Regulations compliant building. This has provided a benchmark $kgCO_2e/m^2$ figure which has been extrapolated out to calculate an energy emissions figure for the Development as a whole. Further information on energy saving measures following the Energy Hierarchy is available from Appendix 15.4.

Carbon Sequestration

15.56 The carbon sequestration potential (i.e. the potential to remove CO_2 from the atmosphere) from the existing habitats within the Site has been estimated. This has been conducted through categorising habitats present on the Site, as per the Biodiversity Net Gain (BNG) assessment (submitted separately as part of the planning application). The carbon sequestration potential for the existing habitat is provided by Natural England's Capital Accounts[xviii] and Natural England's Carbon Storage and Sequestration by Habitat October 2021[xix], which provides tonnes of CO_2 equivalent per hectare (ha) year ($tCO_2eq/ha/yr$) for differing types of habitats.

15.57 As described in Chapter 3, the Site is comprised of agricultural fields used for arable farming and the Carr Dike. The Site extends to 85.31 ha. The habitat types have been matched to those provided by Natural England's Natural Capital Accounts as closely as possible. Where the habitat found on the Site does not accurately fit a classification provided, a worst-case scenario assumption of the habitat sequestrating no carbon has been undertaken. Other habitats provided in the BNG assessment have been grouped according to shared characteristics and agreed with the Project Ecologist.

15.58 This is considered proportionate and appropriate given the high-level nature of this assessment. The habitats used for the post-Development assessment are based only upon what planning permission is sought for, deriving information from the parameter plan and landscape location plan (Figures 3.1 and 3.2) and the BNG assessment submitted separately as part of the planning application.

Significance Criteria

15.59 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. The IEMA GHG guidance outlines that it is essential to provide context for the magnitude of GHG emissions reported in the EIA in a way that aids evaluation of effects. The impacts have therefore been

defined as either negligible, beneficial, or minor, moderate or major adverse as set out in Table 15.2 below. As per the IEMA GHG guidance, when evaluating significance, all new GHG emissions contribute to an adverse environmental effect.

15.60 IEMA provide examples of significance criteria, which are outlined below in Table 15.2. These examples have been utilised alongside professional judgement for assessing the impact of the Development at the national level.

15.61 Effects that are described as 'minor' or 'negligible' are determined to be 'Not Significant' and effects that are described as 'moderate', or 'major' are determined to be 'Significant'.

Table 15.2: Emissions Significance Criteria (National Level)

Effect Significance	Description of Criteria
Beneficial	*'The project's net GHG impacts are below zero and it causes a reduction in atmospheric GHG concentration, whether directly or indirectly, compared to the without-project baseline. A project with beneficial effects substantially exceeds net zero requirements with a positive climate impact'*
Negligible	*'The project's GHG impacts would be reduced through measures that go well beyond existing and emerging policy and design standards for projects of this type, such that radical decarbonisation or net zero is achieved well before 2050. A project with negligible effects provides GHG performance that is well 'ahead of the curve' for the trajectory towards net zero and has minimal residual emissions.'*
Minor	*'The project's GHG impacts would be fully consistent with applicable existing and emerging policy requirements and good practice design standards for projects of this type. A project with minor adverse effects is fully in line with measures necessary to achieve the UK's trajectory towards net zero.'*
Moderate	*'The project's GHG impacts are partially mitigated and may partially meet the applicable existing and emerging policy requirements but would not fully contribute to decarbonisation in line with local and national policy goals for projects of this type. A project with moderate adverse effects falls short of fully contributing to the UK's trajectory towards net zero.'*
Major	*'The project's GHG impacts are not mitigated or are only compliant with do-minimum standards set through regulation, and do not provide further reductions required by existing local and national policy for projects of this type. A project with major adverse effects is locking in emissions and does not make a meaningful contribution to the UK's trajectory towards net zero.'*

15.62 In order to provide specific context for an individual project and the contribution it makes to climate change, national and local 'carbon budgets' have been utilised alongside professional judgment and the IEMA Guidance. The CCC[xx] have published 6 'carbon budgets' of 5-year periods, which limit the volume of carbon emissions that the UK can legally emit, in order to reach net zero by 2050.

15.63 Table 15.3 below shows the adopted carbon budgets up to 2027 for the UK.

Table 15.3: UK Carbon Budgets

Carbon Budget	Total Budget ($MtCO_2e$)
3rd (2018-2022)	2,544
4th (2023-2027)	1,950

15.64 The Tyndall Centre carbon budget tool[xxi] scales down the UK national carbon budget between Local Planning Authorities (LPA), to show how each LPA can make its 'fair' contribution towards a 1.5-degree warming trajectory and net zero.

15.65 Table 15.4 below presents the Barnsley energy CO_2 only budget in the format of the 5-year carbon budget periods in the UK Climate Change Act. To align the 2020 to 2100 carbon budget with the budget periods in the Climate Change Act, estimated CO_2 emissions for Barnsley for 2018 and 2019 have been

based on DESNZ provisional national emissions data for 2018 and assuming the same year on year reduction rate applied to 2019.

Table 15.4: Barnsley Carbon Budgets

Carbon Budget	Total Budget ($MtCO_2e$)
3rd (2018-2022)	5.6
4th (2023-2027)	2.7

15.66 As the completion year of the Development is predicted to be 2026, the 4th carbon budget has been adopted for assessment within this ES chapter.

Limitations and Assumptions

15.67 The following assumptions and limitations that apply to this assessment have been set out in this section.

15.68 The assessment of GHG emissions is based on available best practice information.

15.69 There are inherent assumptions and limitations with adopting local carbon budgets in the assessment of significance. Local carbon budgets are assumed from the UK national carbon budget and there is no legally binding framework behind the local budgets. Furthermore, the carbon budgets are across a 5-year period, whereas the operational assessment only assesses the effects from emissions for one year (2026) within a carbon budget.

15.70 Local carbon budgets also do not distinguish carbon emissions into different sectors (domestic, transport, industrial and commercial) as is the case in the DESNZ data. Therefore, emissions from operational transport, for example, will be compared against the entire BMBC carbon budget, as opposed to an allocated transport budget based on transport emission sources.

15.71 The initial modelling of carbon emissions for vehicles during operations is illustrative as real – time carbon emissions associated with the Development are not available.

15.72 The operational regulated energy assessment has been derived using benchmark figures ($kgCO_2/m^2$) from a Part L 2021 baseline compliant warehouse. The Part L baseline provided TER based on a number of assumptions such as, an air source heat pump being provided as opposed to a gas fired boiler (modelling indicated that the building would not be compliant with building regulations if a gas fired boiler was installed), rooflights to cover a proportion of 6% of each warehouse roof area, glazing is provided for office areas only, the warehouses do not having heating and thermal cooling installed, and the warehouse occupied area is 3.7 m of the overall building height, the rest of the building height is assumed to be an internal void.

15.73 The exact design specifications of the Development are yet to be agreed and will be agreed during detailed design stages. Therefore, the operational energy assessment currently provides a high-level estimate, and is likely to change as the Development goes through the detailed design stage.

15.74 The decommissioning phase is not considered due to the long design life of the assets and given that emissions with the end of the life of this type of asset are relatively small and therefore unlikely to be significant, however, these emissions are considered in the WLC Assessment (Appendix 15.3).

Baseline Conditions

Current Baseline GHG Emissions for the Region

15.75 The current GHG emissions at the Borough Level are provided in Table 15.5. A breakdown of total GHG emissions from the three main sources for BMBC are provided over the period of 2005-2021 utilising the most recent data set.

Table 15.5: GHG Emissions within BMBC 2005-2021

Year	Industry (kt CO_2)	Commercial Total (kt CO2)	Domestic Total (kt CO_2)	Transport Total (kt CO_2)	Grand Total* (kt CO_2)	Population ('000s, mid-year estimate)	Per Capita Emissions (t)
2005	498.1	186.7	572.9	509.5	2,063.6	222.6	9.3
2006	523.4	224.8	564.6	499.1	2,099.3	224.4	9.4
2007	424.4	166.0	543.2	504.1	1,902.2	226.0	8.4
2008	428.2	177.8	538.2	481.7	1,892.7	227.8	8.3
2009	358.3	151.8	492.8	460.1	1,682.5	229.0	7.3
2010	412.2	146.9	532.3	465.7	1,773.7	230.1	7.7
2011	367.4	133.8	466.8	453.7	1,629.0	231.9	7.0
2012	403.4	161.3	496.8	441.8	1,697.2	233.5	7.3
2013	434.2	157.1	486.6	441.1	1,674.6	235.2	7.1
2014	393.1	132.4	416.7	444.3	1,527.5	237.1	6.4
2015	374.7	117.6	406.1	458.7	1,500.0	238.9	6.3
2016	361.0	105.1	385.7	466.2	1,456.8	241.2	6.0
2017	343.5	79.9	369.5	472.5	1,408.0	242.5	5.8
2018	374.0	44.2	362.9	479.9	1,416.7	243.8	5.8
2019	356.1	42.8	358.3	481.2	1,386.0	245.0	5.7
2020	327.0	36.8	345.1	400.4	1,232.8	245.6	5.0
2021	370.6	48.2	353.5	416.1	1,316.9	244.9	5.4

* Includes sectors not shown in the table (Public Sector, Land Use and Land Use Change and Forestry, Agriculture and Waste Management.

15.76 Table 15.5 above shows a declining trend in GHG emissions across all sectors within BMBC. Between 2005 and 2021 per capita emissions fell from 9.3 tonnes CO_2 ('tCO_2') to 5.4 tCO_2.

15.77 GHG emissions have fallen across all sectors, with a decrease of approximately 75% in the commercial sector. Industrial emissions have declined by 25% in this period, whereas transport emissions have fallen by approximately 19%.

15.78 The increases in GHG emissions between 2020 and 2021 is most likely due to the opening of these sectors following Covid-19 lockdowns.

Future Baseline

GHG Emissions

15.79 In absence of the Development, GHG emissions arising from the study area in the future could be expected to decrease. This is as a larger proportion of vehicle movements would be electric vehicles and would therefore be zero emissions. Furthermore, the Site would continue to sequester carbon at its current rate.

Likely Significant Effects

Construction Phase

Construction Transport Emissions

15.80 The Development will have an impact on climate change due to carbon emissions during construction as well as operation. During the construction phase, there may be some emissions of CO_2 from construction traffic accessing the Site, non-road mobile machinery and small generators temporarily used to power machinery and equipment on-site. However, these emissions will be temporary,

occurring between 2024 and 2026. These are highly unlikely to make a significant contribution to the overall UK GHG emissions though they will lead to a net increase in carbon in the short-term due to the nature of the construction operations.

15.81 Carbon emissions associated with construction are relatively small when compared with the total user carbon emissions over the study period. As detailed in Appendix 15.2 the total AADT vehicle movements associated with the construction phase is 1,164 movements. Therefore, upon consideration of the baseline traffic flows for the Site (see Appendix 15.2), there is likely to be a **Negligible** overall effect on the climate from construction vehicle emissions when compared to the baseline of the Site.

Operational Phase

Operational Transport Emissions

15.82 As outlined in the Design and Access Statement (DAS), submitted in support of the planning application, the Site is located directly adjacent to the A635 with links to the M1 and A1(M), the Site is therefore ideally suited for the distribution and logistics sector with strategic links to the north and Midlands. There is currently no primary highway access into the Site other than a gated farm entrance which enters the Site on the northern boundary from the A635. There is a proposed new roundabout providing direct access to the Site from the A635, which is being delivered as part of a separate permission by BMBC and due to be completed by early 2024. The proposed Site access will be via a new arm from the new A635 roundabout to the north of the Site which will run southwards through the Site connecting the Development zones.

15.83 The Development will lead to an increase in traffic movements on the local road network. As shown in Appendix 15.2 in the trip generation summary, the total AADT vehicle movements arising from the Development during operation is 6,657, of which approximately 38% are HGV movements.

15.84 In total, the uplift in vehicle trips from the Development represents 8,491.86 tCO_2e/year of vehicular emissions. This represents 0.31% of the 4th BMBC local carbon budget.

15.85 Nationally, the uplift in vehicular emissions from the Development represents 0.0004% of the UK's 4th carbon budget (1,950 $MtCO_2e$).

15.86 In line with IEMA GHG guidance and the significance criteria displayed in Table 15.2, the uplift in vehicular movements and emissions as a result of the Development would result in a **Moderate Adverse** and **significant** effect.

Operational Energy Use

15.87 As highlighted in 15.55, a high-level estimate has been calculated for the operational regulated energy usage based on a number of assumptions. The TER calculated for warehousing that would be compliant with the Part L 2021 Building Regulations is 2.45 kgCO2e/m^2. As outlined on the parameter plan (Figure 3.1), the maximum parameters for the four warehouses in combination is 204,000m^2.

15.88 Therefore, based on the maximum design parameters, the potential regulated energy usage across the Development is 499.8 tCO_2e. This accounts for approximately 0.018% of BMBC's 4th carbon budget.

15.89 Nationally, this represents approximately 0.00002% of the UK's 4th carbon budget (1,950 $MtCO_2e$).

15.90 In line with IEMA guidance in Table 15.2, the effect of operational energy emissions is considered to be **Minor Adverse** and **not significant**.

Carbon Sequestration Potential

15.91 The potential levels of carbon sequestration at the Site pre and post development have been calculated and are provided in Table 15.6 below.

Table 15.6: Carbon Sequestration Potential for the Development

Habitat Type	Pre-Development (ha)	Post-Development (ha)	Habitat Sequestration potential ($tCO_2eq/ha/yr$)	Total sequestered (baseline) tCO_2eq/yr	Total sequestered (Development) tCO_2eq/yr
Amenity Grassland	0	0.24	1.55	0	0.37
Semi-Natural Grassland	2.70	19.86	1.55	4.19	30.78
Scrub	0	3.07	1.55	0	4.66
Buildings / Hardstanding	0.34	39.59	0	0	0
Shrub	0	0.11	0	0	0
Wet Woodland	0.66	3.67	10.71	7.03	39.34
Arable	79.43	0	5.39	428.14	0
Broadleaved Woodland	3.75	16.10	10.71	40.20	172.39
Stream	0.01	3.25	3.91	0.019	12.69
Native Hedgerow	2.55	6.62	3.67	0.01	0.24
Total				479.58	260.26

15.92 As shown on the parameter plan and the landscape location plan (Figures 3.1 and 3.2), there are areas of green and blue infrastructure throughout the Development. Appropriate green buffer zones will be provided along the northern, southern, and eastern boundaries of the Development. The existing watercourse of Carr Dike which runs through the centre of the Site will be retained, alongside vegetation that abuts the watercourse and vegetation along the southern and eastern boundaries. Structural landscaping will also be provided around the Development zones, the centre of the Development and the northern and western boundaries of the Development.

15.93 There will also be areas of flood attenuation, as shown on Figure 3.1 in the northern and north western portions of the Development.

15.94 The green and blue infrastructure provided, as highlighted on Figure 3.1 and Table 15.6 above will provide a level of carbon sequestration.

15.95 Table 15.6 above shows that the baseline scenario for the Site sequesters approximately 479.58 tCO_2e/year. This primarily comes from arable land and broadleaved woodland throughout the Site.

15.96 The loss of all arable farmland on-site will decrease the potential of the Site to sequester carbon as shown in Table 15.6 above. The carbon sequestration potential for the Site is 260.26 tCO_2e/year. Notwithstanding, the new habitats on-site are more varied, and hedgerows, streams, woodland and grassland are all being enhanced from the baseline scenario.

15.97 Overall, the loss or arable farmland in combination with enhancement of other habitats will decrease the carbon sequestration potential of the Site by 219.32 tCO_2e/year. In line with the IEMA Guidance outlined in Table 15.2 the effect from carbon sequestration loss is considered to be **Moderate Adverse**, which is considered to be **significant**.

Mitigation Measures

Construction Phase

Construction Transport Emissions

15.98 Construction transport emissions will be managed through a Construction Environmental Management Plan (CEMP), to be secured by a planning condition. The CEMP will include measures such as preventing construction vehicle idling, appropriate construction transport routing, and ensuring the use of efficient construction vehicles. These measures will contribute to a reduction of construction transport emissions.

Operational Phase

Operational Transport Emissions

15.99 The Development will include a range of measures to accommodate the increased traffic from the Development and encourage sustainable transport modes.

15.100 Walking and cycling connectivity from the Development to Billingley Green Lane Bus Stop will be provided.

15.101 A new, illuminated, combined footway / cycleway is proposed from the north end of the Development, southwards to connect to the Development zones.

15.102 Secure, sheltered cycle facilities in the Development together with showers, lockers and changing facilities for staff / visitors will be provided at the detailed design phase. This will encourage future staff and visitors to access the Site by bike.

15.103 Electric bike charging stations will be provided as part of the Development, as well as car parking to have electric charging with 5% active and 20% passive spaces.

15.104 The Development will also provide travel planning to include various measures including car sharing schemes, preferential car parking spaces, and travel vouchers.

15.105 These measures in combination will encourage a modal shift to more sustainable modes of transport which will contribute to reducing operational transport emissions. However, the emission reduction cannot be accurately quantified.

Operational Energy Use

15.106 A detailed Energy Statement should be undertaken at the detailed design stage. Energy recommendations for the Development comprise adherence to the 'Energy Hierarchy'[7]. As outlined in the Sustainability and Energy Statement (Appendix 15.4) the Development will incorporate a range of energy efficiency measures, in order to comply with the Part L2A 2021 national building specification including insulated fabric with low air permeability, glazing with suitable U-value, G-value and daylight transmittance, low energy and appropriately zoned lighting and efficient electric water heaters. A high-level review of potential heating and low and zero carbon (LZC) technologies has been carried out for the Development indicates that an Air Source Heat Pump (ASHP) and electric heaters are suitable heating infrastructure for the Development. Further analysis of feasibility for LZC technologies will be undertaken at a detailed design stage. A viability assessment for renewable energy technologies has also been carried out in Appendix 15.4, which indicates that Solar PV is a feasible option for the Development given the roof area. Solar thermal is also a potential option which requires further assessment at detailed design stages.

[7] The Energy Hierarchy lists the actions policy makers, industry and consumers need to take when it comes to energy sources and use, in order of most sustainable to least.

Carbon Sequestration Potential

15.107 As outlined in the DAS, submitted separately as part of the planning application, further landscaping will be included within the Development zones, to be determined through the Reserved Matters stages.

15.108 Landscaping will comprise the conservation of existing hedgerows and trees where possible, reinforced by new tree, hedgerow and shrub planting and other habitats. Largely native trees and shrubs will be planted to reflect those in the existing locality. A mix of planting sizes and densities would be adopted to satisfy the differing objectives, such as establishing well balanced woodland and planting habitats.

15.109 The detailed phases will provide new planting as part of a long-term approach to the growth and management of the overall landscape framework. The long-term management and maintenance of landscaping will be secured by appropriately worded planning conditions.

15.110 As the proposed planting matures over the lifespan of the Development, the carbon sequestration potential of the green and blue infrastructure as part of the Development will improve as planting matures.

15.111 Further information on the landscaping strategy is available in the DAS submitted separately as part of the planning application.

Residual Effects

Construction Phase

Construction Transport Emissions

15.112 As stated previously, construction vehicle emissions are considered to be small compared to the existing baseline. The CEMP and construction routing plan will also include measures to mitigate emissions, albeit an accurate quantification is difficult to obtain. As construction vehicle movements are small compared to the baseline and will be temporary the residual effect of construction vehicle emissions is considered to be **Negligible**.

Operational Phase

Operational Transport Emissions

15.113 As outlined in the additional mitigation measures section above, the Reserved Matters stages will provide opportunities to encourage a modal shift to sustainable modes of transport. Over the lifespan of the Development, it is expected that the composition of EVs associated with the Development will increase as the trajectory to net zero moves closer to 2050. Following the implementation of additional mitigation measures, it is considered that emissions associated with operational transport will decrease over the project lifespan (although this cannot be accurately quantified). Notwithstanding, it is still considered that the residual effect is **Moderate Adverse** and **significant**.

Operational Energy Use

15.114 Following the implementation of additional mitigation measures which adhere to the Energy Hierarchy, the residual effect on operational regulated energy is considered to be **Minor Adverse**, which is **not significant**, in line with Table 15.2.

Carbon Sequestration Potential

15.115 During the operational phase, with careful management outlined in a landscape maintenance regime to be secured through a planning condition, the carbon sequestration potential of new landscaping and planting would improve. Therefore, it is considered that the effect from carbon sequestration potential could be reduced to **Minor Adverse** and **not significant**.

Cumulative Effects

15.116 The assessment of operational transport emissions outlined in Appendix 15.2 considers traffic movements arising from the Development in 2026, which also accounts for projected growth to the opening year. Therefore, this assessment is inherently cumulative, and no specific assessment has been carried out.

15.117 As GHG emissions are global and inherently cumulative, a specific quantitative cumulative assessment is difficult to undertake due to the availability of data for GHG emission sources. However, an assumption can be made that all cumulative schemes will follow the Energy Hierarchy when designing-in energy usage, and all developments should adhere to the appropriate, up-to-date Building Regulations at the time. Therefore, the cumulative effect from operational regulated energy emissions is considered to be **Minor Adverse** and **not significant**.

15.118 Cumulative schemes identified will also include a level of landscaping and planting in accordance with BNG targets. Therefore, cumulative developments will include a level of carbon sequestration. Therefore, the cumulative effect is considered to be **Minor Adverse** and not **significant**.

Summary

15.119 The assessment has been undertaken in accordance with published guidance on considering climate change in EIA and consequently reviews how climate change has been considered at all stages of the project.

15.120 Construction and operation of the Development is likely to result in emissions of CO_2 from upfront and in-use carbon. Effects from construction transport emissions are anticipated to be negligible in comparison to the baseline.

15.121 Indicative results based on operational vehicle projections for traffic modelling scenarios for 2026 indicate the Development will result in an uplift of 6,657 vehicle trips per day. In total, the uplift in vehicular trips represents 8,491.86 tCO_2e/year of vehicular emissions locally. Following the implementation of additional mitigation measures, including a Travel Plan to encourage more sustainable modes of transport, the residual effect is considered Moderate Adverse and significant.

15.122 The assessment of operational energy has provided a high-level estimate of energy GHG emissions based on the TER for a Part L 2021 Building Regulations compliant building. Based on the maximum design parameters, the potential regulated energy usage across the Development is 499.8 tCO_2e. This accounts for approximately 0.018% of BMBC's 4th carbon budget. This results in a Minor Adverse effect which is not significant.

15.123 The proposed planting and landscaping will reduce the carbon sequestration potential of the Site by 219.32 tCO_2e/year. With additional mitigation measures proposed and sequestration potential improving as planting and landscaping matures, the residual effect is reduced to Minor Adverse which is not significant.

15.124 Cumulative effects are considered to be Minor Adverse and not significant.

15.125 Table 15.10 contains a summary of the likely significant effects of the Development.

Part 2: Climate Change Resilience

Introduction

15.126 This part of the Climate Change chapter assesses the vulnerability of the Development to climate change (known as climate change resilience).

15.127 This part of the Climate Change chapter is supported by the following figure and appendices:

- Appendix 15.5: Mean Annual Temperature Anomaly;
- Appendix 15.6: Mean Annual Precipitation Anomaly;
- Appendix 15.7: Maximum Summer Temperature Anomaly;
- Appendix 15.8: Summer Precipitation Anomaly;
- Appendix 15.9: Minimum Winter Temperature Anomaly;
- Appendix 15.10: Winter Precipitation Anomaly; and
- Figure 15.1: UKCP18 25km Grid Square.

Policy Context

National Planning Policy

National Planning Policy Framework and Planning Practice Guidance

15.128 The 2014 PPG recognises that the planning system can *"increase resilience to climate change impact through the location, mix and design of development".* The guidance advises how to identify suitable mitigation and adaptation measures in the planning process to address the impacts of climate change.

15.129 Paragraph 005 of the PPG puts forwards recommendations for Local Planning Authorities to consider:

- Identifying no or low-cost responses to climate risks that also deliver other benefits, such as green infrastructure that improves adaptation, biodiversity and amenity;
- Building in flexibility to allow future adaptation if it is needed, such as setting back new development from rivers so that it does not make it harder to improve flood defences in the future; and
- The potential vulnerability of a development to climate change risk over its whole lifetime.

15.130 Further detailed guidance is also provided with regards to specific considerations for climate change. For example, the PPG companion document to the NPPF sets out the required approach to climate change for the assessment of flood risk. It provides recommendations for sensitivity ranges and allowances for future increases in rainfall, sea levels, river flows and tidal effects such as wind speed and wave height. For example, paragraphs 155 and 156 of the NPPF state:

> *"Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk (whether existing or future). Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere.*

Strategic policies should be informed by a strategic flood risk assessment, and should manage flood risk from all sources. They should consider cumulative impacts in, or affecting, local areas susceptible to flooding, and take account of advice from the Environment Agency and other relevant flood risk management authorities, such as lead local flood authorities and internal drainage boards."

Local Planning Policy

Barnsley Local Plan 2019-2033[xxii]

15.131 The BMBC Local Plan was adopted in January 2019 and provides the overarching framework of spatial policies and principles to support development in the local area. The Local Plan contains specific reference to climate change and includes policies which interface with climate change. Policies particularly relevant to this chapter are summarised below:

Policy CC3: Flood Risk: "The extent and impact of flooding will be reduced by: Not permitting new development where it would be at an unacceptable risk of flooding from any sources of flooding, or would give rise to flooding elsewhere…"

Policy CC4: Sustainable Drainage Systems (SuDS): "All major development will be expected to use Sustainable Drainage Systems (SuDS) to manage surface water drainage, unless it can be demonstrated that all types of SuDS are inappropriate."

Technical Guidance

Institute of Environmental Management and Assessment (IEMA): Environmental Impact Assessment Guide to: Climate Change Resilience and Adaptation[xxiii]

15.132 The Guide to Climate Change Resilience and Adaptation (June 2020) provides a framework for the effective consideration of climate change resilience and adaption in the EIA process in line with the UK Town and Country Planning (EIA) Regulations (2017). This document reflects lessons learnt from emerging practice.

15.133 A step-by-step method presented within this guidance is set out below and has been incorporated within this Chapter:

- Step 0 – Building climate resilience into the project by considering incorporating resilience during the design stage and by identifying appropriate mitigation measures;
- Step 1 – Scoping for the EIA; e.g. identify the climate change projections for use in the assessment and identify key climatic variables relevant to the project;
- Step 2 – Defining the future (climate) baseline; define future conditions using selected climate change projections (i.e. increase in rainfall, increase in mean summer temperature and wind strength);
- Step 3 – Identifying and determining sensitivity of receptors;
- Step 4 – Reviewing and determining magnitude of the effect; consider probability and consequence to determine the magnitude of the effect;
- Step 5 – Determination of significance;
- Step 6 – Developing additional adaptation / EIA mitigation measures; and
- Step 7 (Development permitted) – Monitoring and adaptive management by implementing mitigation measures.

15.134 Environmental Statement's produced in line with this guidance are to be proportionate in their approach and not include superfluous assessment that does not address likely material issues.

15.135 The 2020 IEMA guidance also introduced the concept of 'In-Combination Climate Impacts' (ICCI). An ICCI is when a projected future climate impact (e.g. increase in temperatures) interacts with an effect identified by another topic and exacerbates its impact. ICCI will be summarised within this Chapter.

15.136 Assessments undertaken in line with this guidance are to be proportionate in their approach and not include superfluous assessment that does not address likely material issues.

IEMA Climate Change Adaptation Practitioner Guidancexxiv

15.137 In November 2022, IEMA published guidance on adaptation from both a strategic perspective (i.e., why adaptation must be a core activity for any leading private or public sector organisation), and from a practical one – i.e., how to get started.

15.138 The guidance provides an overview of understanding climate risk and adaptation and offers practical advice to take action to adapt from various perspectives. The guidance includes a 'maturity matrix for adaptation' which sets out 29 actions across five common business functions. The function most appropriate to the Development is 'sites and operations'. This guidance can be adopted to identify the most relevant and useful tasks to form an adaptation approach, which can work in conjunction with the guidance outlined above.

Assessment Methodology

General Approach

15.139 The vulnerability of the Development to climate change considers effects on the Development as a receptor (this is referred to in IEMA Guidance as Climate Change Resilience and Adaptation). A high-level climate change risk and resilience assessment has been undertaken to identify the potential risks of climate change on the Development and to highlight design measures to increase its resilience and adaptation to climate hazards, such as extreme hot and cold weather, intense rainfall, high winds and storm events.

15.140 Guidance is evolving and there is no prescribed way in which climate change should be incorporated into an ES, however, some guidance has been prepared by IEMA, discussed further below, which sets out the two main approaches that can be taken to determine a project's climate change impact. Part 2, assessed in this section is summarised below:

- **Part 2:** The vulnerability of the Development to climate change (climate change adaptation / resilience).

15.141 In lieu of a prescribed methodology, IEMA guidance on Climate Change Resilience and Adaptation (2020) has been prepared to assist practitioners with the effective consideration *"of both climate change resilience and adaptation in the EIA process".* The guidance stresses that climate change should be an integrated consideration within the EIA, by undertaking an assessment that is *"proportional to the evidence base available to support any assessment" and focusses on impacts "specific to project".*

Scope of Assessment

15.142 This part of the Climate Change Chapter assesses the effects of climate change on the Development by:

- Establishing the existing baseline conditions (1991-2020);
- Determining future baseline conditions by reviewing UK climatic projections up to 2100 (including identifying sensitive receptors);

- Assessing the likely significant effects of the Development, with embedded mitigation measures incorporated, on the established baseline and future conditions;
- Identification of additional mitigation measures; and
- Assessment of residual effects.

Spatial Scope

15.143 Scientific evidence shows that our climate is changing. However, there are significant uncertainties in the spatial occurrence within the climate projections utilised in this assessment (25km grid square where the Site is located) (Figure 15.1). The UK Climate Projections (UKCP18) are not predictions or forecasts but simulations of potential scenarios of future climate under a range of hypothetical emissions scenarios and assumptions, and therefore cannot be treated as exact or factual, but projection options.

Temporal Scope

15.144 In considering future climate change scenarios, managing climate change resilience and adaption, the IEMA guidance (2020) recommends the use of the UKCP Website[xxv]. The latest UKCP is UKCP18 which provides updated observations and climate change projections up to 2100 in the UK. Therefore, this assessment assumes projections for the 2100 as the most far-reaching projection and is considered to be appropriate for the design life of the Development.

15.145 As the constriction phase is anticipated to be 2 years, it is considered that changes in the climate that may give rise to potential significant effects are not anticipated to manifest in this timeframe. Therefore, a climate resilience assessment during the construction phase of the Development has been scoped out of this chapter.

Identification of Sensitive Receptors

15.146 Receptors that may be affected by climate change have been identified with consideration of both extreme weather events and gradual climatic changes in the study area for the Development. In accordance with IEMA guidance, the sensitivity of receptors to climate change effects during operation is described in Table 15.7. In ascribing the sensitivity of receptors in relation to potential climate change effects, the susceptibility of the receptor (e.g. ability to be affected by a change) and the vulnerability of the receptor (e.g. potential exposure to a change) must be taken into account. These are defined in IEMA (2020) guidance as follows:

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

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

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

- *High vulnerability = receptor is directly dependent on existing/prevailing climatic factors and reliant on these specific existing climate conditions continuing in future (e.g. river flows and groundwater level) or only able to tolerate a very limited variation in climate conditions.*

- *Moderate vulnerability = receptor is dependent on some climatic factors but able to tolerate a range of conditions (e.g. a species which has a wide geographic range across the entire UK but is not found in southern Spain).*
- *Low vulnerability = climatic factors have little influence on the receptors."*

Table 15.7: Receptor Sensitivity

Receptor	Sensitivity	Reasoning
Operation		
Future users of the Site (employees)	Moderate to High	Some future users of the Site will be more susceptible to climate change than others, depending on a range of factors such as age and existing poor health.
Infrastructure including buildings and roads	Moderate	Infrastructure across the Development ranges in value. Critical infrastructure, such as energy and water pipes/cables are considered to be of moderate susceptibility given that it can tolerate some changes in climate but is critical for the operation of the Development. For potable water, the Development is within an area served by Yorkshire Water. The Environment Agency (EA) Water Stressed Areas Final Classification for 2021 classifies the Yorkshire Water company area as 'not seriously water stressed'.
Ecology, Landscaping and Planting	Moderate	The habitats that have been identified on-site are representative of typical lowland landscapes including woodlands, hedgerows and grasslands (see Chapter 9 for details) are not considered to be of high vulnerability to the broad effects of climate change such as changes in average temperatures. The river (Carr Dike) runs through the Site which is a steep sided watercourse which flows in a south west through the Site, this watercourse is considered to be of Local Importance and could be considered sensitive to changing climatic conditions such as decreasing precipitation. There are species recorded on the Site which are considered to be of District Importance, these are individual breeding birds' species: yellow wig tail and corn bunting. As well as marsh harrier birds. Other notable species are considered to be of local importance ecologically, and so could be considered sensitive to climate change. Dearne Valley Wetlands SSSI is located approximately 100m south west of the Site at its nearest point. The Dearne Valley Wetlands is a cluster of 22 wetland, scrub and woodland areas along the valley of the river Dearne and includes privately owned nature reserves, RSPB reserves and parkland.
Flood Risk	Moderate to High	The Site is predominantly located within Flood Zone 1 (Low Risk). There is an area of increased risk across the northern half of the Site associated with the Carr Dike. The area of increased risk varies from Flood Zone 2 (Medium Risk) to Flood Zone 3 (High Risk). The Site is predominantly classified as being at 'very low' risk of surface water flooding. There are however areas of increased risk within the Site boundary classified as being 'low' to 'high' risk. The flood risk posed to the Site, and the potential surface water run-off rate and volume from the Site, could increase in the future as a result of the predicted effect of climate change. Climate change is integral to the assessment of potential effects and mitigation design in relation to flood risk and therefore the assessment and resulting design of any necessary mitigation measures takes into account the anticipated increase in river flows and the potentially larger, more intense and more frequent storms that are predicted. The latest EA climate change guidance which requires the adoption of climate change allowances on a catchment basis, and subject to the 'flood risk vulnerability' and the design life of a development has been adopted.

Determining Significance and Significance Criteria

15.147 In general EIA practice, the sensitivity of a receptor is typically defined by taking into consideration the vulnerability, value and recoverability of the receptor. IEMA guidance states that receptor vulnerability and uncertainties must be considered. Significance has therefore been determined by IEMA guidance and professional judgement.

15.148 To ensure climate change adaptation is assessed, this chapter draws on recognised climate change projections, existing guidance and emerging good practice, as well as relevant information presented in the ES and documents which form part of the planning application, to ensure that appropriate project mitigation and risk management is included in the Development design. In particular, this chapter draws upon the findings of Chapter 9 Biodiversity, Chapter 10 Water Resources, Chapter 13 Transport, and Chapter 14 Air Quality.

15.149 A comprehensive Flood Risk Assessment (FRA) (Appendix 10.1) has been carried out, in consultation with BMBC, to assess the vulnerability of the Development to all possible types of flooding. The assessment followed technical guidance within the NPPF and examined flood risks at the existing baseline level and at the future baseline for the lifetime of the Development, taking into account projected climate change impacts for all sources of flooding.

15.150 Chapter 9 Biodiversity provides a detailed assessment of potential ecological impacts associated with the Development and evaluates the importance of the habitats and species present on the Site, which is summarised in Table 15.7 above. This Biodiversity Chapter is based on a wide array of surveys as described in Chapter 9.

15.151 An assessment of the effect significance with regard to the Developments' vulnerability to climate change is provided qualitatively with the most significant risks and opportunities for the project identified using professional judgement. The criteria for identifying the vulnerability of a receptor are set out in Table 15.7 above. This view has been taken given the longevity of the life span of the Development (estimated to be 60 years) and in consideration with the uncertainty of the projected pathway of climate change. Professional judgement is drawn as to whether climate changes (taking into account the future baseline) are likely to lead to a significant impact on the Development or not.

15.152 Effects that are described as 'minor' or 'negligible' are determined to be 'Not Significant' and effects that are described as 'moderate', or 'major' are determined to be 'Significant'.

Identifying Climate Change Projections

15.153 The current UKCP18 projections, released in November 2018, are the most up to date climate change projections available. The Met Office states that UKCP18 provides a valid assessment of the UK's future climate over land, but that when considering decisions that are sensitive to projected future changes in summer rainfall, additional information should also be used. In line with IEMA Guidance, this Chapter utilises climate projections using the 'worst case scenario' of future weather projections, and therefore Representative Concentration Pathway (RCP) 8.5[8] scenarios are used. The 2020 IEMA Guidance sets out that the use of the high emissions scenarios (Met Office UKCP18 RCP8.5) is generally recommended, unless the case can be made for using a different, lower emissions scenario.

15.154 Climate projections have been derived from the UKCP18 50th Percentile[9] Climate Projections at 25km grid square 437500, 412500 (where the Site is located, as shown in Figure 15.1) using baseline 1981-2000 scenario RCP 8.5.

15.155 This worst-case scenario assumes a 'business-as-usual' pathway through a combination of assumptions about high population levels, relatively slow income growth with modest rates of

[8] RCP 8.5 is a pathway where greenhouse gas emissions continue to grow unmitigated, leading to a best estimate global average temperature rise of 4.3°C by 2100. RCP 4.5 and RCP 6.0 are two medium stabilisation pathways, with varying levels of mitigation.

[9] The 50th percentile is chosen as it is the average from the typical plume which shows the 5th, 10th, 25th, 50th, 75th, 90th and 95th percentiles for the chosen emissions scenario.

technological change and energy intensity improvements, leading in the long term to high energy demand and GHG emissions in absence of climate change policies.

15.156 Taking into account the nature and location of the Development, the following climate related parameters/hazards are also considered to have the potential to impact upon the operation of the Development:

- Wind (speed, direction and gustiness);
- Temperature; and
- Precipitation.

Assessment of Likely Significant Effects

15.157 The resilience of the Development to climate change impacts is qualitatively assessed, based on professional expertise and judgement, with quantitative evidence where appropriate.

15.158 A high value receptor that has very little resilience to changes in climatic conditions should be considered more likely to be significantly affected than a high value receptor which is more resilient to changes in climatic conditions. The IEMA guidance outlines that if there is uncertainty about how a receptor will adapt to a changing climate, then a precautionary approach should be employed. Therefore, receptors have been assumed to have a moderate to high sensitivity to the changing climate, as summarised in Table 15.7 above.

Limitations and Assumptions

15.159 The UKCP18 climate change projections are not climate change predictions as they include a degree of uncertainty. As stated in the UKCP18 Science Overview Report[xxvi].

> *"While the global and regional projections of future climate use the latest climate models and are diverse they cannot cover all potential future climate outcomes out to 2100 (or beyond in the case of sea level)…"*

15.160 The 21st century projections presented in this report are produced for the RCP[10] climate change scenarios. The results are therefore subject to any inherent limitations of the assumed emissions scenarios including:

> *"The probabilities represent the relative strength of evidence supporting different plausible outcomes for UK climate, based on the climate models, physical insight, observational evidence and statistical methodology used to produce them. However, they may not capture all possible future outcomes, because, for example, some potential influences on future climate are not yet understood well enough to be included in climate models."*

15.161 The assessment of the Developments' direct contributions to climate change, and the resultant resilience of the Development has been based on the information available at the time of writing. This includes transport modelling scenarios which include the totality of the quantum of the Development. A qualitative appraisal of resilience to climate change is provided for the Development.

15.162 The following disciplines identified in other ES topic chapters and other supporting documents, are considered potentially sensitive to climate change.

- Biodiversity;

[10] Established by the Intergovernmental Panel on Climate Change (IPCC).

- Water Resources and Flood Risk;
- Soils and Agricultural Land;
- Noise;
- Transport; and
- Air Quality.

Baseline Conditions

Current Climate Conditions

15.163 This section summarises current climate conditions for the local area based on historic weather data and information about extreme weather events. The information presented below presents average weather conditions along with exceptional weather occurrences. To maintain relevance to current weather trends the displayed information has been calculated using data collected over the past three decades. The climate profile is taken from the closest available data source to the Site, located at Doncaster Sheffield Airport, approximately 26.3km east to the Site[xxvii].

15.164 Climatic averages (1991-2020) for the weather station indicate the following:

- Average annual maximum temperature was 14.47°C;
- Warmest month on average was July (mean maximum temperatures 22.30°C);
- Coldest month on average was January (mean minimum temperatures 1.43°C);
- Average total rainfall was 582.20mm (approximately 28% below the regional average);
- The wettest month on average was December (82.31mm); and
- Driest month on average was March (54.46mm).

15.165 The baseline conditions of other disciplines that could be affected by climate change can be viewed in their respective ES chapters.

Future Baseline

Future Climate Conditions (up to 2100)

Table 15.8: 50th Percentile Climate Projections at 25 km grid square 437500, 412500 using baseline 1981-2000 scenario RCP 8.5

Date	Climate Variable at 50th Percentile					
	Mean air temperature anomaly* at 1.5 m (Â°C)	Annual Precipitation rate anomaly (%)	Maximum Summer air temperature anomaly at 1.5 m (Â°C)	Average Summer Precipitation rate anomaly (%)	Minimum Winter air temperature anomaly at 1.5 m (Â°C)	Average Winter Precipitation rate anomaly (%)
2023	0.79	0.90	1.07	-8.37	0.75	1.57
2025	0.84	0.84	1.13	-8.82	0.81	1.82
2050	1.65	-1.47	2.31	-17.58	1.63	4.70
2080	3.24	-1.82	4.60	-31.90	2.94	12.47
2099	4.61	-2.27	6.73	-48.14	4.14	17.16

*Anomaly refers to the change compared to the baseline. The projections are not absolute values.

15.166 The full datasets can be viewed in Appendices 15.5-15.10.

15.167 Table 15.8 above indicates that the projections show a continuous increase in annual average air temperature over the next 80 years. Annual precipitation is also predicted to decrease over this time.

15.168 The projections in Table 15.8 above suggest that summers will become warmer and drier, with an expected increase in maximum summer temperatures and overall decline in summer precipitation. Natural variations may mean that some cooler and/or wet summers will occur.

15.169 Winters may become milder and wetter, with an overall increase in both minimum winter temperature and winter precipitation. Natural variations may mean that some cold and/or dry winters may still occur.

Wind speed and storms

15.170 Winds associated with major storm events can be some of the most damaging and disruptive events for the UK with implications for property, power networks, road and rail transport and aviation. Calm periods with little wind, particularly over prolonged periods, can affect air quality whilst winds from a particular direction can be a critical factor in the spread of pathogens. Both of these cases are also examples where the combination of factors such as wind, temperature and precipitation can exacerbate their impacts (e.g. air quality issues tend to be worse under conditions of light winds and higher temperatures; pathogen spread can require wind, temperature and precipitation conditions to be favourable[xxviii].

15.171 Changes in wind speeds are not currently available at the regional level and there remains considerable uncertainty in wind speed projections. However, there are small changes in projected wind speed. Across the UK, near surface wind speeds are expected to increase in the second half of the 21st century with winter months experiencing more significant impacts of winds. This is accompanied by an increase in frequency of winter storms over the UK. However, the increase in wind speeds is projected to be modest. There are no compelling trends in storminess as determined by maximum gust speeds from the UK wind network over the last four decades[xxix].

Summary

15.172 The Yorkshire, northern England region, where the Site is located, is set to experience hotter, drier summers and milder, wetter winters. With winter precipitation and the number of heavy rain days projected to increase, flooding events may be more likely and occur on a more frequent basis. Whilst

there are large uncertainties in the frequency and intensity of storms increasing under climate change, wind speeds are also expected to increase slightly.

Likely Significant Effects

15.173 As stated in paragraph 15.145, it is considered that changes in the climate that may give rise to potential significant effects are not anticipated to manifest in the 2-year construction timeframe. Construction phase effects are therefore scoped out of this assessment.

Operational Phase

Climate Change Risk Assessment

15.174 Table 15.9 below outlines the likely significant effects from climate on the identified receptors within the Development.

Table 15.9: Climate Change Risk Assessment

Climate Condition / Hazard	Receptor	Receptor Vulnerability	Potential Impact (with embedded mitigation)	Significance
Long Term Changes to Climate Norms	Future Users of the Site	Moderate to High	The climate is expected to become drier and hotter in summers and milder and wetter in winters in the region where the Site is located. Future site users such as employees and visitors may be at risk to climate extremes and long-term changes to climatic norms. As shown on the parameter plan (Figure 3.1), the Development is to comprise structured landscaping surrounding the Development zones. Blue infrastructure will also be provided with flood attenuation zones towards the north and north west of the Development. The existing Carr Dike watercourse is also to be retained alongside the existing vegetation adjacent to the watercourse. The retention and enhancement of green and blue infrastructure throughout the Development will provide a level of thermal cooling during hot periods, as well as flood attenuation to account for projected increased winter rainfall. Overall, the green infrastructure plans highlighted on Figure 3.1 and the DAS make the Development more resilient to climate change. As outlined in the Sustainability and Energy Statement (Appendix 15.4) the Development will comprise a range of demand reduction energy measures which will manage air flow and heating of the Development to ensure the Development is warm during periods of colder weather and cooler during periods of hot weather.	Minor Adverse
	Infrastructure	Moderate	Infrastructure may require more maintenance and repair as changes to climatic norms may cause increased stress on, for example, below ground cables and pipes. This will be managed at the detailed design stage, where risk assessments will be undertaken to manage risks from future climate change in accordance with nationally accepted standards and guidance. As stated in Table 15.7, the Site's potable water supply comes from Yorkshire Water, which is considered to be 'not seriously water stressed' by the EA. Therefore, the projected reduction in annual rainfall over the next 80 years is not anticipated to significantly affect the potable water supply to the Development.	Minor Adverse
	The Natural Environment (Ecology, Landscaping and Planting)	Moderate	Climate change may have implications on flora and fauna species on the Site, including trees and hedgerows, as well as the Carr Dike watercourse.	Moderate Adverse
	Flood Risk	Moderate to High	A reduction in rainfall annually, as suggested in the future baseline, will likely reduce the overall risk of the Development to flooding.	Negligible
Heatwaves	Future Users of the Site	Moderate to High	As shown in Table 15.8, summer temperatures are anticipated to increase, and heatwaves will become more frequent. Therefore, placing vulnerable receptors, such as future employees at risk.	Minor Adverse

Climate Condition / Hazard	Receptor	Receptor Vulnerability	Potential Impact (with embedded mitigation)	Significance
			As shown on Figure 3.1, the Development will comprise extensive green and blue infrastructure. Structured landscaping will surround the Development zones, as well as flood attenuation ponds to the north and north west. There will also be boundary planting along the northern, eastern, and southern boundaries of the Development. The retention and enhancement of green and blue infrastructure throughout the Development will provide a level of thermal cooling during heatwaves for employees and visitors to utilise. The Sustainability and Energy Statement (Appendix 15.4) outlines that the Development will be formed of sustainable, well-designed buildings which will be sufficiently ventilated to enable fresh air to circulate. This will benefit future users of the Site during periods of hot weather.	
	Infrastructure	Moderate	Infrastructure may require more maintenance and repair as changes to climatic norms may cause increased stress on, for example, below ground cables and pipes. This will be managed at the detailed design stage, where risk assessments will be undertaken to manage risks from future climate change in accordance with nationally accepted standards and guidance. As outlined above, it is anticipated that the potable water supply to the Development should be able to withstand climate extremes such as heatwaves, as the region is not considered to be water stressed.	Minor Adverse
	The Natural Environment (Ecology, Landscaping and Planting)	Moderate	New and existing plant species will be increasingly vulnerable to extreme high temperatures throughout the lifespan of the Development. Attenuation ponds may also evaporate, placing aquatic plants and species at risk of stress and fatality. As shown on the Landscape Location Plan (Figure 3.2), the Development will retain 2.27ha of woodland, 22 individual trees and 0.89km of hedgerows. Habitat creation embedded within the design of the Development will include the creation of 0.24ha of modified grassland, 19.85ha of other neutral grassland, 3.0ha of mixed scrub, 8.68ha of broadleaved woodland, 3.67ha of wet woodland, 2.97ha of ponds (used within SUDS but which permanently hold water), and 0.27ha of other SuDS features, 70 medium sized individual trees and 6.62km of hedgerow. The range of new habitats outlined above will be more resilient to heatwaves than a uniform programme of planting. Retained and new habitats such as woodland and ponds will provide shading and new areas of habitats for fauna supported by the Site, making fauna and flora more resilient to periods of hot weather.	Moderate Adverse
Low Rainfall and Drought	Infrastructure	Moderate	Low rainfall and drought may reduce the potable water supply to the Development, which will potentially impact the operation of the Development. The region in which the Development is located is served by Yorkshire Water, which is within an area that the EA defines as ‘not seriously water stressed’. It is therefore anticipated that the regions water supply will have a level of resilience to cope with periods of low rainfall and drought.	Negligible

Climate Condition / Hazard	Receptor	Receptor Vulnerability	Potential Impact (with embedded mitigation)	Significance
	The Natural Environment (Ecology, Landscaping and Planting)	Moderate	Periods of prolonged low rainfall and drought are projected to become more frequent, as suggested in Table 15.8 with rising summer temperatures and declining summer rainfall over the next 80 years. These conditions will put more stress on new and existing plant species throughout the Development, which without management will be more likely to fail. Furthermore, the existing Carr Dike which runs through the Site is considered to be of Local ecological importance. Declining annual rainfall and significant reductions in summer rainfall may result in the watercourse drying out, particularly in summer months. This would likely result in aquatic plants within and adjacent to the watercourse to fail. A similar consequence may also occur for the proposed flood attenuation areas within the Development. As stated above, the diverse range of new habitat being planted as part of the Development including grassland, waterbodies, hedgerows, trees and woodland will provide a level of resilience to flora and fauna species during periods of low rainfall. As stated in Chapter 9 (Biodiversity), the Development will provide pond habitat increases from only 47m^2 pre-development to 2.97ha during operation, although these ponds would be non-priority habitats and associated with Site drainage – they will provide water supply to ecology, landscaping, and planting during periods of low rainfall.	Moderate Adverse
Heavy Rainfall and Flooding	Future Users of the Site	Moderate to High	The EA climate change allowances map for peak river flow in England[xxx] suggests that in the 2020's, the upper limit of changes in peak river flow in the Don and Rother Management Catchment (where the Site is located) will be a 25% climate change uplift. However, by the 2080's this rises to a 60% upper increase. As shown in the Drainage Management Strategy (Appendix 10.2), the SuDS have been designed in accordance with a 40% climate change uplift applied. A SuDS feasibility study within Appendix 10.2 indicates that a range of SuDS measures are appropriate for the Site including: retention through balancing ponds/swales and sub-surface attenuation, a detention basin, enhanced wet or dry swales, rainwater harvesting, rainwater gardens, filter drainage and conveyance swales may also be used. Permeable paving may be used which will be conveyed into the proposed drainage system and infiltration is subject to further investigation and soak-away testing. The exact design specification of SuDS to be used on-site will be determined at the detailed design stage. The storm-water volumes generated by a 1 in 100-year event (+40% climate change uplift) are classed as exceedance flooding and will be safely contained on-site and directed away from the buildings, where they will sit in the car parking and landscape area and drain into the surface water infrastructure as water levels recede. Therefore, future site users are offered greater protection from flooding.	Minor Adverse

Climate Condition / Hazard	Receptor	Receptor Vulnerability	Potential Impact (with embedded mitigation)	Significance
			The Development is considered to be 'less vulnerable' as it is being proposed for non-residential uses.	
	Infrastructure	Moderate	As stated above, the upper limit of changes in peak river flow in the Don and Rother Management Catchment (where the Site is located) will be a 25% climate change uplift in the 2020's. Rising to a 60% uplift by the 2080's. The increased likelihood of intense periods of rainfall puts the Development at greater risk, particularly in areas where the Site is located in Flood Zones 2 and 3, and at higher risks of surface water flooding - through the central and northern portions of the Site. Flooding therefore poses a risk to infrastructure without additional mitigation. Parameter plans for the Development show a flood mitigation area towards the north of the Site, where flood risk is greatest. The FRA (Appendix 10.1) suggests a 40% climate change uplift has been applied, in line with a central estimate of changes in peak river flow towards the 2080's. Therefore, in line with future climate projections, the Development is potentially at risk of flooding towards the 2080's, using an upper limit, outlined above. However, as Table 15.8 indicates, annual rainfall is projected to decline, and although winter rainfall is projected to increase, the central estimate towards 2080 (a 40% uplift) applied in the FRA is sufficient to mitigate flood risk of the Development. Flood risk is appropriately mitigated through flood compensation areas (FCA) and culverts which will divert surface water flow away from the built development, protecting future infrastructure.	Minor Adverse
	The Natural Environment (Ecology, Landscaping and Planting)	Moderate	As shown on Figure 3.1, the existing watercourse throughout the Development will be retained. The creation of 2.97ha of attenuation pond habitats and 0.27ha of SuDS features, will also create biodiversity enhancements on-site, such as through the creation of aquatic plants and species on-site. As shown on the Landscape Plan submitted as part of the planning application, a range of plant species will be planted including ornamental shrubs, woodland mix, thicket mix, indigenous hedgerows, and wildflower grass. Whether the attenuation ponds will be wet or dry will be considered at detailed design stages. Periods of heavier rainfall will provide biodiversity benefits for the areas designed for flood attenuation. As shown in the Biodiversity chapter, the proposed habitat creation will expand the area of woodland within the Site from 3.16ha pre-development to 17.21ha in the operational phase, extending the corridor of habitat along Carr Dike and introducing additional diversity through the inclusion of mixed woodland and wet woodland creation. In addition, 3.0ha of mixed scrub habitat will be created, predominately at woodland edges or extending from the woodland areas. These habitats would require 10-30 years to establish but once mature and managed appropriately (through a landscaping management regime to be secured via a planning condition) would be	Minor Adverse

Climate Condition / Hazard	Receptor	Receptor Vulnerability	Potential Impact (with embedded mitigation)	Significance
			a permanent significant increase in woodland habitat considered to be medium or potentially high ecological distinctiveness. The increase in woodland and scrub habitat will provide benefits for flood attenuation, slowing down surface run-off rates with increased interception and evapotranspiration. This is particularly important during periods of high intensity and short rainfall, which is predicted to become more common. Furthermore, as shown in Table 15.8, winter rainfall is projected to increase. Therefore, the increased green infrastructure across the Development will reduce run-off and provide flood attenuation to the built development during periods of heavy rainfall and flooding.	
	Flood Risk	Moderate to High	As shown on the parameter plan for the Development (Figure 3.1), this existing Carr Dike watercourse is to be retained, alongside the creation of two flood attenuation areas to the north and north west of the Development. Proposed flood attenuation areas have been located in areas of higher flood risk (Flood Zones 2 and 3), this will provide appropriate flood attenuation during periods of heavy rainfall and will divert surface water flows away from the built development to the flood attenuation areas, reducing the overall flood risk of the Development. The FRA outlines that the post-Development scenario modelling confirmed the proposed mitigation measures, ground raising and FCAs, are to successfully mitigate on-site flooding across the Developments design life. The proposed sequence of FCAs and culverts allow out of bank flows to bypass the Site and re-join the Carr Dike along the western boundary, ensuring no detrimental impacts to third-party land. The modelling also confirms the proposed crossings over the Carr Dike and Highgate Lane Dike do not cause additional flooding. The Development is considered to be ‘less vulnerable’ as it is proposed for non-residential use.	Minor Adverse

Mitigation Measures

Operational Phase

Future Users of the Site

15.175 The future of the Development may be at risk during heatwaves across the lifespan of the Development. A landscaping and SuDS strategy will ensure that green / blue infrastructure is provided and maintained on-site to provide level of thermal cooling / shading.

15.176 Energy demand reduction measures outlined in the Sustainability and Energy Statement (Appendix 15.4) will regulate airflow and ventilation which will provide sufficient cooling during periods of hot weather.

Infrastructure

15.177 At the detailed design stage risk assessments will be undertaken to manage risks from future climate change in accordance with nationally accepted standards and guidance.

15.178 The Sustainability and Energy Statement (Appendix 15.4) outlines that water conservation measures should be considered. There is potential for the Development to target the higher water efficiency standard outlined in Building Regulations Part G, which is 110 litres/person/day. To achieve this, the Development could adopt water efficiency measures such as leak detection systems, flow control devices and pulsed water meters, to reduce the energy demands associated with water heating where relevant.

The Natural Environment (Ecology, Landscaping and Planting)

15.179 As outlined in the DAS, landscaping will comprise the conservation of existing hedgerows and trees where possible, reinforced by new tree, hedgerow and shrub planting and other habitats. Largely native trees and shrubs will be planted to reflect those in the existing locality. A mix of planting sizes and densities would be adopted to satisfy the differing objectives, such as establishing well balanced woodland and planting habitats.

15.180 The detailed phases will provide new planting as part of a long-term approach to the growth and management of the overall landscape framework. A conservation-led Landscape Ecological Management Plan (LEMP) will be produced for the Development and secured via a planning condition. This will provide the over-arching aims and objectives for on-Site habitat creation and management aimed at benefiting biodiversity over the long-term, including details of management responsibilities and mechanisms to secure the long-term management and setting out the framework for ongoing management and monitoring. It will set out the targeted objectives and detailed management prescriptions for each habitat type or feature, the monitoring requirements, and a rolling five-year work programme (for a 30-year period as one of the principles of 'Biodiversity Net Gain'). These measures will seek to benefit local fauna which use or could use the Site. Management and maintenance will provide a level of resilience to climatic changes and extremes of proposed planting and landscaping, increasing chances of survival and maturation.

15.181 The long-term management and maintenance of landscaping will be secured through appropriately worded planning conditions.

Flood Risk

15.182 As stated in the FRA (Appendix 10.1), it is recommended that finished floor levels are raised significantly above the maximum flood level (>2m) ensuring the Development is safe across its design life.

15.183 The car parking and yard catchment areas will be developed at the detailed design stage. It is envisaged that surface water run-offs from this catchment will be drained via drainage channels, kerb

drains and filter drains and then discharge into the new private surface water network. Surface run-off from the roof will also discharge to the new private surface water network.

15.184 An appropriate maintenance strategy and programme, to be secured by a planning condition, will be put in place for the entirety of the Development's operation in order to maintain the surface water drainage regime (SuDS) on-site.

Residual Effects

Operational Phase

Future Users of the Site

15.185 Future users of the Site will be safeguarded during climatic extremes through efficient energy design, planting and landscaping and sufficient flood attenuation, as outlined in Table 15.9. The residual effect on future site users is therefore considered to be **Minor Adverse**, which is **not significant**.

Infrastructure

15.186 It is expected that infrastructure will be safeguarded at the detailed design stages to account for climate change. The Development is also not within an area that is deemed to be water stressed, therefore potable water supply should be resilient during periods of low rainfall. Appropriate flood mitigation set out will also safeguard infrastructure and the built Development from flood risk. The residual effects from climate change on infrastructure is therefore considered to be **Minor Adverse** and **not significant**.

The Natural Environment (Ecology, Landscaping and Planting)

15.187 It is expected that climate change will put ecology, landscaping, and planting under stress in numerous ways, as outlined in Table 15.9. Notwithstanding, a long-term, conservation led approach as outlined in paragraph 15.181 will provide resilience to new and retained planting and allow for appropriate adaptation as the climate changes over the project lifespan. The residual effect on the natural environment is therefore anticipated to be **Minor Adverse** and **not significant**.

Flood Risk

15.188 The Development is within Flood Zones 2 and 3 in the northern and western portion of the Site, as well as higher surface water flooding risk. The Development incorporates green infrastructure and SuDS to mitigate flood risk through the lifespan of the Development. The Development is safeguarded against flooding and a climate change uplift of 40%, predicted as a central peak river flow uplift estimate towards the 2080's. The residual effect is considered to be **Minor Adverse** and **not significant**.

Cumulative Effects

15.189 The combination of cumulative schemes will not impact upon climate change resilience for the Development or committed schemes. A cumulative assessment of climate change resilience is therefore not considered in this ES chapter.

In-Combination Effects

15.190 There is potential for in-combination climate change effects to exacerbate other environmental effects identified in other topic chapters without mitigation. There is a need to deliver a co-ordinated approach to the climate change mitigation measures to provide climate resilience within the Development. The proposed embedded mitigation measures have been outlined throughout this chapter and other technical documents such as the DAS, which is submitted separately with the planning application. It is considered that with the implementation of these embedded mitigation measures and careful consideration of climate change mitigation and adaptation measures at the detailed design stages, the effects identified within the topic chapters will not be exacerbated as a result of climate change. In-combination effects are therefore considered to be Minor Adverse and not significant.

Summary

15.191 UKCP Projections for the 25km grid square where the Site is located (Figure 15.1) project that summers are going to get drier and hotter, whereas winters will get wetter and milder. The Development is host to receptors of varying sensitivity to climate change, such as future users of the Development, infrastructure, the natural environment, and flood risk.

15.192 Following embedded and additional mitigation measures, residual effects from climatic changes on future site users, infrastructure, the natural environment, and flood risk are not considered to be significant.

15.193 Table 15.10 contains a summary of the likely significant effects of the Development.

Table 15.10: Table of Significance – Climate Change Mitigation and Resilience

Potential Effect	Nature of Effect (Permanent/ Temporary)	Significance (Major/Moderate/Minor) (Beneficial/Adverse/Negligible)	Mitigation / Enhancement Measures	Geographical Importance*							Residual Effects (Major/Moderate/Minor) (Beneficial/Adverse/Negligible)
				I	UK	E	R	C	B	L	
Construction											
Construction Transport Emissions	Temporary	Negligible	Implementation of a CEMP to be secured through a planning condition.	X							Negligible
Completed Development (Climate Change Mitigation)											
Operational Transport Emissions	Permanent	Moderate Adverse	Implementation of a Travel Plan. Cycle spaces, improved pedestrian connectivity, EV charging spaces.	X							Moderate Adverse and Significant

Operational Energy Emissions	Permanent	Minor Adverse	Adherence to the Energy Hierarchy and implementation of Be Lean, Be Clean and Be Green Measures.	X							Minor Adverse
Carbon Sequestration Potential	Permanent	Moderate Adverse	A long-term maintenance and management plan to be secured through a planning condition.	X							Minor Adverse
Completed Development (Climate Change Resilience)											
Effects of climate change on future site users	Permanent	Minor Adverse	Adherence to the Energy Hierarchy and implementation of Be Lean, Be Clean and Be Green Measures. Appropriate landscaping and planting and flood mitigation.	X							Minor Adverse

Effects of climate change on infrastructure	Permanent	Minor Adverse	Infrastructure to be safeguarded at detailed design stage e.g. Raised Finished Floor Levels.	X							Minor Adverse
Effects of climate change on the natural environment	Permanent	Moderate Adverse	A long-term maintenance and management plan to be secured through a planning condition.	X							Minor Adverse
Effects of climate change on flood risk	Permanent	Minor Adverse	Designs specifications of SuDS and FCA planting to be secured at the detailed design stage. Maintenance strategy to be secured by planning condition.	X							Minor Adverse
Cumulative Effects											
Construction											
N/A											
Completed Development											

Operational Energy Emissions	Permanent	Minor Adverse	Adherence to the Energy Hierarchy and implementation of Be Lean, Be Clean and Be Green Measures.	X							Minor Adverse
Carbon Sequestration Potential	Permanent	Minor Adverse	A long-term maintenance and management plan to be secured through planning conditions.	X							Minor Adverse

* Geographical Level of Importance

I = International; UK = United Kingdom; E = England; R = Regional; C = County; B = Borough; L = Local

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