LAND AT DEAL GROUND AND MAY GURNEY

Environmental Statement Addendum – Chapter 15: Climate Change

Serruys Property Company Limited

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CONTENTS

15 CLIMATE CHANGE

15.1 INTRODUCTION

15.1.1 Purpose and Structure of the Chapter

This chapter of the ESA reports an assessment of the likely significant effects of the proposed development on the global atmosphere through the emission of greenhouse gases (GHGs); as well as an assessment of climate change resilience and adaptation, including an in-combination climate change impact assessment.

The chapter and its supporting appendices describe the planning policy context, the assessment methodology; the baseline conditions at the application site and surroundings; the likely significant effects of the proposed development; the mitigation measures required to prevent, reduce or offset any significant adverse effects; and the likely residual effects after these measures have been employed.

15.2 METHODOLOGY

15.2.1 Changes in Legislation, Guidance and Planning Policy

The ES that supported the original outline planning application (Lanpro Services, November 2010) (hereafter referred to as the '2010 ES') was prepared prior to 2017, when the requirement to consider the impacts of climate change in EIA in the UK was formally introduced. While reference was made to legislation, guidance and planning policy related to climate change in some of the ES chapters, a specific climate change ES chapter was not included in the ES and, therefore, a specific legislation, guidance and planning policy summary related to the climate assessments reported in this ESA chapter was also not included. The following section sets out the current climate change legislation, guidance, and planning policy context for the proposed development.

15.2.1.1 Guidance

Industry guidance and standards that have been consulted in the undertaking of this assessment, are as follows:

- IEMA Environmental Impact Assessment Guide to: Climate Change Resilience & Adaption, 2020. (the 'IEMA R&A Guidance')
- IEMA guide to 'Assessing Greenhouse Gas Emissions and Evaluating their Significance, Second Edition' (2022) (the 'IEMA GHG Guidance');
- British Standards Institution, PAS 2080 – Carbon Management in Infrastructure Verification;
- RICS Guide to 'Whole life carbon assessment for the built environment', 2017 (the 'RICS Guide');
- BRE Global Methodology For The Environmental Assessment of Buildings Using EN 15978:2011;
- LETI Embodied Carbon Primer 2020;
- RIBA 2030 Climate Challenge Version 2;
- Low Energy Transformation Initiative (LETI) and RIBA, Embodied Carbon Target Alignment, 2021;
- Greater London Authority (GLA) Whole Life-Cycle Carbon Assessments, March 2022;

- BSRIA Rules of Thumb, 2011;
- BS EN 15978:2011 Sustainability of construction works. Assessment of environmental performance of buildings. Calculation method;
- Better Building Partnership 2020 Real Estate Environmental Benchmarks, 2021; and
- BREEAM UK New Construction 2018.

15.2.1.2 Legislation and Policy

This section sets out the legislation and planning policy context for the proposed development and for the context of the assessment process.

15.2.1.2.1 Paris Agreement 2015

Negotiations at the Conference of the Parties (COP) 21 led to the 2015 Paris Agreement, the aim of which is to maintain the increase in global average temperature at 'well below' 2°C and 'pursue efforts' to limit the temperature increase even further to 1.5°C.

A total of 160 parties, including the UK, made voluntary pledges to reduce emissions by 2030, however the cumulative effect of these would still lead to an estimated 3°C of warming or greater.

15.2.1.2.2 The Special Report on Global Warming of 1.5°C, International Panel on Climate Change (IPCC) 2018

The IPCC published a special report in response to the Paris Agreement, to present the impacts of the targeted 1.5°C temperature rise. The report highlighted that to achieve this, global emissions must decrease by 45% by 2030 (against a 1990 baseline), and that net zero global emissions (where emissions and removals from the atmosphere are balanced) must be achieved by 2050. This is noted to require rapid and far-reaching transitions of every sector on an unprecedented scale.

15.2.1.2.3 National Planning Policy Framework

The NPPF 2021 includes mitigating climate change and moving to a low carbon economy as part of its overarching objectives and strategic policy. Section 14 ‘Meeting the challenge of climate change, flooding and coastal change’ sets out that new development should ‘help to reduce greenhouse gas emissions, such as through its location, orientation and design’.

15.2.1.2.4 The Climate Change Act (2008) & The Climate Change Act 2008 (2050 Target Amendment) Order 2019

To support international efforts, the UK Climate Change Act set a legal GHG target for the year of 2050 for the reduction of GHG emission. The target set by this Act is ‘at least 80% lower than the 1990 baseline’ by 2050.

The Act introduced a series of carbon ‘budgets’ to be implemented for succeeding five-year periods to gradually result in an overall reduction in greenhouse gases.

In June 2019 the Climate Change Act was amended to set the overall reduction target by 2050 to ensure that the net UK carbon account is lower than the 1990 baseline.

According to the most recent Progress in reducing emissions (2021 Report to Parliament, the ‘UK’s record to date is strong in parts’ (having outperformed its first and second budgets), ‘but it has fallen

behind on adapting to the changing climate and has not yet provided a coherent plan to reduce emissions in the critical decade ahead'.

15.2.1.2.5 UK Government Carbon Budgets Orders 2009, 2011, 2008 & 2021

A series of Orders set the carbon budget for these five year budgetary periods. These carbon budgets set a cap on the maximum level of the net UK carbon 'account' for each five-year budgetary period. The net UK carbon account is defined in section 27 of the Climate Change Act 2008.

There are budgets currently set up to 2037. The UK is currently in the fourth carbon budgetary period (2023-2027), the budget for which is 1,950 MtCO2e. The UK cannot legally emit more GHGs than this within this budgetary period. The future carbon budgets set are:

- 2028-2032: 1,725 MtCO2e; and
- 2032-2037: 965 MtCO2e.

Whilst budgets are not set beyond this, there is a legal requirement for the UK to reach 0 MtCO2e by 2050.

15.2.1.2.6 UK Government Net Zero Strategy: Build Back Greener (2021)

On 20 April 2021, the Government announced that it "will set the world's most ambitious climate change target" to reduce emissions by 78% by 2035 compared to 1990 levels as part of its sixth carbon budget.

The Net Zero Strategy (21) identifies the following commitments:

- Delivering a decarbonised power system by 2035;
- An ambition for 5 GW UK low carbon hydrogen production capacity by 2030;
- Ambition to deliver 6 MtCO2 per year of industrial Carbon Capture, Utilisation and Storage (CCUS) by 2030, and 9 MtCO2 per year by 2035;
- Making the transition to low carbon buildings affordable and achievable for all by:
- Aiming to phase out the installation of new and replacement natural gas boilers by 2035;
- Making heat pumps as cheap to buy and run as a gas boiler by growing the heat pump market to support 600,000 installations per year by 2028 and expanding UK manufacturing;
- Consulting on phasing out the dirtiest and most expensive fossil fuels first – new oil, coal and liquefied petroleum gas heating - and replace with low carbon alternatives in non-domestic buildings from 2024 and homes from 2026, following natural appliance replacement cycles; and
- Ensure the UK's charging infrastructure network is reliable, accessible, and meets the demands of all motorists.

15.2.1.2.7 UK Government, Part L of the Building Regulations (2021) Conservation of Fuel & Power

Part L of the Building Regulations (2021) Conservation of Fuel & Power provides guidance on how to comply with the energy efficiency requirements of the Building Regulations. It requires that reasonable provision shall be made for the conservation of fuel and power in buildings by:

Limiting heat gain and losses through thermal elements and other parts of the building fabric; and from pipes, ducts and vessels used for space heating, cooling and hot water services; and

Providing fixed building services which are energy efficient; have effective controls; and are commissioned by testing and adjusting as necessary to ensure they use no more fuel or power than is reasonable in the circumstances.

15.2.1.2.8 UK Government, Energy White Paper, 2020

The Energy White Paper: Powering our net zero future (December 2020) is an energy policy in response to the increasing challenges faced by the UK, including climate change, decreasing domestic supplies of fossil fuel and escalating energy prices. The Energy White Paper puts the net zero carbon emissions target and UK's effort to fight climate change at its core, setting the following priorities:

- Transform the energy sector to cut UK's carbon dioxide emissions, the main contributor to global warming;
- Support a green growth of the economy, providing green jobs in new green industries; and
- Secure supply and protect the fuel poor.

15.2.1.2.9 Joint Core Strategy for Broadland, Norwich and South Norfolk, 2011

This Joint Core Strategy (JCS), prepared by the three councils of Broadland, Norwich and South Norfolk, working together with Norfolk County Council as the Greater Norwich Development Partnership (GNDP), sets out the long-term vision and objectives for the area, including strategic policies for steering and shaping development.

The strategy sets out the policies addressing climate change and promoting sustainability with the aim to:

- locate development in places that will minimise adverse impact on the environment, and ensure it is designed to be energy efficient and capable of being adapted as circumstances change; and
- use energy and water wisely and secure more energy from renewable sources

Policy 3: Energy and water sets the below targets with regards to energy efficiency:

- aim to minimise reliance on non-renewable high-carbon energy sources and maximise the use of decentralised and renewable or low-carbon energy sources and sustainable construction technologies, providing at least 10% of the scheme's expected energy requirements.

15.2.1.2.10 Greater Norwich Local Plan (GNLP) Publication Draft Plan

The Broadland District Council, Norfolk County Council and South Norfolk District Council are currently preparing the Greater Norwich Local Plan (GNLP). The GNLP will build on the long-established joint working arrangements for Greater Norwich which have delivered the current Joint Core Strategy (JCS) for the area. The JCS plans for the housing and job needs of the area to 2026 and the GNLP will ensure that these needs continue to be met to 2036.

The GNLP will include strategic planning policies and will also allocate individual sites for development. It will aim to ensure that new homes and jobs are delivered and the environment is protected and enhanced, promoting sustainability and the effective functioning of the area.

The GNLP promotes housing choice and supports economic activity within the rural parishes that surround market towns and key service centres. It also aims to provide a greater degree of opportunity for smaller builders to develop with their local supply chains and bespoke designs.

15.2.1.2.11 Norwich Local Plan: Development Management Policies plan, 2014

The Norwich Local Plan: Development Management Policies provides detailed planning policies to help deliver the JCS strategic policies, objectives and priorities.

In particular, the development management policies plan includes a range of policies, primarily in Policies DM1 - Achieving and delivering sustainable development, DM3 - Design principles and DM4 - Renewable energy, that respectfully deal with matters relating to sustainable design and construction, energy efficiency and greenhouse gas reduction.; and Policy DM2 - Amenity relates to future occupiers' health and wellbeing, with particular regard given to high standard of amenity for satisfactory living and working conditions. Future proofing the proposed development against rising temperatures and tackling the risk of overheating falls within this policy requirements.

15.2.1.2.12 Norwich City Council Environmental Strategy 2020 – 2025

This document is the fourth environmental strategy that Norwich CC has produced and details the council's environmental vision and priorities until 2025. The new strategy commits to working in partnership to make a real difference to how Norwich responds to climate change. The strategy includes 10 strategic priorities in order to be recognised as one of the best councils in the country for addressing the issue of climate change.

15.2.1.2.13 South Norfolk Local Plan: Development Management Policies document, 2015

The Development Management Policies determine how the Council carries out its development management responsibilities to promote sustainable development. A number of relevant policies are set out below.

Policy DM 3.8 'Design Principles applying to all development' sets high quality standards for new developments in terms of scale, massing, materials etc. Optimum building orientation needs to be considered for developments to benefit from sunlight and passive solar energy.

Policy DM 4.1 Renewable Energy supports maximising use of renewable energy technologies on site for reducing carbon emissions further,

15.2.1.2.14 South Norfolk District Council Environmental Strategy and Delivery Plan 2023 –2025

This document is South Norfolk DC's environmental strategy and delivery plan, which details the council's environmental vision and commitments, achievements to date and their priorities/targets until 2025. The delivery plan includes six key principles which underpin South Norfolk's approach to addressing net-zero, climate change and the environment:

- The Energy Transition;
- Doing more ourselves;
- Enhancing our natural environment;
- Enhancing our natural environment;
- Helping people do more at home;
- Sustainable communities; and
- Growing our local businesses.

15.2.2 Scoping Opinion

Comments in relation this technical topic were provided by Norwich City Council (Norwich CC) and South Norfolk District Council (South Norfolk DC) in their respective Scoping Opinions dated 23 November 2022 and 07 December 2022 respectively. In their most recent Scoping Opinion dated 10 May 2023, Norwich CC provided no further comments in relation to this topic. The Broads Authority provided no comments on this topic in their Scoping Opinion dated 02 November 2022.

Table 15.1 summarises the key EIA Scoping Opinion comments with respect to this topic and how and where these have been addressed in the chapter.

Table 15.1 - Comments Provided in Scoping Opinion

Scoping Comments	How addressed in the ESA chapter
South Norfolk DC	
In line with the EIA Regulations 2017, a new chapter addressing climate change should be introduced in the updated ES. This should include a climate change risk assessment prepared in accordance with the principles set out in the IEMA Environmental Impact Assessment Guide to: Climate Change Resilience & Adaption.	This has been undertaken and is reported in this ESA chapter.
This chapter should also include an assessment under relevant local planning policy to include the Joint Core Strategy for Broadland, Norwich and South Norfolk (policy 3).	The Joint Core Strategy for Broadland, Norwich and South Norfolk has been considered in the preparation of this ESA chapter.
Norwich CC	
The 2017 EIA Regulations require an assessment of the impact of the project/development on climate (for example the nature and magnitude of greenhouse gas emissions) and the vulnerability of the project to climate change. A new climate change chapter of the ES should describe the likely climate change hazards and their associated risks to the proposed development and future site users. The contribution of the proposed development to global climate change should also be considered. A risk assessment of key climate change hazards to the proposed development is required to ensure that the proposed development has included design features to adapt to any adverse future climate change risks. In addition, the proposed development will result in greenhouse gas emissions during construction and operation and these emissions should be assessed quantitatively to minimise the proposed development's impact on global climate change. Following guidance within the Institute of Environmental Management and Assessment (IEMA) EIA Guide to Greenhouse Gas Assessment (2022) and EIA Guide to Climate Change Resilience and Adaptation a risk assessment should be produced and include	The assessments reported in this ESA chapter have been undertaken with consideration given to these comments. It should be noted that, as a contractor is not yet appointed, the full detailed scheme information required to undertake a full embodied carbon assessment of the proposed development, such as construction material quantities, is not yet available. As such, conservative estimates have instead been made to inform this ESA chapter, based on benchmarks sourced from relevant industry publications and the proposed floorspace quanta. The assumptions are considered conservative.

Scoping Comments	How addressed in the ESA chapter
the following; • A policy and desk top review using relevant local, regional and national data; • Establishment of baseline conditions by modelling climate change scenarios for the site of the proposed development using data from the UK Climate Change Projections for 2030, 2060 and 2090; • A quantitative assessment of the climate change risks associated with the proposed development; • A quantitative assessment of the greenhouse gas emissions associated with the proposed development based on available data and industry recognised benchmarks; • Mitigation of any adverse climate change risks in the form of adaptation measures as part of the proposed development; and • Mitigation of the impact that the proposed development will have upon climate change should be developed in accordance with relevant local and national policy. • A 'whole life' carbon options analysis, including end of life pathways for construction materials. • The environmental effects of the full range of potential energy sources at the site. • Mitigation should include measures to minimise construction waste and minimise water consumption during demolition and construction and the operational phases of the development. • Relevant local policy would include Joint Core Strategy for Broadland, Norwich and South Norfolk, Policy 3 which requires development to include sources of 'decentralised and renewable or low carbon energy' providing at least 10% of the scheme's expected energy requirements and provisions within emerging/draft Policy 2 of the Greater Norwich Local Plan. • The development will be taking place as we are about to enter into a new low carbon phase of building construction. How the development will meet the Future Homes Standard/Future Buildings Standard requirements moving forward needs to be explained. The Environmental Statement should acknowledge that large parts of the site are located within the administrative area of Norwich City Council and that the council declared and passed a climate emergency motion in January 2019 and have adopted an Environmental Strategy 2020 – 2025. In November 2021 Norwich	Module D in the IEMA GHG Guidance, the 'Beyond Asset Life Cycle' stage, encompasses emissions associated with activities beyond the site boundary and life cycle of the proposed development. This module relates to the repurposing of discarded building elements or any energy recovered from beyond a project's lifecycle. The IEMA GHG Guidance states that "Certain life cycle modules (or stages) can be excluded if these exclusions are clearly highlighted and justified by the practitioner using professional judgement and in accordance with the materiality and cut-off guidance." Reliable information about how the components of the scheme could potentially be repurposed following its demolition at the end of its life is not currently available. Given that Module D lies outside the proposed development's lifecycle and only covers GHG emissions that could potentially be avoided as a result of repurposing of discarded materials, it is considered that the proposed assessment of Modules A to C (only) comprises a conservative assessment. On this basis, consideration of Module D has not been included in the scope of the GHG emissions assessment. It is recognised that covering all GHG emissions associated with a development is challenging and therefore, the IEMA GHG Guidance places emphasis on

Scoping Comments	How addressed in the ESA chapter
Climate Commission a new independent climate commission was launched to support the city's goal of reaching net zero carbon emissions by 2045 and provide leadership and advice regarding climate change and sustainability. The commission will feed into the Norwich 2040 Vision which includes combating climate change as part of 'a liveable city' as one of its key themes.	undertaking a proportionate and appropriate assessment to inform decision making and avoid undue burden to developers and regulators. The assessments reported in this ESA chapter are considered proportionate, appropriate, and conservative.

15.2.3 Additional Consultation

No additional consultations have been undertaken in regard to this topic outside of the EIA scoping process described above.

15.2.4 Assessment Methodology

15.2.4.1 Future Climate Change Projections

As a result of climate change, the climatic conditions at the application site and in the surrounding area are expected to change over the proposed development's lifetime (assumed to be 60 years).

Table 15.2 - summarises the results of the UK Climate Projections (UKCP18) for the Anglian region for the Representative Concentration Pathway 8.5 (RCP8.5) (high) emissions scenario between 2080 and 2099[1]. This emissions scenario has been selected as recommended in the appropriate IEMA guidance[2], as it is the most conservative, highest impact scenario.

Table 15.2 - UKCP18 Projections for Climate Variables for a High Emissions Scenario (RCP8.5) in Anglian Region of the UK

Variable	2070-2089 Projections		
	Projected UKCP18 change at[1]		
	10%	50%	90%
Mean annual temp (°C)	2.5	4.1	5.9
Mean temp. over summer months (°C)	2.7	5.3	7.9
Mean temp. over winter months (°C)	1.4	3.5	5.6

[1] Met Office Hadley Centre (2018). https://www.metoffice.gov.uk/research/approach/collaboration/ukcp/key-results. UKCP18 Probabilistic Climate Projections (2022 Version). Probabilistic and sea level projections. [Online] 2023.

[2] IEMA. Environmental Impact Assessment Guide to: Climate Change Resiliance & Adaptation. s.l. : IEMA, 2020.

Variable	2070-2089 Projections		
	Projected UKCP18 change at[1]		
	10%	50%	90%
Mean winter precipitation change (%)	-1	21	48
Mean summer precipitation change (%)	-63	-38	-6

[1.] The following probability levels of projections have been used:

- **10% level – indicates that 10% of the UKCP18 model runs fall at or below the specified value.**
- **50% level – indicates that 50% of the UKCP18 model runs fall at or below the specified value; and**
- **90% level – indicates that 90% of the UKCP18 model runs fall at or below the specified value.**

Considering the above climate projections, the following climate trends are anticipated for the application site:

- Hotter and drier summers;
- Warmer and wetter winters;
- Drier soils (on average);
- Decreased snowfall and number of very cold days;
- More frequent storms, heavy and extreme rainfall, and extreme winds; and
- Decreased cloud cover.

15.2.4.2 Climate Change Resilience & Adaptation Assessment

Given the predicted changes in climate expected in the future, it is important that climate resilience is incorporated into the design of new developments. Potential adaptation measures that could be incorporated into the scheme design should be evaluated. This should take place at all stages of design development – from optioneering through to detailed design –, not just as a part of the EIA process.

An assessment of the resilience of the proposed development to predicted climate change impacts has been completed in accordance with the IEMA Environmental Impact Assessment Guide to: Climate Change Resilience and Adaptation (the 'IEMA R&A Guidance') and is reported in this ESA chapter.

This has been undertaken in line with the following steps:

- Step 1: Defining the future (climate) baseline;
- Step 2: Identifying receptors and determining their sensitivity of receptors;
- Step 3: Determining the magnitude of impact;
- Step 4: Determining effect significance; and
- Step 5: Developing additional adaptation / EIA mitigation measures.

15.2.4.2.1 Future Climate Trends

The future climate trends for the purposes of this assessment have been informed by the UKCP18 data for the Anglian region for the Representative Concentration Pathway 8.5 (RCP8.5), as set out in Section 15.2.4.1.

15.2.4.2.2 Sensitivity of Receptors

Receptors at the application site that form part of the proposed development and which may be affected by climate change have been identified with consideration of both extreme weather events and gradual climatic changes in the area over the proposed development's design life. The assessment considers impacts on the following receptor types:

- Buildings and infrastructure receptors (including equipment and building operations);
- Human health receptors (including construction workers, and future site users); and
- Environmental receptors (retained and proposed planting).

In line with the IEMA R&A Guidance, sensitivity has been determined with consideration given to the value or importance of the receptor, as well as the susceptibility and vulnerability of the receptor to climate change. The existing sensitivity has been established in the first instance, using the criteria set out in **Table 15.3 –** , which are based on the existing value/importance of the receptor. The future sensitivity has then been established based on how susceptibility and vulnerability to climate change have the potential to alter the existing receptor sensitivity, using professional judgement and the criteria set out in Tables **15.4** and **15.5**.

Table 15.3 – Scale of Existing Sensitivity

Existing Sensitivity	Description
High	Human receptors (construction workers and site users) Ecological receptors of international or national importance (e.g., statutory designated ecological sites, and ancient woodland).
Medium	Permanent (new or retained) buildings and infrastructure Ecological receptors of moderate importance (e.g., mature woodland).
Low	Temporary buildings and infrastructure Ecological receptors with limited, local value (e.g. proposed soft landscaping).

Table 15.4 - Scale of Susceptibility

Susceptibility	Description
High	Receptor has no ability to withstand / not be substantially altered by the projected changes to the existing / prevailing climatic conditions (e.g. lose much of its original function and form)

Susceptibility	Description
Moderate	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	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).

Table 15.5 - Scale of Vulnerability

Vulnerability	Description
High	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	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	Climatic factors have little influence on the receptors (consider whether it is justifiable to assess such receptors further within the context of EIA – i.e. it is likely that such issues should have been excluded through the EIA scoping process).

15.2.4.2.3 Magnitude of Impact

In line with the IEMA guidance, the impact magnitude has been assessed based on a consideration of:

- the probability of the impact occurring, which takes into account the chance of the impact occurring over the relevant time period (e.g. lifespan) of the development, if the risk of impact is not mitigated; and
- the consequence of the impact, which reflects the geographical extent of the impact or the number of receptors affected (e.g. scale), the complexity of the impact, the degree of harm to those affected and the duration, frequency and reversibility of the impact.

The criteria used to determine the probability and consequence of the impacts are set out in **Table 15.6 - Probability Scale** and

Table 15.7 - Consequence Scale respectively.

Table 15.6 - Probability Scale

Scale	Description
Very High	The event occurs multiple times during the lifetime of the project (60 years), e.g. approximately annually, typically 60 events.

Scale	Description
High	The event occurs several times during the lifetime of the project (60 years), e.g. approximately once every five years, typically 12 events.
Medium	The event occurs limited times during the lifetime of the project (60 years), e.g. approximately once every 15 years, typically 4 events.
Low	The event occurs during the lifetime of the project (60 years), e.g. once in 60 years.
Very Low	The event may occur once during the lifetime of the project (60 years).

Table 15.7 - Consequence Scale

Scale	Description
Very Large	- Permanent damage to or loss of infrastructure / buildings. - Serious health effects, possible loss of life. - Extreme financial impact. - Exceptional environmental damage at an international level.
Large	- Extensive infrastructure damage and complete loss of service. - Major health impacts. - Major financial loss. - Considerable environmental damage at a national level.
Medium	- Partial infrastructure damage and some loss of service. - Moderate financial impact. - Adverse effects on health. - Environment damage at a regional level.
Small	- Localised infrastructure disruption and minor loss of service. - Small financial losses. - Slight adverse effects on health. - Environmental damage at a local level.
Very Small	- No damage to infrastructure. - No adverse financial impact. - No impacts on health. - No damage to the environment.

As shown in

Table 15.8 – Magnitude of Impact, the magnitude of the impact has been assessed based on a consideration of the probability of the impact occurring, and the consequence of the impact, should it occur.

Table 15.8 – Magnitude of Impact

		Probability				
		Very High	**High**	**Medium**	**Low**	**Very Low**
Consequence	**Very Large**	Very Large	Very Large / Large	Large	Medium / Small	Small / Very Small
	Large	Very Large / Large	Large	Large / Medium	Medium / Small	Very Small
	Medium	Large	Large / Medium	Medium	Small	Very Small
	Small	Medium / Small	Medium / Small	Small	Small	Very Small
	Very Small	Small / Very Small	Very Small	Very Small	Very Small	Very Small
Where the impact is 'Very Large / Large', 'Large / Medium', 'Medium / Small' or 'Small / Very Small', professional judgement has been applied to determine the appropriate impact magnitude.						

15.2.4.2.4 Scale & Significance of Effect

The scale of the effect has been assessed based on the magnitude of the impact and the sensitivity of the receptor as shown in **Table 15.9 - Scale and Significance of Effect**. Effects of a moderate or major scale are considered to be significant in the context of this assessment.

Table 15.9 - Scale and Significance of Effect

		Receptor Sensitivity		
		High	**Medium**	**Low**
Impact Magnitude	**Very Large**	Major	Major / Moderate	Moderate
	Large	Major	Moderate	Minor
	Medium	Moderate	Moderate	Minor
	Small	Minor	Minor	Minor / Negligible
	Very Small	Negligible	Negligible	Negligible
Where the effect is Negligible/Minor or Minor/Moderate, professional judgement has been applied to determine the appropriate scale of effect.				

15.2.4.3 In-combination Climate Change Impact Assessment

The projected changes in climate as a result of climate change may have an additive effect in respect of the individual environmental effects reported for the various assessments in the ESA technical chapters. These effects may individually be insignificant, but when combined or added, could result in significant effects, requiring additional design and/or mitigation measures.

The ICCI assessment provides a qualitative judgement on whether climate change is likely to alter the significance of any of the effects identified in each technical ESA chapter (ESA Chapters 8 to 14). The ICCI assessment has been undertaken based on the UKCP18 data for the Anglian region for the Representative Concentration Pathway 8.5 (RCP8.5), as set out in Section 15.2.4.1.

The first step of the assessment comprises a screening exercise to identify which technical topic assessments and their results would have the potential to be affected by climate change trends, taking into account embedded mitigation. The technical topics that have been screened out from further consideration in the ICCI assessment on this basis are set out in the section below. For those that have been screened in, the future receptor sensitivity and impact magnitude criteria that have informed the ICCI assessment are set out in the following sections. To ensure the assessment is proportionate, individual negligible or neutral effects and the receptors they affect, as identified in the respective technical topic ESA chapter, have not been considered in this assessment. The Ecology and Air Quality ESA chapters both use a different scale of effect and significance criteria, where 'negligible' or 'neutral' descriptors are not used and instead it is simply stated whether the residual effect is 'significant' or 'not significant'. Only significant effects identified in these chapters have been considered in this ICCI assessment.

15.2.4.3.1 ICCI Screening

The technical topics and the related receptors that have been screened out from further consideration in the ICCI assessment on the basis that they are not considered to have the potential to be significantly affected by climate change trends are set out in **Table 15.10 - Technical Topics Screened out of ICCI Assessment**.

Table 15.10 - Technical Topics Screened out of ICCI Assessment

Technical Topic / Receptor	Sensitivity (Existing)
Landscape & Visual (all receptors)	The only means through which the climate change trends are considered to have the potential to affect the outcomes of the Landscape & Visual Impact Assessment (LVIA) is through potential adverse effects on vegetation, e.g. due to hotter drier summers. However, as set out in the Design Code that accompanies the reserved matters application, it is proposed that the landscaping strategy will include species that are resistant to climate change effects. On this basis, the climate change trends are not expected to affect the outcomes of the LVIA assessment.
Ecology (all receptors)	All residual effects reported in the Ecology ESA chapter are either not significant or are beneficial. The climate change trends are not expected to significantly affect the impacts that are beneficial (and the affected receptors). For example, bats and reptiles would not expect to be adversely affected by warming temperatures. Drier

Technical Topic / Receptor	Sensitivity (Existing)
	soils could potentially affect the wetland/aquatic species/habitats (including Carrow Abbey Marsh County Wildlife Site (CWS) and eutrophic floodplain fen habitat). Fen translocation, swale creation, fen restoration and long-term management, access barriers, and a drainage scheme to mitigate drying of the wetland habitats are proposed, resulting in beneficial residual effects on these receptors. Given that long-term management of these habitats is proposed, significant in-combination climate change effects related to this technical topic are not anticipated.
Air Quality (all receptors)	Given that all residual effects reported in the Air Quality ESA chapter are expected to be 'not significant', significant in-combination climate change effects related to this technical topic are not anticipated.
Hydrology, Hydrogeology, Flood Risk and Surface Water Drainage (all receptors)	The baseline hydrological regime may change in the future, as a result of the predicted climate change trends, irrespective of any development coming forward. River flows, tide levels and rainfall intensities are predicted to increase as a result of climate change. Should such changes materialise, rates of surface water run-off, flood flows within watercourses and flood levels associated with a breach of flood defences would increase. In addition, the seasonality of rainfall and river flows is likely to become more pronounced. The Hydrology, Hydrogeology, Flood Risk and Surface Water Drainage ESA chapter is supported by a Flood Risk Assessment (Appendix 12.1), which takes account of the potential future changes in the hydrological regime by incorporating appropriate allowances for climate change, as published by the EA[3]. The impacts of climate change have therefore already been assessed and reflected in the design of the proposed development. All residual effects reported in the Hydrology, Hydrogeology, Flood Risk and Surface Water Drainage ESA chapter are expected to be Negligible. On this basis, significant in-combination climate change effects related to this technical topic are not anticipated.
Socio-economics & Health (all receptors)	The anticipated climate change trends are not expected to affect the socio-economic effects reported in the Socio-economics & Health ESA chapter. Climate change trends have the potential to affect the health of future users of the application site through: • changes in flood risk (considered separately in the Hydrology, Hydrogeology, Flood Risk and Surface Water Drainage ESA chapter, which identifies that all residual effects are Negligible); and

[3] https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

Technical Topic / Receptor	Sensitivity (Existing)
	• increasing summer temperatures, potentially increasing overheating impacts (considered separately in the Resilience & Adaptation assessment reported in Section 15.3 of this ESA chapter, which identifies that the residual effect would be Negligible), On the basis that these effects have already been considered and have been identified as Negligible, significant in-combination climate change effects related to this technical topic are not anticipated.
Built Heritage (all receptors)	None of the climate change trends are anticipated to affect the assessment of the effects of the proposed development on existing built heritage asset, as reported in the Built Heritage ESA chapter.

15.2.4.3.2 Assessment of Future Receptor Sensitivity

Where the effects of climate change are expected to change the existing receptor sensitivity determined within the respective technical ESA chapter, the new receptor sensitivity (the 'future sensitivity') has been determined.

The future sensitivity has been established based on how susceptibility and vulnerability to climate change have the potential to alter the existing sensitivity (as set out within the respective technical ESA chapter). For each receptor, future sensitivity has been determined, based on the susceptibility and vulnerability criteria set out in **Table 15.4 - Scale of Susceptibility** and **Table 15.5 - Scale of Vulnerability** earlier in this ESA chapter, using professional judgement.

15.2.4.3.3 Assessment of Future Impact Magnitude & Effect Significance

The future impact magnitude (the 'future magnitude') has been established using the existing impact magnitude (determined within the respective technical ESA chapter) and considering whether this magnitude will be made worse or improved with the future climatic baseline, using professional judgement.

Future magnitude has been reported in line with the same scale of impact magnitude, set out for the potential impact within the respective technical ESA chapter.

The future sensitivity and future magnitude have then been amalgamated to determine the future effect significance (the 'future significance') in line with the same effect significance criteria used within the respective technical ESA chapter.

15.2.4.4 Greenhouse Gas (GHG) Emissions Assessment

15.2.4.4.1 Scope of Assessment

The technical scope of this assessment comprises assessment of the likely effects of the proposed development on the global atmosphere through the emission of GHGs into the atmosphere, considering the entire lifecycle of the proposed development ('Before Use', 'Use', and 'End of Life' stages (Modules A to C in the IEMA GHG Guidance). The GHG sources within each stage/module have been assessed in accordance with the RICS Guide.

15.2.4.4.2 Spatial Scope

GHG emission impacts and resulting effects are global. As such, the spatial scope of the assessment is global. The proposed development's GHG emissions have also been considered in the context of both the UK national carbon budgets and recommended carbon budgets for Norwich CC and South Norfolk DC.

15.2.4.4.3 Assessment Scenarios

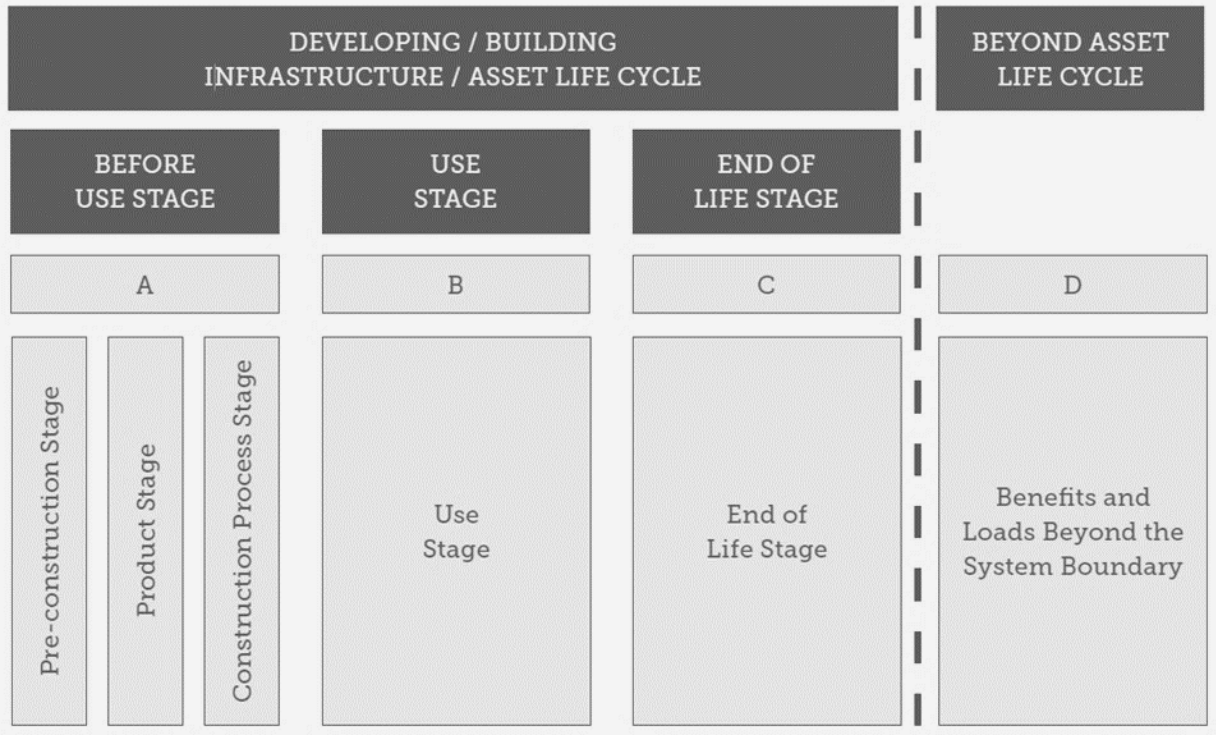
The following scenarios have been considered and where necessary assessed:

- Scenario 1: Existing Baseline;
- Scenario 2: Future Baseline; and
- Scenario 3: Proposed Development Scenario.

15.2.4.4.4 Assessment Method

A GHG emissions assessment typically covers the whole life of a development. This can be broken down into cycle stages or modules of the proposed development, as shown in **Figure 15.1**.

Figure 15.1 - Modular approach of life cycle stages and modules for EIA GHG emissions assessment



Source: IEMA guide to 'Assessing Greenhouse Gas Emissions and Evaluating their Significance'

Figure 15.1 sets out the modular approach that can be used for boundary definition and the gathering and reporting of information associated with the assessment. This replicates the modular approach provided in the IEMA GHG Guidance and is based on the PAS 2080 standard.

The scope of the assessment is set out in **Table 15.11**. The assessment has taken into account the design detail currently available and is based on the lifecycle stages/modules set out in **Figure 15.1** and the activities and methodology set out in the RICS guide.

Table 15.11 - Assessment modules

Lifecycle stage	Description	Activities Included Within Assessment Scope	Equivalent proposed development stage
A	Module A represents the 'Before Use Stage'. It includes GHG emissions associated with preconstruction activities, products and the construction process.	Raw material extraction & supply (A1) Transport to manufacturing plant (A2) Manufacturing & fabrication (A3) Transport to project site (A4) Construction & installation process (A5)	Construction Stage
B	Module B represents the 'Use Stage' and incorporates emissions associated with the operation of the proposed development.	Use (installed products and materials) (B1) Maintenance (B2) Repair (B3) Replacement (B4) Refurbishment (B5) Operational energy use (B6) Operational water use (B7)	Operational Stage
C	Module C represents the 'End of Life Stage'. It comprises GHG emissions associated with the deconstruction and demolition of the proposed development.	Deconstruction Demolition (C1) Transport to disposal facility (C2) Waste processing for reuse, recovery or recycling (C3) Disposal (C4)	Decommissioning stage*
D	Module D, the 'Beyond Asset Life Cycle' stage, encompasses emissions associated with activities beyond the site boundary and life cycle of the proposed development. This module is a voluntary consideration, as it relates to the repurposing of discarded building elements or any	As set out previously, this module has not been assessed. Reliable information about how the components of the scheme could potentially be repurposed following its demolition at the end of its life is not currently available. Given that Module D lies outside the proposed development's lifecycle and only covers GHG emissions that could	-

Lifecycle stage	Description	Activities Included Within Assessment Scope	Equivalent proposed development stage
	energy recovered from beyond a project's lifecycle.	potentially be avoided as a result of repurposing of discarded materials, it is considered that the proposed assessment of Modules A to C (only) comprises a conservative assessment.	
* For the purpose of this assessment, a Reference Study Period (RSP) of 60 years after opening (the fully operational opening year) has been assumed. For the purpose of the assessment, decommissioning has been assumed to take place in the final year of the RSP. However it should be noted that the Applicant does not necessarily propose to decommission the development at the end of this 60 year period.			

It is recognised that covering all GHG emissions associated with a development is challenging and therefore, the IEMA GHG Guidance places emphasis on undertaking a proportionate and appropriate assessment to inform decision making and avoid undue burden to developers and regulators.

15.2.4.4.5 Baseline GHG Emissions

The baseline is a reference point against which the effects of the proposed development can be compared. The IEMA GHG Guidance states that *"the ultimate goal of establishing a baseline is being able to assess and report the net GHG impact of the proposed project."*

The application site is not currently in use and therefore it is assumed that currently there are no GHG emissions from the application site. A detailed assessment of the current baseline GHG emissions has not been necessary.

Should the proposed development not come forward, for the purposes of this assessment, it has been assumed that the application site would remain in its current state. As such, A detailed assessment of the future baseline GHG emissions has also not been necessary.

15.2.4.4.6 The Proposed Development's GHG Emissions

15.2.4.4.6.1 Embodied Carbon (Lifecycle Stages A1 - A5; B1 - B5; & C1 - C4)

The activities that have been included in this portion of the assessment are set out in **Table 15.12 - Activities Considered in Assessment**.

Table 15.12 - Activities Considered in Assessment of Lifecycle Stages A1 - A5; B1 - B5; & C1 - C4

Lifecycle Stage	Activities Incorporated
Product stage (Modules A1-A3)	The carbon emissions generated at this stage arise from extracting the raw materials from the ground, their transport to a point of manufacture and

Lifecycle Stage	Activities Incorporated
	then the primary energy used (and the associated carbon impacts that arise) from transforming the raw materials into construction products.
Transport to project site (Module A4)	The transportation of all materials required for the permanent assets and construction equipment to site from the point of production (or point of storage in the case of plant and machinery).
Construction & installation process (Module A5)	Construction site works activities including installation of materials and products into the infrastructure asset. Waste management activities associated with waste arising from the construction site.
Installed products and materials (Module B1)	This module would potentially include carbon emissions released from building elements and the impact of potential carbon absorption, for example emissions from refrigerants, insulation blowing agents, paints, as well as carbonation from exposed concrete or absorption from green roofs. Carbon sequestration from trees planted, and possibility of carbon sequestration from concrete material used from frames would also potentially be included.
Maintenance (Module B2)	The production, transportation (to and from the site) and end of life processing of all materials required for preventative maintenance, including cleaning. This includes the energy and water use associated with these activities.
Repair (Module B3)	The repair of any components during the use stage of the development. This includes the production, transportation (to and from site) and installation of the repaired items.
Replacement (Module B4)	The production, installation, transportation (to and from the site) and end of life processing of all materials required to replace any assets or any components within assets that have a design life of less than 60 years.
Refurbishment (Module B5)	The production, transportation (to and from the site) and end of life processing of all materials required for any anticipated refurbishment.
Deconstruction Demolition (C1) Transport to disposal facility (C2) Waste processing for reuse, recovery or recycling (C3) Disposal (C4)	The eventual deconstruction and disposal of the proposed development at the end of its life, including impacts of site works by the demolition contractor. No 'credit' is taken for any future carbon benefit associated with the reuse or recycling of a material into new products.

As a contractor is not yet appointed, it has not been possible to undertake the assessment based on detailed construction material quantities. As such, in order to calculate the GHG emissions from each proposed use (residential (Use Class C3) and commercial (Use Class E (restaurants and shops)), LETI and RIBA benchmarks[4] have been used.

For Lifecycle Stages A1 to A5, LETI Band C benchmarks have been used to calculate the GHG emissions (500 $KgCO^2e$/sqm [GIA] for the residential floorspace and 550 $KgCO^2e$/sqm [GIA] for the commercial floorspace (based on the 'Retail' LETI benchmark)). The Band C benchmarks have been selected as these represent LETI's current design targets for buildings and are being targeted by the Applicant.

RIBA Band C benchmarks have been used to calculate the GHG emissions from Lifecycle Stages B1 to B5 and C1 to C4. Given that these benchmarks cover Lifecycle Stages A1 to A5, as well as B1 to B5, and C1 to C4, the LETI Band C benchmarks for Lifecycle Stages A1 to A5 set out above have been subtracted from the RIBA benchmarks to ensure they apply only to Lifecycle Stages B1 to B5 and C1 to C4 (300 $KgCO^2e$/sqm [GIA] for the residential floorspace and 140 $KgCO^2e$/sqm [GIA] for the commercial floorspace (based on the 'Retail' RIBA benchmark)).

In order to separate the Lifecycle Stage B1 to B5 emissions from the Lifecycle Stage C1 to C4 emissions, typical whole life carbon breakdown information from LETI's Embodied Carbon Primer 2020[5] (medium scale residential development, Figure 5.2) has been used, which indicates that emissions from Lifecycle Stage C1 to C4 emissions would be approximately 10% of Lifecycle Stage B1 to B5 emissions.

The benchmarks that have been used for each lifecycle stage in this assessment are set out in **Table 15.13 - Lifecycle Stages A1-A5; B1-B5; & C1-C4 Benchmarks**.

Table 15.13 - Lifecycle Stages A1-A5; B1-B5; & C1-C4 Benchmarks

Proposed Use	Module A1-B5 Benchmark ($KgCO^2e$/sqm [GIA])	Module B1-B5 Benchmark ($KgCO^2e$/sqm [GIA])	Module C1-C4 Benchmark ($KgCO^2e$/sqm [GIA])
Residential (Use Class C3)	500	270	30
Commercial (Use Class E (restaurants and shops)	550	126	14

15.2.4.4.6.2 Operational Energy Use (Lifecycle Stage B6)

An Energy Statement has been prepared and has been submitted alongside the reserved matters application.

An all-electric, fossil fuel free heating strategy, featuring Air Source Heat Pumps (ASHPs), is proposed, to take advantage of the ongoing grid decarbonisation, thus allowing the proposed development to become net zero carbon in due course. Photovoltaic (PV) panels, installed on roofs are also proposed for generating renewable energy on site.

The Standard Assessment Procedure (SAP 10) has used to assess the energy performance of the proposed residential units, in terms of energy consumption for regulated energy uses, equipment and

[4] LETI and RIBA, Embodied Carbon Target Alignment, 2021
[5] LETI Embodied Carbon Primer 2020

cooking appliances. An energy assessment of the commercial elements has also been carried out in line with the National Calculation Methodology (NCM)[6], using IES VE software for Dynamic Simulation Modelling for Part L compliance.

The SAP 10.2[7] carbon emission factors have been used in this assessment to take into account the current grid decarbonisation conditions.

15.2.4.4.6.3 Operational Water Use (Lifecycle Stage B7)

To calculate the GHG emissions attributed to water usage in the proposed residential units, household water consumption benchmarks have been sourced from Part G of the Building regulations[8] (125 litres per person per day). This benchmark is slightly higher than the equivalent benchmarks in the SRIA Rules of Thumb guidance document[9] (120 litres per person per day), and, as such, are considered conservative.

The anticipated population yield of the proposed development has been calculated in the Socio-economics ESA chapter (1,510 people). This total population yield has been allocated between the different phases of the proposed development using the GIA of residential floorspace proposed across the scheme.

The water use benchmark for enclosed shopping centres (758 litres/sq m common parts area (CPA)/year) from the Better Building Partnership 2020 Real Estate Environmental Benchmarks[10] document has been used for the proposed commercial (restaurant and/or shops) floorspace. The 'typical practice' benchmark in the document has been used in preference to the 'good practice' benchmark to ensure a conservative approach. As the floorspace quanta for the proposed development are only available in the form of GIA figures, these have been used in place of NLA and CPA figures. This is considered a conservative approach.

An emission factor for water usage has been sourced from the UK Government GHG Conversion Factors (2021) (149 kgCO2/million litres).

15.2.4.4.7 Programme Assumptions

The assessment has been undertaken based on the proposed indicative construction programme, as confirmed by the Applicant, and the proposed 60-year Reference Study Period (RSP). The assessment is based on the programme assumptions set out in **Table 15.14 - Programme for the Purposes of this Assessment**. Please note that Phase 2 of the construction works has been excluded from the table as it does not include construction of any of the proposed buildings.

[6] https://www.uk-ncm.org.uk/
[7] Department for Business, Energy & Industrial Strategy. The Government's Standard Assessment Procedure for Energy Rating of Dwellings (SAP 10.2). 2021.
[8] UK Government, The Building Regulations 2010, Part G Sanitation, hot water safety and water efficiency, 2015 Edition, with 2016 Amendments
[9] BSRIA . BSRIA Rules of Thumb. 2011
[10] Better Building Partnership, 2020 Real Estate Environmental Benchmarks. 2021.

Table 15.14 - Programme for the Purposes of this Assessment

Lifecycle Module	Element of the Proposed Development	Timescale
Module A: Before Use Stage (A1-A5) (Phase 1)	Yare Edge (Block 1C & 69 houses)	July 2025 to September 2029
Module A: Before Use Stage (A1-A5) (Phase 3-1)	The Views: Stage 1 (Block 1 & 60 houses)	October 2030 to September 2031
Module A: Before Use Stage (A1-A5) (Phase 3-2)	The Views: Stage 2 (Block 2a, Block 2b & 64 houses)	April 2032 to September 2032
Module A: Before Use Stage (A1-A5) (Phase 3-3)	Wensum Edge: Stage 1 (Block 1, Block 5 & 16 houses)	April 2033 to September 2033
Module A: Before Use Stage (A1-A5) (Phase 3-4)	Wensum Edge: Stage 2 (Block 2)	April 2034 to September 2034
Module A: Before Use Stage (A1-A5) (Phase 3-5)	Wensum Edge: Stage 3 (Block 3 & Block 4)	April 2035 to September 2035
Module A: Before Use Stage (A1-A5) (Phase 3-6)	Wensum Edge: Stage 4 (Block 6 & 14 houses)	April 2036 to September 2036
Module A: Before Use Stage (A1-A5) (Phase 3-7)	Wensum Edge: Stage 5 (Block 7 & 50 houses)	April 2037 to September 2037
Module B: Use Stage (B1-B7) (Phase 1)	Yare Edge (Block 1C & 69 houses)	October 2029 to December 2096
Module B: Use Stage (B1-B7) (Phase 3-1)	The Views: Stage 1 (Block 1 & 60 houses)	October 2031 to December 2096
Module B: Use Stage (B1-B7) (Phase 3-2)	The Views: Stage 2 (Block 2a, Block 2b & 64 houses)	October 2032 to December 2096
Module B: Use Stage (B1-B7) (Phase 3-3)	Wensum Edge: Stage 1 (Block 1, Block 5 & 16 houses)	October 2033 to December 2096
Module B: Use Stage (B1-B7) (Phase 3-4)	Wensum Edge: Stage 2 (Block 2)	October 2034 to December 2096
Module B: Use Stage (B1-B7) (Phase 3-5)	Wensum Edge: Stage 3 (Block 3 & Block 4)	October 2035 to December 2096
Module B: Use Stage (B1-B7) (Phase 3-6)	Wensum Edge: Stage 4 (Block 6 & 14 houses)	October 2036 to December 2096
Module B: Use Stage (B1-B7) (Phase 3-7)	Wensum Edge: Stage 5 (Block 7 & 50 houses)	October 2037 to December 2096
Module C: End Of Life Stage (C1-C4) (all phases)	All proposed blocks and houses	January to September 2097

The proposed development's GHG emissions have been allocated from the start of the construction stage (July 2025) to the end of the RSP period (September 2097). It has been assumed that the use of the proposed development would end in December 2096, with the demolition works (the end of life stage) taking place between January and September 2097. The assessment has been based on an equal division of the total or annual total GHG emissions (depended on the lifecycle stage assessment) across the relevant period. In reality, emissions from each of the construction phases would likely ramp up and then ramp down over the relevant period, as would emissions from the Use stage, as the buildings within each phase become occupied. At this stage, it is not possible to accurately establish the rate at which these GHG emissions would ramp up/down and therefore the emissions have been divided on an equal monthly basis, which is considered a conservative approach.

15.2.4.4.8 Assessment Criteria

15.2.4.4.8.1 Receptor Sensitivity & Impact Magnitude Criteria

GHG emission impacts and the resulting effects are global. The receptor for GHG emissions is the global atmosphere. The IEMA GHG Guidance states that "*the receptor has a high sensitivity, given the severe consequences of global climate change and the cumulative contributions of all GHG emission sources*." The magnitude of the impact would be linked to the volume of GHG emissions produced. However, in accordance with the IEMA GHG Guidance, it is not considered necessary to determine the sensitivity of the receptor or the magnitude of the impact in order to assess the significance of the effects of GHG emissions. Therefore, no further reference to receptor sensitivity or impact magnitude has been made in this ESA chapter.

15.2.4.4.8.1.1 Scale of Effect Criteria & Assessment of Significance

The IEMA GHG Guidance sets out defined scale of effect criteria for GHG emissions, in line with which, significance should be assessed. It also advises that the context of the project's carbon footprint should be determined to establish whether it supports or undermines a trajectory towards net zero to aid evaluation of the effects by the relevant decision maker.

ASSESSMENT OF SCALE OF EFFECT & SIGNIFICANCE

The approach to assessing the emissions of GHG has been informed by three overarching principles, which are set out in the guidance:

- The GHG emissions from all projects will contribute to climate change, the largest interrelated cumulative environmental effect;
- The consequences of changing climate have the potential to lead to significant environmental effects on all topics in the EIA Directive (e.g. human health, biodiversity, water, land use, air quality); and
- GHG emissions have a combined environmental effect that is approaching a scientifically defined environmental limit; as such any GHG emissions or reductions from a project might be considered to be significant.

IEMA has further built on these principles as follows:

- When evaluating significance, all new GHG emissions contribute to a negative environmental impact; however, some projects will replace existing development or baseline activity that has a

higher GHG profile. The significance of a project's emissions should therefore be based on its net impact over its lifetime, which may be positive, negative or negligible;

- Where GHG emissions cannot be avoided, the goal of the EIA process should be to reduce the project's residual emissions at all stages; and
- Where GHG emissions remain significant, but cannot be further reduced, approaches to compensate the project's remaining emissions should be considered.

The goal of the Paris Agreement is to limit global temperature rise to well below 2°C, aiming for 1.5°C, compared with pre-industrial levels, with the aim of avoiding severe adverse effects from climate change. Through the Climate Change Act, the UK has set a legally binding GHG reduction target for 2050 with interim five-yearly carbon budgets which define a trajectory towards net zero, which the Climate Change Committee (CCC) have confirmed are compatible with the required magnitude and rate of GHG emissions reductions required in the UK to meet the goals of the Paris Agreement, thereby limiting severe adverse effects.

To meet the 2050 target and interim budgets, action is required to reduce GHG emissions from all sectors, including urban development projects. As stated in the IEMA Guidance, "*EIA for any proposed project must therefore give proportionate consideration to whether and how that project will contribute to or jeopardise the achievement of these targets...*t*he crux of significance therefore is not whether a project emits GHG emissions, nor even the magnitude of GHG emissions alone, but whether it contributes to reducing GHG emissions relative to a comparable baseline consistent with a trajectory towards net zero by 2050*".

On this basis, the IEMA Guidance sets out an approach to the assessment of effect scale and significance comprising judgements on:

- The proposed development's consistency with policy requirements, since these have been implemented to ensure the economy decarbonises in line with the UK's net zero target; and
- The degree to which the proposed development's GHG emissions have been mitigated.

Table 15.15 sets out the scale of effect criteria provided in the IEMA Guidance. The scales of effect are also shown in **Figure 15.2** to illustrate how these relate to the 1.5°C compliance trajectory.

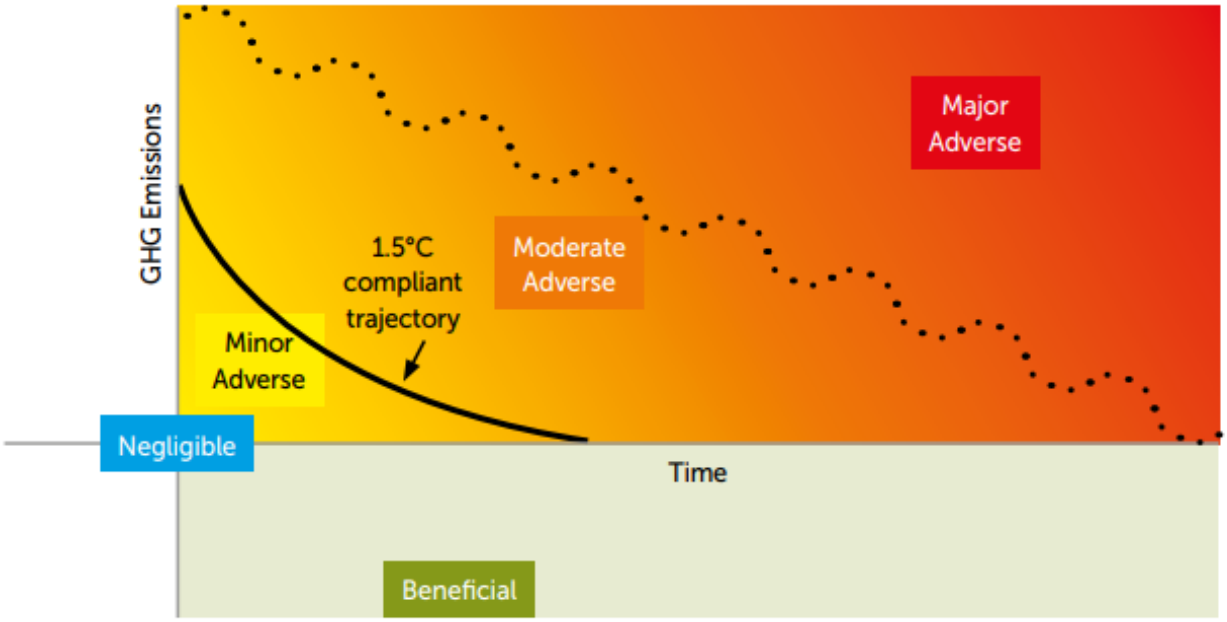
Table 15.15 - Scale of Effect Criteria

Scale of Effect	Criteria
Major adverse	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.
Moderate adverse	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.

Scale of Effect	Criteria
	A project with moderate adverse effects falls short of fully contributing to the UK's trajectory towards net zero
Minor adverse	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.
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.
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.

Source: Institute of Environmental Management & Assessment (IEMA) Guide: Assessing Greenhouse Gas Emissions and Evaluating their Significance, Second Edition

Figure 15.2 - Different levels of significance plotted against the UK's net zero compatible trajectory



Source: IEMA guide to 'Assessing Greenhouse Gas Emissions and Evaluating their Significance' Second Edition

In line with the IEMA Guidance, major and moderate adverse effects and beneficial effects are considered significant in EIA terms.

The IEMA guidance advises that, in the case of large-scale developments, which can in themselves have magnitudes of GHG emissions that materially affect the UK's or a devolved administration's total carbon budget, irrespective of the level of mitigation proposed, if net GHG emissions exceed 5% of the relevant UK or devolved administration carbon budget, the effects of the development are likely to be significant.

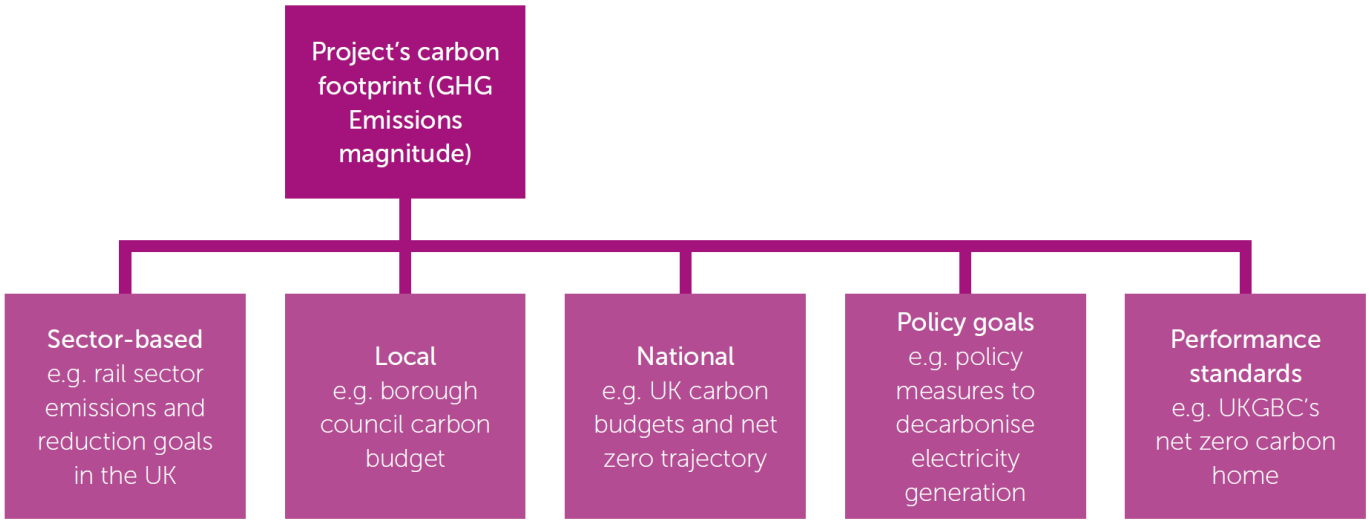
The IEMA Guidance also advises that "*Practitioners should note that existing policy and regulation may in some cases lag behind the necessary levels of GHG emission reductions (or types of actions to achieve those) that are compatible with the UK's or devolved administrations' targets and with a science based 1.5°C compatible trajectory towards net zero. Meeting the minimum standards set through existing policy or regulation cannot necessarily be taken as evidence of avoiding a significant adverse effect, and it is recommended that practitioners consider and have reference also to emerging policy/standards and the guidance of expert bodies such as the CCC on necessary policy developments, particularly for multi-phased projects with long timescales. This must be evaluated by the practitioner as part of the evidence base used in the assessment of effects. References to 'existing' and 'emerging' policy in the principles of significance and example criteria above must be interpreted with this in mind*."

15.2.4.4.8.1.2 Contextualisation of the GHG Emissions

The IEMA guidance also advises that the context of a project's carbon footprint should be determined to establish whether it supports or undermines the trajectory towards net zero to aid evaluation of the GHG emission effects by the relevant decision maker.

As stated previously, the UK has a defined national carbon budget and budgets have also been set by devolved administrations, which the CCC has confirmed are compatible with net zero and international climate commitments. The IEMA Guidance advised that the starting point for contextualising the project's GHG emissions should be the percentage contribution to the relevant national or devolved administration carbon budget. However, it goes on to advise that the contribution of most individual projects to national-level budgets will be small and so this context will have limited value. The guidance therefore sets out a good practice approach for contextualising a project's carbon footprint against pre-determined carbon budgets or against emerging policy and performance standards, where a budget is not available. This is shown in **Figure 15.3**.

Figure 15.3 - Good practice approaches for contextualising a project's GHG emissions



Source: IEMA guide to 'Assessing Greenhouse Gas Emissions and Evaluating their Significance' Second Edition

Norwich CC declared and passed a climate emergency motion in January 2019. While South Norfolk DC has not formally declared a climate emergency, the Council recognise the importance of responding to climate change in its Environmental Strategy and Delivery Plan 2023 –2025[11].

While neither Norwich CC nor South Norfolk DC has yet formally adopted a carbon budget, The Tyndall Centre for Climate Change Research has produced carbon budget reports (the 'Tyndall Carbon Budget Reports') that provide recommended climate change commitments for UK local authority areas that are aligned with the commitments in the Paris Agreement, informed by the latest science on climate change and defined by science based carbon budget setting. The Tyndall Carbon Budget Reports for Norwich CC[12] and South Norfolk DC[13] provide the respective local authorities with recommended budgets for carbon dioxide (CO_2) emissions from the energy system for 2020 to 2100.

In this ESA chapter, the net GHG emissions arising from the proposed development have been considered in the context of both the UK national carbon budgets and the Tyndall Centre recommended energy-only carbon budgets.

The UK national carbon budgets for the period over which the proposed development will be under construction and operational are presented in **Table 15.16**.

Table 15.16 - UK National Carbon Budgets

Carbon Budget	Carbon Budget Period	Million Tonnes of Carbon Dioxide Equivalent ($MtCO^2e$)
Fourth	2023-2027	1,950

[11] https://www.southnorfolkandbroadland.gov.uk/downloads/file/5795/south-norfolk-council-environmental-strategy-and-delivery-plan
[12] https://carbonbudget.manchester.ac.uk/reports/E07000148/
[13] https://carbonbudget.manchester.ac.uk/reports/E07000149/

Carbon Budget	Carbon Budget Period	Million Tonnes of Carbon Dioxide Equivalent ($MtCO^2e$)
Fifth	2028-2032	1,725
Sixth	2033-2037	965

The construction stage of the proposed development is anticipated to fall across all three budget periods. Phases 1, 2, 3-1, and 3-2 of the proposed development are expected to be complete and operational during the fifth carbon budget period, while the remaining phases (Phases 3-3, 3-4, 3-5, 3-6, and 3-7) are expected to be complete and operational during the sixth carbon budget period.

The Tyndall Centre energy-only carbon budgets for Norwich CC and South Norfolk DC for the same period (2023 to 2037) are presented in **Table 15.17 - Tyndall Centre Energy-Only Carbon Budgets for Norwich CC and South Norfolk DC**.

Table 15.17 - Tyndall Centre Energy-Only Carbon Budgets for Norwich CC and South Norfolk DC

Carbon Budget Period	Norwich CC Energy Only Carbon Budget ($MtCO^2e$)	South Norfolk DC Energy Only Carbon Budget ($MtCO^2e$)	Combined Energy Only Carbon Budget ($MtCO^2e$)
2023-2027	1.10	1.70	2.80
2028-2032	0.60	0.80	1.40
2033-2037	0.30	0.40	0.70

For the purpose of this assessment, the results of the emissions calculations have been presented in terms of their percentage contribution to the relevant UK or combined Norwich CC/South Norfolk DC carbon budget period, as set out above. Given that the Tyndall Centre carbon budgets are 'energy-only', the comparison of the proposed development's GHG emissions with these local budgets has been limited to the scheme's operational energy use GHG emissions to ensure consistency.

15.2.4.4.9 Assumptions / Limitations

In undertaking this assessment, there are a number of limitations and constraints affecting the outputs from this work. These include:

- The assessment reported in this chapter is based on the scheme information provided in Chapter 5, specifically including the following scheme information:
  - Deal Ground Area Schedule, dated 23 May 2023 (Stolon Studio Architects); and
  - Construction programme information provided by the Applicant (by email on 21 April 2023 and by phone on 07 June 2023);
- The assessment is also based on various assumptions, set out in the Methodology section of this chapter;

- The necessary detailed scheme information required to undertake a full embodied carbon assessment of the proposed development, such as construction material quantities, is not yet available. As such, estimates have instead been made to inform this ESA chapter, based on benchmarks sourced from relevant industry publications and the proposed floorspace quanta. The assumptions are considered conservative;
- The operational energy emissions assessment is based on SAP 10.2 CO_2 emission factors ($kgCO_2/kWh$). This represents a set period in time and therefore the future operational energy emissions calculated as part of this assessment do not account for the continued decarbonisation of the UK's power grid. This approach is considered conservative; and
- Please note that the total embodied carbon (tCO^2e) results reported in the Sustainability Statement that accompanies the reserved matters application differ to the results reported in this Climate Change ESA chapter as this climate change chapter has included a number of additional, more conservative, assumptions in line with EIA best practice.

Given the conservative assumptions that have informed this assessment, the assessment results are considered conservative and robust.

15.2.5 Effects Not Requiring Further Assessment

The following elements have been excluded from the scope of the assessments reported in this ESA chapter and are therefore not considered further within the chapter.

15.2.5.1 Module D: Beyond Asset Life Cycle' Stage

Module D in the IEMA GHG Guidance, the 'Beyond Asset Life Cycle' stage, encompasses emissions associated with activities beyond the site boundary and life cycle of the proposed development. This module relates to the repurposing of discarded building elements or any energy recovered from beyond a project's lifecycle. The IEMA GHG guidance states that "Certain life cycle modules (or stages) can be excluded if these exclusions are clearly highlighted and justified by the practitioner using professional judgement and in accordance with the materiality and cut-off guidance." Reliable information about how the components of the scheme could potentially be repurposed following its demolition at the end of its life is not currently available. Given that Module D lies outside the proposed development's lifecycle and only covers GHG emissions that could potentially be avoided as a result of repurposing of discarded materials, it is considered that the proposed assessment of Modules A to C (only) comprises a conservative assessment. On this basis, consideration of Module D has not been included in the scope of the GHG emissions assessment.

15.2.5.2 Inter-development Cumulative Effects

The atmospheric concentration of GHGs and the resulting effects on climate change are affected by all sources (anything emitting GHG) and sinks (anything absorbing GHG) globally, anthropogenic and otherwise. As GHG emission impacts and resulting effects are global rather than affecting one localised area, the approach to cumulative effects assessment for GHGs differs from that for many EIA topics where only projects within a geographically bounded study area would be included. As such, as stated in the IEMA GHG Guidance, effects of GHG emissions from specific cumulative schemes should not be individually assessed, as there is no basis for selecting any particular (or more than one) cumulative project that has GHG emissions for assessment over any other. The Guidance goes on to advise that the

contextualisation of GHG emissions should incorporate by its nature the cumulative contributions of other GHG sources which make up that context. As part of this assessment, an inter-development cumulative effects assessment has not been undertaken on a specific cumulative scheme basis; however, the proposed development's GHG emissions have been considered in the context of both the UK national carbon budgets and recommended carbon budgets for Norwich and South Norfolk. As such, the cumulative contributions of other GHG sources that make up the national and Norwich CC/South Norfolk DC contexts have been considered within the GHG emissions assessment.

It is also not appropriate to assessment climate resilience and adaptation and in-combination climate change effects on a specific cumulative scheme basis and therefore this has also not been included in the chapter.

15.3 Climate Change Resilience & Adaptation Assessment

15.3.1 Changes In Baseline Conditions

15.3.1.1 ES Baseline

A climate change chapter was not scoped into the 2010 ES. As such, current baseline conditions related to climate change resilience and adaptation were not reported in the 2010 ES.

15.3.1.2 ES Future Baseline

As previously stated, a climate change chapter was not scoped into the 2010 ES. As such, future baseline conditions related to climate change resilience and adaptation were not reported in the 2010 ES.

15.3.1.3 ESA Future Baseline

The future climate change projections and trends that have informed this assessment are set out in **Section 15.2.4.1**.

Using the criteria set out in **Table 15.3 –** , **Table 15.4 - Scale of Susceptibility** and **Table 15.5 - Scale of Vulnerability** and professional judgement, the future receptor sensitivity that has been determined for each receptor is as follows:

- Human receptors on the application site (construction workers and future residents and other site users) – High Sensitivity;
- Temporary buildings on the application site – Low Sensitivity;
- Proposed permanent buildings on the application site– Medium Sensitivity;
- Proposed utilities infrastructure on the application site – Medium Sensitivity;
- Proposed drainage infrastructure on the application site – Medium Sensitivity; and
- Proposed and retained planting on the application site – Medium Sensitivity.

15.3.1.4 Changes in Baseline

As previously stated, a climate change chapter was not scoped into the 2010 ES. As such, a comparison between the future baseline conditions set out above and the baseline conditions reported in the 2010 ES cannot be undertaken.

15.3.2 Assessment of Effects (Including Mitigation & Residual Effects)

As previously stated, a climate change chapter was not scoped into the 2010 ES. As such, a comparison between the climate change resilience and adaptation effects from the current planning application proposals (the proposed development) and those reported in the 2010 ES cannot be undertaken. The section below set out the climate change resilience and adaptation effects associated with the proposed development.

The potential climate vulnerability impacts assessed in this chapter are reported in **Table 15.18 - Resilience and Adaptation Assessment**, considered on a broad receptor type basis.

Table 15.18 - Resilience and Adaptation Assessment

Receptor(s) affected	Relevant Climate Trends	Description of Impact and proposed mitigation	Magnitude of Impact & Significance of Effect
Temporary site office and welfare facilities	Extreme Weather Events More frequent storms, heavy and extreme rainfall, and extreme winds	Extreme heat events have and will continue to become more likely in the future, while the frequency of extreme cold events has decreased. The evidence is less clear with regard to storms, but it does suggest that storms could occur more frequently in the future. The probability of extreme weather events occurring during the construction stage is considered to be Medium. Extreme weather events could result in damage to construction equipment resulting in delays to the construction programme and associated costs and/or unacceptable safety risks to construction workers. Although it is not possible to mitigate the probability of extreme weather events occurring on a project scale, the consequence of any such event, should it occur, will be reduced through the preparation of Construction Method Statements. These will be prepared by the principle contractor and will set out the response procedure to be followed during severe weather events, ensuring that construction workers are protected. The method statements will be produced as part of the contractors management systems and will form a part of the site induction for all site workers. As a result, the consequence of extreme weather events on temporary site office and welfare facilities would be Small and on construction workers would be Very Small.	Probability: Medium Consequence: Small Impact Magnitude: Small Effect Significance: **Negligible (not significant)**
Construction workers (human health)			Probability: Medium Consequence: Very Small Impact Magnitude: Very Small Effect Significance: **Negligible (not significant)**
Retained and proposed planting	Changes in precipitation:	In the future, more frequent periods of drought conditions (i.e. water shortages) are expected during summer seasons and more frequent	Probability: High Consequence: Small

Receptor(s) affected	Relevant Climate Trends	Description of Impact and proposed mitigation	Magnitude of Impact & Significance of Effect
	wetter winters; and drier summers	oversaturated soils and flooding events are expected during winter seasons. The probability of such conditions arising is considered to be High. These conditions could result in a loss of habitats and trees providing visual screening. It could also result in increased management costs, should vegetation fail and require re-sowing / planting. This could result in environmental effects on the local level, equating to a Small consequence. However, the Design Code submitted alongside the reserved matters application sets out the proposed nature and landscaping strategies, which include the retention of existing trees and vegetation where possible (including preserving riverside habitat on Wensum Edge and Yare Edge, protecting trees in good condition along river edges and protecting on-site marsh habitat) and various biodiversity enhancements, such as the provision of climate resilient species which can contribute to the absorption of runoff and provide benefits for humans and wildlife. An Environmental Action Plan and Nature Conservation Management Plan have been submitted alongside the reserved matters application. These documents include provision for the establishment, maintenance, long-term management and monitoring of newly created landscapes/ habitats and existing features/ habitats at the site. With these measures in place, the consequence is considered to remain Small.	Impact Magnitude: Small Effect Significance: **Minor Adverse (not significant)**
Proposed permanent buildings	Extreme Weather Events More frequent storms, heavy and extreme rainfall, and extreme winds	The frequency of extreme weather events is likely to increase in the future as a result of climate change with storms potentially occurring more frequently. The probability of this happening is considered to be Medium. The proposed development has been designed to meet building regulations to ensure that the proposed buildings will be capable of withstanding storms and strong winds. On this basis, the consequence of extreme weather events on proposed buildings is considered to be Very Small.	Probability: Medium Consequence: Very Small Impact Magnitude: Very Small Effect Significance: **Negligible**

Receptor(s) affected	Relevant Climate Trends	Description of Impact and proposed mitigation	Magnitude of Impact & Significance of Effect
			(not significant)
Proposed drainage infrastructure	Drier summers	Drier summers combined with the projected increase in summer temperatures may increase erosion of soils and their substrates dry out allowing the mobilisation of more debris. The probability of this occurring is considered Medium. This in turn could block or reduce the capacity of the proposed development's drainage infrastructure resulting in decreased drainage capacity and increased maintenance costs. However, a robust drainage maintenance strategy is proposed (the strategy has been submitted alongside the reserved matters application). This will ensure the infrastructure would continue to operate as intended and would not increase flood risk at the application site or surrounding area. The strategy would be responsive to the effects of climate change with increased maintenance completed as necessary. As a result, the consequence is considered to be Small, related to small potential financial losses and impacts to local infrastructure.	Probability: Medium Consequence: Small Impact Magnitude: Small Effect Significance: **Minor Adverse (not significant)**
Utilities infrastructure services	Wetter winters	More frequent heavier and more extreme rainfall events could increase the risk of surface water flooding, exceeding the capacity of the drainage infrastructure. Failure of drainage infrastructure could result in flooding, resulting in an increased risk to additional infrastructure assets such as electricity substations. As the drainage strategy has already considered the likely effects of climate change on the drainage infrastructure, the strategy ensures attenuation is provided for water volumes associated with a 1 in 100-year rainfall event including an allowance for climate change (45%). Therefore, the probability of this event occurring is Low. The consequence would also be Small, as a result of localised nature of any potential infrastructure disruption.	Probability: Low Consequence: Small Impact Magnitude: Small Effect Significance: **Minor Adverse (not significant)**
Residents and other future site users	Wetter winters	More frequent heavier and more extreme rainfall events could increase the risk of flooding at the application site in the future, posing a risk to future site users. The flood risk assessment and drainage strategy that have been submitted	Probability: Low Consequence: Medium

Receptor(s) affected	Relevant Climate Trends	Description of Impact and proposed mitigation	Magnitude of Impact & Significance of Effect
		alongside the reserved matters application have already considered the likely effects of climate change. The majority of the application site falls outside the 1 in 100 year flood extent. The finished floor levels for all dwellings will be set above the 1 in 100 year flood level, including allowing for climate change (45%) and freeboard. Land in the centre of the site will also be lowered to convey water away from buildings during a flood event. Therefore, the probability of this event occurring is Low. Should such an event occur, the consequence would be Medium, given the potential adverse effects on human health.	Impact Magnitude: Small Effect Significance: **Minor Adverse (not significant)**
Residents and other future users of the proposed buildings	Hotter summers	More frequent hotter summers increase the risk that future site users would experience overheating, affecting human health. An overheating assessment has been undertaken and the report is included in the appendices of the Energy Statement, which has been submitted alongside the reserved matters application. The assessment has including dynamic thermal modelling, in line with the guidance and data sets in CIBSE TM59 and TM49 respectively, taking into account the associated Approved Document O requirements. The assessment has considered the proposed apartments that are at higher risk of overheating. These include units with a larger glazing area, units with south/south-west facing windows, top-floor units receiving higher solar gains, units where cross ventilation is not possible and units with easily accessible windows. The analysis results show that all the sample rooms assessed, comply with the overheating criteria, i.e. during moderately warm summer conditions the risk of overheating is low. The risk of overheating in communal corridors has been also assessed. The report sets out the key design principles integrated in the proposed design to mitigate the risk of overheating. The report also provides	Probability: Very Low Consequence: Medium Impact Magnitude: Very Small Effect Significance: **Negligible (not significant)**

Receptor(s) affected	Relevant Climate Trends	Description of Impact and proposed mitigation	Magnitude of Impact & Significance of Effect
		guidelines on how to operate dwellings in the most efficient way to avoid overheating during warmer weather. These will be included in a Home User Guide provided to the future occupants. On this basis, while hotter summers, and increased temperatures in general, are likely to occur as a result of climate change, the probability of overheating effects within the buildings proposed as part of the proposed development occurring is considered to be Very Low. Should such an event occur, the consequence would be Medium, given the potential adverse effects on human health.	

15.4 In-Combination Climate Change Impact (ICCI) Assessment

15.4.1 Changes In Baseline Conditions

15.4.1.1 ES Baseline

A climate change chapter was not scoped into the 2010 ES. As such, current baseline conditions related to climate change were not reported in the 2010 ES.

15.4.1.2 ES Future Baseline

As previously stated, a climate change chapter was not scoped into the 2010 ES. As such, future baseline conditions related to climate change were not reported in the 2010 ES.

15.4.1.3 ESA Current Baseline

The current baseline conditions relevant to this ICCI assessment are set out within each of the respective technical ESA chapters (Chapters 8 to 14).

15.4.1.4 ESA Future Baseline & Receptor Sensitivity

The future climate change projections and trends that have informed this assessment are set out in **Section 15.2.4.1**.

The future receptor sensitivity assessment is set out in **Table 15.19 - Future Receptor Sensitivity Assessment**.

Table 15.19 - Future Receptor Sensitivity Assessment

Receptor	Sensitivity (Existing)	Key Climate Projections	Future Sensitivity Description	Future Sensitivity
Bracondale	High	Hotter and drier summers; Winters will become milder and wetter; Snowfall and the number of very cold days will decrease; Storms, heavy and extreme rainfall, and extreme winds will become more frequent.	According to the receptor sensitivity criteria used in the assessment, receptor sensitivity judgments are based on the uses present on each link, as well as other factors, such as the infrastructure (type of road, footways, provision of pedestrian crossings etc.) present. Hotter and drier summers could lead to greater highway pavement damage necessitating more frequent maintenance. With this minor exception (which would not be expected to affect the receptor sensitivity in isolation), climate change trends are not expected to affect these factors that influence the receptor sensitivity judgements. As such, there would be no change to the receptor sensitivity, which was previous stated as High in the Transport ESA chapter.	Unchanged (High)
Martineau Roundabout	High	Hotter and drier summers; Winters will become milder and wetter; Snowfall and the number of very cold days will decrease; Storms, heavy and extreme rainfall, and extreme winds will become more frequent.	According to the receptor sensitivity criteria used in the assessment, receptor sensitivity judgments are based on the uses present on each link, as well as other factors, such as the infrastructure (type of road, footways, provision of pedestrian crossings etc.) present. Hotter and drier summers could lead to greater highway pavement damage necessitating more frequent maintenance. With this minor exception (which would not be expected to affect the receptor sensitivity in isolation), climate change trends are not expected to affect these factors that influence the receptor sensitivity judgements. As such, there would be no change to the receptor sensitivity, which was previous stated as High in the Transport ESA chapter.	Unchanged (High)

15.4.1.5 Changes in Baseline

As previously stated, a climate change chapter was not scoped into the 2010 ES. As such, a comparison between the current and future baseline conditions set out above and the baseline conditions reported in the 2010 ES cannot be undertaken.

15.4.2 Assessment of Effects (Including Mitigation & Residual Effects)

As previously stated, a climate change chapter was not scoped into the 2010 ES. As such, a comparison between the in-combination climate change effects of the current planning application proposals (the proposed development) and those reported in the 2010 ES cannot be undertaken. The tables below set out the in-combination climate change effects of the proposed development.

Table 15.20 - Future Impact Magnitude & Effect Significance Assessment: Construction Stage

Receptor(s) Affected	Existing Effect	Potential Climate Change Impacts	Additional Mitigation proposed?	Future Magnitude & Effect Significance
Bracondale	**Neutral to Slight Adverse**	Future traffic levels are unlikely to change as a direct result of climate change, but there could be some increases to driver delay, pedestrian amenity, accidents and safety, particularly with increased frequency of storms and extreme rainfall and winds. This is balanced against snowfall on cold days decreasing which would benefit. On balance, there is a policy drive to reductions in private car travel and encourage more sustainable modes as part of commitments to address climate change, which could reduce future traffic flows. Overall, taking a conservative approach, it is considered that the impact magnitude for each impact would remain consistent with that previously assessed.	No	Impact Magnitude: No change to Medium Effect Significance: **Neutral to Slight Adverse** (unchanged)
Martineau Roundabout	**No change to Slight Adverse**	Future traffic levels are unlikely to change as a direct result of climate change, but there could be some increases to driver delay, pedestrian amenity, accidents and safety, particularly with increased frequency of storms and extreme rainfall and winds. This is balanced against snowfall on cold days decreasing which would benefit. On balance, there is a policy drive to reductions in	No	Impact Magnitude: No change to Small Effect Significance: **No Change to Slight Adverse**

Receptor(s) Affected	Existing Effect	Potential Climate Change Impacts	Additional Mitigation proposed?	Future Magnitude & Effect Significance
		private car travel and encourage more sustainable modes as part of commitments to address climate change, which could reduce future traffic flows. Overall, taking a conservative approach, it is considered that the impact magnitude for each impact would remain consistent with that previously assessed.		(unchanged)

Table 15.21 - **Future Impact Magnitude & Effect Significance Assessment: Operational Stage**

Receptor(s) Affected	Existing Effect	Potential Climate Change Impacts	Additional Mitigation proposed?	Future Magnitude & Effect Significance
Bracondale	**Neutral to Moderate Adverse**	Future traffic levels are unlikely to change as a direct result of climate change, but there could be some increases to driver delay, pedestrian amenity, accidents and safety, particularly with increased frequency of storms and extreme rainfall and winds. This is balanced against snowfall on cold days decreasing which would benefit. On balance, there is a policy drive to reductions in private car travel and encourage more sustainable modes as part of commitments to address climate change, which could reduce future traffic flows. Overall, taking a conservative approach, it is considered that the impact magnitude would remain consistent with that previously assessed.	No	Impact Magnitude: No change to Medium Effect Significance: **Neutral to Moderate Adverse** (unchanged)
Martineau Roundabout	**No change to Slight Adverse**	Future traffic levels are unlikely to change as a direct result of climate change, but there could be some increases to driver delay, pedestrian amenity, accidents and safety, particularly with increased frequency of storms and extreme rainfall and winds. This is balanced against snowfall on cold	No	Impact Magnitude: No change to Small Effect Significance:

Receptor(s) Affected	Existing Effect	Potential Climate Change Impacts	Additional Mitigation proposed?	Future Magnitude & Effect Significance
		days decreasing which would benefit. On balance, there is a policy drive to reductions in private car travel and encourage more sustainable modes as part of commitments to address climate change, which could reduce future traffic flows. Overall, taking a conservative approach, it is considered that the impact magnitude would remain consistent with that previously assessed.		**No Change to Slight Adverse** (unchanged)

15.5 GREENHOUSE GAS (GHG) EMISSIONS ASSESSMENT

15.5.1 Changes In Baseline Conditions

15.5.1.1 ES Baseline

A climate change chapter was not scoped into the 2010 ES. As such, current baseline conditions related to GHG emissions were not reported in the 2010 ES.

15.5.1.2 ES Future Baseline

As previously stated, a climate change chapter was not scoped into the 2010 ES. As such, future baseline conditions related to GHG emissions were not reported in the 2010 ES.

15.5.1.3 ESA Current Baseline

The application site is not currently in use and therefore it is assumed that currently there are no GHG emissions from the application site.

15.5.1.4 ESA Future Baseline

Should the proposed development not come forward, for the purposes of this assessment, it has been assumed that the application site would remain in its current state. As such, the future baseline GHG emissions from the application site are also considered to be zero.

15.5.1.5 Changes in Baseline

As previously stated, a climate change chapter was not scoped into the 2010 ES. As such, a comparison between the current and future baseline conditions set out above and the baseline conditions reported in the 2010 ES cannot be undertaken.

15.5.2 Assessment of Effects

15.5.2.1 Embedded Mitigation

Table 15.22 - Embedded Mitigation sets out mitigation measures that have been embedded into the design of the proposed development.

These measures are included within the Energy Statement and the Sustainability Statement submitted alongside the reserved matters application and are therefore considered to be 'embedded'. The low carbon energy strategy has been considered in the operational energy GHG emissions calculations. However, as previously noted, given that a contractor is not yet appointed, limited scheme information on construction material quantities is currently available. As such, the assessment of embodied GHG emissions has had to be based on benchmarks, based on industry guidance, rather than detailed scheme information. Therefore, given the need to ensure the assessment is conservative, it has not been possible to directly take into account the influence of many of these measures within the GHG emission calculations reported in this ESA chapter. The assessment reported in this chapter is therefore considered particularly conservative.

Table 15.22 - Embedded Mitigation

Embedded Mitigation	Description
Implementation of a low carbon energy strategy	**Reduction of Energy Demand** <u>Building orientation</u> Orientation varies across the proposed development. In principle, the proposed design aims to provide all residential areas with adequate levels of daylight for enhanced visual comfort and sunlight for passive heating in winter. Glazing areas, in particular on south and west facades that are more sensitive to solar gains and have a higher risk of overheating, have been optimised, to balance heat losses, solar gains and daylighting. <u>Building form</u> Simplified and compact building forms provide lower surface areas and less thermal junctions, compared to irregular forms. As a result, heat losses either through the envelope surface or element junctions are reduced thus reducing heating demand. The proposed design aims to avoid complex, irregular forms, where possible, to reduce energy demand. <u>Passive solar design & daylight</u> The make-up of the proposed façades has been optimised to balance the proportion of glazing to solid wall, thus providing an optimum amount of daylight and winter solar heating, while limiting excessive solar gains in summer. External shading in the form of balconies and deep window reveals, combined with high performance glass is proposed throughout the scheme for additional solar control. An Overheating Assessment has been completed and is provided in the Energy Statement appendices, which shows that, as a result of the proposed passive design measures, the risk of overheating in the assessed dwellings can be reduced considerably in line with Part O 2021. <u>Building fabric</u> Building fabric of enhanced thermal properties is proposed for the scheme to reduce heat losses as far as practical and cut energy demand for heating. Low Uvalues, exceeding the Part L standards, and robust construction details are proposed to reduce heat losses further. Eliminating thermal bridging is critical for reducing heat demand and complying with the Part L Fabric Energy Efficiency Target. The Part L guidance in limiting thermal bridging by applying insulation continuously, thus avoiding any breaks, and using less conductive materials, will be followed to achieve a low y value. Certified thermal details and products should be

Embedded Mitigation	Description
	used to ensure building fabric is designed to the highest standards. At this stage, performance targets following Government approved details (Scottish Building Standards) have been used with regards to psi-values. Airtightness Robust construction details will be also used to reduce heat losses through infiltration, thus improving the buildings' air tightness. An air permeability rate of 4 m3/m2hr @50Pa is targeted for the scheme at construction. Performance targets Tables 5 and 6 in the Energy Statement list the key targets with regards to the building fabric thermal performance, as assumed in the energy assessment. Achieving the targets will reduce the energy demand prior to considering additional energy efficiency measures and renewable energy technologies for the proposed development. **Energy Efficient Building Services** Space Heating and Hot Water An all-electric, fossil fuel free heating strategy, using heat pumps, is proposed to take advantage of the ongoing grid decarbonisation, thus allowing the development to become net zero carbon in due course. Individual Air Source Heat Pumps (ASHPs) are proposed for the houses to provide both space heating and domestic hot water. A communal energy centre with ASHPs is proposed for each apartment block to provide low carbon heat. To estimate carbon savings from ASHPs, gas-fired boilers are assumed at this stage. Ventilation Dwellings will rely on natural ventilation with intermittent extract fans for maintaining indoor air quality, in line with Part F 2021 Volume 1 requirements. Building services insulation The hot water distribution network, including any hot water tanks and internal pipework, will be insulated to high standards to reduce heat losses. This is critical not only for reducing energy demand but also reduce heat gains from pipework in summer that could potentially increase the risk of overheating. Allowance for the remaining system pipework losses will be accounted for within the final heat source selection and sizing. Heat losses from the LTHW distribution network will be calculated in detail at next stage once the details of the final pipework configuration are established. Lighting Low energy light fittings of LED types will be used within the dwellings and also in all communal areas. PIR sensors will be provided in communal areas to reduce energy consumption further. Commercial units The energy assessment of the commercial units has been carried out on the basis of Shell and Core development. Reasonable assumptions have been made at this stage, regarding the efficiencies of services that will be installed during first fit-out work, in the calculation of the building primary energy rate and building emission rate.

Embedded Mitigation	Description
	Commercial units are assumed to be served by reverse cycled heat pumps, e.g. in the form of a Variable Refrigerant Flow (VRF) system or DX split units, to provide space heating and comfort cooling. Direct electric water heaters are assumed for hot water supply. The units are assumed to rely mostly on natural ventilation with mechanical ventilation provided in back of house areas in the form of extract ventilation e.g. in toilets and kitchen facilities. Low energy light fittings is assumed for all spaces, including display lighting, and energy saving lighting controls, such as PIR sensors in secondary areas e.g. toilets and daylight sensors in front of house areas. <u>Performance targets</u> Tables 7 and 8 in the Energy Statement list the key performance targets with regards to energy efficiency, for the domestic and non-domestic elements separately. **Overheating & Cooling** The proposed design follows the cooling hierarchy to reduce the risk of overheating and therefore demand for active cooling. Measures to eliminate the risk of overheating have been considered and will be integrated in the design of the new dwellings. The following will be applied to maintain thermal comfort during summer within the main living areas: • Openable windows throughout the day to allow for natural ventilation; • Windows can be also left open during the night to allow for night-time cooling i.e. cool down the structure by taking advantage of lower external temperatures at night; • Ground floor windows and windows in accessible rooms will be designed secure so they can be left open at night or when unoccupied; and • Tenants will be advised to purchase A-rated appliances of low energy consumption to reduce internal heat gains. Energy efficiency light fittings that emit less heat than standard types thus reducing overheating will be also specified. The Overheating Assessment, provided in the Energy Statement appendices, has been carried out for the proposed scheme against the Part O 2021 overheating criteria. Results show that all assessed unit types comply with the overheating criteria. **Non-regulated energy use** The energy consumption and associated carbon emissions for non-regulated end uses have been calculated at this stage, using SAP 10 and the NCM for the domestic and non-domestic elements respectively. The carbon emission rate due to the small power, cooking and other appliances is circa 360 tnCO^2. The following strategies are proposed to reduce non-regulated energy use in dwellings: • Kitchens should be fitted out with energy efficient A-rated appliances or, alternatively, information about high efficiency appliances should be provided to future occupants;

Embedded Mitigation	Description
	• Installation of energy meters with display monitors, for encouraging occupants to become more interested and involved in how energy is being used in their house; and • Information should be provided to occupants explaining best practice operation of the installed systems to reduce the energy costs and carbon emissions. It is estimated that proposed strategies may reduce unregulated carbon emissions by at least 10%. However, at this stage, this can only be an assumption as small power consumption depends mainly on occupant's behaviour. **Heating infrastructure** Once demand for energy has been minimised, the next step of the Energy Hierarchy is about exploiting local energy resources (such as secondary heat) and supplying energy efficiently and cleanly to reduce CO2 emissions further. The opportunity to connect to a local district heating network, for providing low carbon heat to the proposed development, has been explored. Given that a heat network is not currently available in close proximity to the proposed site, an all-electric heating system using heat pumps is proposed for providing low carbon heat and take advantage of the ongoing grid decarbonisation, for achieving net zero carbon in the long term. **Renewable energy** Low and zero carbon systems, generating renewable energy on site, have been considered to further reduce carbon emissions, in line with the Councils' policies. A feasibility study of the following renewable energy technologies has been completed at this stage: • Biomass Boilers; • Wind Turbines; • Heat Pumps (Ground/Water/Air); • Solar Hot Water Heating; and • Photovoltaic panels. Air Source Heat Pumps (ASHPs) and Photovoltaic (PV) panels were identified as the most appropriate technologies for this site. Appendix B of Energy Strategy provides further information on the technologies not considered suitable for the scheme. <u>Air Source Heat Pumps</u> Individual ASHPs and communal energy centres using ASHPs are proposed for the houses and apartment blocks respectively to provide low carbon heat. Commercial units are assumed to have reverse-cycled heat pumps for providing both space heating and comfort cooling when required. ASHPs work by absorbing heat from the outside air and transferring it to a fluid, which is compressed to increase its temperature. This heat is then transferred from the compressed fluid into the central heating system, to use for both heating and hot water. At detailed design stage, the external plant will be designed such that the noise levels from the ASHP units will be in accordance with relevant industry standards to reduce or eliminate any noise pollution.

Embedded Mitigation	Description
	The system will comply with the minimum performance requirement set out in Enhanced Capital Allowance. The end user will be provided with detailed information on how to control and operate the system in the most efficient way. <u>Photovoltaic panels</u> Installation of Photovoltaic panels, mainly on flat roofs and pitched roof areas facing due south, is proposed for all the houses and apartment blocks. Where possible, the PV installation will be maximised, considering though the following restrictions: • Parts of the apartment blocks' available roof area will be occupied by the energy centre hosting the outdoor ASHP and other plant units; • Adequate space from the roof edge should be provided for safety and access, and also avoiding overshadowing from the roof parapet; and • When installed on flat roofs, PVs should be installed at a distance from any surrounding roof features that may overshadow them, such as plant screens, stair landings, lift and riser shafts, flues etc. Enough space should be also allowed between successive rows to avoid overshadowing and allow for access. At the next stage a MCS accredited team should be consulted to ensure the output of the PV array is maximised by optimising the location and orientation of the PVs and using the most efficient panels available in the market. The system's layout should consider local health and safety requirements, including accessibility requirements for system maintenance, cleaning the modules, and carrying out maintenance on any of the components. The following table shows this stage assumptions regarding PVs, as used in SAP. Appendix E shows a breakdown of the proposed PV arrays per house type and apartment block. The energy output of the PV panels, circa 618 MWh, will be used to meet the energy demand of the houses and the energy demand of the blocks' communal energy centre. PV panels will offer carbon savings of circa 86 tnCO2 per year.
Reduction of embodied carbon through structural design and material selection	**Locally Sourced** Sourcing materials locally should be considered as it not only reduces the carbon impact, but also has local social and economic benefits. **Design for disassembly** An important consideration for embodied carbon and circular economy is to ensure that materials can be easily dismantled, reused, replaced and recycled wherever possible. Designing interior finishes and MEP equipment for disassembly given these elements are likely to be replaced much more often over a building's lifespan than the structural elements will support optimal resource use. Adhesives and welding should also be avoided where possible. **Modular** Efficient construction methods such as modular systems can result in better build quality, more efficient transport of construction materials, reduced time on site and a reduction in construction waste; all of which contribute significantly to the overall carbon impact of the development. Offsite and modern methods of construction will be considered to increase resource efficiencies across the site. **Timing of WLCA**

Embedded Mitigation	Description
	The process of estimating WLC and considering WLC reduction measures should be incorporated into decision making processes from the outset of a developments design. The earlier WLC is considered the greater impact the assessments and analysis can have in minimising the carbon impact from a building. **Concrete** The production of cement is responsible for the majority of the embodied carbon associated with the use of concrete. It is possible to replace up to 70-80% of the cement content in concrete with an alternative binder, otherwise known as cement replacements. These are typically by-products of other carbon intensive process. One such common example is GGBS (Ground Granulated Blast Furnace Slag) which is a by-product of the iron manufacturing process and therefore has a much lower carbon factor ($kgCO^2e$/kg material) than Portland cement. It should be noted that the availability for large quantities of GGBS are currently uncertain due to high levels of demand. The amount of cement replacement within concrete will also affect the curing times, consistency, and appearance of the finished concrete (the use of GGBS results in a lighter finish than 100% Portland cement concrete). **Timber** Timber should be considered as an alternative to energy intensive materials such as concrete structures and stud walls, PVC/aluminium framed windows and doors and other man-made internal finishes. Timber is not only likely to be less carbon intensive in its production and require less structural reinforcement due to its lightweight profile, but also locks up carbon sequestered during the growth of the plant. **Building Services** Strategies to minimise the carbon impact from services over the building's lifespan may include: • Improving energy efficiency for the building to reduce the demand and size of MEP equipment required which is already being explored through the connection to a district heating from the adjacent site; • LED lights are not only more energy efficient than incandescent lights but also have a longer lifespan. Therefore, LED lights will need to be replaced much less often which reduces the lifetime carbon from these MEP elements; • Where active cooling is required low GWP (global warming potential) refrigerants should be sourced for heat pumps, to minimise the impact from leakages over the building's lifespan; and • Request data from manufacturers using the CIBSE TM65 methodology and data request form. Applying pressure on manufacturers to provide carbon data from their products will increase the accuracy of embodied carbon calculations for building services and create market competition for manufacturers to drive down the embodied carbon from their products. **Internal finishes**

Embedded Mitigation	Description
	Products supported by EPDs should be specified as a preference, as this allows the carbon footprint of like for like products to be compared. Products with EPDs also typically have a lower-than-average carbon footprint because they are not mandatory and therefore are produced for marketing purposes. Bare and exposed finishes reduce the amount of materials and therefore embodied carbon from typical alternative such as painted plasterboard and suspended ceiling systems. Low carbon materials such as glass mineral wool insulation will also be encouraged.
Water Use Reduction	Water efficient fixtures and fittings will be specified throughout the development, in line with DM3 of Norwich's local plan (Norwich City Council, 2014) to deliver an internal water consumption limit of 105 l/p/d. This will be achieved through low flow sanitaryware fittings such as basin and kitchen taps, showers and dual flush cisterns alongside efficient washing machine and, where specified, domestic dishwashers. A water calculation tool detailing indicative flow rates and internal water consumption confirms the development will meet a 105 l/p/d target and has been included in Appendix B of the Sustainability Statement. The European Water Label scheme will also be used to inform sanitary product selection, specifying products that have both a low water and energy rating under this scheme. In addition, automatic metering for residents to monitor water consumption in use will be specified to give transparency of water consumption to residents and incentivise reduced water use. To minimise potable water consumption rainwater harvesting systems will be specified for the houses, contributing to the site's drainage strategy and mitigation to future flood risk.
Waste reduction / Circular Economy Measures	The proposed sustainability strategy encourages a transition to a more circular localised economy, requiring the following principles to be incorporated wherever possible: • Efficient use of resources, utilising standardised components to reduce materials; preferring natural materials and specifying materials with a low embodied carbon (analysed through Whole Life Carbon assessment at RMA stage); • Modular and prefabricated building elements will be considered to reduce construction waste, time and energy use; • Designing for a circular economy and deconstruction, by designing for long life and loose fit, utilising modular systems with components that can be more readily taken apart at end of life. The design team will also ensure that the proposed development is designed for durability, ease of maintenance and part replacement where feasible; • Preference will be given to products that carry third-party verification, either by an Environmental Products declaration (EPD) or Cradle-to-Cradle Certification™; • Use of either reclaimed or recycled materials where feasible, prioritising a minimum of 5 major building elements to have $\geqslant$20% recycled content; • Setting construction resource efficiency targets of 8.5 tonnes of construction waste per 100 sqm in line with good practice Home Quality Mark criteria;

Embedded Mitigation	Description
	• Engage with the Principal Contractor to develop a Site Waste Management Plan and set diversion from landfill waste targets with a minimum 80% construction waste and 90% demolition waste diverted; and • Establish suitable construction servicing and delivery strategy with adequate storage to protect and minimise damage to materials and products.

15.5.2.2 Assessment of Effects (including Embedded Mitigation)

Table 15.23 - Total GHG emissions (tCO^2e) sets out the total GHG emissions (tCO_2e) produced by the proposed development across the 60 year RSP.

Table 15.23 - Total GHG emissions (tCO^2e)

Lifecycle Stage / Module	Total GHG emissions (tCO_2e)
Before Use Stage (A1-A5)	29,601.70
Use Stage Embodied Carbon (B1-B5)	15,647.36
Use Stage Operational Energy Use (B6)	35,957.73 (574.1 tCO_2e per year)
Use Stage Operational Water Use (B7)	656.76 (10.49 tCO_2e per year)
End of Life Stage (C1-C4)	1,738.60
Total	**83,602.14**

Table 15.24 - Comparison with UK Carbon Budgets sets out a consideration of the net GHG emissions arising from the proposed development in the context of the UK national carbon budgets.

Table 15.24 - Comparison with UK Carbon Budgets

UK National Carbon Budgets		GHG Emissions from the Proposed Development	Total Net GHG Emissions (tCO^2e)	% of Carbon Budget
Carbon Budget Period	Carbon Budget ($MtCO_2e$)			
Fourth (2023-2027)	1,950	During the fourth budget period, the proposed development would generate GHG emissions totaling 1,885.85 tCO^2e from construction of the proposed development (Phase 1) (Lifecycle Stage A). It is likely that the proposed embedded mitigation measures would reduce these GHG emissions; however, it has not been possible to quantify these reductions at this stage. It is not considered that the proposed development would have a material impact on the UK's ability to meet this carbon budget.	1,885.85	0.000097
Fifth (2028-2032)	1,725	During the fifth budget period, the proposed development would generate GHG emissions from the construction of the proposed development (Phase 1, Phase 3-1 and Phase 3-2) (Lifecycle Stage A);	8,310.81	0.000482

UK National Carbon Budgets		GHG Emissions from the Proposed Development	Total Net GHG Emissions (tCO^2e)	% of Carbon Budget
Carbon Budget Period	Carbon Budget ($MtCO_2e$)			
		as well as GHG emissions from operational energy and water consumption and embodied carbon associated with the use, maintenance, repair, replacement, and refurbishment of the proposed development (complete and operational development within Phase 1, Phase 3-1 and Phase 3-2) (Lifecycle Stage B). These emissions are anticipated to comprise: • Before Use Stage (A1-A5): 7,876.60 tCO_2e; • Use Stage Embodied Carbon (B1-B5): 123.36 tCO_2e; • Use Stage Operational Energy Use (B6): 305.38 tCO_2e; and • Use Stage Operational Water Use (B7): 5.49 tCO_2e. The proposed development is anticipated to result in a total of 8,310.81 tCO_2e in the fifth UK budget period. It is likely that the proposed embedded mitigation measures would reduce these GHG emissions; however, it has not been possible to quantify these reductions at this stage. It is not considered that the proposed development would have a material impact on the UK's ability to meet this carbon budget.		
Sixth (2033-2037)	965	During the sixth budget period, the proposed development would generate GHG emissions from the construction of the proposed development (Phase 3-3, Phase 3-4, Phase 3-5, Phase 3-6 and Phase 3-7) (Lifecycle Stage A); as well as GHG emissions from operational energy and water consumption and embodied carbon associated with the use, maintenance, repair, replacement, and refurbishment of the proposed development (complete and operational development within all phases) (Lifecycle Stage B). These emissions are anticipated to comprise: • Before Use Stage (A1-A5): 19,839.25 tCO_2e; • Use Stage Embodied Carbon (B1-B5): 758.46 tCO_2e; • Use Stage Operational Energy Use (B6): 1,780.45 tCO_2e; and	22,410.64	0.002322

UK National Carbon Budgets		GHG Emissions from the Proposed Development	Total Net GHG Emissions (tCO^2e)	% of Carbon Budget
Carbon Budget Period	Carbon Budget ($MtCO_2e$)			
		• Use Stage Operational Water Use (B7): 32.47 tCO_2e. The proposed development is anticipated to result in a total of 22,410.64 tCO_2e in the fifth UK budget period. It is likely that the proposed embedded mitigation measures would reduce these GHG emissions; however, it has not been possible to quantify these reductions at this stage. It is not considered that the proposed development would have a material impact on the UK's ability to meet this carbon budget.		

Table 15.25 - Comparison with Combined Tyndall Centre Energy-Only Carbon Budgets for sets out a consideration of the net energy only GHG emissions arising from the proposed development in the context of the combined Tyndall Centre Energy-Only Carbon Budgets for Norwich and South Norfolk.

Table 15.25 - Comparison with Combined Tyndall Centre Energy-Only Carbon Budgets for Norwich and South Norfolk

Combined Energy-Only Carbon Budgets for Norwich and South Norfolk		Energy-only GHG Emissions from the Proposed Development	Total Net Energy-Only GHG Emissions (tCO_2e)	% of Carbon Budget
Carbon Budget Period	Carbon Budget ($MtCO_2e$)			
2023-2027	2.80	During this budget period, the proposed development would not generate any GHG emissions in relation to operational energy. As such, the proposed development is anticipated to result in a total of 0 tCO_2e of energy only GHG emissions during this budget period. It is not considered that the proposed development would have a material impact on Norwich CC and South Norfolk DC's abilities to meet this energy-only carbon budget.	0	0
2028-2032	1.40	During this budget period, the proposed development would generate GHG emissions from operational energy (complete and operational development within Phase 1, Phase 3-1 and Phase 3-2) (Lifecycle Stage B). The proposed development is anticipated to	305.38	0.021813

Combined Energy-Only Carbon Budgets for Norwich and South Norfolk		Energy-only GHG Emissions from the Proposed Development	Total Net Energy-Only GHG Emissions (tCO_2e)	% of Carbon Budget
Carbon Budget Period	Carbon Budget ($MtCO_2e$)			
		result in a total of 305.38 tCO_2e of energy only GHG emissions during this budget period. It is not considered that the proposed development would have a material impact on Norwich CC and South Norfolk DC's abilities to meet this energy-only carbon budget.		
2033-2037	0.70	During this budget period, the proposed development would generate GHG emissions from operational energy (complete and operational development within all phases) (Lifecycle Stage B). The proposed development is anticipated to result in a total of 1,780.45 tCO_2e of energy only GHG emissions during this budget period. It is not considered that the proposed development would have a material impact on Norwich CC and South Norfolk DC's abilities to meet this energy-only carbon budget.	1,780.45	0.254350

15.5.3 Requirement for Additional Mitigation

15.5.3.1 Alternate or Additional Mitigation

As previously stated, a climate change chapter was not scoped into the 2010 ES. As such, mitigation measures related to GHG emissions were not reported in the 2010 ES.

Table 15.26 - **Proposed Additional Mitigation & Enhancement Measures** sets out the additional mitigation measures (additional to the embedded mitigation set out in Section 15.5.2) that have been proposed in order to address the effects identified in Section 15.5.2, as well as how they would be secured.

Table 15.26 - **Proposed Additional Mitigation & Enhancement Measures**

Possible effect being mitigated	Mitigation measure	How secured / trigger
Reduction of GHG emissions from the proposed development during the Before Use Stage (A1-A5)	A Construction and Environmental Management Plan (CEMP) will be prepared in due course setting out the planned procedures for how the impact of construction on the surrounding environment will be reduced during the construction stage. The CEMP will be developed by the Principal Contractor prior to the commencement of work on site and will focus on the following key areas relevant to this GHG emissions assessment: • Emissions to air; • Waste generation; • Use of natural resources; • Use of raw materials; • Energy use; and • Fuel consumption.	Planning condition – CEMP

15.5.4 Residual Effects

15.5.4.1 Comparison with UK National Carbon Budgets & Combined Tyndall Centre Energy-Only Carbon Budgets for Norwich and South Norfolk

Table 15.27 - **Post-Mitigation Comparison with UK National Carbon Budgets** and

Table 15.28 - **Post-Mitigation Comparison with** set out a consideration of the net GHG emissions arising from the proposed development in the context of the UK national carbon budgets and the combined Tyndall Centre Energy-Only Carbon Budgets for Norwich and South Norfolk, respectively, taking into account additional mitigation.

Table 15.27 - **Post-Mitigation Comparison with UK National Carbon Budgets**

Budget period	Residual Effect
Fourth (2023-2027)	During the fourth budget period, the proposed development would generate GHG emissions from construction of the proposed development (Phase 1) (Lifecycle Stage A), equating to 0.000097% of the total carbon budget. It is likely that the proposed embedded mitigation and additional mitigation measures would reduce these GHG emissions; however, it has not been possible to quantify these reductions at this stage. It is not considered that the proposed development would have a material impact on the UK's ability to meet this carbon budget.
Fifth (2028-2032)	During the fifth budget period, the proposed development would generate GHG emissions from the construction of the proposed development (Phase 1, Phase 3-1 and Phase 3-2) (Lifecycle Stage A); as well as GHG emissions from operational energy and water consumption and embodied carbon associated with the use, maintenance, repair, replacement, and refurbishment of the proposed development (complete and operational development within Phase 1, Phase 3-1 and Phase 3-2) (Lifecycle Stage B), equating to

	0.000482% of the total carbon budget. It is likely that the proposed embedded mitigation and additional mitigation measures would reduce these GHG emissions; however, it has not been possible to quantify these reductions at this stage. It is not considered that the proposed development would have a material impact on the UK's ability to meet this carbon budget.
Sixth (2033-2037)	During the sixth budget period, the proposed development would generate GHG emissions from the construction of the proposed development (Phase 3-3, Phase 3-4, Phase 3-5, Phase 3-6 and Phase 3-7) (Lifecycle Stage A); as well as GHG emissions from operational energy and water consumption and embodied carbon associated with the use, maintenance, repair, replacement, and refurbishment of the proposed development (complete and operational development within all phases) (Lifecycle Stage B), equating to 0.002322% of the total carbon budget. It is likely that the proposed embedded mitigation and additional mitigation measures would reduce these GHG emissions; however, it has not been possible to quantify these reductions at this stage. It is not considered that the proposed development would have a material impact on the UK's ability to meet this carbon budget.

Table 15.28 - **Post-Mitigation Comparison with Combined Tyndall Centre Energy-Only Carbon Budgets for Norwich and South Norfolk**

Budget period	Residual Effect
2023-2027	During this budget period, the proposed development would not generate any GHG emissions in relation to operational energy. As such, the proposed development is anticipated to result in a total of 0 tCO2e of energy only GHG emissions during this budget period. It is not considered that the proposed development would have a material impact on Norwich CC and South Norfolk DC's abilities to meet this energy-only carbon budget.
2028-2032	During this budget period, the proposed development would generate GHG emissions from operational energy (complete and operational development within Phase 1, Phase 3-1 and Phase 3-2) (Lifecycle Stage B), equating to 0.021813% of the total combined energy-only carbon budget. It is not considered that the proposed development would have a material impact on Norwich CC and South Norfolk DC's abilities to meet this energy-only carbon budget.
2033-2037	During this budget period, the proposed development would generate GHG emissions from operational energy (complete and operational development within all phases) (Lifecycle Stage B), equating to 0.254350% of the total combined energy-only carbon budget. It is not considered that the proposed development would have a material impact on Norwich CC and South Norfolk DC's abilities to meet this energy-only carbon budget.

15.5.4.2 Significance of effect

Table 15.29 - **Significance of Effect Post-Mitigation Assessment** sets out the assessment of effect significance in accordance with the IEMA Guidance. The residual effect is considered long-term, direct, permanent and irreversible.

Table 15.29 - Significance of Effect Post-Mitigation Assessment

Overall GHG Emissions from the Proposed Development	Compliance with Existing and Emerging Policy	Residual Effect Scale & Significance
The proposed development is estimated to generate GHG emissions totaling 83,602.14 tCO_2e across the 60 year RSP.	The proposed development has been considered in relation to local and national policy in full within the Sustainability Statement that accompanies the planning application. The Sustainability Statement demonstrates that the design of the proposed development incorporates the sustainability features required to comply with the current and emerging planning policy requirements of Norwich CC and South Norfolk DC Planning Policy. The design team have engaged with the planning department and local residents to ensure all opportunities and concerns have been considered and addressed, where feasible, to achieve the best possible design. The proposed energy and sustainability features are set out in Table 15.22 earlier in this ESA chapter. It is considered that the proposed development is consistent with applicable existing and emerging policy requirements and good practice design standards for projects of this type. Therefore, in line with the IEMA Guidance, this is considered to be a Minor Adverse effect. In line with the guidance, this effect is considered to be not significant.	Minor Adverse (not significant)

15.6 Other Environmental Issues

This section sets out any considerations and environmental effects that have been identified with regard to the range of topics which have been introduced into the EIA requirements through the EIA Regulations 2017. Where there are no such considerations or environmental effects relevant to climate change, this is also specified for clarity.

15.6.1 Other Environmental Issues of Relevance

15.6.1.1 Infrastructure

Climate change effects related to proposed infrastructure have been considered where relevant in this ESA chapter.

15.6.1.2 Waste

GHG emissions have been assessed in line with the activities and methodology set out in the RICS guide (as set out in Table 15.10, earlier in this ESA chapter). GHG emissions associated with waste generated by the proposed development during the end-of-life stage have been included in the GHG emissions

assessment. GHG emissions associated with waste generated during the earlier lifecycle stages are considered unlikely to be significant in the context of the proposed development's total greenhouse gas emissions across the 60 year RSP.

Waste is not considered relevant to the climate change resilience and adaptation and in-combination climate change assessments.

15.6.1.3 Population and Human Health

GHG emissions have the potential to indirectly effect human health via their effect on the global atmosphere, contributing to climate change. The goal of the Paris Agreement is to limit global temperature rise to well below 2°C, aiming for 1.5°C, compared with pre-industrial levels, with the aim of avoiding severe adverse impacts from climate change. Such impacts would include impacts on human health, such as death and illness from increasingly frequent extreme weather events, such as heatwaves, storms and floods, the disruption of food systems, increases in zoonoses and food-, water- and vector-borne diseases, and mental health issues. The GHG emissions impact assessment reported in this ES chapter, assesses the GHG emission effects of the proposed development to establish whether it contributes to reducing GHG emissions, consistent with a trajectory towards the UK's net zero by 2050 target, which has been established in response to the goals of the Paris Agreement.

Potential effects on human health have also been considered in the climate change resilience and adaptation and in-combination climate change assessments.

15.6.1.4 Climate and Change

Climate change effects have been assessed in this ESA chapter, including climate change resilience and adaptation effects, in-combination climate change effects, and GHG emission effects.

15.6.1.5 Risk of Major Accidents and/or Disasters

As confirmed by Norwich CC in their 10 May 2023 Scoping Opinion, this topic has been scoped out of the ESA.

15.6.2 Summary

These environmental factors have been considered where relevant in the ESA chapter, as set out above.

15.7 SUMMARY OF EFFECTS

Table 15.30 – **Residual Effects Summary** sets out a summary of the proposed development's residual climate effects.

Table 15.30 – Residual Effects Summary

Receptor	Residual Effect	Residual Effect Scale & Significance
Resilience & Adaptation		
Temporary site office and welfare facilities	Resilience / adaptation to climate change (changes in frequency of extreme heat and cold events and storms)	Negligible (not significant)

Receptor	Residual Effect	Residual Effect Scale & Significance
Construction workers (human health)	Resilience / adaptation to climate change (changes in frequency of extreme heat and cold events and storms)	Negligible (not significant)
Retained and proposed planting	Resilience / adaptation to climate change (wetter winters and drier summers)	Minor Adverse (not significant)
Proposed permanent buildings	Resilience / adaptation to climate change (more frequent extreme weather events)	Negligible (not significant)
Proposed drainage infrastructure	Resilience / adaptation to climate change (drier summers increasing erosion of soils / substrates drying out allowing the mobilisation of more debris)	Minor Adverse (not significant)
Utilities infrastructure services	Resilience / adaptation to climate change (wetter winters increasing surface water flooding)	Minor Adverse (not significant)
Residents and other future site users	Resilience / adaptation to climate change (wetter winters affecting flood risk)	Minor Adverse (not significant)
Residents and other future users of the proposed buildings	Resilience / adaptation to climate change (hotter summers affecting overheating)	Negligible (not significant)
In-combination Climate Change Effects		
All effects reported in the technical ESA chapters (Chapters 8 to 14) are expected to remain **unchanged**.		
GHG Emissions Effects		
The global atmosphere	Greenhouse gas emissions from the proposed development during the before use, in use and end of life stages.	Minor Adverse (not significant)