

Carmoor Road, Manchester

Whole Lifecycle Carbon Assessment

Ensphere Group Ltd on behalf of
Tiger Developments Ltd



Ensphere Group Ltd
55A Catherine Place,
London, SW1E 6DY
+44 (0) 20 7846 9040
www.enspheregroup.com



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Contents

1.	Executive Summary.....	1
2.	Introduction.....	3
3.	Assessment Framework	4
4.	Planning Context	5
5.	Specification of the Object of Assessment	7
6.	Methodology	10
7.	Product Stage [A1-A3].....	12
8.	Construction Process Stage [A4-A5]	16
9.	Use Stage [B1-B7]	18
10.	End of Life Stage [C1 to C4]	25
11.	Benefits & Loads Beyond the System Boundary [D].....	27
12.	Whole Lifecycle Carbon Assessment Results	28
13.	Summary	29
14.	Proposed Development Recommendations	30
	Appendices	31
A.	Existing Site Plan.....	32
B.	Proposed Site Plan.....	34
C.	Key Local Planning Policy Requirements	36
D.	LCA Details.....	42
E.	General Notes	45

1. Executive Summary

- 1.1 This Whole Lifecycle Carbon (“WLC”) compares the carbon emissions resulting from the construction and use of the proposed development at Carmoor Road, Manchester, relative to retaining the existing site.
- 1.2 The proposed development comprises the demolition of existing buildings on site and erection of a multi-storey building for student accommodation, with associated infrastructure.
- 1.3 Consideration has primarily been given to the planning policy and other relevant standards and guidance. A Whole Lifecycle Carbon (“WLC”) was calculated, for the existing and proposed building, comparing the carbon emissions resulting from the construction of the new development (embodied carbon) as well as the use of the buildings (operational carbon) over their lifetime.
- 1.4 All stages of the project have been considered for the proposed development, from raw material extraction, product manufacturing, transport, and installation on site through to the operation, maintenance, and eventual material disposal. In comparison the model for the current site aimed to capture the carbon emissions associated with the existing buildings in operation and its eventual end of life. Therefore, as the buildings are already present, the assessment excluded the emissions from the product and construction stages [A1-A5].
- 1.5 Best available data has been used, with the acknowledgement that this assessment has been undertaken at a relatively early stage of design.
- 1.6 Specialist software has been used with emissions calculated using the One Click LCA software, utilising both the IMPACT compliant & BRE approved LCA calculation tools, with geometry being created and defined within IES VE 2022 and exported to the One Click tool. Operational carbon was based on SAP10.2 results for both buildings.
- 1.7 The assessment has reviewed WLC over a 60-year period, in line with the recommended RICS approach.
- 1.8 This identified total WLC emissions of 5,407,129 kgCO₂e for the proposed development. The key lifecycle stages responsible for these emissions are [A1-A3] Materials Emissions (1,762,297 kg CO₂e), the [B4] Material Replacement (423,200 kg CO₂e) and the [B6] Operational Energy Use (2,401,284 kg CO₂e).
- 1.9 The WLC emissions associated with the continued operation of the exiting site (excluding product and construction stages [A1-A5]) have also been estimated at 8,298,239 kgCO₂e. Over 90% of these emissions are due to the Operational Energy Use (7,934,713 kg CO₂e).

- 1.10 This Whole Life Carbon Assessment therefore shows that the emissions associated with the operation and end-of-life of the existing buildings on site are over 30% higher than the whole life cycle carbon emissions of constructing the proposed student accommodation.
- 1.11 The results demonstrate that redeveloping the site in line with the proposals lead to a significant carbon saving over the life cycle of the building. Recommendations have also been given at the end of this report to encourage further reductions in WLC emissions of the proposed development.

2. Introduction

- 2.1 Ensphere Group Ltd was commissioned by Tiger Developments Ltd to undertake a Whole Lifecycle Carbon Assessment comparison of the existing site versus the proposed development at Carmoor Road, Manchester.

Site and Surroundings

- 2.2 The application site (the 'Site') is located approximately 6km south of Manchester city centre. The site is located adjacent to the A34, accessed via Carmoor Road from the front and Autumn Street to the rear. The proposed development is within a heavily urbanised area and is currently used as a car garage and a private day nursery.
- 2.3 The site is bounded by a student accommodation building to the south west of the site and a community centre to the north side. To the north east of the site there is an office block with associated car parking. The site is situated in a local area that provides ample amenities, including food outlets, supermarkets and household services.

Proposed Development

- 2.4 The proposed development comprises the demolition of existing buildings on site and erection of a multi-storey building for student accommodation, with associated infrastructure.

Report Objectives

- 2.5 To assess the carbon emissions resulting from the construction and use of the building over its entire life, to improve understanding, consistent measurement and enable comparability of results, benchmarking and target setting to achieve carbon reductions.
- 2.6 Furthermore, this report looks at the whole life carbon impacts of retaining the existing buildings on site, versus replacing it with the proposed development, with an aim of demonstrating that the proposed scheme provides a lower carbon option over its lifecycle.

3. Assessment Framework

- 3.1 Whole life-cycle carbon (“WLC”) emissions are the carbon emissions resulting from materials, construction and use of a building over its entire life, including its demolition and disposal. A whole life carbon approach identifies the overall best combined opportunities for reducing lifetime emissions and helps to avoid unintended consequences of focusing on operational emissions alone.

Relevant Standards & Guidance

- 3.2 The framework for appraising the environmental impacts of the built environment is provided by BS EN 15978:2011, a European Standard now adopted at a national level. The Standard specifies the calculation method, based on Life Cycle Assessment (LCA) and other quantified environmental information, to assess the environmental performance of a building. It also gives the means for the reporting and communication of the outcome of the assessment.
- 3.3 The standard gives:
- The description of the object of the assessment;
 - The system boundary that applies at the building level;
 - The procedure to be used at the inventory analysis;
 - The list of indicators and procedures for the calculations of these indicators;
 - The requirements for presentation of the results in reporting and communication; and
 - The requirements for the data necessary for the calculation.
- 3.4 In response to the challenge of ensuring consistency with the application of BS EN 15978, further work has been undertaken by organisations including the Royal Institute of Chartered Surveyors (RICS) and the Building Research Establishment (BRE), with the following references also being pertinent to this assessment:
- RICS Professional Statement – Whole Life Carbon Assessment for the Built Environment 1st Edition (RICS; ISBN 978 1 78321 208 8, November 2017); and
 - BRE Global Methodology for the Environmental Assessment of Buildings Using EN 15978:2011 (Building Research Establishment; ref PN 326 Rev 0.0; January 2018)

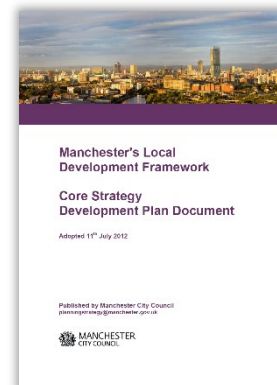
4. Planning Context

Local Context

Manchester Core Strategy 2012 to 2027 (July 2012)

4.1 The Core Strategy was adopted by Manchester City Council on 11th July 2012. It is the key document in Manchester's Local Development Framework and covers a period of 15 years from 2012 to 2027. It describes Manchester today and outlines the Council's vision for Manchester in 2027 along with the planning policies which will be used to deliver that vision.

4.2 The policies considered most pertinent to this report are listed below:



- Policy EN 4 (*Reducing CO2 Emissions by Enabling Low and Zero Carbon Development*) - The Council will seek to reduce fuel poverty and decouple growth in the economy, growth in CO2 emissions, and rising fossil fuel prices, through the use of building materials with low embodied carbon in new development and refurbishment schemes;
- Policy EN 7 (*Energy Infrastructure opportunities*) – There will be a general presumption in favour of low and zero carbon decentralised energy schemes;
- Policy EN 8 (*Adaption to Climate Change*) – All new development will be expected to be adaptable to climate change in terms of the design, layout, siting and function of both buildings and associated external spaces. Developers will be permitted to use green infrastructure elements such as green roofs, green walls, street trees and waterways to contribute to compliance with CO2 mitigation under Policy EN6, subject to sufficient evidence to quantify their contribution to compliance;
- Policy EN 9 (*Green Infrastructure*) - New development will be expected to maintain existing green infrastructure in terms of its quantity, quality and multiple function. Where the opportunity arises and in accordance with current Green Infrastructure Strategies the Council will encourage developers to enhance the quality and quantity of green infrastructure, improve the performance of its functions and create and improve linkages to and between areas of green infrastructure. Where the benefits of a proposed development are considered to outweigh the loss of an existing element of green infrastructure, the developer will be required to demonstrate how this loss will be mitigated in terms of quantity, quality, function and future management;

- Policy EN 17 (*Water Quality*) - Development should avoid any adverse impact on water quality, including during the construction phase, and wherever possible should seek to enhance water quality, both chemical and ecological;
- Policy EN 19 (*Waste*) - Require all developers, including those of new waste management facilities within the District, to demonstrate the proposal's consistency with the principles of the waste hierarchy (prevention, reduction, re-use, recycling/composting, energy recovery, final disposal);
- Policy H 12 (*Purpose Built Student Accommodation*) - Proposals that can demonstrate a positive regeneration impact in their own right will be given preference over other schemes.

5. Specification of the Object of Assessment

- 5.1 The following section outlines the parameters by which the Whole Life-Cycle Carbon Assessment has been undertaken. Specification of the boundaries is necessary to ensure consistency of approach and comparison.

Spatial Boundaries

- 5.2 A Whole Life-Cycle Carbon Assessment should consider all building components and works relating to the project, including any external works within the site boundary. The site boundary needs to be in line with the definition and intended use of the built asset, including all contiguous land that is associated with the project and that supports its operations.
- 5.3 For the WLC assessment, the spatial boundary is consistent with the red-line site boundary presented in support of the application.

Building Physical Characteristics

- 5.4 This section outlines the building parts, elements, and components to be included in a Whole Life-Cycle Carbon Assessment.
- 5.5 The physical characteristics of the proposed development are as described in architect drawings and include:
- Multi-storey building consisting of several apartments.
 - Public realm improvements, including communal amenity and associated refuse and cycle storage.
- 5.6 For the existing site, the physical characteristics of the site are as follows:
- Two uninsulated masonry garage buildings, with associated hardstanding.
 - Three storey converted house and side buildings, most recently used as a day nursery.
- 5.7 In line with the RICS Professional Statement, new build projects assessed are considered to commence their development on a cleared, flat site for consistency purposes. Demolition works are often decoupled from new construction projects, hence the responsibility for any emissions arising from demolition is not necessarily solely attributable to the new build project.

Reference Study Period

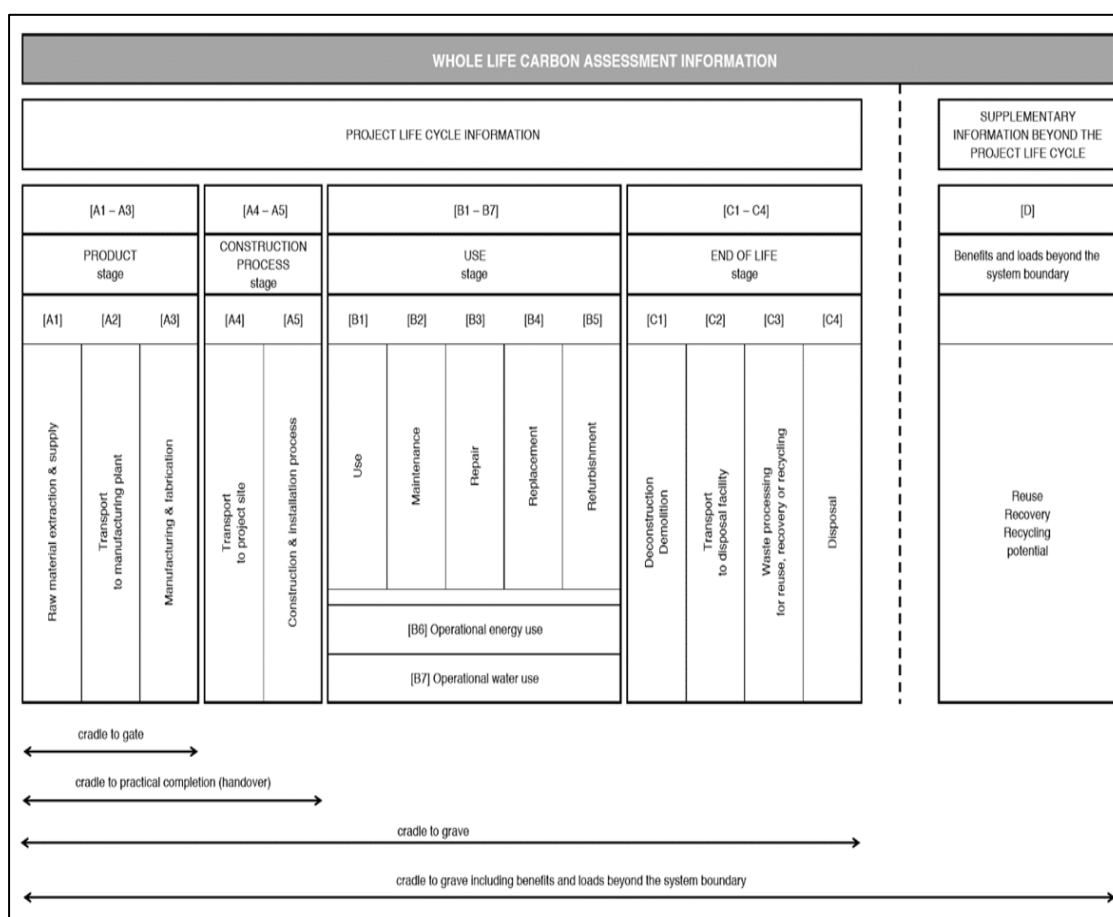
- 5.8 The Reference Study Period (RSP) to be used for the Whole Life-Cycle Carbon Assessment is defined by the RICS PS as being dependent on the nature of the development. Grove Crescent Road South is a residential scheme; however, RICS PS still gives reference to the number of

years referred to under non-domestic standards; including BREEAM 2014 New Construction – Mat01 Life Cycle impacts; and LEED v.4 standards whereby a 60-year study period is specified. The RICS PS references to both the BREEAM and LEED standards are purely to ensure compatibility with other similar approaches. Furthermore, the acknowledgement of the 2014 version of BREEAM is due to the publishing date of the RICS PS; before the release of BREEAM New Construction 2018.

Life Cycle Stages - Overview

- 5.9 The stages are as presented in BS EN 15978:2011, the boundaries of which are all clearly defined to ensure consistency of approach and comparison between the whole life results for different projects.

Figure 5.1 Whole Life Cycle Stages (RICS PS adapt. of BS EN 15978:2011 stages)



- 5.10 Certain potential sources of carbon (e.g., transport emissions associated with the use stage) are outside the scope; and whilst these emissions might be picked up through other assessment (organisational carbon foot printing), they are not including within Whole Life-Cycle Carbon Assessment. This is because the WLC methodology is an assessment of the built environment only.

Units of Measurement

- 5.11 The units of measurement are reported in kgCO₂ equivalent (“kgCO_{2e}”). This is standard unit for measuring carbon footprints and expresses the impact of each different greenhouse gas in terms of the amount of CO₂ that would be required to create the same amount of warming. It therefore allows for the simultaneous assessment of multiple greenhouse gases.

Future Energy Projections

- 5.12 The energy sector is a major carbon emitter and will need to continue to decarbonise over time to be consistent with national policy targets. To enable consistency in the calculation of life cycle carbon impacts, EN15978 suggests that current practices shall apply to any future projections and does not allow for decarbonisation in the calculations. SAP10.2 carbon conversion factors have been used in this assessment.

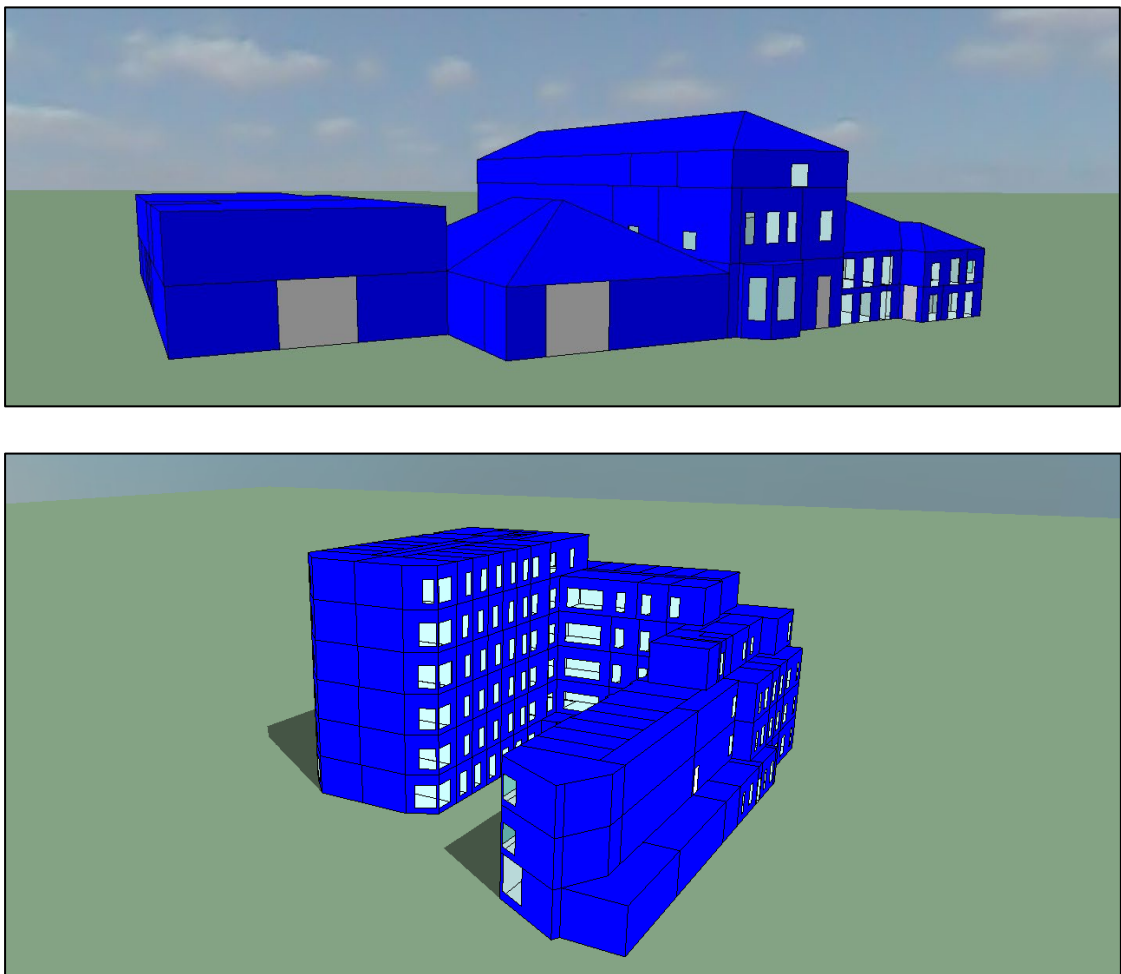
WLC Scope for comparison against the existing building

- 5.13 As this report looks not only at the whole life carbon impacts associated with that of the proposed development, but evaluates emissions in the context of retaining the existing buildings on site, two separate models were produced.
- 5.14 The first model representing the proposed development covered all stages shown in Figure 5.1 (cradle to grave including benefits and loads beyond the system boundary).
- 5.15 The second model produced aimed to capture the carbon emissions associated with the existing buildings in operation and its eventual end of life. Therefore, as the buildings are already present, the assessment excluded the emissions from the product and construction stages [A1-A5], but included the remaining stages (use [B], end of life [C] and benefits and loads beyond the system boundary [D]) to allow for a fair comparison with the proposed development.

6. Methodology

- 6.1 The Whole Life-Cycle Carbon Assessment was calculated using the One Click LCA software, utilising both the IMPACT compliant & BRE approved LCA calculation tools, with geometry being created and defined within IES VE 2022 and exported to the One Click tool.
- 6.2 The geometries of both the proposed and existing buildings were modelled within IES VE 2022, based upon drawings provided by the architect and structures teams. Once this was completed, data detailing the measurements of building elements were exported from IES VE 2022 and inserted into One Click LCA, providing the appropriate material quantities for the assessment. Building materials were then attached to the appropriate building elements based on available information from the design team.
- 6.3 IES VE 2022 does not allow the modelling of non-thermal elements, therefore elements such as the substructure, structural frame and hard landscaping were added manually into One Click LCA.

Figure 6.1 IES Representation of the Site (Existing and Proposed)



- 6.4 As limited information was available for the existing site, materials and system types were assumed based on similar buildings of the same use type and photographs taken of the site. Details for the proposed building in terms of materials and expected energy demands were provided by the project team.

Table 6.1 WLC Primary Data Sources Summary

	Lifecycle Stage	Data Source
Product Stage	A1: Raw Material Supply	IES-VE; One Click LCA database
	A2: Transport	One Click LCA database
	A3: Manufacturing	One Click LCA database
Construction Process Stage	A4: Transport to Building Site	One Click LCA database
	A5: Installation into Building	One Click LCA database
Use Stage	B1: Use / Application	One Click LCA database Submission Documents
	B2: Maintenance	One Click LCA database
	B3: Repair	One Click LCA database
	B4: Replacement	One Click LCA database
	B5: Refurbishment	One Click LCA database
	B6: Operational Energy Use	Building Regulations Part L Report
	B7: Operational Water Use	BSRIA BG9-2011 (Rules of thumb) Employment Density Guide 3 rd Edition
End of Life Stage	C1: Deconstruction / Demolition	One Click LCA database
	C2: Transport	One Click LCA database
	C3: Waste Processing	One Click LCA database
	C4: Disposal	One Click LCA database
Benefits & Loads Beyond the System Boundary	D: Reuse / Recovery / Recycling	One Click LCA database

7. Product Stage [A1-A3]

7.1 The product stage deals with the carbon emissions attributable to the cradle to gate processes; raw materials supply, transport, and manufacturing; and comprise:

- Raw Material Extraction & Supply [A1]
- Transport to Manufacturing Plant [A2]
- Manufacturing & Fabrication [A3]

7.2 The processes covered by [A1–A3] frequently occur in several steps, where components are manufactured and then transported to a further fabrication plant for assembly into a system; and all of these interim steps need to be taken into account.

7.3 The calculation for the carbon emissions associated with the product stage [A1-A3] requires the assignment of suitable embodied carbon factors to the given elemental material quantities, as follows:

$$[A1-A3] = \text{Material quantity (a)} \times \text{Material embodied carbon factor (b)}$$

7.4 Given the early stage of assessment, technical specification is still indicative, therefore generic data, representative of standard, market average specifications have been used.

7.5 Environmental information for the product stage is defined in the product Environmental Product Declaration (EPD). But where no EPD is available, scenarios for products have been defined from cradle to gate modules according to EN15804.

7.6 The following table summarises the building materials assumptions for the proposed building:

Table 7.1 Proposed Development Building Materials

Resource	Quantity (kg)
Foundations & Substructure	
Reinforcement steel (rebar), generic, 80% recycled content, A615	26,232
Ready-mix concrete, normal-strength, generic, C30/37 (4400/5400 PSI), 0% recycled binders in cement (300 kg/m3 / 18.72 lbs/ft3)	378,224
PIR (polyisocyanurate foam) insulation panels, unfaced, generic, L = 0.022 W/mK, R = 4.55 m2K/W (26.7 ft2°Fh/BTU), 100 mm (3.94 in), 45 kg/m3 (2.81 lbs/ft3), Lambda=0.022 W/(m.K)	14,000
Ready-mix concrete, normal-strength, generic, C30/37 (4400/5400 PSI), 10% (typical) recycled binders in cement (300 kg/m3 / 18.72 lbs/ft3)	892,800
Plastic vapour control layer, 0.2 mm (Tommen Gram)	230
Reinforcement steel (rebar), generic, 90% recycled content, A615	33,477
Self levelling mortar, for floors, walls and overhead appl., 3-50 mm, 1400 kg/m3, Pericret (PCI Augsburg)	34,720

Vertical Structures and Façade	
External walls and facade	
Red brick, average production, UK, 215 mm x 102.5 mm x 65 mm, 2.13 kg/unit, 1485 kg/m ³ (Brick Development Association (BDA) Ltd (2019))	400,000
Masonry mortar/facing wall mortar/mortar with special properties, 1500 kg/m ³ , EPD coverage: >1500 kg/m ³ (IWM)	77,000
Polypropylene vapour membrane, French average, 0.18 kg/m ² (MDEGD)	560
Rock wool insulation panels, L=0.035 W/mK, R=4.29 m ² K/W, 150 mm, 9 kg/m ² , 60 kg/m ³ , Lambda=0.035 W/(m.K), Rainscreen Duo Slab 150mm (ROCKWOOL, UK plant)	28,000
Steel purlins and framing, 7850 kg/m ³ , Purlins Roof systems and side rails, SFS Framing, SFS Framing Load bearing structures (Voestalpine Metsec plc)	240,000
Particleboard, type P2, 28mm, 18.4kg/m ² , 659kg/m ³ , biogenic CO ₂ not subtracted (for CML) (INSTITUT TECHNOLOGIQUE FCBA)	57,000
Gypsum plaster, 1100 kg/m ³ (Bundesverband der Gipsindustrie)	10,000
Columns and load-bearing vertical structures	
Ready-mix concrete, normal-strength, generic, C30/37 (4400/5400 PSI), 10% (typical) recycled binders in cement (300 kg/m ³ / 18.72 lbs/ft ³)	508,200
Reinforcement steel (rebar), generic, 90% recycled content, A615	23,100
Internal walls and non-bearing structures	
Gypsum plaster board, regular, generic, 6.5-25 mm (0.25-0.98 in), 10.725 kg/m ² (2.20 lbs/ft ²) (for 12.5 mm/0.49 in), 858 kg/m ³ (53.6 lbs/ft ³)	160,000
Water-borne interior paints, 1.36 kg/L, average coverage 8-10 m ² /L, Biora, Ekora, Kolibri Sand, Paneelikattomaali, Ranch, Superlateksi, Tapettipohjamaali, Teknospro, Tela, Timantti, Trend (Teknos)	2,000
Structural steel profiles, generic, 60% recycled content, I, H, U, L, and T sections, S235, S275 and S355	20,655
Glass wool insulation panels, unfaced, generic, L = 0.031 W/mK, R = 3.23 m ² K/W (18 ft ² °Fh/BTU), 25 kg/m ³ (1.56 lbs/ft ³), (applicable for densities: 0-25 kg/m ³ (0-1.56 lbs/ft ³)), Lambda=0.031 W/(m.K)	19,000
Gypsum plaster board, regular, generic, 6.5-25 mm (0.25-0.98 in), 10.725 kg/m ² (2.20 lbs/ft ²) (for 12.5 mm/0.49 in), 858 kg/m ³ (53.6 lbs/ft ³)	160,000
Horizontal structures: beams, floor's, and roofs	
Ready-mix concrete, normal-strength, generic, C30/37 (4400/5400 PSI), 0% recycled binders in cement (300 kg/m ³ / 18.72 lbs/ft ³)	996,000
Reinforcement steel (rebar), generic, 90% recycled content, A615	42,067
Ready-mix concrete, normal-strength, generic, C30/37 (4400/5400 PSI), 0% recycled binders in cement (300 kg/m ³ / 18.72 lbs/ft ³)	588,000
Reinforcement steel (rebar), generic, 90% recycled content, A615	24,799
Polypropylene vapour membrane, French average, 0.18 kg/m ² (MDEGD)	220
Glass wool insulation, R=5.0 m ² K/W, L=0.040 W/mK, ép. 200 mm, 2.295 kg/m ² , Lambda=0.04 W/(m.K), ISOLANT TOITURE 200 (ISOVER)	2,800

Bituminous waterproofing system - Single layer, 5.44 kg/m2, AXTER, DERBIGUM, MEPLÉ, SIPLAST-ICOPAL, SOPREMA (Chambre Syndicale Française de l'Étanchéité)	6,700
Polyethylene sealing film for slabs, ép. 150 micron, Donnee par default (MDEGD)	170
Drainage floor underlay from EPS, ép.25 mm, DONNEE PAR DEFAULT (DED)	434
Geotextile from polypropylene, 300 g/m2 (MDEGD)	372
Soil substrates for green roofs (MDEGD)	0
Other structures and materials	
Stainless steel bicycle rack, 1.3 kg/unit, DONNEE PAR DEFAULT (MINISTÈRE DE L'ENVIRONNEMENT, DE L'ÉNERGIE ET DE LA MER - MINISTÈRE DU LOGEMENT ET DE L'HABITAT DURABLE)	46
Galvanized steel bicycle shelters, 76.7 kg/unit, DONNEE PAR DEFAULT (DED)	150
Porcelain WC kit (toilet and tank), 37.4 kg/unit, DURAVIT : Duraplus (023009+087920) KOHLER : Odeon Up	6,400
Porcelain sink, 29.6 kg/unit, 50 x 70 cm (SFISB)	5,100
Shower tray made of synthetic material, French average, Long. 90 cm Larg. 90 cm, DONNEE PAR DEFAULT (DED)	4,128
Sink from polyester resin reinforced with fiberglass, 5.77 kg/unit, DONNEE PAR DEFAULT (DED)	350
Ready-mix concrete, normal-strength, generic, C30/37 (4400/5400 PSI), 10% (typical) recycled binders in cement (300 kg/m3 / 18.72 lbs/ft3)	50,400
Reinforcement steel (rebar), generic, 90% recycled content, A615	2,095
Ready-mix concrete, normal-strength, generic, C30/37 (4400/5400 PSI), 10% (typical) recycled binders in cement (300 kg/m3 / 18.72 lbs/ft3)	144,000
Reinforcement steel (rebar), generic, 90% recycled content, A615	6,038
Windows and doors	
Aluminium framed windows, double leaf, 26.55 kg/m2 (SNFA)	17,000
Doors with wooden frame, interior, DONNEE PAR DEFAULT (DED)	3,600
Aluminium door for exterior use, per m2, 70mm, 30.6kg/m2, ALU60 / ALU80 (CETIH)	940
Finishes and coverings	
Emulsion matt paint for allround interior use, Pigment: Lightfast Pigments, binder: PVA Copolymer emulsion , solvent: Water, 1.443 kg/l, 18m2/l, 0.16 kg/m2, Supermatt White, Almond White, Gardenia, Magnolia, Light Base, Medium Base (Dulux Trade)	2,000
Tufted carpet tiles, 4.15 kg/m2, pile material polyamide 6 (Milliken Industrials)	5,200
Foam backed vinyl (PVC) flooring, heterogeneous, 2.6 mm, 1.8 kg/m2, TX Classic (Tarkett)	1,100
Ceramic floor tile, 10 mm, average density 2000 kg/m3 (Mosa)	4,200
External areas and site elements	
Facing bricks, clay pavers and brick slips, 900-2500 kg/m3 (Bauen mit Backstein Zweischalige Wand Marketing)	91,290
Sand, compacted dry density, 1682 kg/m3	45,162

Aggregate (crushed gravel), generic, dry bulk density, 1600 kg/m ³	143,200
Building Technology	
Air to Water heat pump, 95.8 kg/unit, PUZ-WM85VAA (Mitsubishi Electric)	958
Mechanical ventilation system, with air purifier filter, 14.2 kg/unit, VMI® Purevent® (VENTILAIRSEC)	2,400
Solar panel photovoltaic system, 3 000 Wp (Gaia Solar)	3,510
Electric radiator, 1 kW (MDEGD)	172
Drinking water supply piping network, per m ² GIFA (residential buildings)	1,300
Sewage water drainage piping network, per m ² GIFA (residential buildings)	910
Air handling unit, with heat recovery through plate heat exchanger, 10 000 m ³ /h (5885.8 ft ³ /min), 1256 kg/unit (2769 lbs/unit)	1,600
Ventilation ducting, per m linear, D: 63 mm (2.48 in)	1,400
Electricity distribution system, cabling and central, for all building types, per m ² GFA	20,000

Table 7.2 Product Stage [A1-A3] Emissions (kgCO_{2e})

	Proposed Development	Existing Site
1 Substructure	258,852	-
2.1 Frame	73,338	-
2.2 Upper floors	151,272	-
2.3 Roof	120,285	-
2.4 Stairs and Ramps	27,582	-
2.5 External walls	595,694	-
2.6 Windows and External Doors	80,448	-
2.7 Internal Walls and Partitions	164,930	-
2.8 Internal doors	3,779	-
3 Finishes	20,692	-
4 Fittings, furnishings & equipment's	3,309	-
5 Services (MEP)	245,128	-
6 Prefabricated buildings and building units		-
7 Work to existing building		-
8 External works	16,989	-
Other		-
TOTAL kg CO_{2e}	1,762,297	NOT IN SCOPE

8. Construction Process Stage [A4-A5]

- 8.1 Modules [A4] and [A5] respectively capture the emissions associated with the transportation of the materials and components from the factory gate to the project site and their assembly into a building.

Transport Emissions [A4]

- 8.2 Transport emissions must include all stages of the journey of the products following their departure from the final manufacturing plant to the project site, taking into account any interim stops at storage depots / and / or distribution centres.

- 8.3 Transport emissions are calculated as follows:

$$[A4] = \text{Material or system mass (a)} \times \text{Transport distance (b)} \times \text{Carbon conversion factor (c)}$$

- 8.4 For the purposes of this WLC assessment, the One Click LCA library dataset has been used and the following emissions have been calculated in relation to the selected materials.

Table 8.1 Transport to Site [A4] (kgCO_{2e})

	Proposed Development	Existing Site
1 Substructure	10,289	-
2.1 Frame	4,061	-
2.2 Upper floors	7,946	-
2.3 Roof	4,721	-
2.4 Stairs and Ramps	1,551	-
2.5 External walls	2,480	-
2.6 Windows and External Doors	89	-
2.7 Internal Walls and Partitions	890	-
2.8 Internal doors	18	-
3 Finishes	65	-
4 Fittings, furnishings & equipment's	4	-
5 Services (MEP)	642	-
6 Prefabricated buildings and building units		-
7 Work to existing building		-
8 External works	1,037	-
Other		-
TOTAL kg CO_{2e}	33,792	NOT IN SCOPE

Construction – Installation Process Emissions [A5]

- 8.5 The carbon emissions arising from any on- or off-site construction-related activities must be considered in [A5]. This includes any energy consumption for site accommodation, plant use and the impacts associated with any waste generated through the construction process, its treatment and disposal.
- 8.6 The RICS PS permits the use of an average figure of 1,400kgCO_{2e}/£100K of project value for building construction site emissions, in the absence of more specific information. This figure is taken from the BRE SMARTWaste KPIs and is based on the date of the publication, March 2015; and should therefore be adjusted to current value in accordance with CPI.
- 8.7 A similar approach is presented within One Click LCA whereby an average site impacts figure can be adopted based upon gross floor area and verified to the EN15804 standard. This accounts for a global warming potential of 30.34kgCO_{2e}/m² before local compensation.
- 8.8 For the purposes of this WLC assessment, preference has been given to the One Click LCA approach.

Table 8.2 Site Operations [A5] (kgCO_{2e})

	Proposed Development	Existing Site
1 Substructure	14,310	-
2.1 Frame	3,340	-
2.2 Upper floors	6,823	-
2.3 Roof	6,734	-
2.4 Stairs and Ramps	1,253	-
2.5 External walls	25,896	-
2.6 Windows and External Doors	-	-
2.7 Internal Walls and Partitions	16,476	-
2.8 Internal doors	-	-
3 Finishes	3,382	-
4 Fittings, furnishings & equipment's	74	-
5 Services (MEP)	2,041	-
6 Prefabricated buildings and building units		-
7 Work to existing building		-
8 External works	852	-
Other	149,933	-
TOTAL kg CO_{2e}	231,114	NOT IN SCOPE

9. Use Stage [B1-B7]

- 9.1 The use stage captures the carbon emissions associated with the operation of the built asset over its entire life cycle, from practical completion to the end of its service life. This includes any emissions relating to operational energy and water use as well as any embodied carbon impacts associated with maintenance, repair, replacement, and refurbishment of building components.

Use [B1]

- 9.2 The in-use module [B1] captures the emissions arising during the life of a building from its components; including any emissions arising from refrigerants, insulation blowing agents and paints; as well as accounting for the carbonation process in items containing exposed concrete and / or lime.
- 9.3 Carbon absorption potential by green roofs and facades should also be considered, although the absorption potential for areas $<1,000\text{m}^2$ is generally considered negligible.

Refrigerants

- 9.4 For the refrigerants in the proposed building, the WLC assessment has assumed a charge, this will need to be revisited later on in the design. No refrigerants use has been assumed for the existing site.

Carbonation

- 9.5 Cementitious materials, such as concrete, cement and mortar, absorb carbon dioxide when exposed to air. This process is the chemical reversal of the cement production process calcination phase. The amount of carbon dioxide absorbed depends on exposure of the material, duration of the exposure as well as the initial amount of cement.
- 9.6 The figures associated with the carbonisation have been generated through the OneClick LCA software and relate to the selection of materials (detailed above).

Vegetation Carbon Withdrawals

- 9.7 Removals associated with vegetation are not persistent and will be lost unless the project is set up in such a way to preserve vegetation at its eventual demolition. Vegetation carbon withdrawals have therefore not been modelled.

Table 9.1 Use [B1] (kgCO_{2e})

	Proposed Development	Existing Site
1 Substructure		
2.1 Frame		
2.2 Upper floors		
2.3 Roof		
2.4 Stairs and Ramps		
2.5 External walls		
2.6 Windows and External Doors		
2.7 Internal Walls and Partitions		
2.8 Internal doors		
3 Finishes		
4 Fittings, furnishings & equipment's		
5 Services (MEP)	50,821	0
6 Prefabricated buildings and building units		
7 Work to existing building		
8 External works		
Other		
TOTAL kg CO_{2e}	50,821	0

Maintenance [B2]

- 9.8 The [B2] module accounts for the carbon emissions arising from any activities relating to the maintenance processes, including cleaning, and any products used. It also includes any emissions from the energy and water use associated with these activities.
- 9.9 Emissions associated with maintenance are not calculated by the One Click LCA software on the basis that there are no meaningful data sources. Alternatively, the GLA suggests that for module B2 emissions, a total figure of 10 kgCO_{2e}/m² gross internal area (GIA) may be used to cover all building element categories, or 1 per cent of modules A1-A5, whichever is greater. This approach has been adopted to estimate emissions from maintenance in this assessment in the absence of other standardised methodology.

Table 9.2 Maintenance [B2] (kgCO_{2e})

	Proposed Development	Existing Site
1 Substructure		
2.1 Frame		
2.2 Upper floors		
2.3 Roof		
2.4 Stairs and Ramps		
2.5 External walls		

2.6 Windows and External Doors		
2.7 Internal Walls and Partitions		
2.8 Internal doors		
3 Finishes		
4 Fittings, furnishings & equipment's		
5 Services (MEP)	49,368	36,312
6 Prefabricated buildings and building units		
7 Work to existing building		
8 External works		
Other		
TOTAL kg CO_{2e}	49,368	36,312

Repair [B3]

- 9.10 Module [B3] is intended to take account of the carbon emissions arising from all activities that relate to repair processes and any products used. Typically, this would require data from facilities management / maintenance strategy reports, façade access and maintenance strategy, life cycle cost reports, O&M manuals, and professional guidance.
- 9.11 Repair data have been entered into the software for some of the materials selected. As no details are available yet for repair, the data inputted into the tool are based on assumptions of annual rates of repair. For example, it has been assumed that 1 in 50 windows at street level may be broken every 2 years.
- 9.12 The default information associated with other applicable materials, based on their Environmental Product Declaration (EPD), mean that their service life is a lot shorter and thus any emissions from repair works are likely already captured by other [B] modules. Examples include the finishes and coverings, such as paint and carpet tiles, which have a service life of ~10 years. Regardless, emissions associated with repair are not expected to be significant.

Repair [B3] (kgCO_{2e})

	Proposed Development	Existing Site
1 Substructure	-	-
2.1 Frame	-	-
2.2 Upper floors	-	-
2.3 Roof	-	-
2.4 Stairs and Ramps	-	-
2.5 External walls	-	-
2.6 Windows and External Doors	48,744	10,808
2.7 Internal Walls and Partitions	-	-
2.8 Internal doors	2,310	962

3 Finishes	-	-
4 Fittings, furnishings & equipment's	-	-
5 Services (MEP)	-	-
6 Prefabricated buildings and building units		
7 Work to existing building		
8 External works	-	-
Other		
TOTAL kg CO_{2e}	51,054	11,770

Material replacement and refurbishment [B4-B5]

- 9.13 Carbon emissions associated with the anticipated replacement of building components, including any emissions from the replacement process are captured under module [B4]. All emissions arising from the production, transportation to site and installation of the replacement items must be included. This extends to cover any losses during these processes as well as the carbon associated with component removal and end of life treatment.
- 9.14 Emissions from the replacement of items from the following building element groups should be reported: roof, external walls, windows and doors, finishes, fittings, furnishings & equipment, services.
- 9.15 Module [B5] must take into account any carbon emissions associated with any building components used in a refurbishment, including any emissions from refurbishment activities. All emissions arising from the production, transport to site and installation of the components used must be included. This includes any losses during these processes, as well as the carbon associated with their removal and end of life treatment.
- 9.16 The calculation of refurbishment should account for any material additions and variations, instead of like-for-like as in replacement.
- 9.17 It is assumed that items are being replaced on a like-for-like basis and full replacement (100%) of the items is assumed once the specified lifespan is reached.
- 9.18 Details for service life are automatically entered into the One Click LCA software for each of the selected building materials since it is typically quantified in the product's EPD. These emissions are accounted for in the B4 part of the lifecycle. As no refurbishment is planned for the building, it has been assumed that no change of use will occur during the service life of the project.

Table 9.3 Material replacement and refurbishment [B4-B5] (kgCO_{2e})

	Proposed Development	Existing Site
1 Substructure		

2.1 Frame		
2.2 Upper floors		
2.3 Roof	28,849	37,212
2.4 Stairs and Ramps		
2.5 External walls	12,191	6,565
2.6 Windows and External Doors	10,360	18,013
2.7 Internal Walls and Partitions	16,742	3,014
2.8 Internal doors	3,849	1,604
3 Finishes	99,124	52,215
4 Fittings, furnishings & equipment's		
5 Services (MEP)	252,086	96,616
6 Prefabricated buildings and building units		
7 Work to existing building		
8 External works		
Other		
TOTAL kg CO_{2e}	423,200	215,239

Operational Energy Use [B6]

- 9.19 The operational carbon emissions arising from the energy use of building-integrated systems as projected and/or measured throughout the life cycle of the project must be reported under module [B6].
- 9.20 The operational emissions include the following:
- All emissions regulated under Part L of the Building Regulations - including space heating, hot water supply, cooling, lighting and auxiliary.
 - Emissions from non-regulated building-integrated systems – including lifts, safety, securing and communications systems.
 - Emissions from non-building-related systems – including ICT equipment, cooking appliances, specialist equipment – can represent a significant part of the total operational emissions and should be including where possible.
 - Any impact from waste produced by operational energy use should also be considered including any treatment and transportation these might require.
 - Where building operation requires fuel to be transported to the site (e.g., gas bottles, oil suppliers etc.) the transport emissions associated with the fuel delivered should be included.

- Any benefit from energy produced onsite and exported to the grid is covered within module [D].

- 9.21 The RICS PS states that the effect of the anticipated future grid decarbonisation should be accounted for when estimating the operational carbon impact over the life of the project. Consideration should also be given to the impact of climate change the potential affects this would have on heating and cooling demands over the life cycle.

Emissions Regulated Under Part L of the Building Regulations

- 9.22 An initial assessment of regulated emissions in the proposed development has been undertaken by FUTURESERV Ltd.
- 9.23 Emissions associated with the Building Regulations are assessed to be 3.78 kg CO₂ per m² per annum using the SAP10.2 carbon conversion factors. This equates to 1,088 tonnes over a 60-year time period.
- 9.24 In contrast, a further assessment has been conducted for the existing site. This estimates regulated energy emissions at 7,548 tonnes over a 60-year time period.

Emissions from Non-regulated Building-integrated Systems

- 9.25 A number of sources of emissions are excluded from the Building Regulations, notably those associated with Equipment with lifts, safety, securing and communications systems, external lighting, and other equipment's etc. The Building Regulations report provides a figure for estimated unrelated energy use and this has been used as the basis for predicting this figure.
- 9.26 Emissions associated with the unregulated energy use are assessed to be 1,313 tonnes over a 60-year time period for the proposed development using the SAP10.2 carbon conversion factors. A further assessment has been conducted for the existing site which calculates unregulated energy emissions at circa 378 tonnes over a 60-year time period.

Operational Water Use [B7]

- 9.27 All carbon emissions related to water supply and wastewater treatment, over the life cycle of the building (excluding water use during maintenance, repair, replacement, and refurbishment that are reported elsewhere), must be reported under module [B7].
- 9.28 Estimates on anticipated water consumption in the UK have been made based on the values provided in Table 22 of the BSRIA Rules of thumb – Guidelines for the building services, 5th edition for the respective building type, and the proposed number of occupiers detailed in the Area and Accommodation Schedule. In the absence of project specific information at early design stages, the most applicable category has been used as a proxy for maximum daily water consumption for the student accommodation.

- 9.29 For the proposed development, emissions associated with operational water usage are estimated to be ~300 tonnes over the 60-year period.
- 9.30 The same approach was employed to estimate water use for the existing site, assuming current occupation and use of the buildings. The most applicable categories were used as proxy for maximum daily water consumption for the various building types (between 15 to 45 litres per person).
- 9.31 For the existing site, emissions associated with operational water usage are estimated to be ~less than 10 tonnes over the 60-year period.

10. End of Life Stage [C1 to C4]

- 10.1 The EoL stage commences when the built asset has reached the end of its life and will no longer be used. For the purposes of the whole life carbon assessment this is assumed to occur at the end of the reference study period of the building. The reference study period is used for consistency and comparability of results, irrespective of other factors which might determine the lifespan of the building (e.g., lease period).
- 10.2 Any emissions arising from decommissioning, stripping out, disassembly, deconstruction and demolition operations as well as from transport, processing and disposal of materials at the end of life of the project must be accounted for in module [C], which is subdivided as follows:
- deconstruction and demolition emissions [C1]
 - transport emissions [C2]
 - waste processing for reuse, recovery or recycling emissions [C3]
 - disposal emissions [C4]
- 10.3 The carbon emissions arising from any on or off-site deconstruction and demolition activities, including any energy consumption for site accommodation and plant use, must be considered in [C1].
- 10.4 According to the RICS PS, an average rate of 3.4 kgCO_{2e}/m² GIA (rate from monitored demolition case studies in central London) based on aggregated data should be used in the absence of more specific information.
- 10.5 Any carbon emissions associated with the transportation of deconstruction and demolition arisings to the appropriate disposal site, including any interim stations, must be captured within module [C2].
- 10.6 The transport emissions for the discarded items should be calculated based on the following formula:
- $$[C2] = \text{Mass of waste to be transported (a)} \times \text{Transport carbon factor (b)} \times \text{Distance to disposal site (c)}$$
- 10.7 The RICS PS outlines acceptable assumptions to be used in the absence of more specific data.
- 10.8 When materials and/or components are intended to be recovered and reused or recycled after the end of the life of the built asset, any carbon emissions associated with their treatment and processing prior to reaching the end-of-waste state must be included in module [C3].

- 10.9 For elements not expected to be recovered and repurposed but intended for final disposal either in landfill or incineration, an allowance for the emissions arising from their disposal must be included in [C4].
- 10.10 The RICS PS outlines acceptable assumptions to be used in the absence of more specific data.
- 10.11 Library data associated with the One Click LCA generates figures for the total C1-C4 emissions on the basis of the materials selected. The following has been calculated:

Table 10.1 Total End of Life Stages [C1-C4] (kgCO_{2e})

	Proposed Development	Existing Site
1 Substructure	36,133	40,345
2.1 Frame	2,598	1,113
2.2 Upper floors	4,961	13,950
2.3 Roof	5,455	7,009
2.4 Stairs and Ramps	965	557
2.5 External walls	102,810	55,892
2.6 Windows and External Doors	703	143
2.7 Internal Walls and Partitions	8,201	1,485
2.8 Internal doors	6,653	2,772
3 Finishes	13,061	7,335
4 Fittings, furnishings & equipment's	10	4
5 Services (MEP)	1,441	771
6 Prefabricated buildings and building units	-	-
7 Work to existing building	-	-
8 External works	299	268
Other	-	-
TOTAL kg CO_{2e}	200,090	143,971

11. Benefits & Loads Beyond the System Boundary

[D]

- 11.1 Module [D] covers any benefits or burdens accruing from the repurposing of elements discarded from the built asset, or any energy recovered from them beyond the project's life cycle. Module [D] is intended to provide a broader picture of the environmental impacts of a project by accounting for the future potential of its components when these are repurposed i.e., recovered and reused and/ or recycled. Module [D] captures the avoided emissions (or potential loads) from utilising repurposed items to substitute primary materials. Module [D] can be used as a metric for quantifying circularity and assessing future resource efficiency.
- 11.2 It is communicated separately as it occurs beyond the life cycle of the project under study and also bears high inherent uncertainty regarding the future treatment of building components. In the absence of more specific data, reliance is given to the data within the One Click LCA tool.

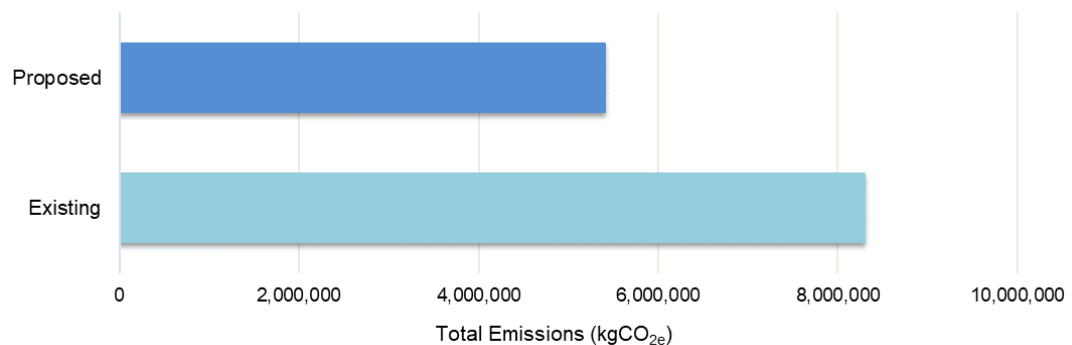
Table 11.1 Benefits and Loads Beyond the System Boundary [D] (kgCO_{2e})

	Proposed Development	Existing Site
1 Substructure	(81,891)	(84,742)
2.1 Frame	(17,282)	(7,407)
2.2 Upper floors	(33,366)	(93,818)
2.3 Roof	(26,757)	(34,342)
2.4 Stairs and Ramps	(6,448)	(3,725)
2.5 External walls	(301,575)	(163,560)
2.6 Windows and External Doors	(5,134)	(4,665)
2.7 Internal Walls and Partitions	(19,608)	(3,530)
2.8 Internal doors	-	-
3 Finishes	(34,544)	(19,476)
4 Fittings, furnishings & equipment's	(593)	(250)
5 Services (MEP)	(138,731)	(75,105)
6 Prefabricated buildings and building units		
7 Work to existing building		
8 External works	(376)	(338)
Other		
TOTAL kg CO_{2e}	(666,305)	(490,957)

12. Whole Lifecycle Carbon Assessment Results

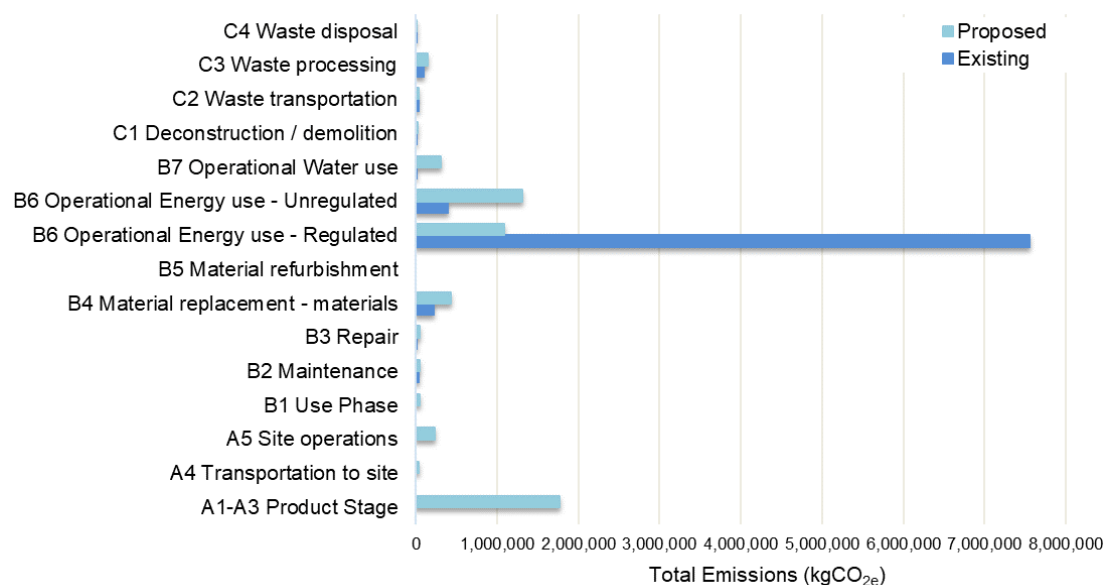
- 12.1 This Whole Life Carbon Assessment shows that the emissions associated with the operation and end-of-life of the existing site are over 30% higher than the whole life cycle carbon emissions of the proposed student accommodation.

Figure 12.1 Total emissions for the proposed development relative to retaining the existing site (kgCO_{2e})



- 12.2 The main difference is in relation to the operational energy use which is much lower for the proposed development which has ASHPs on hot water and a photovoltaic array, than the existing building with gas fired boilers. As the national grid is decarbonising rapidly, with an all electric system, the proposed building's operational energy use will effectively become net-zero over time.

Figure 12.2 All emissions for the proposed development relative to retaining the existing site (kgCO_{2e})



13. Summary

- 13.1 A Whole Life-Cycle Carbon Assessment has been undertaken for a proposed development at Carmoor Road, Manchester.
- 13.2 The proposed development comprises the demolition of existing buildings on site and erection of a multi-storey building for student accommodation, with associated infrastructure. In comparison, the existing site consists of several buildings which are currently in use as garages and a nursery.
- 13.3 The assessment has been undertaken on the basis of information available at RIBA Stage 2 of the design.
- 13.4 The RICS Professional Statement - Whole Life Carbon Assessment for the Built Environment 1st Edition (RICS; ISBN 978 1 78321 208 8; November 2017); and BRE Global Methodology for the Environmental Assessment of Buildings Using EN 15978:2011 (Building Research Establishment; ref: PN 326 Rev 0.0; January 2018) have been considered.
- 13.5 The assessment has reviewed WLC over a 60-year period, in line with the recommended RICS approach. The WLC for retaining the existing site and proposed development have been assessed separately, with varying scopes.
- 13.6 This identified total WLC emissions of 5,407,129 kgCO₂e for the proposed development. The key lifecycle stages responsible for these emissions are [A1-A3] Materials Emissions (1,762,297 kg CO₂e), the [B4] Material Replacement (423,200 kg CO₂e) and the [B6] Operational Energy Use (2,401,284 kg CO₂e).
- 13.7 The WLC emissions associated with the continued operation of the exiting site (excluding product and construction stages [A1-A5]) have also been estimated at 8,298,239 kgCO₂e. Over 90% of these emissions are due to the Operational Energy Use (7,934,713 kg CO₂e).
- 13.8 The results reveal that redeveloping the site in line with the proposals lead to a significant carbon saving over the life cycle of the building. This demonstrates that the proposed development will not only enhance the local townscape with a new building that provides high quality residential accommodation, but it will also optimise resources and energy use in comparison with the existing building. Redevelopment of the site thus provides not only a socioeconomic benefit in terms of increasing housing provision, but also aligns with the environmental objectives of the Council.

14. Proposed Development Recommendations

14.1 The following comprises a series of recommendations to assist with further reducing the carbon emissions associated with the proposed development.

14.2 The Whole Life-Cycle Carbon Assessment has identified the following key areas as being the most significant contributors to emissions.

[A1-A3] Product Stage

14.3 These were assessed to represent 1,762,297 kgCO_{2e}, equating to roughly 33% of the total. These emissions are largely associated with the material choices associated with the substructure, superstructure, and external works; where decisions are also influenced by factors such as structural performance, cost and aesthetics.

14.4 There may be scope to investigate alternatives with a lower carbon footprint; however, given the nature of the proposed development, the potential for significant reductions may be limited. Nevertheless, it is recommended that material options be revisited as the detail of the design development to review the potential extent of savings.

[B4-5] Material replacement and refurbishment

14.5 Material replacement and refurbishment emissions were assessed at 423,200 kgCO_{2e}, roughly 8% of the total. These emissions are associated with the estimated lifespans associated with the selected materials and it may be feasible to identify more resilient materials products with longer lifespans.

[B6] Operational Energy Use

14.6 Operational energy use emissions were assessed at 2,401,284 kgCO_{2e} (regulated and unregulated); representing ~44% of the total.

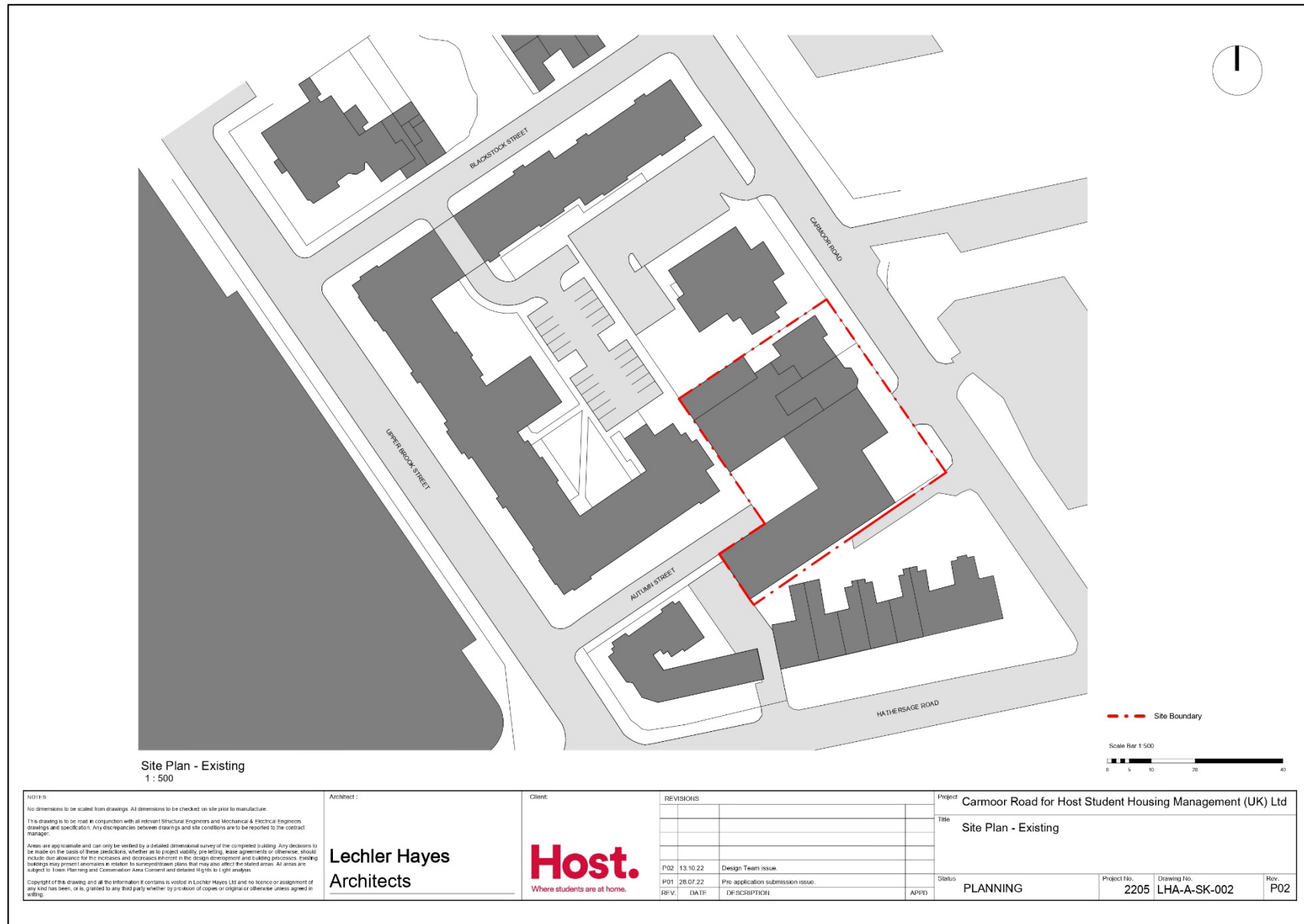
14.7 Operational energy use is expected to contribute significantly to emissions over the buildings predicted lifetime, this figure may not however fully account for future grid decarbonisation in the UK over the next 60 years as it is based on current (SAP10.2) carbon conversion factors and will likely steadily reduce over time.

Offsetting

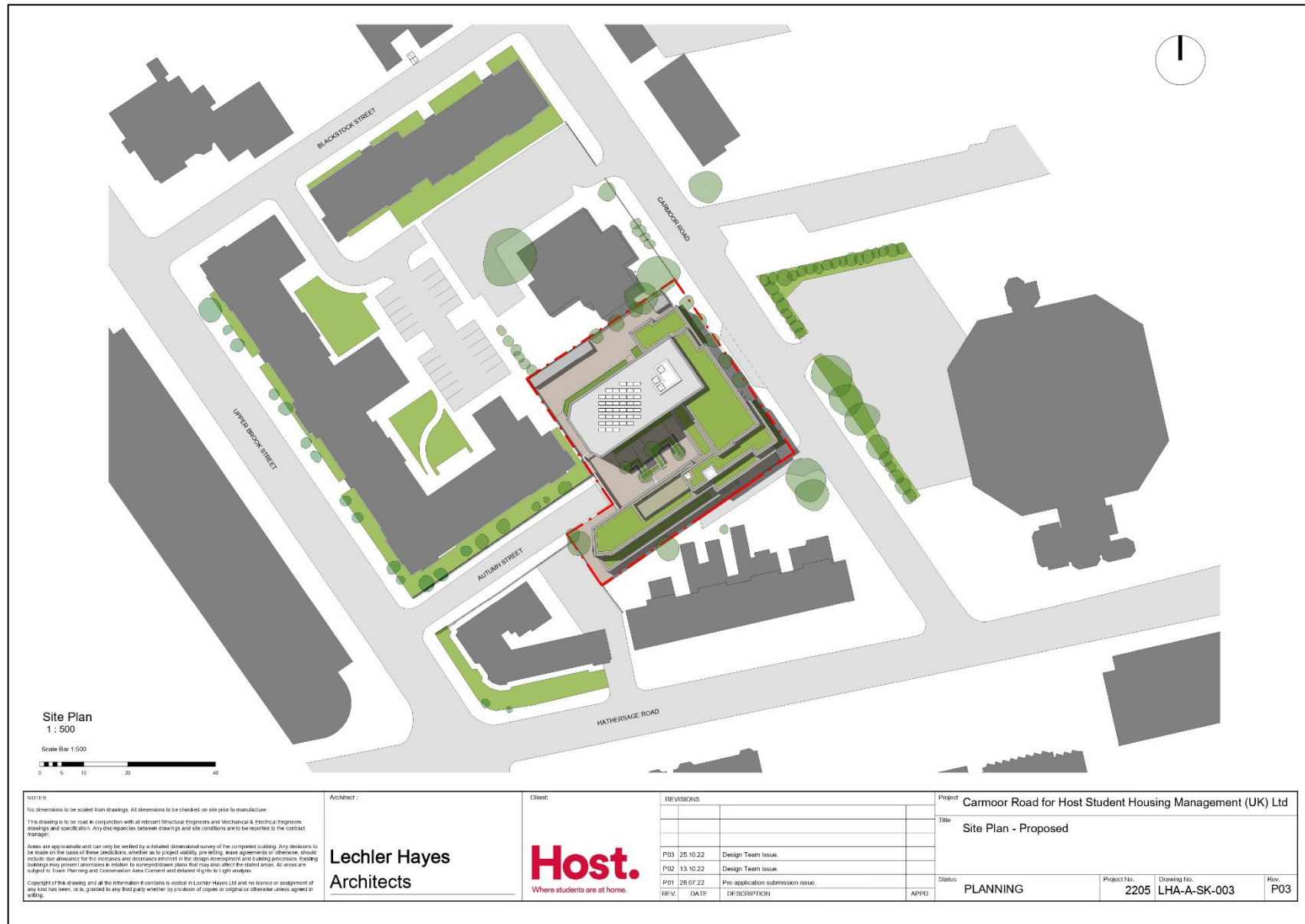
14.8 Acknowledging that it is not always feasible to completely eradicate WLC emissions through design decisions, consideration could be given to the potential for offsetting the impacts through abatement measures elsewhere and / or contributions to facilitate such abatements (e.g., green tariff electricity).

Appendices

A. Existing Site Plan



B. Proposed Site Plan



C. Key Local Planning Policy Requirements

Manchester Core Strategy 2012 to 2027 (July 2012)**Policy EN 4: Reducing CO2 Emissions by Enabling Low and Zero Carbon Development**

The Council will seek to reduce fuel poverty and decouple growth in the economy, growth in CO2 emissions, and rising fossil fuel prices, through the following actions:

- All development must follow the principle of the Energy Hierarchy, being designed:
 - a. to reduce the need for energy through design features that provide passive heating, natural lighting and cooling
 - b. to reduce the need for energy through energy efficient features such as improved insulation and glazing
 - c. to meet residual energy requirements through the use of low or zero carbon energy generating technologies
- Wherever possible new development and retrofit projects, including energy generation plant, must be located and designed in a manner that allows advantage to be taken of opportunities for low and zero carbon energy supplies.
- Where possible new development and retrofit projects will be used as a mechanism to help improve energy efficiency and provide low and zero carbon energy supplies to existing buildings.
- Where appropriate new development and retrofit projects will be required to connect to and/or make contributions to low or zero carbon energy schemes and/or to incorporate provision to enable future connection to any existing / potential decentralised energy schemes.
- The use of building materials with low embodied carbon in new development and refurbishment schemes.

Policy EN 7: Energy Infrastructure opportunities

There will be a general presumption in favour of low and zero carbon decentralised energy schemes, subject to the following considerations:

- That any new generating plant capable of producing heat and cooling as well as electricity should be located in a way that facilitates future connection to a local distributed energy system.
- That any energy centre, including generating plant, standby/boiler plant and substations, shall be located and designed to a high quality so as to integrate with and contribute to the townscape.
- Biofuels should be obtained from sustainable sources and processes and in a way that minimises transport impacts, following a sequential approach in order to minimise CO2 emissions – firstly prioritising local and regional sources, followed by national, European and international.
- Consideration should be given to biofuel delivery by rail and waterways where possible. Where large-scale fuel or feedstock delivery is required by road the energy centre must be located in or adjacent to light industrial, industrial or leisure uses with any impact on local residential amenity minimised.
- The cumulative impact of energy schemes will be taken into account when considering applications, to include modelled impacts on air quality and landscape character, with reference to Policy EN16.
- Flood risk, through the Manchester-Salford-Trafford Strategic Flood Risk Assessment.

In determining proposals for development, consideration will be given to the need to safeguard strategic energy sites and network routes, both proposed or existing, where these have been identified as having strategic significance for the delivery of low or zero carbon energy infrastructure or, would be required in order to achieve the successful regeneration of an area in line with targets for reducing carbon emissions.

Policy EN 8: Adaption to Climate Change

All new development will be expected to be adaptable to climate change in terms of the design, layout, siting and function of both buildings and associated external spaces. In achieving developments which are adaptable to climate change developers should have regard to the following, although this is not an exhaustive list:

- Minimisation of flood risk by appropriate siting, drainage, and treatment of surface areas to ensure rain water permeability
- Reduction in urban heat island effect through the use of Green Infrastructure such as green roofs, green walls, increased tree cover and waterways
- The need to control overheating of buildings through passive design
- The opportunity to provide linked and diverse green space to enhance natural habitats which will assist species adaptation

Developers will be permitted to use green infrastructure elements such as green roofs, green walls, street trees and waterways to contribute to compliance with CO2 mitigation under Policy EN6, subject to sufficient evidence to quantify their contribution to compliance.

Policy EN 9: Green Infrastructure

New development will be expected to maintain existing green infrastructure in terms of item quantity, quality and multiple function. Where the opportunity arises and in accordance with current Green Infrastructure Strategies the Council will encourage developers to enhance the quality and quantity of green infrastructure, improve the performance of its functions and create and improve linkages to and between areas of green infrastructure. Where the benefits of a proposed development are considered to outweigh the loss of an existing element of green infrastructure, the developer will be required to demonstrate how this loss will be mitigated in terms of quantity, quality, function and future management.

Key features of Manchester's green infrastructure will include:

- The continued development of a network of green spaces, water bodies, canals, paths and cycleways, with priority given to those parts of the City where there is an identified existing lack of open space. The Council will seek to protect existing street trees and promote new planting, particularly where this can enhance green links in the urban area.
- The continued maintenance and management of the Rivers Mersey and Irwell and their tributaries, for example the River Irk, River Medlock, Chorlton Platt Gore, Gatley Brook, Moston Brook and adjoining land, with regard to their multiple functions including recreation, flood management, and biodiversity.
- The provision of new, and improvements to the quality and accessibility of existing green infrastructure assets, to mitigate for any loss of green infrastructure as a result of development such as the Metrolink extension programme.
- The encouragement of green roofs, green walls, tree planting and other forms of green infrastructure to allow for the adaption to climate change in heavily urbanised areas.

New green infrastructure provision should be an exemplar of best practice and innovation in terms of both its design and management.

Policy EN 17: Water Quality

With reference to the Manchester-Salford-Trafford SFRA and other relevant documents:

- Development should avoid any adverse impact on water quality, including during the construction phase, and wherever possible should seek to enhance water quality, both chemical and ecological;
- Development should minimise surface water run-off from development and associated roads, and maximise the use of appropriate sustainable drainage systems, to minimise groundwater contamination, and to avoid pollutants reaching watercourses;
- Development close to a watercourse should also ensure that waste or litter cannot enter the watercourse from the site;
- Development should, where feasible and appropriate, seek to open up any culverted or hidden watercourse beneath the site to improve the ecological status of that watercourse.

Policy EN 19: Waste

The council will

- Work with other Districts through the Greater Manchester Joint Waste Development Plan Document (GMJWDPD) to safeguard existing sites for waste management and identify and safeguard new sites in existing areas of employment where appropriate.
- Require all developers, including those of new waste management facilities within the District, to demonstrate the proposal's consistency with the principles of the waste hierarchy (prevention, reduction, re-use, recycling/composting, energy recovery, final disposal)
- Require all developers of new waste management facilities within the District to plan for and, where appropriate, use sustainable modes for waste transport, including use of modes such as rail and the Manchester Ship Canal.
- Require all developers to submit a waste management plan to demonstrate how both construction and demolition waste will be minimised and recycled on site wherever possible and how the sustainable waste management needs of the end user will be met.
- Have full regard to the economic and environmental benefits that well designed and run, waste management facilities can bring to the District, subject to any conditions required to protect the amenity of existing adjacent users.

- Promote the development of innovation and technological advancement within the sustainable waste management industry, aiming to achieve a closed-loop waste management system.
- Require waste management practices to have full regard to the environmental, social and economic impacts of such development and encourage long-term benefits in improving the environment, the regeneration of areas in need of investment and co-location with other employment uses where appropriate.
- Encourage communities to take responsibility for the waste they create through the provision of accessible facilities.

Policy H 12: Purpose Built Student Accommodation

The provision of new purpose built student accommodation will be supported where the development satisfies the criteria below. Priority will be given to schemes which are part of the universities' redevelopment plans or which are being progressed in partnership with the universities, and which clearly meet Manchester City Council's regeneration priorities.

- Sites should be in close proximity to the University campuses or to a high frequency public transport route which passes this area.
- The Regional Centre, including the Oxford Road Corridor, is a strategic area for low and zero carbon decentralised energy infrastructure. Proposed schemes that fall within this area will be expected to take place in the context of the energy proposals plans as required by Policy EN 5.
- High density developments should be sited in locations where this is compatible with existing developments and initiatives, and where retail facilities are within walking distance. Proposals should not lead to an increase in on-street parking in the surrounding area.
- Proposals that can demonstrate a positive regeneration impact in their own right will be given preference over other schemes. This can be demonstrated for example through impact assessments on district centres and the wider area. Proposals should contribute to providing a mix of uses and support district and local centres, in line with relevant Strategic Regeneration Frameworks, local plans and other masterplans as student accommodation should closely integrate with existing neighbourhoods to contribute in a positive way to their vibrancy without increasing pressure on existing neighbourhood services to the detriment of existing residents.
- Proposals should be designed to be safe and secure for their users, and avoid causing an increase in crime in the surrounding area. Consideration needs to be given to how proposed developments could assist in improving the safety of the surrounding area in terms of increased informal surveillance or other measures to contribute to crime prevention.
- Consideration should be given to the design and layout of the student accommodation and siting of individual uses within the overall development in relation to adjacent neighbouring uses. The aim is to ensure that there is no unacceptable effect on residential amenity in the surrounding area through increased noise, disturbance or impact on the streetscene either from the proposed development itself or when combined with existing accommodation.

- Where appropriate proposals should contribute to the re-use of Listed Buildings and other buildings with a particular heritage value.
- Consideration should be given to provision and management of waste disposal facilities, that will ensure that waste is disposed of in accordance with the waste hierarchy set out in Policy EN 19, within the development at an early stage.
- Developers will be required to demonstrate that there is a need for additional student accommodation or that they have entered into a formal agreement with a University, or another provider of higher education, for the supply of all or some of the bedspaces.
- Applicants/developers must demonstrate to the Council that their proposals for purpose built student accommodation are deliverable.

D. LCA Details

One Click LCA

One Click LCA is specialised software developed by Bionova Ltd, that provides the means to generate quick and accurate building level Lifecycle Assessments using designs imported from tools such as Revit, IFC (BIM), Excel, IESVE, energy models (gbXML).

Further, it provides access to one of the largest LCA database's currently available with Environmental Product Declarations (EPD) from manufacturers as well as generic materials.

There are a number of calculation tools available within the One Click LCA tool, for the purposes of this LCA the following were utilised:

- LCA for BREEAM UK – The official BRE-approved LCA in compliance with all current BREEAM UK versions, it is used to calculate the different material options for the Superstructure, Substructure and Hard landscaping.
- LCA for BREEAM UK IMPACT-compliant – This is an IMPACT-compliant LCA application according to IMPACT v5, this is used to produce the baseline LCA for the superstructure as required by the Mat01 BREEAM criteria.

IMPACT

IMPACT is a specification and database for use by software developers to incorporate into their tool, enabling a consistent Life Cycle Assessment. IMPACT compliant calculation tools work by allowing the user to attribute environmental information to drawn or scheduled items in the BIM (For the purposes of this LCA the imported IESVE data model). The quantity information imported within the BIM is multiplied by the environmental impact and/or costs 'rates' to produce an overall impact and cost for the whole (or selected part) of the design.

For the purposes of this LCA an IMPACT compliant calculation tool available through One Click LCA has been used to generate an environmental benchmark for comparison with the BREEAM LCA benchmarks.

Environmental Product Declarations (EPD)

An environmental product declaration or EPD is a document which is used to quantifiably demonstrate the environmental performance of a product. The European Standard for the generation of environmental product declarations for construction products is EN 15804 and was published by the CEN Technical Committee for the sustainability of construction works (CEN TC350 in 2012.)

EPD are generated based on data obtained through Life Cycle Assessment (LCA), with the LCA being performed using a peer-reviewed Product Category Rules (PCR) document in line with EN 15804, ISO 14025, and other related international standard.

EN15804:2012 & Life cycle assessment scope and system boundaries

EN 15804:2012 + A1:2013 'Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products' is a European standard that provides core product category rules (PCR) for Type III environmental declarations for any construction product and construction service. The core PCR defines the parameters to be declared and the way in which they are collated and reported, describing which stages of a product's life cycle are considered in the PED and which processes are to be included in the life cycle stages. Further information can be found on the European Committee for Standardisation's website.

Further detailed explanation of the life cycle stage and analysis scope of the EN 15804 standard are as follows:

Product Stage	Description
A1-A3 Construction Materials	Raw material supply (A1) includes emissions generated when raw materials are taken from nature, transported to industrial units for processing and processed. Loss of raw material and energy are also considered. Transport impacts (A2) include exhaust emissions resulting from the transport of all raw materials from suppliers to the manufacturer's production plant as well as impacts of production of fuels. Production impacts (A3) cover the manufacturing of the production materials and fuels used by machines, as well as handling of waste formed in the production processes at the manufacturer's production plants until end-of-waste state.
A4 Transportation to site	A4 includes exhaust emissions resulting from the transport of building products from manufacturer's production plant to building site as well as the environmental impacts of production of the used fuel.
A5 Construction/installation process	A5 covers the exhaust emissions resulting from using energy during the site operations, the environmental impacts of production processes of fuel and energy and water as well as handling of waste until the end-of-waste state.
B1-B5 Maintenance and material replacement	The environmental impacts of maintenance and material replacements (B1-B5) include environmental impacts from replacing building products after they reach the end of their service life. The emissions cover impacts from raw material supply, transportation and production of the replacing new material as well as the impacts from manufacturing the replacing material as well as handling of waste until the end-of-waste state.
B6 Energy use	The considered use phase energy consumption (B6) impacts include exhaust emissions from any building level energy production as well as the environmental impacts of production processes of fuel and externally produced energy. Energy transmission losses are also considered.

B7 Water use	The considered use phase water consumption (B7) impacts include the environmental impacts of production processes of fresh water and the impacts from wastewater treatment.
C1-C4 Deconstruction	The impacts of deconstruction include impacts for processing recyclable construction waste flows for recycling (C3) until the end-of-waste stage or the impacts of pre-processing and landfilling for waste streams that cannot be recycled (C4) based on type of material. Additionally, deconstruction impacts include emissions caused by waste energy recovery.
D External impacts/end-of-life benefits	The external benefits include emission benefits from recycling recyclable building waste. Benefits for re-used or recycled material types include positive impact of replacing virgin-based material with recycled material and benefits for materials that can be recovered for energy cover positive impact for replacing other energy streams based on average impacts of energy production.

E. General Notes

The report is based on information available at the time of the writing and discussions with the client during any project meetings. Where any data supplied by the client or from other sources have been used it has been assumed that the information is correct. No responsibility can be accepted by Ensphere Group Ltd for inaccuracies in the data supplied by any other party.

The review of planning policy and other requirements does not constitute a detailed review. Its purpose is as a guide to provide the context for the development and to determine the likely requirements of the Local Authority.

No site visits have been carried out, unless otherwise specified.

This report is prepared and written in the context of an agreed scope of work and should not be used in a different context. Furthermore, new information, improved practices and changes in guidance may necessitate a re-interpretation of the report in whole or in part after its original submission.

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Ensphere Group Ltd
55A Catherine Place,
London, SW1E 6DY
+44 (0) 20 7846 9040
www.enspheregroup.com