



Former Boddingtons Development Manchester

Whole Life Cycle Assessment

DN0107-WW-ZZ-ZZ-RP-CS-00008

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Executive Summary

Wallace Whittle have been appointed to undertake a Whole Life Carbon Assessment for the new domestic led mixed-use scheme at former Boddingtons site, Manchester. This report presents the results and key findings of this assessment.

A Whole Life Cycle Assessment (WLC) is a method to assess the environmental impacts associated with a building through the stages of its life cycle – from cradle to grave. The WLC Assessment has been undertaken based upon the RICS methodology, which requires that the assessment should be undertaken against the following four stages in the life of a typical building, described as life-cycle modules. The stages are shown below:

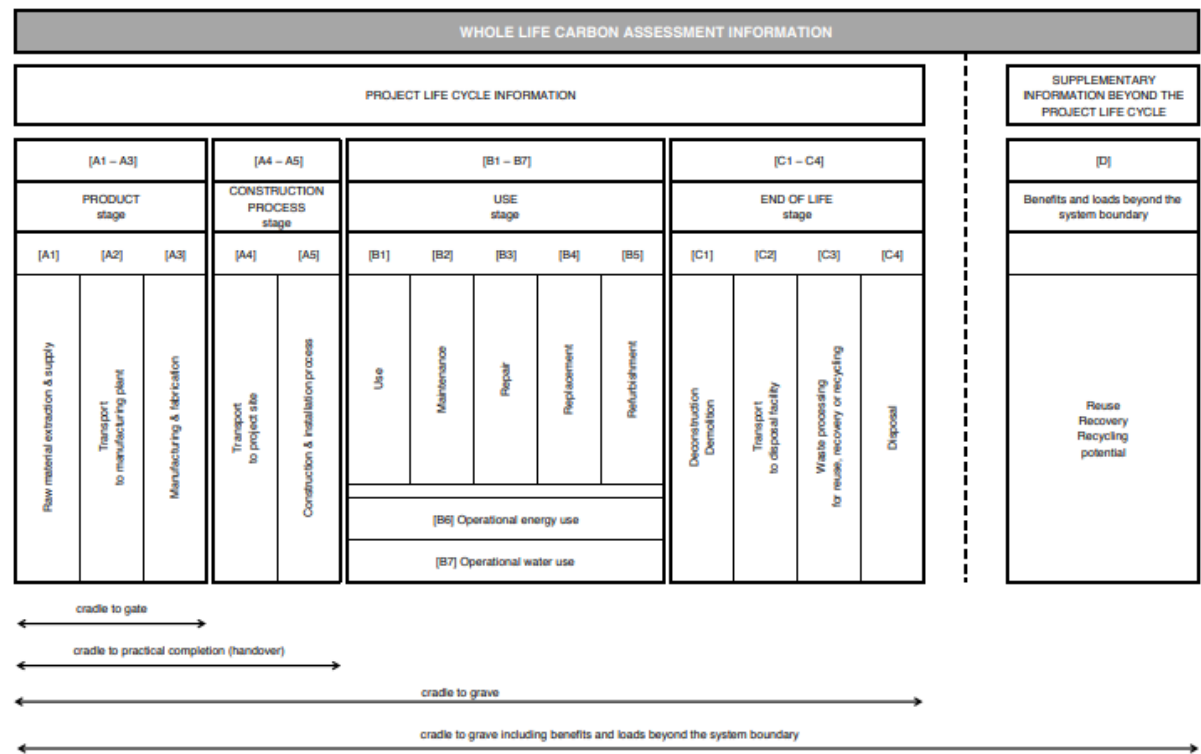


Figure 1 - Whole Life Carbon Stages

The aim of the exercise was to: appraise options for reducing its impact and inform the design team of the relative life cycle carbon emissions associated with the proposed developments construction materials.

The development Whole Life Carbon emissions were based on the information provided at RIBA stage 2, and were calculated to be 748 kgCO₂e/m² for modules A-C (excluding B6-7) which is below the GLA aspirational target of <800 kgCO₂e/m² set within their guidance. In terms of the upfront embodied carbon (modules A1-5) the development shows a result of 468 kgCO₂e/m² which achieves the aspirational target of <500 kgCO₂e/m² as set out in the GLA Whole Life Carbon Assessment Guidance.

Table 1 below gives a summary of the results broken down by life cycle modules with Figures 2 and 3 showing a graphical comparison for upfront embodied carbon and whole life carbon respectively.

Stages	Boddingtons Absolute GWP (kgCO ₂ e)	Boddingtons Unitary GWP (kgCO ₂ e/m ²)	GLA Benchmark Target (kgCO ₂ e/m ²)	GLA Aspirational Target (kgCO ₂ e/m ²)
Modules A1-5	20,428,863	468	<850	<500
Modules B1-5 & C1-4	12,252,591	281	<350	<300
Modules B6&B7	19,749,201	453	N/A	N/A
Modules A-C	32,681,455	749	<1200	<800
Total (Excluding Module D)	52,430,655	1,201	N/A	N/A

Table 1 - Whole Life Carbon Assessment Results at Stage 2 and the associated targets

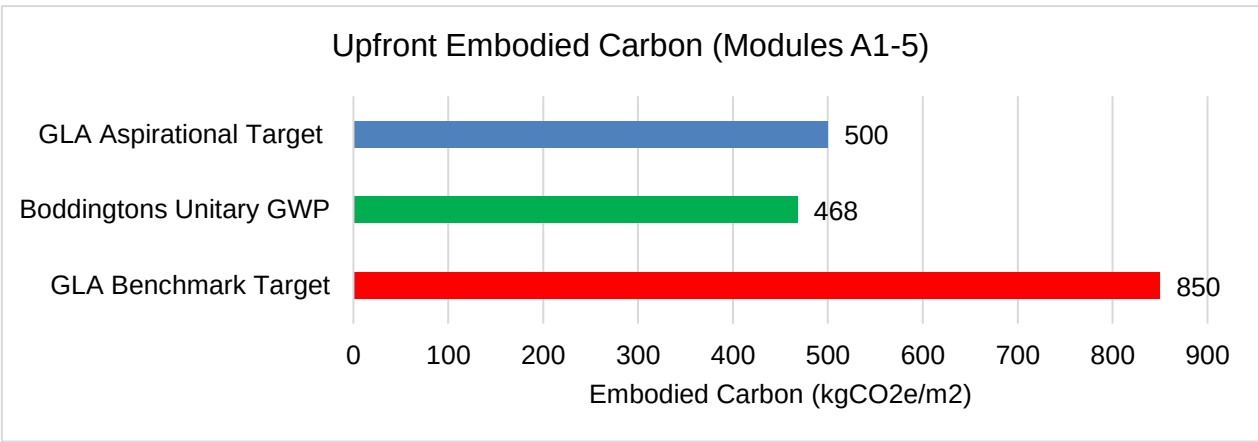


Figure 2 - Upfront embodied carbon result at Stage 2 and comparison with the associated targets

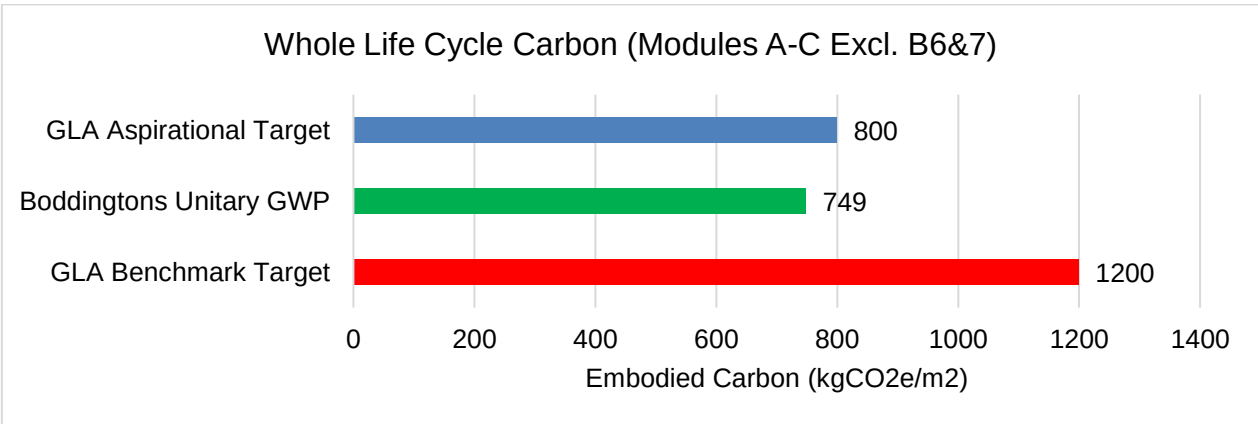


Figure 3 - Whole Life Carbon Assessment result at Stage 2 and comparison with the associated targets

1.0 Introduction

Wallace Whittle have been appointed to undertake a Whole Life Carbon Assessment for the the new domestic led mixed-use scheme at former Boddingtons site, Manchester.

A Whole Life Cycle (WLC) assessment is a method to assess the environmental impacts associated with a building through the stages of its life cycle – from cradle to grave. The assessment assesses the development’s operational carbon emissions (including both energy and water use) and the embodied carbon emissions. Embodied carbon emissions are those associated with raw material extraction, manufacture and transport of building materials, construction and the emissions associated with the use, maintenance, repair, and replacement along with deconstruction, demolition, and finally material disposal. The study also includes an assessment of the potential carbon emissions ‘benefit’ from the reuse or recycling of building components after the end of a building life.

This assessment is aligned with the RIBA stage 2 information for planning and has been carried out in line with RICS professional statement:

1.1 Development Overview

1.1.1 Site Location

The proposed development is located on a former industrial brownfield site formerly the Boddington brewery site. Most of the site has been cleared with existing buildings surrounding the site occupied and in situ. Great Ducie Street a main arterial route out of Manchester, is in the proximity of the site. The site is within walking distance of Manchester City Centre.

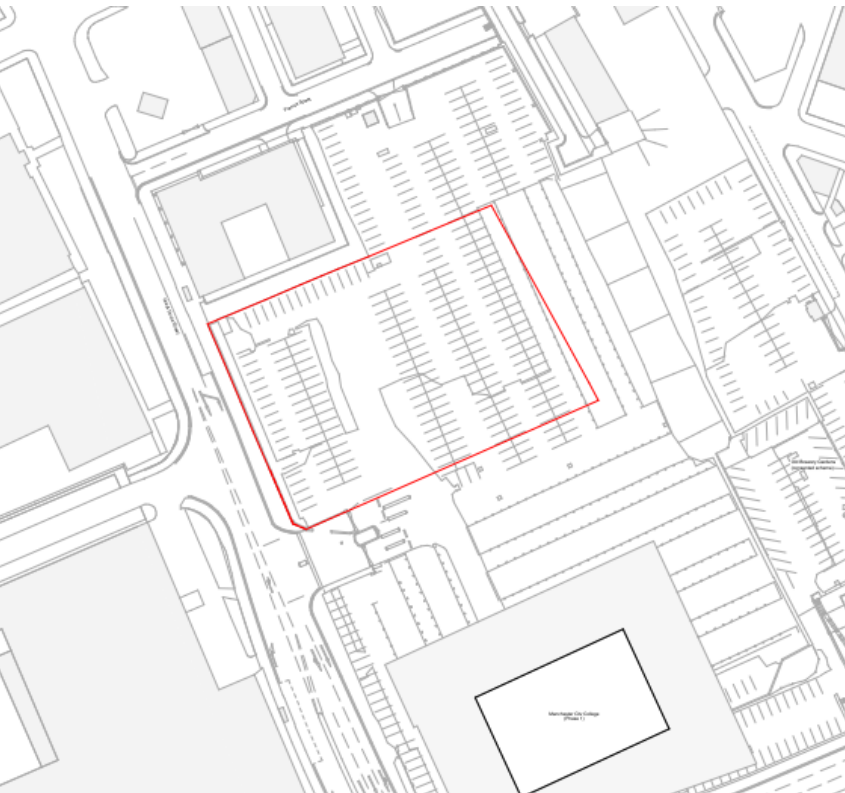


Figure 1.1.1 - Site Location Plan (A3564-ASA-XX-XX-DR-A-0100 P06)

1.1.2 Proposed Development

The development on the former Boddington brewery site is a mixed-use development comprising of residential and commercial uses, and where the residential plot proposes 505 mixed tenure units, split between two blocks ranging from 12 to 29 storeys. The ground floor proposes commercial use space and in addition to the creation of a new courtyard pocket park, landscaping, cycle parking, accessible parking spaces, highways work, access arrangements, and other associated works. An area breakdown and an image of the proposed site can be found below.

Tenant / Use	Net Area (NIA m²)	Gross Area (GIA m²)
Residential	32,062	41,623.7
Commercial	679.5	694
Ancillary	0	1,326.6
Site Wide Summary	32,741.5	43,644.3

Table 1.1.2 - Area schedule (A3564-ASA-ZZ-ZZ-SH-A-0701-P02)

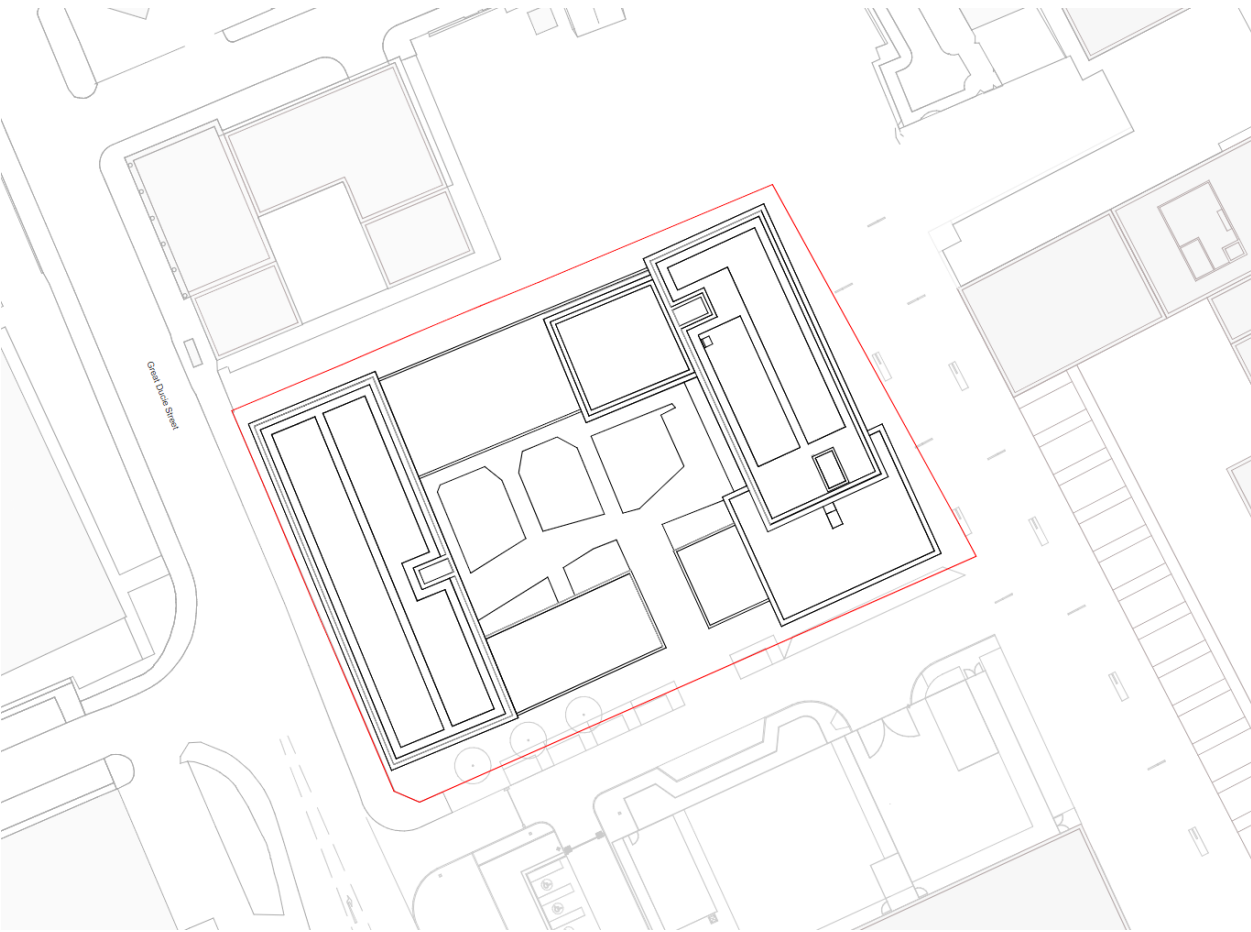


Figure 1.1.2 - Site Plan Proposed (A3564-ASA-XX-XX-DR-A-0101-P06)

2.0 Legislation and Policy

2.1 Relevant Legislation and Guidance

The relevant legislation and guidance are followed in accordance with The National Planning Policy Framework (2021), the Manchester Policy EN 4, from Manchester Core Strategy 2012 to 2027, and London Planning Guidance (GLA), Whole Life-Cycle Carbon Assessments (2022).

2.2 National Planning Policy Framework (2021)

An effective planning system is required to contribute to achieving sustainable development. The National Planning Policy Framework (NPPF), 2021, outlines what the government deems as sustainable development in England.

- Paragraph 8: Achieving Sustainable development means that the planning system has three overarching objectives; a) economic objective b) social objective and c) environmental objective focused on mitigating and adapting to climate change, including moving to a low carbon economy.
- Paragraph 20: Strategic policies should make sufficient provision for planning measures to address climate change mitigation and adaptation.
- Paragraph 148: The planning system should support the transition to a low carbon future in a changing climate. It should help to shape places in ways that contribute to radical reductions in greenhouse gas emissions and support renewable and low carbon energy.
- Paragraph 150: New development should be planned for in ways that avoid increased vulnerability to the impacts arising from climate change and can help to reduce greenhouse carbon emissions.
- Paragraph 154: When determining planning applications for renewable and low carbon development, local planning authorities should recognize that even small- scale projects provide a valuable contribution to cutting greenhouse gas emissions and approve the application if its impacts are or can be made acceptable.

2.3 Planning Practise Guidance (2018)

The government have provided guidance for various aspects to be considered during the planning stages of any development. One relevant section is the planning practice guidance on climate change. In this, possibilities to identify suitable mitigation and adaptation measures in the planning process are advised, to address the impacts of climate change.

2.4 Manchester City Council – 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:
 - to reduce the need for energy through design features that provide passive heating, natural lighting, and cooling.
 - to reduce the need for energy through energy efficient features such as improved insulation and glazing
 - 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.

2.5 GLA Benchmarks

Using the WLC benchmarks

3.2.4 WLC benchmarks have been developed for the most typical typologies and can be found in Appendix 2 of the GLA Guidance document together with an explanation of how they have been developed.

3.2.5 The estimated total WLC emissions form the baseline for the development. All developments, regardless of their scope, are expected to compare their WLC baseline against the most relevant benchmark. If the WLC emissions of a development falls outside the range of the benchmarks (whether they are higher or lower), applicants should explain why in the relevant text box of the template.

3.2.6 Mixed-use developments should compare their WLC baseline with the benchmark of the typology which makes up the greatest proportion of the development in GIA. If the uses are relatively equally split, then the highest WLC benchmark should be used for comparison.

3.2.7 It is good practice to set targets for WLC emissions reductions and to track progress against them throughout the project. Applicants can use the benchmarks as a basis for this but are encouraged to go further, where possible.

2.6 RICS Whole Life Carbon Assessment for the Built Environment 1st Edition, November 2017

The RICS Whole Life Carbon professional statement is intended to standardise whole life carbon assessment and enhance consistency in outputs by providing specific practical guidance for the interpretation and implementation of the methodology in EN 15978 in carbon calculations, this is to achieve coherent and comparable results that can be used to benchmark the whole life carbon performance of built assets.

3.0 Life Cycle Modules

The GLA’s guidance references RICS and BS EN15978 which notes that the WLC assessment should be undertaken against the following four stages in the life of a typical building, described as life-cycle modules:

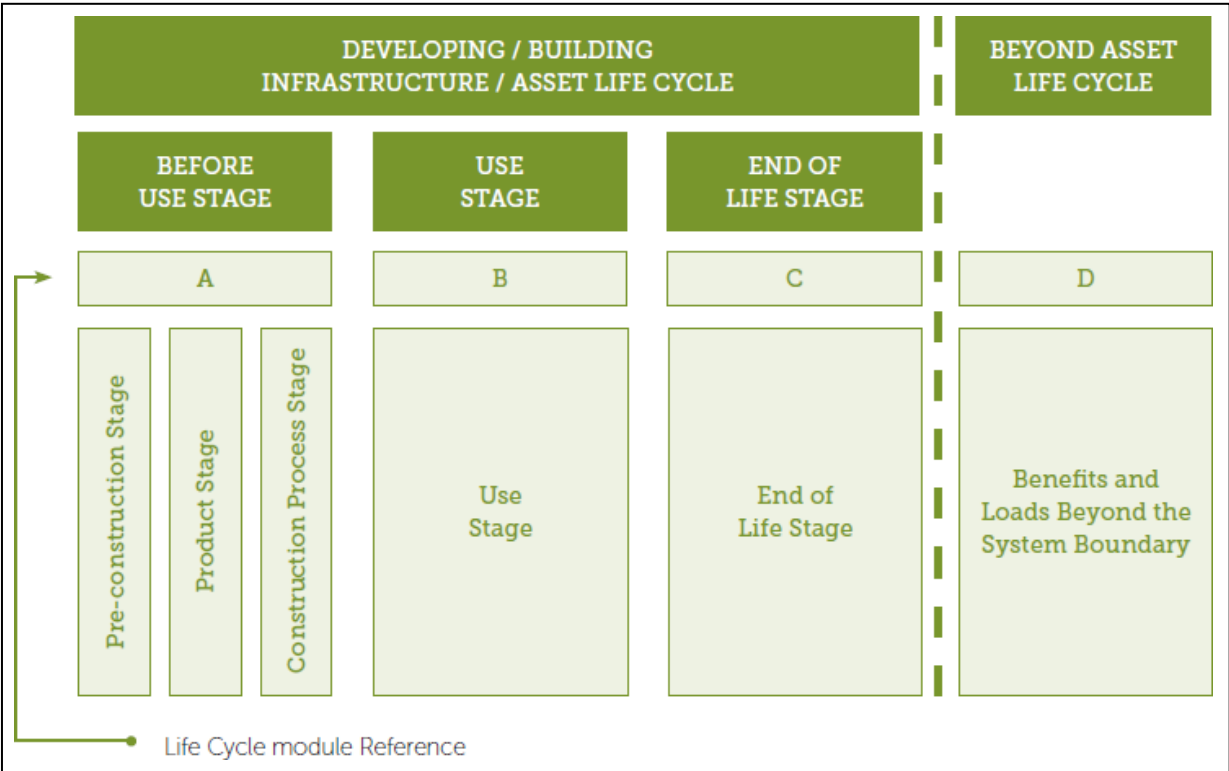


Figure 3.0.1 - Life Cycle Modules Overview

3.1 Module A1-5 (Product Sourcing and Construction Stage)

The product stage, detailed in Modules [A1] to [A3] deals with the carbon emissions involved in the cradle to gate processes, raw material supply, transport, and manufacturing. A4-5: Modules [A4] and [A5] respectively identify the emissions correlating to the transportation of the materials and components from the factory gate to the project site, and the assembly of the materials into a building.

3.2 Module B1-7 (Use Stage)

Any emissions relating to operational energy are included here regulated and unregulated emissions, water use, and any embodied carbon impacts associated with maintenance, repair, replacement, and refurbishment of building components are all included. Due to the limited information available on the materials/ manufacturers anticipated to be used at this stage, B2/B3 Maintenance/Repair are unable to be calculated, therefore any assumptions may negatively impact the results.

3.3 Module C1-4 (End of Life Stage)

Within this module, any emissions generated 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 are accounted for.

3.4 Module D (Benefits and Loads Beyond the System Boundary)

Within this module, any emissions generated 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 are accounted for.

WHOLE LIFE CARBON ASSESSMENT INFORMATION													
PROJECT LIFE CYCLE INFORMATION													
[A1 – A3]			[A4 – A5]		[B1 – B7]					[C1 – C4]			
PRODUCT stage			CONSTRUCTION PROCESS stage		USE stage					END OF LIFE stage			
[A1]	[A2]	[A3]	[A4]	[A5]	[B1]	[B2]	[B3]	[B4]	[B5]	[C1]	[C2]	[C3]	[C4]
Raw material extraction & supply	Transport to manufacturing plant	Manufacturing & fabrication	Transport to project site	Construction & installation process	Use	Maintenance	Repair	Replacement	Refurbishment	Deconstruction Demolition	Transport to disposal facility	Waste processing for reuse, recovery or recycling	Disposal
					[B6] Operational energy use								
					[B7] Operational water use								

Figure 3.4 - Life Cycle Modules Breakdown

4.0 Methodology

4.1 Assessment Scope

The assessment of Whole Life Cycle (WLC) emissions consists of the following sections: total operational carbon emissions (which includes both unregulated and regulated); embodied carbon emissions; and any future potential carbon emissions 'benefits', post end-of-life, including benefits from reuse and recycling of building structure and materials.

The following has been completed for the former Boddingtons Development:

- An assessment has been completed considering the current state of the electricity grid using SAP 10 figures within One Click.

These assessments have been undertaken in line with the RICS Professional Statement: Whole Life Carbon Assessment for the Built Environment.

4.2 Operational Carbon Emissions

The operational carbon emissions are calculated based on the Part L assessments undertaken for the former Boddingtons Development emissions as part of the energy strategy for planning. This encompasses carbon emissions related to both regulated and unregulated energy uses, accumulated over a 60-year period.

4.3 Embodied Carbon Assessment and End-of-life Emissions

For this assessment, the Life Cycle Assessment (LCA) tool – One Click LCA – has been used to make allocations for the anticipated material quantities in an inventory analysis. One Click has a library of materials with associated Environmental Product Declarations (EPDs) which are produced by the manufacturer and give the carbon emission of a product.

The OneClick LCA database has a limited number of entries, preventing the assessment of specific construction specification. In the scenario where a specified material isn't included in the database, the most similar material in terms of material composition is selected instead.

The LCA process and results included by this report have been assessed in line with BS 15978:2011 and the RICS Professional Statement: Whole Life Carbon assessment for the built environment. All EPDs used have been produced in line with the requirements of BS EN 15804:2012. Hence, each material has been assessed against the following lifecycle stages:

- A1-3 Product Stage, A4 Material Transportation to Site, A5 Construction, and Installation Process.
- B1 Use, B4-5 Replacement and Maintenance
- C1-4 End of Life

The following stages, B2 Maintenance and B3 Repair have been excluded from the calculation as optional, an explanation is given in the key assumptions table.

4.4 Life Cycle Assessment Impacts

A Life Cycle Assessment considers a range of environmental indicators that assess the relevant overall impacts of the materials selections. Ideally, an LCA assessment will include all the environmental impacts related to a product or material. However, due to the lack of information or a clear calculation methodology for Key Performance Indicators (KPIs), not all environmental impacts can be considered.

4.5 Key Assumptions

The following table provides the key assumptions used with the Life Cycle Assessment:

Environmental Indicators
This assessment includes analysis of embodied carbon of the development as 'global warming potential' using the annotation of CO₂e (CO₂ equivalent). Standard ratios are used to convert the various greenhouse gases into equivalent amounts of CO₂. These ratios are based on the global warming potential (GWP) of each gas. GWP is a relative measure of how much a given mass of greenhouse gas is estimated to contribute to global warming over a given time interval typically 100 years. It is expressed relative to carbon dioxide which is set as the baseline which other emitters are compared against, and which therefore has a GWP of 1.
CO ₂ eq Emissions Factors
CO₂eq emissions from consuming gas, electricity and water were calculated by OneClick LCA.
WLC Benchmarks
For the Former Boddingtons Development, an overall target for stages A-C of 748 kgCO₂e/m²_{GIA} has been set with a benchmark target of <1200 kgCO₂e/m²_{GIA} (these targets assume decarbonisation and exclude stages B6 and B7 for water consumption and operational energy).
Study Period
The reference study period for domestic and non-domestic projects has been taken as 60 years as per the RICS professional statement
Functional Unit
To allow comparison with benchmark data, the Functional Unit (FU) for embodied carbon is shown in kgCO₂e/m² of floor area (GIA). A total area of 43,644.3 m² (GIA) was used as extracted from projects area schedule.
Software Tools
OneClick LCA software and its accompanying database has been used to evaluate the buildings embodied carbon emissions. OneClick LCA is an approved software tool recognised by the GLA and BRE.
System Boundary
The assessment includes all embodied and operational impact from 'cradle' to 'grave', from production of raw materials (Stage A1) through to disposal (Stage C4).
Assessment Scope
The assessment covers the entire building and the hard landscaping up to the development's boundary.
Elements included in Study
The elements included in the study are based on Table 6 from 'Whole life carbon assessment for the built environment' provided by RICS Professional Statement and in accordance with each elements scope of work.

Material Specification
Model inputs have been taken from: 230720 Boddingtons Stage 3 Cost Plan (MB) 230713 The-Structural-Carbon-Tool-v2-0_bldg A (MB) 230713 The-Structural-Carbon-Tool-v2-0_bldg B (MB) 230721 Reinforcement and Roof Slab Calculations (MB) These were provided by the Cost Consultant and the Structural Engineer. Where not clearly specified, the material type/specification was assumed to be generic (industry average) or, where not available, the closest best practice available product was assumed.
Expected Lifespans
The OneClick LCA default lifespans have been used for all materials.

Table 4.5 - Key Assumptions

4.6 Limitations

Whole Life Cycle Carbon Assessments can be difficult to apply with limited data at the pre-planning stage. Whilst this assessment has been undertaken in-line with current industry best practice standards (BS EN 15978) and BRE compliant databases (using OneClick LCA software), the following limitations should be noted:

- This study has been based on the materials and areas specified by the outline cost estimates and supporting information.
- Whole-life cycle assessment is imprecise method with most data estimated at this stage.
- The OneClick LCA database has a limited number of entries, preventing the assessment of specific construction specification.
- Quantification of embodied carbon of building services is a relatively new area with LCAs and therefore available data is limited, and approximations have been made to best represent the proposed systems. For example, the OneClick LCA does not include an extensive building services resource.
- The OneClick database includes standard assumptions for the waste factor, life expectancy, recycled content, and transport distance for each material type.

4.7 Data Sources

There are several approaches to complete a building specific life cycle assessment. A flexible approach is required when utilising a dataset of product specific environmental product declarations and more generic data within the One Click LCA tool.

For this assessment material information has come from the cost plan, however, material information can also be sourced from any of the following:

- Cost Plan
- Revit model
- IES Model
- Architectural Drawings and Build-ups

Additional information can also be sourced from:

- Accommodation and Residential area schedule
- Energy Statement
- Mechanical Stage 2 Design report

5.0 Inputs

5.1 Operational Carbon Assessment

Operational carbon emissions are estimated as part of the Energy Strategy, submitted in support of the planning application. The assessment of operational carbon emissions has been based on the methodology set out in Part L of the building regulations, and a total of regulated and unregulated carbon emissions is reported.

- Residential areas: Operational carbon emissions are based on SAP calculations in line with Part L1A methodology.
- Commercial areas: Operational carbon emissions will be based on BRUKL calculations of regulated and unregulated energy. The commercial energy use has been estimated using a factor of 110kWh/m².

5.2 Embodied Carbon and End-of-Life Assessment

The building elements table below, lists the building elements covered in the assessment, in line with the RICS Professional Statement.

Item	Building Part/Element Group	Building Element	Basis for Information
0	Demolition	0.1 Toxic/Hazardous/Contaminated Material treatment*	The feasibility cost estimate provided by the project quantity surveyors did not include an allowance for contaminated land removal and treatment.
		0.2 Major Demolition Works*	
		0.3 & 0.5 Temporary/Enabling Works	
		0.4 Specialist groundworks	
1	Substructure	1.1 Substructure	
2	Superstructure	2.1 Frame	
		2.2 Upper floor incl. balconies	
		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	3.1 Wall finishes	
		3.2 Floor finishes	
		3.3 Ceiling finishes	
4	Fittings, furnishings & equipment (FFE)	4.1 Fittings, furnishings & equipment incl. building-related and non-building-related	
5	Services (MEP)	5.1-5.14 Services incl. building-related and non-building-related	Building services data uses data provided from the Building Services engineers which align with the proposed services strategy for the project. The lengths of duct's, electrical distribution and water distribution were calculated on a m2 GIA basis using in-built EPD within OneClick LCA.
6	Prefabricated buildings and building units	6.1 Prefabricated buildings and building units	No prefabricated works are applicable
7	Work to existing building	7.1 Minor demolition and alteration Works	No minor works are applicable
8	External works	8.1 Site preparation works	
		8.2 Roads, paths, paving's, and surfacing's	
		8.3 Soft landscaping, planting, and irrigation systems	
		8.4 Fencing, railings, and walls	
		8.5 External fixtures	
		8.6 External drainage	
		8.7 External services	
		8.8 Minor building works and ancillary buildings	

Table 5.2 - Building Elements

5.3 Life-Cycle Modules

Module	Commentary of Data Source
A1-A3 Construction Materials	Calculated using EPD's which align with the exact product (were known) or the most applicable similar product.
A4 Transportation to Site	The transport distances were estimated based on typical average transport distances based on material type & project location, provided by One Click LCA.
A5 Construction Process	The software's average site impact template for temperature climate was used. This was due to lack of site-specific construction data. The scenario considers electricity, fuel, waste, and transportation impacts.
B1 Use	Use (B1) include the impact of refrigerant leakage at leakage rate of 3% a year and 98% end of life recovery.
B2 Maintenance and B3 Repair	Maintenance (B2) and Repair (B3) have not been considered due to accurate data being unavailable at this early stage. This is due to a lack of information to accurately account for these emissions. This is due to there being no maintenance strategy reports, façade access and maintenance strategy, life cycle cost reports, O&M manuals available as advised by the RICS document to calculate this figure
B4 Replacement and B5 Refurbishment	Replacement (B4) and Refurbishment (B5) account for the technical service life of the building components "BCIS Life expectancy of building components" The OneClick LCA default service lives have been used for all materials. Refurbishment (B5) would typically involve a predetermined change of use at a point during the service life of the project, as well as a sizeable amount of works to several parts of the building. It has been assumed that this will not occur in a residential building and due to the commercial units being <1% of the overall area, B5 figures have been assumed to be 0 kgCO ₂ eq. OneClick LCA calculations for B4/B5 have combined the 2 modules and therefore as a significant majority of the works will come under B4 with this category being used to cover both.
B6 Energy Use	The anticipated annual energy consumption during operation has been taken from the projects design stage energy modelling provided by Wallace Whittle as part of the Energy Statement. This data is sourced from SAP 10 emission factors. The commercial energy use has been estimated using a factor of 110kWh/m ² .

Module	Commentary of Data Source
B7 Water Use	Residential water consumption is based on Building Regulations Part G 'Enhanced Consumption' of 105 l/pp/d and multiplied by the intended full occupancy of the development, using a combined EPD for freshwater and wastewater. Retail water consumption is based on the Plumbing Engineering Services Design Guide which gives a consumption of 40-45l/pp/d. This multiplied by the estimated occupancy. The occupancy of the retail area is based on 5m ² /per person (given by the BISRA Rules of Thumb) multiplied by the retail GIA.
C1-C4 Deconstruction	C1 (Deconstruction/demolition) and C2 (Transport) are based on default values. The waste resulted from the demolition process has been included in accordance with Gross Internal Area. These scenarios consider electricity and diesel usage in the deconstruction process. C3 (Waste Processing) and C4 (Disposal) use OneClick LCA's default end of life scenarios, please refer to the appendix for further detail.
D External impacts/end of life benefits	D (End of Life) use OneClick LCA's default end of life scenarios, please refer to the appendix for further detail.

Table 5.3 - Life-cycle Modules

6.0 Results

6.1 Embodied Carbon Emissions

The following tables shows the estimated embodied carbon of the former Boddingtons Development broken down by life cycle stage and main building elements with decarbonisation. The full table of results can be seen in section 6.2.

Stages	Absolute GWP (kgCO ₂ e)	Unitary GWP (kg CO ₂ e/m ²)
Embodied Carbon Modules A1-5	20,428,863	468
Embodied Carbon Modules B1-5 & C1-4	12,252,591	281
Operational Carbon Modules B6-7	19,749,201	453
Total (Excluding Module D)	52,430,655	1,201

Table 6.1.1 - Whole Life Cycle Emissions by Lifecycle Stage

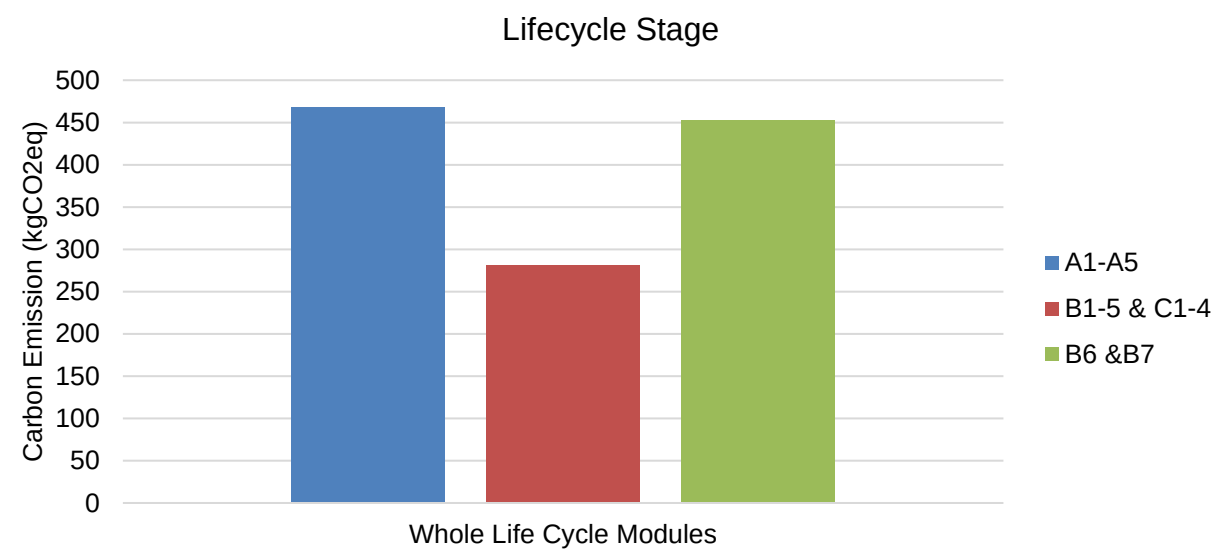


Figure 6.1.1 - Life Cycle Module Comparison

Stage	Carbon Emission Percentage
A1-3 Materials	34.7%
A4 Transportation	0.7%
A5 Site	2.8%
B4 Replacement	20.1%
B6 Operational Energy	34.8%
B7 Water	2.2%
C1 Demolition	0.3%
C2 Waste Transportation	0.8%
C3 Waste Processing	1.2%

Table 6.1.2 - Life Cycle modules percentage breakdown

Building Element	A1-3 GWP (kgCO ₂ eq)	A4 GWP (kgCO ₂ eq)	A5 GWP (kgCO ₂ eq)	A1-5 Absolute GWP (kgCO ₂ e)	A1-5 Unitary GWP (kg CO ₂ e/m ²)
0.4 Groundworks	0	0	197.12	197.12	0
1.0 Substructure	1773376.63	79738.26	88700.59	1941815.48	44
2.1 Frame	1163146.44	9289.94	28955.83	1201392.21	28
2.2 Upper Floors	4784043.99	193917.15	225124.74	5203085.88	119
2.3 Roof	263019.74	9876.11	10771.01	283666.86	6
2.4 Stairs & Ramps	34345.31	1319.47	1331.38	36996.16	1
2.5 Ext. Walls	4322190.51	76143.86	253991	4652325.37	107
2.6 Windows & Ext. Doors	517497.03	891.42	0	518388.45	12
2.7 Int. Walls & Partitions	850490.38	7635.42	77430.42	935556.22	21
2.8 Int. Doors	143194.33	717.96	0	143912.29	3
3.0 Finishes	1396674.7	3128.38	182119.15	1581922.23	36
4.0 Fittings, furnishings, and equipment	0	0	0	0	0
5.0 Building Services/MEP	1696442.7	3999.66	18273.26	1718715.62	39
6.0 Prefabricated Buildings and Building Units	1521356.4	10105.38	0	1531461.78	35
7.0 Works to Existing Building	0	0	0	0	0
8.0 External Works	49079.6	1168.35	622314.04	672561.99	15
Total kgCO ₂ e	18514857.75	397931.37	1516074.21	20428863.33	468
Total kgCO ₂ e/GIA	424	9	35	468	N/A

Table 6.1.3 - Embodied Carbon Emissions by RICS Category for module A

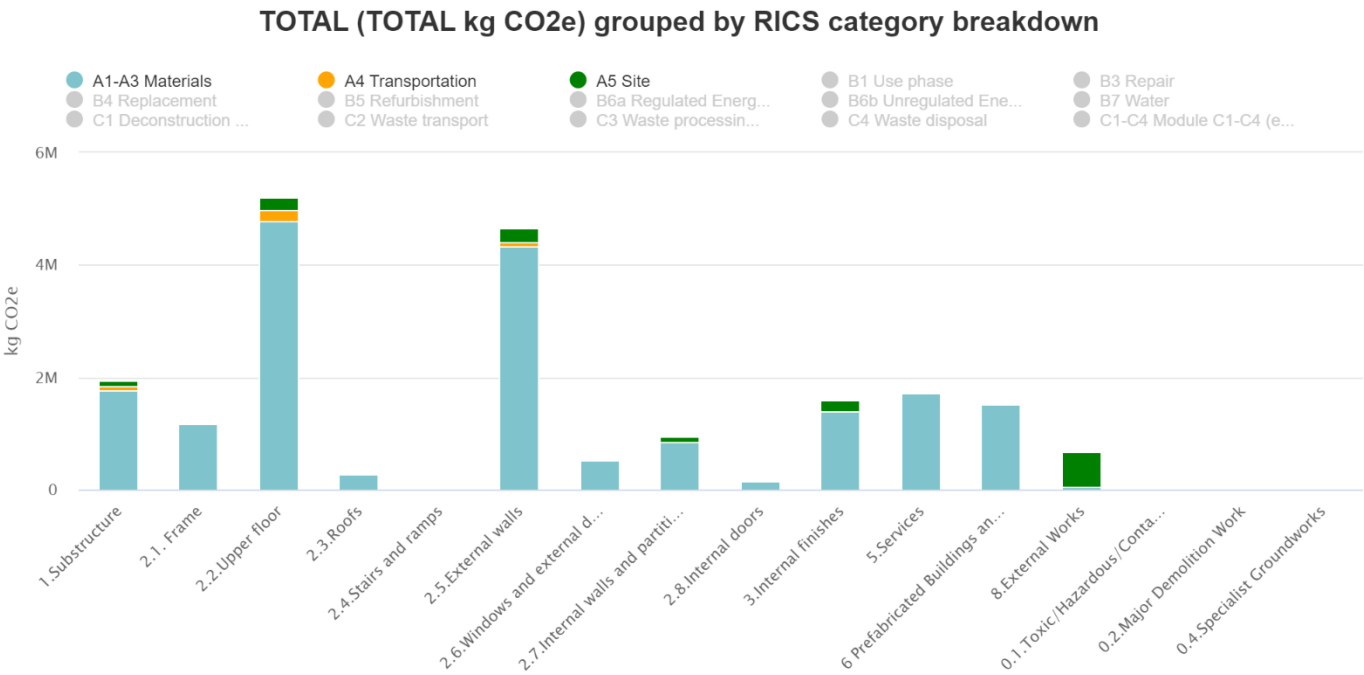


Figure 6.1.2 - Embodied Carbon Emissions by RICS Category for modules A1-5

Stages	GLA Aspirational Target (kgCO ₂ e)	GLA Benchmark Target (kgCO ₂ e)	WLC of Project (kgCO ₂ e)	Comments
Modules A-C (Excluding B6-B7)	<800	<1200	748	It must be noted that volumes and weights of materials proposed for the various materials are only estimates and no defined figures have been set. Despite these limitations, it can still be understood that the development has been designed efficiently.

Table 6.1.4 - Embodied Carbon Target Comparison

6.2 Estimated Whole Life Carbon (WLC) Emissions

	Biogenic Carbon	A1-A3 Product Stage	A4 Transportation to Site	A5 Site Operations	B1 Use Phase	B2 Maintenance	B3 Repair	B4 Replacement	B6 Operational Energy Use	B7 Operational Water Use	C1 Deconstruction / Demolition	C2 Waste Transportation	C3 Waste Processing	C4 Waste Disposal	Total kg CO ₂ e	Module D (excluded from totals)
0.2 Demolition	0	0	0	0	0	0	0	0	0	0	148390.62	0	0	0	148390.62	0
0.4 Groundworks	0	0	0	197.12	0	0	0	0	0	0	0	0	0	0	197.12	0
1.0 Substructure	0	1773376.63	79738.26	88700.59	0	0	0	0	0	0	0	51209.77	4689.62	0	1997714.87	-745094.63
2.1 Frame	0	1163146.44	9289.94	28955.83	0	0	0	0	0	0	0	25463.85	2036.73	0	1228892.79	-527614.72
2.2 Upper Floors	0	4784043.99	193917.15	225124.74	0	0	0	0	0	0	0	133251.03	11876.78	0	5348213.69	-2075749.91
2.3 Roof	0	263019.74	9876.11	10771.01	0	0	0	787.74	0	0	0	7791.89	750.91	54.89	293052.29	-121666.83
2.4 Stairs & Ramps	0	34345.31	1319.47	1331.38	0	0	0	0	0	0	0	786.1	74.19	0	37856.45	-11007.75
2.5 Ext. Walls	0	4322190.51	76143.86	253991	0	0	0	0	0	0	0	79670.9	6123.23	0	4738119.49	-2448001.98
2.6 Windows & Ext. Doors	0	517497.03	891.42	0	0	0	0	222037.29	0	0	0	6857.04	84.25	89.35	747456.38	-55250.07
2.7. Int. Walls & Partitions	0	850490.38	7635.42	77430.42	0	0	0	204661.97	0	0	0	46016.8	1920.76	204.13	1188359.88	-157364.01
2.8 Int. Doors	-264414.15	143194.33	717.96	0	0	0	0	146023.04	0	0	0	552.28	265897.62	75	292046.08	0
3.0 Finishes	-37694.16	1396674.7	3128.38	182119.15	0	0	0	3970532.04	0	0	0	8890.2	623677.37	26.78	6147354.47	-1992351.71
4.0 Fittings, furnishings & equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.0 Services (MEP)	0	1696442.7	3999.66	18273.26	11251.28	0	0	3015679.32	18587264.16	1161936.52	0	16437.3	1476.29	111.61	24512872.11	-2390617.33
6.0 Prefabricated	-28406.4	1521356.4	10105.38	0	0	0	0	3154419.49	0	0	0	41717.87	32153.23	283.27	4731629.24	-6484995.88
7.0 Works to Existing Building	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8.0 Ext. works	0	49079.6	1168.35	622314.04	0	0	0	7162.96	0	0	0	1250.74	143.66	0	681119.34	-15618.88
Total (kgCO ₂ eq)	-330514.71	18514857.75	397931.37	1516074.21	11251.28	0	0	10721303.85	18587264.16	1161936.52	148390.62	419895.78	950904.63	845.05	52100140.52	-17025333.7

Table 6.2 - Whole Life Cycle Results

7.0 Whole Life Cycle Conclusion

This report summaries the outcome of the Whole Life Carbon (WLC) assessment undertaken for the mixed-use development at former Boddingtons Development, completed in accordance with the RICS professional statement.

The following summaries the performance of the development

The life cycle module that constitutes the greatest proportion of the total Whole Life Carbon emissions of the development is Module B6: Operational Energy use at 34.8% of the total Whole Life Carbon emissions. The next highest category is Module A1-A3 at 34.7% which is significant primarily due to the relatively high product stage emissions.

Overall, the development achieves the GLA benchmark target and the aspirational target. The provision of more accurate design information in later stages will give a more accurate result.

The results are shown below by table 7.0.1:

Stages	Former Boddingtons Development WLC Emissions	GLA Benchmark Target	GLA Aspirational Target
		(kgCO ₂ e/m ² GIA)	
Modules A-C (Excluding B6 & B7)	749	<1200	<800
Modules A1-5	468	<850	<500
Module B1-5 & C1-C4	281	<350	<300
Operational Carbon Modules B6-7	453	N/A	N/A

Table 7.0.1 - Whole Life Cycle Results Table



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