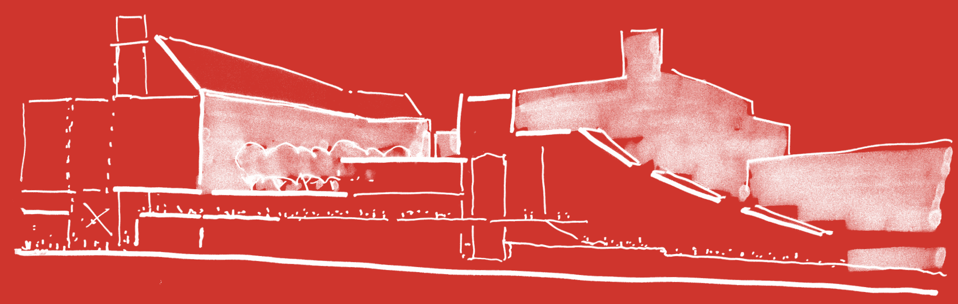
The British Library Extension
January 2022

Circular Economy Statement



Stanhope, Mitsui Fudosan UK, British Library

British Library Extension

Detailed Circular Economy Statement

ARUP-CE-REP-0001

01 | November 2021

Job number 249622-00

Ove Arup & Partners Ltd
13 Fitzroy Street
London
W1T 4BQ
United Kingdom
www.arup.com

ARUP

Contents

1 Executive summary

This report gives an overview of the strategies to be implemented in The British Library Extension located in the London Borough of Camden, in order for it to meet circular economy principles. The statement will cover the relevant planning policies regarding to circular economy and describe how these policies will be achieved within the development in order to minimise the environmental impact and reduce waste.

This document has been prepared on behalf of the British Library and SMBL Developments Ltd (Stanhope PLC and Mitsui Fudosan) as the 'Applicants' to support the applications for planning permission and listed building consent at the land to the north of the British Library ('the Site').

The proposed development is for the demolition of the existing British Library Centre for Conservation and temporary Story Garden to allow for an extension to the northern aspect of the existing Grade I listed British Library building on Euston Road, London.

1.1 Scope

The development will provide library accommodation; commercial space, including lab-enabled floor space designed to cater for knowledge quarter uses, retail space, and the Crossrail 2 works at basement level (excluding the eastern shaft). The development comprises of a basement, lower ground, upper ground, and 10 storeys above ground.

The application for the project is referable to the Mayor of London, therefore discussions have taken place with the Greater London Authority (GLA). The draft sustainability strategy was presented to the GLA on 11/03/2021 and feedback has been integrated into the scheme. This circular economy statement is developed in accordance with policy SI7 of the London Plan.

The promotion of a more circular economy that achieves improved resource efficiency and innovation is one of the objectives of Policy SI7 of the London Plan. This is in order to maintain products and materials at their highest use for as long as possible.

The project also follows the guidance of the Camden Planning Guidance Energy Efficiency and Adaptation document which states that ‘All development should seek to optimise resource efficiency and use circular economy principles.’

Figure 1 Illustrative view of the Proposed Development from Ossulston Street (RSHP 31-08-21)

1.2 Engaged disciplines

This Circular Economy Statement defines the project aspirations and sets out the strategic approach to including circular economy principles in the proposal. This statement identifies key opportunities from various disciplines engaged in the development, design and delivery of the project. This includes:

- Architect – Rogers Stirk Harbour + Partners
- Clients – Stanhope, Mitsui Fudosan UK, British Library
- Façade Engineer – Arup
- Landscape Architect – DSDHA
- MEPH Engineer – Arup
- Project Manager – Stanhope
- Structural Engineer – Arup

All key stakeholders will be required to be actively engaged with the circular economy approach throughout the design and construction of the project.

1.3 Summary

According to GLA guidance, Circular Economy Statements should inform important, early decisions and be submitted at outline/pre-application (RIBA Stage 1/2), full application (RIBA Stage 2/3) and post-completion stages (RIBA Stages 4-7).

This building's approach to circular economy was determined through a detailed workshop prior to Stage 2. The workshop took place on 22/03/2021 and addressed the circular economy approach and life cycle assessment strategy. There were 12 members of the design team present at this workshop across a range of disciplines, including MEP, Structures, Architects, Landscape Architects, and Façades. The workshop took place at the project's early stage. Therefore the design team was able to consider the brief and determine a strategic approach toward integrating circular economy principles into the project.

The circular economy measures that are being targeted for the project are as follows:

- Minimising the quantities of materials used
- Minimising the quantities of other resources used (energy, water, land)
- Specifying and sourcing materials responsibly and sustainably
- Designing for reusability / recoverability / longevity / adaptability / flexibility
- Designing out construction, demolition, excavation, industrial and municipal waste arisings
- Demolition waste (how waste from demolition of the layers will be managed)
- Excavation waste (how waste from excavation will be managed)
- Construction waste (how waste arising from construction of the layers will be reused or recycled)
- Municipal and industrial waste (how the design will support operational waste management)

The project will be required to monitor and report on the performance of circular economy measures, including work towards the recycling and re-use targets for biodegradable and recyclable waste, municipal waste, and construction, demolition and excavation waste specified in the London Plan.

During the Developed and Technical Design stages, the design team will review performance against previous stages and London Plan targets. Documentation will be provided to demonstrate the incorporation of outcomes from Concept Design stage and outline any additional actions to be taken.

During construction, the implementation of agreed measures must be monitored and documented. The contractor must also demonstrate additional activities that have been undertaken to identify circular economy and waste reduction measures on site. Monitoring in relation to disassembly and functional adaptability of the building will be developed during later stages of design.

1.4 Key commitments and targets

Key GLA targets for the project are as follows:

Existing site targets

- GLA target: 95% diversion from landfill at demolition stage
- GLA target: 95% beneficial use from excavation

New development targets

- GLA target: 95% diversion from landfill at construction stage

Municipal waste during operation

- GLA target: 65% municipal waste recycling by 2030

BREEAM supports circular economy principles and commitments. Achievement of the following credits form key targets for the project:

Mat 06 Material Efficiency	At the Preparation and Brief and Concept Design stages, set targets and report on opportunities and methods to optimise the use of materials.
Wst 01 Pre-demolition audit	A pre-demolition audit has been undertaken to identify existing buildings, structures or hard surfaces on site.
Wat 01 Water consumption	Reduce the consumption of potable water for sanitary use in new buildings through the use of water efficient components and water recycling systems.
Man 03 Responsible construction practices	The principal contractor will be required to commit to monitoring construction site impacts including energy use, water consumption and transportation data.
Man 04 Commissioning and handover	Prior to handover two user guides will be developed (one technical, and one non-technical) and training provided so staff are able to facilitate optimal operational energy performance across the building lifecycle.
Mat 01 Life cycle assessment	A BREEAM-compliant life cycle assessment will be produced for the building and options appraisal undertaken to select materials with a lower environmental impact over the life cycle of the building.
Mat 03 Sustainable procurement	A sustainable procurement plan will be developed for the project to guide specification towards sustainable construction products prior to concept design.
Mat 03 Legal and sustainable timber	All timber and timber-based products used during the construction process of the project should be demonstrated as legal and sustainable timber.

Wst 02 Use of recycled and sustainably sourced aggregates	The project will investigate and specify more sustainably sourced aggregates and will encourage reuse where appropriate and avoid waste/pollution arising from disposal of demolition and other forms of waste.
Mat 05 Designing for durability and resilience	Strategies have been put in place to reduce risk of building deterioration and maintenance e.g. use of robust back of house materials to increase longevity.
Wst 06 Design for disassembly and adaptability	A Functional Adaptation Strategy will be undertaken by the end of concept design to explore, and give recommendations on, the ease of disassembly and functional adaptation of different design scenarios.
Wst 05 Adaptation to climate change	A Climate Change Adaptation Strategy appraisal will be undertaken, and strategies implemented, to maximise building longevity.
Wst 01 Construction waste management	A Resource Management Plan has been prepared covering non-hazardous waste materials and data on waste arisings and waste management routes.
Wst 03 Operational waste	A dedicated space will be provided for the segregation and storage of operational recyclable waste generated. Dedicated waste spaces for the office & retail units, big enough for general waste, recyclables & food waste will be provided.

The project team is committed to monitor and report on the performance of circular economy measures, including work towards the recycling and re-use targets for biodegradable and recyclable waste, municipal waste, and construction, demolition and excavation waste specified in the London Plan.

During the Developed and Technical Design stages, the design team will review performance against previous stages and London Plan targets. Documentation will be provided to demonstrate the incorporation of outcomes from Concept Design stage and outline any additional actions to be taken.

During construction, the implementation of agreed measures must be monitored and documented. The contractor must also demonstrate additional activities have been undertaken to identify circular economy and waste reduction measures on site. Monitoring in relation to disassembly and functional adaptability of the building will be developed during later stages of design.

2 Introduction

2.1 Scope

A Circular Economy is defined in London Plan (2021) Policy SI7 'Reducing waste and supporting the Circular Economy' as one where materials are retained in use at their highest value for as long as possible and are then reused or recycled, leaving a minimum of residual waste. This stands in opposition to the present 'Take, Make, Dispose' model, or 'linear' economy, as shown in Figure 1.

This report gives an overview of the strategies to be implemented in The British Library Extension located in the London Borough of Camden, in order for it to meet circular economy principles. The statement will cover the relevant planning policies regarding to circular economy and describe how these policies will be achieved within the development in order to minimise the environmental impact and reduce waste.

This document has been prepared on behalf of the British Library and SMBL Developments Ltd (Stanhope PLC and Mitsui Fudosan) as the 'Applicants' to support the applications for planning permission and listed building consent at the land to the north of the British Library ('the Site').

The proposed development is for the demolition of the existing British Library Centre for Conservation and temporary Story Garden to allow for an extension to the northern aspect of the existing Grade I listed British Library building on Euston Road, London.

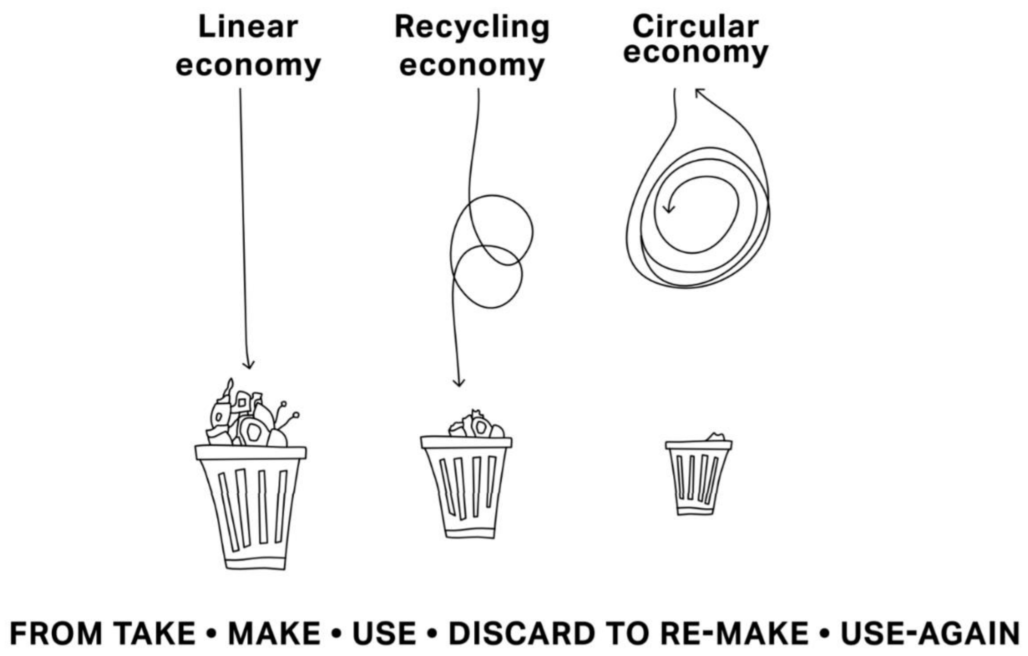


Figure 2 Circular economy concepts (Source: GLA Circular Economy Statement Guidance 2020)

2.2 Circular economy principles

This report gives an overview of the circular economy principles to be implemented in The British Library Extension which is located in the London Borough of Camden. The statement will cover the relevant planning policies regarding to circular economy and waste management and describe how these policies will be achieved within the development in order to minimise the environmental impact and reduce waste.

As defined by the Ellen MacArthur Foundation:

'A circular economy is based on the principles of designing out waste and pollution, keeping products and materials in use, and regenerating natural systems.'

The project aspires to incorporate circular economy principles into the whole life cycle of the development. This will begin from the strip out and demolition of the existing buildings on site, to the construction of the new building and fit out of the new development. The principles will also be incorporated into the future operation and maintenance of the building until its end of life.

The following circular economy principles have been considered during the design process of the development and are referenced in this circular economy statement:

- Conservation of resources
- Designing for adaptability
- Designing for longevity
- Designing for disassembly, re-use and recycling
- Designing out waste
- Managing waste sustainably

2.3 Description of development

The British Library is located in the London Borough of Camden. The proposed extension to the British Library building is a joint venture by Stanhope, Mitsui Fudosan UK, and The British Library. The development site is bounded by Midland Road to the east, the existing British Library building to the south, Ossulston Street to the west, and Dangoor Walk to the north.

The Proposed Development would involve extending the northern aspect of the existing British Library to provide library accommodation; commercial space designed to cater for knowledge quarter uses; retail space; and the Crossrail 2 works at basement level (excluding the eastern shaft). The Proposed Development would provide a gross internal area (GIA) of up to approximately 100,448m^2.

With respect to Crossrail 2, the Proposed Development would provide the main civils and structural elements of the Euston St Pancras Station eastern shaft and passenger subway tunnel connecting the Crossrail 2 escalators and lifts to the Midland Road ticket hall space/connection to Thameslink platforms for Crossrail 2, as part of their development. The BL tank farm would be replaced and relocated as part of the Proposed Development, at approximately 700m^2 (GIA). There will be adaptions to existing operational areas, including a loading bay.

The Proposed Development would be approximately 68m AOD and the new space would be split across 13 floors, one of which would be below ground level. At its deepest point, the basement would be constructed to approximately 6m AOD whilst the Crossrail 2 infrastructure would be constructed to approximately -19.5m AOD.

The BLCC and the Story Garden are located within the Site. In order to facilitate the construction of the Proposed Development, the BLCC would be relocated and a new community garden would be created within the Site. The BLCC functions are integral to the operations of the British Library and would be temporarily accommodated within the existing Library until the relocated BLCC facility is completed.

The proposed floor area for each use type is detailed in Table 1.

Table 1 Proposed area schedule

Use type	Gross Internal Area (GIA)
Library	15, 105 m^2
Commercial	77,046 m^2
Commercial (retail)	558 m^2
CR2	7,739 m^2
Total development	**100,448 m^2**

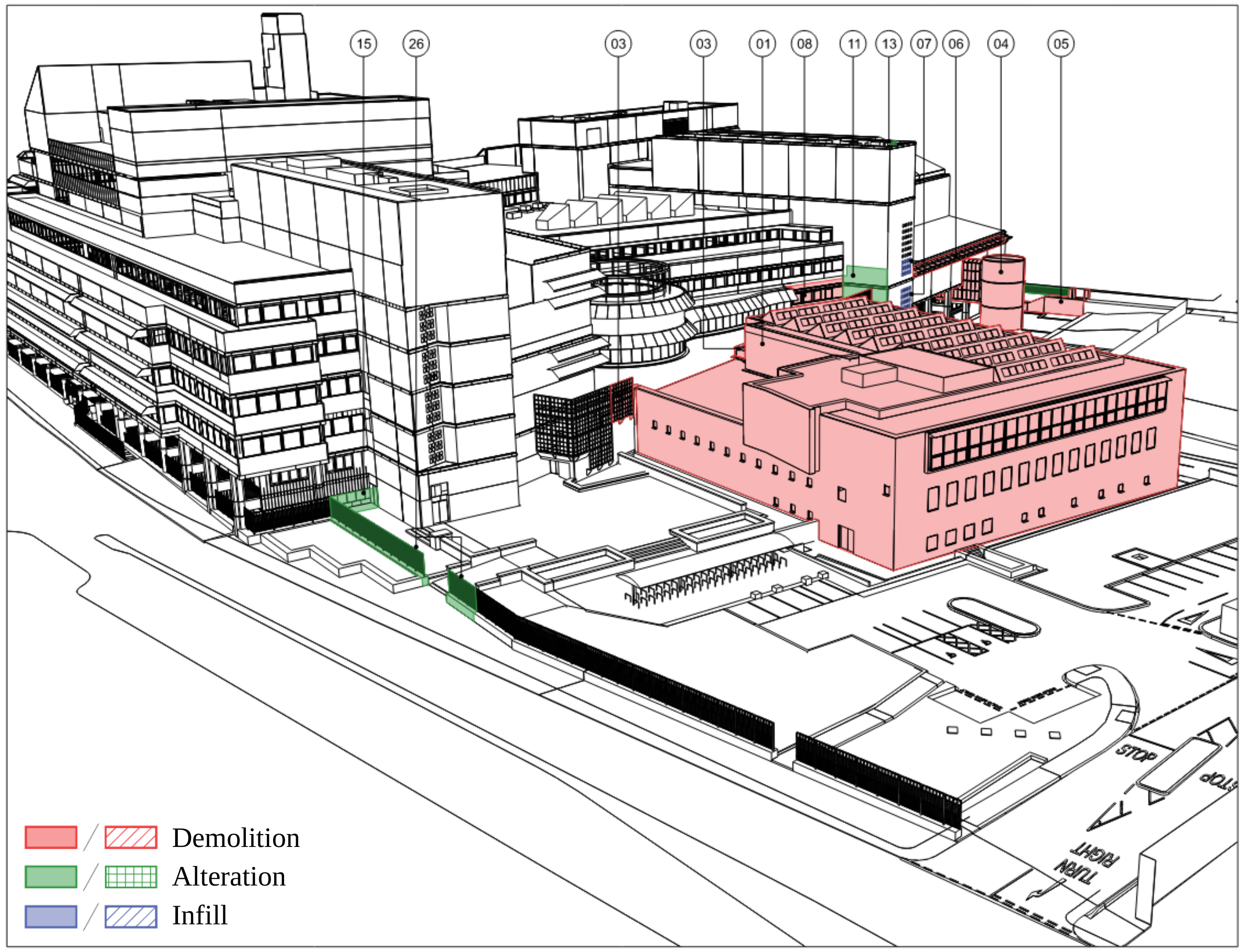


Figure 3 Existing Building Indicating Areas of Demolition / Alteration (RSHP 31-08-21)

Additionally, the project proposes to achieve BREEAM Excellent, and is being assessed for its sustainability performance as follows:

Building	Use	BREEAM Scheme	Target
The British Library Extension	Bespoke: Office, lab, culture	BREEAM 2018 'new build' commercial	Excellent

2.4 London Plan requirements

The project aims to meet or exceed the targets specified by Sustainable Infrastructure Policy SI 7 'Reducing waste and supporting the circular economy' in the London Plan (2021). The policy is defined below:

A) Resource conservation, waste reduction, increases in material re-use and recycling, and reductions in waste going for disposal will be achieved by the mayor, waste planning authorities and industry working in collaboration to:

1. Promote a more circular economy that improves resource efficiency and innovation to keep products and materials at their highest use for as long as possible
2. Encourage waste minimisation and waste prevention through the re-use of materials and using fewer resources in the production and distribution of products
3. Ensure that there is zero biodegradable or recyclable waste to landfill by 2026
4. Meet or exceed the municipal waste recycling target of 65% by 2030
5. Meet or exceed the targets for each of the following waste and material streams:
    a. Construction and demolition – 95% re-use/recycling/recovery
    b. Excavation – 95% beneficial use
6. Design developments with adequate, flexible, and easily accessible storage space and collection systems that support, as a minimum, the separate collection of dry recyclables (at least card, paper, mixed plastics, metals, glass) and food.

B) Referable applications should promote circular economy outcomes and aim to be net zero-waste. A Circular Economy Statement should be submitted, to demonstrate:

1. How all materials arising from demolition and remediation works will be re-used and/or recycled
2. How the proposal's design and construction will reduce material demands and enable building materials, components and products to be disassembled and re-used at the end of their useful life
3. Opportunities for managing as much waste as possible on site
4. Adequate and easily accessible storage space and collection systems to support recycling and re-use
5. How much waste the proposal is expected to generate, and how and where the waste will be managed in accordance with the waste hierarchy
6. How performance will be monitored and reported.

C) Development Plans that apply circular economy principles and set local lower thresholds for the application of Circular Economy Statements for development proposals are supported.

2.5 Local policy requirements

The local policy specified by the London Borough of Camden has additional requirements and targets. Camden Planning Guidance (CPG) provides advice and information on how the local council will apply planning policies. The adopted CPG documents can be 'material considerations' in planning decisions. However, they have less weight than the Local Plan or other development plan documents. The latest CPG documents were approved by Council on 15 January 2021 following consultation.

Relevant guidance is as follows, from Section 9 of CPG 'Energy efficiency and adaptation'

Key messages

- We will expect creative and innovative solutions to repurposing existing buildings, and avoiding demolition where feasible;
- All developments should seek to optimise resource efficiency and use circular economy principles.

Supporting information

- Condition and feasibility study, and options appraisal. (applies to: major redevelopment applications, any development proposing substantial demolition)
- Whole Life Carbon assessment and pre-demolition audit. (All applications where the option is substantial demolition)
- Resource efficiency plan. (All major applications, and new buildings)

Circular Economy

9.12 There are various stages of the development process where resource efficiencies can be made and we will expect these to be demonstrated in your Sustainability or Energy statement where relevant.

Design stage

- Energy efficient building design
- Minimise the quantities of materials used
- Where demolition is involved, submission of a pre-demolition audit, implementing careful demolition strategies, segregating materials and conducting analysis to maximise reuse and reclamation
- Use of reclaimed / recycled content, and enabling reuse of building materials (local sourcing through material exchange portals)
- High durability materials and low maintenance requirements
- Design to allow for flexibility –reconfiguration/ remodelling
- Design to allow for easy repair/ replacement of components
- Design for deconstruction and reuse of materials

Construction stage:

- Minimise the quantities of other resources used (energy, water, land)
- More efficient use of resources and materials including minimising waste generation
- Divert waste from landfill (via reuse, recycling or recovery)

- Demolition and construction waste -95% to reuse, recycling, recovery (excavation 95% ‘beneficial use’)
- Use efficient demolition equipment
- More efficient modes of transporting materials
- Local sourcing of materials responsibly and sustainably
- Post completion bill of materials (including as a minimum the building layer, element, material and quantity)
- Efficient construction processes and machinery

Operation stage:

- Use a soft landings approach to ensure the building is operating efficiently as designed
- Implement a good maintenance/ repair strategy to maximise life of materials
- Consider repair before replacement
- When replacements required select high durability materials with low maintenance requirements

Deconstruction/ end-of-life, and managing waste:

- Design for deconstruction and reuse of materials
- Divert waste from landfill (via reuse, recycling or recovery)
- Demolition and construction waste -95% to reuse, recycling, recovery
- Excavation 95% ‘beneficial use’
- Use efficient demolition equipment

The London Borough of Camden Local Plan was first adopted in 2010; this is now replaced with the 2017 version. The Local Plan will cover the period from 2016-2031. The Local Plan contain planning policies covering energy consumption and carbon emissions. Camden’s Local Development Framework (LDF) contains policies covering energy performance and carbon emissions of proposed developments, in particular policies CC1 and CC2.

Policy CC1 Climate change mitigation

The Council will require all development to minimise the effects of climate change and encourage all developments to meet the highest feasible environmental standards that are financially viable during construction and occupation. We will:

a. promote zero carbon development and require all development to reduce carbon dioxide emissions through following the steps in the energy hierarchy;

b. require all major development to demonstrate how London Plan targets for carbon dioxide emissions have been met;

c. ensure that the location of development and mix of land uses minimise the need to travel by car and help to support decentralised energy networks;

d. support and encourage sensitive energy efficiency improvements to existing buildings;

e. require all proposals that involve substantial demolition to demonstrate that it is not possible to retain and improve the existing building; and

f. expect all developments to optimise resource efficiency.

For decentralised energy networks, we will promote decentralised energy by:

g. working with local organisations and developers to implement decentralised energy networks in the parts of Camden most likely to support them;

h. protecting existing decentralised energy networks (e.g. at Gower Street, Bloomsbury, King’s Cross, Gospel Oak and Somers Town) and safeguarding potential network routes; and

i. requiring all major developments to assess the feasibility of connecting to an existing decentralised energy network, or where this is not possible establishing a new network.

To ensure that the Council can monitor the effectiveness of renewable and low carbon technologies, major developments will be required to install appropriate monitoring equipment.

Policy CC2 Adapting to climate change

The Council will require development to be resilient to climate change. All development should adopt appropriate climate change adaptation measures such as:

a. the protection of existing green spaces and promoting new appropriate green infrastructure;

b. not increasing, and wherever possible reducing, surface water runoff through increasing permeable surfaces and use of Sustainable Drainage Systems;

c. incorporating bio-diverse roofs, combination green and blue roofs and green walls where appropriate; and

d. measures to reduce the impact of urban and dwelling overheating, including application of the cooling hierarchy.

Any development involving 5 or more residential units or 500 sqm or more of any additional floorspace is required to demonstrate the above in a Sustainability Statement.

Sustainable design and construction measures

The Council will promote and measure sustainable design and construction by:

e. ensuring development schemes demonstrate how adaptation measures and sustainable development principles have been incorporated into the design and proposed implementation;

f. encourage new build residential development to use the Home Quality Mark and Passivhaus design standards;

g. encouraging conversions and extensions of 500 sqm of residential floorspace or above or five or more dwellings to achieve “excellent” in BREEAM domestic refurbishment; and

h. expecting non-domestic developments of 500 sqm of floorspace or above to achieve “excellent” in BREEAM assessments and encouraging zero carbon in new development from 2019.

2.6 Circular economy aspirations

This Circular Economy statement also considers the six sustainability principles or clusters that were defined at the early project stage by the Applicant with support of the Architects (RSHP), Quantity Surveyors (Alinea) and Engineers (Arup).

A Sustainability Visioning workshop was held on 16/06/20 to explore the opportunities, constraints and aspirations for Sustainability at the British Library Extension project. External drivers towards sustainability were identified to include policies & strategies from Mitsui, Stanhope and the British Library, and also from external stakeholders including Camden and the Greater London Authority

The United Nations Sustainable Development Goals (UNSDGs) were used as a framework to identify the areas where the project could contribute towards sustainable outcomes, both in terms of impact of the intervention, and in terms of the level of influence that the project team could potentially have on the outcome.

Following the workshops, the outcomes of the discussion have been mapped onto Stanhope's Sustainability Pro-forma, in order to start to set out specific design and project interventions to be targeted by the design team.

Six key clusters emerged, defining the main areas of intervention and target setting:

1 **PARTNERSHIPS** to magnify the positive outcomes of the British Library project across wider communities.

- Stakeholder engagement
- Collaboration within the Project Team

2 Creating an **INCLUSIVE PLACE** that adds social value to the local Camden area and community.

- Inclusive and diverse places
- Health and Wellbeing
- Transport
- Heritage
- Certification ratings
- Water and drainage

3 **PATHWAY TOWARDS NET ZERO CARBON** and future **RESILIENCE** through integrated design.

- Operational energy and carbon. Renewable energy
- Embodied Carbon, Circular Economy and Waste
- Resilient buildings

4 Creating a hub that supports **INNOVATION** and delivers sustainable **EMPLOYMENT**.

- Occupant satisfaction
- Innovation
- Work conditions

5 Using the available space to focus on high quality **BIODIVERSE HABITATS**, which engage users.

- Protect biodiversity
- Protect trees and forestry

6 Using the Library project to support the needs of the **LOCAL COMMUNITY**.

- Protect local community
- Provide opportunities

The above targets are incorporated into the circular economy strategy and referenced in this document where relevant. These will be used as focus areas for delivering measurable value to the British Library Extension. They are also tracked and managed through the project's BREEAM assessment.

2.7 Method statement

According to GLA guidance, Circular Economy Statements should inform important, early decisions and be submitted at outline/pre-application (RIBA Stage 1/2), full application (RIBA Stage 2/3) and post-completion stages (RIBA Stages 4-7).

This building's approach to circular economy was determined through a detailed workshop prior to Stage 2. The workshop took place on 22/03/2021 and addressed the circular economy approach and life cycle assessment strategy. There were 12 members of the design team present at this workshop across a range of disciplines, including MEP, Structures, Architects, Landscape Architects, and Façades. The workshop took place at the project's early stage. Therefore, the design team was able to consider the brief and determine a strategic approach toward integrating circular economy principles in the project.

The workshop was an interactive workshop using a platform called Miro Board. The contribution of the members of the design team defined the capacity of their disciplines to meet the project's circular economy principles and aspirations being targeted by writing their ideas and inputs onto colour-coded notes. The interactive nature of the platform created useful discussion and enabled all disciplines to contribute. This interactive board remained accessible for a period of time after the workshop, to allow additional time for contribution.

The Circular Economy Statement has been prepared by Arup Sustainability team based on contributions from the design team. As per GLA guidance, the approach has been categorised according to the 'Shearing Layers' concept. The Shearing Layers represent the various 'layers' of a building which each have their own life-cycle. Each layer requires different circular economy approaches to be adopted given their different uses/exposures. The layers of analysis are detailed in Table 2 and the Shearing Layers concept is demonstrated in Figure 4.

Table 2 Building layers

Layer	Summary	RICS categories
Site	The geographical setting, urban location and external works	External works
Substructure	Excavations, foundations, basements and ground floors	Substructure
Superstructure	Load-bearing elements above plinth including roof supporting structure	Frame Upper floors inc. balconies Stairs and ramps
Shell/Skin	The layer keeping out water, wind, heat, cold, direct sunlight and noise	Roof, External walls Windows and external doors
Services	Installations to ensure comfort, practicality, accessibility, and safety	Building Services
Space	The layout of internal walls, ceilings, floors, finishes, doors, fitted furniture	Internal walls and partitions, Internal doors, Wall, floor and ceiling finishes
Stuff	Anything that could fall if the building was turned upside down	Fitting, furnishings and equipment
Construction stuff	Any temporary installations/works/ materials, packaging and equipment	Facilitating works

Division of the circular economy approach into shearing layers enabled all the disciplines in attendance at the workshops to contribute to the overarching strategy, thus leading to a more holistic and wide-reaching scheme. This had a clear influence on both the brief and also other aspects of the building design, such as material specification and sourcing.

There have also been specific efforts to clearly define activities and targets relating to excavation, demolition, construction and municipal waste. These metrics will ensure that opportunities are taken in the project to design out waste over the course of the development life span.

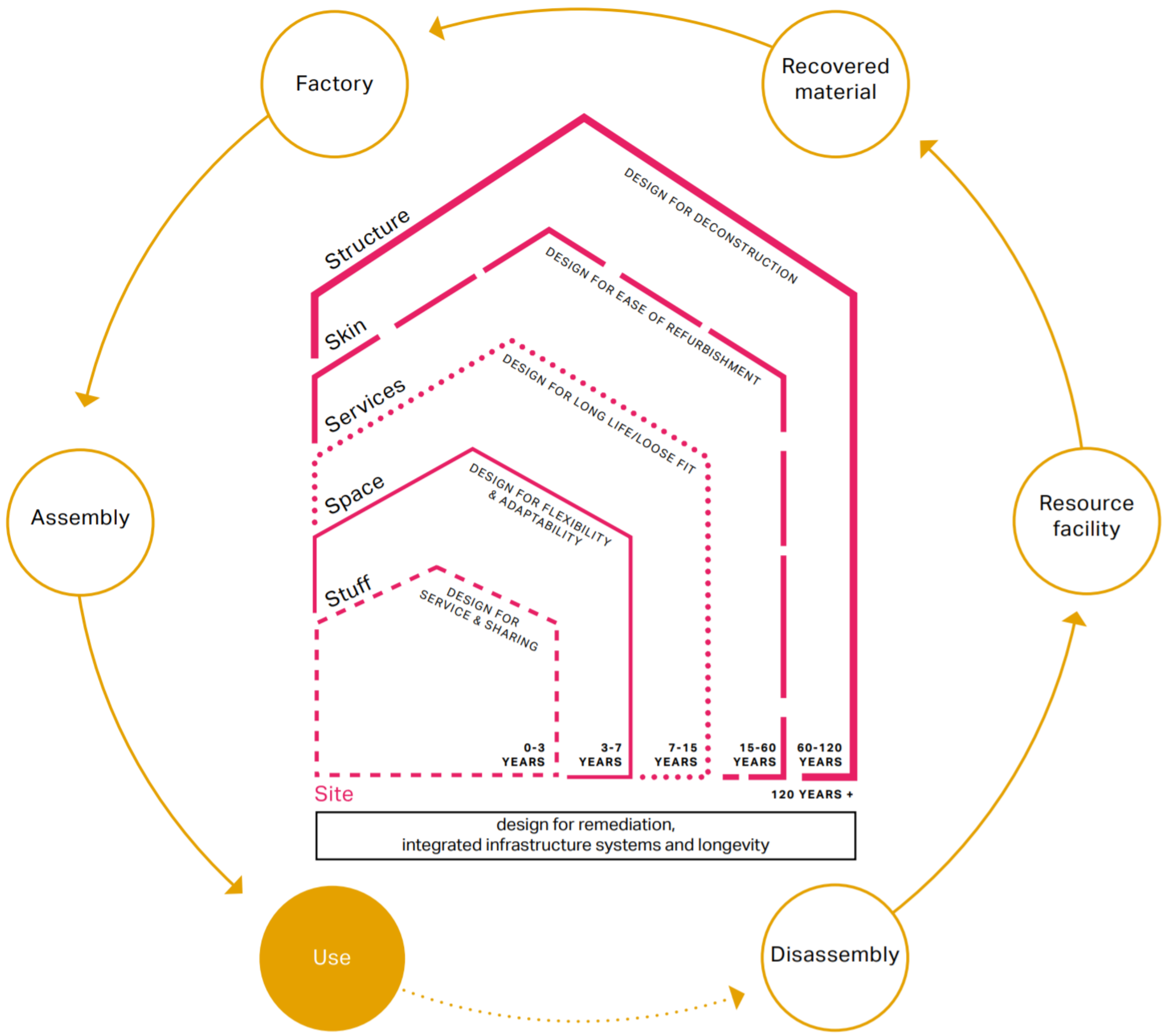


Figure 4 Shearing Layers diagram (Source: GLA Circular Economy Statement Guidance 2020)

3 Circular economy goals and strategic approach

The Circular Economy strategy for the Proposed Development has been defined according to its specific context and needs. The strategy recognises that different approaches should be adopted for the different parts of the development in order to optimise resource management, offer sustainability improvements, and potential cost savings too. The following approaches have been identified for the Proposed Development:

- Deconstruct and re-use (the existing BLCC and Story Garden on site)
- Design for longevity (25+ year lifespan of the Proposed Development)
- Design for adaptability (5 - 25 year changes in the Proposed Development's internal uses due to changing ways of working)
- Design for disassembly (of the Proposed Development at end of building life and end of component service life)
- Recoverability (maximising opportunities to recover/re-use/recycle waste within the Proposed Development through organised operational waste management)

One key workshop has taken place at the project's early stages in which the design team were able to consider the brief and discuss the overarching circular economy strategy for the project. The detailed strategic approach being taken is summarised in Table 3.

Table 3 - Strategic approaches

Aspect	Phase	Steering approach	Target	Supporting documents	Relevant credits (BREEAM)
Existing developments/components: British Library Centre for Conservation (BLCC) and Story Garden					
Circular economy approach for the existing site	Demolition Phase	**Deconstruct and re-use** Wherever possible efforts will be made to effectively manage waste from the existing site during the demolition of the BLCC and Story Garden. The following areas will be targeted: • Identifying opportunities for re-use of materials on site • Identifying routes for recycling in order to divert from landfill • Identifying opportunities for re-use of FF&E from the previous buildings on site • Segregating materials e.g. glass, to maximise opportunities for recycling • Recovering materials e.g. concrete and masonry, which once processed can be re-used	GLA target: 95% diversion from landfill at demolition stage GLA target: 95% beneficial use from excavation	Pre-Demolition Audit Condition and feasibility study BLCC Demolition Justification Report	Wst01 – construction waste management
New development/components: Proposed Development					
Circular economy approach for the new development	Cradle to Grave	**Design for adaptability, longevity and disassembly** The new building will follow best practice circular economy principles in its design and construction. Wherever possible opportunities will be taken with the overarching aims of conserving resources, designing to eliminate waste, and managing waste effectively. The following areas will be targeted: • Minimising the quantities of materials and resources used (energy, water, land) • Specifying and sourcing materials responsibly and sustainably • Designing for reusability / recoverability / longevity / adaptability / flexibility • Designing out construction, demolition, excavation, industrial and municipal waste arisings	GLA target: 95% diversion from landfill at construction stage	Sustainable Procurement Plan Sustainability Strategy Options Appraisal Whole Life Carbon Assessment Resource Efficiency Plan	Mat06 – material efficiency Wat01 – water consumption Mat03 – sustainable procurement Wst06 – design for disassembly and adaptability
New development/components: Proposed Development					
Circular economy approach for municipal waste during operation	During Occupation	**Design for recoverability** The new building will be designed efficiently to minimise and manage operational waste in the building. The following strategies will be targeted: • Provide adequate space for waste storage and separation • Work with the design team to integrate best practice procedures • Ensure external access bays are appropriately designed to maximise efficient waste removal • Design with consideration as to the flow of waste throughout the building	GLA target: 65% municipal waste recycling by 2030	Waste Management Strategy	Wst03 – operational waste

A BLCC Demolition Justification Report is appended to the Stage 2 Whole Life Cycle Assessment submitted as part of this application. The report provides a whole life carbon-based justification for demolition of the BLCC and temporary Story Garden on the site of the Proposed Development.

The report justifies the chosen circular economy strategy to 'deconstruct and re-use' rather than retain existing buildings on the site.

Key findings of the report that provide a rationale for redevelopment are as follows:

- The existing BLCC is excluded from the Grade I listing that covers the British Library and is described in the list entry as 'not part of the special interest' of the library.
- An Early Stage BLCC Retention Study undertaken by Allies and Morrison Architects found that the BLCC's location within the development site creates a series of challenges in achieving some of the main project objectives.
- Notably, retention of the BLCC would restrict opportunities to create free-flowing pedestrian movement between existing and proposed library areas; force a densification of commercial development around the site perimeter; and reduce the daylighting levels reaching the BLCC's north lights, which are crucial to the conservation operation of the building.
- Achieving the aspirations envisaged for the future Crossrail 2 station at Euston/St Pancras would not be possible without the demolition of existing buildings on the site, most notably the BLCC.
- It is anticipated that over 98% of waste can be diverted from landfill for the full demolition works at the British Library project (including the BLCC, pepperpot stair and internal alterations to the Library's north façade).
- A whole life carbon assessment over a 60-year time period was carried out to compare the whole life carbon impact of the demolition (Scenario 1) versus retention (Scenario 2) of the BLCC. As shown in Figure 5 the study demonstrates that there are carbon benefits over a 60-year lifespan from the demolition of the BLCC, versus its retention. For further details on this study, please refer to the Stage 2 Whole Life Cycle Assessment in Appendix C.

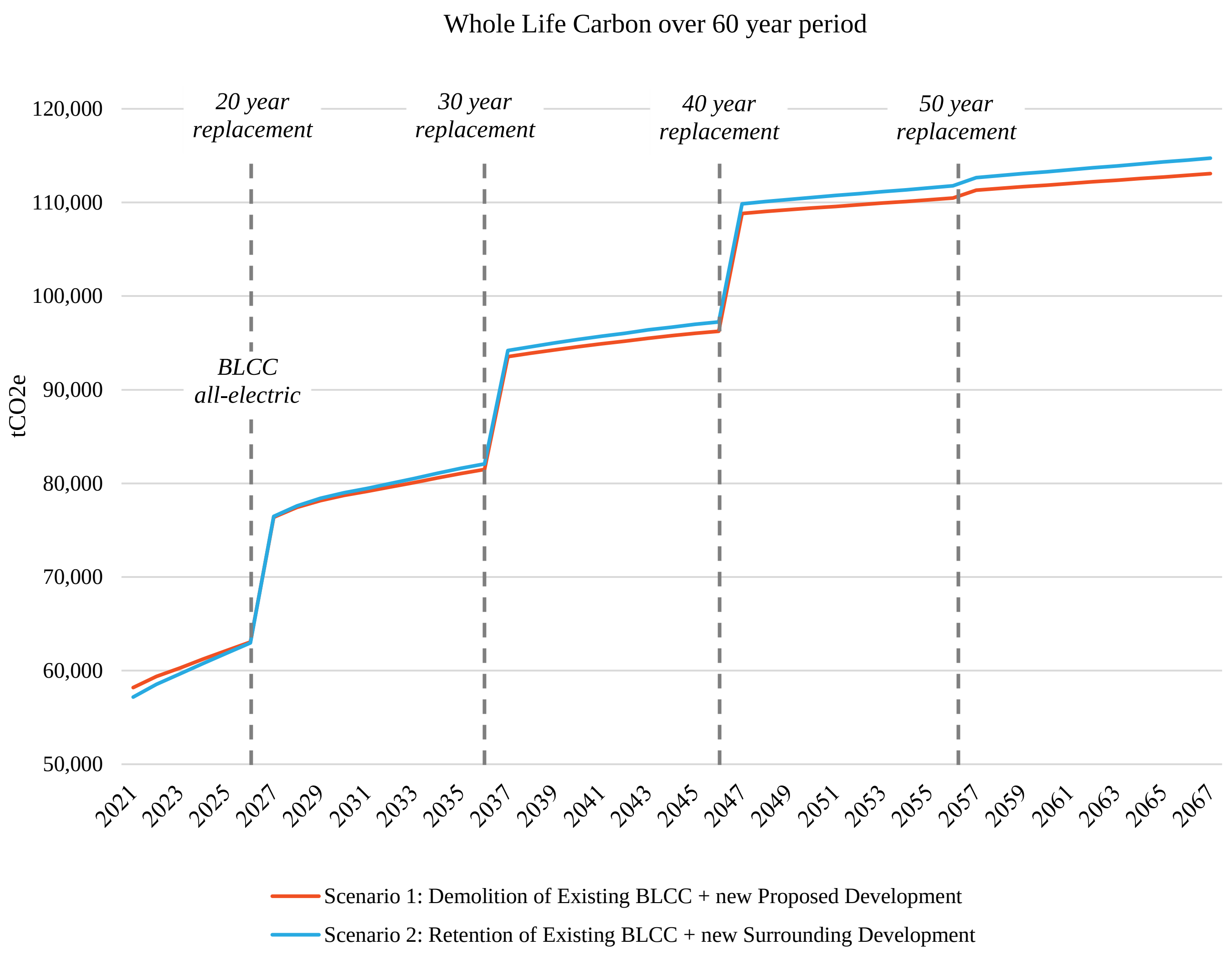


Figure 5 Whole life carbon emissions associated with demolition versus retention of buildings on site

4 Circular economy commitments

4.1 Project commitments

Table 4 details the key project commitments to meeting circular economy principles.

Table 4 - Key commitments

	Site	Sub-structure	Super-structure	Shell / Skin	Services	Space	Stuff	Construction Stuff
	Section A: Conserve resources							
Minimising the quantities of materials used	Under BREEAM Wst 01 a **pre-demolition audit** has been undertaken to identify any reusable materials within the existing buildings, structures or hard surfaces on site, and therefore **maximise opportunities for material recovery.** This scope is for the provision of a pre-demolition audit, and prior to strip out or demolition works. has been specified and will be undertaken to identify any existing buildings, structures or hard surfaces on site, and therefore maximise opportunities for material recovery. Commitment has been made to undertake a **Whole Life Carbon Assessment** for the project at Stage 2 by Arup Sustainability. Using this assessment, opportunities will be taken wherever possible to **minimise embodied and operational carbon** across building life cycle. An **options appraisal** has taken place to quantify the embodied carbon impact of different design options as the project develops.	Material quantities have been reduced in the design through **optimisation of the raft foundations**. Raft depth has been reduced in non-critical locations and piles have been specified for settlement control. This is enhanced in the basement where depth is minimised and only increased where expressly needed. Future opportunities have been explored around the **re-use of existing piles and pile caps on site** from the demolition of the BLCC building. Over-specification of waterproofing has been identified as a potential occurrence therefore strategies have been discussed to prevent this from happening within the new British Library Extension. The adoption of **drained cavity approaches** over wall tanking is being considered and would reduce the quantity of waterproofing specified.	**Post tension concrete has been specified** to reduce the required slab thicknesses. This has a ripple effect as it reduces the building dead load which in turn reduces the demand for more (or larger) transfer structures. The design offsets concrete usage in the building's middle bays with Cross Laminated Timber/ Dowel Laminated **Timber drop-in panels**. This also improves the future flexibility (and therefore material wastage) as slab openings are more easily incorporated by lifting out individual timber panels. The design team has challenged the project brief of design-imposed loads in order to **refine the loading plan**. This requires balancing the impact of increased flexibility in future loading versus the higher material quantities required and related embodied carbon impact of designing for higher loads.	The façade is designed around the use of **standardised elements, repetitive modules and off-site manufacture**. This significantly reduces material wastage. **Interstitial blinds** have been specified to control both glare and solar gain instead of utilising the façade design itself to meet these aims, which would require greater material quantities (and higher embodied carbon). The use of **lightweight facade materials** - principally aluminium and glass reinforced concrete cladding – reduces the building dead load which in turn reduces the demand for more (or larger) transfer structures.	The project brief has been reviewed to ensure servicing requirements are representative and therefore **servicing will be sized appropriately**. Additionally, servicing routes are designed to be as short as possible and modular elements will be used where possible to reduce wastage. There is ongoing consideration into the **possibility of combining systems for the new building with the existing British Library plant** in order to maximise efficiency and reduce the volume of plant equipment required.	Finishes are being specified economically to only the required elements such as soffits. **Exposed services are being considered** meaning there would be no suspended ceilings and therefore significant reduction in materials. The building will be designed to **maximise off site manufacture**. The specification of higher-quality material finishes produced off-site means there is greater opportunity to leave structure exposed, therefore minimising finishing materials.	The project is **considering the re-use or adaptation of existing British Library FF&E**, in particular any equipment from the BLCC building which is being demolished and reconstructed within the scheme. A **modular design for WC blocks** will reduce materials requirements and make use of off-site manufacture.	Under BREEAM Wst 01 a **pre-demolition audit** has been undertaken to identify any existing buildings, structures or hard surfaces on site, and therefore maximise opportunities for material recovery. This scope is for the provision of a pre-refurbishment/ demolition audit, to be carried out pre-planning during RIBA Stage 1, and prior to strip out or demolition works.

	Site	Sub-structure	Super-structure	Shell / Skin	Services	Space	Stuff	Construction Stuff
Minimising the quantities of other resources used (energy, water, land)	This development is being built on a **brownfield site** therefore does not negatively impact open land in the city. There is also significant **densification of site usage** by comparison to the existing arrangement. Besides, the development will host a **variety of uses** that otherwise would have been constructed in different plots of land. **Major transportation infrastructure will be incorporated** into the development meaning a separate building is not required. The project specifies **drought tolerant planting and efficient irrigation systems** to minimise water usage.			The façade will be designed to allow for **natural ventilation wherever possible**, e.g. library level mixed mode and natural ventilation around circulation areas and on upper level commercial floors. This reduces dependency on mechanical systems and also enhances the wellbeing of occupants. Under BREEAM Ene 04 opportunities have been taken to develop **low carbon design and optimise passive strategies** to reduce the total HVAC energy loads in line with analysis, for example the façade systems are designed to be bespoke according to their orientation, therefore ensuring the fabric performs as efficiently as possible.	Under BREEAM Man 04 prior to handover **two user guides will be developed and training provided** so staff are able to facilitate optimal operational energy performance across the building life cycle. Under BREEAM Ene 01, opportunities will be taken to reduce energy use and carbon emissions within the project. A **detailed energy model has been produced** to take into account factors like occupancy, weather scenarios and management of building services, which will enable the design team to predict the expected energy performance and take appropriate actions to **reduce any performance gap post occupation.**	**Quantifying the embodied carbon of internal finishes** (notably floor coverings) will be used to inform their selection. Embodied carbon data will be compared against the material life span to ensure the most optimal choices are made. Daylighting studies will be undertaken to **maximise natural lighting opportunities** for internal spaces, and therefore reduce artificial lighting demand.	**Water efficient sanitaryware** will be specified throughout the new development.	Under BREEAM Man 03 the principal contractor will commit to **monitor construction site impacts** including energy use, water consumption and transportation data. Targets will be set for site energy consumption and site potable water consumption. Under BREEAM Man 04 the principal contractor will undertake a properly planned **handover and commissioning process** at post-construction to quality-assure the integrity of the building fabric and **correct any defects** such as air leakage or discontinuity of insulation.
Specifying and sourcing materials responsibly and sustainably	Under BREEAM Mat 03 a **sustainable procurement plan** will be developed for the project to guide specification towards sustainable construction products prior to concept design. The landscape architects will investigate opportunities to **re-use material from the BLCC in the new landscaping**.	Under BREEAM Wst 02 the project aims to specify more **sustainably sourced aggregates** and maximise the cement substitution of concrete mixes. Efforts will be made to **specify recycled aggregate as appropriate**.	Under BREEAM Wst 02 the project aims to specify more **sustainably sourced aggregates** and maximise the cement substitution of concrete mixes. The project will **ensure the longevity of specified components** (>20-30 years).	The project aims to specify **aluminium with a high recycled content**, particularly in acknowledgement of the high embodied carbon impact of this material. Discussions will take place to determine whether **bricks from the demolished BLCC can be reclaimed** and used within the new proposal.	The project aims to work with manufacturers that provide **Environmental Product Declarations** and product warranty.	**Timber has been selected for internal finishes** on the building's lower levels wherever possible which is considered a more sustainable material than alternatives. All timber will be FSC certified. **Insulation** will be specified according to a **high environmental and performance rating**.	Materials will be specified prioritising a **high recycled content and re-use potential.**	Under BREEAM Mat 03 all timber and timber-based products used during the construction process of the project are **legal and sustainable timber.**

	Site	Sub-structure	Super-structure	Shell / Skin	Services	Space	Stuff	Construction Stuff
	Section B: Design to eliminate waste (and for ease of maintenance)							
Designing for reusability / recoverability / longevity / adaptability / flexibility	Under BREEAM Wst 05 a **Climate Change Adaptation Strategy** appraisal will be undertaken to **maximise building longevity**. Recommendations from the study will be integrated into the design.	Under BREEAM Wst 06 a **Functional Adaptation Strategy** will be undertaken by the end of concept design to explore, and give recommendations on, the ease of disassembly and functional adaptation of different design scenarios. The **basement raft foundation design acts as an alternative to deep piling thereby creating much greater flexibility** for Cross Rail 2 infrastructure. A long life loose fit approach has been taken in the **design of column free spaces** which allow for future flexibility.	The **external stair cores are modular** in their design, therefore can be disassembled to allow for future re-use. This also allows for the replacement of individual elements where wear and tear has occurred. Cross Laminated Timber/ Dowel Laminated **Timber drop-in panels can be re-used** or alternatively are a lower carbon incineration option. The drop-in panels also improve the future flexibility as **slab openings are easily incorporated** by lifting out panels.	**Durable finishes will be specified** that will increase the service life of the façade, for example **anodizing to make the skin corrosion resistant**. Ensure longevity of components (>20-30 years). The project intends to **avoid frit coverage as this limits opportunity to recycle** the glazing at the end of life or replacement period. The **flexible shell design on upper levels** can accommodate offices or life sciences, with minimal upgrades required. This provides future flexibility for different spatial and building uses.	**Ease of maintenance** will be a strong consideration in the project's servicing strategy, **particularly the transfer deck.** An **Operations and Maintenance (O&M) program** will be produced, and records kept across the building life cycle to increase longevity. The building will take a **long life loose fit approach**. Post tension concrete flat slabs efficiently provide flat soffits which enable greater flexibility of servicing / fit-out.	Under BREEAM Mat 05 strategies have been put in place to **reduce risk of building deterioration** and maintenance requirements. **Flexible, open floor plates on commercial levels** on an efficient grid have been designed to allow for varying future uses. The design proposes a physical extension to existing library using the **same floor levels to ensure longevity of use** and connection with the existing Grade I Listed building. A long life loose fit approach has been taken in the **design of column free spaces** which allow for future flexibility.		**Detailed design records will be taken** from the process in order to inform future designers.
Designing out construction, demolition, excavation, industrial and municipal waste arisings	Under BREEAM Wst 01 a **pre-demolition audit** has been undertaken to identify any existing buildings, structures or hard surfaces on site, and therefore maximise opportunities for material recovery. The landscape architects will investigate opportunities to re-use material from the BLCC in the new landscaping, e.g. **Reuse of bricks for the Community Garden pavement**. BLCC bricks may be reused as a subbase for landscape pending further input from the structural engineer.	Opportunities will be explored as the design progresses on how to **make use of excavated materials from the site**, for example clay from the ground, or demolition material from the existing buildings could be used as hardcore in the new building, etc.	The use of **timber secondary structure at transfer level** in the design to the BLCC and atrium roof allows for greater material recyclability. The project will aim to **avoid single-use timber formwork** by working with the contractor to select an adequate formwork system.	**Mechanical fixings will allow a full disassembly** of the facade. The façade is designed around the use of **standardised elements, repetitive modules and off-site manufacture**. This significantly reduces material wastage when it comes to demolition / deconstruction.			A **modular design for WC blocks** will reduce material wastage by making use of off-site manufacture.	Under BREEAM Wst 01 a **Resource Management Plan** will be prepared covering non-hazardous waste materials and data on waste arisings and waste management routes, allowing targets to be set for the project. Targeting **80% Construction, Demolition and Excavation waste to be recycled** as aggregates Construction waste generation: **Max 6.5 t / 100 m^2 GIA**

	Site	Sub-structure	Super-structure	Shell / Skin	Services	Space	Stuff	Construction Stuff
	Section C: Manage waste							
Demolition waste (how waste from demolition of the layers will be managed)	Under BREEAM Wst 01 a **pre-demolition audit** has been undertaken to identify any existing buildings, structures or hard surfaces on site, and therefore maximise opportunities for material recovery.		There is opportunity to **adopt simple, repeated bolted steel elements for external stairs** supplied from EAF which would reduce the project embodied carbon and enable greater recyclability.					
Excavation waste (how waste from excavation will be managed)	This project is targeting **95% of non-hazardous construction, demolition and excavation waste to be recycled.**		N/A	N/A	N/A	N/A	N/A	
Construction waste (how waste arising from construction of the layers will be reused or recycled)	The project is targeting **95% diversion of construction waste from landfill**.			The **façade is designed around the use of standardised elements, repetitive modules and off-site manufacture**. This significantly reduces material wastage.			N/A	Under BREEAM Man 03 the principal contractor will be requested to commit to **monitor construction site impacts** including energy use, water consumption and transportation data. Targets will be set for site energy consumption and site potable water consumption.
Municipal and industrial waste (how the design will support operational waste management)	Under BREEAM Wst 03 guidance **a dedicated space will be provided for the segregation and storage of operational recyclable waste generated**. Waste strategy and waste management is being built into the project Logistics from concept design stage.	N/A	N/A	N/A		The **design will establish recycling loop systems and provision of collection facilities**, including paper, food, lights and batteries.		**Offsite consolidation of waste** is under consideration.

Table 5 summarises the key project commitments to meeting circular economy principles and details the challenges to implementation.

Table 5 Summary of key commitments

	Summary	Challenges	Counter-Actions + Plan to prove and quantify
	Section A: Conserve resources		
Minimising the quantities of materials used	In order to minimise the quantities of materials used a site-wide pre-demolition audit has been undertaken and adhered to so that all recovery opportunities are taken. Material quantities will be reduced wherever practicable through lean design principles and off-site manufacture. High-quality materials specification will increase opportunities to express the building structure and reduce finishing layers.	Specification of high-quality, bespoke-finish materials comes with higher initial capital costs then specifying materials without the quality finish, which may pose a challenge to the design.	The contractor should ensure that value-engineering is not solely driven by the lowest capital cost. This is particularly relevant in this case given that the approach being considered is to select higher-quality material finishes with an exposed servicing strategy, which will ultimately reduce the quantities of finishing materials required in the project. BREEAM Wst 01 – Pre-demolition audit A pre-demolition audit has been undertaken to identify existing buildings, structures or hard surfaces on site, and therefore maximise opportunities for material recovery.
Minimising the quantities of other resources used (energy, water, land)	In order to minimise the quantities of other resources used (energy, water, land) an energy model has been produced for the building to explore low carbon options. The project aims to maximise opportunities for passive heating, lighting, cooling and ventilation. A whole life carbon assessment and options appraisal will be undertaken and handover and commissioning will take place at project completion.	The main challenge will be ensuring appropriate actions take place at post-construction stage to ensure the handover and commissioning takes place effectively, and also to ensure the building performs as per the predictions from the energy model.	Handover and commissioning must be planned prior to completion to ensure relevant parties are informed of their responsibilities. Post-occupancy evaluation must take place to understand any key divergence of the real building performance compared to the predicted energy model. Steps should be taken to correct any issues as soon as practicable. BREEAM Wat 01 – Water consumption This credit seeks to reduce the consumption of potable water for sanitary use in new buildings through the use of water efficient components and water recycling systems. Strategies should be demonstrated to meet this credit. BREEAM Man 03 - Responsible construction practices The principal contractor has committed to monitor construction site impacts including energy use, water consumption and transportation data, and targets have been set. BREEAM Man 04 - Commissioning and handover Prior to handover two user guides will be developed and training provided so staff are able to facilitate optimal operational energy performance across the building lifecycle. Handover and commissioning must be planned prior to completion to ensure relevant parties are informed of their responsibilities.
Specifying and sourcing materials responsibly and sustainably	In order to specify and source materials responsibly and sustainably a sustainable procurement plan will be produced to guide the material selection. Sustainably sourced materials with high recycled content and re-use potential will be specified wherever practicable, and Environmental Product Declarations will be sought as often as possible.	Potential for supply delays or constrained options through specifying higher recycled content in materials. This may lead to increased costs. EPDs can also be difficult to source.	Ensure recycled content materials are specified as early as possible in the process to allow time for effective sourcing. The contractor must proactively seek EPDs and work with manufacturers who have a track record of providing this information. BREEAM Mat 03 – Sustainable procurement A sustainable procurement plan will be developed for the project to guide specification towards sustainable construction products prior to concept design. Implementation of the responsible sourcing strategy must take place before Stage 2. BREEAM Mat 03 - Legal and sustainable timber All timber and timber-based products used during the construction process of the project should be demonstrated as legal and sustainable timber. BREEAM Wst 02 – Use of recycled and sustainably sourced aggregates

			The project has specified more sustainably sourced aggregates and will encourage reuse where appropriate and avoid waste/pollution arising from disposal of demolition and other forms of waste.
	Section B: Design to eliminate waste (and for ease of maintenance)		
Designing for reusability / recoverability / longevity / adaptability / flexibility	In order to design for reusability / recoverability / longevity / adaptability / flexibility, the project will select standardised of components wherever possible to reduce wastage. A long life, loose fit approach will be taken throughout the design process, with consideration of future alternative uses accounted for through provision of open space and column free interiors.	The challenge in designing for flexibility will be communication and collaboration between all disciplines in the design team to ensure targets are definitely met.	Communication on specific flexibility targets is essential throughout the design stage. It would be useful if this were led by the architect or alternatively the sustainability consultant to keep all parties engaged and knowledgeable about the strategy e.g. if a space is being considered for alternative uses, what MEP systems will need to be provided? BREEAM Mat 05 - Designing for durability and resilience Strategies have been put in place to reduce risk of building deterioration and maintenance e.g. use of robust back of house materials to increase longevity. BREEAM Wst06 – Design for disassembly and adaptability A Functional Adaptation Strategy will be undertaken by the end of concept design to explore, and give recommendations on, the ease of disassembly and functional adaptation of different design scenarios. BREEAM Wst 05 - Adaptation to climate change A Climate Change Adaptation Strategy appraisal will be undertaken, and strategies implemented, to maximise building longevity.
Designing out construction, demolition, excavation, industrial and municipal waste arisings	In order to design out construction, demolition, excavation, industrial and municipal waste arisings the project is targeting 80% construction, demolition and excavation waste to be recycled as aggregates and construction waste generation to be max 6.5 t/100m2GIA. A Resource Management Plan will be prepared to guide the process.	The major challenge here will be effective monitoring and data collection on the waste production at all stages of the build.	The Resource Management Plan should be followed as a guide throughout the building construction stage and the contractor should ensure this is well-circulated to all involved parties to ensure it is complied with. BREEAM Wst 01 - Construction waste management A Resource Management Plan will be prepared covering non-hazardous waste materials and data on waste arisings and waste management routes. BREEAM Mat 06 - Material efficiency Targets will be set to optimise the use of materials e.g. positioning of the basement wall line to limit demolition of existing wall, piles and foundation. BREEAM Wst 03 - Operational waste A dedicated space will be provided for the segregation and storage of operational recyclable waste generated. Dedicated waste spaces for the office & retail units, big enough for general waste, recyclables & food waste will be provided.
	Section C: Manage waste		
Demolition waste (how waste from demolition of the layers will be managed)	In order to manage waste from demolition of the layers a pre-demolition audit has been specified. Opportunities will be identified wherever possible to adopt standardised and/or repeated elements to enable greater recyclability.	The challenge here will be effective monitoring and data collection to ensure the waste project targets for demolition, construction and excavation are met and followed through according to plan.	The contractor should ensure all on site are aware of the demolition waste targets prior to starting on site. BREEAM Wst 01 – Pre-demolition audit A pre-demolition audit has been undertaken to ensure recovery of as much demolition material as possible.

Excavation waste (how waste from excavation will be managed)	In order to manage waste from excavation this project targets 95% of non-hazardous construction, demolition and excavation waste to be recycled.		The contractor should ensure all on site are aware of the excavation waste targets prior to starting on site. Reporting obligations on contractors will be included for all waste.
Construction waste (how waste arising from construction of the layers will be reused or recycled)	In order to manage the reuse and recycling of waste arising from construction of the layers the façade is designed around the use of standardised elements, repetitive modules and off-site manufacture. This significantly reduces material wastage during construction. The principal contractor has also committed to monitoring construction site impacts and setting appropriate targets e.g. the project is targeting 95% diversion of waste from landfill.		The contractor should ensure all on site are aware of the construction waste targets and construction waste management plan prior to starting on site. BREEAM Man 03 - Responsible construction practices The principal contractor is committed to monitor construction site impacts including energy use, water consumption and transportation data.
Municipal and industrial waste (how the design will support operational waste management)	The design will support operational waste management through provision of dedicated space for the segregation and storage of operational recyclable waste. The waste strategy and management are being built into the project Logistics from concept design stage.	The challenge will be ensuring at post-occupancy stage that the strategies put in place and facilities provided are effectively utilised by occupants.	Handover and commissioning must be planned prior to completion to ensure occupants and building operation managers are informed of their responsibilities and are able to make best use of the recycling facilities provided. BREEAM Wst 03 – Operational Waste Under BREEAM Wst 03 a dedicated space has been provided for the segregation and storage of operational recyclable waste generated. Dedicated waste spaces for the office & retail units, big enough for general waste, recyclables & food waste segregation.

4.2 Bill of materials

Opportunities have been considered to conserve resources by applying lean design principles and by sourcing materials sustainably. Table 6 is a Bill of Materials for the project which estimates the quantity of materials in each building layer.

Table 6 - Bill of materials

Layer	Element/Material	Material quantity (kg)	Material intensity (kg/m^2 GIA)	Recycled content (% by value)	Source of information
Substructure	Concrete	65,294,400 kg	729.95	No final product specifications have yet been made. Performance against this target will be tracked when it is possible to do so. At present, the project is aiming for the following: • High levels of GGBS content in all concrete elements (40% GGBS or higher) • Recycled content in aluminium façade elements (20% recycled content or higher) • Minimum 20% of materials (by value) should be identified for re-use or recycling, as per GLA circular economy guidance	All materials weight information is sourced from the RICS-scope LCA model (which is based on material quantities various sources including the Stage 2 cost plan and quantities agreed with the project team), created using OneClick LCA's GLA tool.
	Reinforcement	4,134,500 kg	46.22		
Superstructure: Frame	Carbon steel reinforcing bar	1,942,090 kg	21.71		
	Steel Decking	48,804 kg	0.55		
	Glue laminated timber	82,569 kg	0.92		
	Formwork	83,700 kg	0.94		
	Concrete	25,128,000 kg	280.91		
	Reinforcement	3,660,000 kg	40.92		
	Timber Panels	445,000 kg	4.97		
	Steel	1,200,000 kg	13.42		
Superstructure: Upper Floors	Concrete	65,520,000 kg	732.47		
	Reinforcement	1,901,375 kg	21.26		
Superstructure: Roof	Concrete	6,183,360 kg	69.13		
	Reinforcement	101,138 kg	1.13		
	Aluminium frame	38,598 kg	0.43		
	Rockwool Insulation	5,702 kg	0.06		
	Glasswool Insulation	13,490 kg	0.15		
	Steel Decking	813 kg	0.01		
	Waterproofing	31,976 kg	0.36		
	Concrete paving	1,587,060 kg	17.74		
	Polypropolene Membrane	3,527 kg	0.04		
Superstructure: Stairs and Ramps	Concrete	482,400 kg	5.39		
	Reinforcement	20,110 kg	0.22		
Superstructure: External Walls	Concrete	6,960,000 kg	77.81		
	Rockwool Insulation	145,706 kg	1.63		

	Gypsum Plasterboard	52,113 kg	0.58		
	Masonry Mortar	76,200 kg	0.85		
	Curtain Wall	2,295 kg	0.03		
	Aluminium profile	440,910 kg	4.93		
	Binds	55,406 kg	0.62		
	Powder Coated Aluminium	5,050 kg	0.06		
	Wall Mortar	5,334 kg	0.06		
	Aluminium Frame	277,354 kg	3.10		
External works	Sand	320,842 kg	3.59		
	Paving Stone	755,136 kg	8.44		
	Asphalt	75,200 kg	0.84		

4.3 Recycling and waste

The pre-demolition audit results have been used to quantify how much waste the demolition is expected to generate. Construction waste targets are to be included in the contractor tender and a Resource Management Plan will be developed by an appointed contractor before commencement of construction. Quantities are in line with any targets specified in the London Plan, therefore supporting the move to zero biodegradable or recyclable waste to landfill by 2026, and also exceeding targets of 95% re-use/recycling/recovery of construction, demolition and excavation waste.

Table 7 - Recycling and waste metrics

Category	Total Estimate	Of which…				Source of information
	t/m^2 GIA	% reused / recycled onsite	% reused / recycled offsite	% not reused or recycled (max 5%)		
				% to landfill	% to other management (e.g. incineration)	
Excavation waste	TBC upon contractor's appointment	> 95 % beneficial use		< 5 %		TBC upon contractor's appointment London Plan 2021 (95% target)
				< 5 %	< 5 %	
Demolition waste	0.048	8.2 %	91.8 %	0 - 2 %		Keltbray Pre-Demolition Audit 03/08/21
				0 %	0 - 2 %	
Construction waste	Total target ≤ 0.012	> 95 %		< 5 %		BREEAM Wst 01 Targeting 1 credit London Plan 2021 (95% target)
				< 5 %	< 5 %	
	(m^3) / annum	% reused on or off site	% recycled or composted, on or off site	% not reused or recycled		
				% to landfill	% to other management (e.g. incineration)	
Municipal waste	24,358 m^3 / annum	Maximum 74.8 % recycled Maximum 0.8 % food waste composted		**Max 35% and no recyclable or compostable waste**		Arup Delivery & Servicing Management Plan - Draft 4 18/08/21
				Minimum 24.4 % to landfill / incineration		
Industrial waste (if applicable)	N/A	N/A	N/A	**Max 35% and no recyclable or compostable waste**		N/A
				N/A	N/A	

A letter confirming there is landfill capacity to accept waste from the Proposed Development can be found in Appendix B.

4.4 Operational Waste

The design of the Proposed Development will support operational waste management through provision of dedicated space for the segregation and storage of operational recyclable waste. The waste strategy and management are being built into the project Logistics from concept design stage and follow the waste hierarchy.

The waste management strategy has been developed in accordance with LBC guidance and BS 5906:2005 Waste management in buildings – a code of practice.

The Proposed Development will have dedicated storage facilities sized to accommodate two days' worth of British Library, including the ATI, waste.

Primary waste streams (residual, paper, cardboard, comingled plastic and aluminium, glass and food waste) will be collected daily, with specialist waste streams collected less frequently. The British Library waste room will contain a 1,100L in-bin compactor for residual waste, and a twin baler for cardboard and paper. Bulky waste from the British Library, such as wood, metal and general waste will be stored in a waste skip behind one of the maintenance bays.

Commercial, including lab-enabled floorspace, and retail waste will be stored and collected together. The commercial waste rooms have been sized for two days' worth of waste storage however collections are to be undertaken daily. Commercial tenants will segregate residual, paper, cardboard, plastic, aluminium, glass and food waste individually and take them to the service yard. The commercial waste room will contain a 1,100L in-bin compactor for residual waste, and a twin baler for cardboard and surplus paper (the commercial tenants will have a $10m^3$ compactor, located in the service yard behind one of the maintenance bays, for paper waste; the twin baler will only be used for surplus paper that is not able to be stored in the compactor).

Provision will be made for the storage and handling of WEEE, confidential paper waste, hazardous waste, used cooking oil, batteries, photocopier cartridges, fluorescent tubes and bulbs, sanitary waste and landscaping waste.

The lab-enabled floorspace will generate specialist waste streams which may include chemical waste, solvent waste, clinical waste and radioactive waste, and therefore separate chemical and clinical waste rooms will be provided. The waste stores and compactors will be externally accessible for the refuse collection vehicle. Waste will be collected directly by the appointed commercial waste contractor(s).

Storage will be provided to accommodate two days' waste generation for all primary streams, therefore, missing a single waste collection will not have a detrimental impact on waste storage.

Public areas such as seating, stairways and pathways, will be monitored throughout the day and cleaned by the FM team and general public bins will be emptied as necessary.

4.5 Circular economy narrative

The circular economy ambitions are structured around the nine Circular Economy Principles as defined by the GLA. For each principle the following is proposed:

1.1. Minimise the quantities of materials used

- In order to minimise the quantities of materials used a site-wide pre-demolition audit will be undertaken and adhered to so that all recovery opportunities are taken. Material quantities will be reduced wherever practicable through lean design principles and off-site manufacture. High-quality materials specification will increase opportunities to express the building structure and reduce finishing layers.
- A life cycle carbon assessment will be produced for the building and options appraisal undertaken to identify potential material efficiencies and select materials with a lower environmental impact over the life cycle of the building.
- The contractor should ensure that value-engineering is not solely driven by the lowest capital cost. This is particularly relevant in this case given that the approach being considered is to select higher-quality material finishes with an exposed servicing strategy, which will ultimately reduce the quantities of finishing materials required in the project.
- The following BREEAM credit will demonstrate compliance with the targets above:
    - Wst 01 – Pre-demolition audit
    - Mat 01 – Life Cycle Assessment

1.2. Minimise the quantities of other resources used

- In order to minimise the quantities of other resources used (energy, water, land) an energy model has been produced for the building to explore low carbon options. The project aims to maximise opportunities for passive heating, lighting, cooling and ventilation. A whole life carbon assessment and options appraisal will be undertaken and handover and commissioning will take place at project completion.
- The main challenge will be ensuring appropriate actions take place at post-construction stage to ensure the handover and commissioning takes place effectively, and also to ensure the building performs as per the predictions from the energy model.
- Handover and commissioning must be planned prior to completion to ensure relevant parties are informed of their responsibilities. Post-occupancy evaluation must take place to understand any key divergence of the real building performance compared to the predicted energy model. Steps should be taken to correct any issues as soon as practicable.
- The following BREEAM credits will demonstrate compliance with the targets above:
    - Wat 01 – Water consumption
    - Man 03 - Responsible construction practices
    - Man 04 - Commissioning and handover

1.3. Specify and source materials and other resources responsibly and sustainably

- In order to specify and source materials responsibly and sustainably a sustainable procurement plan will be produced to guide the material selection. Sustainably sourced materials with high recycled content and re-use potential will be specified wherever practicable, and Environmental Product Declarations will be sought as often as possible.

- There is potential for supply delays or constrained options through specifying higher recycled content in materials. This may lead to increased costs. EPDs can also be difficult to source and may require chasing from manufacturers.
- In order to meet these targets materials with high recycled content must be specified as early as possible in the process to allow time for effective sourcing. The contractor must proactively seek EPDs and work with manufacturers who have a track record of providing this information.
- The following BREEAM credits will demonstrate compliance with the targets above:
  - Mat 03 – Sustainable procurement
  - Mat 03 - Legal and sustainable timber
  - Wst 02 – Use of recycled and sustainably sourced aggregates

2.1. Design for longevity, adaptability or flexibility and reusability or recoverability

- In order to design for reusability / recoverability / longevity / adaptability / flexibility, the project will select standardised components wherever possible to reduce wastage. A long life loose fit approach will be taken throughout the design process, with consideration of future alternative uses accounted for through provision of open space and column free interiors.
- The challenge in designing for flexibility will be communication and collaboration between all disciplines in the design team to ensure targets are definitely met.
- Communication on specific flexibility targets is essential throughout the design stage. It would be useful if this were led by the architect or alternatively the sustainability consultant to keep all parties engaged and knowledgeable about the strategy e.g. if a space is being considered for alternative uses, what MEP systems will need to be provided?
- The following BREEAM credits will demonstrate compliance with the targets above:
  - Mat 05 - Designing for durability and resilience
  - Wst 06 – Design for disassembly and adaptability
  - Wst 05 - Adaptation to climate change

2.2. Design out construction, demolition, excavation and municipal waste arising

- In order to design out construction, demolition, excavation, industrial and municipal waste arisings the project is targeting 80% construction, demolition and excavation waste to be recycled as aggregates; and construction waste generation to be max 6.5 t/100m^{2}GIA. A Resource Management Plan will be prepared to guide the process.
- The major challenge here will be effective monitoring and data collection on the waste production at all stages of the build.
- The Resource Management Plan should be followed as a guide throughout the building construction stage and the contractor should ensure this is well-circulated to all involved parties to ensure it is complied with.
- Operational waste arising will be managed in accordance with the waste hierarchy.
- The following BREEAM credits will demonstrate compliance with the targets above:
  - Wst 01 - Construction waste management
  - Mat 06 - Material efficiency
  - Wst 03 - Operational waste

3.1. Manage demolition waste

- In order to manage waste from demolition of the layers a pre-demolition audit has been specified. Opportunities will be identified wherever possible to adopt standardised and/or repeated elements to enable greater recyclability.
- The challenge here will be effective monitoring and data collection to ensure the waste project targets for demolition are met and followed through according to plan.
- The contractor should ensure all on site are aware of the demolition waste targets prior to starting on site.
- The following BREEAM credit will demonstrate compliance with the targets above:
  - Wst 01 – Pre-demolition audit

3.2. Manage excavation waste

- In order to manage waste from excavation this project targets 95% of non-hazardous construction, demolition and excavation waste to be recycled.
- The challenge here will be effective monitoring and data collection to ensure the waste project targets for excavation are met and followed through according to plan.
- The contractor should ensure all on site are aware of the excavation waste targets prior to starting on site.

3.3. Manage construction waste

- In order to manage the reuse and recycling of waste arising from construction of the layers the façade is designed around the use of standardised elements, repetitive modules and off-site manufacture. This significantly reduces material wastage during construction. The principal contractor has also committed to monitoring construction site impacts and setting appropriate targets e.g. the project is targeting 95% diversion of waste from landfill.
- The challenge here will be effective monitoring and data collection to ensure the waste project targets for construction are met and followed through according to plan.
- The contractor should ensure all on site are aware of the construction waste targets and construction waste management plan prior to starting on site.
- The following BREEAM credit will demonstrate compliance with the targets above:
  - Man 03 - Responsible construction practices

3.4. Manage municipal waste

- The design will support operational waste management through provision of dedicated space for the segregation and storage of operational recyclable waste. The waste strategy and management are being built into the project Logistics from concept design stage.
- The challenge will be ensuring at post-occupancy stage that the strategies put in place and facilities provided are effectively utilised by occupants.
- Handover and commissioning must be planned prior to completion to ensure occupants and building operation managers are informed of their responsibilities and are able to make best use of the recycling facilities provided.
- The following BREEAM credit will demonstrate compliance with the targets above:
  - Wst 03 – Operational Waste

4.6 Plans for implementation

The project team will be required to monitor and report on the performance of circular economy measures, including work towards the recycling and re-use targets for biodegradable and recyclable waste, municipal waste, and construction, demolition and excavation waste specified in the London Plan.

During the Developed and Technical Design stages, the design team will review performance against previous stages and London Plan targets. Documentation will be provided to demonstrate the incorporation of outcomes from Concept Design stage and outline any additional actions to be taken.

During construction, the implementation of agreed measures will be monitored and documented. The contractor must also demonstrate additional activities have been undertaken to identify circular economy and waste reduction measures on site. Monitoring in relation to disassembly and functional adaptability of the building will be developed during later stages of design.

A Post Completion Circular Economy Report will be prepared and submitted to Camden Council and the GLA within 2 months of practical completion. The Post Completion Report will set out the predicted and actual performance against all numerical targets, and provide updated versions of Tables within this report, the recycling and waste reporting form, and bill of materials.

4.7 End-of-life strategy

The end-of-life strategy demonstrates how the proposal's design and construction will reduce material demands and enable building materials, components and products to be disassembled and reused at the end of their useful life.

Under BREEAM Wst 06 a Functional Adaptation Strategy will be undertaken at the end of concept design stage to explore, and give recommendations on, the ease of disassembly and functional adaptation of different design scenarios.

Under BREEAM Man 04 prior to handover two user guides will be developed; a non-technical user guide for distribution to the building occupiers, and a technical user guide for the premises facilities managers. Training will also be provided so staff are able to facilitate optimal operational energy performance across the building lifecycle. This should include an overview of the building and its environmental strategy, e.g. energy, water or waste efficiency policy or strategy, and how users should engage with and deliver the policy or strategy. The transfer of information to future building users to facilitate the end-of-life strategy is a key aspect of the building's environmental strategy and whole life-cycle considerations.

In line with the approach for the demolition of existing buildings on site, the eventual demolition and deconstruction of the new build will target the following:

- Diversion of waste from landfill (via reuse, recycling or recovery)
- Demolition and construction waste -95% to reuse, recycling, recovery
- Excavation 95% 'beneficial use'
- Use of efficient demolition equipment

5 Conclusions

The circular economy statement has set out how the development will address all the requirements specified in Policy SI 7 Reducing waste and supporting the circular economy in the GLA's London Plan (2021).

The key waste-related circular economy strategies to be implemented are as follows:

- The project is targeting 80% construction, demolition and excavation waste to be recycled as aggregates and construction waste generation to be max 6.5 t/100m^{2}GIA.
- A Resource Management Plan will be prepared to guide the process.
- A Pre-demolition Audit has been undertaken.
- Opportunities identified should be integrated wherever possible to adopt standardised and/or repeated elements to enable greater recyclability.
- The project is targeting 95% of non-hazardous construction, demolition and excavation waste to be recycled.
- The principal contractor will be required to commit to monitoring construction site impacts and setting appropriate targets
- The design supports operational waste management through provision of dedicated space for the segregation and storage of operational recyclable waste.

The statement demonstrates how the Proposed Development will promote circular economy outcomes and describes how resource conservation, waste reduction, increases in material re-use/ recycling, and reductions in waste going to landfill will be achieved. Actual performance against the targets laid out in this statement will be submitted and recorded at practical completion.

6 Appendices

Appendix A: Pre-demolition audit

Pre-Demolition Audit

British Library

96 Euston Rd, London NW1 2DB

Revision History				
Document No.	Revision No.	Issue Date	Author	Description of Modifications
KBY_PDA_BritishLibrary_001	00	03/08/21	G. Neal	First Issue

	Print Name	Position	Signature	Issued to:
Author	Gemma Neal	Environmental Advisor		Environmental Manager
Checked by	Kiro Tamer	Environmental Manager		Contracts Manager
Approved by	Thomas Blake	Contracts Manager		Client

Contents

1. Introduction

1.1 Objectives

Keltbray Limited has produced this pre-demolition document for the proposed development to take place at British Library with the aim to identify and assist in maximising resource recovery by ensuring that the maximum potential for reuse, recycling and recovery is considered and planned at early stages. This Report has been carried out during Concepts design (Stage 2) and prior to any strip out having taken place.

It is considered that this phase of the project is a very important part of the whole development and it is essential that all involved contractors in the project delivery fully understand the impacts of waste generated and contribute on targeting high rates of waste re-use, recycling and diversion from landfill.

The British Library is the national library of the United Kingdom and is one of the largest libraries in the world. It is estimated to contain between 170 and 200 million items from many countries. As a legal deposit library, the British Library receives copies of all books produced in the United Kingdom and Ireland, including a significant proportion of overseas titles distributed in the UK. The Library is a non-departmental public body sponsored by the Department for Digital, Culture, Media and Sport.

The British Library Centre for Conservation was built 14 Years ago by Sir Robert McAlpine

Structure of the building broadly consists of

- 3 Storey steel frame consisting of LG, G, 1st & Roof with large steel beams supporting terrace
- Reinforced concrete slabs (poured insitu floors & precast planks for roof support)
- External walls are Insulated Metsec with facing fletton brick
- Apexes at roof level are zinc & glass
- 2nr reinforced concrete stair cores (fire escapes)
- Block walls separate the plant rooms

The project will be registered under BREEAM and is targeting BREEAM ‘Outstanding’ this audit has been completed in accordance with BREEAM requirements by a competent person, as defined by the scheme. In order to achieve exemplary level credits or similar scoring systems, a target of 90% or higher (95% if demolition waste) of the tonnage of waste produced during the demolition phases is to be diverted from landfill.

A range of sustainability measures need to be implemented by the contractor in the proposed development including:

- Plant and equipment salvage - The specification of the equipment and plant to be removed from site needs to be checked and evaluated for compliance with legal requirements so they can be reused in another project;
- Waste - Encourage and assist the project delivery team to reduce, reuse, recycle on site/off-site all non-hazardous waste
- All sustainability measured KPI’s will be logged, recorded and communicated at regular intervals using dedicated SMARTWaste management tool

The project delivery team will set waste stream targets based on industry guidance and codes of practice. During the demolition phase, the contractor will carry out continuous record keeping in relation to waste management and waste disposal from site. This will be compared on a monthly basis with the previous period and a report form will be communicated to all stakeholders

The pre-demolition waste audit report not only identifies the quantities and types of waste arising from the project, but also outlines potentials for to maximising reuse off or on-site.

2. Pre-Commencement Site Audit

A Pre-Commencement site audit was carried out at the British Library. A site visit by Gemma Neal, Milena Santoro Environmental Advisors and Tom Blake, Project Manager for Keltbray was conducted on 03rd August 2021.

The audit findings were combined with "Desktop-Study" data available. An initial meeting was conducted with client and information on the building was shared prior to the site visit being conducted. For the production of the report joint knowledge and experience in the demolition industry and sustainability field was applied for making recommendations of expected waste arisings and options for the reuse and recycling of different waste streams.

The pre-demolition waste audit findings will need to be incorporated in the project Site Waste Management Plan. Waste reuse and removal quantities as well as site deliveries throughout the duration of the project will be recorded and reported as per BREEAM requirements using the SMARTWaste software.

Approximate quantities of the waste material have been estimated with the likely quantities and areas for possible re-use and recycling, see Appendix 1.

2.1 Key Materials

The pre-demolition audits contained within Appendix 1 have identified the key materials that will arise as a result of demolition and associated works on site. Key materials identified include; Key materials identified include; concrete, hardcore, tiles and ceramics, metals, timber, gypsum (plasterboard), plastic and glass, for which the most suitable waste management options have been determined in order to maximise the recovery of each of the materials.

Pre-demolition and demolition audit material	Key Waste Group (BREEAM)	Potential Waste Management Options Identified
Concrete / screed	Concrete (17 01 01)	WC's and sinks in good condition could be repurposed. Crushed inert material could be repurposed and reused onsite in the future redevelopment or offsite. **Recycled Material Supplies,** E16 2AX, Licence KB3136AM **SRC Aggregates**, RM9 6RJ, Licence HB3109CX **Powerday Brixton**, SW9 7DT, Licence JB3637RK
Blockwork, Ballast, glazed brickwork	Hardcore (17 01 07)	
Toilet and sink, tiles, urinals, roof tiles	Tiles and ceramics (17 01 03)	

Pre-demolition and demolition audit material	Key Waste Group (BREEAM)	Potential Waste Management Options Identified
		Westminster Waste, SE16 3DH, Licence EB3338AX
Steel / Handrail / SS Sinks / Radiators / Lift Doors / Server Racks / flag poles / corrugated cladding / railings / Raised computer flooring / skirting / ceiling tiles	Metals (17 04)	Sinks in good condition could be repurposed. Radiators were generally not modern and would be suitable for recycling. **EMR Canningtown**, E16 4SZ, Licence: QP3796NY
Plaster / Plasterboard	Gypsum (17 08 02)	If non-haz classification - offsite recycling options for vinyl flooring via manufacturers should be explored for closed loop recycling **Powerday Brixton**, SW9 7DT, Licence JB3637RK **Westminster Waste**, SE16 3DH, Licence EB3338AX
Vinyl / plastic flooring	Plastic (17 02 03), Plastic haz (17 02 04*)	
Timber / cupboards / doors / parquet flooring / partitions / service risers / skirting / window sills	Timber (17 02 01)	
Blinds	Plastic (17 02 03), Textiles (20 01 11)	
Water Storage tanks	Plastic (17 02 03)	
Glass partitions / in doors	Glass (17 02 02)	
WC cubicle	Timber (17 02 01), Plastic (17 02 03)	
Carpet / underlay	Floor coverings (soft) (20 01 11)	Carpet tiles in good condition could be used on other projects / given to charities or local groups **Powerday Brixton**, SW9 7DT, Licence JB3637RK **Westminster Waste**, SE16 3DH, Licence EB3338AX
Jute Acoustic Panelling	Textiles (20 01 11)	**Westminster Waste**, SE16 3DH, Licence EB3338AX
Windows / secondary glazing	Glass (17 02 02), Metals (17 04), Timber (17 02 01)	**Powerday Brixton**, SW9 7DT, Licence JB3637RK **Westminster Waste**, SE16 3DH, Licence EB3338AX **EMR Canningtown**, E16 4SZ, Licence: QP3796NY
M&E, ducting	Metals (17 04), Plastic (17 02 03), Cables (17 04 11)	
Suspended Ceiling	Metals (17 04), Ceiling tiles	
Lights	Fluorescent tubes (20 01 21*)	**Boiler and Plant Dismantlers Ltd**, Nazeing Essex, EN9 2RJ **Envirowaste,** Leyton Industrial Village, Argall Avenue, London, E10 7QP

Pre-demolition and demolition audit material	Key Waste Group (BREEAM)	Potential Waste Management Options Identified
AC (Air Con) unit	Electrical ad electronic equipment (16 02, 16 02 11*)	Some modern AC in good condition could be repurposed **Boiler and Plant Dismantlers Ltd**, Nazeing Essex, EN9 2RJ
Furniture and kitchen appliances	Furniture (20 03 07), Metals (17 04), Timber (17 02 01), Discarded equipment (16 02 14)	Some furniture and appliances in good condition could be repurposed or donated to local charities such as Emmaus or British Heart Foundation. **Envirowaste,** Leyton Industrial Village, Argall Avenue, London, E10 7QP **Powerday Brixton**, SW9 7DT, Licence JB3637RK
Insulation	Insulation Materials (17 06 04)	**Powerday Brixton**, SW9 7DT, Licence JB3637RK **Westminster Waste**, SE16 3DH, Licence EB3338AX
Various redundant plant and equipment	Discarded equipment and machinery (16 02)	Various plant and equipment not generally cost beneficial to be salvaged. **Boiler and Plant Dismantlers Ltd**, Nazeing Essex, EN9 2RJ

2.2 Findings and Recording

Audit findings are outlined in Appendix 1.

Site Waste Management

- Contractor will provide evidence to demonstrate that the majority of non-hazardous waste generated by site activities will be reused and recycled.
- Contractor will provide evidence that the majority of waste generated on site is reused / recycled where practicable.
- A dedicated area will be provided for the storage of recyclable waste streams.
- The project records will be updated regularly (weekly/monthly basis) to identify the waste streams and the amounts of waste to date.
- Display boards will be used on site to communicate to all personnel the environmental records and to date environmental progress.

Development and implementation of a good practice SWMP will address some of the key constraints associated with the reuse and recycling of materials early in the project stages. Factors to consider include constraints around the demand for the recycled materials, programme timescales allowing for good practice to be implemented and physical constraints of the operational site size which may limit the processing and segregation capability onsite. Setting targets and monitoring progress is therefore essential as this will help to promote recovery of waste.

As stated in the waste hierarchy, prevention is the primary measure for reducing waste and materials for re-use or recycling on site will be subject to the relevant guidance and legislation. Items that hold a high recycling potential and have been identified as key materials make up at least 94% of the waste and include: metal ceiling grids; concrete from screed removal; wood from skirting and various types of doors; brickwork and plasterboard. Some items including existing backup generators and plant will be salvaged

Other items in good condition such as sinks, WC's and carpet could be sent offsite to be re-used, or otherwise recycled.

Some furniture, appliances and carpet in good condition could be reused on other projects or offered to local charities such as Emmaus or British Heart Foundation. Marketplaces such as Globechain also allow listing of unwanted items. If not suitable or there is no demand for such items then they can be reused or recycled through a waste management firm such as Envirowaste Ltd.

It is not thought that there is enough space for onsite processing of inert material without significant programme impacts. Therefore good quality inert material could be taken offsite for reuse on nearby projects or onward recycling for the industry in London, with Recycled Material Suppliers (RMS) and SRC Aggregates both named as potential waste contractors for aggregate processing.

Air conditioning units and any refrigerant contained within can be sent for reuse offsite where possible or disposal in compliance with EU regulations.

Once onsite applications for material arisings from site have been exhausted the London Waste Map is a useful tool to identify suitable waste contractors local to the project, with the view to also keep resources localised in London: https://apps.london.gov.uk/waste/

For the purposes of this pre-demolition audit waste contractors have been suggested for the key materials identified to maximise recycling in line with the waste hierarchy, with onsite segregation also key to achieving this. Selection of local waste management contractors has also been considered, to reduce distance travelled and associated carbon emissions for the development's waste removal and to support overall sustainability.

Powerday PLC and Westminster Waste Ltd that assure zero waste to landfill have been named as options for most non-metallic and non-hazardous waste identified as key materials and European Metal Recycling Ltd suggested for recycling of metallic waste. These waste management contractors all have waste facilities located with good access to the project.

Envirowaste Ltd recycle a variety of wastes including furniture, white goods, fluorescent lights and WEEE wastes and strive to either reuse or recycle these wastes in the most ethical and sustainable way possible.

Boiler and Plant Dismantlers Ltd, who specialise in the decommissioning, recovery, transportation and disposal of hazardous and controlled waste, have been highlighted as an option for the recovery of fluorescent lights, AC units and redundant plant and equipment.

The fire doors will be recyclable unless they contain asbestos, in which case any asbestos material identified is 'hazardous' waste and as such will be disposed of in an appropriately licenced landfill facility authorised to take the waste.

No asbestos register / survey or COSHH inventory was available for the purposes of this pre-demolition audit. A full R&D asbestos survey will be required to identify all asbestos in the building to allow appropriate removal and management. Building been up since 2007 so is thought to contain no asbestos

A COSHH register (if available) will inform the contractor of the hazardous materials to manage throughout the building. If no COSHH register is available any such items will need to be tested and classified prior to removal offsite, which will also determine the most appropriate waste management route.

Waste classification testing will confirm the correct EWC Code to apply to each type of waste streams identified before removal for site and confirm the appropriate waste management route for the waste. For wood waste specifically, at least one sample for each type of wood waste i.e. doors, floors, service risers, windows and handrails should be taken to determine the 'Grade' of waste wood and appropriate recycling options in line with Environment Agency Waste Wood Guidance. The vinyl flooring and insulation material will also need to be tested to determine make up of these materials and the correct EWC Codes to apply.

Insulation materials from demolition are usually hard to recycle due to contamination as well as being of low value, lack of end markets and appropriate recycling facilities. To confirm correct waste management route, testing will be necessary to determine whether the insulation contains Hexabromocyclododecane (referred to as HBCDD or HBCD) a brominated flame retardant. Any waste containing HBCD must be destroyed and can no longer be landfilled, re-used or recycled.

Vinyl flooring can be recycled by take-back schemes via manufacturer for closed loop recycling however as recyclability is dependent on key factors such as the condition, colour and any contamination it is likely that recovery will be the most appropriate waste management route. Some vinyl floor coverings contain polyvinylchloride (PVC) and so can be hazardous, appropriate testing will determine this.

3. Summary

The pre-demolition and demolition audit has identified that a number of items including brick, acoustic boarding, carpet, porcelain sinks and WC's which could be salvaged if in good enough condition for reuse on or offsite in other projects.

Items that hold a high recycling potential and have been identified as key materials include: hardcore, tiles and ceramics, metals, timber, gypsum (plasterboard), plastic and glass. Potential waste contractors for these key materials have been identified to maximise their recycling potential.

It is anticipated that over 98% of waste can be diverted from landfill for the demolition works at the British Library project with the aim of achieving zero non-hazardous waste to landfill and exemplary level BREEAM credits. Selection of waste management contractors and segregation of waste will be an important factor to achieving this to separate key materials for potential recycling, salvage and re-use.

Appendixes

Appendix 1 – Audit Findings

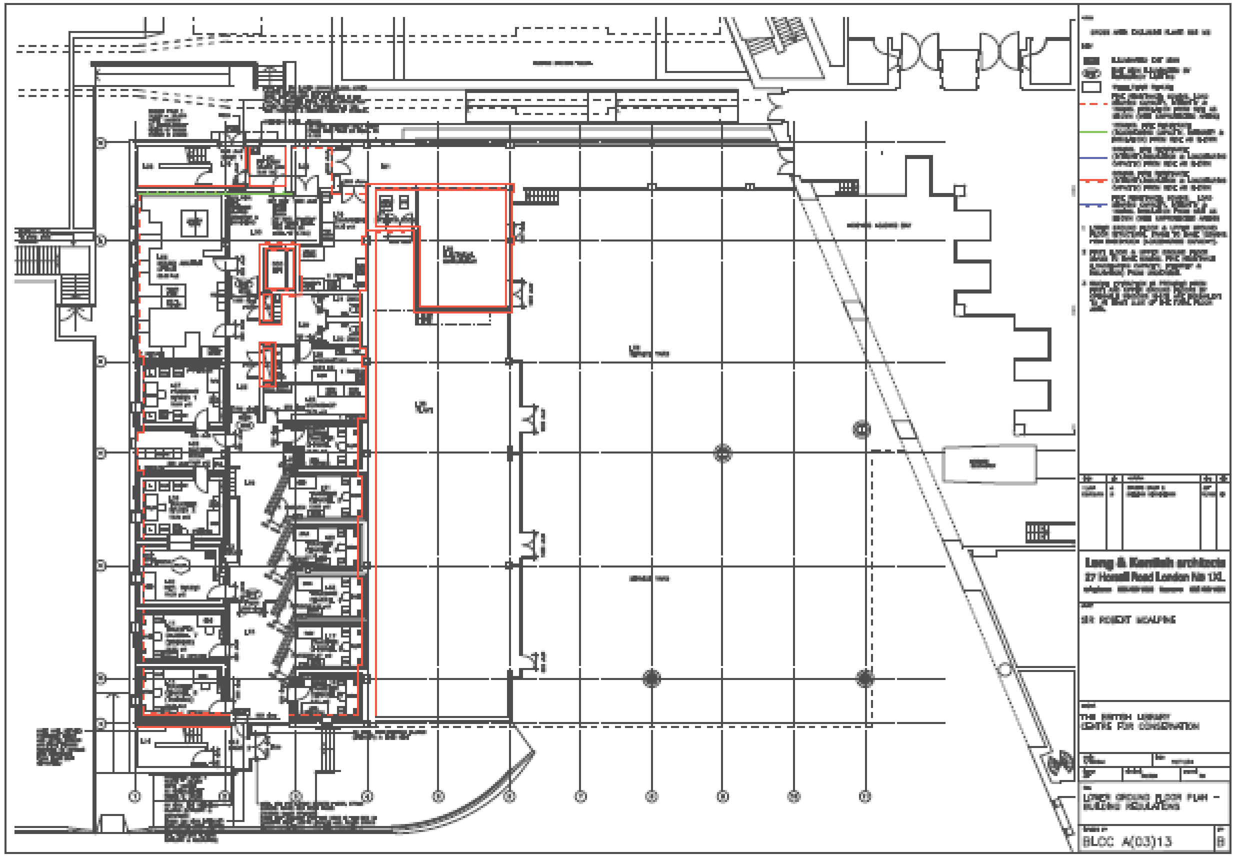
Waste type	Volume forecast (m^3)	Conversion Factor *	Tonnage Forecast	Target %
Concrete (17 01 01)	1,360	1.24	1,686	100% recycled offsite
Inert / Hardcore (17 01 07)	529.824	1.2	635	100% recycled offsite
Brick	202.216	1.2	243	100% Reclaimed / Reused – on or offsite
Metals (17 04)	174.546	0.42	73	98-100% recycled offsite
Tiles and Ceramics (17 01 03)	34.216	0.59	20	20% WC in good condition potentially reused 80-100% recycled offsite
Floor coverings (soft) (20 01 11)	1473.892	0.27	398	60% tiles in good condition reused onsite if there is a use for them in the future development or otherwise offsite 40% recycled/ recovered offsite
Timber (17 02 01)	15.107	0.34	5	70% recycled offsite / 30% recovered offsite
Gypsum (17 08 02), Insulation Materials (17 06 04)	2103.858	0.33	694	95% recycled offsite / 5% recovered offsite 100% energy recovery
Furniture (20 03 07)	3124.458	0.18	562	70% reused / recycled on or offsite Remaining material recovered offsite to divert from landfill
Glass (17 02 02)	24.489	0.25	6	

Waste type	Volume forecast (m^3)	Conversion Factor *	Tonnage Forecast	Target %
				70% recycled aiming to be achieved with remaining material recovered to divert from landfill
Plastic (excluding packaging waste)	7.041	0.23	2	
Cable (17 04 11)	7.681	0.25	2	
Misc. / Mixed Demolition waste (17 09 04)	74.651	0.32	24	
Discarded equipment and machinery – non-haz (16 02)	403.293	0.25	100	70% recycled / 30% recovered offsite
Asbestos (17 06 05* / 01*) Not assessed – Assumed minimal as building constructed post 2000	TBC	TBC	TBC	100% to landfill
Total	**9559.73**	**-**	**4,450**	**Recommended targets:** **80% reuse / recycle non-hazardous waste** **98% - 100% Target for overall diversion of non-hazardous waste from landfill**

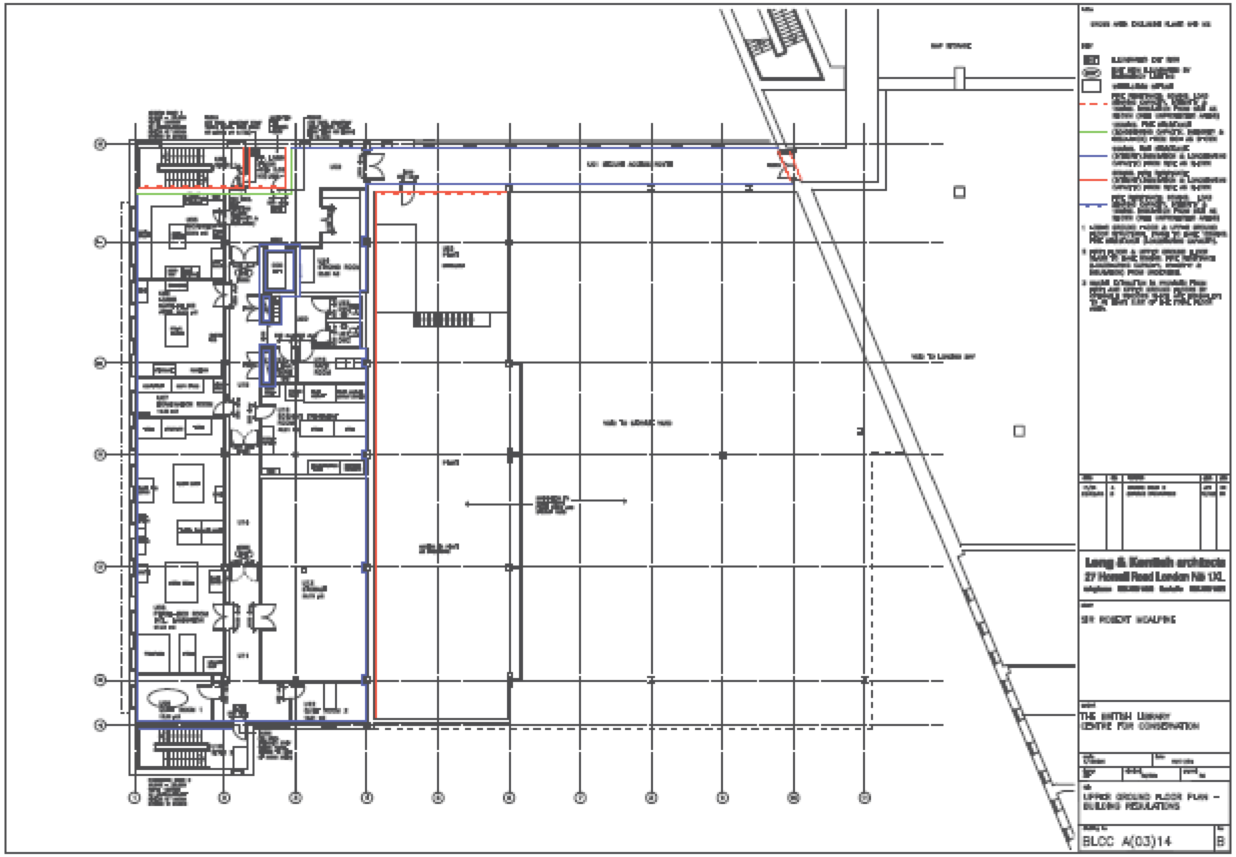
***This table has been populated using BRE's SMARTWaste tool and approved conversion factors**

Appendix 2 - Existing Site Plans

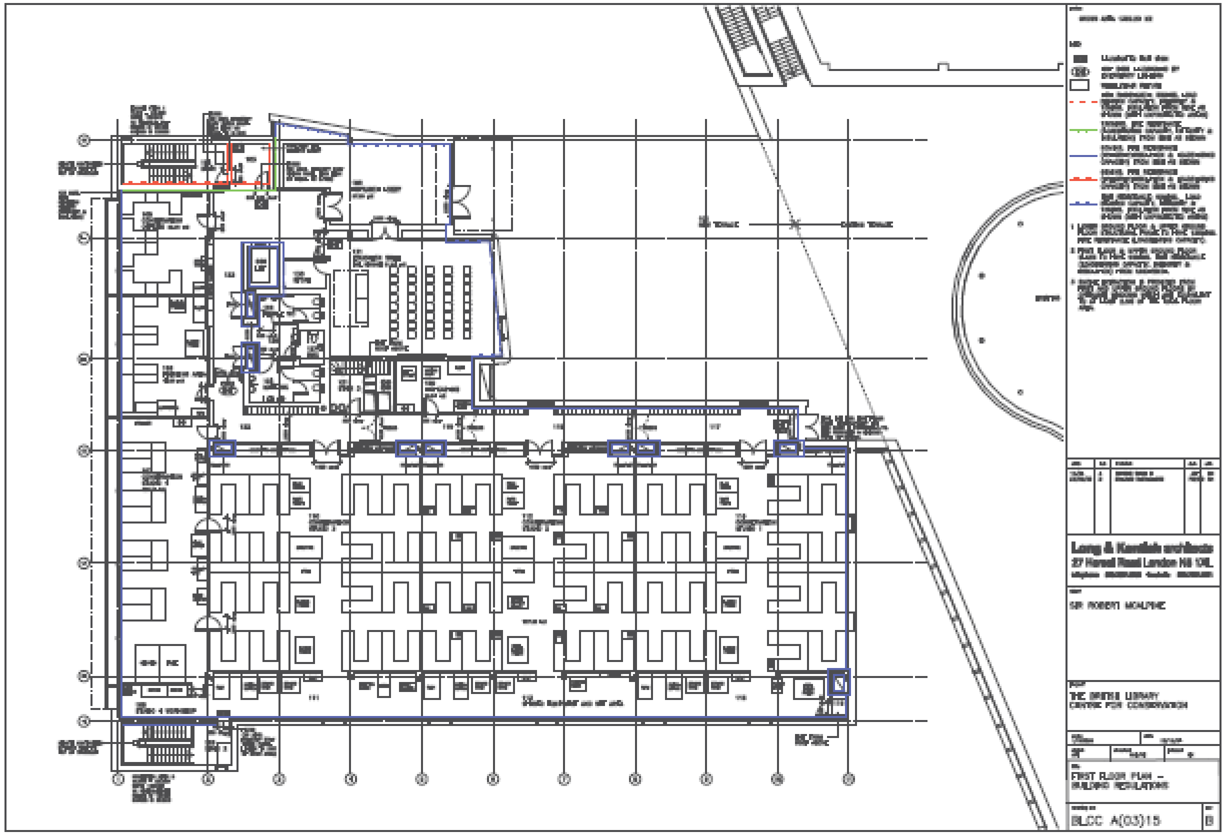
Pre Demolition Audit – Lower Ground



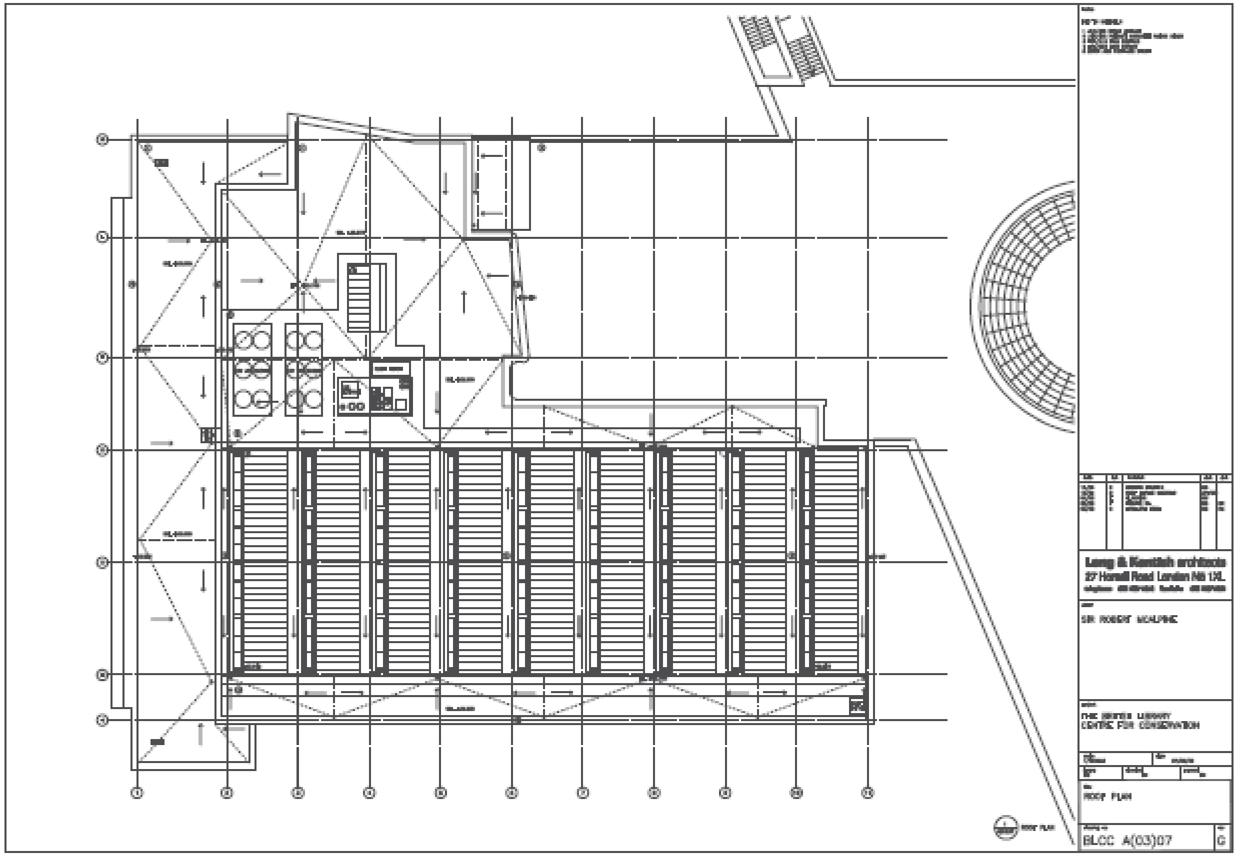
Pre Demolition Audit – Ground



Pre Demolition Audit – First Floor



Pre Demolition Audit – Roof Plan Existing



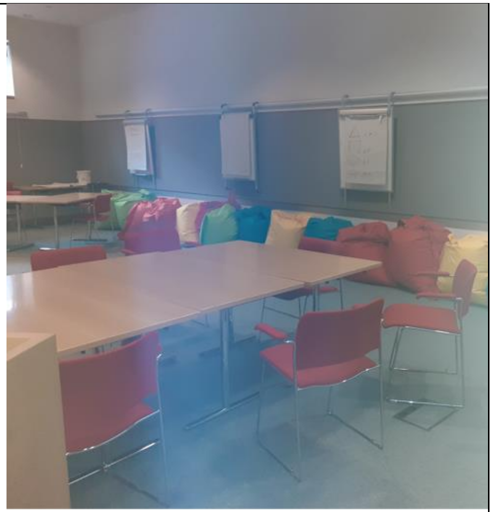
Appendix 3 - Site Photos

 	 	 
External – Timber	External – Concrete paving Slabs	External – Brick

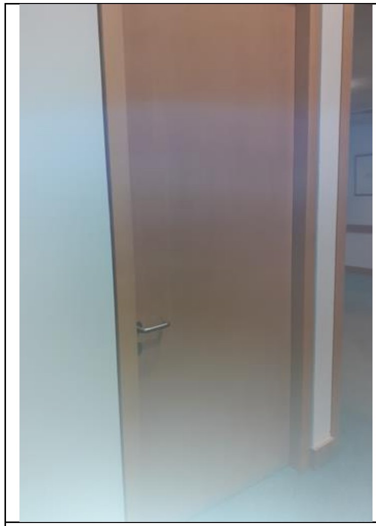
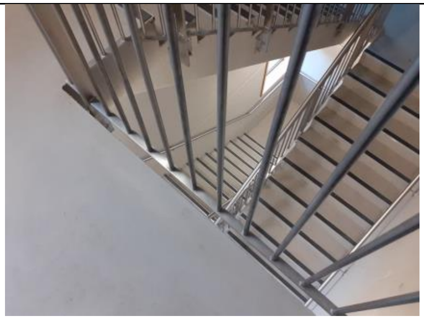
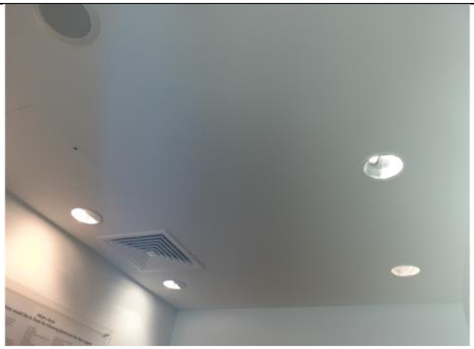



Various plant and equipment, Large calorifier, Invertor AHU,

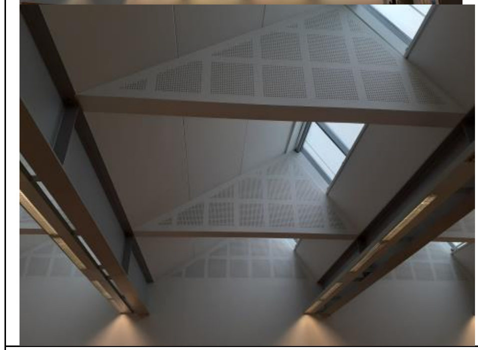
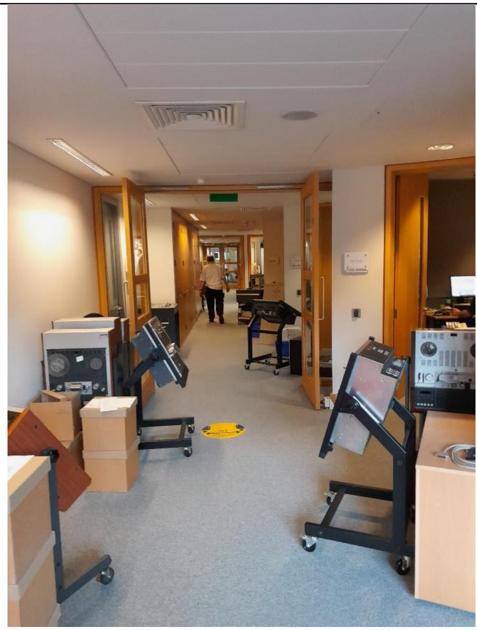


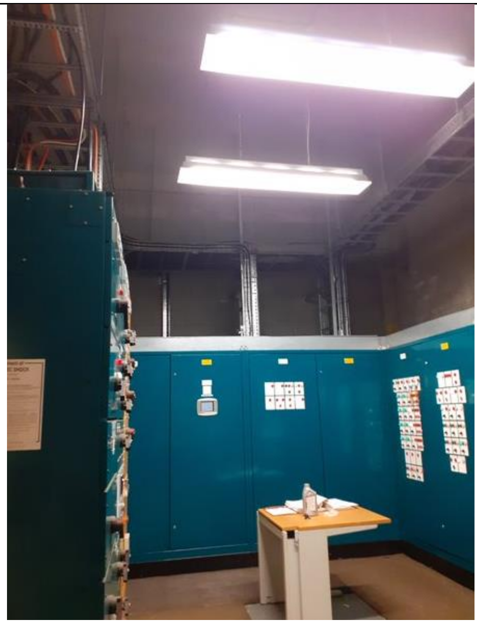



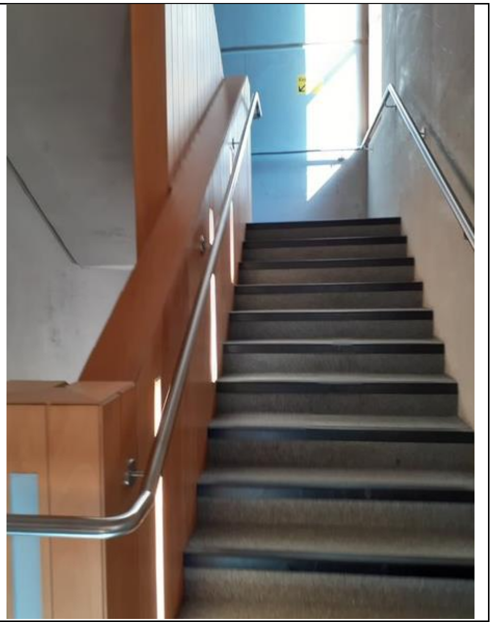
Various plant and equipment, radiators, furniture, Acoustic Boarding

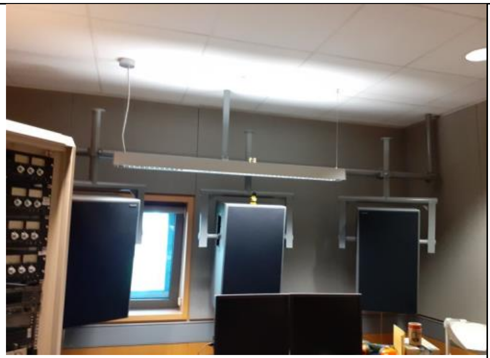
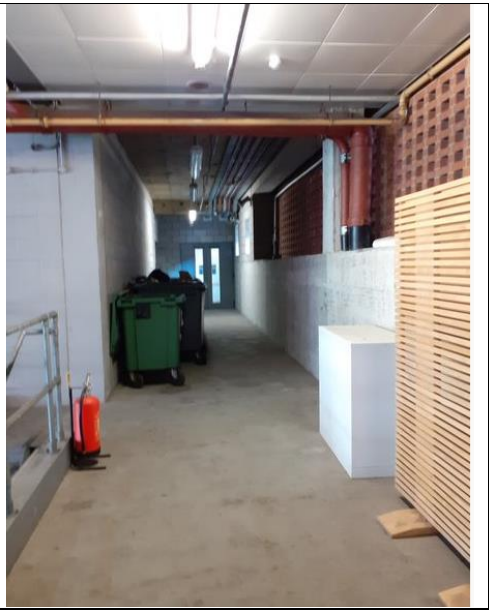
			
Beachwood fire doors	Stairs –vinyl, metal nosing and railings	LED lighting	Fire door

			
Vinyl flooring	Office equipment	Large steel beams supporting zinc & glass apex roof structures	Ceramic tiles, trench heating
			
Sink unit	Carpet Throughout	WC - Tiled, ceramic sinks	Glass metal doors, plasterboard partitions

 			
Suspended glass ceilings with florescent lighting	Beachwood cupboards seen throughout building	Typical floor – Beachwood fire doors, stud walls with plasterboard & additional local acoustic boarding. Raised flooring	Carpet tiles in good condition

		 	 
Metallic passenger lift with some timber interior	Switch Room	Underside of Terrace Structure – RC Framing & Column supports. - Pre-cast concrete planks	Roof –Concrete paving slabs/ Ballast

			
Air condenser unit	Zinc & glass apex roof structures	Fluorescent lighting	Carpet stairs with timber frame and metal handrail

			
Air con unit, electrics, cabling	Ceiling tiles, lighting, various equipment	Metal railings	Ceiling Tiles, fluorescent lighting

Appendix B: Landfill capacity confirmation

Ingrebourne Valley Limited

Mr T Good
Head of Haulage Operations
Keltbray Limited
St Andrews House
Portsmouth Road
Esher
Surrey KT10 9TA

20 August 2021

Dear Terry,

Re : Future Tipping Arrangements

As discussed, presently we can offer the following void space :

- Wennington Quarry 1,800,000 tonnes (progressively following excavation of mineral)
- Elsenham Quarry 1,500,000 tonnes (non-haz permit)
- Denham Quarry 1,400,000 tonnes (new access road opens in September)
- Slade Farm @ Beaconsfield Services 1,200,000 tonnes (progressively following excavation of mineral)
- Medina Farm near golf course 500,000 tonnes
- Subject to submission of permit and granting by the Environment Agency, Orsett Quarry 6,000,000 tonnes

Please do not hesitate to contact me should you require further information.

With kind regards.

Yours sincerely,
For and on behalf of
INGREBOURNE VALLEY LIMITED

Andy Clark
Managing Director

Ingrebourne Valley Ltd, Cecil House, Harlow Common, Essex CM17 9HY
t: 01279 422436 f: 01279 452190 www.ingrebournevalley.com
Registered in Cardiff No: 02848746 VAT Ref. No. 666 0501 46

Appendix C: Stage 2 Whole Life Cycle Assessment

Stanhope, Mitsui Fudosan UK, British Library

British Library Extension

Stage 2 Whole Life Cycle Assessment

ARUP-S0-REP-0001

00 | November 2021

Job number 274016-00

Ove Arup & Partners Ltd
13 Fitzroy Street
London
W1T 4BQ
United Kingdom
www.arup.com

ARUP

Contents

Executive Summary

This document has been prepared on behalf of the British Library and SMBL Developments Ltd (Stanhope PLC and Mitsui Fudosan) as the 'Applicants' to support the applications for planning permission and listed building consent at the land to the north of the British Library ('the Site').

This report describes the RIBA Stage 2 Whole Life Cycle Assessment (WLCA) of the British Library (BL) Extension project ('the Proposed Development'), located in the London Borough of Camden. The analysis is in accordance with the RICS Professional Statement and aligns with BS EN 15978:2011.

This document supports the planning application submission through alignment with London Plan (2021) Policy SI 2 *Minimising greenhouse gas emissions*, which requires development proposals referable to the Mayor to calculate whole life carbon emissions. The report is structured according to the Mayor's draft guidance on WLCA reports. For more information, please see the completed GLA WLCA Template submitted as part of this application.

It additionally aligns with the London Borough of Camden Local Plan (2017) Policy CC1 *Climate Change Mitigation* and Camden Planning Guidance 'Energy Efficiency and Adaptation' (2021).

This assessment is reported according to the following scopes:

- Modules A1-A5: Emissions at practical completion
- Modules A-C: Emissions over the building life cycle (60 years)

See the Appendix for further details on reporting modules A-D.

Results

The Proposed Development has been modelled at Stage 2, with the core structure as follows:

- Substructure: Raft foundation with secant perimeter piling
- Transfer level frame: Concrete primary beams and columns, glulam secondary trusses
- Upper Floors: Concrete columns and beams, timber/concrete hybrid floor slabs
- Unitised façade system: Closed cavity façade (CCF) modules, double-glazed units, brickwork

Based on the current Stage 2 design, the assessment identifies the following:

- The Stage 2 embodied carbon footprint of the Proposed Development at practical completion (A1-A5) is approximately **56,546 tCO2e (635 kgCO2e/m^2 GIA).**
- The Stage 2 embodied carbon footprint of the Proposed Development over the building life cycle of 60 years (A-C) is approximately **97,070 tCO2e (1,089 kgCO2e/m^2 GIA).**
- The whole life carbon emissions of the Proposed Development are approximately **195,140 tCO2e (2,190 kgCO$_2$e/m^2 GIA)** over the building life cycle of 60 years (A-C). Within this figure, operational carbon accounts for **50.3%** of the total.

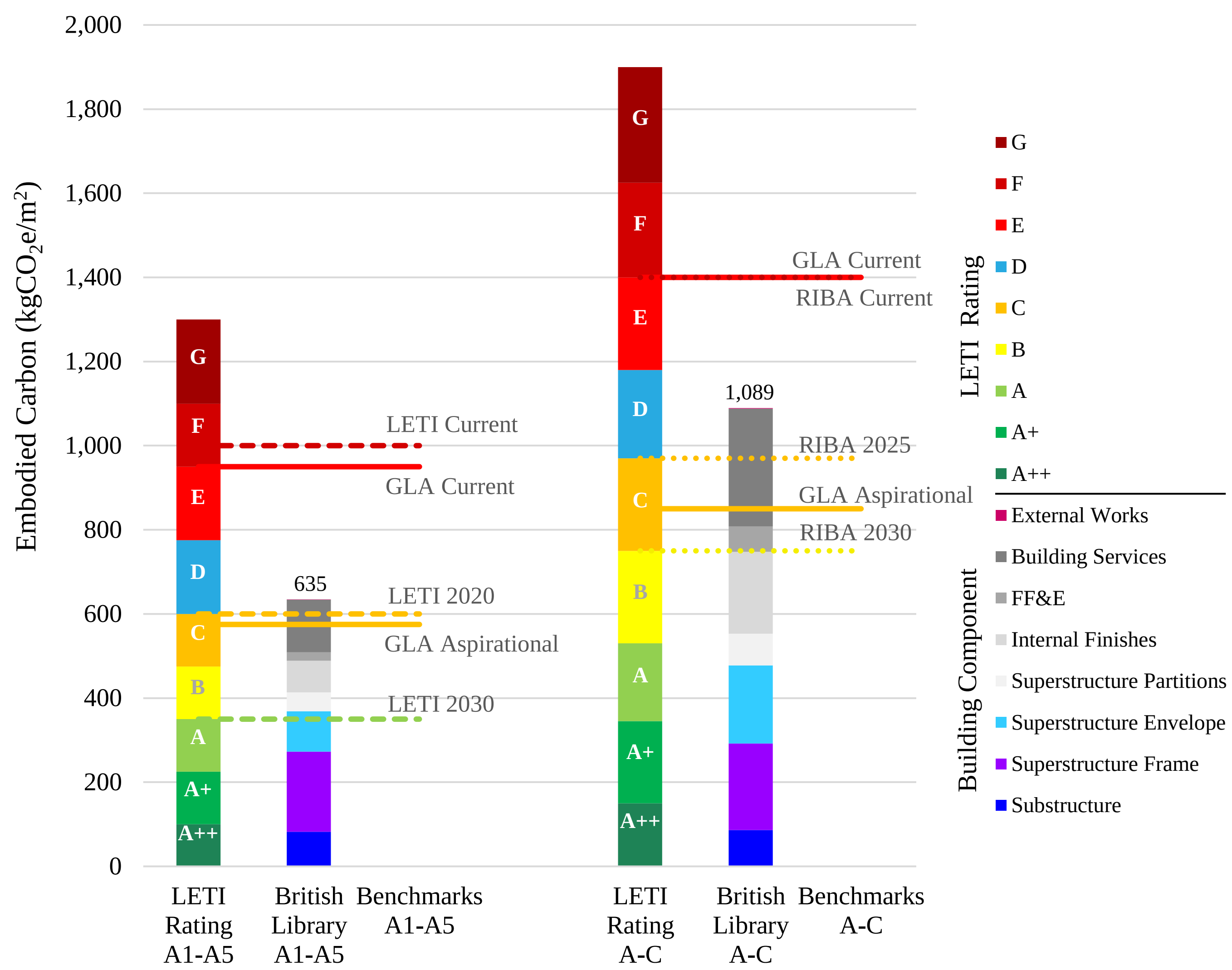


Figure 1 Baseline emission results for the proposed British Library Extension compared to GLA, LETI and RIBA benchmarks, at practical completion (A1-A5) and over the building life cycle (A-C).

Figure 1 shows the Stage 2 Baseline results at practical completion (A1-A5) and over the building life cycle (A-C). The Stage 2 Baseline results are compared to the following benchmarks:

- London Energy Transformation Initiative (LETI): Defines current practice benchmarks and targets for 2020 and 2030 (A1-A5 only)
- The Royal Institute of British Architects 2030 Climate Challenge (RIBA): Defines benchmarks and targets for buildings to aim to meet net zero over life cycle (A-C)
- Greater London Authority (GLA): The Whole-Life Carbon Guidance developed within the London Plan defines benchmarks and aspirational targets for buildings (A1-A5, A-C).

In the graph above, the grey areas represent the building components not detailed in the Stage 2 cost plan. In these cases, GLA office benchmark values have been used. It is important to note that while the GLA office benchmarks have been used, the Proposed Development incorporates lab-enabled office space. This requires stricter levels of specification in areas such as finishes and MEP specification, which will therefore increase the embodied carbon liability.

Stage 2 Optioneering

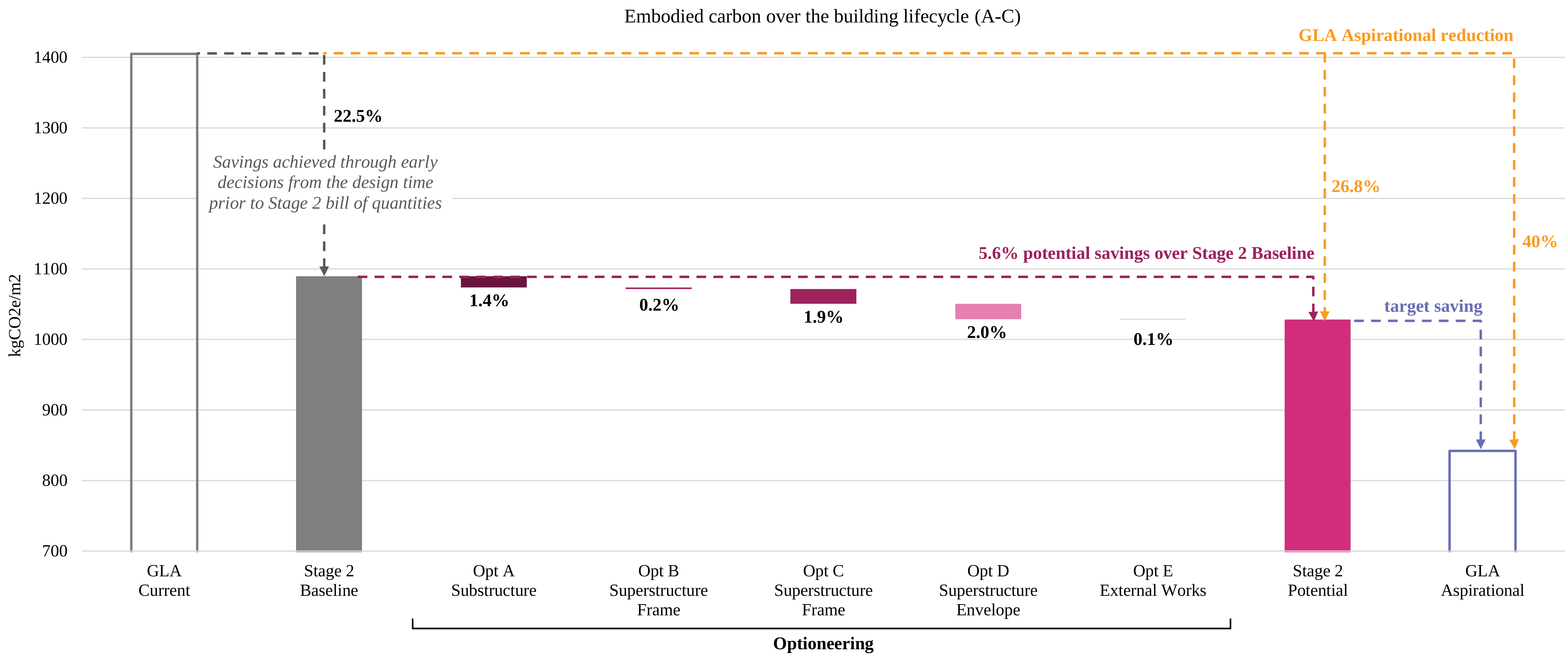


Figure 2 Waterfall graph showing the potential embodied carbon reduction from alternative design options, against GLA Current and GLA Aspirational targets over the building life cycle (A-C)

		Stage 2 Baseline		Stage 2 Potential	Savings (A-C) kgCO₂e	Savings (A-C) %
Substructure	Concrete elements	40% GGBS content in concrete mix	**A**	60% GGBS content in concrete mix	1,390,649	1.43%
Superstructure	Upper floors	CLT infills 40% GGBS content in concrete mix	**B**	CLT cassettes + concrete beams 40% GGBS content in concrete mix	205,492	0.21%
Superstructure	Upper floors	CLT infills 40% GGBS content in concrete mix	**C**	CLT infills 60% GGBS content in concrete mix	1,866,730	1.92%
Facade	Façade	Standard aluminium fins	**D**	20% recycled content in aluminium fins	1,918,705	1.98%
External works	Paving	381m^2 Permeable resin-bound aggregate, 128m^2 Concrete grass-crete, 320m^2 Parking asphalt, 2986m^2 Natural stone setts	**E**	Replacement of Natural stone setts (2986m^2) with Permeable resin-bound aggregate	55,222	0.06%
				Total Savings	**5,436,798**	**5.60%**

Table 1 Alternative design options and resulting embodied carbon savings over the building life cycle (A-C)

The Design Team took actions to reduce the project embodied carbon early on in the design process. Baseline material specifications that reduced the carbon footprint of the building before materials were quantified are therefore reflected in the cost plan used to calculate the Stage 2 Baseline impact.

For example, the baseline specification for concrete uses 40% GGBS content, which is significantly higher than typical values; the baseline design includes CLT components, which have reduced the weight of the structure and therefore the material volume of the substructure; and both the substructure and superstructure have been efficiently designed to overcome the challenges posed by the location of Crossrail 2 underneath the building.

All these design decisions led the Stage 2 Baseline carbon footprint calculated in this LCA to be **22.5% lower** than GLA current practice, in spite of the structural challenges this building has overcome.

The Stage 2 optioneering analysis models five alternative design options demonstrating opportunities for further embodied carbon reduction.

As shown in Figure 2 and Table 1, utilising all five of these reduction options would further reduce the embodied carbon of the Proposed Development (over the Stage 2 Baseline) by **5.6%** over the building life cycle (A-C), which is equivalent to **5,436,798 kgCO$_2$e.**

The main recommendations for achieving the Stage 2 Potential scenario are:

Specify a concrete mix with **60% GGBS content**

↓

Explore the use of **CLT casettes** and concrete beams in place of PT slabs

↓

Specify **20% recycled content aluminium** for the façade fins

↓

Replace natural stone setts with **permeable resin-bound aggregate** in the hard landscaping

The Stage 2 Baseline results demonstrate that the current design is 22.5% less carbon intensive than the GLA benchmark defining current practice.

Results also identify the opportunity to further reduce embodied carbon emissions by 5.6% (against the Stage 2 Baseline model) across building components quantified at this stage (substructure, frame, envelope and external works).

This significant carbon reduction over the GLA current practice benchmark also demonstrates the Project Team's commitment to the aspiration of reducing embodied carbon by a total of 40% to meet the GLA Aspirational target.

During RIBA Stages 3 and 4, additional LCAs will assess all building components in detail to identify opportunities to further reduce the emissions by the remaining 17.5% (or 13.2% if the Stage 2 Potential options are incorporated) in order to meet the project's 40% carbon reduction aspiration.

Based on the current Stage 2 design, the embodied carbon footprint of the proposed development at practical completion (A1-A5) is approximately **56,546 tCO2e (635 kgCO2e/m^2 GIA)** and over the building life cycle of 60 years (A-C) is approximately **97,070 tCO2e (1,089 kgCO2e/m^2 GIA).**

	Embodied carbon over life cycle per m^2 GIA (kgCO2/m^2)	Embodied carbon over life cycle (kgCO2)
GLA Current Practice benchmark	1,400	124,741,400
British Library Stage 2 Baseline	1,089	97,069,731
Savings	**311**	**27,671,669**

By comparison to the GLA Current Practice benchmarks, the Stage 2 Baseline demonstrates a saving of approximately **27,671 tCO2e** over the building life cycle (A-C).

This tonnage of carbon equates to the following savings:

5,500
approx. return flights from London to Sydney

157,200
approx. planted trees to offset carbon

1 Introduction

1.1 Background

This document has been prepared on behalf of the British Library and SMBL Developments Ltd (Stanhope PLC and Mitsui Fudosan) as the 'Applicants' to support the applications for planning permission and listed building consent at the land to the north of the British Library ('the Site').

The Proposed Development would involve extending the northern aspect of the existing British Library to provide library accommodation; commercial space designed to cater for knowledge quarter uses (including life sciences, cultural, scientific and heritage collections and data sciences); retail space; and the Crossrail 2 works at basement level (excluding the eastern shaft) and commercial development.

The proposal is modelled to a Gross Internal Area (GIA) of 89,101 m^2 (Alinea area schedule, 23-08-21) and a design life of 60 years.

Figure 3 Illustrative view of the Proposed Development from Ossulston Street

1.2 Aim and objectives

The aim of this study is to assess the whole life and embodied carbon associated with the proposed development and provide recommendations for reducing the embodied carbon.

The following objectives help to achieve this aim:

- Inform the design team of the embodied carbon associated with the Stage 2 design at practical completion (modules A1-A5) and over life cycle (60 years, modules A-C)
- Identify the key building elements with the highest embodied carbon (kgCO_2e)
- Investigate a range of interventions to determine options for carbon emission reduction

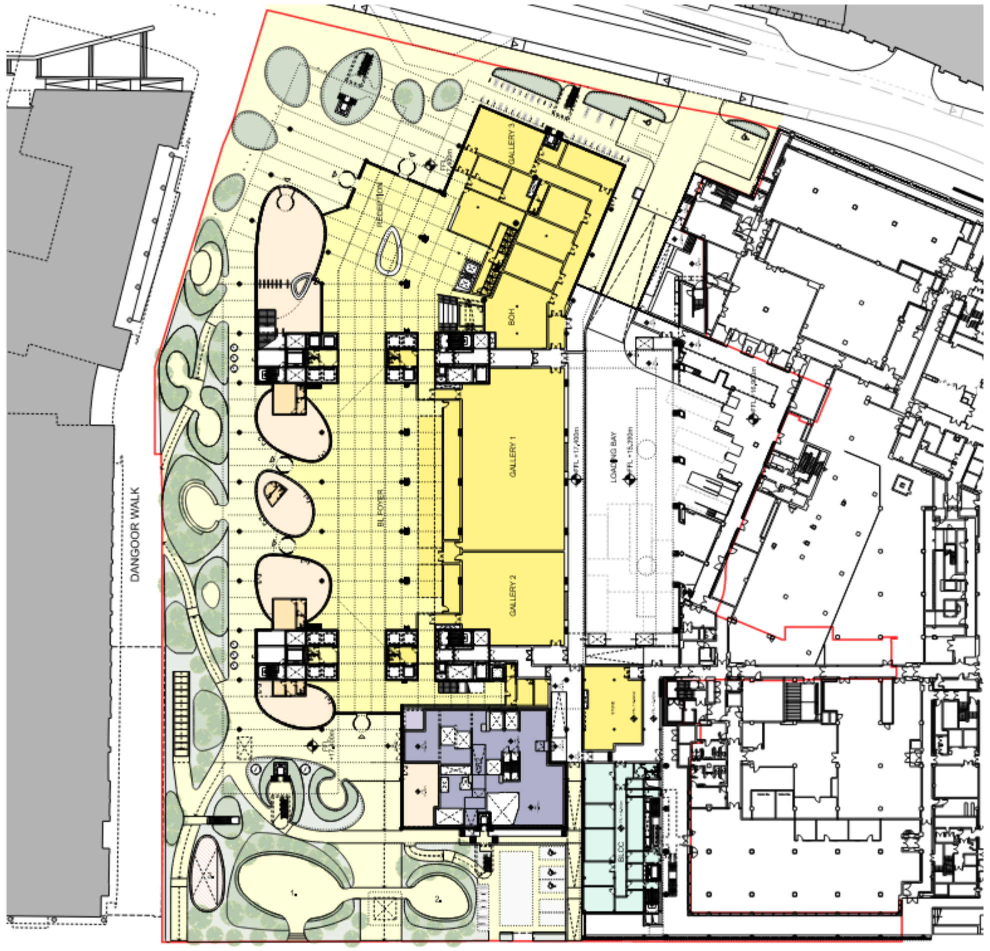


Figure 4 Proposed Lower Ground floor plan (RSHP, 24-09-2021)

1.3 Methodology

This assessment was carried out using OneClick LCA which is an IMPACT (Integrated Material Profile and Costing Tool) compliant software programme.

The study is reported according to the following scopes:

1. Emissions at practical completion (modules A1-A5)
2. Over building life cycle (modules A-C, 60 years)

The Proposed Development has been modelled at Stage 2, with the core structure as follows:

- Substructure: Raft foundation with secant perimeter piling
- Transfer level frame: Concrete primary beams and columns, glulam secondary trusses
- Upper Floors: Concrete columns and beams, timber/concrete hybrid floor slabs
- Unitised façade system: Closed cavity façade (CCF) modules, double-glazed units, brickwork

The Stage 2 Baseline emissions were calculated using Stage 2 cost plan quantities provided by Alinea on 21-06-21. Alinea were able to quantify materials in the following layers:

- Substructure
- Superstructure frame
- Superstructure envelope

These quantities were supplemented by the following:

- Façade: CCF (closed cavity façade) module build-ups provided by Arup Facades
- Substructure: Secant piling volumes provided by Arup Structures
- External works: Hard landscaping areas provided by landscape architects, DSDHA

The baseline results use material specifications provided by the design team. Where these were unavailable, default specification values provided by the RICS Professional Statement have been used. These default values define “average industry standard practice”.

Detailed information for the remaining elements including internal walls/partitions, doors, finishes, FF&E and building services were not available at Stage 2, therefore GLA benchmark values have been used to estimate their embodied carbon contribution. Wherever GLA benchmarks have been used in tables and graphs, it has been clearly noted.

It is therefore anticipated that an increase in embodied carbon could take place from Stage 2 to Stages 3+ once the missing elements are quantifiable in greater detail.

2 Results

2.1 Whole life carbon (embodied and operational)

The estimated whole life carbon emissions of the Proposed Development are summarised in Table 2. The whole life carbon emissions account for the embodied carbon and also the operational carbon, over the building's 60-year lifespan.

The results show that the Proposed Development accounts for a whole life carbon figure of approximately **195,140 tCO2e (2,190 kgCO$_2$e/m^2 GIA)** over the building life cycle of 60 years (A-C). Rows shaded in grey are building elements that could not be quantified at Stage 2, so use GLA benchmark values.

The operational carbon data has been provided by Arup and is detailed within the Energy Statement for the Proposed Development. The data is based on the UK Building Regulation Part L analysis Arup have undertaken of the current Stage 2 design.

The estimated operational carbon data is divided into 'regulated' and 'unregulated' sources. Regulated energy is building energy consumption that is inherent to the building design (i.e. space heating and cooling, hot water, ventilation, and lighting), whereas unregulated energy is that resulting from systems/processes that are not controlled by the design team (i.e. IT equipment, kitchen appliances, and laptops).

Table 2 Whole life carbon emissions of the Stage 2 Baseline in accordance with RICS methodology and EN 15978

	A1-A3 Product Stage	A4-A5 Transportation to site & site operations	B3-B5 Repair & Replacement	C1-C4 End of Life stage	TOTAL (kgCO$_2$e)
Substructure	6,515,801	785,933	0	380,963	7,682,697
Frame	15,579,534	1,432,155	590,661	756,436	18,358,786
Envelope	8,023,752	517,430	7,868,122	121,003	16,530,307
Partitions					6,682,575
Internal finishes					17,374,695
FF&E					5,346,060
Building services					24,948,280
External works	64,484	14,651	64,484	2,713	146,331
				Total Embodied Carbon	**97,069,731**
B6 Regulated					37,296,000
B6 Unregulated					60,774,000
				Total Operational Carbon	**98,070,000**
Whole life carbon: 195,139,731 kgCO$_2$e					

Results accounting for grid decarbonisation

The Energy Strategy produced by Arup comprises a number of passive and low energy design measures that have optimised the operational performance of the Proposed Development, which is reflected in the operational carbon figures. These measures are as follows:

- High performance glazing
- Improved building fabric thermal insulation
- Low building air leakage rate
- Low energy lighting
- Efficient central heating and cooling systems

Beyond this, the whole life carbon emissions of the Proposed Development have been modelled to account for UK grid decarbonisation forecasts.

Following RICS guidance, FES 2021 compliant adjustment coefficients have been applied to the embodied carbon assessment to calculate the future impact of the decarbonisation of the UK electricity grid. Where GLA benchmark values have been used, a decarbonisation assumption has been made in line with the modelled elements which showed that applying decarbonisation reduces the embodied carbon by an average of 11.46%.

Adjustment coefficients calculated from the FES 2021 'slow progression' scenario for a 60-year lifespan have also been applied to the operational carbon figures provided in the Energy Statement.

Table 3 Whole life carbon emissions of the Stage 2 Baseline in accordance with RICS methodology and EN 15978 accounting for FES 2021 'slow progression' grid decarbonisation

	A1-A3 Product Stage	A4-A5 Transportation to site & site operations	B3-B5 Repair & Replacement	C1-C4 End of Life stage	TOTAL (kgCO$_2$e)
Substructure	6,515,801	785,933		380,963	7,682,697
Frame	15,579,534	1,432,155	522,032	756,436	18,290,156
Envelope	8,023,752	517,430	6,948,934	121,003	15,611,119
Partitions					5,923,434
Internal finishes					15,400,930
FF&E					4,738,748
Building services					22,114,155
External works	64,484	14,651	56,950	2,713	138,798
				Total Embodied Carbon	**89,900,037**
B6 Regulated					8,329,005
B6 Unregulated					13,565,605
				Total Operational Carbon	**21,894,610**
Whole life carbon (with decarbonisation): 111,794,647 kgCO$_2$e					

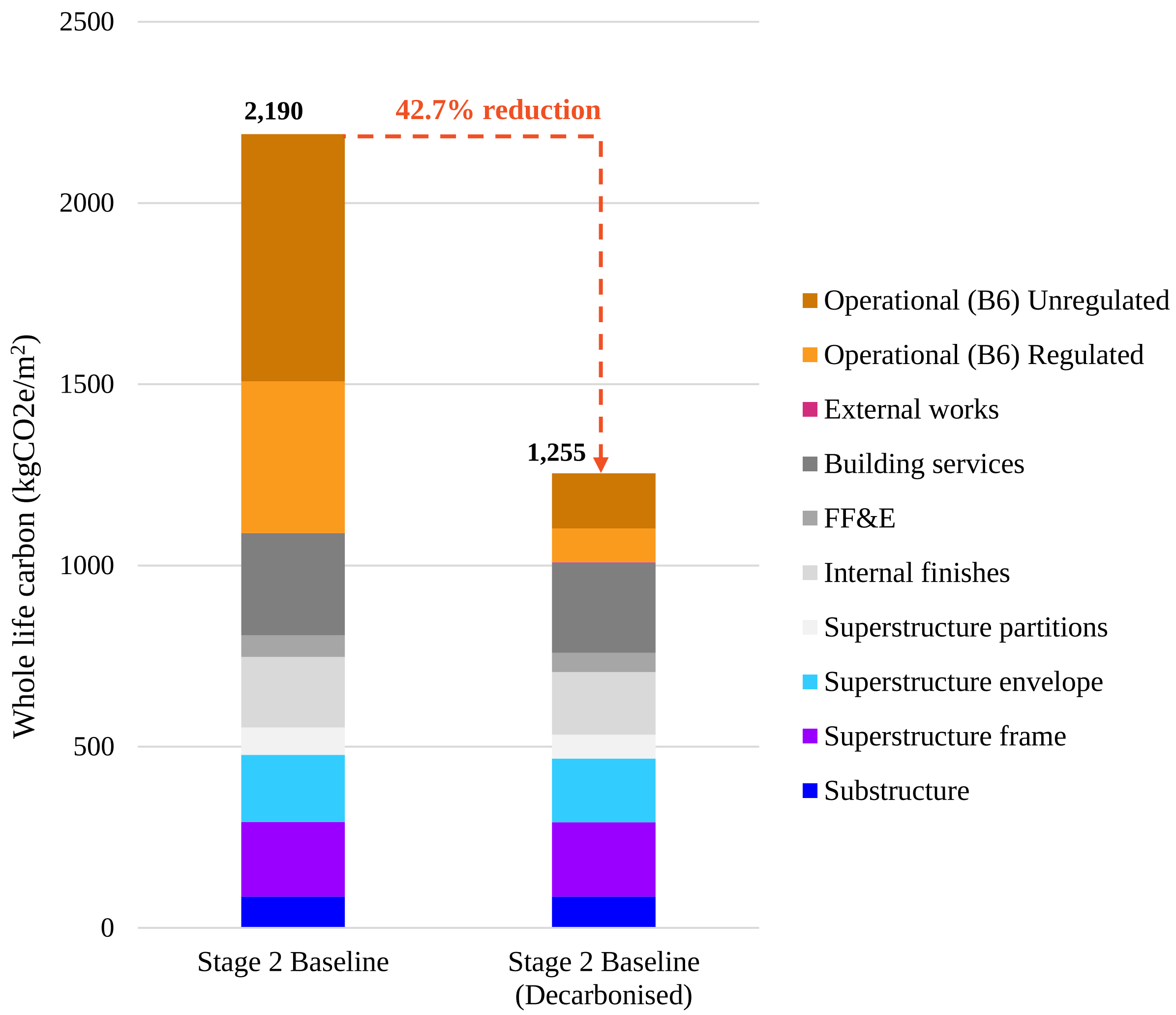


Figure 5 Whole life carbon emissions of the Stage 2 Baseline, with and without decarbonisation

Comparison of the whole life carbon emissions of the Stage 2 baseline both with and without UK grid decarbonisation are shown in Figure 5. When the decarbonisation scenario is applied, the whole life carbon emissions of the Proposed Development are shown to reduce by **42.7%** over the building life cycle (A-C), which is equivalent to **47,208,395 kgCO₂e.** This carbon reduction is primarily seen in the (B6) operational carbon figures (both regulated and unregulated).

2.2 Embodied carbon assessment

The estimated embodied carbon emissions of the Proposed Development at Stage 2 are summarised in Table 4. These are excluding operational carbon.

The assessment estimates that Stage 2 embodied carbon footprint of the proposed development at practical completion (A1-A5) is approximately **56,546 tCO2e (635 kgCO2e/m^2 GIA).**

The Stage 2 embodied carbon footprint of the Proposed Development over the building life cycle of 60 years (A-C) is approximately **97,070 tCO2e (1,089 kgCO2e/m^2 GIA).**

Table 4 Stage 2 Baseline embodied carbon emissions to practical completion (A1-A5) and over life cycle (A-C) per building element

Building Element	Results at practical completion (A1-A5)		Results over building life cycle (A-C)	
	kgCO_2e	kgCO_2e/m^2 GIA	kgCO_2e	kgCO_2e/m^2 GIA
Substructure	7,301,734	82	7,682,697	86
Superstructure frame	17,011,689	191	18,358,786	206
Superstructure envelope	8,541,182	96	16,530,307	186
Superstructure partitions	4,009,545	45	6,682,575	75
Internal finishes	6,682,575	75	17,374,695	195
FF&E	1,782,020	20	5,346,060	60
Building services	11,137,625	125	24,948,280	280
External works	79,135	1	146,331	2
TOTAL	**56,545,505**	**635**	**97,069,731**	**1,089**

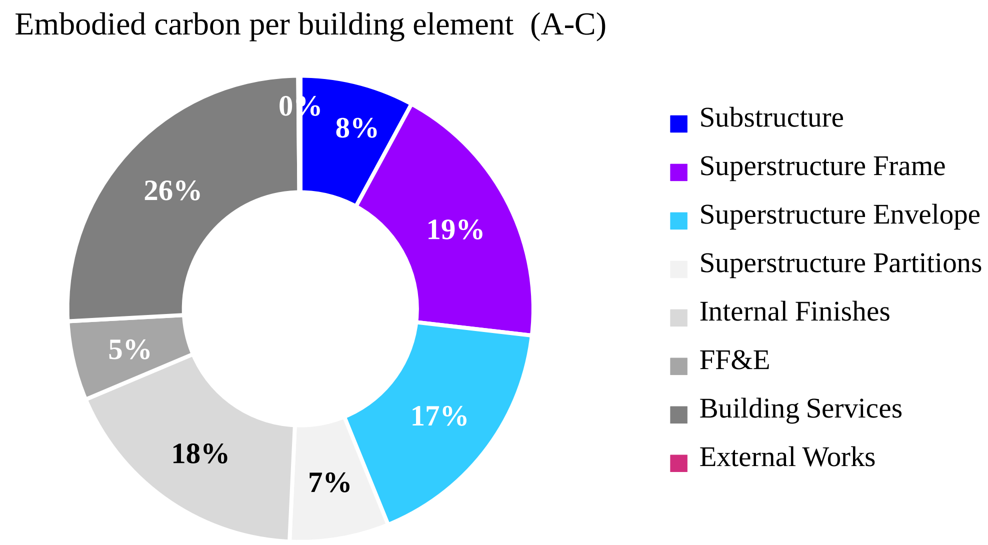


Figure 6 Breakdown of embodied carbon over life cycle per building element (A-C)

The pie chart in Figure 6 presents the embodied carbon of the Proposed Development over the building life cycle (A-C) broken down into building elements. Elements shaded in grey are not sufficiently detailed at planning stage and have therefore not been measured and quantified in the cost plan. GLA benchmark values have been used to complete the carbon footprint calculation of the building. Additional LCAs at Stages 3 and 4 will quantify and optimise the carbon emissions for these elements. Qualitative recommendations to inform early low carbon decisions for these components are included in Section 5 of this report.

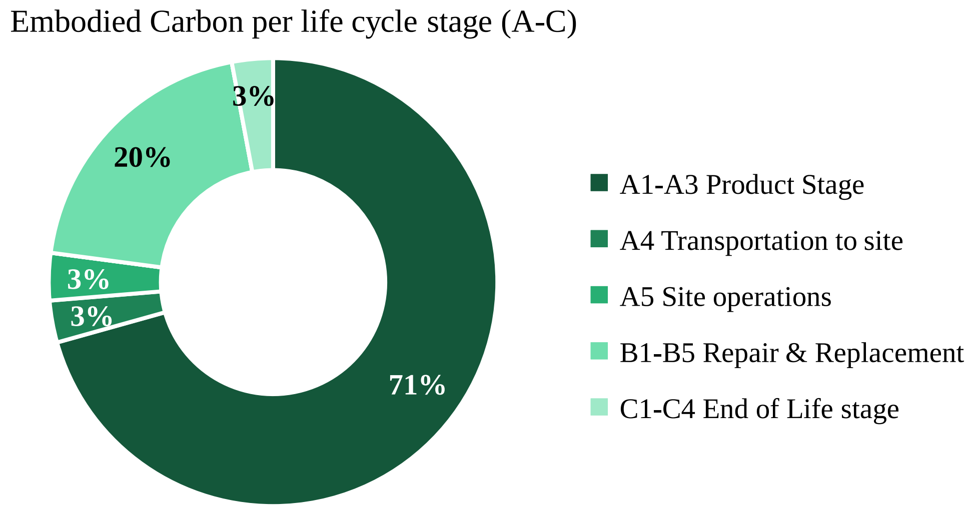


Figure 7 Breakdown of embodied carbon over life cycle per life cycle stage (A-C)

The pie chart in Figure 7 illustrates the share of embodied carbon over life cycle (A-C) for the Proposed Development per life cycle stage.

Results show that 71% of the embodied carbon emissions are attributed to the product and transportation stages (modules A1-A3). These modules focus on the extraction, processing and manufacturing of the materials (‘cradle to gate’) and therefore emphasises that the initial selection of materials is crucial in reducing the carbon emissions of the development.

Transport of equipment and materials (module A4) has been calculated in accordance with the RICS default figures because at this stage it is not possible to determine the locations, distances and means of transport for all construction materials and equipment. Consequently, the emissions which derive from stage A4 are indicative and may be reconsidered during construction.

2.3 High impact construction materials

Table 5 provides a summary of the ten key construction materials that are responsible for the greatest carbon emissions of the Proposed Development at practical completion.

The key drivers of the carbon emissions shown may be sheer quantity of material and/or carbon intensity (high impact materials).

Table 5 Construction materials with the highest embodied carbon at product stage (tCO_2e)

Material Category *NB: (Only substructure, frame, envelope and external works have been modelled)*	**Cradle to gate impacts (modules A1-A3)**	
	tCO_2e	**% of total**
Ready-mix concrete	10,293	34.10%
Reinforcement steel	4,865	16.10%
Aluminium profile	4,787	15.90%
Structural hollow steel sections	3,307	11.00%
Carbon steel reinforcing bar	2,292	7.60%
Aluminium frame windows	1,223	4.10%
Double glazing	680	2.30%
Aluminium interior blinds	596	2.00%
Float glass	412	1.40%
Concrete paving	245	0.80%
TOTAL	**28,700**	**95.30%**

2.4 Benchmark comparison

Figure 8 compares the Stage 2 Baseline design with the following benchmarks:

- London Energy Transformation Initiative (LETI): Defines current practice benchmarks and targets for 2020 and 2030 (A1-A5 only)
- The Royal Institute of British Architects 2030 Climate Challenge (RIBA): Defines benchmarks and targets for buildings to aim to meet net zero over life cycle (A-C)
- Greater London Authority (GLA): Whole-Life Carbon Guidance developed within the London Plan defines benchmarks and aspirational targets for buildings (A1-A5 and A-C).

In the graphs, the grey areas represent data gaps in the Stage 2 cost plan. In these cases, GLA office benchmark values have been used. It is important to note that while the GLA office benchmarks have been used, the Proposed Development incorporates lab-enabled office space. This requires stricter levels of specification in areas such as finishes and MEP specification, which is likely to result in an increase in embodied carbon impacts over a typical office fit out.

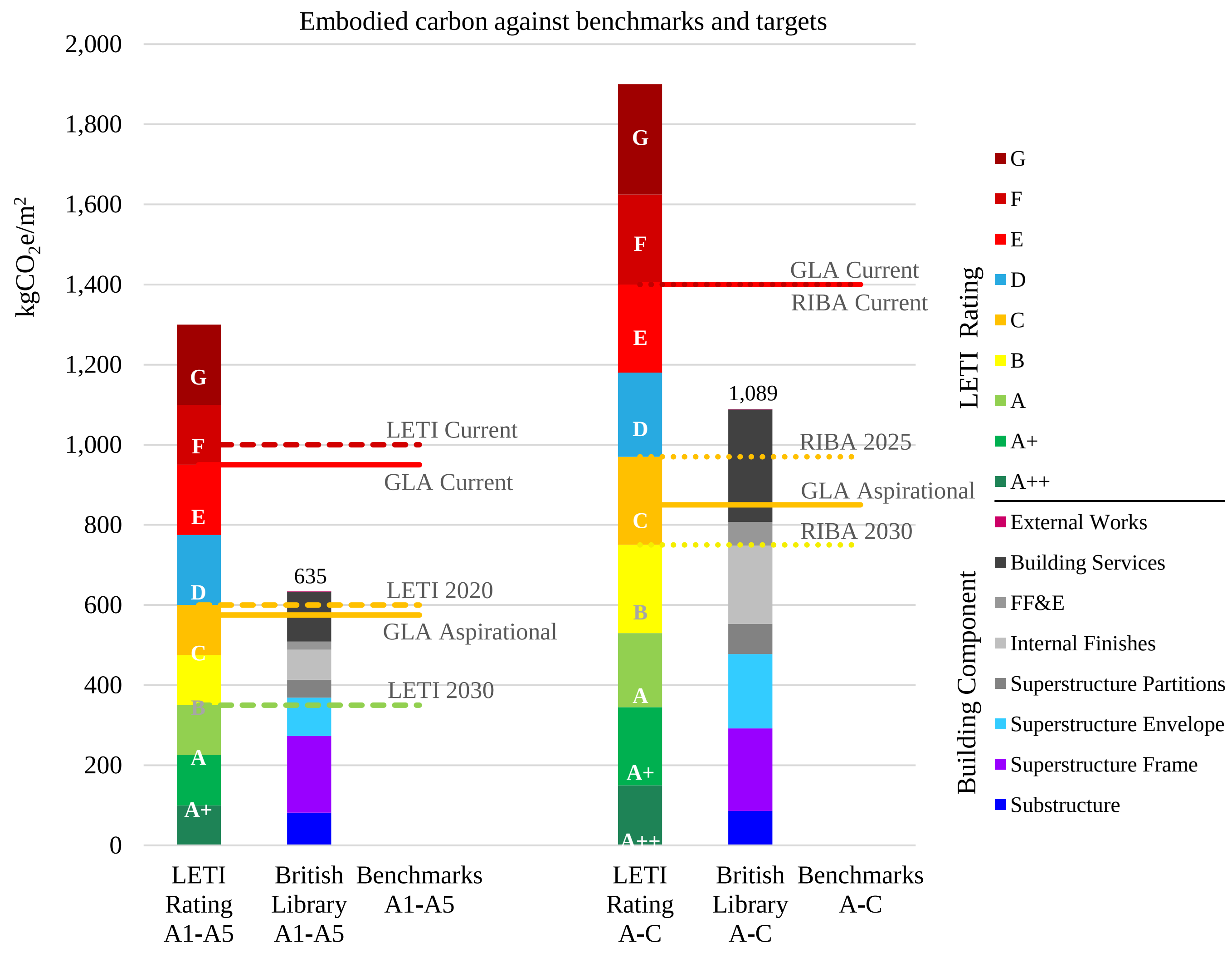


Figure 8 Baseline emissions compared to GLA, LETI and RIBA benchmarks, at practical completion (A1-A5) and over the building life cycle (A-C).

The benchmarks defined by the GLA's WLCA guidance provide a reference for the embodied carbon impact of Current Practice design, as well as an Aspirational Target (best current practice). This is defined as a 40% carbon reduction from current practice.

LETI has defined similar targets (A1-A5) for best practice embodied carbon performance at design level. The LETI target for buildings designed today (LETI 2020) aligns with the GLA Aspirational target (A1-A5).

RIBA targets define the same good practice over the building life cycle (A-C) but consider the targets to be applied to the year of completion (up to 2030).

Aligning the embodied carbon impact of the British Library Extension with the GLA's Aspirational Targets, LETI targets for 2020 and RIBA targets for 2025-2030 ensures best practice in embodied carbon performance within the current market and technical availability.

Figure 9 compares the Stage 2 Baseline design with GLA benchmark and aspirational targets at practical completion (A1-A5) and over whole life cycle (A-C), broken down into building elements. This is useful to highlight the building elements that meet the aspirational target for example the Substructure, and those that are further away from the target, for example the Superstructure Envelope. This should guide the design team in future stages to focus efforts on carbon reduction in the façade design, for example through an extended service life.

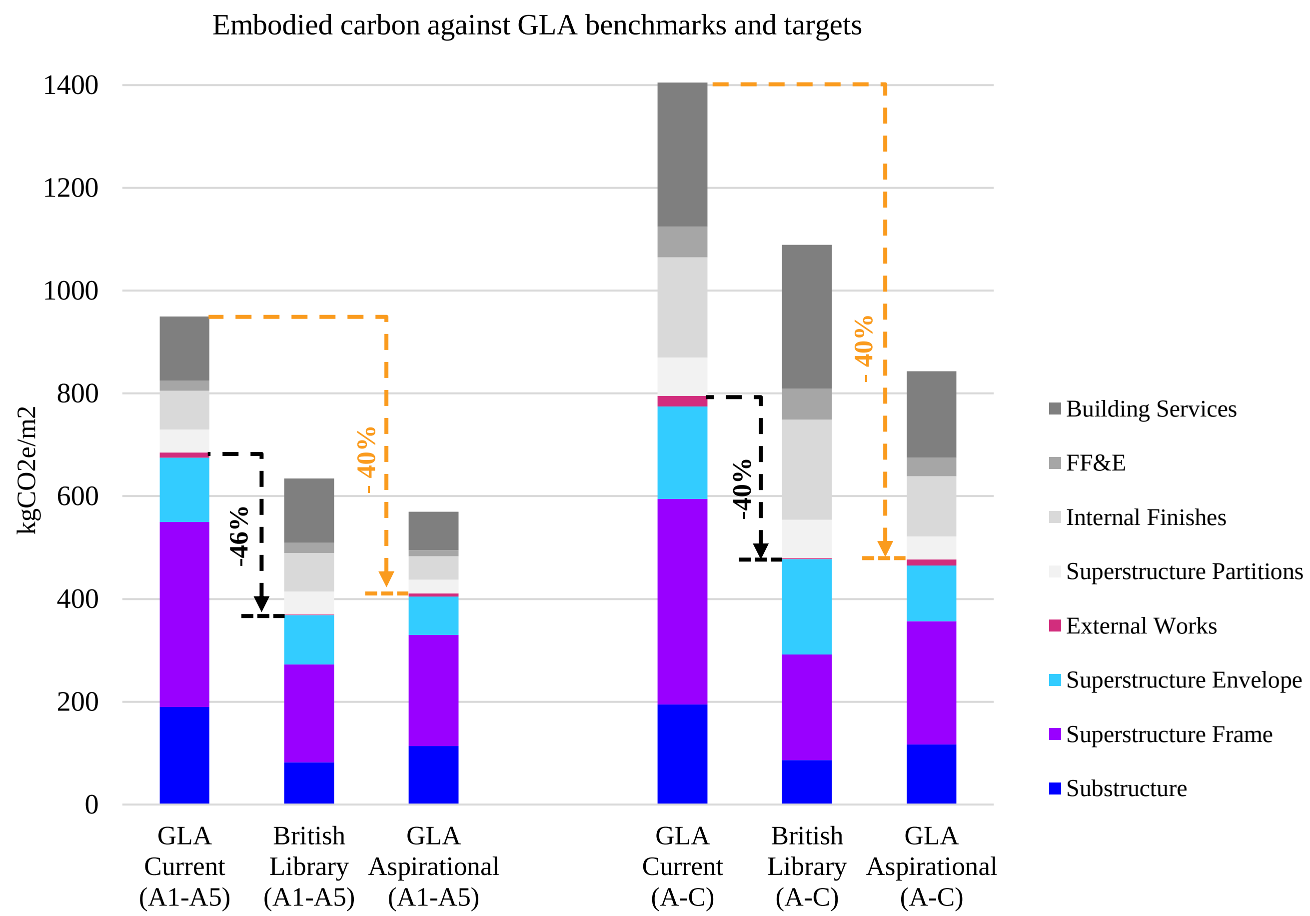


Figure 9 Baseline emissions compared to GLA benchmarks and aspirational targets, at practical completion (A1-A5) and over the building life cycle (A-C).

3 BREEAM Mat 01 Results

The Proposed Development is targeting credits under BREEAM Mat 01.

The BREEAM Materials (Mat 01) credit aims to reduce the burden on the environment from construction products. This is achieved by recognising and encouraging measures to optimise construction product consumption efficiency, and by selecting products with a low environmental impact (including embodied carbon), over the life cycle of the building.

It is important to note that work was undertaken to maximise the efficiency of the structure by Arup structural engineers at RIBA Stage 1, the outcome of which fed into the current Stage 2 Baseline design. This optimisation is therefore not captured within the BREEAM Mat 01 assessment. The British Library extension superstructure and substructure are both low embodied carbon by design and are therefore both substantially better than business as usual.

3.1 Baseline superstructure option

The first of the points available for Mat 01 is awarded based on the environmental impact of the building compared with the BREEAM LCA benchmark. The baseline option for the RIBA Stage 2 design is:

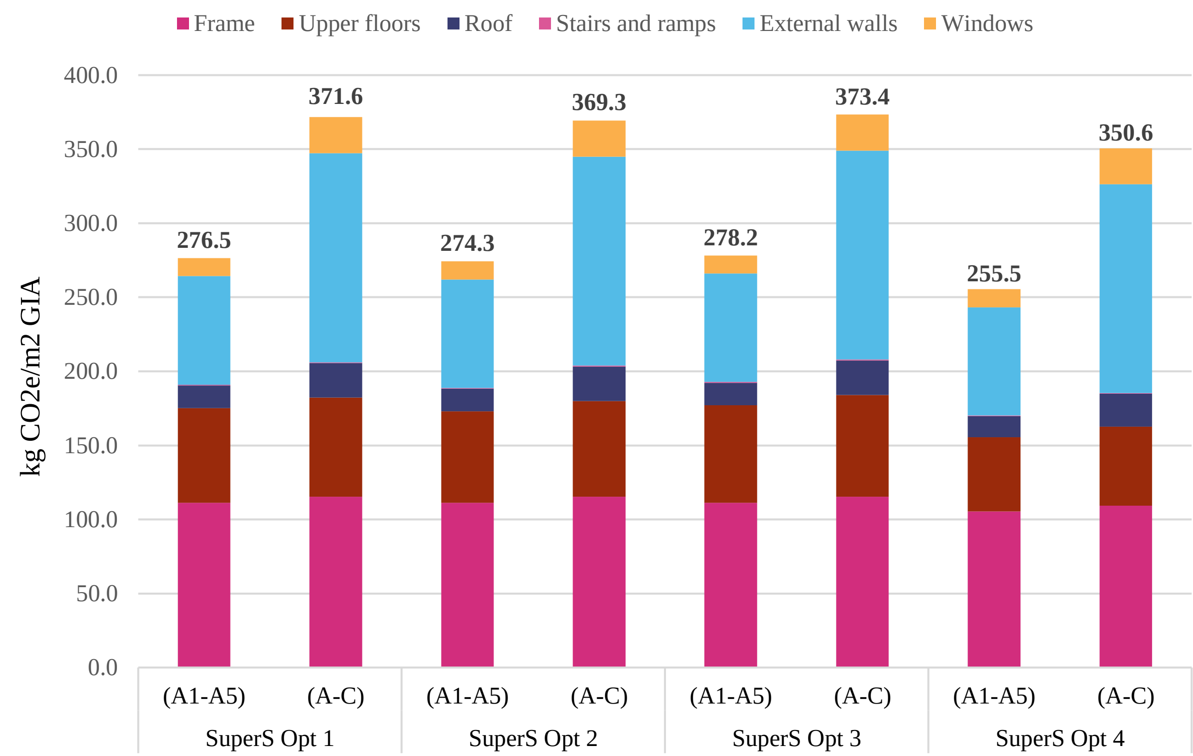
- Mat01_CD_SuperS_B

Compared with the BREEAM LCA benchmark, the Stage 2 baseline achieves 4.06 no. ecopoints/m^2 NIA, which equates to 69.3% worse than the benchmark. The project is performing worse than the BREEAM benchmark, therefore it does not achieve the point available for this element of the Mat 01 credit.

3.2 Superstructure options appraisal

Different design options were considered at RIBA Stage 2 to explore reduction of the building's environmental impact. For the BREEAM options appraisal, 4no. significantly different design options for the superstructure have been considered and are presented in the table below. The orange cross denotes an option that has not been chosen within the baseline design but has been identified as an opportunity for further exploration at the next stage.

Superstructure Option Ref	**Description**	**Chosen Option**
Option 1 (Baseline) Mat01_CD_SuperS_Opt1	40% GGBS content in concrete mix CLT Infills (less PT slabs)	✓
Option 2 Mat01_CD_SuperS_Opt2	CLT Cassettes and concrete beams (less PT slabs)	✗
Option 3 Mat01_CD_SuperS_Opt3	PT slabs (no CLT)	✗
Option 4 Mat01_CD_SuperS_Opt4	60% GGBS content in concrete mix	✗



Percentage change from baseline Opt 1		SuperS Opt 2 (A1-A5)	SuperS Opt 2 (A-C)	SuperS Opt 3 (A1-A5)	SuperS Opt 3 (A-C)	SuperS Opt 4 (A1-A5)	SuperS Opt 4 (A-C)
	(A1-A5)	- 0.80 %		+ 0.63 %		- 7.60 %	
	(A-C)		- 0.62 %		+ 0.47 %		- 5.65 %

Figure 10 Summary of superstructure results A1-A5 (EC-PC) and A-C (EC-LC)

Figure 10 compares all 4 superstructure options. Each option reports embodied carbon stages to practical completion (A1-A5) as well as over the life cycle (A-C). Each column is split according to the different categories' contributions. The figure does not include construction site operations.

Superstructure Option 1 is the baseline model and utilises CLT infills and retains the baseline 40% GGBS content in the concrete mix. This has an embodied carbon over the building life cycle (A-C) of 371.6 kgCO2e/m^2. Superstructure Option 3 which incorporates no CLT infills has a 0.47% higher embodied carbon over the building life cycle (A-C), performing the worst of the modelled options.

Superstructure Option 4 with the highest GGBS content in the concrete mix (60% GGBS) has the lowest embodied carbon over the building life cycle (A-C). This is 5.65% lower than the baseline Option 1, demonstrating the positive impact of increased GGBS content. In RIBA Stage 3 the structural team should explore the capacity of the structure to adopt higher GGBS content, including considerations towards program, and potential cost implications.

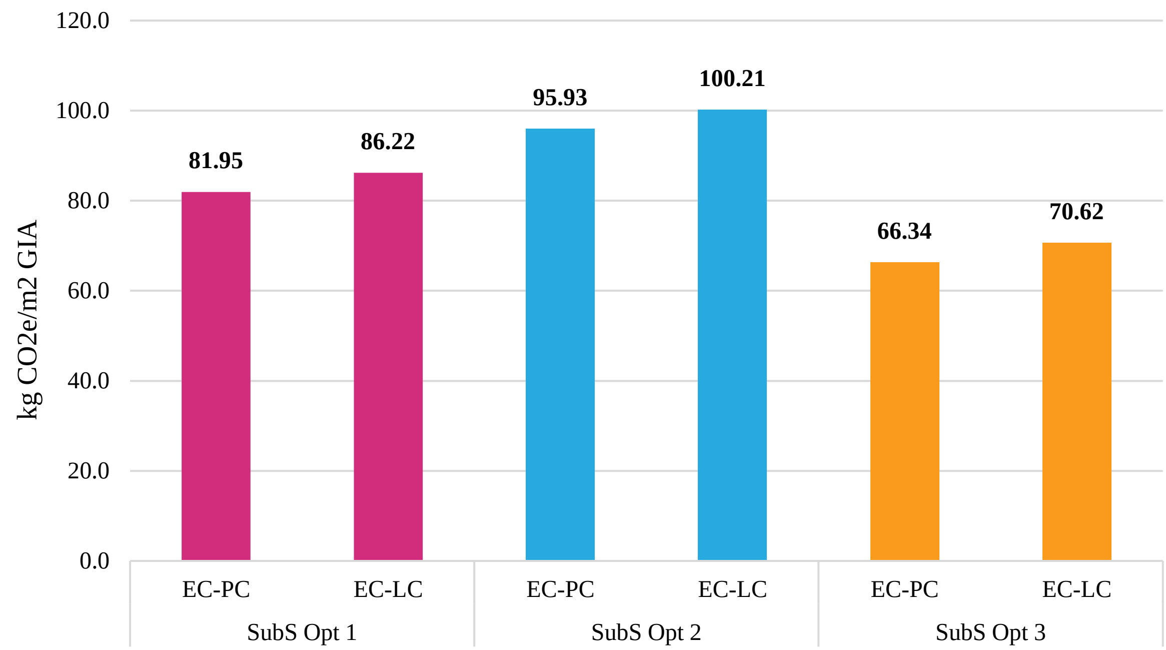
Superstructure Option 2 incorporates CLT cassettes into the frame design and has a 0.62% reduction in embodied carbon over the building life cycle (A-C) compared to baseline Option 1. Given the lack of detailed quantities available at this stage, it is estimated that these values give a conservative insight into the potential embodied carbon reduction from the use of CLT cassettes. Further investigations in later design stages (with the incorporation of the carbon sequestration potential of timber) are recommended to explore the full potential of this design option.

3.3 Substructure options appraisal

For the BREEAM options appraisal, 3no. significantly different design options have been considered at RIBA Stage 2 to explore the reduction of the environmental impact of the substructure. All substructure options are modelled on the current design of a raft foundation with secant piling.

All the substructure design options are presented in the table below. The orange cross denotes an option that has not been chosen within the baseline design, but has been identified as an opportunity for further exploration at the next design stage.

Substructure Option Ref	Description	Chosen Option
Option 1 (Baseline) Mat01_CD_SubS_HL_Opt1	40% GGBS content in concrete mix	✓
Option 2 Mat01_CD_SubS_HL_Opt3	20% GGBS content in concrete mix	✗
Option 3 Mat01_CD_SubS_HL_Opt4	60% GGBS content in concrete mix	✗



Percentage change from baseline Opt 1					
	(A1-A5)	+ 17.06 %		- 19.05 %	
	(A-C)		+ 16.21 %		- 18.10 %

Figure 11 Summary of substructure results A1-A5 (EC-PC) and A-C (EC-LC)

Figure 11 shows that there is a notable reduction in embodied carbon between the substructure options. This figure does not include construction site operations. The current baseline Option 1 uses 40% GGBS content in the concrete mix. Option 3 uses a higher content of 60% GGBS in the concrete mix and demonstrates an 18.10% reduction in embodied carbon over the building life cycle (A-C) compared to baseline Option 1. This is a positive result because the GGBS content can be optimised in later design stages during early procurement exercises. A higher content will however need to be discussed with both the design team and the client, because it affects curing time, which in turn affects the project programme.

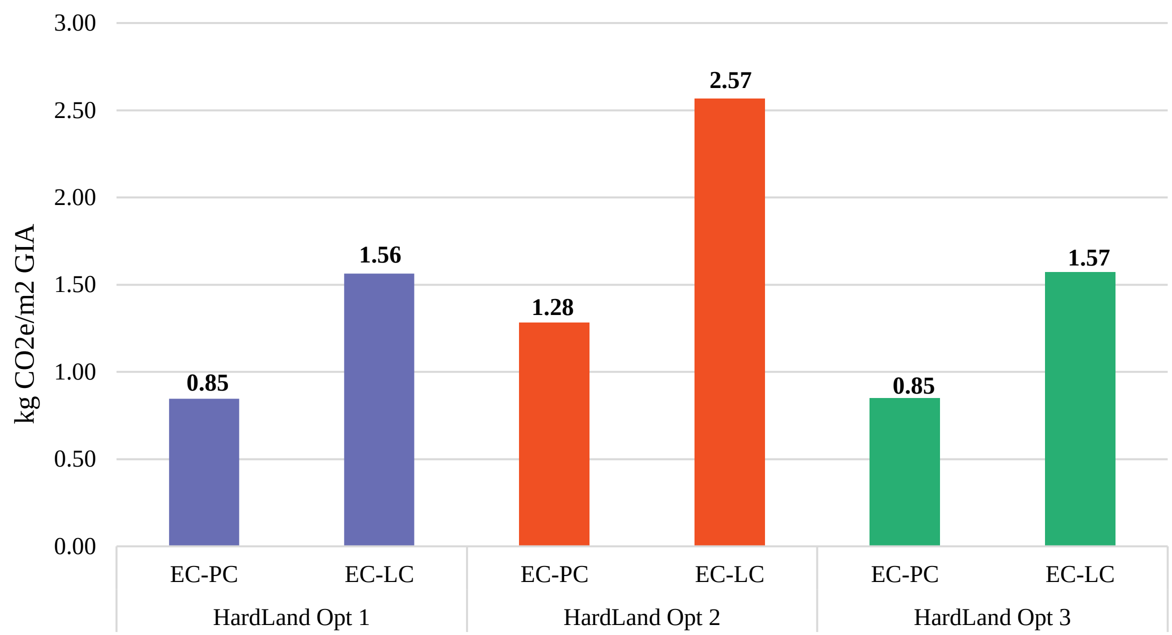
3.4 Hard landscaping options appraisal

For the BREEAM options appraisal, 3no. significantly different design options have been considered at RIBA Stage 2 to explore the reduction of the environmental impact of the hard landscaping. These were provided by landscape architects DSDHA on 04/08/2021. This study does not include construction site operations.

All the hard landscaping design options are presented in the table below:

Hard Landscaping Option Ref	Description	Chosen Option
Option 1 (Baseline) Mat01_CD_SubS_HL_Opt2	381 m^2 Permeable resin-bound aggregate 128 m^2 Concrete grass-crete 320 m^2 Parking asphalt 2986 m^2 Natural stone setts *Total hard landscaping = 3815 m^2*	✓
Option Mat01_CD_SubS_HL_Opt5	509 m^2 Permeable resin-bound aggregate 3306 m^2 Brick paving *Total hard landscaping = 3815 m^2*	✗
Option Mat01_CD_SubS_HL_Opt6	381 m^2 Permeable resin-bound aggregate 128 m^2 Concrete grass-crete 1567 m^2 Concrete flags 1739 m^2 Concrete block paving units *Total hard landscaping = 3815 m^2*	✗

Figure 12 shows that Option 1 (the baseline option) marginally has the lowest embodied carbon. Option 1 and Option 3 have similar embodied carbon impacts. However, it also shows that hard landscaping Option 2 has a significantly higher embodied carbon value. This is due to the use of brick paving which is more carbon intensive than concrete flags.



Percentage change from baseline Opt 1	(A1-A5)	+ 51.54 %		+ 0.40 %	
	(A-C)		+ 64.14 %		+ 0.65 %

Figure 12 Summary of hard landscaping results A1-A5 (EC-PC) and A-C (EC-LC)

3.5 Mat 01 Score

All embodied carbon results have been extracted from the OneClick LCA tool in excel spreadsheet version and linked to the BREEAM Mat 01 reporting tool (current version 2.2) to calculate the credits achieved for RIBA stage 2. For the options comparison, the ‘OneClick LCA (LCA for BREEAM UK)’ materials database was used. The OneClick LCA tool is IMPACT-compliant, so it can be used for the BREEAM Mat 01 options appraisal credits.

Overall, the number of BREEAM Mat 01 credits achieved at RIBA Stage 2 for the ‘new-build’ scheme are summarised in Table 6.

Table 6 BREEAM Mat 01 credits achieved at RIBA Stage 2

	Benchmark comparison	Options appraisal		Credits Achieved
	Superstructure	Superstructure	Substructure & Hard Landscaping	
Concept Design	0	2.67	1	3
Technical Design	To be updated at Stage 4			0
TOTAL	-	-	-	3

The number of BREEAM Mat 01 credits achieved at RIBA Stage 2 is 2no. credits for the appraisal of 4no. superstructure design options and 1 further credit for the appraisal of 3no. substructure and 3no. hard landscaping design options. Further LCA modelling of the superstructure is required at RIBA Stage 4 to achieve further credits.

4 Opportunities for embodied carbon reduction

Following the BREEAM Mat 01 options appraisal, further optioneering has taken place to identify valuable actions to reduce the embodied carbon at this design stage. These are Options A, B, C, D and E. Where BREEAM Mat 01 options were shown to offer significant savings, they have been incorporated into the Options. This has occurred as follows:

- BREEAM Substructure Option 3 aligns with proposed Option A
- BREEAM Superstructure Option 2 aligns with proposed Option B
- BREEAM Superstructure Option 4 aligns with proposed Option C

Proposed Options D and E offer new reduction opportunities that go beyond those modelled within the BREEAM Mat 01 assessment.

A summary of recommendations to reduce the embodied carbon footprint of the proposed scheme are presented in Table 7. The Stage 2 Baseline assessment uses material specifications provided by the design team. Where material specifications were unavailable, default values have been used according to the RICS Professional Statement, which define "average industry standard practice".

Table 7 Alternative designs modelled and resulting savings in embodied carbon at practical completion (A1-A5) and over life cycle (A-C, 60 years)

			Stage 2 Baseline	Reduction Options	Savings (A1-A5)		Savings (A-C)	
	Category	Element(s)	Assumptions	Assumptions	$kgCO_2e$	%	$kgCO_2e$	%
A	Substructure	Concrete elements	40% GGBS content in concrete mix	60% GGBS content in concrete mix	1,390,649	2.46%	1,390,649	1.43%
B	Superstructure	Upper floors	CLT infills 40% GGBS content in concrete mix	CLT cassettes + concrete beams 40% GGBS content in concrete mix	197,749	0.35%	205,492	0.21%
C	Superstructure	Upper floors	CLT infills 40% GGBS content in concrete mix	CLT infills 60% GGBS content in concrete mix	1,871,913	3.31%	1,866,730	1.92%
D	Facade	Façade	Standard aluminium fins	20% recycled content in aluminium fins	994,196	1.76%	1,918,705	1.98%
E	Hard Landscaping	Paving	381 m^2 Permeable resin-bound aggregate 128 m^2 Concrete grass-crete 320 m^2 Parking asphalt 2986 m^2 Natural stone setts	Replacement of all natural stone setts (2986m^2) with Permeable resin-bound aggregate	29,614	0.05%	55,222	0.06%
				Total Savings	**4,484,120 $kgCO_2e$**	**7.93% (A1-A5)**	**5,436,798 $kgCO_2e$**	**5.60% (A-C)**

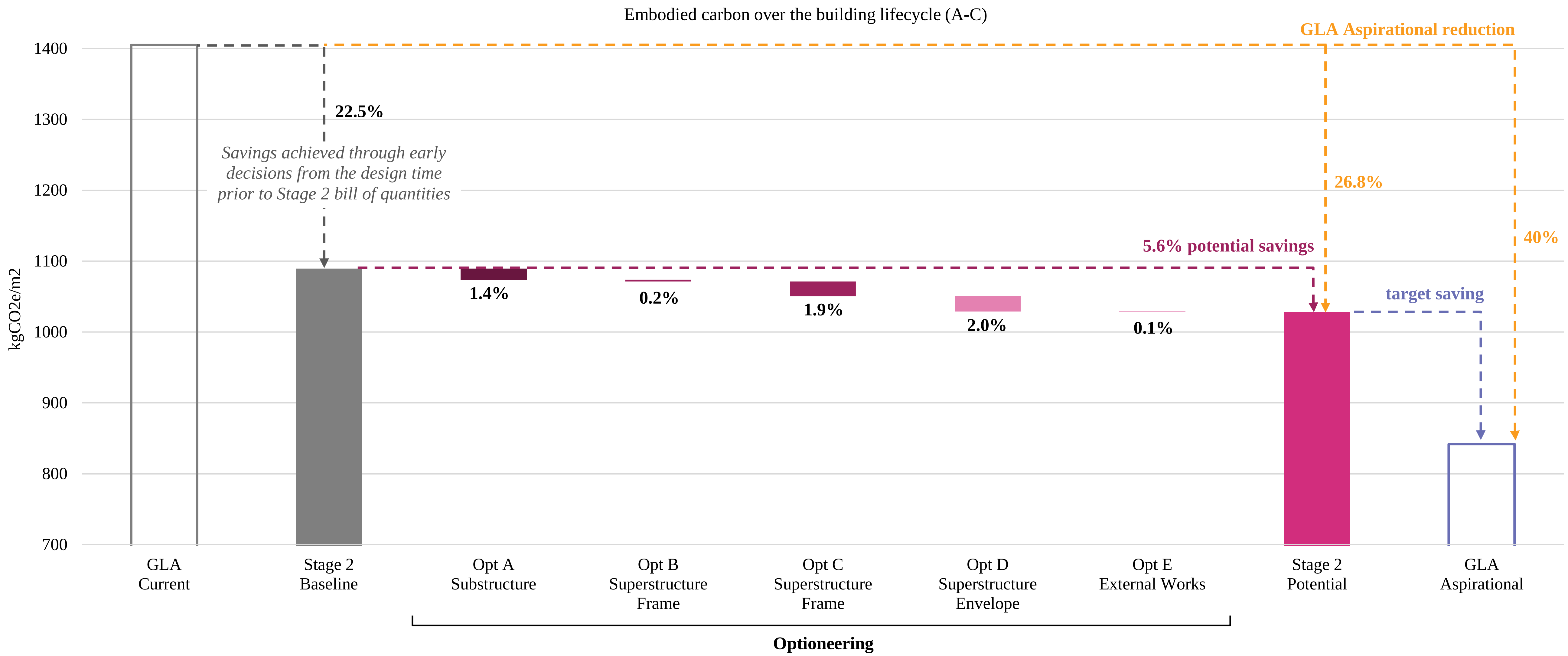


Figure 13 Waterfall graph showing the potential embodied carbon reduction from alternative design options, against GLA Current and GLA Aspirational targets over the building life cycle (A-C)

The Stage 2 optioneering analysis models five alternative design options (Opt A to Opt E) demonstrating opportunities for embodied carbon reduction. As shown in Figure 13 utilising all five of these reduction options would reduce the embodied carbon of the Proposed Development by **5.60%** over the building life cycle (A-C), which is equivalent to **5,436,798 kgCO_2e.**

The Stage 2 Baseline demonstrates a betterment of 22.5% embodied carbon over the building life cycle (A-C) by comparison to the GLA Current practice benchmark. This has been achieved through design optimisation from the earliest design stages prior to the Stage 2 proposal, for example in the design of the foundations and superstructure.

The Proposed Development incorporates CLT into the Stage 2 Baseline design which is not typical practice, and also uses better specification by default with all concrete constituting 40% GGBS content. The façade was also optimised through early-stage studies comparing the embodied carbon impact of aluminium, bronze and terracotta. The aluminium façade was shown to be most carbon efficient and was therefore selected for the Stage 2 Baseline design.

The main recommendations for achieving the Stage 2 Potential scenario are as follows:

Option A: The specification of a concrete mix for the substructure with 60% GGBS content would significantly reduce the embodied carbon impact of the proposal. Modelling demonstrates a saving of 1.43% which is equivalent to 1,390,649 kgCO_2e.

Option B: The use of CLT casettes and concrete beams in place of PT slabs for the superstructure shows potential for embodied carbon savings in later design stages. Present modelling demonstrates a saving of 0.21% which is equivalent to 205,492 kgCO_2e.

Given the lack of detailed quantities available at this stage, it is estimated that these values give a conservative insight into the potential embodied carbon reduction from the use of CLT cassettes. Further investigations in later design stages (with the incorporation of the carbon sequestration potential of timber) are recommended to explore the full potential of this design option.

Option C: As in the substructure, the specification of a concrete mix with 60% GGBS content for the superstructure would significantly reduce the embodied carbon impact of the proposal by comparison to a 40% GGBS content specification (as was modelled in the Stage 2 Baseline assessment). Modelling demonstrates a saving of 1.92% which is equivalent to 1,866,730 kgCO_2e.

Option D: Specifying aluminium containing 20% recycled content for the façade fins has been shown to have a positive impact in reducing the building's embodied carbon. Modelling demonstrates a saving of 1.98% which is equivalent to 1,918,705 kgCO_2e, compared to the Stage 2 Baseline model which uses a standard aluminium with no recycled content.

Option E: Altering the hard landscaping materials selected for the design of external areas of the Proposed Development can reduce the embodied carbon. Landscape architects, DSDHA, provided quantities for 3 alternative design options as part of the BREEAM Mat01 assessment, and selected the option with the lowest embodied carbon to form the current Stage 2 Baseline design.

Within this, the permeable resin-bound aggregate has a lower embodied carbon than the natural stone setts, so Option E has been modelled with full replacement of the natural stone setts (2986m^2) with permeable resin-bound aggregate. Compared to the Stage 2 Baseline model, this change demonstrates a saving of 0.06% which is equivalent to 55,222 kgCO_2e.

5 Carbon comparative studies

The following carbon comparative studies should act as further options to develop the 'Potential' design scenario and to inform early decisions in the selection of materials for the building components not sufficiently defined at planning stage. We recommend targeting the frame and building services, as these areas typically make up the highest proportion of the whole building embodied carbon emissions.

5.1 Frame

Structural concrete

Concrete production is one of the most carbon intensive industries, creating up to 50% of worldwide man-made carbon dioxide emissions. Where its use cannot be avoided, for instance in the substructure, high Portland cement (PC) replacement should be targeted. Partial replacement of conventional clinker can be achieved with alternatives such ground granulated blast-furnace slag (GGBS) or pulverised fly ash (PFA). These materials are also typically cheaper than Portland cement.

The pie charts below illustrate the embodied carbon impact of the cement in concrete for the product stage only (A1 to A3). Though it forms only approximately 11% of the overall mass, it is responsible for 97% of the embodied carbon. Prioritising cement replacement options when considering how to best reduce embodied carbon is therefore sensible.

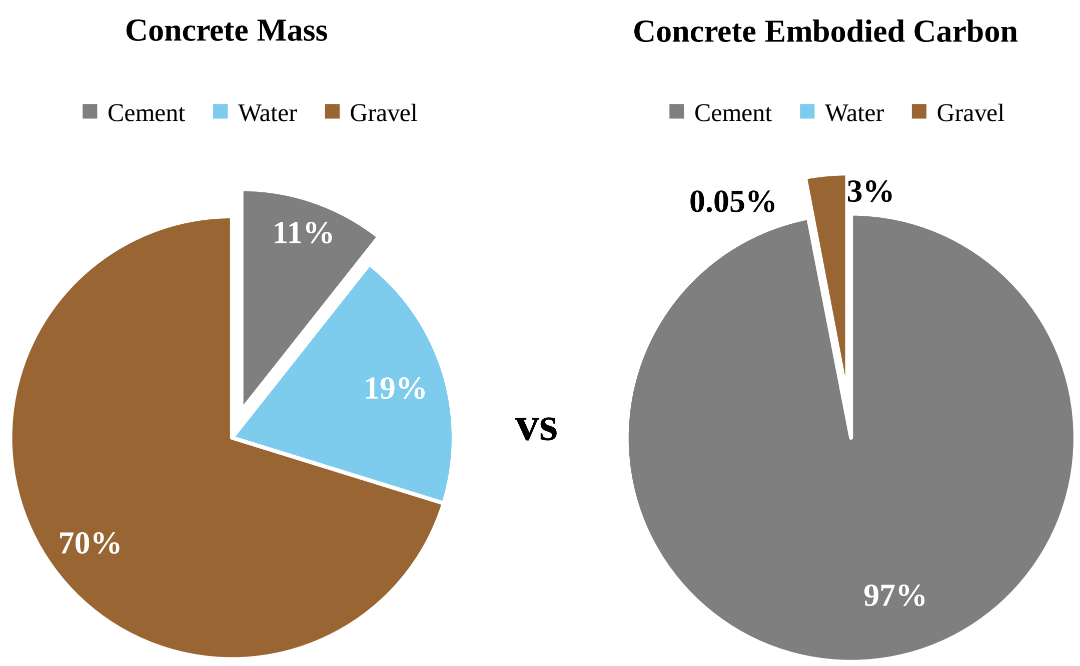


Figure 14 Concrete mass versus embodied carbon impact

An analysis was conducted to show the impact on the embodied carbon emissions of different percentages of cement replacement up to 100% (CEMfree). For this study, 50 km distance for transport to the site was assumed. However, the design team and the Contractor should consider opportunities of collaboration with suppliers closer to the British Library Extension site, where possible.

Structural steel

Structural steel provides high strength with a relatively low weight. It is 100% recyclable without degrading, enabling recycling and reuse multiple times. Secondary steel (scrap steel) holds an economic value leading to very high steel recovery rates (>90% for the construction industry according to estimations by steel associations).

Steel is produced via two main routes: the blast furnace-basic oxygen furnace (BF-BOF) route and the electric arc furnace (EAF) route. The key difference between the routes is the type of raw materials they consume. For the BF-BOF route these are predominantly iron ore, coal and recycled steel, while the EAF route produces steel using mainly recycled steel and electricity.

European manufactured structural steel sections are currently manufactured mainly via the BOF route. This process utilises approximately 20-30% of recycled steel scrap.

For this study, 300 km distance for transport to site was assumed. However, the design team and the Contractor should consider opportunities for collaboration with suppliers close to site, where applicable. UK and other European manufacturers should be considered when steel is produced via EAF route (low carbon electricity mix). HISTAR sections are a lower carbon alternative but they need to be procured from Europe (1500km distance for transport to site) and are subject to availability.

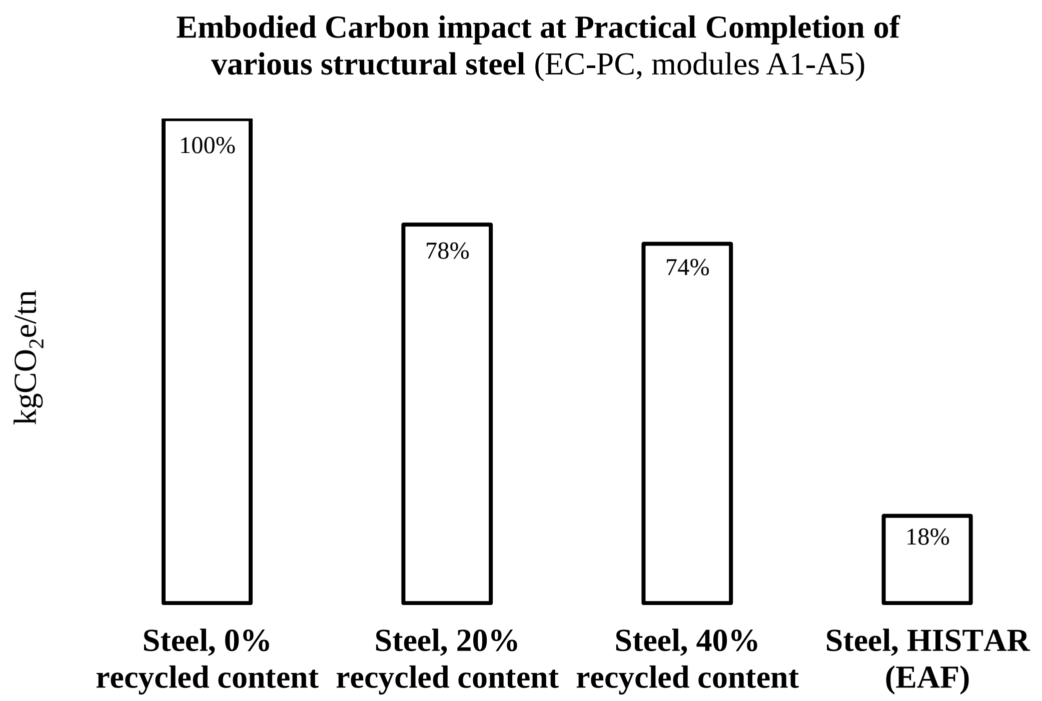


Figure 15 Embodied carbon at practical completion of various structural steel sections

5.2 Building services

In the case of building services, engineers have long been considering the operational carbon through the impacts of wider mechanical, electrical and plumbing strategies, however there is a need to also understand the embodied carbon impact of those systems so that informed choices can be made using 'whole life' thinking.

Design decisions are being investigated to reduce the amount of physical material required by services in the Proposed Development, which will reduce the embodied carbon. Strategies to reduce material volume as are follows:

- Low-level underfloor ventilation paired with a chilled soffit is being reviewed for areas of the building where internal loads allow, i.e. north commercial office floors. This has the benefit of removing significant amounts of ductwork on office floors and removing on-floor emitters such as FCUs. This results in a significant reduction in embodied carbon.
- Positioning equipment close to their point of use acts to minimise services distribution, and therefore the associated material required. Additionally, the grouping of similar adjacent spaces on the same mechanical and electrical systems can reduce overall distribution required.
- Reducing internal loads will reduce overall distribution sizes (e.g. pipe sizes) which provides additional materials (and therefore embodied carbon) savings.

The design team is encouraged to continually review alternative low carbon materials and track design decisions relating to them.

Ductwork

In comparing the embodied carbon impact of different ductwork options, a circular duct of 400mm dia and 1-metre length was used as the functional unit all assumed to meet the same performance standards. The three options modelled are:

- Traditional galvanised steel duct with 50mm thk Rockwool insulation
- Traditional galvanised steel duct with 50mm thk Paroc insulation
- Pre-insulated non-metal duct with 90mm thk phenolic insulation (e.g. 'Koolduct')

The above calculations also allow for galvanised steel fixings (suspension rings etc).

The pre-insulated ductwork ('Koolduct') has the lowest embodied carbon impact thanks to the omission of the galvanised steel casing which is the most carbon intensive element of typical ducts. Although this ductwork type does not always meet the air tightness and pressure resistance requirements for all office spaces and it may compromise the ventilation system's performance, the MEP Engineer is advised to investigate whether it can be used in non-office use areas like plant rooms and back-of-house. Alternatively, replacing the standard stone wool insulation with similar less carbon intensive products (such as Paroc), can provide some embodied carbon savings.

[1] http://www.cooperindustries.com/content/dam/public/bline/Resources/Library/catalogs/pipe_hangers/pipe_hangers_and_supports/rd-schedule4080steelpipedata.pdf

[2] https://www.oekobaudat.de/OEKOBAU.DAT/datasetdetail/process.xhtml?uuid=8622539c-592c-45b0-9a4b-e5f8b4fea367

[3] http://www.cooperindustries.com/content/dam/public/bline/Resources/Library/catalogs/pipe_hangers/pipe_hangers_and_supports/rd-coppertubingdata.pdf

Another low carbon alternative for ductwork is corrugated cardboard (such as GatorDuct). This product was not modelled in this instance as the manufacturer could not provide its Environmental Product Declaration (EPD).

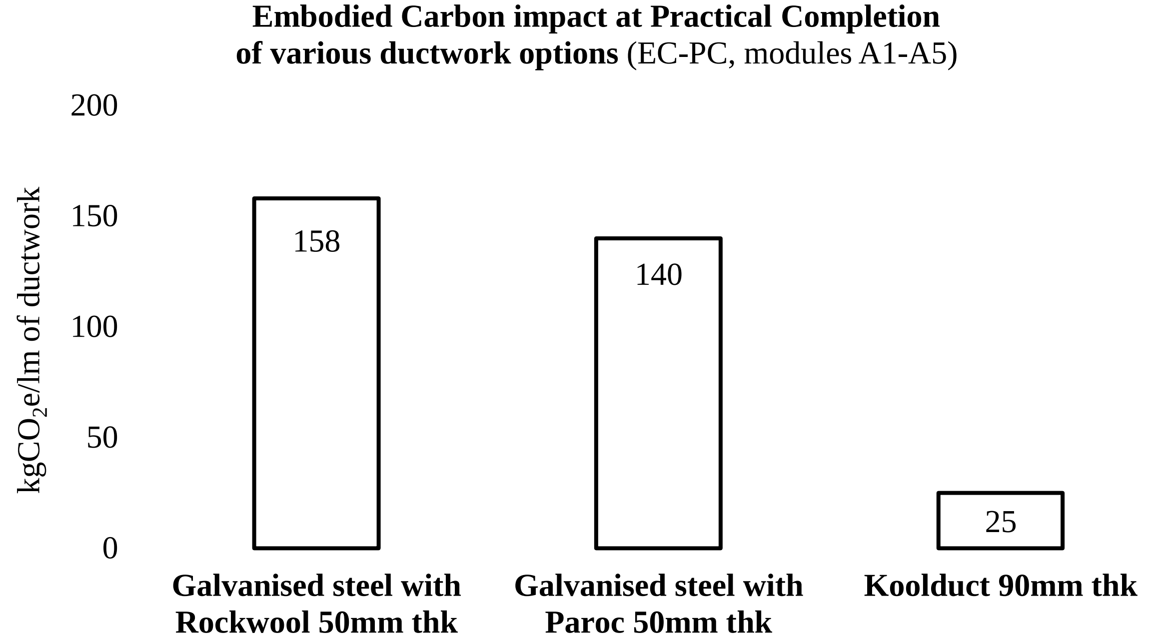


Figure 16 Embodied carbon at practical completion of various ductworks

Pipework

There are a number of factors for consideration in selection of pipework however this comparative study (summarised in Figure 17) provides and comparison of common pipework materials.

The functional unit of this study is 2" (50mm) NB pipe and 1-metre length. Corresponding wall thicknesses and weight per metre used for this study are noted in the reference for each item, below.

- Steel pipe (Schedule 40)[1] (specific steel type not specified, refer to specific dataset[2])
- Steel pipe (Schedule 80)[8] (specific steel type not specified, refer to specific dataset[9])
- Copper (Type L)[3]
- Cast iron[4]
- PVC (Schedule 40)[5]
- PVC (Schedule 80)[12]

Note that this study compares pipes of 2" diameter which may not be directly comparable due to specific performance limitations. Furthermore, the difference in embodied carbon between these materials at larger pipe diameters may be different as pipe wall thicknesses (and

[4] http://www.cooperindustries.com/content/dam/public/bline/Resources/Library/catalogs/pipe_hangers/pipe_hangers_and_supports/rd-castironsoilpipedata.pdf

[5] http://www.cooperindustries.com/content/dam/public/bline/Resources/Library/catalogs/pipe_hangers/pipe_hangers_and_supports/rd-schedule4080pvcplasticpipedata.pdf

therefore kg/m) are expected to increase at different rates depending on specific material properties and performance requirements.

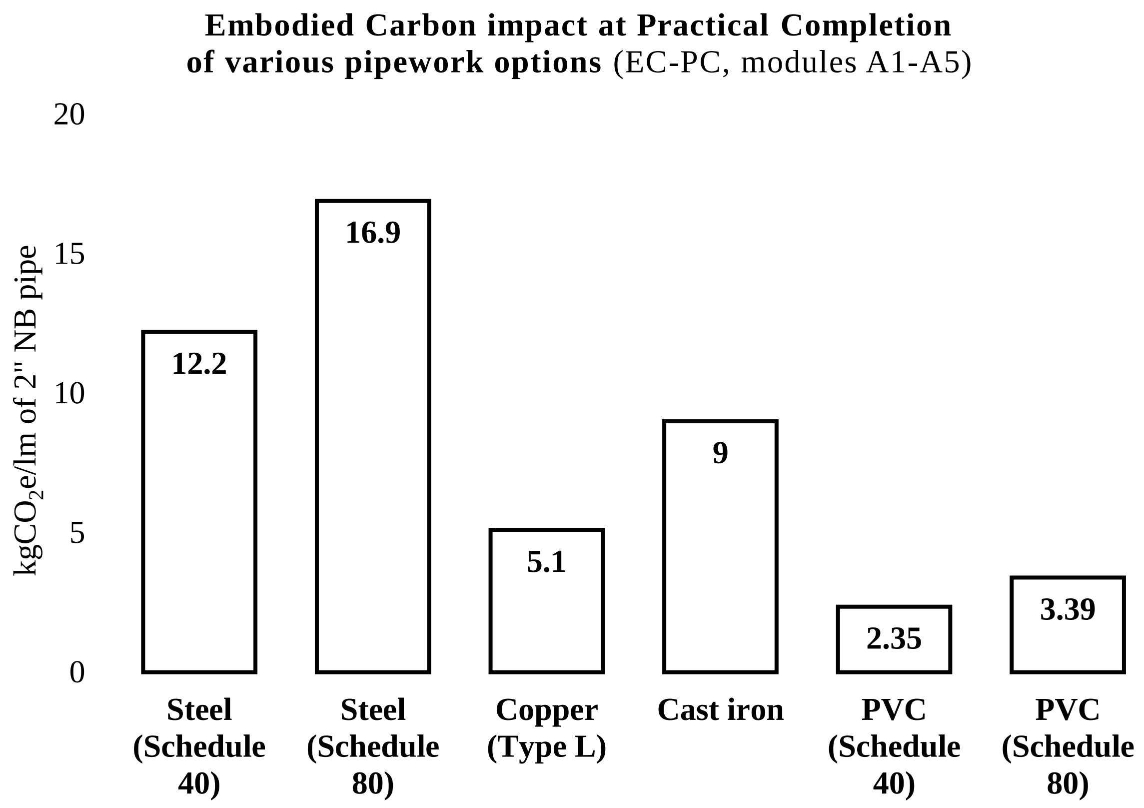


Figure 17 Embodied carbon at practical completion of various pipework materials

6 Conclusions

The following conclusions can be drawn from this study:

- The British Library development is **on track** to achieve its aspiration of **40% carbon reduction from current practice**. This aspiration has already been achieved for the building components sufficiently designed at this stage (substructure, frame, envelope and external works).
- The Stage 2 embodied carbon footprint of the proposed development at practical completion (A1-A5) is approximately **56,546 tCO2e (635 kgCO2e/m^2 GIA).**
- The Stage 2 embodied carbon footprint of the proposed development over the building life cycle of 60 years (A-C) is approximately **97,070 tCO2e (1,089 kgCO2e/m^2 GIA).**
- Alternative design options (Options A, B, C, D and E) are recommended for feasibility testing by the design team. If these options are implemented into the design, then modelling suggests that the embodied carbon footprint could drop to **91,632,933 kgCO$_2$e (1,028 kgCO$_2$e/m^2 GIA)** over the building life cycle of 60 years (A-C).
- The whole life carbon emissions of the Proposed Development are approximately **195,140 tCO2e (2,190 kgCO$_2$e/m^2 GIA)** over the building life cycle of 60 years (A-C). Within this figure, operational carbon accounts for **50.3%** of the total.
- It is recommended that the design team review the findings of this study and carry out feasibility testing to ensure the viability of these changes. If one, or a combination, of the alternative options investigated in this study are pursued then it is suggested that the embodied carbon is tracked stage on stage through further LCA study. The findings of this study should be evaluated with consideration of the study limitations.

Any further steps taken during RIBA Stages 2-4 and the construction stage to reduce embodied carbon should be documented for future learning through materials workshops attended by members of the project team to identify materials efficiency opportunities for the project.

The following next steps are recommended to be explored during Stages 2-4 to further reduce the embodied carbon of the British Library Extension:

1. Maximise opportunities to use reclaimed or recycled components: e.g. recycled materials from the demolished building
2. Model internal walls/partitions, doors, finishes, FF&E and building services items using detailed information, rather than GLA benchmarks as have been used in this study. Detailed information for these items would be required from the design team.

Appendix E: BLCC Demolition Justification Report

Stanhope, Mitsui Fudosan UK, British Library

British Library Extension

BLCC Demolition Justification Report

Rev 3.0 | November 2021

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number Job number

Ove Arup & Partners Ltd
8 Fitzroy Street
London
W1T 4BJ
United Kingdom
www.arup.com

ARUP

Contents

1 Executive Summary

This report provides a whole life carbon-based justification for demolition of the British Library Centre for Conservation (BLCC) and temporary Story Garden on the British Library site at 96 Euston Rd, London.

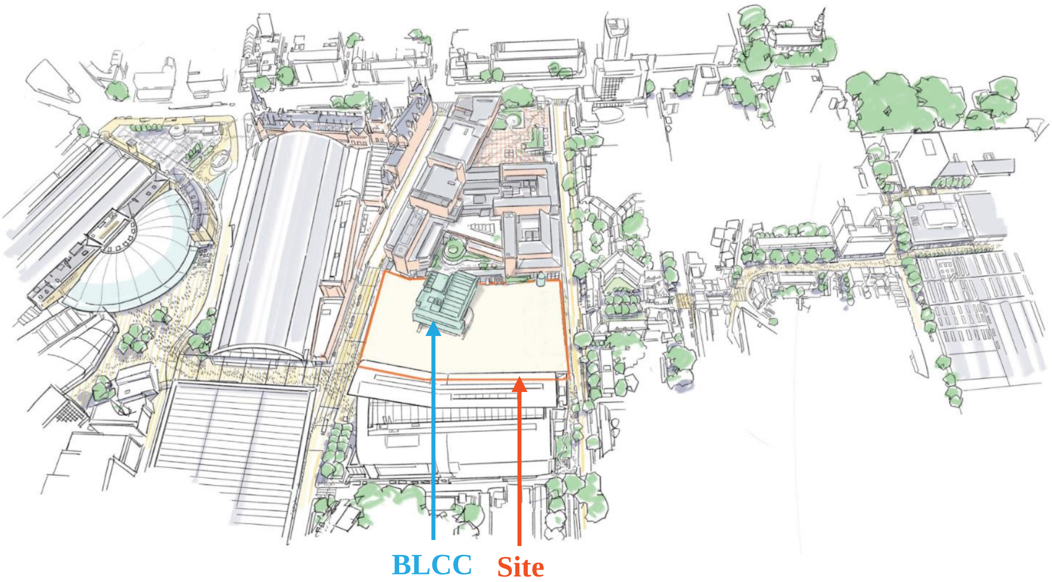


Figure 1 The Application Site with the BLCC shown in blue

The demolition would form part of the Proposed British Library Extension, a new mixed-use development located to the north of the existing British Library in Somers Town, Camden (See Figure 1).

This document has been prepared in response to the requirements outlined in the Camden Planning Guidance (CPG) (2021) Energy and Efficiency - *Chapter 9: Reuse and optimising resource efficiency*.

Local Plan policy CC1 states that Camden Council require all proposals that involve substantial demolition to demonstrate that it is not possible to retain and improve the existing building; and expect all developments to optimise resource efficiency. Paragraph 8.17 of the Local Plan states this should be justified in terms of optimisation of resources and energy use.

This report, the Pre-Demolition Audit, and the Whole Life Carbon Assessment, collectively provide evidence that the above requirements have been met.

Key findings of this report are as follows:

- The existing BLCC is excluded from the Grade I listing that covers the British Library and is described in the list entry as ‘not part of the special interest’ of the library. Additionally, the BLCC has recently received a Certificate of Immunity from Listing (dated 5th October 2021).
- An Early Stage BLCC Retention Study undertaken by Allies and Morrison Architects found that the BLCC’s location within the development site creates a series of challenges in achieving some of the main project objectives.

- Notably, retention of the BLCC would restrict opportunities to create free-flowing pedestrian movement between existing and proposed library areas; force a densification of commercial development around the site perimeter; and reduce the daylighting levels reaching the BLCC's north lights, which are crucial to the conservation operation of the building.
- It was concluded that achieving the aspirations envisaged for the future Crossrail 2 station at Euston/St Pancras would not be possible without the demolition of existing buildings on the site, most notably the BLCC.
- A whole life carbon assessment over a 60-year time period has been carried out to compare the whole life carbon impact of the demolition versus retention of the BLCC. Results are summarised in Figure 2.
- This whole life carbon study demonstrates that there are carbon benefits over a 60-year lifespan from the demolition of the BLCC, versus its retention.
- It is anticipated that over 98% of waste can be diverted from landfill for the full demolition works at the British Library project (including the BLCC, pepperpot stair and internal alterations to the Library's north façade).
- The newly proposed BLCC will add significant value to the public realm, and the new community garden will positively contribute to the surrounding area.

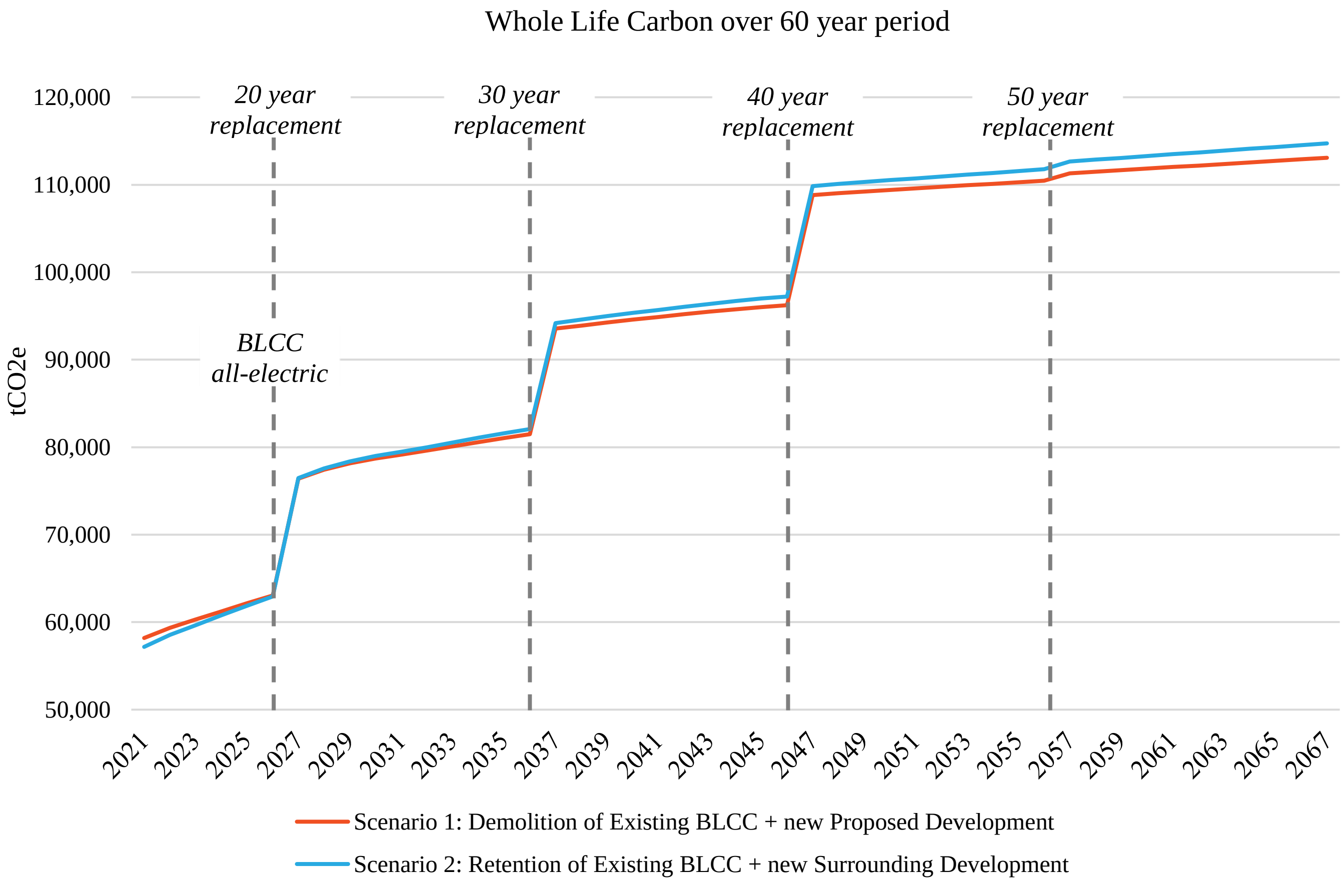


Figure 2 Whole life carbon emissions associated with Scenarios 1 and 2

2 Introduction

This report provides a whole life carbon-based justification for demolition of the British Library Centre for Conservation (BLCC) and temporary Story Garden on the British Library site at 96 Euston Rd, London.

The demolition of the BLCC and Story Garden would form part of the Proposed British Library Extension, a new mixed-use development located to the north of the existing British Library in Somers Town, Camden.

This document has been prepared in response to the requirements outlined in Camden Planning Guidance (CPG) (2021) Energy and Efficiency - *Chapter 9: Reuse and optimising resource efficiency.*

Local Plan policy CC1 states that Camden Council require all proposals that involve substantial demolition to demonstrate that it is not possible to retain and improve the existing building; and expect all developments to optimise resource efficiency. Paragraph 8.17 of the Local Plan states this should be justified in terms of optimisation of resources and energy use.

This report, alongside the Pre-Demolition Audit, and Whole Life Carbon Assessment, collectively provide evidence to support the case for demolition of the BLCC and Story Garden.

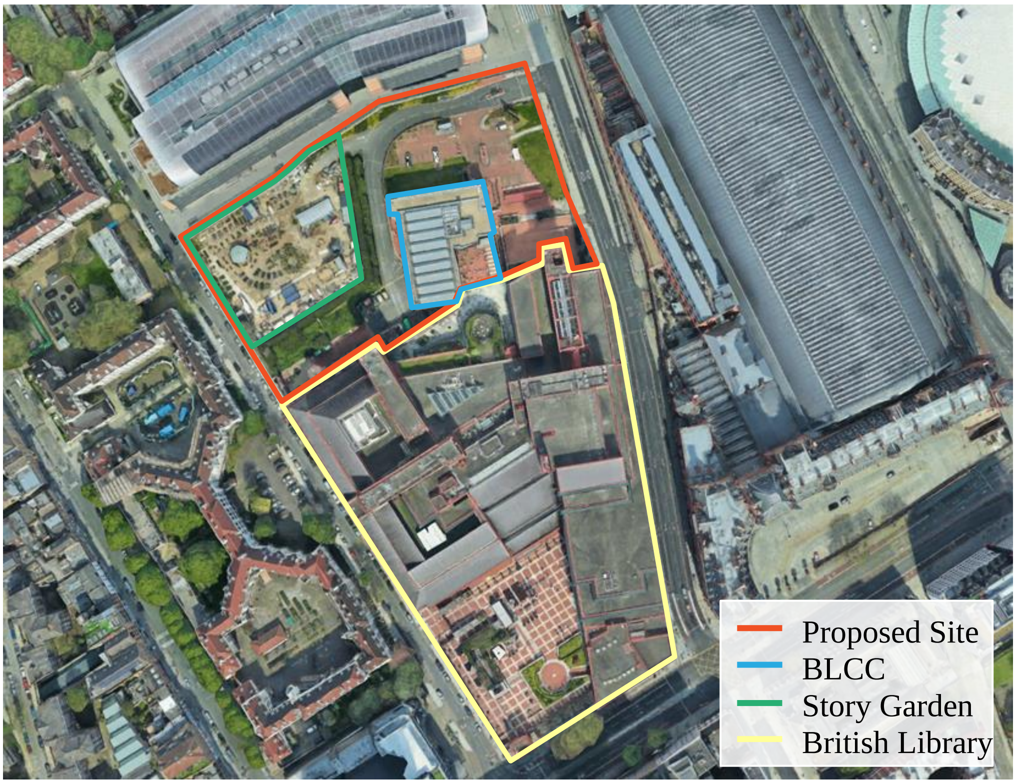


Figure 3 Aerial view of the Existing Site

The Proposed Development comprises of:

- British Library accommodation
- Commercial, including lab-enabled, floorspace
- Retail space
- Crossrail 2 works
- Relocated new British Library Centre for Conservation facilities

The Existing Site will need to be cleared in order to make way for the Proposed Development. As shown in Figure 3, this includes the British Library Centre for Conservation (BLCC) and the Story Garden, a temporary urban food growing garden built for and by the local community, which is run by Global Generation.

Although the Proposed Site forms part of the exiting British Library site, it has never been integrated into its campus. Currently, the existing British Library's plan terminates on its Northern range which houses the British Library Centre for Conservation, the Level 01 Terrace as well as the Library's loading bay, some staff parking and access roads.

There are notably no existing public connections at the northern side of the British Library and the library's internal circulation is truncated at this juncture and loops back on itself.

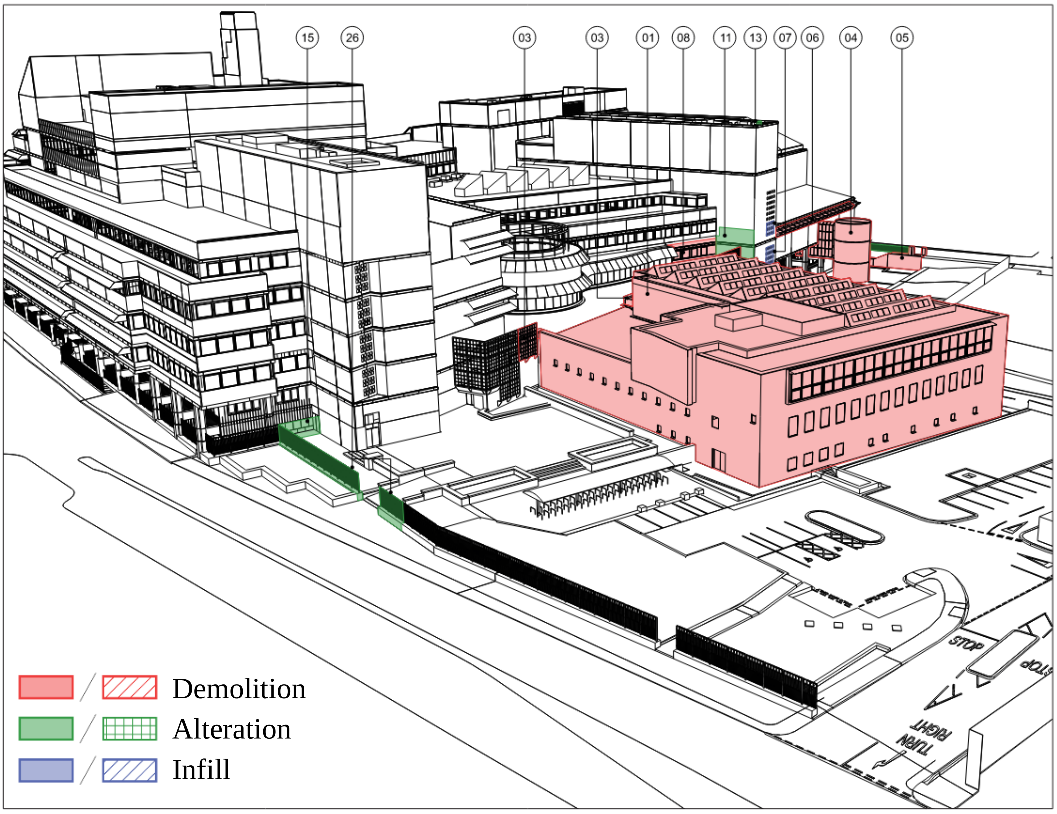


Figure 4 Existing building indicating areas of demolition/alteration (RSHP 31-08-21)

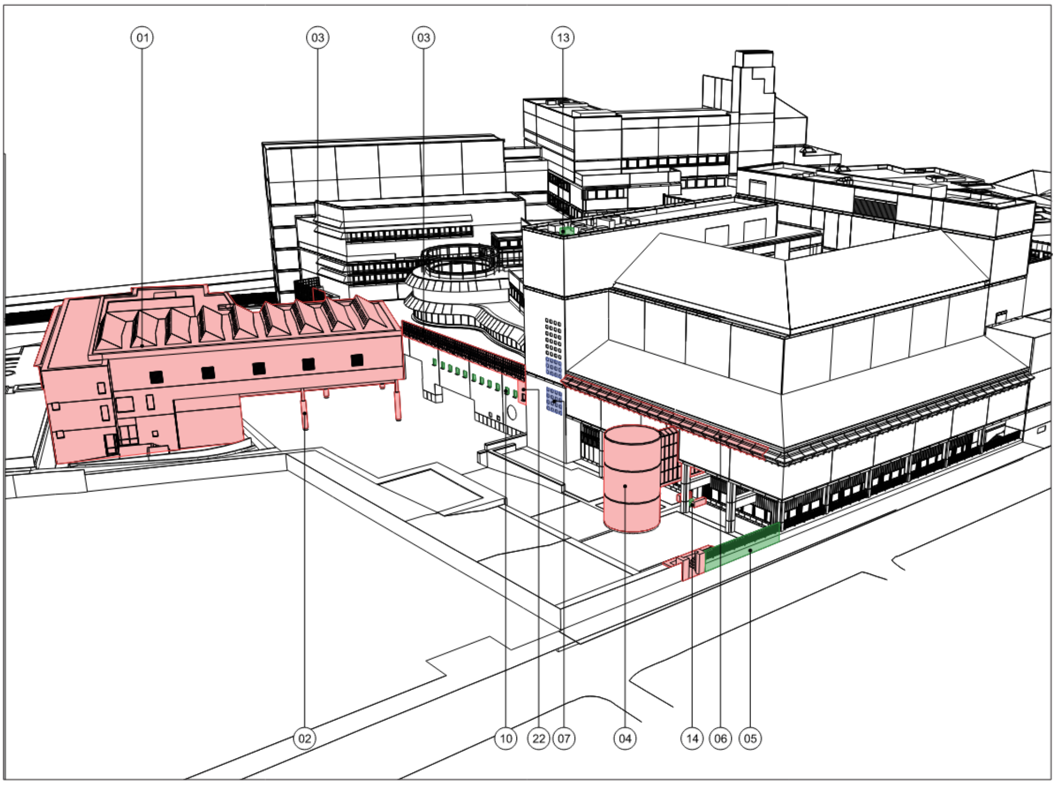


Figure 5 Existing building indicating areas of demolition/alteration (RSHP 31-08-21)

3 Existing BLCC

The 3-storey British Library Centre for Conservation (BLCC) designed by Long & Kentish architects was completed in 2007 and additionally houses the National Sound Archive (NSA). This building is connected to the original British Library building via an external deck above the library's loading bay.

The BLCC was constructed to a tight budget and a lower cost per square meter than the British Library, as a design and build contract. It was programmed as a back-of-house facility for the conservation of books and to house the BL's sound archive, with the public only able to access a small exhibition space near the entrance of the building of the first-floor terrace.

The BLCC architecture is subservient to the library and faced in matching red bricks. Its interior is more modest than that of the public areas in the British Library.

It is important to recognise that while the British Library is Grade I listed, the more recently constructed BLCC is excluded from the listing. The BLCC is described in the list entry as 'not part of the special interest' of the library. Additionally, the BLCC has recently received a Certificate of Immunity from Listing (dated 5th October 2021).

Figure 6 Aerial image showing the existing BLCC (left) and the British Library (right)

4 Existing Story Garden

The north-west corner of the existing site is currently occupied by the meanwhile Story Garden, a temporary urban food growing garden built in 2019 for and by the local community, which is run by Global Generation. The garden was approved under a temporary planning permission (ref: 2018/5663/P), to be relocated upon the commencement of construction for the Proposed Development.

Figure 7 Photograph showing the Story Garden (Source: Global Generation)

The Story Garden was created as a temporary space in partnership with the British Library, Stanhope and SMBL Developments Ltd. to make use of the unoccupied plot. It has provided a green social space in the heart of Somers Town whilst long-term plans for the site were drawn up.

As shown in Figure 7, the Story Garden consists of raised beds, a polytunnel, a series of portacabins, sheds, and a 5m circular wooden yurt. All built elements were brought to site with temporariness in mind, are portable and can be relocated. As a result, there is a negligible carbon impact from the removal of the Story Garden from its present site.

The Story Garden has proved to be a popular amenity for the local residents, a space for people to connect with nature and offering advice and education to assist with growing flowers, fruit and vegetables. It has also provided a safe environment in which to host community and calendar events and workshops, providing facilities through collaboration with local families, children and young people, local workers, companies and institutions.

The Project Team has committed to create a new community garden within the Site as part of the Proposed Development. This will be of high ecological value and create new biodiverse habitats in the area, whilst also mirroring the community-central approach and resulting value of the previous Story Garden. This is notable in the co-design approach to the Proposed Development's community gardens, as detailed in the Public Realm and Landscape Design Statement submitted as part of this application.

The removal of the temporary Story Garden from its present site is predicted to have a negligible carbon impact.

5 BLCC Retention

A study was undertaken to understand the impact of retention of the existing BLCC upon the Development Potential of the Site as part of the Invitation to Submit Final Tender. In line with the hierarchy provided in Camden's Energy and Efficiency CPG, this study considers the opportunities for *i. Refit, ii. Refurbish, iii. Substantial refurbishment and extension,* and *iv. Reclaim and recycle.*

A preliminary 'Proof of Concept' proposal, prepared by Allies and Morrison Architects, formed part of the original PQQ material. The SMBL Developments Ltd. team considered the possibility of BLCC retention and presented their thoughts to the British Library.

Site constraints

SMBL considered the possibility of BLCC retention. The three main factors preventing the retention of the BLCC were:

Firstly, the central plan position of the BLCC in relation to existing reading room wings serves to restrict to a large degree the opportunity to create free-flowing pedestrian movement between existing and proposed library areas.

The relatively solid form of the BLCC and the sensitivity of the activities which take place inside do not lend themselves to being surrounded by publicly accessible circulation areas. In effect, the BLCC acts as a 'bung' within the 'necking' formed by the rectilinear blocks of reading rooms located along the main street frontages.

Figure 8 Plan view of an early massing study exploring the retention of the existing BLCC

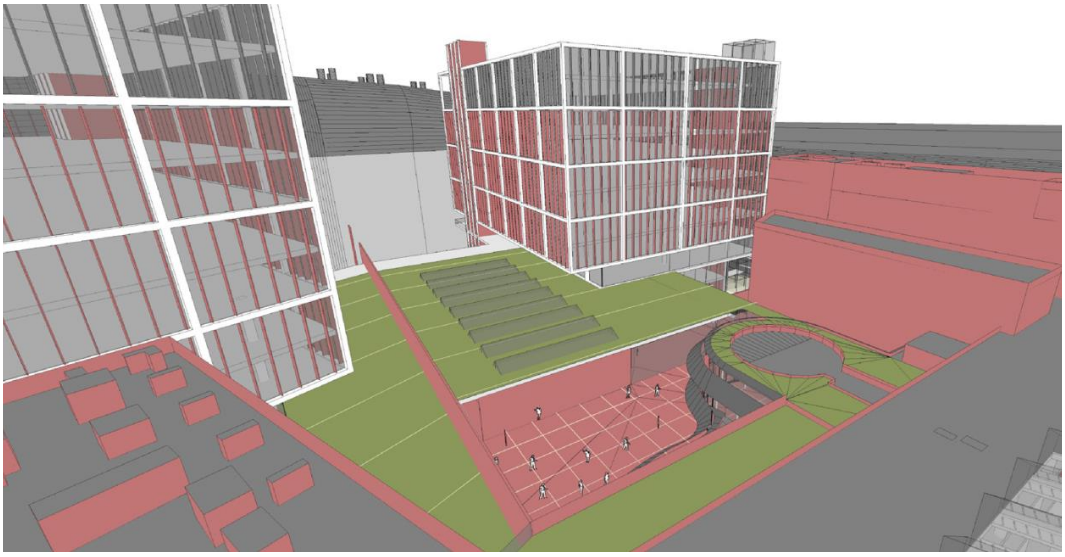


Figure 9 Massing study view of the existing British library terrace with retention of the existing BLCC

Secondly, retaining the BLCC presents challenges in realising the development potential of the site. Although relatively small and low, the central location of the BLCC leaves narrow residual areas of the site available for development which would require commensurately denser commercial development around the site perimeter.

For neighbours and adjoining owners, the perception and scale of such development runs counter to BL’s aspiration for greater openness and transparency and may be counter-productive, pushing building heights into areas of greater impact and risk.

Thirdly, if the existing BLCC were to be retained within a new development of taller buildings surrounding it, it is doubtful whether residual levels of daylighting would remain sufficient to serve the building’s north lights, crucial to the conservation operation of the building. This would not allow the BLCC to deliver the high-quality internal conditions required to realise its conservation ambitions.

For all of the above reasons, the base assumption of the Invitation to Submit Final Tender (ISFT) (competition) scheme assumed the removal and relocation of the BLCC elsewhere within the development site.

Assessment under Camden’s CPG

Taking into account the condition of the existing building and feasibility of re-use as detailed above, assessment of the BLCC under Camden’s Energy and Efficiency CPG hierarchy concludes the following:

i. Refit

Refit involves the retention of the existing structure as is, including minor works, and the replacement of building services to continue occupation of the building.

This option is not viable for the BLCC because a refit would not be sufficient enough to tackle the predicted lack of residual daylighting levels that will reach the BLCC if it is contained within a taller surrounding development. It was decided by the Project Team that a refit would not allow the BLCC to deliver the high-quality internal conditions required to realise its conservation ambitions.

ii. Refurbish

Refurbishment seeks to significantly improve the service life of the existing building. This option provides an opportunity to retrofit the building to reduce carbon emissions and include sustainable adaptation measures.

Refurbishment was considered by the Project Team as demonstrated within the BLCC retention study. It was concluded that refurbishment was not a viable option for the BLCC, because the reason for demolition is not related to poor building quality or limited service life, rather the BLCC creates a massing problem due to its prominent position on the Site of the Proposed Development.

iii. Substantial refurbishment and extension

Substantial refurbishment and extension takes into consideration the need to optimise site capacity and alter the existing structure to meet future needs.

This option is not viable for the BLCC because a substantial refurbishment and extension would not be sufficient enough to tackle the predicted lack of residual daylighting levels that will reach the BLCC if it is contained within a taller surrounding development, as was modelled in the BLCC retention scenario. This would not allow the BLCC to deliver the high-quality internal conditions required to realise its conservation ambitions.

Furthermore, in the case of extension, the relatively solid form of the BLCC and the sensitivity of the activities which take place inside do not lend themselves to being surrounded by publicly accessible circulation areas, which would be required if the proposal was to extend the existing buildings. Retention of the BLCC would restrict opportunities to create free-flowing pedestrian movement between existing and proposed library areas and in the case of extension would force a densification of commercial development around the site perimeter. Although relatively small and low, the central location of the BLCC leaves narrow residual areas of the site available for development.

iv. Reclaim and recycle

Given that the above options are demonstrated as unfeasible in the case of the BLCC, the Proposed Development has specified a Pre-Demolition Audit which identifies all materials within the BLCC and documents how they should be managed. This can be found appended to this document. The Pre-Demolition Audit prioritises re-use of waste on and off site, followed by waste recycling, and only finally specifies transportation to landfill.

Section 7 of this document details the whole life carbon study from the demolition of the BLCC, versus its retention. The study demonstrates that there are carbon benefits from the BLCC's demolition over a 60-year lifespan. Beyond this, the Circular Economy Statement submitted as part of this application demonstrates the Proposed Development's commitment to maximise reclamation and recycling across the project lifecycle.

Under Camden's Energy and Efficiency CPG hierarchy, this study concludes that *iv. Reclaim and recycle* (after demolition) is the most viable option for the Proposed Development.

The demolition of the existing BLCC and Story Garden, with commitment to maximise waste reclamation and recycling, is therefore considered an acceptable approach in order to enable greater social value in the Proposed Development and help realise its goals.

6 Integration of Crossrail 2

The proposals for the British Library Extension include a complex of structural enclosures above and below ground, to house the future requirements of Transport for London' Crossrail 2 (CR2) implementation.

Throughout the design process there have been ongoing discussions regarding the value of retaining the existing BLCC. For example, at the Design Review Panel No. 1 (23rd October 2020) the design team presented work in progress building upon the earlier scheme, updating LB Camden with latest work showing Crossrail 2 proposal and reinforcing earlier discussions which explained the need to remove and replace the existing BLCC in order to allow for the Crossrail 2 construction.

Crossrail 2 is planned to connect North and South London, and to run beneath the Library site. One of the most important advances anticipated in the Crossrail 2 strategy is the creation of a new station, beneath Somers Town, connecting Euston and St Pancras Stations, two of London's most strategic transport terminals. This forms a key aspect of the Proposed Development.

With the creation of this new transport infrastructure, the St Pancras area will become even more significant as London's most important transport interchange.

To create the new Crossrail 2 station, and make the connection between Euston and St Pancras, TfL require:

- A deep shaft at the western end of the site, descending from street level through 6 underground levels, to the future depth of the CR2 running tunnels. The shaft will connect to the running tunnels and platform of the new station, and house ventilation, escape and vertical transport infrastructure facilities, including escalators, when CR2 is eventually commissioned.
- A basement, to accommodate a series of plant rooms, including a large ventilation fan chamber, connecting to the deep shaft
- A pedestrian passageway connecting east-west across the site, at basement level, to provide a secure route for passengers between the new CR2 station platform and a new ticket hall under Midland Road (not forming part of the proposals)
- Ventilation, escape, servicing, and access facilities at street level and above, in a 'headhouse' and through ventilation funnels.

The scale, functions and arrangements of these elements have been the subject of three years' collaboration between Transport for London (TfL) and the Applicant.

The design, which forms part of the proposals for planning, is underpinned by a wealth of technical detail and engineering design that has established the technical viability and capacity of the shaft, basement, and passenger passageway to accommodate the future engineering installations and internal fit-out that will be carried out by Transport for London when Crossrail 2 is commissioned. Until then, the spaces created under the new building will be dormant.

Given this context, it was therefore concluded that achieving the aspirations envisaged for the future Crossrail 2 station at Euston/St Pancras would not be possible without the demolition of existing buildings on the site, most notably the BLCC.

7 BLCC Whole Life Carbon Study

This section demonstrates that under the assumptions outlined in this assessment, there are carbon benefits over a 60-year lifespan from the demolition of the BLCC, versus its retention – even considering a conservative approach to analysis. Due to the relatively small size of the BLCC, its demolition does not have a substantial impact on the carbon footprint of the whole development.

Scenarios

A whole life carbon assessment over a 60-year time period has been carried out to compare the whole life carbon impact of the following scenarios:

Scenario 1: The demolition of the existing BLCC + construction of the Proposed Development

Scenario 2: The retention of the existing BLCC + construction of a new Surrounding Development, which would be constructed around the existing BLCC.

Data

The whole life carbon study combines the following data:

- Operational energy consumption of the existing BLCC
- Predicted operational energy consumption of the Proposed Development based on the current Energy Statement
- Embodied carbon from the demolition of the existing BLCC and re-use of materials as specified in the Pre-Demolition Audit
- Embodied carbon of the Proposed Development
- Embodied carbon of material replacement cycles over the 60-year life span based on the LCA (presented as part of this planning application)
- ‘End of life’ embodied carbon data based on the LCA (presented as part of this planning application)

In Scenario 2 (retention of the existing BLCC) an assumption has been made for the GIA of a hypothetical new Surrounding Development which would be built around the retained existing BLCC. The GIA values used in this study are detailed in Table 1.

Table 1 Gross internal areas

	GIA (m^2)
Existing BLCC	2,672
New Surrounding Development	87,500
New Proposed Development	89,451

Operational energy in the existing BLCC

Operational energy figures for the existing BLCC have been provided by the British Library. The existing BLCC has an average energy consumption of 262,390 kWh per annum. This is split into electricity and gas. On average, the energy consumed is sourced from 88% electricity, and 12% gas. In winter months the gas use can be as high as 23% of the overall operational energy consumption.

The operational energy consumption of the existing BLCC is incorporated into the whole life carbon study. It assumes an average energy consumption of 146,611 kWh (electricity) and 115,779 kWh (gas) per annum.

All-electric energy

Although the operational energy consumption of the existing BLCC is presently a combination of gas and electric, it is anticipated that the gas contribution would be phased out within the 60-year lifespan of this study.

Within the whole life carbon study, an assumption has been made that in the year 2027, the existing BLCC would be retrofitted to operate as a fully electric building. The year 2027 was selected as the BLCC was constructed in 2007, and under the RICS Professional Statement guidance, MEP systems have a 20-year expected lifespan. The model has assumed that the kWh demand has remained consistent, and the efficiency of the systems proposed to meet the demand have been upgraded from 96% for the gas boilers to 300% for likely new Air Source Heat Pumps.

The transition to fully electric systems follows the expected evolution of building regulations and the requirements to decarbonise the existing building stock. When the life spans of the current MEP systems come to an end, the new systems will need to comply with stricter net zero carbon requirements. This will be met by increased dependence on a decarbonised electricity grid, so any new MEP system is assumed to be fully electric.

Decarbonisation

The operational carbon data for the Proposed Development has been provided by Arup and is detailed within the Energy Statement for the Proposed Development. The data is based on the UK Building Regulation Part L analysis Arup have undertaken of the current Stage 2 design.

This whole life carbon study has been modelled to account for UK grid decarbonisation forecasts.

Adjustment coefficients calculated from the FES 2021 ‘slow progression’ scenario for a 60-year lifespan have been applied to the operational carbon figures provided for both the Proposed Development (Scenario 1) and new Surrounding Development (Scenario 2).

Replacement cycles

Assumptions for the lifespan of different building elements follows guidance set out in the RICS Professional Statement. These are detailed in Table 2.

These assumptions have been incorporated into the whole life carbon study to ensure the embodied carbon associated with replacement is accounted for.

Table 2 Component lifespan assumptions

Building element	Lifespan (years)
Superstructure (only select elements)	30
Façade	30
Internal walls and partitions	30
Internal finishes	20
FF&E	10
Building services	20

Pre-Demolition Audit forecasts

The Pre-Demolition Audit has identified the key materials that will arise as a result of demolition and associated works on site.

Key materials identified include concrete, hardcore, tiles and ceramics, metals, timber, gypsum (plasterboard), plastic and glass, for which the most suitable waste management options have been determined in order to maximise the recovery of each of the materials.

The findings also include a forecast tonnage or volume of each of the key materials that are anticipated to arise from the demolition. This WLC assessment includes the embodied carbon impact of the demolition and processing of all the materials identified in the pre-demolition audit (Modules C1-C4). These quantities have also been modelled in Table 3 (A1-A3) to calculate the anticipated carbon footprint of the materials that may be reused in the new development.

Table 3 The carbon footprint of materials from the demolition of buildings on site, as forecast within the Pre-Demolition Audit

Demolition materials	**Cradle to gate impacts (modules A1-A3)**	
	tCO_2e	**% of total**
Metals	3,434	54.70%
Soft floor coverings	1,180	18.80%
Concrete	422	6.70%
Brick	288	4.60%
Gypsum plaster board	262	4.20%
Furniture	253	4.00%
Insulation	207	3.30%
Discarded equipment and machinery	187	3.00%
Plastic	20	0.30%
Glass	8.6	0.10%
Cables	7	0.10%
Timber	2.5	000%
Hardcore	2.6	0.00%
Mixed demolition aggregate	0.3	0.00%
Tiles and ceramics	0.075	0.00%

There is a potential opportunity to re-use some of these materials on site, which would reduce the volume of materials to be sourced in the Proposed Development. This could provide significant carbon savings.

The results of the study are shown in Figure 10. Note that the vertical axis of the graph starts at 50,000 tCO2e.

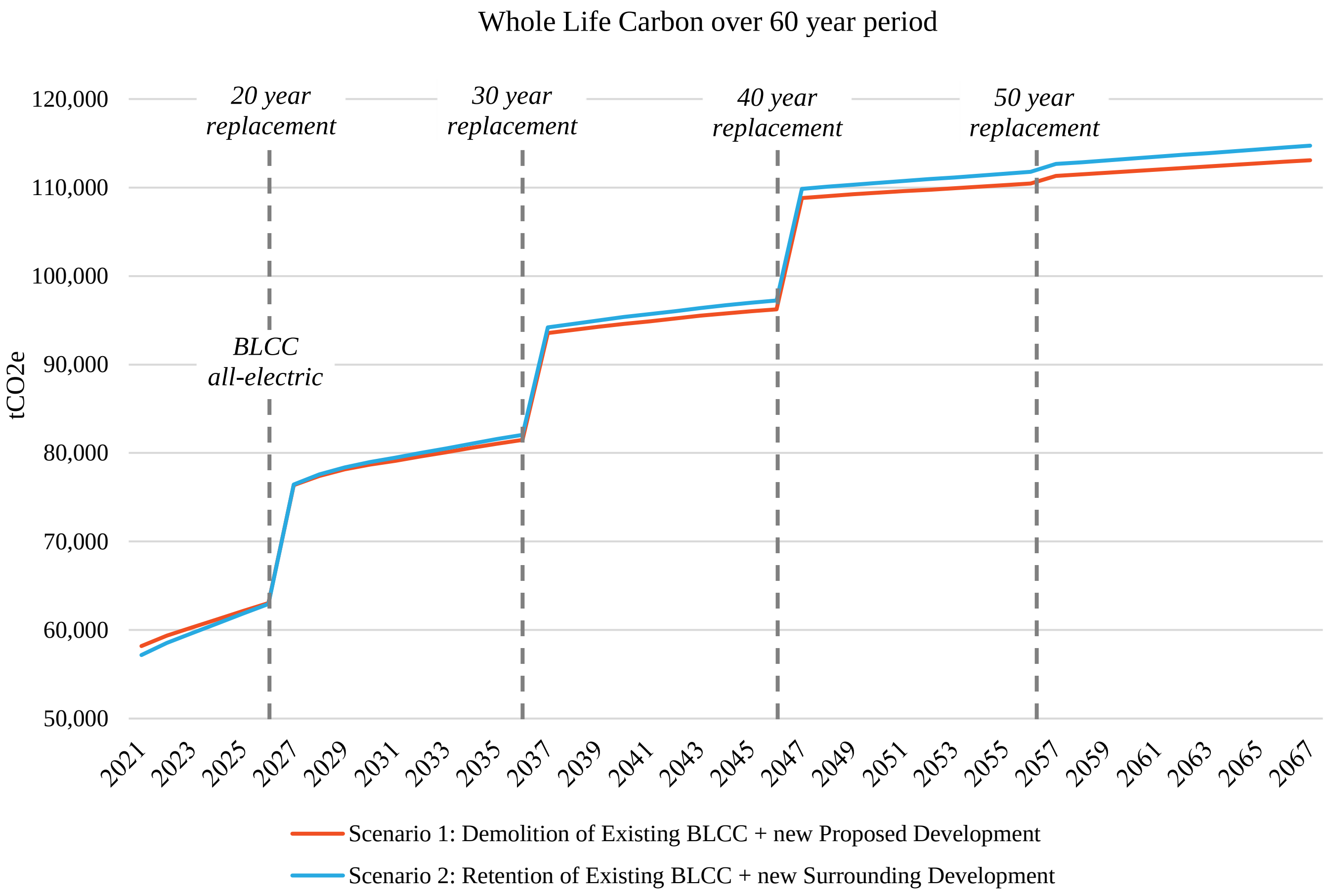


Figure 10 Whole life carbon comparison over the building's 60-year life span (from 2007)

A comparison of the carbon emissions of the two scenarios is shown in Table 4.

Table 4 Cumulative carbon emissions comparison between Scenarios 1 and 2

	Cumulative carbon emissions (tCO_2e)		
	2027	2047	2067
Scenario 1 (demolition)	76,385	108,816	111,318
Scenario 2 (retention)	76,460	109,841	112,658
Carbon impact of retaining the BLCC (Scenario 1 – Scenario 2)	+ 75	+ 1025	+ 1340
% reduction in cumulative carbon emissions between Scenario 1 (demolition) and Scenario 2 (retention)	0.10%	0.93%	1.19%

This assessment has not included the impact on operational performance that a future retrofit of the BLCC could have. It is difficult to predict the scale of this potential improvement over time, however we can predict that a future improvement to the thermal performance of the BLCC to match the levels achieved within the Proposed Development would reduce the operational energy, but not significantly enough to revert the initial trend.

The key findings from this study are as follows:

- Scenario 1 (BLCC demolition) has a lower whole life carbon impact over a 60-year study period than Scenario 2 (BLCC retention). The reason for this is two-fold. The existing BLCC depends on an electric/gas split, of which the gas proportion accounts for a higher operational carbon figure per annum than an all-electric comparison. Over the span of the assessment, even accounting for an MEP system upgrade to all-electric, the higher operational figure outweighs the additional carbon cost of the demolition process.
- By 2067, Scenario 1 (BLCC demolition) offers a reduction of **1.19%** over Scenario 2 (BLCC retention), which accounts for a total saving of **1340 tCO2e.**
- While initially Scenario 1 (BLCC demolition) has a higher whole life carbon footprint, by the year 2027, both Scenarios 1 and 2 demonstrate equal whole life carbon footprints. From the year 2027 onwards, Scenario 1 has a lower whole life carbon footprint than Scenario 2.
- Over the full 60-year study period, the carbon difference between the two schemes continues to increase, implying that Scenario 1 (BLCC demolition) will offer even greater savings over the long run.

The calculations of the carbon emissions have assumed that the relative operational and embodied carbon impacts (kgCO2e/m^2) of both the Proposed Development and Surrounding Development scenarios are comparable.

However, in reality, a development designed to surround the existing BLCC building would experience significant site constraints that would likely create a building that is less carbon efficient than a new building developed without those constraints.

This whole life carbon study demonstrates that there are carbon benefits over a 60-year lifespan from the demolition of the BLCC, versus its retention.

8 Demolition Plan

In order to facilitate the construction of the Proposed Development, the BLCC would be relocated. The BLCC functions are integral to the operations of the British Library and therefore would be temporarily accommodated within the existing Library until the relocated BLCC facility is completed.

Although the existing Story Garden will be removed, a new community garden would be created within the Site. This would be of high ecological value and create new biodiverse habitats in the area.

It is recognised that there would be a delay between the closure of the Story Garden and the completion of the new community garden. However, discussions are ongoing so as to provide a continuation of the community service, by identifying projects within the local area that could be undertaken during the construction period.

The Proposed Development will re-use as many key recyclable elements from the demolition as possible in the construction of the new library.

Please refer to both the Pre-Demolition Audit and the Circular Economy Statement completed and submitted as part the application for further details on the materials that have the potential to be re-used and the team's commitments to re-use them.

The Pre-Demolition Audit has been carried out during Concept Design stage prior to any strip out. This early-stage intervention is critical in ensuring all contractors can contribute to maximise rates of waste re-use, recycling and diversion from landfill.

Key takeaways from the Pre-Demolition Audit are as follows:

The structure of the BLCC broadly consists of:

- 3-storey steel frame consisting of LG, G, 1st & Roof with large steel beams supporting terrace
- Reinforced concrete slabs (poured in-situ floors & precast planks for roof support)
- External walls of Insulated Metsec with facing fletton brick
- Apexes at roof level are zinc & glass
- 2nr reinforced concrete stair cores (fire escapes)
- Block walls separating plant rooms

A range of sustainability measures must be implemented by the contractor in the proposed development including:

- Plant and equipment salvage - The specification of the equipment and plant to be removed from site needs to be checked and evaluated for compliance with legal requirements so they can be reused in another project
- Waste - Encourage and assist the project delivery team to reduce, reuse, and recycle all non-hazardous waste on-site/off-site
- All sustainability measured KPI's will be logged, recorded and communicated at regular intervals using a dedicated SMARTWaste management tool

Materials holding a high recycling potential have been identified within the Pre-Demolition Audit, and it is anticipated that over 98% of waste can be diverted from landfill for the demolition works at the British Library project (including the BLCC, pepperpot stair and internal alterations to the Library's north façade).

9 Proposed BLCC

The Proposed Development seeks to integrate the BLCC facility more closely with the inner workings of the library where the visibility of activities taking place can form a key part of the outreach programme of the library itself. This contrasts the existing BLCC is currently accessible to the public only via the external terrace at Level 01 on Ossulston Street.

Figure 11 Proposed View of the new BLCC from Ossulston Street

The demolition of the BLCC would require the removal of the pepperpot stair, a cylindrical brick enclosure containing escape stairs and bridge links to office accommodation and reading rooms at upper ground floor and level 01 respectively. However, in the Proposed Development, the stair will be relocated to a new position on Ossulston Street which corresponds with part of the site anticipated for extension in original design drawings by Colin Wilson.

The form of the new BLCC extends the massing, articulation and materiality of the Ossulston Street frontage, taking cues from height datums found in the existing building. Set-backs at lower ground and upper ground floors continue that of the Proposed View from Ossulston Street perimeter colonnade, with the more solid brick enclosure of the Humanities reading room echoed in the conservation studio. PPC/painted metal horizontals pick up on existing horizontal datums.

A glazed clerestory at roof level takes advantage of greater height offered by the proposed transfer structure of the adjacent extension and corresponds to the height on Ossulston Street of the existing red cornice, quietly announcing a more contemporary presence. The existing cornice is terminated on the north elevation by a full-height brick recess containing the BLCC service core which provides an interruption to the frontage; its proportion resembling the proportion of existing rectilinear brick projections found throughout the library.

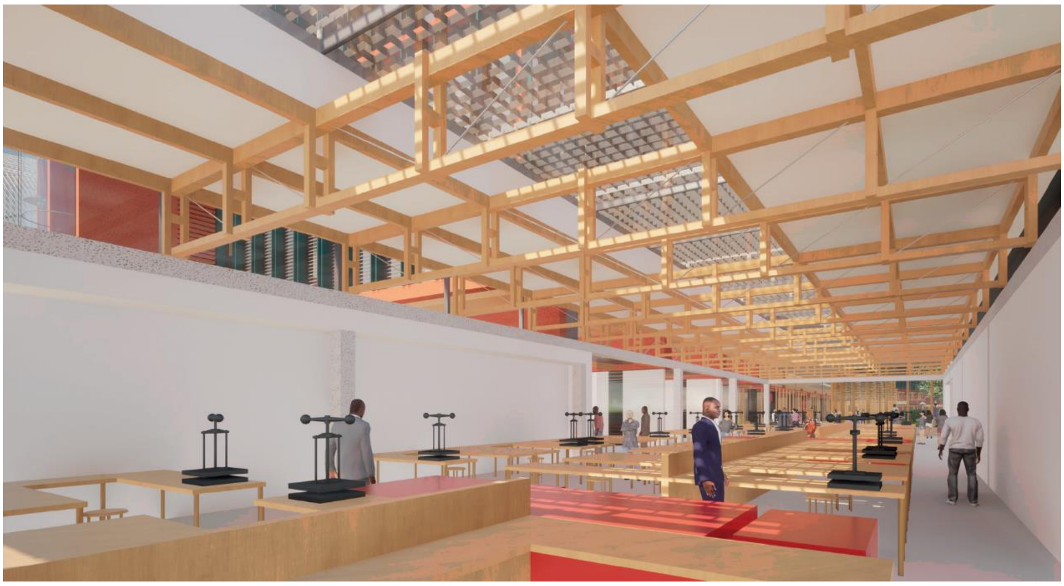


Figure 12 Illustrative view of main BLCC conservation studio looking east

Figure 13 View looking South towards Ossulston Street

The sustainability performance of the proposed British Library Extension will be benchmarked using the Building Research Establishment Environmental Assessment Method (BREEAM) New Construction 2018. The bespoke BREEAM pre-assessments for the office, culture, laboratory and retail areas will set the proposal above and beyond typical buildings, and a minimum target of an Excellent rating with an aspiration for Outstanding emphasises the project value.

For further details on the value of the Proposed Development, please see the Sustainability Statement and also the Social Value Report which were both submitted as part of this application.

10 Proposed Community Garden

As part of the planning application a community and co-design strategy has been developed which identifies how the existing story garden on site can be provided again, designed to suit the needs of the users of the local neighbourhood and connect to the wider community gardens and green spaces in Somers Town.

The landscape and public realm proposals for the site include new Community Garden spaces on the west side of the site, close to the Ossulston Street entrance to the new extension building. DSDHA have worked with Global Generation to research and analyse the site context with regard to local initiatives and community projects.

A ‘hub and spoke’ model has also been developed which sees the Community Garden at the British Library Extension as a ‘hub’ which can support ‘spokes’ (various learning and greening initiatives) across Somers Town. Further detail on plans for community engagement and consultation on this aspect of the landscape and public realm at the British Library Extension is given in the Public Realm and Landscape Design Statement submitted as part of this application.

The site is currently disconnected from the many surrounding green spaces, minimising the ecological value of it as a space. Although there are pockets of habitat within the current site, there is significant scope and opportunity to increase these size and variety of habitats in the future proposals.

By providing new habitat types that are not present the development, the proposal can enhance the area’s biodiversity and also better connect the wider green space network by creating islands in the urban neighbourhood for bugs and birds to use as stepping stones. These islands will also have the effect of significantly greening the site for its human users and contributing to their wellbeing.

11 Conclusion

Conclusively, it has been demonstrated across a range of considerations, that the demolition of the existing BLCC and Story Garden on the proposed site will have a positive contribution on the overall British Library extension.

Key outcomes are as follows:

- The existing BLCC is excluded from the Grade I listing that covers the British Library and is described in the list entry as ‘not part of the special interest’ of the library. Additionally, the BLCC has recently received a Certificate of Immunity from Listing (dated 5th October 2021).
- Retention of the BLCC would restrict opportunities to create free-flowing pedestrian movement between existing and proposed library areas; force a densification of commercial development around the site perimeter; and reduce the daylighting levels reaching the BLCC’s north lights, which are crucial to the conservation operation of the building.
- It was concluded that achieving the aspirations envisaged for the future Crossrail 2 station at Euston/St Pancras would not be possible without the demolition of existing buildings on the site, most notably the BLCC
- This whole life carbon study demonstrates that there are carbon benefits over a 60-year lifespan from the demolition of the BLCC, versus its retention.
- It is anticipated that over 98% of waste can be diverted from landfill for the full demolition works at the British Library project (including the BLCC, pepperpot stair and internal alterations to the Library’s north façade).
- The newly proposed BLCC will add significant value to the public realm, and the new community garden will positively contribute to the surrounding area.

This report, alongside the Pre-Demolition Audit, and Whole Life Carbon Assessment, collectively provide evidence that the requirements detailed in Camden Planning Guidance (CPG) (2021) Energy and Efficiency - *Chapter 9: Reuse and optimising resource* efficiency, have been met.

ARUP

8 Fitzroy Street
London W1T 4BJ