MURPHY'S YARD

AN APPLICATION BY FOLGATE ESTATES LIMITED

OUTLINE CIRCULAR ECONOMY STATEMENT

JUNE 2021

FOLGATE ESTATES LIMITED

Studio Egret West

DP9

TRIUM

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Audit sheet.

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Contents.

Executive Summary.

Scope.

Hoare Lea has been appointed by Folgate Estates to prepare a Circular Economy Statement in support of the outline planning application for the redevelopment of Murphy's Yard site, Kentish Town, in the London Borough of Camden (LBC).

This report constitutes a Circular Economy Statement which sets out the strategic approach to Circular Economy implemented by the project. This Circular Economy Statement is focuses on the work carried out to define a strategic approach to Circular Economy principles for the project and identify high level strategic opportunities early in the development process.

Site location.

Murphy's Yard site is approx. 6.23-hectare and is located in the northern part of Kentish Town, within the London Borough of Camden. It lies to the west of Highgate Road and is bounded to the north, west and south by railway lines. The northern tip of the site is directly opposite Hampstead Heath. The site is with access off Gordon House Road, Sanderson Close and Greenwood Place.

Development description.

Outline planning permission with all matters reserved for the demolition of existing buildings and structures and redevelopment to be carried out in phases (with each phase being an independent act of development) comprising the following mix of uses: residential (Use Class C3), residential institution (Use Class C2), industrial (Use Class B2 and/or B8), commercial floorspace (Class E), flexible commercial and Sui Generis floorspace (Use Class E and/or Sui Generis Use), Community (F1 and/or F2), Sui Generis, and cycle and vehicle parking, refuse and recycling storage, plant, highway and access improvements, amenity space, landscape and public realm improvements, and all associated works.

Summary of the approach to circular economy.

The construction and operation of the built environment consumes 60% of all materials in the UK. At the end of life, materials are often diverted from landfill, but in reality, down-cycled, reducing their value.

There is growing industry consensus that the way we design, build, operate and dispose of our buildings and associated facilities needs a major overhaul to obviate waste and increase efficiency. There is an incredible breadth of opportunity that this shift in approach will create across the entire supply chain.

Designing for longevity and adaptability and maximizing the use of recycled and renewable materials could reduce greenhouse gas emissions while increasing innovation opportunities and economic growth. Replacing finite and fossil-based materials with responsibly managed renewable materials can decrease carbon emissions whilst reducing dependency on finite resources.

Before considering future waste elimination and sustainable waste management practices, opportunities for retaining and refurbishing /re-purposing existing buildings, materials and other resources on site have been assessed by the design team to maximise the residual value of existing structures and conserve resources by reducing the need for new materials.

The proposal involves retention of existing buildings elements and reuse of existing demolished/dismantled materials on site.

A pre-demolition audit and cut and fill calculation will be undertaken to investigate how recycling of construction, demolition and excavation material can be maximised. This will highlight specific elements of the existing building and hardstanding on the site which can be re-used or recycled/recovered, including but not limited to crushing existing concrete for reuse at the Proposed Development. There is likely to be areas of contamination on the site due to its past industrial uses, so selection of suitable cut and fill materials re-use on the site will require consideration of these details.

New buildings developed on the site will follow best practise principles in their design and construction with the overarching aims of reducing material usage, minimising waste, and embedding longevity, flexibility and adaptability. It is expected that the different building typologies will lead to a variance in the final strategies adopted across the site. Furthermore, advances in innovation and best practice over time combined with effective feedback loop mechanisms are expected to lead to continuous improvement as the design and construction develops.

Table 1: Circular Economy Strategic Approach

Aspect	Building /Area	Steering approach	Explanation	Supporting Analysis
Circular economy approach for the new development	Sub-structure	Reduce the quantities of materials used and avoid excavation required on site	Retained existing foundation. Reduce the required material for the substructure by using lean design principles.	Included in: Design and access statement by Studio Egret West Structural Design Information by Arup Flood Risk and Drainage Strategy Report by Arup Stage 2 MEP Review by Hoare Lea Land Contamination Report
	Superstructure	Reduce the quantities of materials used	Retained and reuse of existing building elements. Using lean design principles and DfMA approach and lightweight materials	
	Construction waste	Manage construction waste	Resource Management Plan Investigating available modern construction technologies and offsite pre-manufacture to avoid waste.	
	Excavation waste	Manage excavation waste	Limited basement. Piled foundation minimises excavation waste. Where possible on-site use of non-hazardous excavation material.	
Circular economy approach for municipal waste during operation	All domestic and non-domestic areas	Efficient management of operational waste	Appropriate refuse storage to enable recycling and best practise waste management.	Included in: Operational Waste Management Strategy

1. Introduction.

1.1 Site location.

The 6.23-hectare site is located in the northern part of Kentish Town, within the London Borough of Camden.

Murphy's Yard site lies to the west of Highgate Road and is bounded to the north, west and south by railway lines. The northern tip of the site is directly opposite Hampstead Heath. The site is with access off Gordon House Road, Sanderson Close and Greenwood Place.

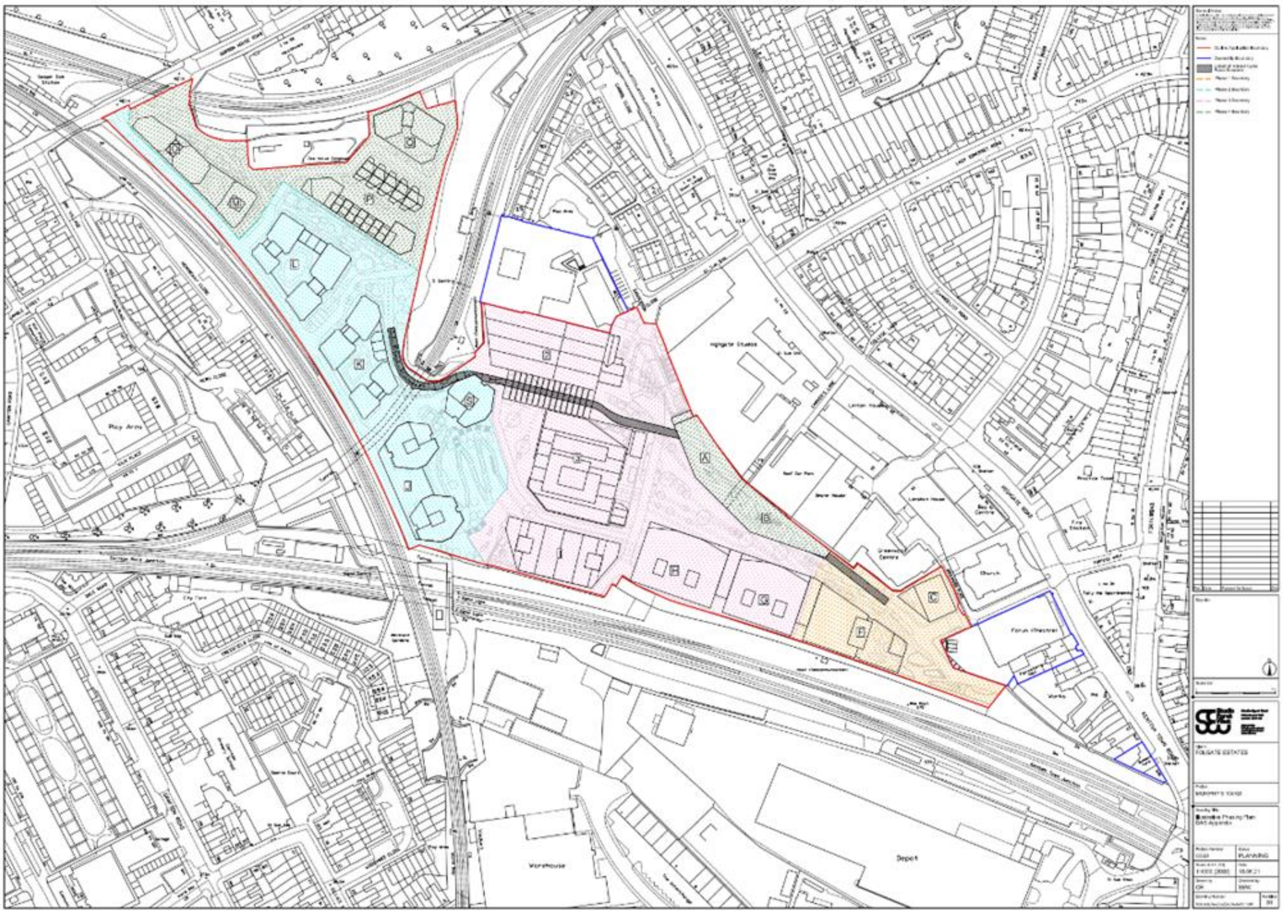

Figure 1: Illustrative view of the Proposed Development (Credit: SEW Architects).

1.2 Development description.

Outline planning permission with all matters reserved for the demolition of existing buildings and structures and redevelopment to be carried out in phases (with each phase being an independent act of development) comprising the following mix of uses: residential (Use Class C3), residential institution (Use Class C2), industrial (Use Class B2 and/or B8), commercial floorspace (Class E), flexible commercial and Sui Generis floorspace (Use Class E and/or Sui Generis Use), Community (F1 and/or F2), Sui Generis, and cycle and vehicle parking, refuse and recycling storage, plant, highway and access improvements, amenity space, landscape and public realm improvements, and all associated works.

1.3 Site context.

The Site is part of a Wider Development Area including redevelopments of the Regis Road Growth Area and the Murphy's Yard site.

Murphy's Yard is designated as an industry area within Camden's Local Plan. The site is occupied by the company's head offices and is largely covered by surface parking and yard space with a number of workshops and sheds, of which some are locally listed that offer a glimpse to the site's historical industrial use.

There are three locomotive sheds on the site which are locally listed. Other than these large buildings, development on the site is very low intensity. The railway lines support important biodiverse corridors and Sites of Importance for Nature Conservation. Their dense planting, particularly to the north of the site, lends a green character to an otherwise industrial area.

There are significant level changes across the site, the land rises from Kentish Town towards Dartmouth Park and Hampstead Heath.

The Proposed Development at the Site would involve retention of locally listed buildings fabric and structure, partial and complete demolition of buildings, site clearance and the redevelopment to provide a mixed-use scheme as summarised in 2.2 section above.

1.4 Project team.

The key project team members are detailed in Table 2.

Table 2: Key Project Team Members

Discipline	Organisation
Client / Developer	Folgate Estates Ltd
Planning Consultant	DP9 limited
Cost Consultant	Cast Consultancy
Architect / Landscape Architect / Urban Design	Studio Egret West
Heritage Consultant	Peter Stewart Consultancy
Townscape Consultant	RPS
EIA Coordination	Trium Environmental
Building Services Consultant	Hoare Lea
Sustainability/Energy/Circular Economy/Operational Waste Consultant	Hoare Lea
Civils / Drainage / Structural Consultant	Arup
Biodiversity	Studio Egret West
Noise and Vibration	Sandy Brown Associates
Transport Consultant	Curtins

2. Policy.

The New London Plan (March 2021) includes the following policies in relation to the Circular Economy.

2.1 SI 7 Reducing waste and supporting the circular economy.

"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 reuse 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 per cent by 2030

5. Meet or exceed the targets for each of the following waste and material streams:
    i) Construction and demolition – 95 per cent
    ii) Excavation – 95 per cent 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."

2.2 D1 London's form and characteristics.

The Circular Economy Design Principles are also referenced in the "Policy D1 London's form and characteristics".

This Circular Economy Statement is based on the GLA's draft guidance document "Circular Economy Statement Guidance Draft for Consultation October 2020 "which interprets the policies set out above and describes what Circular Economy Statements should include.

3. Method Statement.

A holistic, interdisciplinary approach has been adopted to define and communicate the sustainability and Circular Economy strategy for Murphy's Yard.

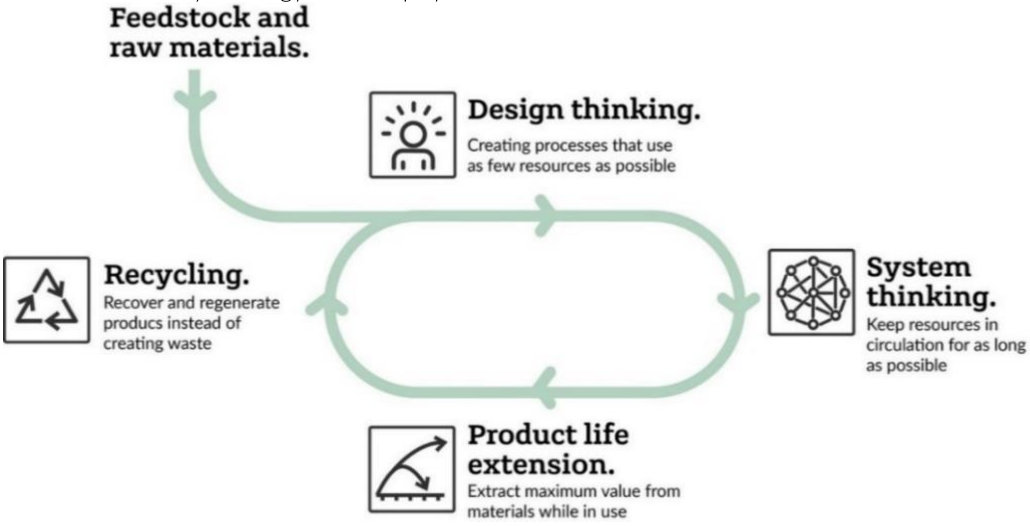

Figure 2: Circular Economy overarching principles.

The design of the development is based on sustainable design and construction principles as informed by planning requirements and industry best practice.

3.1 Circular economy approach.

- Working with all key stakeholders, an overall sustainability vision for the development has been defined and agreed.
- Sustainability workshops have been held during the early design stages, in collaboration with the client and project team to help steer the sustainability vision and circular economy principles.
- Circular economy principles have been reviewed by the project team as part of this process.
- Additional workshops will be held during the detailed design stages to explore further opportunities to incorporate key Circular Economy principles into aspects of the design, procurement and construction process.
- As the proposals move toward construction stage, early engagement will be sought with contractors to assist in refining strategies for delivery.
- Robust data collection plans will be implemented through design and construction to facilitate ongoing monitoring against intended outcomes, such as percentage of waste diverted from landfill and recycling percentages of construction waste.

3.2 Circular economy aspirations.

Consumption of natural resources has historically followed a linear approach, heightened by the industrial revolution, which while lifting the living standards of millions, also dramatically increased pressure on environmental resources. Under the traditional take-make-use-dispose model raw materials are collected, then transformed into products that are used until they are finally discarded as waste. Apart from failing to capture value over the lifetime of products, this system also produces a range of negative externalities that include resource scarcity, unsustainable levels of water extraction, rising carbon emissions, and widespread ecosystem pollution.

The built environment sector is a major consumer of natural resources. There is growing industry consensus that the way we design, build, operate and dispose of our buildings and associated facilities needs a major overhaul to obviate waste and increase efficiency. There is an incredible breadth of opportunity that this shift in approach will create across the entire supply chain.

4. Circular Economy – Strategic Approach.

Circular Economy considerations have formed a key part of the project sustainability strategy. It is recognised that in order to implement Circular Economy principles most effectively, it is helpful to explore high level strategic opportunities as early in the development process as possible. Whilst the requirements for Circular Economy statement were not applicable to the original application, the principles of circular economy were applied to this process, through the general approach to sustainability.

As discussed earlier, a series of sustainability-focused workshops were held in collaboration with the client and project team to help craft a holistic and consistent sustainability approach for the development. Considerations around resource efficiency, material circularity and ethical sourcing have been a critical element of the overarching sustainability strategy.

It is acknowledged that the approach to circular economy will evolve as the design evolves, or in response to wider considerations and feedback from the GLA or other stakeholders.

Key strategic implementations for the scheme explored throughout this document include the aspects as set out Table 5.

Table 3: Circular Economy Strategic Approach

Aspect	Building /Area	Steering approach	Explanation	Supporting Analysis
Circular economy approach for the new development	Sub-structure	Minimise the quantities of materials used and minimise excavation required on site	Retained existing foundation. Minimising the required material for the substructure by using lean design principles.	Included in: Design and access statement by Studio Egret West Structural Design Information by Arup Flood Risk and Drainage Strategy Report by Arup Stage 2 MEP Review by Hoare Lea Land Contamination Report
	Superstructure	Minimise the quantities of materials used	Retained and reuse of existing building elements. Using lean design principles and DfMA approach and lightweight materials	
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Circular economy approach for municipal waste during operation	All domestic and non-domestic areas	Efficient management of operational waste	Appropriate refuse storage to enable recycling and best practise waste management.	Included in: Operational Waste Management Strategy by Hoare Lea

4.1 Circular economy approach for the new development.

The buildings developed on the site will follow best practise principles in their design and construction with the overarching aims of reducing material usage, minimising waste, and embedding longevity, flexibility and adaptability.

The following focus areas have been reviewed to maximise opportunities to embed circular economy principles:

- Lean design principles
- Material efficiency
- Adaptability
- Flexibility
- Low carbon construction
- Offsite / modular construction
- Design for Manufacture and Assembly (DfMA)
- Minimisation of excavation waste
- Material circularity
- Material procurement via leasing frameworks
- Responsible procurement
- Sustainable sourcing
- Local sourcing
- Supply chain engagement
- Structural and fabric resilience
- Life-cycle assessments
- Disassembly and demount ability

It is expected that the proposed development will have a long life and is likely to be retained as commercial-led mixed use development throughout its life.

4.2 Circular economy approach for the existing site.

The site measures 6.27-hectare and due to its history occupation, there is a widespread land contamination, including a mixture of asbestos, gas and petrol products and heavy materials. Land contamination is worse at the north corner of the site. Remedial measures to be adopted to mitigate health risks and safeguard new buildings from contamination.

There are significant level changes across the site, the land rises from Kentish Town towards Dartmouth Park and Hampstead Heath. The Proposed Development would utilise the site's natural topography to propose interesting and attractive level changes within the landscape design, public realm and buildings ground floor and access levels.

Limited basement is considered which will reduce significantly the quantity of excavation on site, minimise quantity of materials used and provide more flexibility for future adaptation.

The existing site comprises of a number of workshops and sheds, of which some are locally listed, while some are of low quality with no architectural, structural nor spatial value.

The proposals are considering retention of existing façade at ground floor and reuse of structural elements (columns and trusses) where possible within parts of the development. In certain areas it is possible that the façade will be retained, while the steel roof structures could be reused in the entrance ways of new buildings. In addition, existing ground floor (where possible) and foundations are also to be reused which will minimise materials and excavation required on site.

Demolition/dismantling of existing buildings, buildings' elements and site clearance is proposed which gives the opportunity for reusing existing materials on site. Some of the existing buildings consisting of single storey shed brickwork construction, which dismantled bricks would be considered to be used on site either as sculpture in the landscape design or as crushed bricks. Further consideration will be given by the design team to maximise the reuse of demolished/dismantled materials on site, where possible.

The demolition will be undertaken by a demolition contractor who will provide a pre-demolition audit to maximise the recovery of materials for subsequent high grade or value application.

4.3 Circular economy approach for municipal waste during operation.

Circular economy principles including reducing municipal waste will be considered as part of the design team discussions waste store design.

A detailed Operational Waste Management Strategy (OWMS) will be developed including the principles that the site will follow to reduce operational waste, the area available for segregated waste storage and waste collection measures. The design would be based on waste management principles contained within relevant Building Regulations, British Standards, BREEAM requirements, Local Authority Requirements and Waste Collection Services.

For further detail on municipal waste during operation, please refer to 'manage municipal waste' within section 5.4.1 below.

4.4 Addressing the circular economy principles.

The following details the Circular Economy opportunities identified for the Proposed Development, as explored through the application of nine Circular Economy principles: These are further summarised in the Key commitments section.

Reducing the quantities of materials used

The first approach to reduce the quantity of materials used, is to retain some of the existing building elements on site.

In addition, there is the opportunity to reuse materials from demolition/dismantle of existing buildings on site. Couple of examples would be the reuse of dismantled bricks as sculpture in the landscape and the reuse of steel roof structure in the entrance ways of new buildings. Full consideration will be given by the design team to maximise the reuse of demolished/dismantled materials on site.

Due to the nature of the existing site, piled foundation is proposed which also reduces the amount of building materials and excavated material as it is limited to the thickness of a piling mat and the waste arising from piling.

During detailed design consideration will be given for a limited area of basement on site which, reduces significantly the quantity of excavation, minimises quantity of materials used and provides more flexibility for future adaptation.

Apart from reuse of existing materials, the scheme will also aim for the use of materials with higher levels of recycled content (whenever possible) within the structural, architectural, hard landscape and building services elements. The building specifications developed at the later design stages will explore the opportunities for the use of recyclable materials.

There is a certain degree of layout repetition within the Proposed Development. This will allow an opportunity for standard components being employed, and increase the opportunity for modular design for off-site manufacturing and assembly (DfMA) and for prefabrication of architectural and MEP elements/equipment, including the below:

- Structural elements could be constructed as precast elements either on or off site;
- Architectural elements could be modular design for DfMA;
- Apartment utility cupboards;
- Service cupboard; and
- MEP systems will be designed around propriety product-based systems, manufactured for assembly on-site.

During the next design stages, further consideration will be given by the design team to maximise the buildings elements that could be constructed off site (DfMA) and prefabricated. These DfMA and prefabricated solutions will minimise the quantity of materials used, reduce waste during construction, contribute to improving programme and minimise working at height which are additional benefits to the development.

Service distribution will follow a direct route to avoid unnecessary lengths of material being required. In addition, pipes and ducts will be sized as efficiently as possible to minimise the amount of material.

Engagement with the demolition and principal contractors will happen during RIBA Stage 4, when further opportunities to reduce materials used through adoption of DfMA and off-site manufacture, reuse of materials on site, and smart procurement will be given.

Reducing the quantities of other resources used

In addition to reducing use of land resources, the scheme will be designed to address efficient use of energy and water.

The entire site of the proposed development is on previously occupied land. The proposal creates a new mixed-use and landscape-led development. Building footprint areas are minimised to provide a new high-quality public realm and enhanced landscaped area for use by both the development's building users and the public. The development is envisaged as within a Heath Line which is a new green connection between Hampstead Health and Kentish Town that will prioritise pedestrian and cycle movements through the area. The Health Line should open up Murphy's Yard to the public and create a linear park with a variety of public spaces along its route.

The surface water management strategy will promote the use of SuDS integrated within the overall soft and hard landscaping proposals. In addition to bio-retention areas and tree pits in public realm areas, opportunities to implement green and brown roofs will be maximised on buildings and will consist of both intensive and extensive planting regimes subject to roof constraints. The feasibility of lined permeable paving will rely on careful co-ordination with utilities and underground obstructions but could provide additional shallow attenuation and pre-treatment of surface water runoff. As the layout develops close co-ordination with the landscape strategy will ensure that SuDS are maximised throughout the proposals and integrated in a holistic manner, delivering additional benefits such as pollution control, reduction of storm water, energy use, increased biodiversity and provision of a water-based amenity space.

Additionally, operational energy demands will be reduced in line with London Plan requirements.

Water meters will be installed in each building to help monitor and reduce operational water use. Water efficient fittings such as dual flush WCs, spray taps and low flow shower, will be proposed where possible. Thus, water efficient irrigation system will be considered in the detailed design stage.

Specifying and sourcing materials responsibly and sustainably

The scheme will aim to support the local procurement of materials, with prioritisation of products under a recognised responsible sourcing certification scheme.

A Sustainable Procurement Plan (SPP) will be provided to guide specifications towards sustainable construction products. The SPP will include sustainability aims, objectives and strategic targets to guide procurement activities, requirement for assessing the potential to procure construction products locally, and the requirement for 100% of timber and timber-based products used on the project to be 'Legal' and 'Sustainable' as per the UK Government's timber Procurement Policy.

There will be a procedure in place to check and verify the effective implementation of the Sustainable Procurement Plan.

Design for longevity, adaptability or flexibility and reusability or recoverability

The Proposed Development aspires to deliver a design for long-term adaptability and flexibility.

Limited areas of basements are proposed as these are inherently inflexible and environmentally carry a more significant impact than other forms of construction.

The building structure, façade, communal internal spaces and landscape will be designed with robust materials for longevity and easy maintenance.

Most of the non-domestic areas are designed as shell and core and simplified as much as possible to provide flexibility for tenants and change of use in the future should demand trends dictate. This includes floor plate dimensions, floor to ceiling heights, location and size of building core, risers and shafts.

MEP equipment/products are designed as 'plug and play' and can be easily adaptable, flexible, reused or recovered without much waste generated.

Design out construction, demolition, excavation and municipal waste arising

As mentioned on previous sections, many building elements will be retained which will reduce significantly the amount of new construction materials required as well as the amount of materials to be demolished on site.

Considering the current proposal includes the demolition/dismantle of existing buildings, there is the opportunity to reuse of existing materials on site. The demolition will be undertaken by a demolition contractor who will provide a pre-demolition audit to maximise the recovery of materials for subsequent high grade or value application.

There is limited basement proposed on site which reduces significantly the quantity of excavation. In addition, excavation will be also reduced by the proposed pile foundation, as excavated material is limited to the thickness of a piling mat.

There is a widespread land contamination, including a mixture of asbestos, gas and petrol products and heavy materials. Land contamination is worse at the north corner of the site. Remedial measures to be adopted to mitigate health risks and safeguard new buildings from contamination.

There are significant level changes across the site, the land rises from Kentish Town towards Dartmouth Park and Hampstead Heath. The Proposed Development utilise the site's natural topography to propose interesting and attractive level changes within the landscape design, public realm and buildings ground floor and access levels.

Construction waste arising from the Proposed Development will be minimised through adoption of pre-fabrication and DfMA methods whenever possible.

MEP systems are designed for efficient maintenance during lifetime, generating limited waste. MEP equipment/products are designed as plug and play and can be easily replaced without waste generate.

4.4.1 Site waste / resource management commitments confirmation

The Proposed Development to address waste management at all stages of the development's life from design and construction through to the end use and activity on site, ensuring all waste is managed towards the upper end of the waste hierarchy.

The SWMP will contain calculation of the total non-hazardous waste materials (from on-site construction and dedicated off-site manufacture or fabrication), including demolition and excavation waste for the Proposed Development. Thus, commitments and targets will be set for construction waste resource efficiency for non-hazardous waste materials (excluding demolition and excavation waste) generated in tonnes or m^3 per $100m^2$ (gross Internal floor area - GIA) against benchmarks, and for diversion of resources from landfill, in line with BREEAM UK New Construction 2018, Wst 01 construction waste management criteria.

In addition, the SWMP will also include the following percentage calculation for the total non-hazardous waste arising (tonnes/m^2 GIA) from site activities:

- The proportion that will be used or recycled on site (%)
- The proportion that will be reused or recycled off site (%)
- The proportion of waste not being reused or recycled (this would include waste sent to landfill or used for energy recovery

Manage demolition waste

Demolition/dismantle of existing buildings, buildings' elements and site clearance is proposed which gives the opportunity for reusing existing materials on site. Some of the existing buildings consisting of single story shed brickwork construction, which dismantled bricks are to be used on site either as sculpture in the landscape design or as crushed bricks. In addition, the reuse of steel roof structure in the entrance ways of new buildings is proposed. Further consideration will be given by the design team to maximise the reuse of demolished / dismantled materials on site, where possible.

The appointed demolition contractor will undertake a pre-demolition audit to maximise the recovery of materials for subsequent high grade or value application. The pre-demolition audit will cover:

- Identification and quantification of the key materials where present on the project;
- Potential applications and any related issues for the reuse and recycling of the key materials in accordance with the waste hierarchy;
- Opportunities for reuse and recycling within the same development;
- Identification of local reprocessors or recyclers for recycling of materials;

- Identification of overall recycling targets where appropriate;
- Identification of reuse targets where appropriate; and
- Identification of overall landfill diversion rate for all key materials.

It is intended that the GLA target is achieved for 95% of non-hazardous demolition waste to be diverted from landfill.

Manage excavation waste

There are significant level changes across the site, the land rises from Kentish Town towards Dartmouth Park and Hampstead Heath. The Proposed Development utilise the site's natural topography to propose interesting and attractive level changes within the landscape design, public realm and buildings ground floor and access levels. Nevertheless, there is 36,000m^3 excess cut to be removed from site (from 80,000m^3 initially proposed), in which 2/3 are re-usable while 1/3 is assumed to be non-usable.

There is a widespread land contamination, including a mixture of asbestos, gas and petrol products and heavy materials. Land contamination is worse at the north corner of the site. Remedial measures to be adopted to mitigate health risks and safeguard new buildings from contamination.

A limited area of basement level is proposed. Significant areas of basement would normally result in large volume of excavated material being removed off site. In addition, excavation will be also reduced by the proposed pile foundation, as excavated material is limited to the thickness of a piling mat and limited arisings.

The following excavation waste calculation will be provided:

- Total estimated material arising in tonne. If contamination is present, indicate the amount;
- The proportion of non-contaminated material that will be reused on site (%)
- The proportion of non-contaminated material that will be reused off site (%)
- The proportion of non-contaminated material leaving the site with no destination for reuse (%)

It is intended that the GLA target is considered for 95% of excavation waste to be of beneficial use. It is estimated that approximately 30% of the excavation waste will be unsuitable for re-use. Therefore the target would not apply to this excavation waste.

Manage construction waste

As outlined above, the aim would be to reduce construction waste arising through the use of off-site construction and good site waste management practices.

A Resource Management Plan (RMP) will be provided containing calculation of the total non-hazardous waste materials (from on-site construction and dedicated off-site manufacture or fabrication), including demolition and excavation waste for the Proposed Development. Thus, commitments and targets will be set for construction waste resource efficiency for non-hazardous waste materials (excluding demolition and excavation waste) generated in tonnes or m^3 per 100m^2 (gross Internal floor area - GIA) against benchmarks, and for diversion of resources from landfill, in line with BREEAM UK New Construction 2018, Wst 01 construction waste management criteria.

In addition, the RMP will also include the following percentage calculation for the total non-hazardous waste arising (tonnes/m^2 GIA) from site activities:

- The proportion that will be used or recycled on site (%)
- The proportion that will be reused or recycled off site (%)
- The proportion of waste not being reused or recycled (this would include waste sent to landfill or used for energy recovery

The project materials waste arising, and waste management routes will be monitored and recorded for construction, demolition and excavation, using a web-based tool such as SMARTWaste®.

It is intended that the GLA target is achieved for 95% of non-hazardous construction waste to be diverted from landfill.

Manage municipal waste

The operational waste will be reduced, in line with the National Planning Policy for Waste, London Environment Strategy, Camden Planning Guidance Design March 2019 and Camden's Environment Service technical guidance for recycling and waste.

An Operational Waste Management Strategy (OWMS) will be developed. It would include the waste management principles, Local Authority (London Borough of Camden) requirements, and the proposed waste management strategies for both the Detailed and the Outlined planning areas within the Proposed Development.

The bin storage arrangements will be flexible to ensure that the development will be able to target the overall 65% municipal waste recycling target required by the policy "SI 7 Reducing waste and supporting the circular economy".

4.4.2 Landfill capacity

The Applicant would seek to provide the written confirmation to the GLA that the destination landfills have the capacity to receive waste for the construction stage.

Residential waste destinations are the responsibility of the local authority and outside of the control of the applicant.

Commercial and industrial waste collection destinations is the responsibility of the chosen waste contractor for commercial waste collection.

For residential, commercial and industrial waste, segregation of recyclables and residual waste is encouraged through the provision of suitable areas for the storage of these waste streams. This is expected to assist with maximising waste diverted from landfill for both waste streams of municipal waste.

4.5 Key Commitments.

Table 4 details the key commitments in relation to Circular Economy

Table 4 Key Commitments

Building "Layer" (as per GLA guidance)	Site	Substructure	Superstructure	Shell/Skin	Services	Space	Stuff	Construction Stuff	Summary	Challenges	Counter-Actions + Who + When	Plan to prove and quality
	SECTION A: CONSERVE RESOURCES											
Minimising the quantities of materials used	Widespread land contamination, remedial measures to be adopted. Limited basement level proposed. Pre demolition audit to be undertaken to maximise the reuse of demolished materials on-site.	Retention of existing foundations. Efficient design of foundation (CFA piled with associated pile caps) to minimise the quantities of concrete. The piles will be installed from existing ground level as limited	Lean and simple design principles adopted to minimise material volume and waste during construction. Lightweight structure frame considered. Building structure has been designed to allow for prefabricated elements.	Retention of existing façade. Lightweight structure proposed . High degree of layout repetition to ensure opportunity for standards components to be employed, DfMA or prefabrication.	Considering offsite and prefabrication of apartment utility cupboards and MEP systems that will be designed around propriety product-based systems, manufactured for assembly on-site (risers, plant rooms, etc).	Aim to rationalise floor finishes and screed to reduce building weight. Aim to reduce use of plasterboard, where possible.		Material procurement measures include DfMA and off-site manufacture, reuse of materials on site, and smart procurement.	Design optimisation to reduce the building's loading	Ensuring modular design does not increase internal wall thicknesses.	Ensure structural design is optimised. Pre-construction supply chain engagement.	Material efficiency review exercise at next stage of design.

Building "Layer" (as per GLA guidance)	Site	Substructure	Superstructure	Shell/Skin	Services	Space	Stuff	Construction Stuff	Summary	Challenges	Counter-Actions + Who + When	Plan to prove and quality
	There are significant level changes across the site.	basement is proposed.										
Minimising the quantities of other resources used (energy, water, land)	The site is on previously occupied land. Landscape-led development. Use of SuDS include bio-retention areas, tree pits, green and brown roofs.	Consider DfMA, prefabricated elements and modular design opportunities in order to reduce construction programme therefore associated resources (energy, water, etc).			Use of photovoltaics and high efficiency air source heat pumps to reduce grid electricity consumption.	Water efficient fitting and irrigation to be considered.			**Landscape-led development.** **Use of SUDS.** **Consideration of DfMA and offsite fabrication where possible.**	Maturity of the market /design solutions. Specific site constraints driving bespoke solutions.	Ensure structural design is optimised. Pre-construction supply chain engagement	Review exercise at next stage of design.

Building "Layer" (as per GLA guidance)	Site	Substructure	Superstructure	Shell/Skin	Services	Space	Stuff	Construction Stuff	Summary	Challenges	Counter-Actions + Who + When	Plan to prove and quality
Specifying and sourcing materials responsibly and sustainably	Prioritise locally sourced materials where possible, if required.	Maximise the use of secondary aggregate and cement replacement materials within concrete specification.	Cement and aggregates must be from certifiable sources. All reinforcement steel to be 100% recycled. All the timber used will be FSC or PEFC.	Priority for local material sourcing and products under a recognised responsible sourcing certification scheme.					Materials to be responsibly sourced, locally where possible. Maximise recycled content within building materials.	Potential cost premium. Higher recycled content targets may limit supply chain. Structural constraints for higher GGBS content.	Ensure structural design is optimised (Structural engineer). Pre-construction supply chain engagement.	Review exercise at next stage of design.

Building "Layer" (as per GLA guidance)	Site	Substructure	Superstructure	Shell/Skin	Services	Space	Stuff	Construction Stuff	Summary	Challenges	Counter-Actions + Who + When	Plan to prove and quality
	SECTION B: DESIGN TO ELIMINATE WASTE (AND FOR EASE OF MAINTENANCE)											
Designing for reusability / recoverability / longevity / adaptability / flexibility	Limited basement proposed providing more flexibility. Materials selection for an increased durability, low maintenance, high reusability and recoverability.		The following aspects have been considered: - Modular assembly - Off-site fabrication - Standardised components Floor plate dimension and structural frame modulation secure long-term flexibility and adaptability. Measures adopted on architectural and structural systems / materials selection for an increased durability,		MEP equipment / products are designed as plug and play and can be easily adaptable, flexible, reused or recovered.	The internal walls are easily removed to enable a future reconfiguration of the space, if required.			**Design spaces for flexibility whilst enabling access to all elements that could be re-used/replaced.** **Adaptable ground floor space.**	Has to be designed for current use but flexible for future use adaptation.	Sufficient space to allow alternative use.	Review exercise at next stage of design.

Building "Layer" (as per GLA guidance)	Site	Substructure	Superstructure	Shell/Skin	Services	Space	Stuff	Construction Stuff	Summary	Challenges	Counter-Actions + Who + When	Plan to prove and quality
			low maintenance, high reusability and recoverability.									
Designing out construction, demolition, excavation, industrial and municipal waste arising	Existing buildings to be demolished which gives the opportunity for reusing of materials on site.	Use of crushed material salvaged from the demolition works.	The following have been considered: - Modular construction - DfMA approaches - Supplier take-back schemes	The following have been considered: - Modular construction - DfMA approaches - Supplier take-back schemes - Just-in-time delivery	The following have been considered: - Modular construction - DfMA approaches - Supplier take-back schemes - Just-in-time delivery	The following have been considered: - Supplier take-back schemes - Just-in-time delivery - Minimising Packaging			**Designing out waste through modular design.**	Relative cost, availability and access for installing off-site, modular components to be considered	Pre-construction supply chain engagement.	Review exercise at next stage of design.
	SECTION C: MANAGE WASTE											

Building "Layer" (as per GLA guidance)	Site	Substructure	Superstructure	Shell/Skin	Services	Space	Stuff	Construction Stuff	Summary	Challenges	Counter-Actions + Who + When	Plan to prove and quality
Demolition waste (how waste from demolition of the layers will be managed)	Pre demolition audit to be undertaken by demolition contractor to maximise the recovery of material for subsequent high grade or value application.								Pre demolition audit required to ensure recovery of materials are maximised. Achieve GLA target for 95% of non-hazardous demolition waste to be diverted from landfill.	Possibility of asbestos contamination.	Pre-demolition audit and asbestos survey to be completed.	Review to be followed.
Excavation waste (how waste from excavatio	Widespread land contamination, remedial measures	A piled foundation on substructure solution	N/A	N/A	N/A	N/A	N/A	N/A	Detailed cut and fill calculations to be undertaken.	Depends on calculation for cut and space for fill on	Calculations and landscaping features should	Cut and fill, and intrusive investigation

Building "Layer" (as per GLA guidance)	Site	Substructure	Superstructure	Shell/Skin	Services	Space	Stuff	Construction Stuff	Summary	Challenges	Counter-Actions + Who + When	Plan to prove and quality
n will be managed)	to be adopted. There are significant level changes across the site. Although the proposal respect site's topography, there will be unbalance on cut and fill. Limited area of basement level considered.	proposed. This minimises the amount of excavated material which is limited to the thickness of a piling mat.							**Intrusive investigation required to assess risk of contamination on site.** **Consider GLA target for 95% of excavation waste to be of beneficial use.**	site and intrusive investigation findings, including contamination and required remediation measures.	accommodate cut material.	exercises.
Construction waste (how	Consideration to off-site construction using DfMA and good practice site waste management.							Consider construction	**Achieve GLA target for**	RMP to be undertaken including	RMP to be complete	Review to be followed.

Building "Layer" (as per GLA guidance)	Site	Substructure	Superstructure	Shell/Skin	Services	Space	Stuff	Construction Stuff	Summary	Challenges	Counter-Actions + Who + When	Plan to prove and quality
waste arising from construction of the layers will be reused or recycled)	RMP will include targets for the construction waste resource efficiency (amount of waste generated per 100m^2 GIA) and for diversion of resources from landfill. Include non-hazardous waste materials from demolition and excavation into the RMP. Aim to maximise the recovery and reuse of construction materials. The project materials waste arising, and waste management routes will be monitored and recorded for construction, demolition and excavation, using a web-based tool such as SMARTWaste®.							incentives to reduce waste.	95% of non-hazardous construction waste to be diverted from landfill.	non-hazardous waste materials from demolition and excavation.	d by appointed principal contractor.	
Municipal and industrial waste (how the design will support operational waste management)	Operational waste management strategy would include waste storage calculation, waste storage provisions, operational waste management for both domestic and non-domestic within the Outlined Planning Areas Predicted waste streams includes residual (including food), mixed dry recyclable (MDR) and bulk waste. Suitable refuse storage will be proposed to enable adequate segregation and storage of all operational waste. These waste stores will be flexible and should reflect the waste collection service offered by LBC (which may be extended in the future to include food waste collection), as well as increase on the recycling rate of the development with time.								Appropriate refuse storage to enable recycling and best practise waste management. Achieve 65% municipal waste recycling target required by the policy "SI			

Building "Layer" (as per GLA guidance)	Site	Substructure	Superstructure	Shell/Skin	Services	Space	Stuff	Construction Stuff	Summary	Challenges	Counter-Actions + Who + When	Plan to prove and quality
									7 Reducing waste and supporting the circular economy".			

4.6 Recycling and Waste.

Table 5 includes the recycling and waste information that is not currently available but that the design team will provide at the next stage of the building detailed design, when demolition and principal contractors are appointed to undertake the cut and fill, demolition and construction works. Indicative targets have been included.

Table 5: Recycling and Waste Reporting and Targets Summary

Category	Total Estimate	Of Which			Notes
	tonnes/m^2 Gross Internal Area (GIA)	% reused or recycled onsite	% reused or recycled offsite	% to landfill (target)	
Excavation waste	Unknown at this stage	Unknown at this stage	Unknown at this stage	5% maximum	Cut and fill calculation to be undertaken. Moderate risk of contamination on site, intrusive investigation required. All non-hazardous excavation waste to be targeted for re-use on or off site..
Demolition waste	Unknown at this stage	Unknown at this stage	Unknown at this stage	5% maximum	Pre-demolition audit to be undertaken. Maximise the recovery of demolition material for subsequent high grade or value application

Category	Total Estimate	Of Which			Notes
Construction waste	Unknown at this stage	Unknown at this stage	Unknown at this stage	5% maximum	SWMP to be completed, including non-hazardous waste materials from excavation and demolition.
	l/annum	% reused on or off site	% recycled or composted, on or off site	% to landfill	
Municipal waste Outlined Planning Areas	Residential:	Space provided for segregation as per local authority policy.	Space provided for segregation as per local authority policy.	35% maximum AND no recyclable or compostable waste.	Waste generation estimates as per LBC policy.
	Non-Residential:	Unknown at this stage	Unknown at this stage		

4.7 Plan for implementation.

In line with Circular Economy principles, the main priority is to extend the lifetime of the building through careful design and specification.

At detailed design stage plans for implementation of the circular economy principles and achieving the targets and commitments will be further developed. These will include the below:

- Development of a programme and outlining the method that will allow the development to achieve the longer-term targets.
- Upon appointment a Resource Management Plan (RMP) will be developed by the main contractor, this will be used to outline the developments progress against the shorter-term site waste targets.
- Upon appointment a Municipal / Operational Waste Management Plan (MWMP/OWMP) will be developed by the main contractor, this will be used to outline the developments progress against the shorter-term municipal waste targets.
- Strategies for end of life disassembly will be further developed, including investigating which elements or components can be reused, recycled or composted.

4.8 End-of-life strategy.

In line with Circular Economy principles, the main priority is to extend the lifetime of the building through careful design and specification and to ensure that if the building is to be deconstructed at a later date that there is a clear process to follow. This will be further developed during the detailed design.

Building components may be disassembled at the end of the building life, either to be re-used in total or in part as other permanent or even temporary structures. This would be subject to material and component standards still applying, and if their systems could suit new systems at that future time. Or be otherwise recycled if appropriate recycling centres exist in the vicinity and is environmentally and economically appropriate and viable to do so at that future time.

4.8.1 End-of-life strategy

An end of life strategy will be produced prior to completion to describe how building materials, components and products can be disassembled and re-used at the end of their useful life. This will include how the information will be communicated to future building users.

5. Conclusion.

The Circular Economy approach and commitments for this project have been developed through a collaborative and cross-disciplinary approach. The interventions proposed address Folgate Estates Ltd desire to embed sustainable practice, waste reduction and circular economy principles within the built environment. This statement covers a wide range of interventions in developing a design approach that prioritises Circular Economy principles and will help to reduce the material impact and waste generated by the built environment.

Appendix A: Whole Life-cycle Carbon Assessment.

A whole life-cycle carbon assessment has been undertaken at the outline stage for the Murphy's Yard proposed development.

Methodology.

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

This assessment has been undertaken in line with the draft GLA guidance for undertaking outline WLC Assessments and therefore in line with the RICS Professional Statement: Whole Life Carbon Assessment for the Built Environment.

Operational carbon emissions
In line with the draft GLA guidance, the operational carbon emissions are estimated based on the Part L assessments undertaken for the Proposed Development as part of the outline Energy Strategy for planning. This encompasses carbon emissions related to both regulated and unregulated energy uses (in line with Part L definitions), accumulated over a 60-year study period.

Embodied carbon assessment and end-of-life emissions
To assess the embodied carbon for the project, a Life Cycle Assessment (LCA) tool – One Click LCA – has been used to make allocations for the anticipated materials quantities in an area extents analysis. The materials are represented within the model by using materials with associated Environmental Product Declarations (EPDs). EPDs are produced by manufacturers and identify the carbon emissions of a product. By scheduling the materials proposed for the development, the overall carbon emissions can be approximated.

It should be noted here that the LCA tool has a limited database of materials. In the scenario where a specified material isn't included in the database, the most likely material in terms of material composition is selected instead.

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

- A1-A3: Product stage
- A4: Material transportation to site
- B4-B5: Replacement and maintenance
- C1-C4: End of life

Together with these stages, the contribution of life cycle stage A5 has also been explored separately, giving an estimate of the emissions related to the construction. I.e. the electrical consumption and waste disposal.

In line with the draft GLA guidance, the assessment includes the following elements:

- Demolition
- Facilitating works
- Substructure
- Superstructure (frame, upper floors, roof, stairs and ramps, external walls, windows and external doors, internal walls and partitions, internal doors)
- Finishes
- Fittings, furnishings and equipment
- Building services
- Prefabricated buildings and building units

- Work to existing building
- External works (hard and soft landscaping, fencing, fixtures, drainage, services)

Current and future carbon emissions

In line with the guidance given in the draft GLA guidance to Whole Life Carbon assessments, the assessment has been undertaken based on two sets of carbon emissions:

SAP 10

The first set of figures is based on the current status of the electricity grid and provides a point-in-time assessment. For materials manufactured in the UK, SAP 10 emission factors are used in line with the GLA's Energy Assessment Guidance. Products sourced from outside the UK use data appropriate to the local energy grid at that location. This set of figures is used in the comparison to the WLC benchmarks.

Decarbonisation

It is also important to consider the potential longer-term decarbonisation of the electricity grid and how this may impact on design decisions. The second set of figures is therefore based on the expected decarbonisation of the electricity grid over the lifetime of the development (i.e. 60 years).

The RICS WLC guidance (2017) and the GLA WLC guidance (2020) documents makes reference to use of the "slow progression' scenario *from the latest Future Energy Scenarios* (FES) developed by the National Grid and makes reference to the 2015 edition of FES.

This edition has been revised each year, with the latest edition 2020 accounting for more recent developments in the future performance of the National Grid, the actual performance of the national grid deviated from the FES 2016 'Slow Progression' scenario and is inaccurate.

Therefore, for this Whole Life Carbon Assessment, the National Grid's 2020 edition of the 'Steady Progression' scenario was chosen as this more closely maps the departments of Business Energy and Industrial Strategy (BEIS) declared grid carbon projection.

Inputs.

This section sets out the inputs used in the outline Whole Life Carbon assessment.

Operational carbon assessment

Operational carbon emissions are estimated using Part L 2013 benchmark data for the different areas of the proposed development, submitted in support of the planning application. The assessment of operational carbon emissions has been based on the methodology set out in Part L of the building regulations, and a total of regulated and unregulated carbon emissions is reported.

- Residential areas: Operational carbon emissions are based on benchmark data in line with Part L1A methodology.
- Non-residential areas: Operational carbon emissions are based on benchmark data of regulated and unregulated energy.

Embodied Carbon and end-of-life assessment

Table 6 lists the building elements covered by the assessment, in line with the Royal Institute of Chartered Surveyors (RICS) Professional Statement: Whole Life Carbon assessment for the built environment.

Table 7 provides the life-cycle modules included in the assessment and commentary on the data source.

Table 6: Data used in the embodied carbon assessment.

Building element group	Building element (NRM level 2)	Basis for information
Demolition	0.1 Toxic/hazardous/contaminated material treatment	An allowance for contaminated land removal and treatment has not been provided for the Proposed Development at this outline stage of design.
	0.2 Major demolition works	An allowance for site excavation and demolition works was included in the assessment and used the average intensity of 1.39 kg CO_2e / m3 cleared debris, as developed by OneClick LCA software.
0 Facilitating works	0.3 & 0.5 Temporary/enabling works	Due to the early stage of the design (RIBA Stage 2) this information is not yet available and as such has not been included in the assessment.
	0.4 Specialist groundworks	No specialist ground works were included separately, with individual ground works accounted for in the relevant sub structure / external landscaping sections
1 substructure	1.1 Substructure	The specific foundations quantity was determined by OneClick LCA's carbon designer tool commensurate with the relevant building types.
2. Superstructure	2.1 Frame	Material quantity and composition of the frame were calculated using OneClick LCA's carbon designer tool commensurate with the relevant building types. The composition was informed by outline information provided by the structural engineer.
	2.2 Upper floors incl. balconies	Material quantity and composition of the upper floor and balconies were calculated using OneClick LCA's carbon designer tool commensurate with the relevant building type. The composition was informed by outline information provided by the structural engineer.
	2.3 Roof	Material quantity and composition of the roof were calculated using OneClick LCA's carbon designer tool commensurate with the relevant building type. This data incorporates the development dimensions for each building core and then compiled in the assessment.
	2.4 Stairs and ramps	Material quantity and composition of the stairs were calculated using OneClick LCA's carbon designer tool commensurate with the relevant building type.
	2.5 External walls	The external wall areas were calculated using OneClick LCA's carbon designer tool commensurate with the relevant building type and re-adjusted to match the outline use types.
	2.6 Windows and external doors	The window and door areas were calculated using OneClick LCA's carbon designer tool commensurate with the relevant building type and typical wall build ups from other projects provided by the project architect,
	2.7 Internal walls and partitions	The internal partition areas were calculated using OneClick LCA's carbon designer tool commensurate with the relevant building type

Building element group	Building element (NRM level 2)	Basis for information
	2.8 Internal doors	The internal doors areas were calculated using OneClick LCA's carbon designer tool commensurate with the relevant building type.
3 Finishes	3.1 Wall finishes	The wall, floor and ceiling finishes were calculated using OneClick LCA's carbon designer tool commensurate with the relevant building type.
	3.2 Floor finishes	
	3.3 Ceiling finishes	
4 Fittings, furnishings and equipment (FF&E)	4.1 Fittings, furnishings & equipment incl. building-related* and non-building-related**	The quantum of FFE for the residential apartments uses benchmark data from previous comparable assessments. The quantum of sanitaryware were calculated based on the area schedule and occupancy, with EPD's matched to the fittings proposed to be installed. FF&E is not applicable to the non-residential uses as these are being built out to a shell-only speculative standard and the detailed use types are unknown.
5 Building services/ MEP	5.1–5.14 Services incl. building-related* and nonbuilding-related**	Building services data uses data provided from the Building Services engineers which have been assumed in line with typical services strategy for the project.
6 Prefabricated Buildings and Building Units	6.1 Prefabricated buildings and building units	No prefabricated elements are applicable.
7 Work to Existing Building	7.1 Minor demolition and alteration works	No minor works were applicable.
8 External works	8.1 Site preparation works	Due to the early stage of the design (RIBA Stage 2) this information is not yet available and as such has not been included in the assessment.
	8.2 Roads, paths, paving and surfacing	Data for roads, paths, paving and surfacing is based on outline information provided from the landscape architect.
	8.3 Soft landscaping, planting and irrigation systems	Data for Soft landscaping, planting and irrigation systems is based on outline information provided from the landscape architect.
	8.4 Fencing, railings and walls	Due to the early stage of the outline design (RIBA Stage 2) this information is not yet available and as such has not been included in the assessment.
	8.5 External fixtures	Due to the early stage of the outline design (RIBA Stage 2) this information is not yet available and as such has not been included in the assessment.
	8.6 External drainage	Due to the early stage of the outline design (RIBA Stage 2) this information is not yet available and as such has not been included in the assessment.

Building element group	Building element (NRM level 2)	Basis for information
	8.7 External services	Due to the early stage of the outline design (RIBA Stage 2) this information is not yet available and as such has not been included in the assessment.
	8.8 Minor building works and ancillary buildings	No allowance was considered for minor building works and ancillary buildings.

Table 7 Life-cycle modules included in the assessment and commentary on the data source

Module	Description	Commentary of Data Source
A1-A3 Construction Materials	Raw material supply (A1) includes emissions generated when raw materials are taken from nature, transported to industrial units for processing and processed. Loss of raw material and energy are also taken into account. Transport impacts (A2) include exhaust emissions resulting from the transport of all raw materials from suppliers to the manufacturer's production plant as well as impacts of production of fuels. Production impacts (A3) cover the manufacturing of the production materials and fuels used by machines, as well as handling of waste formed in the production processes at the manufacturer's production plants until end-of-waste state.	Calculated using EPD's which align with the exact product (where known) or the most applicable similar product.
A4 Transportation to site	A4 includes exhaust emissions resulting from the transport of building products from manufacturer's production plant to building site as well as the environmental impacts of production of the used fuel.	Transport distances were estimated based on typical average transport distances based on material type & project location, provided by OneClick LCA.
A5 Construction/ installation process	A5 covers the exhaust emissions resulting from using energy during the site operations, the environmental impacts of production processes of fuel and energy and water as well as handling of waste until the end-of-waste state.	Due to lack of site-specific construction data, the climate zone average construction impact was used and sized based upon the scale of the development.
B1-B5 Maintenance and material replacement	The environmental impacts of maintenance and material replacements (B1-B5) include environmental impacts from replacing building products after they reach the end of their service life. The emissions cover impacts from raw material supply, transportation and production of the replaced new material as well as the impacts from manufacturing the replaced material and handling of waste until the end-of-waste state.	Use (B1) include the impact of refrigerant leakage at leakage rate of 3% a year and 98% end of life recovery. Maintenance (B2) and Repair (B3) have not been considered due to accurate data being unavailable at this early stage. Replacement (B4) and Refurbishment (B5) account for

Module	Description	Commentary of Data Source
		the technical service life of the building components "BCIS Life expectancy of building components"
B6 Energy use	The considered use phase energy consumption (B6) impacts include exhaust emissions from any building level energy production as well as the environmental impacts of production processes of fuel and externally produced energy. Energy transmission losses are also taken into account.	Energy consumption taken from benchmark data for the use types.
B7 Water use	The considered use phase water consumption (B7) impacts include the environmental impacts of production processes of fresh water and the impacts from wastewater treatment.	Water consumption based on Building Regulations Part G 'Enhanced Consumption' of 105 l/p/d and multiplied by the intended occupancy of the development, using the EPD for Thames Water.
C1-C4 Deconstruction	The impacts of deconstruction include impacts for processing recyclable construction waste flows for recycling (C3) until the end-of-waste stage or the impacts of pre-processing and landfilling for waste streams that cannot be recycled (C4) based on type of material. Additionally, deconstruction impacts include emissions caused by waste energy recovery.	C1 Deconstruction/demolition) and C2 (Transport) are based on default values. C3 (Waste Processing) and C4 (Disposal) use OneClick LCA's default end of life scenarios.
D External impacts/end-of-life benefits	External benefits for re-used or recycled material types include the positive impact of replacing virgin-based material with recycled material and the benefits of the energy which can be recovered from the materials.	D (End of Life) use OneClick LCA's default end of life scenarios.

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