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UCL Institute of Education Woburn Square relocation

Woburn Square relocation – Level 9

Interim Energy & Sustainability Statement

035833

26 April 2022

Revision P00

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author	**Daniela Catalano**
date	**26/04/2022**
approved	**Neil Shankland**
signature	Neil Shankland 2022.03.25 15:36:29Z00'00'
date	**26/04/2022**

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1 Introduction

This report sets out the interim energy & sustainability statement for the UCL Institute of Education (IOE) refurbishment, Woburn Square relocation covering levels 5 and 9 in zone C. The studies contain a summary of the Camden Council planning requirements, the energy strategy, thermal comfort assessment and BREEAM strategy. Whilst this report covers the Level 5 and 9 proposals, it is also being submitted as part of the level 9 Listed Building Consent Application.

The refurbished levels 5 and 9 zone C in IOE are 944 m^2 GIA. In line with Camden's Core Strategy and Camden Planning Guidance the proposals would not be considered as a 'major development'. The application would only be considered as a 'major development' if over 1000 m^2 of floorspace was being created and this is not the case for the level 5 and 9 proposals.

The UCL Institute of Education is a Grade II* listed building, however, despite this limiting factor significant efforts are being made by the design team to enhance the sustainability of the building. Key measures include:

- Improving the thermal performance of the building fabric in line with heritage constraints, through the addition of secondary glazing, where consented, and internal insulation to cladding panels.
- Upgrading all major MEP systems and lighting. To comply with Building Regulations, all performance values are better or equal to Part L2B 2013 (including 2016 amendments) and Non-Domestic Building Services Compliance Guide 2013.
- Retaining connection to the Bloomsbury Heat and Power network, which includes boiler and combined heat and power plant, that has a decarbonisation plan underway (by Ramboll)
- BREEAM 'Excellent' strategy – this includes a wide variety of sustainability measures including the integration of low flow water fittings, responsible sourcing of construction materials, measures to enhance site ecology, security studies, acoustic measures, and stringent sustainability criteria for the Contractor.

Figure 1—1 shows the 'Lean, Clean, Green' regulated non-domestic $kgCO_2/m^2$ savings following the GLA energy hierarchy for the refurbished areas (Levels 5 and 9 in zone C). As shown, a 37% reduction in regulated $kgCO_2/m^2$ emissions over the GLA baseline building is calculated from the combination of passive measures, HVAC improvements and connection to the Bloomsbury Heat and Power network. As no renewable energy systems (e.g., PV panels) are proposed specifically for Woburn Square there is no renewable reduction.

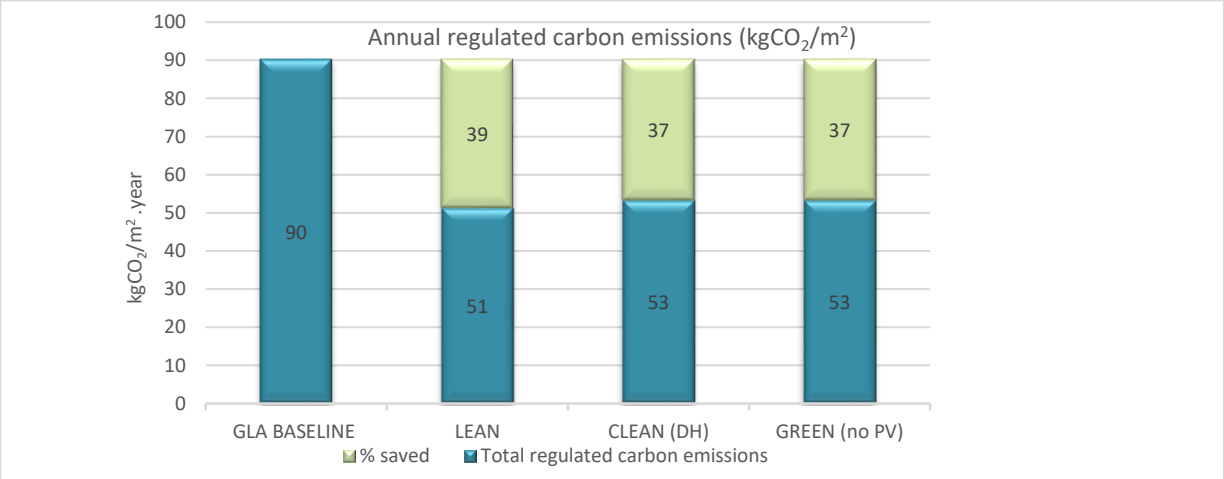

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Figure 1—1 Total regulated kgCO_2/m^2 emissions for the GLA Baseline and lean, clean and green scenarios covering Levels 5 and 9 zone C.

In line with the energy hierarchy reporting requirements for Camden, Table 1—1 shows the calculated 'Lean, Clean, Green' CO_2 savings (Tonnes CO_2 / year) for the proposed upgrade works.

Table 1—1 Total regulated tonnes CO_2 reduction per annum for Levels 5 and 9 zone C

	UCL IoE Phase 2 refurbishment (Levels 5 and 9 zone C – Woburn Square relocation)		
	Total regulated emissions (tonnes CO_2 per annum)	**Stage reduction (tonnes CO_2 per annum)**	**Percentage savings (% CO_2)**
Part L 2013 Baseline	73.2	-	-
Be Lean	41.5	31.6	43%
Be Clean	43.2	30.0	41%
Be Green	43.2	30.0	41%
Total	43.2	30.0	41%
Target (Be Green)	47.6	25.6	35%
Shortfall	0	0	0

In terms of renewable energy, there is a Camden Planning requirement to target at least a 20% reduction in CO_2 emissions through the installation of on-site renewable energy technologies. Solar photovoltaic (PV) panels are not included in the application for Levels 5 and 9 zone C as it falls outside of the scope of works. The implementation of solar PV was however investigated as part of a masterplan wide study, and it will be taken in consideration in future phases of the masterplan if deemed acceptable to heritage considerations.

Thermal comfort was assessed on Levels 5 and 9 zone C occupied spaces using IES-Virtual Environment in accordance with the methodology described in CIBSE Guide A. Results indicate that the mechanical ventilation and cooling approach integrated with the fabric improvements ensure optimum comfort in these spaces. Overall, the proposed building cooling demand is lower than the notional building, as shown below.

Table 1—2 Summary of notional vs. actual cooling demand

		Notional	Actual
MJ/m^2	**Cooling demand**	676.4	467.1

In relation to BREEAM, there is good potential to undertake an extensive and sustainable refurbishment for the UCL IOE, which achieves a BREEAM Excellent rating. Phases 1-3 of the UCL IOE refurbishment will be submitted together under one BREEAM 2014 (RFO) refurbishment and fit out assessment 2014. The summary information presented in this submission shows progress to date on the Phase 1 and 2 works, including the newly introduced Levels 5 and 9 zone C areas.

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2 Planning Checklist

2.1 Overview

In January 2021 Camden Council released new adopted standards for Energy Efficiency and Adaptation[1]. This chapter of the report provides a summary of these new requirements, which are addressed throughout this energy & sustainability statement.

For information, previous phases of the UCL IOE refurbishment have been assessed based on the Camden Planning Guidance CGP3 requirements (July 2015). Narrative supporting these requirements is also given.

2.2 Camden Planning Guidance – Energy Efficiency and Adaptation (January 2021)

Energy & overheating statement

- Energy statements are required for all developments involving more than 500m^2 of any (gross internal) floorspace.
- Deep refurbishments (i.e. refurbishments assessed under Building Regulations Part L1B/L2B) should also meet the London Plan carbon reduction targets for new buildings.
- Major non-residential development to achieve 15% reduction (beyond part L Building regulations), in accordance with the new London Plan, through on-site energy efficient measures (Be lean stage).
- All (new) major developments in Camden are expected to assess the feasibility of decentralised energy network growth
- Developments more than 500m^2 of any gross internal floorspace to achieve 20% reduction in carbon dioxide emissions from on-site renewable energy generation
- Sensitive improvements can be made to historic buildings to reduce carbon dioxide emissions.
- As a guide, at least 10% of the project cost should be spent on environmental improvements.
- Active cooling (air conditioning) will only be permitted where its need is demonstrated and the steps in the cooling hierarchy are followed.
- Development is expected to reduce overheating risk through following the steps in the cooling hierarchy. All new development should submit a statement demonstrating how the cooling hierarchy has been followed.

Sustainability statement

- BREEAM Excellent is required for all non-residential development of 500m^2 or more floorspace
- All developments involving 500^2 or more of any additional floorspace should address sustainable design and construction measures (proposed in design and implementation) in a Sustainability Statement
- All developments should demonstrate how sustainable design principles have been considered and incorporated.
- We will expect creative and innovative solutions to repurposing existing buildings and avoiding demolition where feasible.
- All development should seek to optimise resource efficiency and use circular economy principles.
- Whole Life Carbon assessment and pre-demolition audits to be carried out (for all applications where the option is substantial demolition)

[1] https://www.camden.gov.uk/documents/20142/4823269/Energy+efficiency+CPG+Jan+2021.pdf/96c4fe9d-d3a4-4067-1030-29689a859887?t=1611732902542

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- All developments should seek opportunities to make a positive contribution to green space provision or greening

The carbon reduction targets for developments in Camden are outlined in Table 2—1 and Table 2—2 below. The application of levels 5 and 9 includes the relevant energy and sustainability information and consideration (non-domestic refurbishment energy performance against carbon reduction targets, thermal comfort and BREEAM assessment).

Table 2—1 Camden requirements for energy statements for non-domestic buildings, including refurbishment

✓ Development should comply with these standards/provide this information	Non-domestic New Build (assessed under L2A)			Non-domestic Refurbishment (assessed under L2B)		
	Major (>1,000 sqm)	Medium (500sq.m and <1,000 sqm)	Minor (<500sq.m)	Major (>1,000 sqm)	Medium (500sq.m and <1,000 sqm)	Minor (<500sq.m)
Energy and carbon reduction targets						
Energy Statement required *(Local Plan CC1, London Plan 5.2, 5.3)* follow GLA Guidance on Preparing Energy Assessments.	✓	✓	Not required	✓	✓	Not required
Energy assessment methodology	National Calculation Methodology (NCM) and implemented through Simplified Building Energy Model (SBEM) v5.2d or later or equivalent software – presented in the BRUKL Non regulated emissions (i.e. catering and computing) should also be included in the report but included in the overall carbon reduction figures. The total non-regulated emissions can be established from individual end use figures from CIBSE guide baselines (e.g. CIBSE Guide F) or through evidence established through previous development work					
Baseline calculation	Notional Building Target Emissions Rate (TER) set by Building Regulations			Building Emissions Rate (BER) for the existing building, as well as a Building Regulations Compliant baseline (i.e. inputting the minimum building specification according to Part L2B following application of the usual Part L1B "payback test" methodology)		

Table 2—2 Camden requirements for carbon reduction for non-domestic buildings, including refurbishment.

Development should comply with these standards/provide this information	Non-domestic New Build (assessed under L2A)			Non-domestic Refurbishment (assessed under L2B)		
	Major (>1,000 sqm)	Medium (500sq.m and <1,000 sqm)	Minor (<500sq.m)	Major (>1,000 sqm)	Medium (500sq.m and <1,000 sqm)	Minor (<500sq.m)
Energy and carbon reduction targets						
Overall carbon reduction targets	*Zero carbon, minimum 35% reduction below Part L Building Regulations on-site, with 15% reduction through on-site energy efficiency measures) (London Plan Local Plan CC1)*	*Greatest possible reduction below Part L of 2013 Building Regulations (Local Plan CC1)*	*Greatest possible reduction below Part L of 2013 Building Regulations (Local Plan CC1)*	*Greatest possible reduction, meeting Part L2B for retained thermal elements. (London Plan 5.4, Local Plan CC1)*	*Greatest possible reduction below Part L of 2013 Building Regulations (Local Plan CC1)*	*Greatest possible reduction below Part L of 2013 Building Regulations (Local Plan CC1)*
Reduction in CO2 from onsite renewables (after all other energy efficiency measures have been incorporated)	*20% (London Plan, Local Plan CC1)*	*20% (London Plan, Local Plan CC1)*	*Incorporate renewables where feasible*	*20% (London Plan, Local Plan CC1*	*20% (London Plan, Local Plan CC1*	*Incorporate renewables where feasible*

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2.3 Camden Planning Guidance – Sustainability CGP3 (July 2015)

Table 2—3 outlines the Camden Council planning requirements the IOE has been following to date in relation to sustainability for existing buildings based on Camden Sustainability CGP3 (July 2015). Commentary in relation to the proposed works for levels 5 and 9 zone C is given.

Table 2—3 Camden planning checklist

Requirement	Commentary
Energy efficiency: existing buildings • All buildings, whether being updated or refurbished, are expected to reduce their carbon emissions by making improvements to the existing building. Work involving a change of use or an extension to an existing property is included. As a guide, at least 10% of the project cost should be spent on the improvements. • Where retro-fitting measures are not identified at application stage we will most likely secure the implementation of environmental improvements by way of condition. • Development involving a change of use or a conversion of more than 500sq m of any floorspace, will be expected to achieve 60% of the un-weighted credits in the Energy category in their BREEAM assessment. • Special consideration will be given to buildings that are protected e.g. listed buildings	*Substantial works are planned to improve the energy efficiency of this Grade II* listed building. Works in level 5 & 9 zone C include new secondary glazing, internal wall and roof insulation works where practical and new MEP systems throughout. Overall, a 37% reduction in regulated CO_2 is calculated following the 'lean, clean, green' hierarchy. For previous phases, it was estimated that 19.8% of project costs are being spent on energy efficiency. Works to levels 5 & 9 will be similar, given the same level of energy efficiency is being applied.*
Decentralised energy • Where feasible and viable your development will be required to connect to a decentralised energy network or include CHP.	*Levels 5 & 9 areas will be connected to the Bloomsbury Heat and Power (BHP) district heating network*
Cooling hierarchy • Proposals should align to the GLA cooling hierarchy: a. Minimising internal heat generation through energy efficient design b. Reducing the amount of heat entering the building in summer c. Use of thermal mass and high ceilings to manage the heat within the building d. Passive ventilation e. Mechanical ventilation	*The GLA cooling hierarchy has been followed. The strategy maximises passive design where feasible using exposed thermal mass, blinds on all windows to reduce solar gain, and low energy lighting/small power to reduce internal heat gains. For all spaces, BREEAM thermal comfort modelling has been carried out for levels 5 & 9 occupied areas.*
Monitoring and management • Proposals should include appropriate Building Management Systems, metering, monitoring and management	*The refurbishment works for levels 5 & 9 areas include the provision of new energy meters that will be connected to the UCL BMS.*
Renewable energy • All developments are to target at least a 20% reduction in carbon dioxide emissions through the installation of on-site renewable energy technologies. Special consideration will be given to heritage buildings and features to ensure that their historic and architectural features are preserved.	*Solar photovoltaic (PV) panels will not be included in the application for levels 5 & 9.*
Sustainability assessment tools (BREEAM) • Submission of a pre-assessment report at the planning application stage. The report should summarise the design strategy for achieving your chosen level of BREEAM and/or Code for Sustainable Homes and include details of the credits proposed to be achieved.	*The project is targeting a BREEAM Excellent rating with a single assessment across Phases 1-3. BREEAM Excellent rating of 75.8% is currently deemed achievable for the development. The project is currently*

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<table>
<tr><th>Requirement</th><th>Commentary</th></tr>
<tr><td>

Pre-assessment report is to be carried out by a licensed assessor. The name of the assessor and their licence number should be clearly stated on the report.
You are strongly encouraged to meet the following standards in accordance with Development Policy DP22 - Promoting sustainable design and construction:

<table>
<tr><th>Time period</th><th>Minimum rating</th><th>Minimum standard for categories (% of un-weighted credits)</th></tr>
<tr><td>2010-2012</td><td>'very good'</td><td rowspan="2">Energy 60%
Water 60%
Materials 40%</td></tr>
<tr><td>2013+</td><td>'excellent'</td></tr>
</table>
</td><td>targeting 10 credits for the development under Energy category Ene01. 77% of credits are targeted in the water category. 61% of credits are targeted in the material category and 54% in the waste category. Buro Happold is appointed as BREEAM Assessor and BREEAM AP for the scheme. The Contractor also has a BREEAM AP as their sustainability champion.</td></tr>
<tr><td>Water efficiency
The Council expects all developments to be designed to be water efficient by minimising water use and maximising the re-use of water. This includes new and existing buildings.
The Council will require developments over 1000sq m to include a grey water harvesting system, unless the applicant demonstrates to the Council's satisfaction that this is not feasible.</td><td>Low flow fittings will be targeted as part of refurbishment works in line with BREEAM Wat01. Grey water recycling feasibility to be confirmed by MEP engineer in Phases 3.</td></tr>
<tr><td>Sustainable use of materials & waste
All developments should aim for at least 10% of the total value of materials used to be derived from recycled and reused sources. This should relate to the WRAP Quick Wins assessments or equivalent. Special consideration will be given to heritage buildings and features to ensure that their historic and architectural features are preserved.
Major developments are anticipated to be able to achieve 15-20% of the total value of materials used to be derived from recycled and reused sources.
Construction waste and waste to landfill should be minimised</td><td>For levels 5 & 9 a high-level pre-refurbishment audit will be carried out by the Contractor to identify opportunities for material re-use and recycling with monitoring the construction waste activities throughout construction works.</td></tr>
<tr><td>Adapting to climate change
All development is expected to consider the impact of climate change and be designed to cope with the anticipated conditions.</td><td>A climate change risk assessment was conducted for BREEAM credit Wst05 covering the masterplan.</td></tr>
<tr><td>Brown roofs, green roofs and green walls
The Council will expect all developments to incorporate brown roofs, green roofs and green walls unless it is demonstrated this is not possible or appropriate. This includes new and existing buildings. Special consideration will be given to historic buildings to ensure historic and architectural features are preserved.</td><td>As the building is listed, the ecologist has recommended that external terrace areas include planters with native species. Terrace areas do not feature in levels 5 & 9 works.</td></tr>
<tr><td>Flooding
Developments must not increase the risk of flooding and are required to put in place mitigation measures where there is known to be a risk of flooding. Within the areas shown on Core Strategy Map 5 (Development Policies Map 2) we will expect water infrastructure to be designed to cope with a 1 in 100-year storm event in order to limit the flooding of, and damage to, property.</td><td>The site is in flood risk zone 1 (low risk of flooding). The proposed levels 5 & 9 refurbishment works will not increase surface water run-off.</td></tr>
<tr><td>External lighting
Lighting can have particular negative impacts on biodiversity. Unnecessary lighting should be avoided. Where lighting may harm biodiversity timers or specific coloured lighting will be required to minimise any disturbance.</td><td>BREEAM requirements for external lighting have been embedded into the project.</td></tr>
<tr><td>Local food growing
We encourage food to be grown wherever possible and suitable. Rooftops and shared spaces such as gardens and parks provide opportunities.</td><td>Local food growing is not incorporated into the scheme.</td></tr>
<tr><td>Biodiversity</td><td>An ecology study has been completed, recommending planting of native species on external terrace areas.</td></tr>
</table>

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Requirement	Commentary
• Proposals should demonstrate how biodiversity considerations have been incorporated into the development; if any mitigation measures will be included; and what positive measures for enhancing biodiversity are planned.	

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3 BREEAM Assessment Strategy

3.1 Overview

BREEAM (which stands for the "Building Research Establishment Environmental Assessment Methodology") sets the standard for best practice in sustainable building design, construction and operation and has become one of the most comprehensive and widely recognised measures of a building's environmental performance.

Phases 1-3 of the UCL IOE refurbishment will be submitted together under one BREEAM Refurbishment and Fit-out 2014 (RFO). The "UCL Sustainable Building Standard" states that all refurbishment projects with building services or building fabric upgrades must achieve a **BREEAM Excellent** rating.

Facilitating this approach in a complex phased project will require careful project management with the Contractor providing design stage and post construction BREEAM evidence for each element of the project as if it were a single assessment in its own right.

Supporting this process, the Contractor has nominated a Sustainability Champion throughout the design and construction process to formally report progress on BREEAM items to the client and BREEAM Assessor. Providing overall leadership to the BREEAM assessment is Buro Happold, who is appointed in a client-side role as BREEAM Assessor and BREEAM AP for the project.

3.2 Pre-assessment score

The BREEAM pre-assessment score (consisting of Phase 1 and 2 combined works, including Levels 5 and 9 zone C) for the UCL IOE masterplan is shown in Figure 3—1 and Levels 5 and 9 zone C in Figure 3—2. As shown, the project is on track to achieve a score is 75.8% surpassing the 'Excellent' threshold.

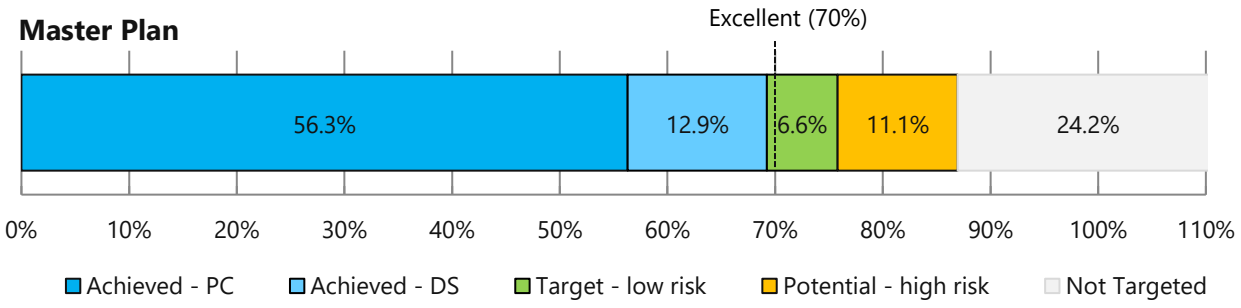

Figure 3—1 BREEAM pre-assessment score (Phase 1 and 2, including Levels 5 and 9 zone C masterplan progress)

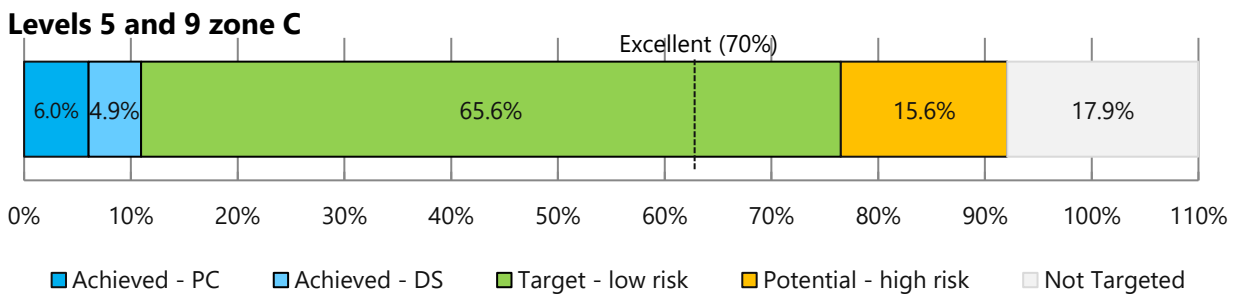

Figure 3—2 BREEAM pre-assessment score Levels 5 and 9 zone C progress

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The Masterplan assessment tracking schedule has been updated based on information and advice received from the design team to identify the targeted and potential scores for the development. As shown, 56.3% of 'post construction' evidence has already been secured based on 'masterplan' studies from Phase 1 and 2 that can be carried forward into Levels 5 and 9 zone C.

Figure 3—3 and Figure 3—4show the build-up of the BREEAM score by category.

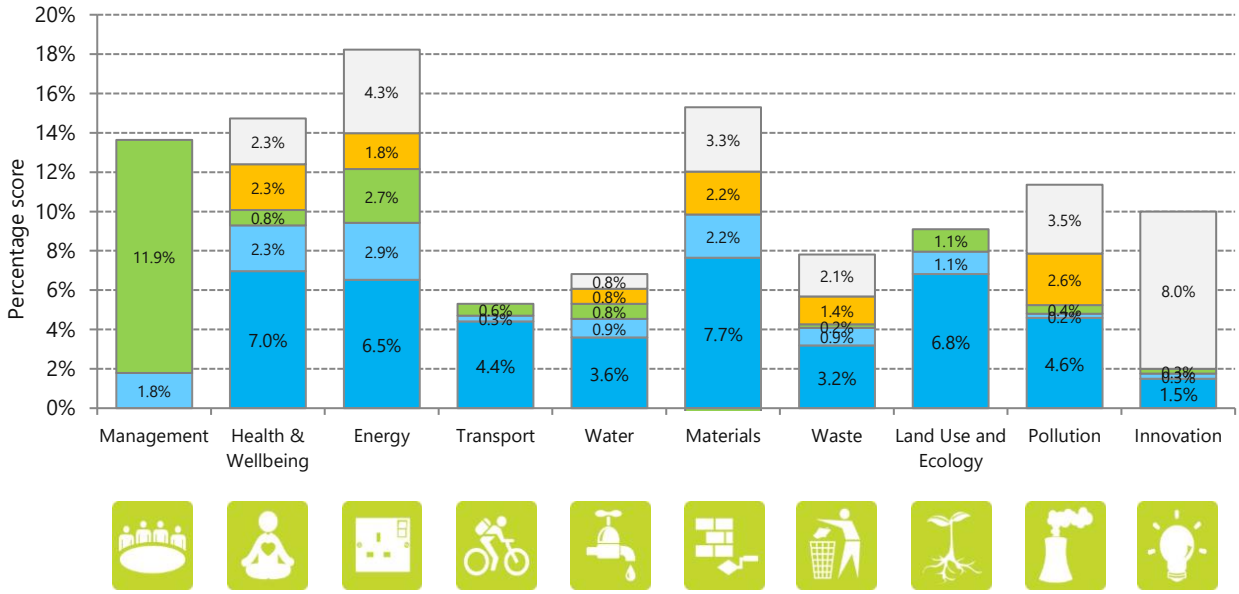

Figure 3—3 BREEAM pre-assessment score by category (Phase 1 and 2 masterplan progresses, including Levels 5 and 9 zone C)

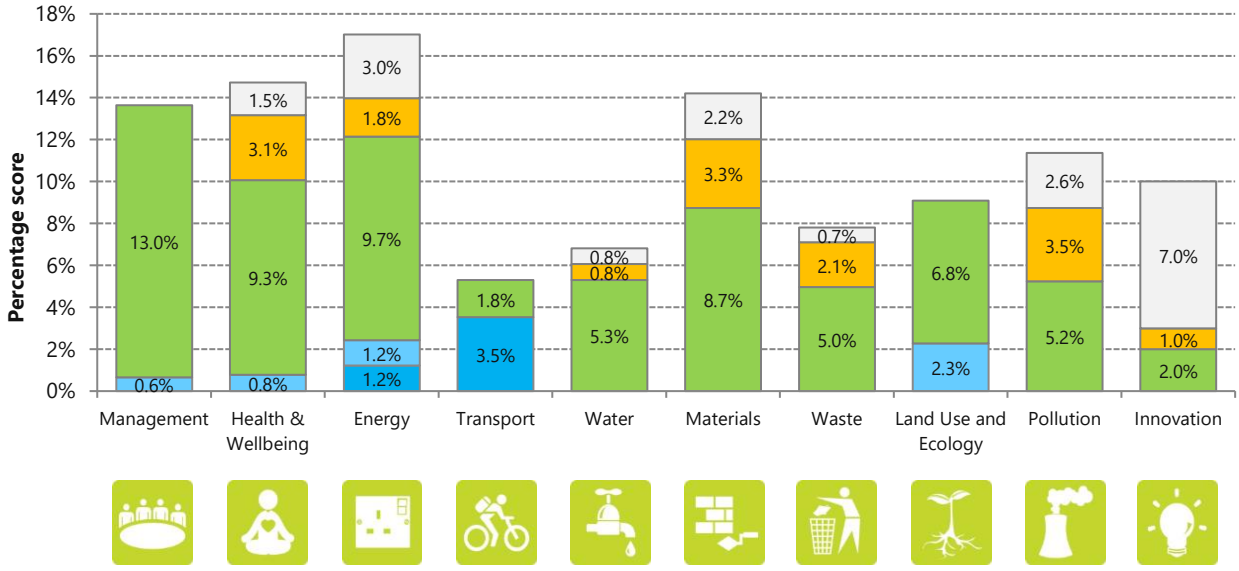

Figure 3—4 BREEAM pre-assessment score by category Levels 5 and 9 zone C progress

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3.3 Supporting commentary

In support of the Camden planning checklist, further commentary on key areas of interest is provided below:

Materials sourcing and waste

As part of the BREEAM assessment several credits are targeted relating to materials sourcing. Overall, in the materials category 61% of credits are targeted at low risk. Credits include sourcing A/A+ rated materials using the BRE green guide, responsible sourcing, designing for durability and robustness and tracking of material efficiency decisions. Regarding waste, 63% of credits in the waste category are targeted. Construction waste activities shall also be monitored throughout construction works.

Green infrastructure and biodiversity

In line with the ecologist's recommendations, planters with native species shall be provided to the master plan terrace areas (applicable to areas outside of this application). Overall, in the ecology category 4/4 credits are targeted.

Water efficiency and SuDS (including rainwater and greywater harvesting)

Low flow water fittings have been specified achieving a reduction in potable water usage of over 40%. Overall, in the water category 77% of credits are targeted. The site is in flood risk zone 1 (low risk of flooding). The proposed Phase 2 refurbishment works including Levels 5 and 9 zone C will not increase surface water run-off.

Building Management Systems, metering, monitoring and management

The sub-metering for Levels 5 and 9 zone C covers LTHW, cooling, AHUs, MCCP control panels, systems above 50kW, lighting and small power. Metering and Sub-metering for data will be made available to the UCL campus wide metering EMON System and Schneider Stuxtureware platform.

Resource efficiency and use circular economy principles

Credits relating to Material efficiency, Functional adaptability and Adaptation to climate change have all been pursued for Levels 5 and 9 zone C, requiring the design team to review and optimise the resources used as part of the refurbishment, considering a number of circular economy principles.

Whole Life Carbon assessment and pre-demolition audits

A pre-refurbishment audit was carried out specifically for Levels 5 and 9 zone C to identify opportunities for material re-use and recycling. The recommendations and opportunities identified in the audit will now be reviewed by the design team and materials incorporated into the deign where possible, minimising the amount of waste produced. Even though a full Whole Life Carbon assessment is not carried out as part of the development, credits relating to use of low embodied carbon via sourcing A/A+ rated materials using the BRE green guide and demonstrating improved energy efficiencies in the proposed development through targeting 10 credits in Ene01.

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4 Energy Strategy

4.1 Overview

This section of the report describes the energy strategy for the Levels 5 and 9 zone C of the UCL IOE refurbishment.

In order to comply with Camden Planning requirements for refurbishments, energy modelling following the GLA energy statement is required. This should be achieved by reporting performance through a 'Lean, Clean, Green' approach as illustrated in Figure 4—1.

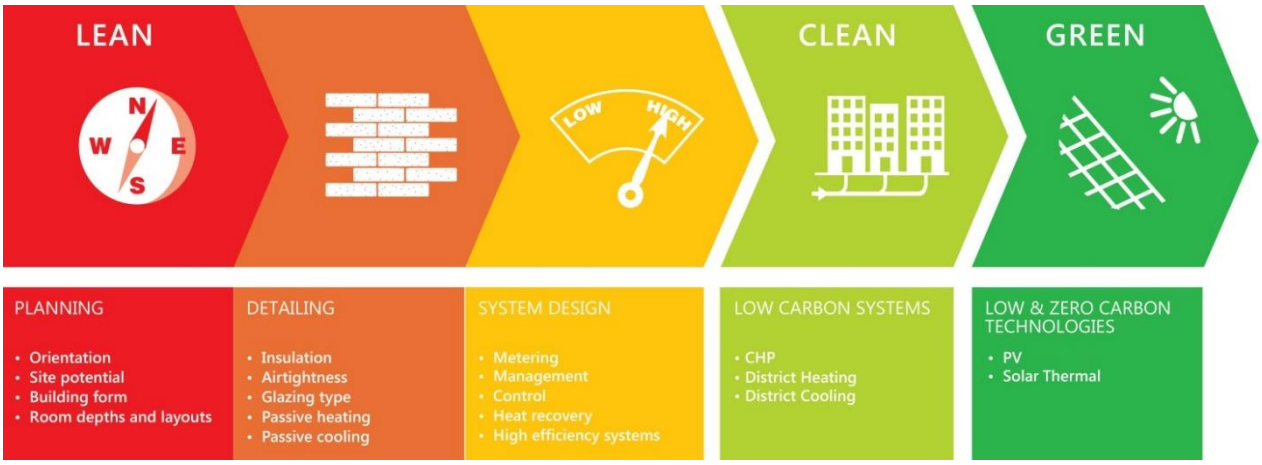

Figure 4—1 Summary of GLA 'lean, clean, green' energy hierarchy (indicative)

4.2 Carbon Emission Factors

In terms of CO_2 emissions, the UCL IOE is connected to the existing Bloomsbury Heat and Power (BHP) district heating network, which provides low-carbon heat and electricity, generated simultaneously via a CHP (combined heat and power) engine. The Bloomsbury campus district heating supplies medium temperature hot water (MTHW) to multiple spaces within the IOE complex by using local heat exchangers to distribute low variable and constant temperature heating water circuits throughout the complex. Therefore, the "Clean" energy strategy for the project must include a district heating network providing heating and DHW, whereas newly formed and existing air-cooled chillers with primary cooling system serves cooling to the whole development.

For the purposes of compliance with building regulations, the BHP network carbon factor used in all Phase 1 and 2 planning submissions to date was applied to this application. The BHP carbon factor was calculated using SAP 2012 carbon factors as per GLA Energy assessment guidance. According to the GLA (extract below) it is still acceptable to use the SAP 2012 carbon if the development:

a) is in a heat network priority area (Bloomsbury Heat Power area),
b) is connecting to an existing DHN network (BHP network),
c) decarbonisation plan for the network is underway (by Ramboll).

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4.3 Modelling summary

Building compliance energy modelling has been conducted in IES Virtual Environment 2021. The whole energy model focusing on level 5 and 9 is shown in Figure 4—2. The layouts of the existing Level 5 and 9 are based on the document released in January 2022, while the proposed layouts are based on drawings received in March 2022 by Penoyre & Prasad.

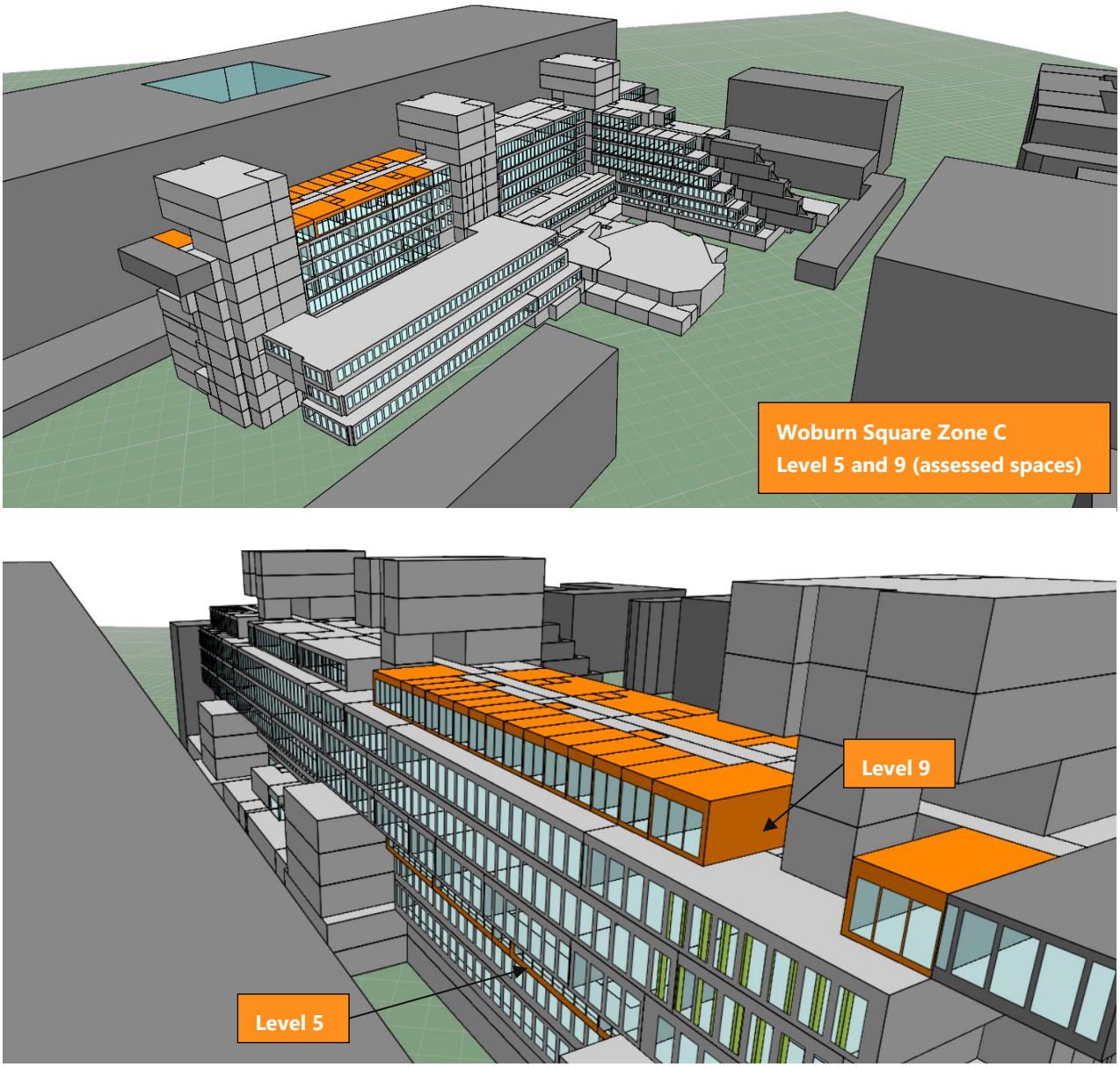

Figure 4—2 UCL IOE whole building energy model taken from IESVE 2021

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In line with GLA reporting requirements for refurbished buildings, the following design scenarios have been modelled:

- **GLA Baseline**
  - Existing building with non-domestic notional fabric parameters (GLA notional specification described in Appendix 4)
  - Existing building with 84% efficient gas boiler and hot water efficiency and HVAC system as per the actual building.
- **BE LEAN**
  - Actual building with improved building fabric elements
  - Daylight dimming and improved lighting energy efficiency
  - Improved HVAC efficiency & improved boiler efficiency (91%)

- **BE CLEAN**
  - Actual building with Bloomsbury campus district heating system

- **BE GREEN**
  - Model is the same as the clean model as no PV or other renewables will be implemented as part of this refurbishment.

4.4 Building Fabric inputs

Building fabric input parameters for the existing and proposed building models are summarised in Table 6—2. Note that in some cases Part L2B U-values are not technically feasible on the listed building, but this has been deemed as acceptable by Building Control.

The following section describes how the building fabric upgrade strategy for Phase 1 and 2 deviated from the Part L2B standard due to limitations associated with the Grade II* listed building's construction. These deviations to Phase 1 were approved by MLM Building Control (03/April/2018). Note that similar restrictions also apply to Phase 2.

I. Main façade, opaque panel & fins - The opaque panel below the glazing was insulated to a centre pane U-value of 0.3 W/m^2.K (in line with Part L2B), however when including the thermal bridging from the exposed concrete fins and slab edge that cannot be insulated, the overall U-value of opaque elements was calculated as 1.7 W/m^2.K. Figure 4—3 shows the main façade for information.

II. Internal wall insulation - Where it was feasible to internally insulate concrete walls, the Arup report (refer to 180124_Thermal assessments) recommended a U-value of 0.7 W/m^2.K, as opposed to the Part L2B U-value of 0.3 W/m^2.K. The U-value of 0.7 W/m^2.K is based on the Building Regulations Part C (section 5.36) limiting U-value for resistance to surface condensation and mould growth.

I. Main façade, glazing - The single glazed windows were upgraded with a single glazed secondary glazing system achieving a centre pane U-value of 1.7 W/m^2.K and overall U-value of 2.1 W/m^2.K. By comparison, the Part L2B requirement is to achieve a centre pane U-value of 1.2 W/m^2.K and overall U-value of 1.8 W/m^2.K. The option of a double-glazed secondary glazing system was discussed with Building Control, however, it was advised by Arup that the framing would be problematic from a heritage point of view, would not significantly improve the U-value and could create a condensation risk.
Figure 4—4 presents the comparison of existing windows and the proposed secondary glazing included in the energy assessment of level 5 and 9.

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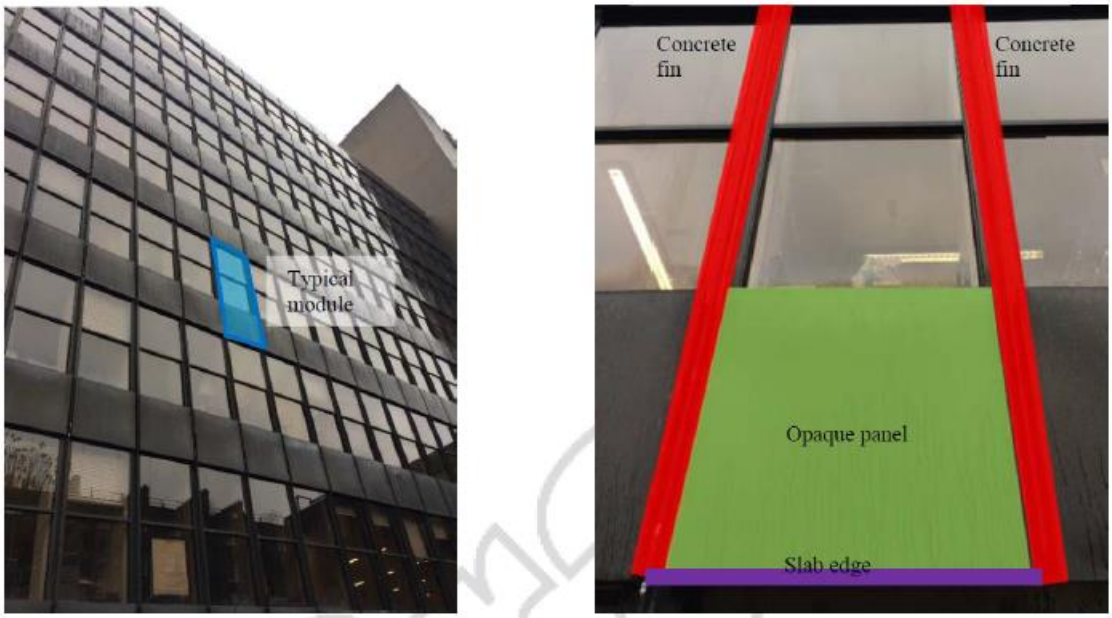

Figure 4—3 Main façade detail, where the opaque panel was insulated internally, and the glazing was upgraded with single glazed secondary glazing. The concrete fins and slab edge were not insulated due to heritage restrictions.

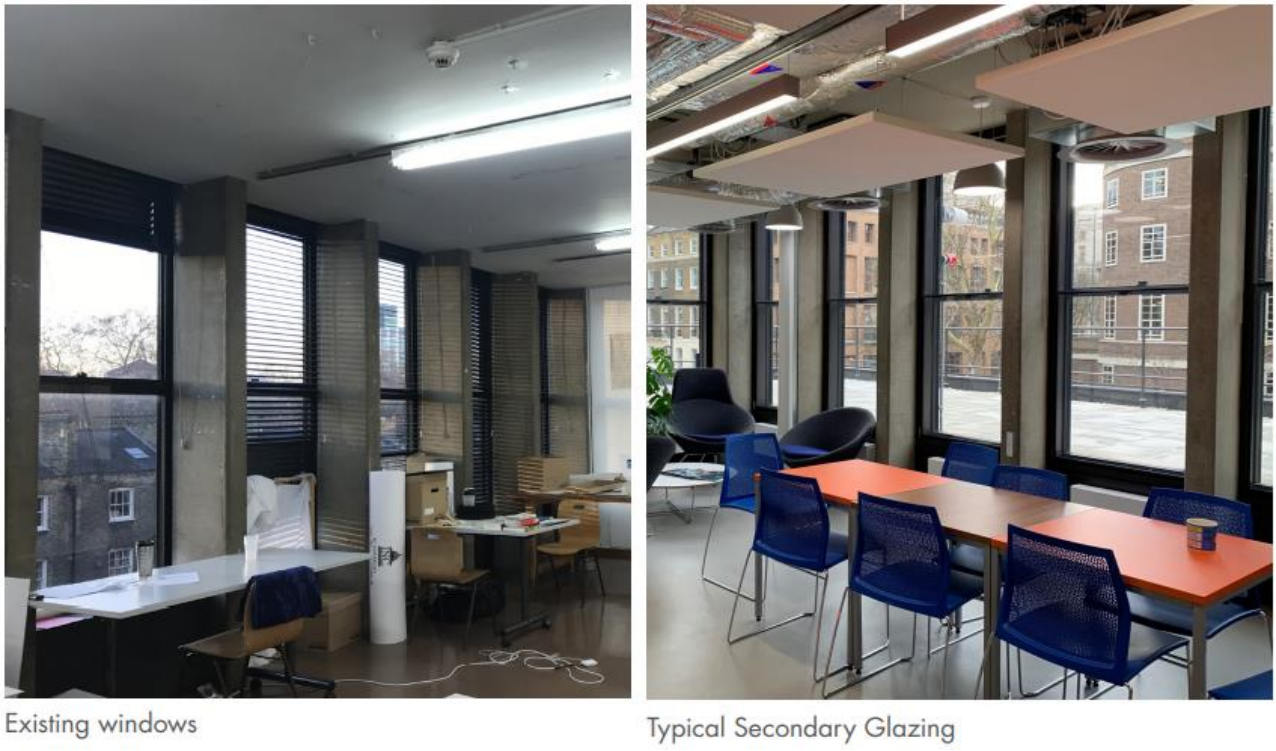

Figure 4—4 Existing windows and the proposed secondary glazing

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4.5 Building Services Inputs

Building services input parameters for the existing and proposed building models are summarised in Appendix A.4.

4.6 Energy and carbon emission results

Energy modelling and CO_2 reduction modelling results are given below in Table 4—1. The table gives a summary of the GLA modelling results, whereby the % saving represents the reduction against the Part L 2013 notional Building and 35% improvement is typically required to meet London Plan performance.

Table 4—1 Energy modelling results for Phase 2

		LEAN			CLEAN	GREEN
Annual carbon emissions ($kgCO_2/m^2$)	**GLA Baseline**	**Improved fabric**	**Lighting controls & efficiency**	**Improved HVAC efficiency**	**DH system**	**No renewable**
Heating	11.0	8.0			8.6	8.6
Hot water	46.8	22.3			23.8	23.8
Cooling	2.4	2.6			2.5	2.5
Auxiliary	19.1	14.5			14.5	14.5
Lighting	11.0	3.9			3.9	3.9
Building emission rate	**90.3**	**51.2**			**53.3**	**53.3**
% Saving		**-39%**			**-37%**	**-37%**

Figure 4—5 illustrates the CO_2 saving results. As shown, the preliminary modelling results achieve a **39%** savings through fabric and servicing improvements over the GLA Baseline. The district heating system reduces CO_2 emissions by **37%** over the GLA Baseline model without significant negative impacts. As no renewable energy systems (e.g., PV panels) are proposed specifically for Levels 5 and 9 zone C areas there is no renewable reduction.

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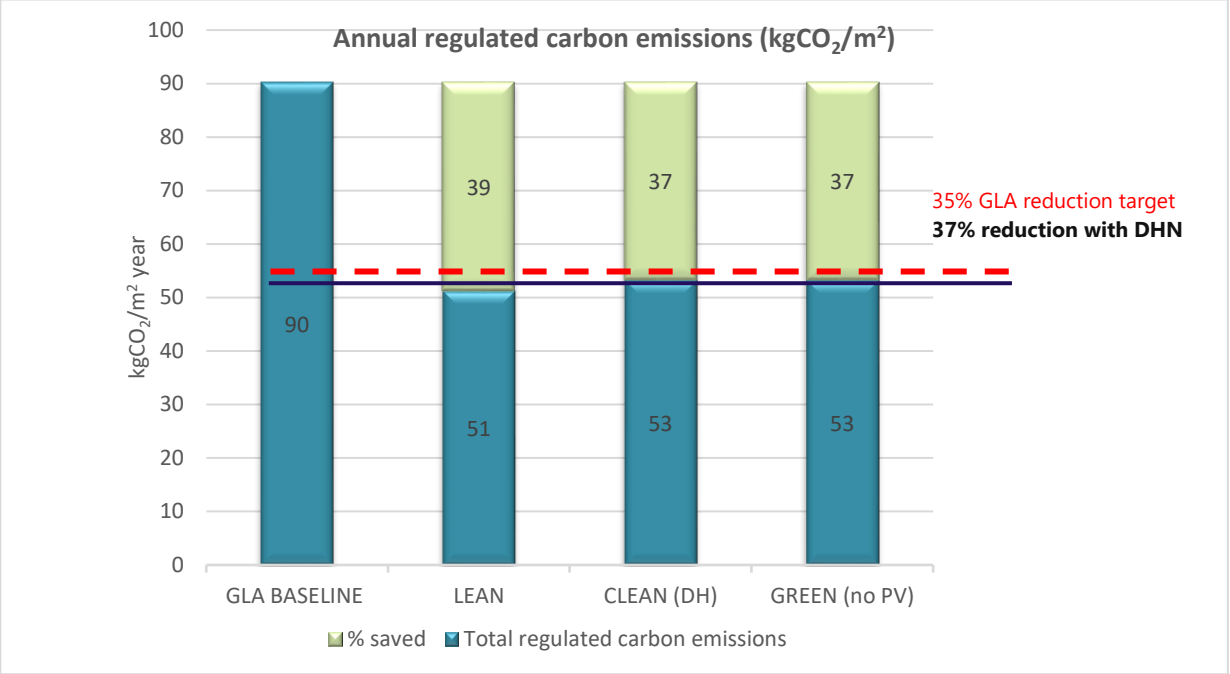

Figure 4—5 Regulated CO_2 reduction results expressed using the GLA lean, clean, green hierarchy

Table 4—2 give a summary of carbon and energy stage reductions. As shown in Figure 4—6, the highest energy consumption is from DHW, due to the hot water demand, the existing storage heat losses and secondary circulation losses. The next highest load in the actual building is auxiliary energy use, followed by heating energy.

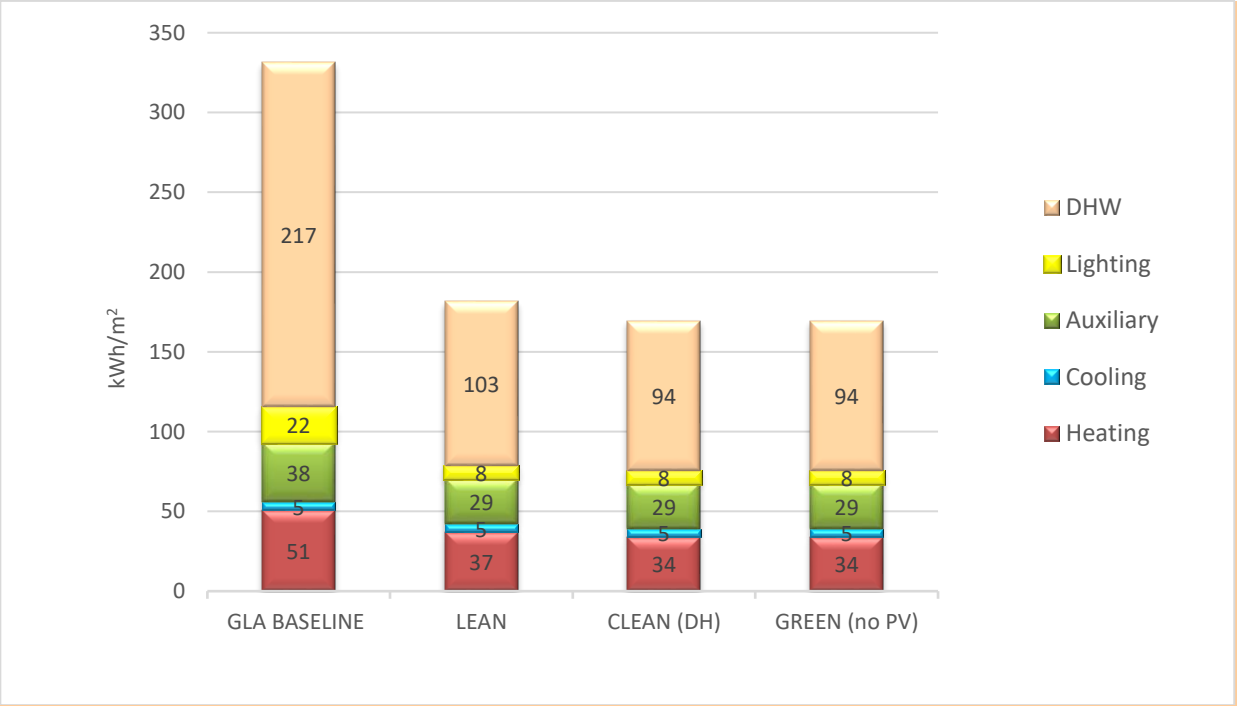

Figure 4—6 Predicted annual regulated energy reduction for Woburn Square level 5 and 9 in zone C

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Table 4—2 Energy end use results and CO_2 reduction modelling results for Phase 2

		Baseline (Existing)	LEAN	CLEAN	GREEN
Building emission rate ($kgCO_2/m^2$)					
Carbon savings (%)		-	**39%**	**37%**	**37%**
$kgCO_2/m^2$	Heating	11.0	8.0	8.6	8.6
	Hot water	46.8	22.3	23.8	23.8
	Cooling	2.4	2.6	2.5	2.5
	Auxiliary	19.1	14.5	14.5	14.5
	Lighting	11.0	3.9	3.9	3.9
		Baseline (Existing)	**LEAN**	**CLEAN**	**GREEN**
Total regulated energy end use		331.6	181.7	169.3	169.3
Energy kWh/m^2	Heating	50.8	36.9	34.0	34.0
	Cooling	4.8	5.1	4.9	4.9
	Auxiliary	37.8	28.6	28.6	28.6
	Lighting	21.7	7.7	7.7	7.7
	Domestic hot water	216.5	103.4	94.1	94.1

For further details of the 'Lean, Clean, Green' energy models, see the BRUKL report in Appendix D

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5 Thermal comfort analysis

5.1 Overview

This section contains a thermal comfort assessment for Levels 5 and 9 zone C across the occupied areas within the building. The assessment was based on the adaptive comfort standard specified in CIBSE Guide A according with BREEAM 2014 UK Refurbishment Non-domestic buildings using baseline and projected weather data.

The thermal comfort strategy for UCL IOE has been developed following the GLA cooling hierarchy shown below, whereby active cooling systems are only utilised when all passive design measures have been exhausted.

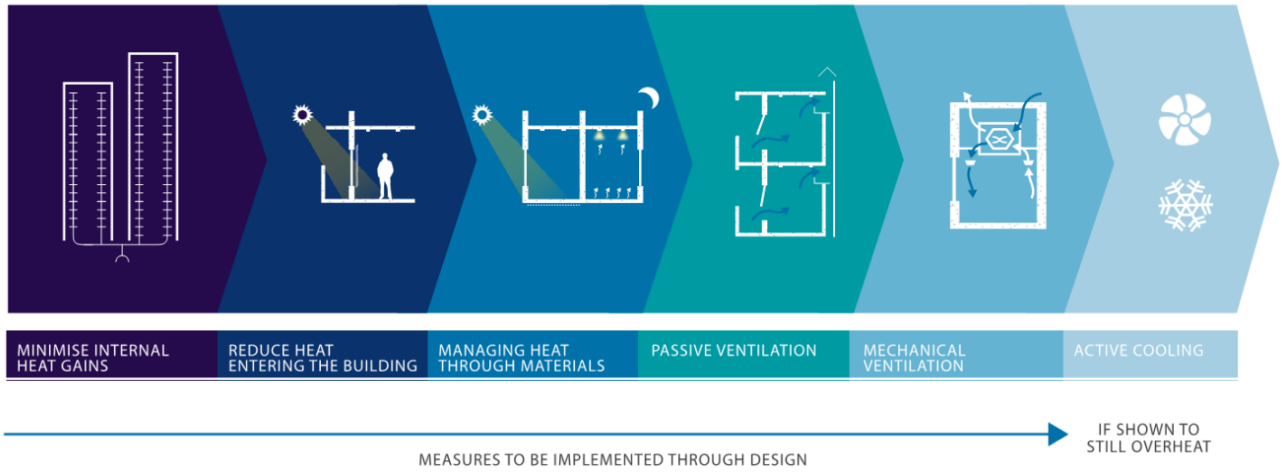

Figure 5—1 Summary of GLA cooling hierarchy followed (indicative)

5.2 Modelling summary

The thermal comfort assessment was carried out in IES Virtual Environment 2021, in accordance with CIBSE AM11 and BREEAM credit Hea04. Results are assessed against the CIBSE Guide A methodology.

An image of the IES model, incorporating adjacent buildings is shown in Figure 5—2. The model reflects the RIBA Stage 3 design and is based on drawings issued by Penoyre & Prasad in March 2022.

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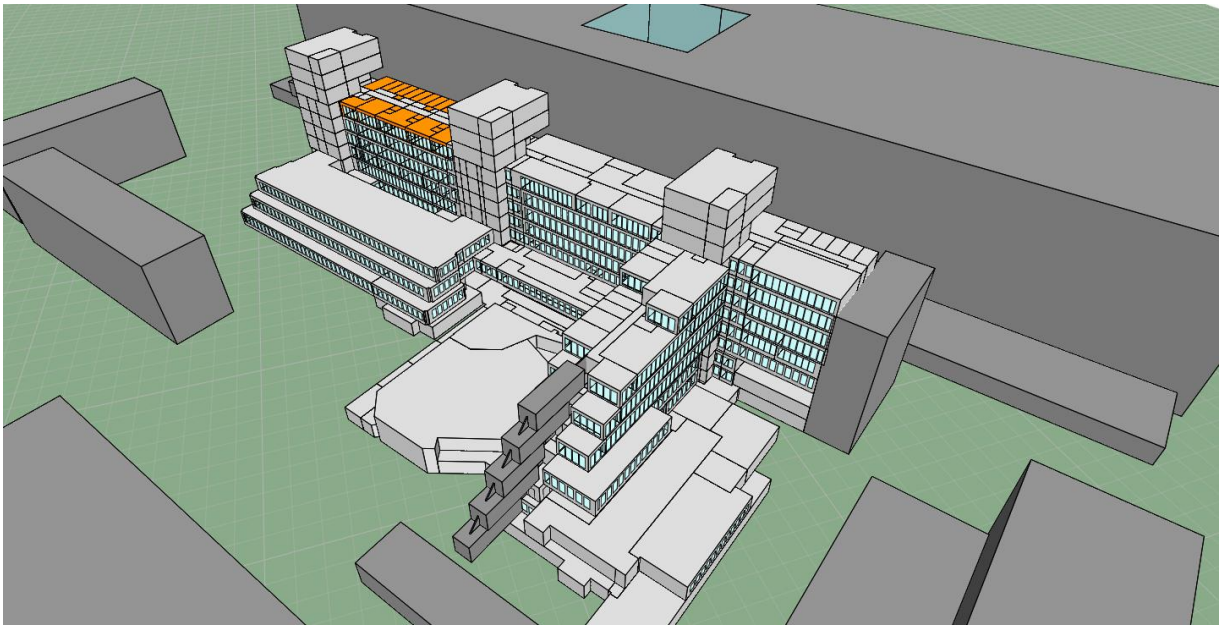

Figure 5—2 Phase 2 Zone C (Level 5 and 9) geometry created in IESVE 2021

Weather files

As per BREEAM Hea04 and UCL Sustainable Building Standard guidelines, two sets of weather files were tested:

Table 5—1 Summary of weather files used

Weather file set	Description	Notes
London_LWC_DSY1_2020High50.epw	CIBSE weather file (DSY1 moderately warm summer)	In accordance with the BREEAM the naturally ventilated spaces as workspaces and office units are tested in the current scenario
London_LWC_DSY1_2050Medium50.epw	Future weather predictions for 2050's under medium-risk climate change scenario	In accordance with BREEAM the naturally ventilated spaces as workspaces and office units are tested in a 2050 scenario

PMV/PPD and Hours of Exceedance

For air-conditioned spaces, the predicted mean value (PMV) and predicted percentage dissatisfied (PPD) values indicate the level of thermal comfort in a space. Table 5—2 provides the acceptable ranges for PMV and PPD for any space, as defined in CIBSE Guide A. Both values must fall within their respective ranges for each space in winter and summer in order to demonstrate compliance.

Table 5—2 PMV and PPD ranges

	Minimum allowable value	Maximum allowable value	Notes
PMV	-0.5	+0.5	It is desirable to achieve a PMV of 0; negative scores suggest temperatures are below the optimal thermal comfort (i.e. too cold), and positive scores are above optimal thermal comfort (i.e. too hot).
PPD	5%	10%	The PPD is a percentage that represents the number of people that would be thermally uncomfortable with the same conditions, level of activity and clothing in each thermal environment

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The appropriate values of design room operative temperature are also used for the thermal comfort evaluation. Table 5—3 provides the summary of recommended operative temperature for summer and winter by CIBSE Guide A for each type of room included in the proposed spaces. CIBSE Guide A sets a limit of three per cent of the occupied hours that operative temperature exceeds the threshold temperature by 1 Kelvin or more for mechanically ventilated and mechanically cooled space.

Table 5—3 Recommended operative temperature of office and teaching spaces based on CIBSE Guide A

Operative temperatures CIBSE A (2015), table 5.1	Winter min	Winter max	Summer min	Summer max
Office	19	24	21	25
Teaching Space	20	23	21	25

Heat gains

Inputs for internal equipment and lighting heat gains are given in Table 5—4. It is assumed that most of the equipment gains in the teaching spaces will be from personal laptop use by students, whereas in the offices and workspaces there are likely to be a mix of laptops, screens, computers, and additional facilities such as photocopiers.

Meeting rooms are likely to have laptops and projector screens while quiet booth equipment load will mainly from personal laptops only. The tea point, where people gather for break, will have food heating and cooling appliances.

Table 5—4 - Internal gains for occupancy, equipment, and lighting

	Occupancy (m^2/p)	Load/Person	Lighting (w/m^2)	Equipment (w/m^2)
Cellular office (9th Level)	4	Sens. Load (75 W/p) Lat. Load (55 W/p)	4.3	15
Cellular office (5th Level)	8	Sens. Load (75 W/p) Lat. Load (55 W/p)	6.3	15
Workspaces	4	Sens. Load (75 W/p) Lat. Load (55 W/p)	4.3	14
Teaching IOE studies	3	Sens. Load (75 W/p) Lat. Load (55 W/p)	4.3	10
Meeting room	3	Sens. Load (75 W/p) Lat. Load (55 W/p)	4.3	10
Quiet Booth	3	Sens. Load (75 W/p) Lat. Load (55 W/p)	4.3	3
Tea point	3	Sens. Load (75 W/p) Lat. Load (55 W/p)	3	10
Profile	30% 8AM to 9AM 50% 9AM to 9.30AM 100% 9.30AM to 6PM 50% 6PM to 7PM 30% 7PM to 10PM		100% 8AM to 10PM, 10% at night	100% 9AM to 7PM, 10% at night

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Occupancy densities are illustrated in Figure 5—3. Circulation spaces are typically not considered occupied if not occupied for longer than 30 minutes, however, the circulation space serving the workspaces may be considered a transition space with working area, it is likely that such an area might be used by staff or students and is considered during the thermal comfort analysis.

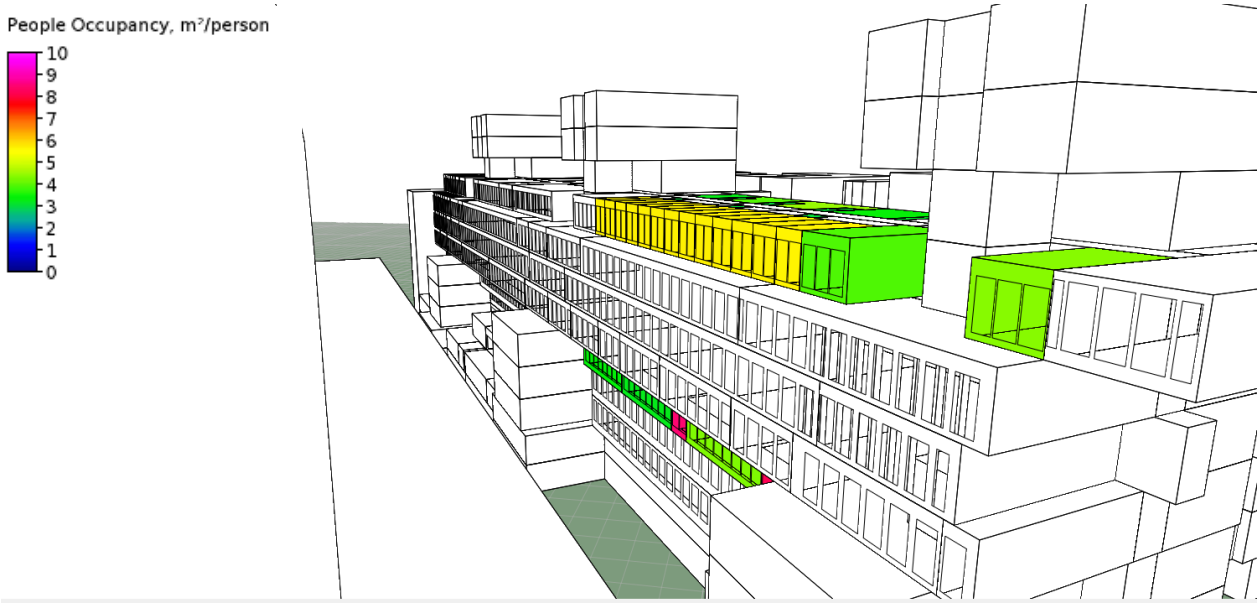

Figure 5—3 Occupancy density Phase 2 Zone C Levels 5 and 9

5.3 Ventilation strategy

Windows in the Zone C spaces on levels 5 and 9 are sash windows, proposed to be improved with a secondary glazing panel. Sash windows are typically openable up to 50%. However, due to security reasons, most windows are locked and limited to an opening of circa 10%.

In order to achieve adequate thermal comfort rooms from levels 5 and 9 have the following ventilation features:

Level 5:

- Variable air volume (VAV) and CO_2 sensors installed in an occupied space and connected to VAV systems to modulate the fresh air provision into each room.
- Dropping down of blinds and opening of window sash in workspaces and cellular offices in the façade.
- Provision of airflow supplied at 20°C for internal cellular offices and teaching spaces where teaching spaces are mechanically cooled via FCUs.
- Provision of airflow supplied at 18°C for workspace and cellular office at the perimeter side and the kitchen.

Level 9:

- Variable air volume (VAV) and CO_2 sensors installed in an occupied space and connected to VAV systems to modulate the fresh air provision into each room.
- Provision of airflow supplied at 20°C for all cellular offices, workspaces, tea point, and teaching spaces where all are mechanically cooled via FCU
- Provision of airflow supplied at 20°C for meeting rooms and quiet booths

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Figure 5—4 illustrates the HVAC strategy applied to level 5 and 9 Zone C

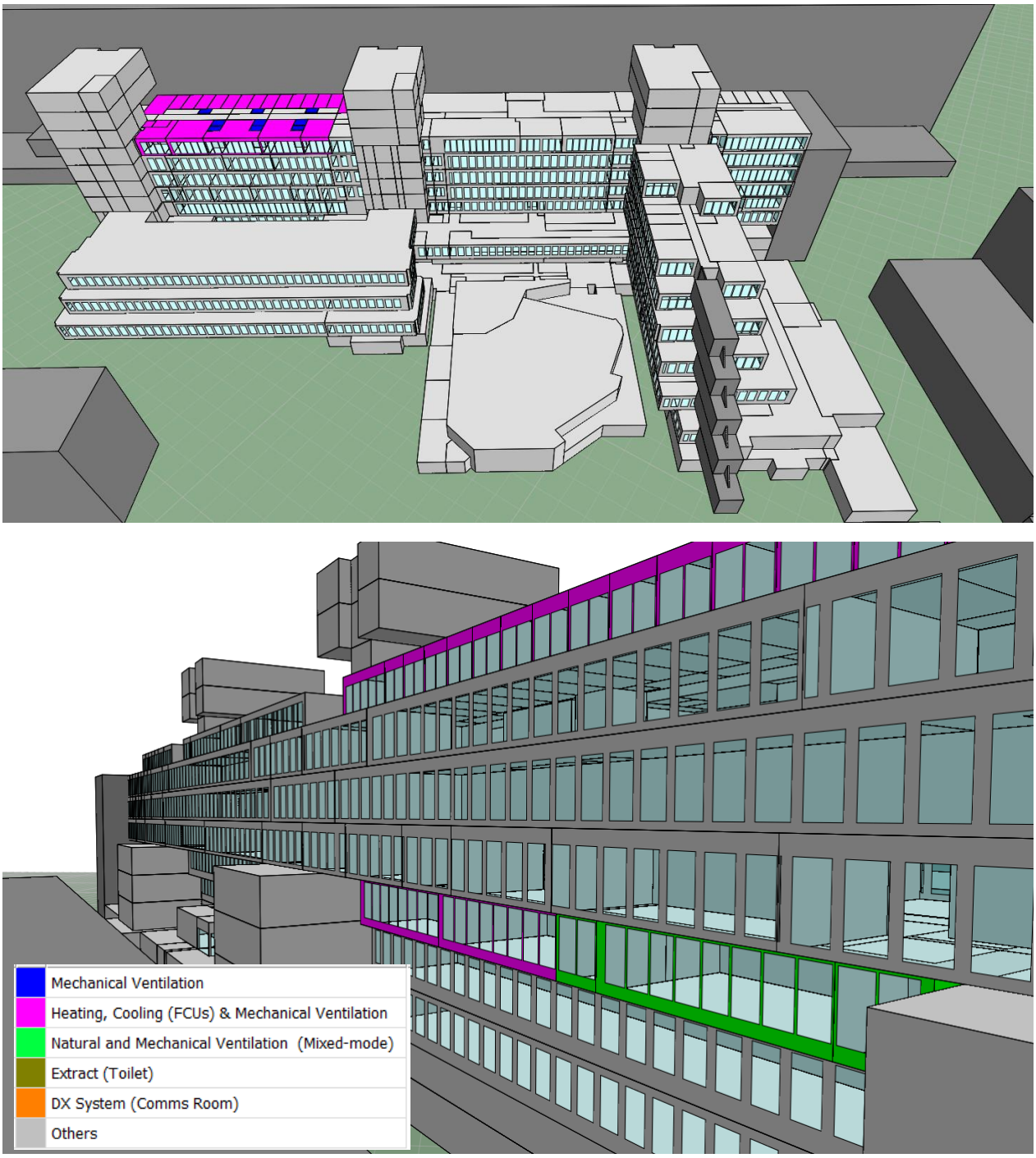

Figure 5—4 Phase 2 Zone C Levels 5 and 9 space conditioning strategies

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Table 5—5 and Table 5—6 outline the ventilation strategy in terms of flow rates on levels 5 and 9.

Table 5—5 Air flow rate controlled by temperature profile and window opening profile applied to thermal model in IESVE 2021

Phase 2 Zone C (Level 9)	Mechanical ventilation strategy
Cellular Office 1&2	Flow rates 9 l/s m^2 supplied at 20°C controlled by outside air temperature and the spaces are cooled with FCU
Cellular Office 3-16	Flow rate 1-3 l/s m^2 supplied at 20°C controlled by outside air temperature and the spaces are cooled with FCU
Workspace	Flow rate 2.7 – 3.7 l/s m^2 (96 l/s) supplied at 20°C controlled by outside air temperature and the spaces are cooled with FCU
Meeting room	Flow rate 18 - 24 l/s m^2 (72 l/s) supplied at 20°C controlled by outside air temperature
Quiet Booth	Flow rate 19 l/s m^2 (59 l/s) supplied at 20°C controlled by outside air temperature
Tea point	Flow rate 3 l/s m^2 supplied at 20°C controlled by outside air temperature and the spaces are cooled with FCU

Table 5—6 Air flow rate controlled by temperature profile and window opening profile applied to thermal model in IESVE 2021

Phase 2 Zone C (level 5)	Mechanical ventilation strategy	Opening profile IES thermal model
Teaching Space	Flow rate 1.7 – 2.0 l/s m^2 (120 l/s) supplied at 20°C controlled by outside air temperature	
Workspace	Flow rate 3.7 l/s m^2 (250 l/s) supplied at 18°C controlled by outside air temperature	Openable area 50% based on modulating profile applied to sash window: The bottom/top panel gradually opens when internal temperature is over 20°C until is fully open at 24 °C in summer months. (T_{dr}>20) Activation of blinds in response to solar radiation is applied.
Cellular offices	Flow rate 3 l/s m^2 supplied at 20°C controlled by outside air temperature. *Cellular office_2 flow rate is 7.6 l/s m^2 *Cellular office_3 supplied at 18°C controlled by outside air temperature.	Openable area 50% based on modulating profile applied to sash window: The bottom/top panel gradually opens when internal temperature is over 22 °C until is fully open at 24 °C in summer months. (T_{dr}>22) Activation of blinds in response to solar radiation is applied for cellular offices with windows.

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Table 5—7 identifies heating and cooling set points agreed with the building services engineers.

Table 5—7 Heating and cooling set points per space function

Space use	Heating set-point (°C)	Cooling set-point (°C)
Office/Workspace (9th Level)	21 ±4	23 ±2
Office/Workspace (5th Level)	-	-
Teaching Space	21 ±2	23 ±2
Meeting room/Quiet Booth	21 ±2	-
Break out	21 ±2	23 ±2

5.4 Baseline & future weather results

Table 5—8 and Table 5—9 contain the modelling results for all occupied spaces assessed against baseline and future weather data for Phase 2 zone C (levels 5 and 9). Spaces are deemed to "Pass" the CIBSE Guide A criteria if at least 2 of 3 requirements are met. As shown, all spaces PASS the CIBSE Guide A criteria in the baseline and future scenarios.

Table 5—8 Summary of PMV/PPD results, baseline weather

	PMV scale		PPD (%)		RESULT
Space ID	**Mean winter**	**Mean summer**	**Mean winter**	**Mean summer**	
Air-Conditioned occupied spaces	0.01	0.36	5.73	9.31	**Acceptable**

Table 5—9 Summary of PMV/PPD results, future weather

	PMV scale		PPD (%)		RESULT
Space ID	**Mean winter**	**Mean summer**	**Mean winter**	**Mean summer**	
Air-Conditioned occupied spaces	0.04	0.40	5.85	10.03	**Acceptable**

In terms of the hours of exceedance of allowable temperature in summer and winter, Table 5—10 to Table 5—13 summarise the results under baseline weather. See the results under the future predicted DSY1_2050Medium50 weather conditions in Appendix B.1.

Locations of the assessed spaces are shown in the plans in Appendix B.2.

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Table 5—10 Percent of hours exceeding the CIBSE Guide A allowable comfort temperature for winter and summer under DSY1_2020High50 weather condition

Space	Space type	Winter			Summer			PMV		PPD (%)		CIBSE A Target	
		CIBSE Guide A temp range (°C)	Winter Min temp (°C)	Winter Max temp (°C)	CIBSE Guide A temp range (°C)	Summer Min temp (°C)	Summer Max temp (°C)	Winter mean PMV	Summer mean PMV	Winter mean PPD (%)	Summer mean PPD (%)	% hour of exceedance	Pass (<3%)
L5_ZC_Kitchen	Office	18-25	20.04	23.11	20-26	20.14	26.7	-0.07	0.53	5.9	13.7	1.3	Pass
L5_ZC_WS_E_01	Office	18-25	20.59	21.71	20-26	20.68	27.0	-0.06	0.32	5.2	10.1	2.4	Pass
L5_ZC_CO_E_03	Office	18-25	19.49	21.99	20-26	19.25	28.6	-0.06	0.32	5.3	10.6	3.4	Pass
L5_ZC_CO_E_01	Office	18-25	19.58	21.99	20-26	19.41	28.5	-0.08	0.33	5.4	10.6	3.0	Pass
L5_ZC_CO_E_02	Office	18-25	20.81	21.84	20-26	20.86	25.07	-0.05	0.29	5.2	8.0	0	Pass
L5_ZC_CO_E_04	Teaching Space	19-24	20.91	23.04	20-26	20.94	26.81	0.04	0.50	5.5	12.2	0	Pass
L5_ZC_TS_E_2	Teaching Space	19-24	20.55	23.28	20-26	20.65	24.49	0.12	0.52	6.3	11.6	0	Pass
L5_ZC_TS_E_1	Teaching Space	19-24	20.62	23.33	20-26	20.71	24.44	0.17	0.54	6.7	11.9	0	Pass

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Table 5—11 Percent of hours exceeding the CIBSE Guide A allowable comfort temperature for winter and summer under DSY1_2020High50 weather condition

		Winter			Summer			PMV		PPD (%)		CIBSE A Target	
Space	Space type	CIBSE Guide A temp range (°C)	Winter Min temp (°C)	Winter Max temp (°C)	CIBSE Guide A temp range (°C)	Summer Min temp (°C)	Summer Max temp (°C)	Winter mean PMV	Summer mean PMV	Winter mean PPD (%)	Summer mean PPD (%)	% hour of exceedance	Pass (<3%)
L9_ZC_CO_E_02	Office	18-25	20.49	22.52	20-26	20.60	24.03	-0.05	0.35	5.4	8.6	0	Pass
L9_ZC_CO_E_03	Office	18-25	20.33	23.20	20-26	20.38	24.09	0.02	0.43	5.8	9.7	0	Pass
L9_ZC_CO_E_04	Office	18-25	20.36	23.21	20-26	20.24	24.08	0.03	0.43	5.8	9.7	0	Pass
L9_ZC_CO_E_05	Office	18-25	20.38	23.21	20-26	20.23	24.08	0.03	0.43	5.8	9.7	0	Pass
L9_ZC_CO_E_07	Office	18-25	20.37	23.21	20-26	20.23	24.08	0.03	0.43	5.8	9.7	0	Pass
L9_ZC_CO_E_08	Office	18-25	20.39	23.22	20-26	20.24	24.08	0.03	0.43	5.8	9.7	0	Pass
L9_ZC_CO_E_01	Office	18-25	20.48	22.31	20-26	20.58	24.02	-0.07	0.33	5.3	8.4	0	Pass
L9_ZC_CO_E_06	Office	18-25	20.39	23.21	20-26	20.24	24.08	0.03	0.43	5.8	9.7	0	Pass

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Table 5—12 Percent of hours exceeding the CIBSE Guide A allowable comfort temperature for winter and summer under DSY1_2020High50 weather condition

		Winter			Summer			PMV		PPD (%)		CIBSE A Target	
Space	Space type	CIBSE Guide A temp range (°C)	Winter Min temp (°C)	Winter Max temp (°C)	CIBSE Guide A temp range (°C)	Summer Min temp (°C)	Summer Max temp (°C)	Winter mean PMV	Summer mean PMV	Winter mean PPD (%)	Summer mean PPD (%)	% hour of exceedance	Pass (<3%)
L9_ZC_CO_E_09	Office	18-25	20.49	23.21	20-26	20.31	24.08	0.06	0.45	5.9	10.1	0	Pass
L9_ZC_CO_E_10	Office	18-25	20.51	23.21	20-26	20.33	24.08	0.06	0.45	5.9	10.1	0	Pass
L9_ZC_CO_E_11	Office	18-25	20.48	23.21	20-26	20.31	24.08	0.06	0.45	5.9	10.1	0	Pass
L9_ZC_CO_E_12	Office	18-25	20.48	23.21	20-26	20.30	24.08	0.06	0.45	5.9	10.1	0	Pass
L9_ZC_CO_E_13	Office	18-25	20.50	23.21	20-26	20.31	24.08	0.06	0.45	5.9	10.1	0	Pass
L9_ZC_CO_E_14	Office	18-25	20.51	23.21	20-26	20.33	24.08	0.06	0.45	5.9	10.1	0	Pass
L9_ZC_CO_E_15	Office	18-25	20.62	23.22	20-26	20.51	24.06	0.07	0.45	6.0	10.1	0	Pass
L9_ZC_WS_W_02	Office	18-25	20.35	25.16	20-26	20.37	25.74	0.08	0.50	6.4	11.7	0	Pass
L9_ZC_WS_W_03	Office	18-25	20.39	24.97	20-26	20.43	25.54	0.08	0.50	6.3	11.5	0	Pass
L9_ZC_WS_W_04	Office	18-25	20.45	24.73	20-26	20.51	25.26	0.09	0.50	6.3	11.4	0	Pass
L9_ZC_WS_W_01	Office	18-25	20.46	24.66	20-26	20.51	25.17	0.10	0.50	6.3	11.3	0	Pass
L9_ZC_CO_E_16	Office	18-25	20.49	23.16	20-26	20.58	24.28	0.00	0.44	5.8	10.1	0	Pass

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Table 5—13 Percent of hours exceeding the CIBSE Guide A allowable comfort temperature for winter and summer under DSY1_2020High50 weather condition

Space	Space type	Winter			Summer			PMV		PPD (%)		CIBSE A Target	
		CIBSE Guide A temp range (°C)	Winter Min temp (°C)	Winter Max temp (°C)	CIBSE Guide A temp range (°C)	Summer Min temp (°C)	Summer Max temp (°C)	Winter mean PMV	Summer mean PMV	Winter mean PPD (%)	Summer mean PPD (%)	% hour of exceedance	Pass (<3%)
L9_ZC_MR_E_01	Office	18-25	20.90	21.78	20-26	20.92	22.27	-0.04	0.13	5.2	5.7	0	Pass
L9_ZC_MR_E_02	Office	18-25	20.91	21.85	20-26	20.93	22.30	-0.04	0.13	5.2	5.7	0	Pass
L9_ZC_MR_E_03	Office	18-25	20.91	21.82	20-26	20.93	22.27	-0.04	0.12	5.2	5.7	0	Pass
L9_ZC_MR_W_05	Office	18-25	20.89	22.20	20-26	20.92	22.68	-0.02	0.16	5.2	5.9	0	Pass
L9_ZC_MR_W_04	Office	18-25	20.90	22.15	20-26	20.92	22.64	-0.02	0.16	5.2	5.9	0	Pass
L9_ZC_MR_W_06	Office	18-25	20.89	22.17	20-26	20.92	22.66	-0.02	0.16	5.2	5.9	0	Pass
L9_ZC_Tea_W_01	Office	18-25	19.66	24.59	20-26	19.72	25.05	0.08	0.50	6.8	11.4	0	Pass
L9_ZC_QR_1	Office	18-25	20.04	21.86	20-26	20.16	22.34	-0.09	0.10	5.4	5.6	0	Pass
L9_ZC_QR_2	Office	18-25	20.00	21.87	20-26	20.12	22.30	-0.09	0.10	5.4	5.6	0	Pass
L9_ZC_QR_3	Office	18-25	20.03	21.84	20-26	20.17	22.34	-0.09	0.10	5.4	5.6	0	Pass

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5.5 Cooling demand vs. notional building

The area weighted average building cooling demands (MJ/m^2) for the actual building and notional building, extracted from the BRUKL, for level 5 and 9 areas are shown in Table 5—14. As shown, the actual cooling demand is below the notional, demonstrating the GLA cooling hierarchy was applied successfully.

Table 5—14 Cooling demand for the notional building compared to actual

	Fan coil system energy demand	Single-duct VAV	Constant volume system (fixed fresh air rate)	Total Cooling energy demand	% Saved
	MJ/m^2	MJ/m^2	MJ/m^2	MJ/m^2	%
Actual	131.2	332.53	3.38	467.1	
Notional	176.65	493.26	6.5	676.4	54%

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6 Conclusion

This report has set out the interim energy and sustainability strategy for the UCL Institute of Education refurbishment, Woburn Square relocation covering levels 5 and 9 zone C.

Headline outcomes include:

- The project is on track to achieve a BREEAM Excellent rating, with a score of 75.8%
- The levels 5 and 9 zone C energy strategy achieves a 37% reduction in regulated CO_2 emissions
- The mechanically ventilated occupied spaces under current weather conditions pass the CIBSE guide A thermal comfort requirements. Similarly, the air-conditioned rooms with active cooling demonstrated adequate thermal comfort has been achieved with a cooling demand lower than the notional building.

In summary, there is good potential to undertake an extensive and sustainable refurbishment for the UCL Institute of Education, which achieves BREEAM Excellent and provides comfortable internal environments. Works undertaken to date for levels 5 and 9 zone C have shown that this will require investment in passive design and fabric improvements, for which an appropriate strategy has been developed in line with the heritage consultant's advice.

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Appendix A

A.1 Existing and proposed floorplans

Figure 6—1 Level 5 – existing layout

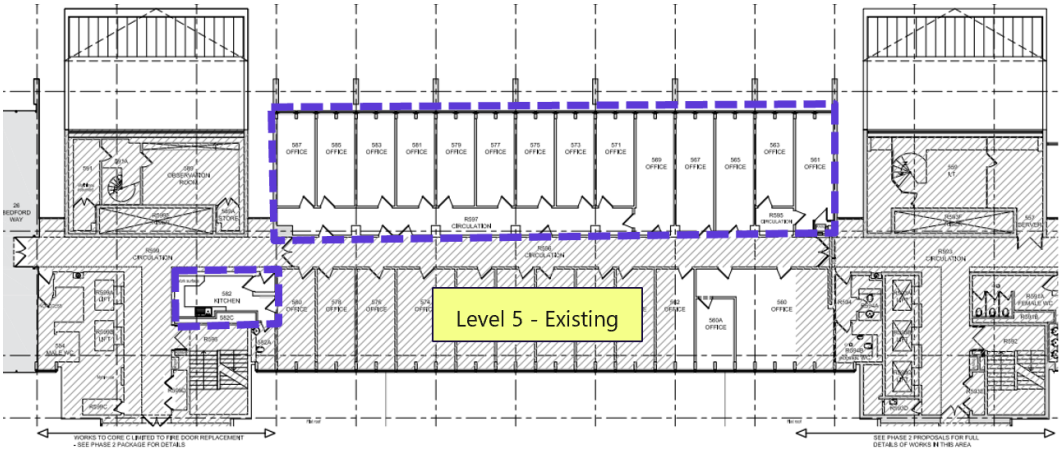

Figure 6—2 Level 5 – proposed layout

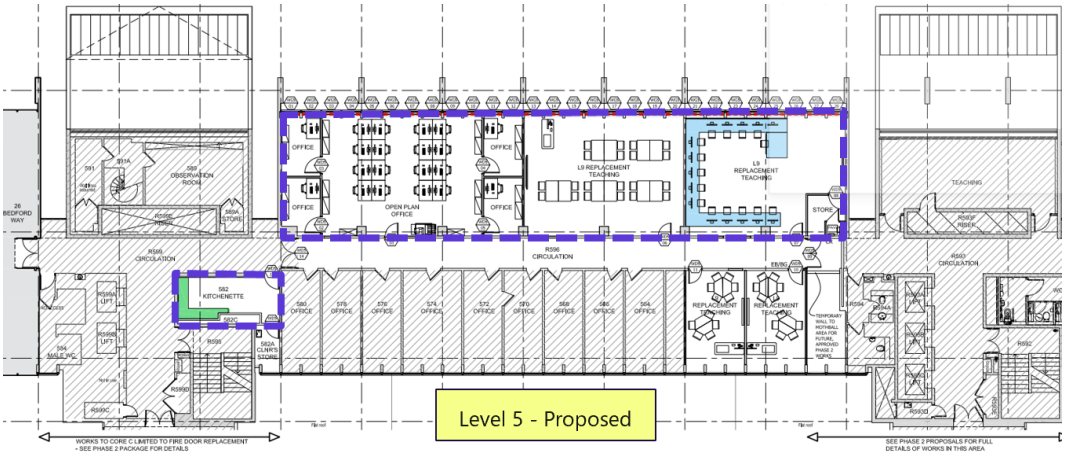

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Figure 6—3 Level 9 – existing layout

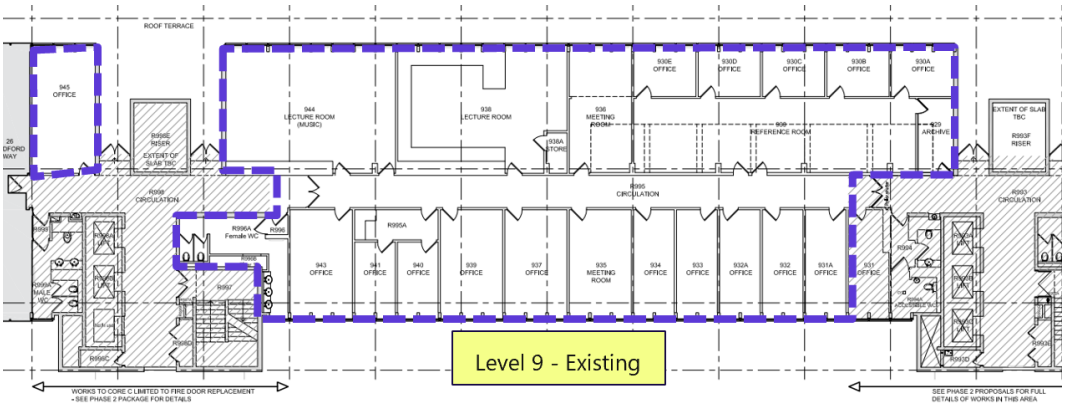
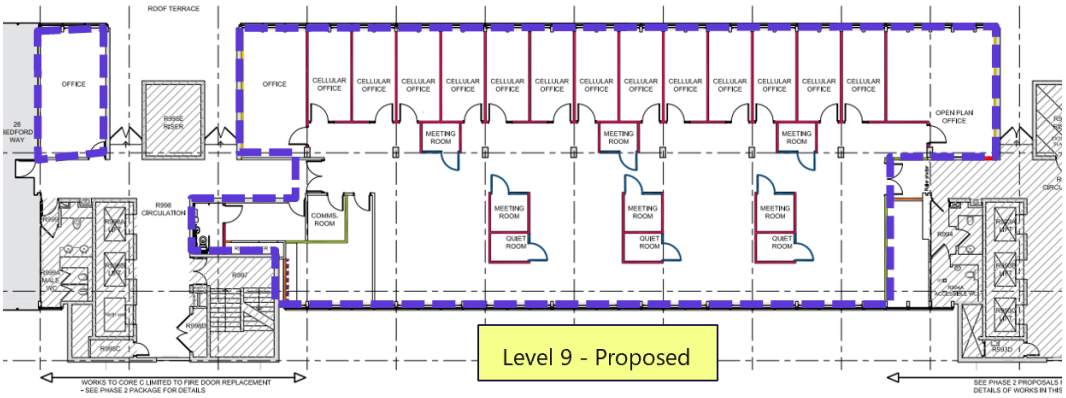


Figure 6—4 Level 9 – proposed layout



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A.2 Energy modelling summary table

Table 6—1 Proposed works and existing notional specifications

		Woburn Square ZONE C		
Level	**GIA (m2)**	**Building type**	**Building fabric works**	**Mechanical system works**
ZONE C_L5_Level	366	as existing	Ext wall: 0.55 Roof: 0.18 Floor: 0.25 Glazing 1.80 G value: 0.40* Air Permeability: 25	Centralised balance mechanical system (no VAV) with radiator only
		as proposed	Ext wall: 0.30 Roof: 0.18 Floor: 0.25 Glazing 2.1 with secondary glazing G value: 0.40** Air Permeability: 9.5	New ventilation shall be provided and suggested to bring supply air with VAV from plantroom 5/8-01. Teaching spaces: Existing air-cooled chiller with fan coil units (same chiller serving zones A-B) Cellular offices/workspace: No cooling
ZONE C_L9_Level	578	as existing	Ext wall: 0.55 Roof: 0.18 Floor: 0.25 Glazing 1.80 G value: 0.40* Air Permeability: 25	Centralised balance mechanical system with radiator and DX cooling
		as proposed	Ext wall: 0.30 Roof: 0.18 Floor: 0.25 Glazing 2.1 with secondary glazing G value: 0.40** Air Permeability: 9.5	Replacement of the existing AHU with VAV in plantroom 7 Heat recovery 80% Offices/workspaces/tea point: Existing air-cooled chiller with fan coil units (same chiller serving zones A-B) Comms room: DX cooling
Total	944			

*g-value of existing based on GLA specification

**Average g-value of existing and adding secondary glazing

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A.3 Building fabric values for the PartL2B energy models

Table 6—2 Building fabric parameters

		(GLA Baseline)	Improved case (Lean and Clean model)	Part L2B 2013 (for reference)		
		(Based on GLA notional specifications)		Threshold of retained Element	Value of replacement element	New thermal elements and controlled fittings
Fabric U-values (W/m2K)	Opaque panel	Applied solid wall 0.55 W/m^2.K	Opaque panelling below the glazing shall be upgraded to a centre pane U-value of 0.3 W/m^2.K (equivalent to an overall U-value of 1.7 W/m^2.K when all thermal bridging is considered)	0.7	0.3	0.28
	Glazing	Glazing at 1.8 W/m^2.K: single glazing metal frame	Secondary glazing, U-value = 2.1 W/m^2.K	3.3	1.8 W/m^{2}K	
					heritage constraint does not allow to achieve a centre pane U value of 1.8 W/m^2.K	
	Solid wall	0.55 W/m^2.K (183 mm cast concrete, membrane)	Walls (forming the external envelope) shall be internally insulated to achieve a U-value of 0.3 W/m^2.K or where not feasible 0.7 W/m2.K as a minimum value.	0.7	0.3	0.28
	Roof	0.18 W/m^2.K (100 mm concrete deck & membrane, 154mm insulation)	0.18 W/m^2.K for improved elements	0.35	0.18 flat roof	
	Internal wall	1.5 W/m^2.K (two 15 mm plasterboard, 25mm polyurethane board)	1.5 W/m^2.K (two 15mm plasterboard, 25mm polyurethane board)			
	Internal floor/ceiling	1.0	1.5 W/m^2.K (300 reinforced concrete, 20mm screed)			
	Ground floor	0.25 W/m^2.K (100 mm reinf. Concrete & 20 mm chipboard flooring+ 98.2 mm insulation)	0.25 W/m^2.K			
	Exposed floor	0.25 W/m^2.K	0.25 W/m^2.K			
	G-value	0.40	<0.40			
Air tightness	50 Pa (m3/h.m2 @ 50 Pa)	25 **	10**			

** To be tested by the contractor and confirmed with accredited air pressure test

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A.4 Building services inputs for heating, cooling, ventilation, DHW and lighting

Table 6—3 Heating and cooling distribution

	Existing (GLA)	Improved (Be Lean)	Improved (Be Clean)	Part L2B limiting efficiencies for new systems
	Central heating using water, radiators			
Heating source	Existing radiator	Zone C levels with new radiator	Zone C levels with new radiator	
Heat source	Boiler	Boiler	District heating	
Pump type	Constant temperature heating system with constant speed pumps	Variable speed, sensors across the pump		
Boiler Efficiency	84%	91%	-	
Cooling				
Cooling source	Existing air-cooled chiller	Existing air-cooled chiller	Existing air-cooled chiller	
Power (kW)	700	501-750	501-750	
SEER / EER	3.4/3.9	4.43/4.62	4.43/4.62	
Level 9 - workspaces	Existing Local VRF or DX cooling system serving lecture rooms	Mechanical cooling provision via FCUs	Mechanical cooling provision via FCUs	
	SEER / EER 3.4/3.9	SEER / EER 4.43/4.62	SEER / EER 4.43/4.62	
	0.5 W/(l/s)	SFP 0.15 W/(l/s)	SFP 0.15 W/(l/s)	
Level 5 - open plan office	n/a	No active cooling	No active cooling	
Level 5 - cellular office	n/a	No active cooling	No active cooling	
Level 5 - teaching rooms	n/a	Mechanical cooling provision via FCUs	Mechanical cooling provision via FCUs	
	n/a	SEER / EER 4.43/4.62	SEER / EER 4.43/4.62	
	n/a	SFP 0.15 W/(l/s)	SFP 0.15 W/(l/s)	
Level 9 - Quiet booth/meeting rooms	n/a	No active cooling	No active cooling	
Level 9 - Comms room	n/a	DX cooling system - power inverter heat pump	DX cooling system - power inverter heat pump	
	n/a	COP/EER 3.48/3.87	COP/EER 3.48/3.87	
	n/a	SFP 0.4 W/(l/s)	SFP 0.4 W/(l/s)	

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Table 6—4 Mechanical ventilation strategy

	Existing (GLA)	Improved (Be Lean)	Improved (Be Clean)	Part L2B limiting efficiencies for new systems
Ventilation	**Centralised balanced mech vent**			
Duct air leakage standard	Not tested	Tested	Tested	-
AHU air leakage standard	Not tested	L1	L1	-
Heat recovery %	70%	80%	80%	*Thermal wheel > 65%*
Toilet (extract)	0.5 (W/(l/s) @ 10ACH	0.4 (W/(l/s) with a duty of 50 l/s	0.4 (W/(l/s) with a duty of 50 l/s	*Local supply or extract units serving single zone without heat recovery* SFP (W/(l/s) < *0.4*
L5 Central ventilation AHU specific fan power	Existing AHU	New AHU with heat recovery, heating and cooling coils to supply air from existing plantroom AHU-PR5/8-01	New AHU with heat recovery, heating and cooling coils to supply air from existing plantroom AHU-PR5/8-02	SFP (W/(l/s) < 2.2
	Heat recovery 70%	Heat recovery 80%	Heat recovery 80%	
	SFP 2.2 W/(l/s))	AHU Plant selected with SFP 1.8 W/(l/s))	AHU Plant selected with SFP 1.8 W/(l/s))	
L9 Central ventilation AHU Specific fan power	Centralised Mech Ventilation	Replacement of the existing AHU in plantroom 7	Replacement of the existing AHU in plantroom 7	SFP (W/(l/s) < 2.2
	Heat recovery 70%	Heat recovery 80%	Heat recovery 80%	
	SFP 2.2 W/(l/s))	SFP 1.8 W/(l/s))	SFP 1.8 W/(l/s))	

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L5_kitchen supply and extract	Supply fan 0.5 @ 65 l/s	Supply fan 0.40 @ 65 l/s	Supply fan 0.40 @ 65 l/s	*Local supply or extract units serving single zone without heat recovery*
	Extract fan 0.5 @ 10ACH	Extract fan 0.5 @ 10ACH	Extract fan 0.5 @ 10ACH	Fan remote from zone SFP (W/(l/s) < *1.0*
L9 corridor (extract air from adjacent rooms)	Extract fan 0.5 @ 10ACH	Extract fan 0.5 @ 10ACH	Extract fan 0.5 @ 10ACH	SFP (W/(l/s) < *0.4*
L5 – open plan offices Cellular offices teaching rooms	n/a	The new fresh air and return ductwork to be provided with VAV terminal boxes	The new fresh air and return ductwork to be provided with VAV terminal boxes	Fan assisted terminal VAV unit SFP (W/(l/s) < *1.1*
L9 - offices/meeting/quiet rooms	n/a	The new fresh air and return ductwork to be provided with VAV terminal boxes	The new fresh air and return ductwork to be provided with VAV terminal boxes	
SFP (W/(l/s)	n/a	0.40 W/(l/s))	0.40 W/(l/s))	
Control ventilation	n/a	Demand control ventilation based on occupancy with damper	Demand control ventilation based on occupancy with damper	-

Table 6—5 System metering

	Existing (GLA)	**Improved (Be Lean)**	**Improved (Be Clean)**	**Part L2B limiting efficiencies for new systems**
Metering				
System metering	No	Yes	Yes	-
Metering warns "out of range" values	No	Yes	Yes	-

Table 6—6 Lighting efficacies

	Existing (GLA)	**Improved (Be Lean)**	**Improved (Be Clean)**	**Part L2B limiting efficiencies for new systems**
Lighting Efficacy Llm/W				
Back of the house	51	*90*	*90*	*>60 Llm/W*
Lift Lobby	51	*74-98*	*74-98*	*>60 Llm/W*
Kitchen	51	*100*	*100*	*>60 Llm/W*
Toilets	51	*100*	*100*	*>60 Llm/W*

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	Existing (GLA)	Improved (Be Lean)	Improved (Be Clean)	Part L2B limiting efficiencies for new systems
Office plan	51	*90-100*	*90-100*	*>60 Llm/W*
Comms room	51	*120*	*120*	*>60 Llm/W*
Cellular Office	51	*90-100*	*90-100*	*>60 Llm/W*
Meeting room	51	*105*	*105*	*>60 Llm/W*
Quiet booth	51	*105*	*105*	*>60 Llm/W*
Tea point	51	*105*	*105*	*>60 Llm/W*
Teaching room	51	*90-100*	*90-100*	*>60 Llm/W*
Locker room	51	*100*	*100*	*>60 Llm/W*
Corridor	51	*98*	*98*	*>60 Llm/W*

Table 6—7 Lighting control philosophy

Lighting Control Strategy			
	Existing (GLA)	**Improved (Be Lean)**	**Improved (Be Clean)**
Parasitic power W/m^2	0.3 W/m^2	0.1 W/m^2	0.1 W/m^2
Office open plan	Occupancy sensing time-switch	Absence detection (each desk with own switch) Daylight dimming	Absence detection (each desk with own switch) Daylight dimming
Cellular office	Occupancy sensing time-switch	Absence detection (each desk with own switch) Daylight dimming	Absence detection (each desk with own switch) Daylight dimming
Teaching space	Occupancy sensing time-switch	Absence detection (Scene setting at the entrance) Daylight dimming	Absence detection (Scene setting at the entrance) Daylight dimming
Meeting room	Occupancy sensing time-switch	Absence detection	Absence detection
Toilets	Occupancy sensing time-switch	Presence detection	Presence detection
Corridor	None	Presence detection	Presence detection
Locker room	Occupancy sensing time-switch	Presence detection	Presence detection
Comms Room	Occupancy sensing time-switch	Manual switching	Manual switching
Kitchenette	Occupancy sensing time-switch	Presence detection	Presence detection
Tea point	Occupancy sensing time-switch	Presence detection	Presence detection

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Appendix B

B.1 Thermal comfort results under future weather conditions (predicted DSY1_2050Medium50)

Table 6—8 Percent of hours exceeding the CIBSE Guide A allowable comfort temperature for winter and summer under the predicted future weather condition DSY1_2050Medium50

Space	Space type	Winter			Summer			PMV		PPD (%)		CIBSE A Target	
		CIBSE Guide A temp range (°C)	Winter Min temp (°C)	Winter Max temp (°C)	CIBSE Guide A temp range (°C)	Summer Min temp (°C)	Summer Max temp (°C)	Winter mean PMV	Summer mean PMV	Winter mean PPD (%)	Summer mean PPD (%)	% hour of exceedance	Pass (<3%)
L5_ZC_Kitchen	Office	18-25	20.06	23.45	20-26	20.17	27.22	-0.02	0.61	6.0	15.9	2.8	Pass
L5_ZC_WS_E_01	Office	18-25	20.63	22.43	20-26	20.72	28.39	-0.04	0.42	5.2	12.4	4.4	Fail
L5_ZC_CO_E_03	Office	18-25	19.69	22.26	20-26	19.56	29.14	-0.04	0.43	5.3	13.1	6.1	Fail
L5_ZC_CO_E_01	Office	18-25	19.83	22.12	20-26	19.79	29.30	-0.05	0.44	5.4	13.3	5.9	Fail
L5_ZC_CO_E_02	Office	18-25	20.83	22.07	20-26	20.88	25.43	-0.03	0.35	5.2	9.1	0	Pass
L5_ZC_CO_E_04	Teaching Space	19-24	20.92	23.34	20-26	20.96	27.19	0.07	0.57	5.6	14.1	1.7	Pass
L5_ZC_TS_E_2	Teaching Space	19-24	20.60	23.34	20-26	20.71	24.55	0.17	0.55	6.6	12.3	0	Pass
L5_ZC_TS_E_1	Teaching Space	19-24	20.66	23.38	20-26	20.76	24.52	0.22	0.57	7.1	12.5	0	Pass
L9_ZC_CO_E_02	Office	18-25	20.53	22.71	20-26	20.64	24.13	-0.03	0.39	5.4	9.3	0	Pass
L9_ZC_CO_E_03	Office	18-25	20.55	23.23	20-26	20.58	24.12	0.06	0.46	5.9	10.2	0	Pass
L9_ZC_CO_E_04	Office	18-25	20.59	23.24	20-26	20.48	24.11	0.07	0.46	5.9	10.2	0	Pass
L9_ZC_CO_E_05	Office	18-25	20.61	23.24	20-26	20.48	24.11	0.07	0.46	5.9	10.2	0	Pass
L9_ZC_CO_E_07	Office	18-25	20.60	23.24	20-26	20.47	24.11	0.07	0.46	6.0	10.2	0	Pass
L9_ZC_CO_E_08	Office	18-25	20.61	23.24	20-26	20.48	24.11	0.07	0.46	6.0	10.2	0	Pass
L9_ZC_CO_E_01	Office	18-25	20.52	22.50	20-26	20.62	24.12	-0.04	0.37	5.3	9.0	0	Pass

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Space	Space type	Winter			Summer			PMV		PPD (%)		CIBSE A Target	
		CIBSE Guide A temp range (°C)	Winter Min temp (°C)	Winter Max temp (°C)	CIBSE Guide A temp range (°C)	Summer Min temp (°C)	Summer Max temp (°C)	Winter mean PMV	Summer mean PMV	Winter mean PPD (%)	Summer mean PPD (%)	% hour of exceedance	Pass (<3%)
L9_ZC_CO_E_06	Office	18-25	20.61	23.24	20-26	20.48	24.11	0.07	0.46	5.9	10.2	0	Pass
L9_ZC_CO_E_09	Office	18-25	20.65	23.24	20-26	20.55	24.11	0.10	0.48	6.1	10.6	0	Pass
L9_ZC_CO_E_10	Office	18-25	20.65	23.24	20-26	20.57	24.11	0.10	0.48	6.1	10.6	0	Pass
L9_ZC_CO_E_11	Office	18-25	20.65	23.24	20-26	20.55	24.11	0.10	0.48	6.1	10.6	0	Pass
L9_ZC_CO_E_12	Office	18-25	20.65	23.24	20-26	20.55	24.11	0.10	0.48	6.1	10.6	0	Pass
L9_ZC_CO_E_13	Office	18-25	20.65	23.24	20-26	20.55	24.11	0.10	0.48	6.1	10.6	0	Pass
L9_ZC_CO_E_14	Office	18-25	20.65	23.24	20-26	20.56	24.11	0.10	0.48	6.1	10.6	0	Pass
L9_ZC_CO_E_15	Office	18-25	20.68	23.25	20-26	20.70	24.09	0.11	0.48	6.2	10.6	0	Pass
L9_ZC_WS_W_02	Office	18-25	20.40	25.23	20-26	20.43	25.82	0.12	0.54	6.6	12.4	0.1	Pass
L9_ZC_WS_W_03	Office	18-25	20.43	25.05	20-26	20.49	25.61	0.12	0.54	6.6	12.2	0	Pass
L9_ZC_WS_W_04	Office	18-25	20.49	24.80	20-26	20.56	25.34	0.13	0.54	6.5	12.1	0	Pass
L9_ZC_WS_W_01	Office	18-25	20.50	24.73	20-26	20.56	25.24	0.14	0.53	6.6	12.0	0	Pass
L9_ZC_CO_E_16	Office	18-25	20.53	23.22	20-26	20.62	24.32	0.04	0.48	5.9	10.7	0	Pass
L9_ZC_MR_E_01	Office	18-25	20.91	21.82	20-26	20.93	22.32	-0.02	0.15	5.2	5.8	0	Pass
L9_ZC_MR_E_02	Office	18-25	20.92	21.89	20-26	20.94	22.35	-0.02	0.15	5.2	5.9	0	Pass
L9_ZC_MR_E_03	Office	18-25	20.92	21.86	20-26	20.94	22.32	-0.02	0.15	5.2	5.8	0	Pass
L9_ZC_MR_W_05	Office	18-25	20.90	22.26	20-26	20.93	22.75	0.00	0.18	5.2	6.1	0	Pass
L9_ZC_MR_W_04	Office	18-25	20.90	22.21	20-26	20.94	22.70	0.00	0.18	5.2	6.1	0	Pass
L9_ZC_MR_W_06	Office	18-25	20.90	22.22	20-26	20.94	22.72	0.00	0.18	5.2	6.1	0	Pass
L9_ZC_Tea_W_01	Office	18-25	19.69	24.65	20-26	19.76	25.10	0.13	0.53	7.1	12.1	0	Pass

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Space	Space type	Winter			Summer			PMV		PPD (%)		CIBSE A Target	
		CIBSE Guide A temp range (°C)	Winter Min temp (°C)	Winter Max temp (°C)	CIBSE Guide A temp range (°C)	Summer Min temp (°C)	Summer Max temp (°C)	Winter mean PMV	Summer mean PMV	Winter mean PPD (%)	Summer mean PPD (%)	% hour of exceedance	Pass (<3%)
L9_ZC_QR_1	Office	18-25	20.09	21.92	20-26	20.21	22.40	-0.07	0.13	5.3	5.8	0	Pass
L9_ZC_QR_2	Office	18-25	20.06	21.92	20-26	20.16	22.36	-0.07	0.12	5.4	5.7	0	Pass
L9_ZC_QR_3	Office	18-25	20.09	21.90	20-26	20.21	22.40	-0.07	0.13	5.3	5.8	0	Pass

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B.2 Room names used for thermal comfort analysis

Figure 6—5 Level 5 proposed zone C floorplan

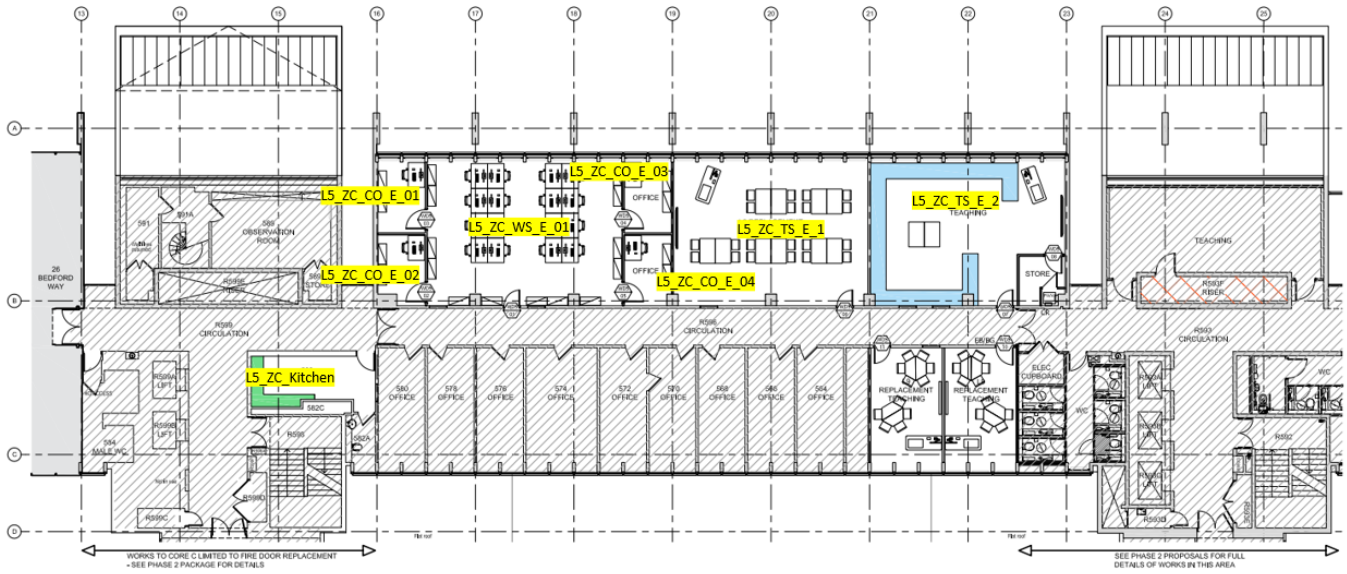
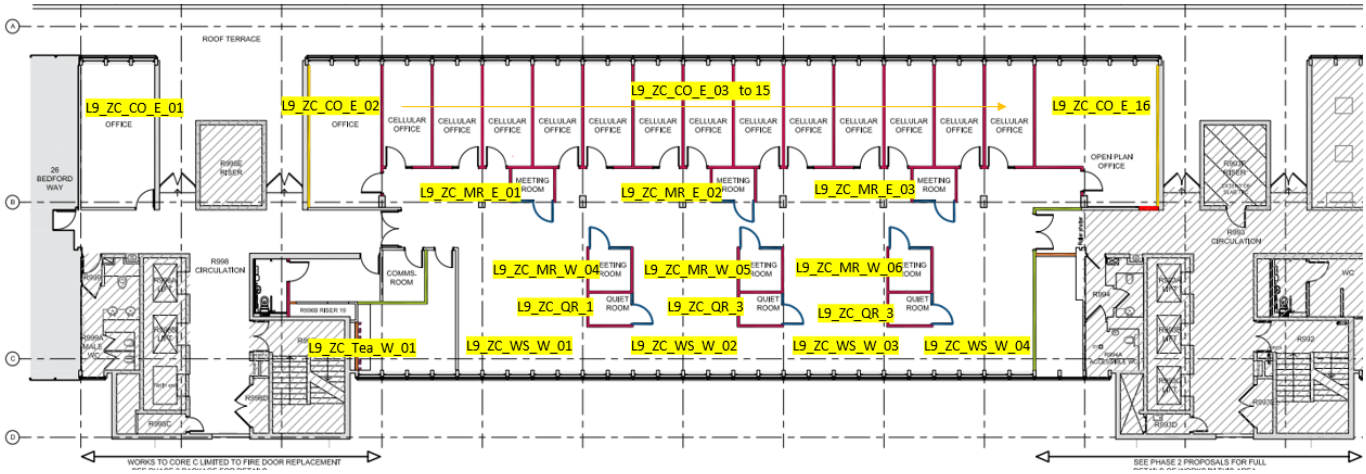


Figure 6—6 Level 9 proposed zone C floorplan



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Appendix C – BREEAM TRACKER

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UCL Institute of Education - Phase 2 and Level 5 and 9 Core C - BREEAM Tracker

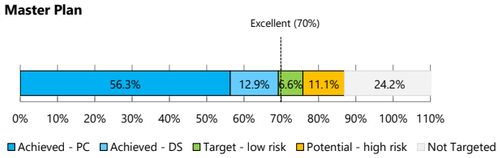
UCL IOE - BREEAM tracker

BURO HAPPOLD

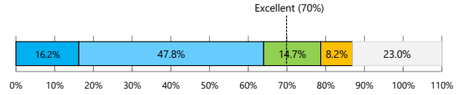
Scheme BREEAM RFO 2014
Project: UCL Institute of Education - Masterplan
BRE Ref BREEAM-0067-3285
Stages: Phase 1A Wing L2&3 (RIBA Stage 6)
Phase 1A Cores B-C Level 3 (RIBA Stage 6)
Phase 1B Wing L4&5 (RIBA Stage 6)
Phase 2 - All areas (RIBA Stage 4)
Phase 2 - Level 5 and 9 (RIBA Stage 2)
Date: 23-Mar-22
Rev: 54

Select >>	IOE Masterplan
TARGET RATING	EXCELLENT
TARGETED LOW RISK SCORE	75.8%
MINIMUM STANDARDS ON TRACK?	YES
ACHIEVED CREDITS (DS)	69.2%
ACHIEVED CREDITS (PC)	56.3%
Masterplan scoring based on:	Phase 1-2

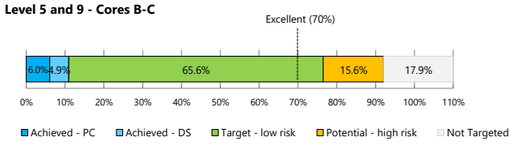
Master Plan



Phase 2 - All areas



Level 5 and 9 - Cores B-C



					IOE Masterplan					Phase 2 - All areas					Level 5&9 - Core B-C								
				%	75.8	86.9	24.2	69.2	56.3	78.7	86.9	23.0	64.0	16.2	76.5	92.1	17.9	11.0	6.0	0.0			
Credit Ref:	**Credit Issue** **(Mandatory Credits for Excellent shown red)**	**RIBA Stage**	Available	% Score Value	Targeted - Low Risk	High risk - TBC	Not Targeted	Achieved - DS	Achieved - PC	Targeted - Low Risk	High risk - TBC	Not Targeted	Achieved - DS	Achieved - PC	Targeted - Low Risk	High risk - TBC	Not Targeted	Achieved - DS	Achieved - PC	**Owner** (lead, support)	**IOE Masterplan credits - Phases 1-3** Actions & **risks** Design stage evidence closed / Design & post construction evidence closed	**Owner** (lead, support)	**Phase 2 - All areas** Actions & **risks** Design stage evidence closed / Design & post construction evidence closed	**Owner** (lead, support)	**Level 5 and 9 Core B-C** Actions & **risks** Design stage evidence closed / Design & post construction evidence closed
MANAGEMENT																							
Man 01	**Project Brief and Design**																						
Man 01	Stakeholder Consultation - Project Delivery (Defining roles and responsibilities)	**Stage 2**	1	0.65%	1		**1**	**1**		1		**1**	**1**		1		**1**	**1**		Arcadis, HB	**Crit 1a-e, 2, 3a-k** - All early stage masterplan evidence covering Phases 1-3 received covering all criteria. **Crit 4** - See specific phases	Arcadis, P&P	**Crit 1a-e, 2, 3a-k** - See masterplan evidence. **Crit 4** - Meeting minutes and updated project execution plan for Phase 2 to be provided, showing how the consultation process have influenced or changed the Initial Project Brief	Arcadis, P&P	**Crit 1a-e, 2, 3a-k** - See masterplan evidence. **Crit 4** - Meeting minutes and updated project execution plan for Level 9 Core B-C to be provided, showing how the consultation process have influenced or changed the Initial Project Brief
Man 01	Stakeholder Consultation -Third Parties (End users, local community, statutory consultees, etc.)	**Stage 2**	1	0.65%	1		**1**	**1**		1		**1**	**1**		1		**1**	**1**		HB, Arcadis	**Crit 5** - Consultation evidence from masterplan stages provided. **Crit 6** - Masterplan phasing strategy evidence provided. **Crit 7** - See specific phases. **Crit 8** - Architect leading consultation independently.	Arcadis, P&P	**Crit 5** - Consultation evidence needed (UCL, MLM, heritage) **Crit 6** - Design / phasing strategy presentations needed **Crit 7** - Feedback presentations to stakeholders needed **Crit 8** - Architect leading consultation independently.	Arcadis, P&P	**Crit 5** - Consultation evidence needed (UCL, MLM, heritage) **Crit 6** - Design / phasing strategy presentations needed **Crit 7** - Feedback presentations to stakeholders needed **Crit 8** - Architect leading consultation independently.
Man 01	Sustainability Champion (Design Stage) - Appointment of a BREEAM AP to set BREEAM performance targets	**Stage 1**	1	0.65%	1		**1**	**1**		1		**1**	**1**		1					BH sust, Arcadis	Crit 9 - Mark Dowson (BuroHappold) appointed as BREEAM AP Crit 10 - BREEAM Excellent target included in UCL Sust Standard Crit 11 - BREEAM Excellent must be achieved to secure credit.	n/a	n/a	n/a	n/a
Man 01	Sustainability Champion (Design Stage) - Involvement of a BREEAM AP to monitor and advise on BREEAM progress	**Stage 2 - 4**	1	0.65%	1		**1**	**1**		1		**1**	**1**		1					BH sust	**Crit 12** - Dependent on securing previous credit **Crit 13** - See specific phases	BH sust	**Crit 12** - See masterplan evidence. **Crit 13** - BREEAM AP evidence at RIBA stages 2-4 to be gathered and written up.	BH sust	**Crit 12** - See masterplan evidence. **Crit 13** - BREEAM AP evidence at RIBA stages 2-4 to be gathered and written up.
Man 02	**Life Cycle Cost and Service Life Planning**																						
Man 02	Elemental Life Cycle Cost (LCC) analysis to PD156865:2008	**Stage 2**	2	1.30%	2		**2**	**2**		2		**2**	**2**		2					n/a	n/a	AECOM BH Sust	**Crit 1-2** - RIBA Stage 4 LCC report received from AECOM specific for Phase 1. The LCC report included an options appraisal that recommended secondary glazing, LED lighting (over T5 tubes) and tiled carpeting (over carpet role).	G&T	**Crit 1-2** - G&T will need to update previous report to reflect addition of Level 5 and 9 Core B-C areas. Note this is a RIBA Stage 2 study.
	Component Level LCC Plan to PD156865:2008 (Envelope, Services, Finishes and external spaces)	**Stage 4**	1	0.65%	1		**1**	**1**		1		**1**	**1**		1					n/a	n/a	Mace	**Crit 3** - As above, Mace has updated the RIBA Stage 4 LCC study to reflect the addition of Phase 2	G&T	**Crit 3** - As above, G&T will need to update the RIBA Stage 4 LCC study to reflect the addition of Level 5 and 9 Core B-C
	Capital Cost Reporting (£/m2) to the BRE		1	0.65%	1		**0.8**	**0.8**		1					1					n/a	n/a	Mace	**Crit 4.** RIBA Stage 4 capital cost confirmation needed	G&T	**Crit 4.** RIBA Stage 4 capital cost confirmation needed
Man 03	**Responsible Construction Practices**																						
	Pre-Requisite: Responsibly sourced timber		Pre-requisite	-	Y					Y			**1**		Y					n/a	n/a	Overbury	**Crit 1-2** - Contractor provided a letter of intent for Phase 2 confirming that all timber will be legally harvested and traded.	Contractor P&P	**Crit 1-2** - Contractor to provide a letter of intent for Level 5 and 9 Core B-C confirming that all timber will be legally harvested and traded.
	Environmental Management System operated by the Principal Contractor (E.g. ISO14001, BS8555)		1	0.65%	1		**1**	**1**		1		**1**	**1**		1					n/a	n/a	Overbury	**Crit 2-3** - Overbury have provided a letter of intent confirming PPG6 will be followed. EMS certificate has also been provided. **Crit 3 (PC)** -Post construction evidence also provided (PPG6 examples)	n/a	n/a
	Sustainability Champion (Construction Stage) - BREEAM AP appointed to monitor and advise on progress	**Stage 5 Stage 6**	1	0.65%	1		**0.8**	**0.8**		1					1					n/a	n/a	n/a	n/a	n/a	n/a
	Considerate Construction (CCS or equivalent) **(ONE CREDIT NEEDED FOR BREEAM EXCELLENT)**		2	1.30%	2		**1.8**	**1.5**		2		**1**			2					n/a	n/a	Overbury	**Crit 7-8** - Contractor provided a letter of intent confirming that Phase 2 will be registered for the Considerate Construction Scheme, targeting a score of 40 with 7 in all sections. CCS registration details to be confirmed.	Overbury	**Crit 7-8** - Contractor to provide a letter of intent confirming that Level 5 and 9 Core B-C will be registered for the Considerate Construction Scheme, targeting a score of 40 with 7 in all sections. CCS registration details to be confirmed.

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Credit Ref:	Credit Issue (Mandatory Credits for Excellent shown red)	RIBA Stage	Available	% Score Value	IOE Masterplan %	Targeted - Low Risk 75.8	High risk - TBC 86.9	Not Targeted 24.2	Achieved - DS 69.2	Achieved - PC 56.3	Phase 2 - All areas	Targeted - Low Risk 78.7	High risk - TBC 86.9	Not Targeted 23.0	Achieved - DS 64.0	Achieved - PC 16.2	Level 5&9 - Core B-C	Targeted - Low Risk 76.5	High risk - TBC 92.1	Not Targeted 17.9	Achieved - DS 11.0	Achieved - PC 6.0	0.0	Owner (lead, support)	IOE Masterplan credits - Phases 1-3 Actions & risks — Design stage evidence closed / Design & post construction evidence closed	Owner (lead, support)	Phase 2 - All areas Actions & risks — Design stage evidence closed / Design & post construction evidence closed	Owner (lead, support)	Level 5 and 9 Core B-C Actions & risks — Design stage evidence closed / Design & post construction evidence closed
	Monitoring of Construction-site impacts (Energy and water consumption; transport movements for delivery of materials and waste transfer)		2	1.30%		2			1.8	1.5		2			1			2						n/a	n/a	Overbury	**Crit 9** - Contractor confirmed who is responsible for site monitoring **Crit 10-15** - Contractor confirmed in a letter for Phase 2 that energy and water shall be monitored. **Crit 16-19** - Contractor confirmed transport monitoring shall be in line with BREEAM RFO requirements	Overbury	**Crit 9** - Contractor to confirm who is responsible for site monitoring **Crit 10-15** - Contractor to confirm in a letter for Level 5 and 9 Core B-C that energy and water shall be monitored. **Crit 16-19** - Contractor to confirm transport monitoring shall be in line with BREEAM RFO requirements
Man 04	**Commissioning and Handover**																												
	Commissioning and Testing Schedule, including assignment of responsibilities, in line with Building Regulations, CIBSE and BSRIA.		1	0.65%		1			1	0.8		1			1			1						n/a	n/a	Overbury BH Mech Long and Partners	**Crit 1-4** - Contractor to provide a letter confirming responsibilities, commitment to follow BSRIA/CIBSE standard, a commissioning schedule, programme. Project team member(s) is appointed to monitor and programme commissioning **Crit 1-2** - Commissioning schedule **Cri 4** - Main programme of works has a line for commissioning	Overbury BH Mech	**Crit 1-4** - Contractor to confirm that all BREEAM commissioning requirements are included in the RIBA Stage 3-4 design, and provide all supplementary evidence.
	Commissioning Building Services - Appointment of a specialist commissioning manager	**Stage 4**	1	0.65%		1			1	0.8		1			1			1						n/a	n/a	Overbury BH Mech Long and Partners	**Crit 5-6** - Contractor to confirm that all BREEAM commissioning requirements are included in the RIBA Stage 3-4 design and provide all supplementary evidence as per previous levels.	Overbury BH Mech	**Crit 1-4** - Contractor to confirm that all BREEAM commissioning requirements are included in the RIBA Stage 3-4 design and provide all supplementary evidence as per previous levels.
	Testing and Inspecting Building Fabric (E.g. Thermographic survey, air tightness)		1	0.65%		1			0.8	0.8		1						1						n/a	n/a	IOE / Arcadis	**Crit 7-8** - Contractor to provide a letter confirming that Phase 2 will be air tightness tested and undergo thermal imaging, with any defects rectified.	Overbury BH Mech	**Crit 7-8** - Contractor to confirm that Level 5 and 9 Core B-C will be air tightness tested and undergo thermal imaging, with any defects rectified.
	Handover - Building User Guide and Training Schedule **(Crit 10 NEEDED FOR BREEAM EXCELLENT)**		1	0.65%		1			1	0.8		1			1			1						n/a	n/a	Overbury	**Crit 9-10** - Contractor to provide a letter confirming that a Building User Guide and training schedule will be completed in line with BREEAM requirements.	Overbury BH Mech	**Crit 9-10** - Contractor to provide design stage evidence for Level 5 and 9 Core B-C confirming that the BUS and training schedule will be completed in line with BREEAM requirements.
Man 05	**Aftercare**																												
	Aftercare Support for building occupants (Aftercare team for 12 months; Energy/water monitoring for 12 months)		1	0.65%		1			1	0.8		1			1			1						n/a	n/a	Overbury	**Crit 1-2** - Contractor to provide letter confirming that all aftercare requirements will be met.	Overbury BH Mech	**Crit 1-2** - Contractor to provide letter confirming that all aftercare requirements will be met.
	Seasonal Commissioning over a 12 month period post-occupation **(ONE CREDIT NEEDED FOR EXCELLENT RATING)**		1	0.65%		1			1	0.8		1			1			1						n/a	n/a	Overbury	**Crit 3** - Contractor to provide letter confirming that all seasonal commissioning requirements in BREEAM RFO will also be allowed for in Phase 2.	Overbury BH Mech	**Crit 3** - Contractor to confirm that all seasonal commissioning requirements in BREEAM RFO will also be allowed for in Level 5 and 9 Core B-C.
	Post Occupancy Evaluation (Independent third party POE one year after occupation)		1	0.65%		1			1			1			1			1					1	UCL	**Crit 4-5** - Letter of intent has been issued by UCL. **Crit 4-5** - Phase 1 POE report to be provided, once complete **Crit 4-5** - Phase 2 POE report to be provided, once complete	n/a	n/a	n/a	n/a
HEALTH & WELLBEING																													
Hea 01	**Visual comfort**																												
	Glare Control Strategy (E.g. Building integrated measures, brise soleil, blinds)		1	0.77%		1			1	0.8		1			1			1						n/a	n/a	Architon LLP. Overbury	**Crit 1-2** - Architectural specs required to confirm blinds will have transmittance value < 0.1 Drawings provided to confirm that all applicable windows on Phase 2 will also have blinds installed.	P&P. Overbury	**Crit 1-2** - Architectural specs / drawings required to confirm that all windows onLevel 5 and 9 Core B-C will also have blinds installed.
	Daylighting		3	2.32%		1	1	1	0.5	0.3		1	1	1	1			1	2					n/a	n/a	BH sust	**Crit 3-5** - BH sustainability carried out preliminary daylight modelling at RIBA Stage 3, showing 1 credit can be awarded.	BH sust	**Crit 3-5** - BH sustainability to carry out preliminary daylight modelling at RIBA Stage 3.
	View Out		2	1.55%		1	1		0.8	0.5		1	1		1			1	1					n/a	n/a	Architon LLP	**Crit 6-9** - Phase 2 areas to be assessed for inclusion in wider masterplan assessment. 80% of occupied spaces are within 7m of window. window must be 20%> of wall area or more depending on room depth check BS 8206 (i.e. 14m of a wall 35% window)	P&P	**Crit 6-9** - Level 5 and 9 Core B-C areas to be assessed for inclusion in wider masterplan assessment. 80% of occupied spaces are within 7m of wall. window must be 20%> of wall area or more depending on room depth check BS 8206

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Credit Ref:	Credit Issue (Mandatory Credits for Excellent shown red)	RIBA Stage	Available	% Score Value	IOE Masplan %	75.8	86.9	24.2	69.2	56.3	Phase 2 - All areas	78.7	86.9	23.0	64.0	16.2	Level 5&9 - Core B-C	76.5	92.1	17.9	11.0	6.0	0.0	Owner (lead, support)	IOE Masterplan credits - Phases 1-3 Actions & risks	Owner (lead, support)	Phase 2 - All areas Actions & risks	Owner (lead, support)	Level 5 and 9 Core B-C Actions & risks
						Targeted - Low Risk	High risk - TBC	Not Targeted	Achieved - DS	Achieved - PC		Targeted - Low Risk	High risk - TBC	Not Targeted	Achieved - DS	Achieved - PC		Targeted - Low Risk	High risk - TBC	Not Targeted	Achieved - DS	Achieved - PC			Design stage evidence closed Design & post construction evidence closed		Design stage evidence closed Design & post construction evidence closed		Design stage evidence closed Design & post construction evidence closed
	Internal and External Lighting Levels to CIBSE codes; Adequate zoning and local occupant control		1	0.77%	1			1	0.8	1				1		1							n/a	n/a	Overbury BH Elec Long and Partners	Crit 10-16 - Design stage evidence for Phase 2 covering internal lighting, external lighting and zoning/occupant control (e.g. specs, marked up drawings, lighting calcs with letter signed confirming compliance).	Overbury BH Elec	Crit 10-16 - Contractor to provide design stage evidence for Level 5 and 9 Core B-C covering internal lighting, external lighting and zoning/occupant control (e.g. specs, marked up drawings, lighting calcs with letter signed).
Hea 02	**Indoor air quality**																												
	Indoor Air Quality Plan		1	0.77%	1			1	1	1				1	1	1						1	BH IAQ team, Mace	Crit 1 - The BH environment team have prepared in the indoor air quality plan for the project in line with BREEAM RFO requirements.	Overbury	Crit 1 - Overbury to confirm how the air quality plan requirements is to be followed during construction of Phase 2.	Overbury	Crit 1 - Overbury to confirm how the air quality plan requirements is to be followed during construction of Level 5 and 9 Core B-C.
	Minimising sources of external air pollution - Ventilation Strategy		1	0.77%			1						1						1				n/a	n/a	Overbury BH Mech	Crit 2-5 - Floor plans for Phase 2 and whole building show supply/extract locations on the external façade are too close to sources of pollution for compliance.	n/a	n/a
	Minimising sources of internal air pollution - Specification of Low VOC finishes and fittings		1	0.77%	1			1	1	1				1	1	1						1	n/a	n/a	Overbury Architon LLP	Crit 6-7 - Contractor provided details of VOC standards to be applied for levels 4&5. (i.e. letter / schedule) Architon LLP provided evidence within specifications.	Overbury P&P	Crit 6-7 - Contractor to provide details of VOC standards to be applied for Level 5 and 9 Core B-C. P&P to provide evidence if they are providing specifications.
	Minimising sources of internal air pollution - Pre-completion indoor air quality testing		1	0.77%		1		0.5	0.3			1		1				1					n/a	n/a	Overbury	Crit 8-12 - Contractor provided letter confirming that the VOC testing shall also take place 'post construction, but pre-occupancy' on Phase 2.	Overbury	Crit 8-12 - Contractor to provide letter confirming that the VOC testing shall also take place 'post construction, but pre-occupancy' on Level 5 and 9 Core B-C.
	Potential for Natural Ventilation		1	0.77%			1						1						1				n/a	Credit not achievable. Early modelling showed the need for mechanical cooling. BREEAM credit requires full Natural Ventilation everywhere.	n/a	n/a	n/a	n/a
Hea 04	**Thermal Comfort**																												
	Thermal Modelling		1	0.77%	1			1	0.8	1				1		1							n/a	n/a	BH sust	Crit 1-5 - Thermal comfort modelling for Phase 2. Nat vent and air conditioned areas separately assessed. All spaces must pass. (Stage 4 model to be used as evidence)	BH sust	Crit 1-5 - Thermal comfort modelling for Level 5 and 9 Core B-C. Nat vent and air conditioned areas separately assessed. All spaces must pass.
	Adaptability - For a Projected Climate Change Scenario		1	0.77%	1			1	0.8	1				1		1							n/a	n/a	BH sust	Crit 6-9 - Thermal comfort modelling for Phase 2 using future climate data. Nat vent and air conditioned areas separately assessed. (Stage 4 model to be used as evidence)	BH sust	Crit 1-5 - Thermal comfort modelling for Level 5 and 9 Core B-C using future climate data. Nat vent and air conditioned areas separately assessed. All spaces must pass.
	Thermal Zoning and Controls		1	0.77%	1			1	0.8	1				1		1							n/a	n/a	Overbury BH Mech Long and Partners	Crit 10-12a - Contractor provide zoning strategy drawings and confirm how modelling has informed the approach. Crit 12b-e - BH MEP / Contractor confirmed that UCL have been consulted on decisions relating to heating/cooling controls and zoning.	Overbury BH Mech	Crit 10-12a - Contractor to provide zoning strategy drawings and confirm how modelling has informed the approach. Crit 12b-e - BH MEP / Contractor to confirm that UCL have been consulted on decisions relating to heating/cooling controls and zoning.
Hea 05	**Acoustic performance**																												

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					IOE Masterplan					Phase 2 - All areas					Level 5&9 - Core B-C								
				%	75.8	86.9	24.2	69.2	56.3	78.7	86.9	23.0	64.0	16.2	76.5	92.1	17.9	11.0	6.0	0.0			
Credit Ref:	**Credit Issue (Mandatory Credits for Excellent shown red)**	**RIBA Stage**	**Available**	**% Score Value**	**Targeted - Low Risk**	**High risk - TBC**	**Not Targeted**	**Achieved - DS**	**Achieved - PC**	**Targeted - Low Risk**	**High risk - TBC**	**Not Targeted**	**Achieved - DS**	**Achieved - PC**	**Targeted - Low Risk**	**High risk - TBC**	**Not Targeted**	**Achieved - DS**	**Achieved - PC**	**Owner (lead, support)**	**IOE Masterplan credits - Phases 1-3 Actions & risks**	**Owner (lead, support)**	**Phase 2 - All areas Actions & risks**	**Owner (lead, support)**	**Level 5 and 9 Core B-C Actions & risks**
																					Design stage evidence closed		Design stage evidence closed		Design stage evidence closed
																					Design & post construction evidence closed		Design & post construction evidence closed		Design & post construction evidence closed
	Acoustic performance standards and testing (Sound insulation, indoor ambient noise level and reverberation times)		3	2.32%	3			**3**	**2.3**	3			**3**		3					n/a	n/a	BH acoustics, Overbury	**Crit 1-3** - Acoustics report and drawing mark-ups and signed letter has been provided for Phase 2.	BH acoustics, P&P	**Crit 1-3** - Acoustics report and mark-up to be provided for Level 5 and 9 Core B-C. Supporting design response.
Hea 06	**Safety and security**																								
Hea 06	Security of Site and Building (Security Needs Assessment)	**Stage 2**	1	0.77%	1			**0.3**		1					1					n/a	n/a	BH security, Reliance	**Crit 1-2** - RIBA Stage 2 security needs assessment has been updated by SQSS **Crit 3 -** Security drawings for Phase 2 to be prepared. BH security to provide similar sign off at RIBA stage 4. Email confirmation that recommendation noted within the SNA have been implemented into the design.	BH security, P&P	**Crit 1-2** - Stage 2 security mark-up to be provided, together with meeting minutes reviewing the security strategy. Principles to be included should include: • A 24-hour security presence for the building • Access control comprising of electronic access control systems (EACS) with card access throughout, and restricted spaces requiring card and PIN access. Other doors will be subject to mechanical locks. • CCTV cameras and Intruder Detection Systems (IDS) are to be used in spaces where this measure is appropriate to the threat. • The principles of Secured by Design should be followed throughout the development design where relevant (e.g. Directional signage & well defined routes that do not compromise security, clear sightlines, physical protection etc) **Crit 3 -** BH security to provide similar sign off at RIBA stage 4.
ENERGY																									
Ene 01	**Reduction of CO2 emissions**																								
	Energy Performance **(SIX CREDITS NEEDED FOR BREEAM EXCELLENT UNDER THE RFO ASSESSMENT)**		15	9.11%	10	3	4	**8**	**5.3**	13		2	**13**	**2**	10	3	2	**2**	**2**	Heritage consultant	Crit 3-7 - Energy efficiency study compliant with BREEAM undertaken by heritage consultant securing 2 credits (applicable to historic buildings only).	BH sust	**Crit 1-2** - RIBA Stage 3-4 BREEAM RFO energy modelling results, for pre and post refurbishment	BH sust	**Crit 1-2** - RIBA Stage 3-4 BREEAM RFO energy modelling results
Ene 02	**Energy monitoring**																								
	Sub-Metering of Major Energy Consuming Systems **(ONE CREDIT NEEDED FOR BREEAM VERY GOOD OR EXCELLENT RATING)**		1	0.61%	1			**1**	**0.8**	1			**1**		1					n/a	n/a	Overbury BH Mech, BH Elec Long and Partners	**Crit 1-4** - Metering pack and specifications in line with BREEAM.	Overbury BH Mech, BH Elec	**Crit 1-4** - Contractor to provide metering pack and specifications in line with BREEAM. Including a Split meter for lighting and power
	Sub-Metering of High Energy Load and Tenancy Areas		1	0.61%	1			**1**	**0.8**	1			**1**		1					n/a	n/a	Overbury BH Mech, BH Elec Long and Partners	**Crit 5** - Metering pack and specifications in line with BREEAM requirements for education buildings.	Overbury BH Mech, BH Elec	**Crit 5** - Contractor to provide metering pack and specifications in line with BREEAM requirements for education buildings.
Ene 03	**External lighting**																								
	External Lighting - Energy efficient specification		1	0.61%	1			**0.8**	**0.5**	1			**1**		1					n/a	n/a	Overbury BH Elec Long and Partners	**Crit 1-3** - Scope for external lighting on Phase 2 confirmed. letter confirming external lighting meets the BREEAM requirements and provide design stage evidence. External lighting specification (showing not less than 60 luminaire lumens per circuit Watt.) External light drawings	n/a	n/a
Ene 04	**Low Carbon Design**																								
Ene 04	Passive Design Analysis	**Stage 2**	1	0.61%	1			**1**	**0.8**	1			**1**		1				**1**	BH sust	**Crit 2-3** - RIBA Stage 2 passive design analysis was completed covering the IOE masterplan. Can be used for all stages.	BH sust	**Crit 1 -** Hea04 achieved **Crit 2-3** - The passive design analysis recommended the use of secondary glazing, insulation and exposed thermal mass. Photographs of these measures were undertaken. Insulation was noted by the increased wall thicknesses.	BH sust	**Crit 1 -** Hea04 achieved **Crit 2-3** - The passive design analysis recommended the use of secondary glazing, insulation and exposed thermal mass. Photographs of these measures were undertaken. Insulation was noted by the increased wall thicknesses.
Ene 04	Free Cooling	**Stage 2**	1	0.61%			1					1					1			n/a	Credit not achievable. Early modelling showed the need for mechanical cooling. BREEAM credit requires all passive cooling.	n/a	n/a	n/a	n/a

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Credit Ref:	Credit Issue (Mandatory Credits for Excellent shown red)	RIBA Stage	Available	% Score Value	IOE Masplan Targeted - Low Risk	IOE Masplan High risk - TBC	IOE Masplan Not Targeted	IOE Masplan Achieved - DS	IOE Masplan Achieved - PC	Phase 2 - All areas Targeted - Low Risk	Phase 2 - All areas High risk - TBC	Phase 2 - All areas Not Targeted	Phase 2 - All areas Achieved - DS	Phase 2 - All areas Achieved - PC	Level 5&9 - Core B-C Targeted - Low Risk	Level 5&9 - Core B-C High risk - TBC	Level 5&9 - Core B-C Not Targeted	Level 5&9 - Core B-C Achieved - DS	Level 5&9 - Core B-C Achieved - PC	Owner (lead, support)	IOE Masterplan credits - Phases 1-3 Actions & risks (Design stage evidence closed / Design & post construction evidence closed)	Owner (lead, support)	Phase 2 - All areas Actions & risks (Design stage evidence closed / Design & post construction evidence closed)	Owner (lead, support)	Level 5 and 9 Core B-C Actions & risks (Design stage evidence closed / Design & post construction evidence closed)
	%				75.8	86.9	24.2	69.2	56.3	78.7	86.9	23.0	64.0	16.2	76.5	92.1	17.9	11.0	6.0	0.0					
Ene 04	Low and Zero Carbon Feasibility Study	Stage 2	1	0.61%	1			1		1			1		1			1		BH sust Arcadis	Crit 7-8 - BH sustainability carried out a masterplan LZC study at RIBA Stage 2. The study identified the Bloomsbury Heat & Power network as a key strategy, which the building is connecting to. Solar PV was also identified as a potential option. **Crit 7-8 - CHPQA information needed and/or evidence of PV installation going ahead on project.**	n/a	n/a	n/a	n/a
Ene 06	**Energy efficient transportation systems**																								
	Energy Consumption (Lift analysis, energy options appraisal)		1	0.61%	1			0.3	0.3	1					1					n/a	n/a	n/a	n/a	n/a	n/a
	Energy Efficient Features - Three of the following that offer most energy savings: Standby, energy efficient lighting, VVVF, Regenerative drive.		2	1.22%	2			0.5	0.5	2					2					n/a	n/a	n/a	n/a	n/a	n/a
Ene 08	**Energy efficient equipment**																								
	Energy Efficient Equipment		2	1.22%	2			2	2	2			2	2	2					n/a	n/a	BH Sust UCL	Crit 1-2 - RIBA Stage 4 to TM54 for the new levels. Crit 3 - UCL provided letter confirming Energy Star compliance.	BH Sust	Crit 1-2 - RIBA Stage 4 to TM54 for the new levels. - BH scope does not currently include assessment. Crit 3 - UCL to provide letter confirming Energy Star compliance.
TRANSPORT																									
Tra 01	**Public Transport Accessibility**																								
	Public Transport Accessibility Index (AI)		5	2.94%	5			5	5	5			5	5	5			5	5	BH sust	Crit 1-2 - The transport index has been calculated for the masterplan and achieves maximum score. No further action needed.	n/a	n/a	n/a	n/a
Tra 02	**Proximity to Amenities**																								
	Proximity to Amenities		1	0.59%	1			1	1	1			1	1	1			1	1	BH sust, UCL	Crit 1 - Maps have been produced indicating the safe pedestrian routes to amenities. Ben Stubbs has confirmed these are valid.	n/a	n/a	n/a	n/a
Tra 03	**Cyclist Facilities**																								
	Cycle Storage		1	0.59%	1			1	0.8	1			1		1					UCL, P&P, Arcadis	Crit 1 - 92 cycle spaces needed to meet BREEAM requirement (as per BH email 16/Apr/2019). Cycle spaces would need to be covered and fully 'breeam compliant' (see definitions in manual)	n/a	Credits dependant on Phase 3	n/a	n/a
	Cyclist Facilities		1	0.59%	1			1	0.8	1			1		1					UCL, P&P, Arcadis	Crit 2-3 - Credit is contingent on achieving criteria 1 above. In addition to this we would need at least two of the following: • 8 showers • 92 lockers • Appropriately sized changing facilities • Appropriately sized drying spaces	n/a	Credits dependant on Phase 3	n/a	n/a
Tra 05	**Travel plan**																								
	Travel plan based on site specific travel survey/assessment	Stage 3	1	0.59%	1					1					1					Iceni, BH sust Arcadis, UCL	Crit 1, 2b-f, 3 - Iceni has prepared a travel plan for IOE. **Crit 2a - Transport survey data for IOE is required for the travel plan. Survey has been completed but Iceni have not responded to email to update the report. Arcadis to intervene.** Crit 4 - A letter of confirmation will be needed from UCL	n/a	n/a	n/a	n/a
WATER																									
Wat 01	**Water Consumption**																								
	Minimising water consumption **(ONE CREDIT NEEDED FOR BREEAM VERY GOOD AND EXCELLENT RATING, WHERE APPLICABLE)**		5	3.79%	3	1	1	3.3	2.5	3	1	1	3		3	1	1			n/a	n/a	Overbury Architon LLP, BH Mech Long and Partners	Crit 1-3 - Water fitting flow rates (hand basin taps, kitchenette taps, WCs, dishwashers, urinals, showers, as applicable) and provide product datasheets. Supporting sanitary schedule and floor plans provided	Overbury P&P, BH Mech	Crit 1-3 - Contractor to confirm final flow rates and provide product datasheets.
Wat 02	**Water Monitoring**																								
	Water Monitoring **(Crit 1 NEEDED FOR BREEAM VERY GOOD OR EXCELLENT RATING)**		1	0.76%	1			1	0.8	1			1		1					Arcadis, BH MEP	Crit 1 - Mains water meter for IOE to meet minimum standards for BREEAM. Arcadis/UCL to confirm. New meter may be needed. Crit 2 - Separate water meter for Phase 1 wing. Crit 3-5 - Each main and sub have pulsed output connected to BMS. Relevant contractor to provide meter schematics and relevant evidence.	Overbury BH Mech Long and Partners	Crit 2 - Water sub-metering to be confirmed for Phase 2 in line with BREEAM requirements. Water meter Schematics	Overbury BH Mech	Crit 2 - Water sub-metering to be confirmed for Level 5 and 9 Core B-C in line with BREEAM requirements. OR narative that the floor plates do not meet the 10% threshold needed for meter.

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Credit Ref:	Credit Issue (Mandatory Credits for Excellent shown red)	RIBA Stage	Available	% Score Value	IOE Masplan %	75.8	86.9	24.2	69.2	56.3	Phase 2 - All areas	78.7	86.9	23.0	64.0	16.2	Level 5&9 - Core B-C	76.5	92.1	17.9	11.0	6.0	0.0	Owner (lead, support)	IOE Masterplan credits - Phases 1-3 Actions & risks	Owner (lead, support)	Phase 2 - All areas Actions & risks	Owner (lead, support)	Level 5 and 9 Core B-C Actions & risks
						Targeted - Low Risk	High risk - TBC	Not Targeted	Achieved - DS	Achieved - PC		Targeted - Low Risk	High risk - TBC	Not Targeted	Achieved - DS	Achieved - PC		Targeted - Low Risk	High risk - TBC	Not Targeted	Achieved - DS	Achieved - PC			Design stage evidence closed / Design & post construction evidence closed		Design stage evidence closed / Design & post construction evidence closed		Design stage evidence closed / Design & post construction evidence closed
Wat 03	**Water Leak Detection**																												
	Leak Detection System - mains water supply		1	0.76%		1						1						1						Arcadis, BH MEP	**Crit 1** - Leak detection system will need to be installed on the mains water supply in line with BREEAM requirements. This would de-risk credit for all phases. Arcadis/UCL to confirm.	n/a	n/a	n/a	n/a
	Flow control devices to WC areas		1	0.76%		1			**1**	**0.8**		1			**1**			1						n/a	n/a	Overbury BH PH Long and Partners	Crit 2 - Contractor to provide solenoid shut of valves for WC areas for Phase 2. Schematics / drawings showing solenoid shut of valves for WC areas to be provided	Overbury BH PH	Crit 2 - Contractor to provide solenoid shut of valves for WC areas for Level 5 and 9 Core B-C.
Wat 04	**Water Efficient Equipment**																												
	Water Efficient Equipment		1	0.76%		1			**0.8**	**0.8**		1						1						UCL, P&P Arcadis, Architon LLP	**Crit 1-2** - Scope of irrigation for Phase 1-3 TBC. All planters to be low water use. Where there are soft landscaped areas however no irrigation systems are specified, and therefore there are no unregulated water demands for the building, the credit available under this assessment issue can be awarded by default. Where there are no soft landscaped areas and no other unregulated water demands for the building, this credit is filtered out of the assessment.	n/a	n/a	n/a	n/a
MATERIALS																													
Mat 01	**Life Cycle Impacts**																												
	Green Guide rating of main building elements		6	6.56%		3	1	2	**3.8**	**2.8**		4		2	**4**			3	1	2				n/a	n/a	Architon LLP, Overbury	Crit 1-7 - Option 1 compliance route taken (The Green Guide to Specification). The Mat 1 Template to be filled in for all relevant areas of the refurbishment including but not limited to all of new elements including external walls, external windows, internal floor finishes, upper floors, internal walls and partitions and roofs. - Minimum Materials of Green Guide rating of A - Self declared recycled content: Where newly specified materials have recycled content to ISO 14021 that meets good practice levels of recycled content set out in Choosing construction products, Guide to the recycled content of mainstream construction products, WRAP. - Element type drawings, build ups / details - Floor plans, section and elevation drawings Crit 8-10 - Option 2 compliance route not taken.	Overbury	Crit 1-7 - Option 1 compliance route taken (The Green Guide to Specification). The Mat 1 Template to be filled in for all relevant areas of the refurbishment including but not limited to all of new elements including external walls, external windows, internal floor finishes, upper floors, internal walls and partitions and roofs. - Minimum Materials of Green Guide rating of A - Self declared recycled content: Where newly specified materials have recycled content to ISO 14021 that meets good practice levels of recycled content set out in Choosing construction products, Guide to the recycled content of mainstream construction products, WRAP. - Element type drawings, build ups / details - Floor plans, section and elevation drawings Crit 8-10 - Option 2 compliance route not taken. P&P to provide information on materials and fit out. Contractor to provide information on MEP.
Mat 03	**Responsible sourcing of materials**																												
	Pre-Requisite: Responsible sourced timber (Crit 1 NEEDED FOR BREEAM VERY GOOD OR EXCELLENT RATING)		Pre-requisite	-		Y						Y			**Y**			Y						n/a	n/a	Architon LLP, Overbury	**Crit 1-2** - Contractor provided a letter of intent for Phase 2 confirming that all timber will be legally harvested and traded.	P&P, Overbury	**Crit 1-2** - Contractor to provide a letter of intent for Level 5 and 9 Core B-C confirming that all timber will be legally harvested and traded.
	Sustainable Procurement Plan		1	1.09%		1			**1**	**1**		1			**1**	**1**		1						n/a	n/a	Overbury	Crit 3 - Overbury have provided a copy of the Sustainable Procurement Plan for Phase 2. The document, cover aims, objectives and targets, material tracking procedures, risks & opportunities.	n/a	n/a
	Responsible Sourcing of Materials		3	3.28%		1	1	1	**1.5**	**1**		1	1	1	**2**			1	2					n/a	n/a	Architon LLP, Overbury	**Crit 3-4** - Contractor to ensure materials are procured following FSC/PEFC, BES 6001 standards, with ISO 14001 (supply chain and process) as a minimum requirement. Contractor to provide required schedule of materials for design stage evidence.	P&P, Overbury	**Crit 3-4** - Contractor to ensure materials are procured following FSC/PEFC, BES 6001 standards, with ISO 14001 (supply chain and process) as a minimum requirement. Contractor to provide required schedule of materials for design stage evidence.
Mat 04	**Insulation**																												

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					IOE Masterplan					Phase 2 - All areas					Level 5&9 - Core B-C							
				%	75.8	86.9	24.2	69.2	56.3	78.7	86.9	23.0	64.0	16.2	76.5	92.1	17.9	11.0	6.0	0.0		
Credit Ref:	**Credit Issue (Mandatory Credits for Excellent shown red)**	**RIBA Stage**	Available	% Score Value	Targeted - Low Risk	High risk - TBC	Not Targeted	Achieved - DS	Achieved - PC	Targeted - Low Risk	High risk - TBC	Not Targeted	Achieved - DS	Achieved - PC	Targeted - Low Risk	High risk - TBC	Not Targeted	Achieved - DS	Achieved - PC	**Owner** (lead, support)	**IOE Masterplan credits - Phases 1-3** Actions & **risks** (Design stage evidence closed / Design & post construction evidence closed)	**Owner** (lead, support)	**Phase 2 - All areas** Actions & **risks** (Design stage evidence closed / Design & post construction evidence closed)	**Owner** (lead, support)	**Level 5 and 9 Core B-C** Actions & **risks** (Design stage evidence closed / Design & post construction evidence closed)
	Embodied impact of insulation (fabric and building services)		1	1.09%	1			**1**	**0.8**	1			**1**		1					n/a	n/a	Architon LLP, Overbury, BH Mech Long and Partners	Crit 1-2 - Architon LLP to provide schedule of insulation volumes for each element (external walls, GF, Roof), conductivity and green guide rating (A or A+) with manufacturer EPD where available. Crit 1-2 - Long and Partners to provide schedule of insulation volumes for Building services, conductivity and green guide rating (A or A+) with manufacturer EPD where available.	P&P, Overbury, BH Mech	Crit 1-2 - Contractor to provide schedule of insulation volumes for each element (external walls, GF, Roof, Building services), conductivity and green guide rating (A or A+) with manufacturer EPD where available.
Mat 05	**Designing for Durability and Resilience**																							
	Protecting Vulnerable Parts of the Building From Damage (criteria below also needed for credit)		1	1.09%	1			**1**	**0.8**	1			**1**		1					n/a	n/a	Architon LLP, Overbury, Brickler	Crit 1 - Contractor / Architon LLP to provide Phase 2 drawings marking up durability measures e.g. protection to entrance areas, corridors, lifts, stairs, protection in kitchen areas, trolley movement, protection against vehicle collision where vehicle movement and parkin occurs within 1m of building.	P&P, Overbury	Crit 1 - Contractor / P&P to provide Level 5 and 9 Core B-C drawings marking up durability measures e.g. protection to entrance areas, corridors, lifts, stairs, protection in kitchen areas, trolley movement, protection against vehicle collision where vehicle movement and parkin occurs within 1m of building.
	Protecting Parts of the Building from Material Degradation (criteria above also needed for credit)																			P&P, HB, AECOM, Arcadis, Architon LLP	**Crit 2,3,5** - P&P and AECOM to complete the materials degradation schedule for Phase 1 -3areas (BH sust have template), listing all applicable new and existing elements and protection standards. **Crit 4** - AECOM/Arcadis to provide structural survey reports assessing the severity of any degradation effects.	n/a	n/a	n/a	n/a
Mat 06	**Material Efficiency**																							
Mat 06	Material Efficiency	**Stage 1-5**	1	1.09%	1			**0.8**	**0.8**	1					1					n/a	n/a	BH MEP, Architon LLP, AECOM, Overbury	**Crit 1-2 -** Team to review Mat06 template at each RIBA Stage for Phase 2. RIBA Stage 1&2 - Phase 2 template completed RIBA Stage 3 - Template updated and/or confirmed no changes RIBA Stage 4 - TBC RIBA Stage 5 - TBC	BH sust, BH MEP, P&P, AECOM, Overbury	**Crit 1-2 -** Team to review Mat06 template at each RIBA Stage for Level 5 and 9 Core B-C. RIBA Stage 1&2 - MEP, Architect, Structures RIBA Stage 3 - TBC RIBA Stage 4 - TBC RIBA Stage 5 - TBC
WASTE																								
Wst 01	**Construction Waste Management**																							
Wst 01	Pre refurbishment audit	**Stage 2**	1	0.71%	1			**0.8**	**0.8**	1			**1**	**1**	1					n/a	n/a	Overbury	**Crit 1** - Pre-refurbishment audit for Phase 2 (and 3?) to be conducted prior to strip out works.	Overbury ?	**Crit 1** - Pre-refurbishment audit for Level 5 and 9 Core B-C (and Phase 3?) to be conducted prior to strip out works.
	Reuse and direct recycling of materials		2	1.42%		1	1	**1**	**0.8**		1	1	**1**			2				n/a	n/a	Overbury	**Crit 2-4** - As per L2&3, Contractor to confirm approach against Wst01 schedule (table 61) for Phase 2. Provide written confirmation of routes & tracking procedures for each material type.	Overbury	**Crit 2-4** - As per L2&3, Contractor to confirm approach against Wst01 schedule (table 61) for Level 5 and 9 Core B-C. Provide written confirmation of routes & tracking procedures for each material type.
	Construction Resource Efficiency		3	2.13%	1	1	1	**1**	**0.5**	1	1	1	**2**		2	1				n/a	n/a	Overbury	**Crit 5-6** - Contractor provided covering letter and SWMP for Phase 2 areas.	Overbury	**Crit 5-6** - Contractor to provide covering letter and SWMP for Level 5 and 9 Core B-C areas.
	Diversion of Resources from Landfill		1	0.71%	1			**1**	**0.8**	1			**1**		1					n/a	n/a	Overbury	**Crit 5-6** - Contractor to provide covering letter and SWMP for Phase 2 areas.	Overbury	**Crit 5-6** - Contractor to provide covering letter and SWMP for Level 5 and 9 Core B-C areas.
Wst 02	**Recycled Aggregates**																							
	Recycled Aggregates for high grade use		1	0.71%			1					1					1			AECOM	Credit not targeted. Structural engineer to review requirements and confirm if feasible to target for the project.	AECOM	Credit not targeted. Structural engineer to review requirements and confirm if feasible to target for the project.	AECOM	Credit not targeted. Structural engineer to review requirements and confirm if feasible to target for the project.

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						Targeted - Low Risk	High risk - TBC	Not Targeted	Achieved - DS	Achieved - PC		Targeted - Low Risk	High risk - TBC	Not Targeted	Achieved - DS	Achieved - PC		Targeted - Low Risk	High risk - TBC	Not Targeted	Achieved - DS	Achieved - PC			Design stage evidence closed / Design & post construction evidence closed		Design stage evidence closed / Design & post construction evidence closed		Design stage evidence closed / Design & post construction evidence closed
Wst 03	**Operational waste**																												
	Operational Waste **(ONE CREDIT NEEDED FOR BREEAM EXCELLENT)**		1	0.71%		1						1						1						UCL	**Crit 1-2** - UCL to confirm waste streams and sizing figures for the project. Requirements for waste store to be reviewed in line with BREEAM requirements and operational FM strategy.	n/a	n/a	n/a	n/a
Wst 05	**Adaptation to Climate Change**																												
Wst 05	Adaptation to Climate Change - Structural and Fabric Resilience	**Stage 2**	1	0.71%		1			**1**	**1**		1			**1**	**1**		1						BH sust, BH MEP, AECOM, HB	**Crit 1** - Climate change risk assessment was conducted for the IOE masterplan at RIBA Stage 2. Credit closed.	n/a	n/a	n/a	n/a
Wst 06	**Functional Adaptability**																												
Wst 06	Functional adaptability strategy	**Stage 2 Stage 4**	1	0.71%		1			**1**	**0.8**		1			**1**			1						n/a	n/a	P&P, BH MEP, Overbury	Crit 1 - P&P have provided RIBA Stage 2 functional adaptability mark-ups for Phase 2. Crit 2 - Contractor provide RIBA Stage 4 letter .	P&P, BH MEP, Overbury	**Crit 1** - P&P have provided RIBA Stage 2 functional adaptability mark-ups for Level 5 and 9 Core B-C. **Crit 2** - Contractor will need to provide RIBA Stage 4 evidence.
LAND USE & ECOLOGY																													
Le 02	**Ecological Value of Site and Protection of Ecological Features**																												
	Protection of existing ecological features		1	2.27%		1			**1**	**0.8**		1			**1**			1						Ecologist	**Crit 1-2** - An ecology report has been prepared. Requirements include protection of trees with trunks over 100mm diameter in accordance with BS5837:2012. Checks on any works that may disturb nests and eggs in areas such as trees, roof, gutters, soffit boxes, external beams. An ecologist is required on site should the Contractor's biodiversity champion deem necessary to check for any black redstart birds that may be nesting in roof areas and on gravel areas of the roof.	Overbury	**Crit 1-2** - Contractor sustainability champion to ensure measures are implemented in line with ecologist's report. Contractor to provide evidence before work starts on site- that sustainability champion undertook survey- survey report and pictures of protection measures in place required as evidence. Contractor to provide program and justification how activities have been timed to avoid negative impact on biodiversity- check ecologist report	Overbury	**Crit 1-2** - Contractor sustainability champion to ensure measures are implemented in line with ecologist's report. Contractor to provide evidence before work starts on site- that sustainability champion undertook survey- survey report and pictures of protection measures in place required as evidence. Contractor to provide program and justification how activities have been timed to avoid negative impact on biodiversity- check ecologist report
Le 04	**Enhancing Site Ecology**																												
LE 04	Ecologist's Report and Recommendations	**Stage 1 Stage 2**	1	2.27%		1			**0.8**	**0.8**		1						1						Ecologist	Crit 1-3 - An ecology report was prepared. The report identified that external terraces should include planters.	Overbury Arcadis	Crit 3 - NO landscaping strategy currently in place for Phase 2. CREDIT AT RISK as Ecology report measures have not been followed (e.g. green roof, planters etc.). Ecologist to be consulted to confirm if credit is still achievable	n/a	n/a
Le 05	**Long Term Impact on Biodiversity**																												
	Long Term Impact on Biodiversity (Landscape and habitat management plan; Site management for minimal impact on biodiversity)		2	4.55%		2			**1.8**	**1.5**		2			**1**			2			**1**			Ecologist	Crit 1-3 - An ecology report was prepared. The SQE confirmed that a landscape and habitat management plan is not necessary. Although the contractor will be required to appoint a biodiversity champion and monitor on-site activities.	Overbury	**Crit 3** - Contractor provided letter confirming the scope of the biodiversity champion, and provide evidence of checks undertaken to date.	n/a	n/a
POLLUTION																													
Pol 01	**Impact of Refrigerants**																												
	No Refrigerant Use		0	0.00%																				n/a	n/a building has refrigerants	n/a	n/a building has refrigerants	n/a	n/a building has refrigerants
	Pre-Requisite for buildings that use refrigerants (compliance with industry standards and best practice)		Pre-requisite	-		Y						Y						Y						n/a	n/a	Overbury BH Mech Long and Partners	**Crit 2** - Contractor to provide evidence that all systems will comply with the requirements of BS EN 378:20081 (parts 2 and 3) and where refrigeration systems containing ammonia are installed, the Institute of Refrigeration Ammonia Refrigeration Systems Code of Practice.	Overbury BH Mech	**Crit 2** - Contractor to provide evidence that all systems will comply with the requirements of BS EN 378:20081 (parts 2 and 3) and where refrigeration systems containing ammonia are installed, the Institute of Refrigeration Ammonia Refrigeration Systems Code of Practice.
	Impact of Refrigerant (Low DELC C02 refrigerants)		2	1.75%		1	1		**0.8**	**0.8**		1	1					1	1					n/a	n/a	Overbury BH Mech Long and Partners	**Crit 3-4** - Not targeted **Crit 5** - Contractor to provide evidence for DELC CO2 calculation (refrigerant type, volume of refrigerant charge, cooling capacity etc. for each system) plus supporting tech-subs / datasheets.	Overbury BH Mech	**Crit 3-4** - Not targeted **Crit 5** - Contractor to provide evidence for DELC CO2 calculation (refrigerant type, volume of refrigerant charge, cooling capacity etc. for each system) plus supporting tech-subs / datasheets.
	Leak detection and containment		1	0.87%			1						1						1					n/a	n/a	n/a	n/a	Overbury BH Mech	**Crit 6-7** - Contractor to provide schematics and manufacturer specs for leak detection on systems with refrigerant charge above 6kg.
Pol 02	**NOx Emissions**																												
	Low N0x Emissions plant for space heating and hot water		3	2.62%			3		**0.8**	**0.8**			3						3					UCL Arcadis	**Crit 1** - Arcadis/UCL to request information about the NOx emissions for the BHP energy centre.	Overbury BH Mech	**Crit 1 -** Contractor to confirm the heating and hot water loads for Phase 2 served by each item on plant (e.g. DH, heat pumps, any new boilers etc.). Calculation is then rated to heat output from each system as per BREEAM method.	n/a	n/a
Pol 03	**Surface Water Run Off**																												

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	Flood Risk Management		2	1.75%		2			1.5	1.5		2						2						AECOM	Crit 1-6 - FRA report confirms that the site is located in flood risk zone 1 (low risk of flooding).	n/a	n/a	n/a	n/a
	Surface Water Run Off - neutral impact		1	0.87%		1			0.8	0.8		1						1						AECOM	Crit 7-8 - The FRA report confirms the proposed Phase 1-3 refurbishment works will not increase surface water run off.	n/a	n/a	n/a	n/a
	Surface Water Run Off - 50% reduction		1	0.87%				1						1						1				n/a	Credit not targeted as these works are not included in the scope of the refurbishment strategy.	n/a	n/a	n/a	n/a
	Minimising Watercourse Pollution		1	0.87%				1						1						1				n/a	Credit not targeted as these works are not included in the scope of the refurbishment strategy.	n/a	n/a	n/a	n/a
Pol 04	**Reduction of Night Time Light Pollution**																												
	Reduction of Night Time Light Pollution		1	0.87%		1			0.8	0.8		1						1						n/a	n/a	Overbury BH Elec Long and Partners	Crit 1-3 - Contractor to confirm the scope and external lighting and provide drawings, calculations and tech-subs confirming controls and ILP guidance has been followed.	Overbury BH Elec	Crit 1-3 - Contractor to confirm the scope and external lighting and provide drawings, calculations and tech-subs confirming controls and ILP guidance has been followed.
Pol 05	**Reduction of Noise Pollution**																												
	Reduction of Noise Pollution		1	0.87%		1			1	0.8		1			1			1						BH acoustics	Crit 2-5 - Acoustics study was carried out for Phase 1 and 2. To comply with the planning requirements of Camden Council, noise emissions from new plant should be a minimum of 5dB below the lowest measured background noise level. Since the requirements of the LA are more stringent, BREEAM criteria can automatically be met when the local planning requirements are satisfied. Crit 2-5 - Acoustics confirmation for Phases 3 needed	Overbury BH Acoustics	Crit 2-5 - Contractor provided letter of intent confirming that acoustic recommendations will be implemented and that post construction testing shall be carried out to the required standard.	Overbury BH Acoustics	Crit 2-5 - Contractor to provide letter of intent confirming that acoustic recommendations will be implemented and that post construction testing shall be carried out to the required standard.
INNOVATION																													
Man 03	Exemplary Level Credit: CCS score of 40 or above		1	1.00%		1			0.8	0.5		1			1			1						n/a	n/a	Overbury	Crit 7-8 - Contractor to provide a letter of intent confirming that Phase 2 will be registered for the Considerate Construction Scheme, targeting a score of 40 with 7 in all sections.	Overbury	Crit 7-8 - Contractor to provide a letter of intent confirming that Level 5 and 9 Core B-C will be registered for the Considerate Construction Scheme, targeting a score of 40 with 7 in all sections.
Man 05	Exemplary Level Crit: Building performance review at quarterly intervals over first 3 years of occupation		1	1.00%		1			1	1		1			1	1		1						UCL	Crit 4-5 - Letter of intent has been signed by UCL.	n/a	n/a	n/a	n/a
Hea 02	Exemplary Level Crit: - Minimising sources of internal air pollution through specification of exemplary low VOC products		1	1.00%				1						1					1					n/a	n/a	Overbury Architon LLP	Crit 6-7 - Contractor to provide details of VOC standards to be applied for Phase 2. Architon LLP to provide evidence if they are providing specifications.	Overbury P&P	Crit 6-7 - Contractor to provide details of VOC standards to be applied for Level 9 Core B-C. P&P to provide evidence if they are providing specifications.
Wat 01	Exemplary Level Crit: Exemplary water efficiency and rain/water recycling for WC/urinal flushing		1	1.00%				1						1						1				BH MEP	Credit to be reviewed at masterplan level. Phase 1 areas are not currently targeting this level of performance.	n/a	n/a	n/a	n/a
Mat 01	Exemplary Level Crit Green Guide to Specification (Elemental Approach)		1	1.00%				1						1						1				P&P	Very high scoring would be required on the BREEAM RFO Mat01 (option 2) tool to achieve this. The main limitation is providing 'robust environmental information' for MEP items.	n/a	n/a	n/a	n/a
Mat 01	Exemplary Level Crit Compliant Life Cycle Assessment Software Tools (Whole Building Approach)		2	2.00%				2						2						2				BH sust,	IES IMPACT software would need to be used to carry out a whole building LCA. This is currently not included in the scope.	n/a	n/a	n/a	n/a
Mat 03	Exemplary Level Crit - At least 70% of the available RSM points are achieved		1	1.00%				1						1						1				Contractor	Very stringent responsible sourcing would be required to achieve this innovation credit.	n/a	n/a	n/a	n/a
Wst 01	Exemplary Level Crit - ≤ 1.4m3 per 100m2 waste, and 95% diversion from landfill.		1	1.00%				1						1						1				Contractor	Waste generation targets are likely to be too challenging for the project to achieve. (Mace have already flagged that the target of 4.5m3/100m2 is already challenging).	n/a	n/a	n/a	n/a
Wst 05	Exemplary Credit - Responding to Adaptation to Climate Change		1	1.00%				1						1						1				AECOM, BH sust	A number of requirements have been met. In order to achieve this credit, the key limitation is that 2 credits are needed on "Pol 03 - 50% reduction in surface water run-off" which is currently outside of the scope of the project. 8 credits would also be needed on Ene01.	n/a	n/a	n/a	n/a

UCL Institute of Education - Phase 2 and Level 5 and 9 Core C - BREEAM Tracker

Rev: 54

Credit Ref:	Credit Issue (Mandatory Credits for Excellent shown red)	RIBA Stage	Available	% Score Value	IOE Masterplan %	75.8	86.9	24.2	69.2	56.3	Phase 2 - All areas	78.7	86.9	23.0	64.0	16.2	Level 5&9 - Core B-C	76.5	92.1	17.9	11.0	6.0	0.0	Owner (lead, support)	IOE Masterplan credits - Phases 1-3 Actions & risks	Owner (lead, support)	Phase 2 - All areas Actions & risks	Owner (lead, support)	Level 5 and 9 Core B-C Actions & risks
						Targeted - Low Risk	High risk - TBC	Not Targeted	Achieved - DS	Achieved - PC		Targeted - Low Risk	High risk - TBC	Not Targeted	Achieved - DS	Achieved - PC		Targeted - Low Risk	High risk - TBC	Not Targeted	Achieved - DS	Achieved - PC			Design stage evidence closed Design & post construction evidence closed		Design stage evidence closed Design & post construction evidence closed		Design stage evidence closed Design & post construction evidence closed
	BESPOKE BRE Approved Innovations		Varies																					UCL, BH Sust, Contractor	Identify any possible opportunities for masterplan level bespoke innovation credits UCL sustainability may be able to fund (e.g. wellness faculties, air quality enhancers, innovative PV solutions, window traffic light systems, living lab sensors, phase change materials, productivity surveys, flow batteries, outdoor gym etc.).	n/a	n/a	n/a	n/a

[1] Note: a maximum of 10 credits can be awarded from the available innovation credits

Appendix D - BRUKLs

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BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name **Modular and Portable**

UCL_Woburn Square_GLA Baseline

As designed

Date: Wed Mar 23 14:11:43 2022

Administrative information

Building Details

Address: Address 1, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.13

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.13

BRUKL compliance check version: v5.6.b.0

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

The building does not comply with England Building Regulations Part L 2013

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	24.3
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	24.3
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	89.6
Are emissions from the building less than or equal to the target?	BER > TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.54	0.54	L500005F:Surf[0]
Floor	0.25	0.25	0.25	L5000067:Surf[0]
Roof	0.25	0.18	0.18	L9000001:Surf[0]
Windows***, roof windows, and rooflights	2.2	1.8	2.05	L900002D:Surf[0]
Personnel doors	2.2	-	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values $[W/(m^2K)]$

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values $[W/(m^2K)]$

$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values $[W/(m^2K)]$

* There might be more than one surface where the maximum U-value occurs.

** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

*** Display windows and similar glazing are excluded from the U-value check.

N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	19