APPENDIX 5.0

ENERGY AND OVERHEATING RISK ASSESSMENTS BY XCO2

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ENERGY ASSESSMENT ADDENDUM

10.045 - 8 GLOUCESTER GATE

03/04/2025 *by AG, reviewed by TKi*

This addendum provides supplementary analysis to the existing energy assessment for the proposed development at 8 Gloucester Gate, focusing on the comparative carbon emissions performance of three different development scenarios in line with SAP 10.2. The analysis assesses whole dwelling operational energy savings for each scenario to determine the environmental benefits of the proposed scheme.

EXECUTIVE SUMMARY

This analysis has been carried in response to the Decision Notice (ref: 2024.3349.P) issued by Camden Council dated 14th January 2025 and supports the Applicant's Statement of Case.

This energy assessment was conducted to evaluate the environmental impact of proposed construction scenarios for the Closet Wing at 8 Gloucester Gate in the London Borough of Camden. This assessment aims to determine which development approach, either full reconstruction or targeted refurbishment, delivers the most significant operational energy savings and carbon emissions reductions, against the existing building performance.

The assessment aligns with relevant energy policies and Part L 2021 Building Regulations, demonstrating the importance of enhanced building fabric and passive design measures in achieving sustainable development. The analysis follows the Standard Assessment Procedure (SAP 10.2), which provides a standardised approach to measuring energy performance and carbon emissions.

Two proposed scenarios were assessed against the baseline of the existing dwelling (Scenario 1). Scenario 2, representing the proposed scheme, involves the complete reconstruction of the Closet Wing and upgrades to the existing dwelling thermal elements where it is deemed feasible, while Scenario 3 considers refurbishing the Closet Wing by reconstructing its rear section from circa 1987.

The analysis finds that Scenario 2 (proposed scheme) leads to the greatest improvement, achieving a 16.3% reduction in carbon emissions compared to the existing dwelling. Scenario 3 (refurbish rear Closet Wing) offers a more modest 3.3% reduction. These findings highlight that while refurbishment provides some benefits, full reconstruction is the more effective strategy for energy efficiency and carbon emissions reduction.

Table 1. SAP Energy Assessment Results

SAP Results			
	Scenario 1 Existing Dwelling	**Scenario 2** Proposed Scheme	**Scenario 3** Refurbish Rear Closet Wing
Model Floor Area (m^2)	549	573	549
Dwelling Emission Rate ($kgCO2/m^2/yr$)	33.6	26.8	32.5
Total Regulated Carbon Emissions (tonnesCO2/yr)	18.4	15.4	17.8
Whole Dwelling Operational Carbon Savings (%)	-	**16.3%**	**3.3%**

INTRODUCTION

The proposed development located in Gloucester Gate is in close proximity to Regent's Park, within the London Borough of Camden. This section presents the description of the site and of the development proposal.

SITE

The site is located at 8 Gloucester Gate in the London Borough of Camden. It is on a private residential road in close proximity to Regent's Park, served by a number of local amenities and public transport facilities.

The development comprises three existing structures: the main house, the mews located behind the main house and the Closet Wing that connects the other two structures on the basement floor. The main house is five-storey terraced house with four bedrooms, reception, formal dining area and library/ study rooms. The mews comprises a bedroom, living room and a two-car garage below. Both structures were built in the 1800s. The Closet Wing extension is a three-storey structure comprising of a family room and jacuzzi room at basement level, a kitchen on the ground floor and a bedroom on the first floor.

The location of the development site is shown in Figure 1 below.

Figure 1. Location of the application site.

PROPOSED SCHEME (SCENARIO 2)

It is proposed that the Closet Wing will be a three-storey link building, with a curved façade facing onto the central courtyard of the existing dwelling. This new structure will include a gym/studio at the basement level, a kitchen with dining area on the ground floor, and a study on the first floor. This proposal had previously been assessed under the 'Be Lean - Use Less Energy' strategy outlined in the Energy & Overheating Risk Statement, dated July 2024, as per the planning application submitted.

However, for the purposes of this analysis, two proposals have been considered for the Closet Wing. The first proposal involves demolishing and reconstructing the entire Closet Wing (Figure 2) as described above, alongside upgrading specific elements of the existing dwelling (main house and mews house) where deemed feasible. Figure 3 and Figure 4 indicate portions of the house external envelope that are proposed to be upgraded or replaced.

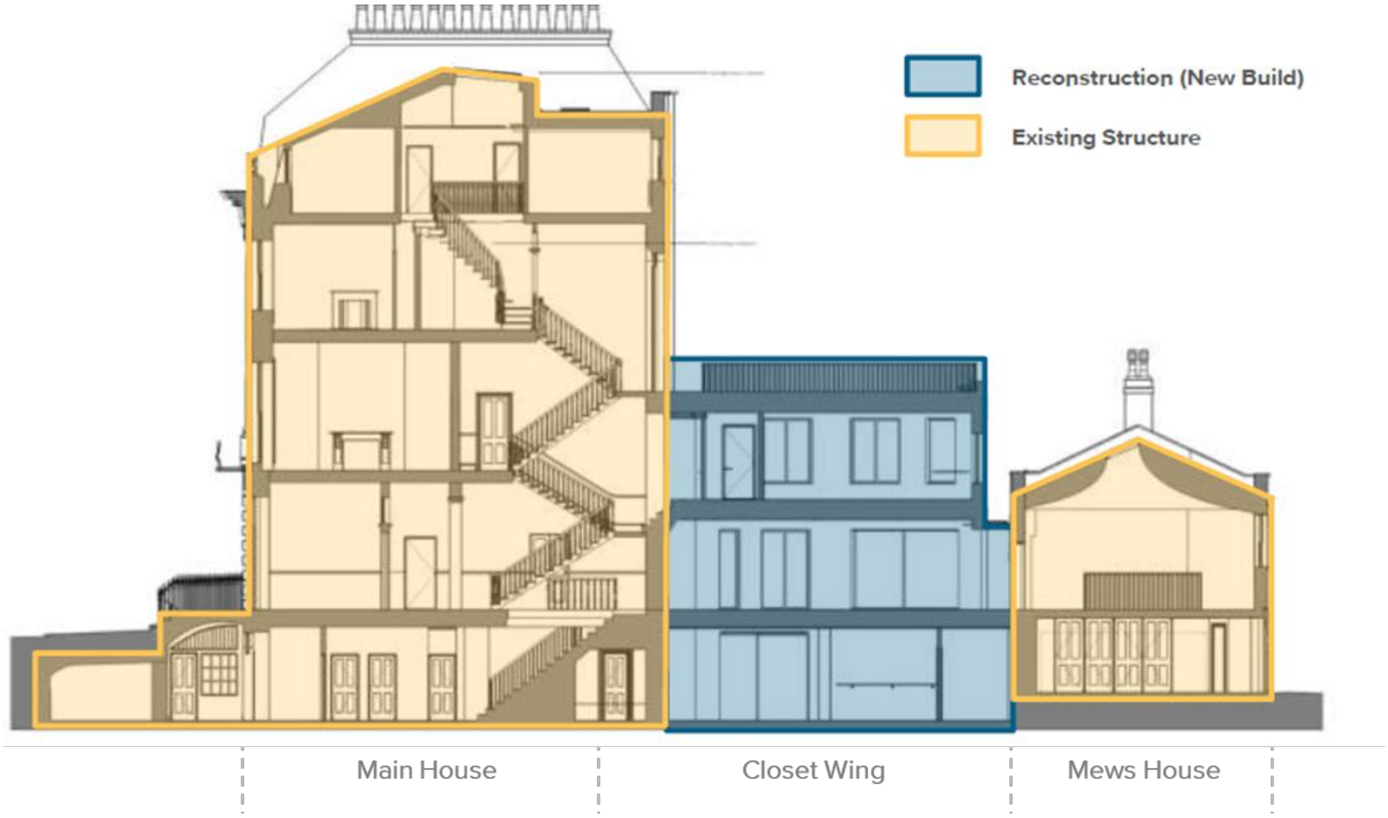

Figure 2. Section of proposed scheme (courtesy of Dowen Farmer Architects)

Figure 3. Floor plan showing building fabric improvements (courtesy of Dowen Farmer Architects)

Figure 4. Section showing building fabric improvements (courtesy of Dowen Farmer Architects).

ALTERNATIVE SCHEME (SCENARIO 3)

The second option focuses on refurbishing only the rear part of the Closet Wing, which was last renovated in 1987. The refurbishment area is illustrated in Figure 5.

Figure 5. Refurbishment area of the Closet Wing (courtesy of Dowen Farmer Architects)

METHODOLOGY

To assess the reduction in carbon emissions over the existing situation, the following three scenarios are considered:

Scenario 1: Existing Dwelling

The carbon emissions of the existing dwelling are calculated based on the current measurements and fabric of the building.

Scenario 2: Proposed Scheme

The carbon emissions for the proposed scheme are based on the reconstruction of the Closet Wing and upgrades to the existing dwelling thermal elements where it is deemed feasible, ensuring compliance with Part L 2021 of the Building Regulations for new-build elements. This scenario has been analysed in the energy assessment under the 'Be Lean – Use Less Energy' strategy outlined in the Energy & Overheating Risk Statement, dated July 2024.

Scenario 3: Refurbish Rear Closet Wing

In this scenario, carbon emissions are estimated based on the refurbishment of the Rear Closet Wing, ensuring compliance with Part L 2021 of the Building Regulations for new fabric elements in existing dwellings.

To quantify the carbon emissions, the SAP methodology has been applied using the Elmhurst Design SAP10 software to model the energy performance and calculate the resulting carbon emissions. The Dwelling Emission Rate (DER) is used to determine the emissions by multiplying it by the total floor area of the property. The resulting Regulated Carbon Emissions are then compared across all three scenarios to assess the benefits achieved by Scenario 2 and Scenario 3 relative to the existing dwelling in Scenario 1.

SAP BACKGROUND

The Standard Assessment Procedure (SAP) is the government's established method for estimating the energy performance of residential properties. SAP is based on the BRE Domestic Energy Model (BREDEM), and is used to assess the energy efficiency of homes. The latest software version of SAP 10.2 has been used for this assessment.

The SAP calculation considers a range of factors that influence a dwelling's energy efficiency, including construction materials, thermal insulation, air leakage, ventilation characteristics, heating system efficiency and control, solar gains through windows, fuel types for heating, lighting, and water, energy for space cooling (if applicable), and the presence of renewable energy technologies.

Key indicators of energy performance in SAP include Fabric Energy Efficiency (FEE), energy consumption per unit floor area, SAP Rating (energy cost rating), the Environmental Impact (EI) Rating based on CO_2 emissions, Dwelling Primary Energy Rate (DPER), and the Dwelling CO_2 Emission Rate (DER). For this assessment, the DER is used to measure the annual CO_2 emissions per unit floor area for space heating, water heating, lighting, and ventilation, adjusted for savings from energy generation technologies. The DER is applied to ensure compliance with Building Regulations and is measured in $kgCO_2/m^2$/year.

MODELLING PARAMETERS

The heat loss of different building fabric elements depends on their U-values. A building with lower U-values provides better insulation, which in turn reduces heating demand during colder months. Assumptions regarding the U-values for each scenario have been made based on the existing building fabric and the proposed improvements.

For Scenario 1, the existing U-values were assumed in accordance with Appendix S: Reduced Data SAP for existing dwellings, as per the age band classification. The external walls are assumed to be solid brick, the floor is assumed to be uninsulated solid concrete with single-glazed sash windows and solid wooden doors. The assumed U-values for the existing fabric are presented in Table 2.

Table 2. U-values for Scenario 1: Existing Dwelling

Existing Dwelling (U-values in W/m².K)		
Element	**Scenario 1** Existing Dwelling	
	(Before 1900)	(1983-1990)
External wall	1.7	0.6
Floor	0.34	
Roof	2.3	0.4
Windows/ Rooflights	4.8	
Half glazed door	3.9	
Door	3	

For Scenario 2, the proposed Closet Wing extension will incorporate high levels of insulation and high-performance triple-glazing beyond Part L 2021 minimum requirements and notional building specifications, in order to reduce the demand for space heating. Target U-values for this element of the development are shown in Table 3.

Table 3. U-values for Scenario 2: Proposed Scheme (for Closet Wing and new elements within Existing Dwelling)

Closet Wing & Existing House upgrade targets (U-values in W/m².K)			
Element	**Building Regulations**	**Proposed**	**Improvement**
Wall	0.18	0.15	17%
Floor	0.18	0.10	44%
Roof	0.15	0.10	33%
New Glazing	1.4	0.80	43%
Replaced Glazing	1.4	1.20	14%
Roof Light	2.2	1.20	45%

Furthermore, upgrades to the existing dwelling thermal elements are proposed where it is deemed feasible to do so, with consideration to the Grade I Listed Building status. Proposals to upgrade insulation and windows have considered heritage value and any other constraints.

Any replacement windows will prioritise high-performance double glazing, and new exposed floor and roof of the proposed mews studio will aim to maximise thermal performance, as indicated within Table 3. Further details and mark ups of elements to be upgraded can be found in the original statement.

For Scenario 3, where the rear closet wing is refurbished, the U-values of the refurbished elements are assumed to comply with Part L of the Building Regulations. The relevant U-values for this scenario are shown in Table 4.

Table 4. U-values for Scenario 2: Refurbish Rear Closet Wing

Refurbish Rear Closet Wing (U-values in W/m2.K)	
Element	**Scenario 3** Refurbish Rear Closet Wing
External wall	0.18
Floor	0.18
Roof	0.15
Windows	1.4
Door	1.4

RESULTS

The SAP calculation results for the three scenarios are summarised in Table 5. The results compare the existing dwelling to the proposed scheme and alternative development scenario, in terms of resultant regulated carbon emissions from the SAP calculations.

Table 5. SAP Energy Assessment Results

SAP Results			
	Scenario 1 Existing Dwelling	**Scenario 2** Proposed Scheme	**Scenario 3** Refurbish Rear Closet Wing
Model Floor Area (m^2)	549	573	549
Dwelling Emission Rate ($kgCO_2/m^2/yr$)	33.6	26.8	32.5
Total Regulated Carbon Emissions ($tonnesCO_2/yr$)	18.4	15.4	17.8
Whole Dwelling Operational Carbon Savings (%)	-	**16.3%**	**3.3%**

The results of Scenario 2 show that the DER is reduced to 26.8 $kgCO_2/m^2/yr$, resulting in a total of 15.4 tonnes CO_2/yr; a saving of 3.0 $tonnesCO_2/yr$. This represents a 16.3% reduction in carbon emissions compared to the existing dwelling. The significant reduction is primarily due to enhanced insulation, the incorporation of triple-glazing, and other energy-efficient upgrades.

On the other hand, Scenario 3 shows some improvement, with the DER decreasing to 32.5 $kgCO_2/m^2/yr$, leading to 17.8 tonnes CO_2 per year, offering only a 3.3% reduction in emissions compared to the existing dwelling.

Overall, Scenario 2 provides the most significant carbon savings and delivers the greatest environmental benefit in terms of operation energy and carbon emissions.

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OVERHEATING RISK ASSESSMENT ADDENDUM

10.045 – 8 GLOUCESTER GATE

07/04/2025 *by PB, reviewed by TKi*

This addendum provides supplementary analysis to the existing overheating risk assessment of the main house at the proposed development at 8 Gloucester Gate. The focus is on additional analysis of mitigation measures in reducing overheating risks within the occupied zones of the existing building. This analysis pertains to the main house spaces, where comfort cooling is proposed. It should be noted that, for the alternative mitigation measures explored in this analysis, the spaces do not meet all CIBSE TM59 overheating risk criteria.

EXECUTIVE SUMMARY

This analysis has been carried in response to the Decision Notice (ref: 2024.3349.P) issued by Camden Council dated 14th January 2025, and supports the Applicant's Statement of Case.

An overheating analysis has been conducted for the main house of the proposed development at 8 Gloucester Gate located in the London Borough of Camden. The purpose of this analysis is to test potential mitigation measures following Camden Council's feedback regarding passive mitigation strategies and the application of the Cooling Hierarchy, with the aim of testing the feasibility of a suitable compliant alternative strategy than the proposed comfort cooling.

Compliance with CIBSE TM59 overheating risk criteria is proposed to improve the comfort of occupants as well as future-proof the scheme by accounting for projected increased ambient air temperatures from climate change. This addendum builds on the Energy & Overheating Statement produced by XCO2, dated July 2024, with additional modelling of these mitigation strategies.

ID	Overheating Risk Mitigation Measure	Bedrooms TM59 night-time 26°C criterion	Bedrooms TM52 Criterion 1	Living Rooms TM52 Criterion 1	CIBSE TM59 Compliance (Pass/Fail)	Overheating Risk Impact	Suitability of Measure
		No. of rooms not meeting criteria					
0	Existing baseline	5/5	1/5	1/2	Fail	-	-
1	Ceiling fans	5/5	2/5	1/2	Fail	Found to be ineffective in reducing overheating risk.	n/a
2	MVHR	5/5	0/5	1/2	Fail	Achieves small reduction in overheating risk, but not significant.	Likely unsuitable due to ductwork requirements. Plant space would also need to be considered.
3	Internal blinds	5/5	0/5	0/2	Fail	Achieves reasonable reduction in overheating risk in daytime, but not significant at night-time.	Could be used in conjunction with comfort cooling to help reduce energy demand, but does not offer significant benefit.

						Also not a permissible strategy under Part O.	
4	External shading	5/5	0/5	0/2	Fail	Achieves reasonable reduction in overheating risk in daytime, but not significant at night-time.	Deemed not feasible due to heritage constraints, since external shading would likely be unacceptable on the front façade.
5	Security grilles for secure night-time window opening	1/5	0/5	1/2	Fail	Achieves significant reduction in overheating risk in daytime and night-time. Could achieve compliance in conjunction with other options.	Deemed not feasible due to heritage constraints, since window railings/grilles would likely be unacceptable on the front façade. Utilising greater levels of natural ventilation at night-time could also expose the occupants to high noise levels during sleeping hours.
6	Reduce g-value of the front façade windows	5/5	0/5	0/2	Fail	Achieves reasonable reduction in overheating risk in daytime, but not significant at night-time.	Likely to be deemed unfeasible due to the heritage constraints pertaining to the front façade. New double glazing has been discounted by the Council; therefore the remaining option would be a solar film which may damage the aesthetic of the front façade.
7	Comfort Cooling (as proposed)	0/5	0/5	0/2	Pass	Effective in mitigating overheating risk.	Feasible. As proposed.

The finding of the overheating assessment for the main house of the proposed development show that full compliance with CIBSE TM59 could not be achieved through the passive strategies explored. Various passive measures were tested, including ceiling fans, an MVHR system, internal and external blinds, security grilles and reducing the g-value of front façade windows. None of these measures resulted in full compliance.

Whilst some measures could be combined with each other to improve results and reduce overheating risk further, it was found that most of the measures were deemed unsuitable due to other project requirements, as described in the above table and discussed further in this addendum.

As a result, it should be considered that comfort cooling is the most suitable solution to optimise occupant comfort and future-proof the dwelling against rising ambient temperatures due to climate change.

INTRODUCTION

The proposed development located in Gloucester Gate is in close proximity to Regent's Park, within the London Borough of Camden. This section presents the description of the site and of the development proposal.

SITE

The site is located at 8 Gloucester Gate in the London Borough of Camden. It is on a private residential road in close proximity to Regent's Park, served by a number of local amenities and public transport facilities.

The development comprises three existing structures: the main house, the mews located behind the main house and the Closet Wing that connects the other two structures on the basement floor. The main house is five-storey terraced house with four bedrooms, reception, formal dining area and library/ study rooms. The mews comprises a bedroom, living room and a two-car garage below. Both structures were built in the 1800s. The Closet Wing extension is a three-storey structure comprising of a family room and jacuzzi room at basement level, a kitchen on the ground floor and a bedroom on the first floor.

The location of the development site is shown in Figure 1 below.

Figure 1. Location of the application site.

PROPOSED SCHEME

It is proposed that the Closet Wing will be a three-storey link building, with a curved façade facing onto the central courtyard of the existing dwelling. This new structure will include a gym/studio at the basement level, a kitchen with dining area on the ground floor, and a study on the first floor.

As part of the development, it is proposed that comfort cooling will be installed to maintain occupant thermal comfort within the key spaces in the Main House; the Master Bedroom, Bedroom 2, Bedroom 3, Bedroom 4, Bedroom 5 and Reception Room.

Please note that this addendum is therefore related only to the existing main house building including the spaces listed above, and not the proposed new closet wing or mews building (see Figure 2).

Figure 2. Section of proposed scheme (courtesy of Dowen Farmer Architects)

METHODOLOGY

In order to assess the thermal performance of the development, models were constructed within thermal simulation software. The internal temperature, lighting and ventilation conditions were estimated for all habitable internal spaces. In total 7 habitable spaces were included in the assessment. This includes 4 double bedrooms, 1 single bedroom and 2 living rooms. Non-habitable spaces such as bathrooms, storage rooms and circulation areas have also been included in the assessment; and their internal gains have been accounted for in the model.

With the aim of giving the most robust consideration, the performance of the various occupied rooms was compared with CIBSE Technical Memorandum 59[1] performance recommendations. These are rigorous targets that determine the acceptability of overheating based on the temperature differential between the internal and the external environment (ΔT), considering the frequency of high temperature difference beyond which the level of overheating is considered unacceptable. Specifically, for bedrooms, the methodology aims to evaluate comfort during the sleeping hours by setting a maximum number of hours for which the operative temperature can exceed 26°C.

Although there are no regulatory requirements to assess existing buildings for overheating risk, the habitable spaces in the existing portion of the house have been assessed against CIBSE TM59 criteria to test thermal comfort levels. The buildings have been modelled using dynamic thermal simulation software which is fully compliant with CIBSE Applications Manual AM11. The software can compute operative temperatures using CIBSE weather data sets, building fabric specification, window areas and opening, all aspects of solar and internal gains as well as natural ventilation flows within buildings.

For the full set of assumptions and parameters used for the baseline model, including fabric specification, occupancy, internal gains and window opening types, please refer to the original Energy & Overheating Risk Statement submitted in support of this application. However, some of the key baseline model assumptions are set out below:

[1] CIBSE TM59:2017 – Design Methodology for the assessment of overheating risk in homes

- Fabric performance: The building fabric u-values for the existing structure were based on Reduced Data SAP for existing dwellings (Appendix S), under Age Band A. The u-value of 4.8 and solar transmittance of 0.85 for the existing single glazed windows were taken from Table S14. In the absence of documentary evidence for the existing windows, this was deemed a reasonable estimate.
- Occupancy: Predicted occupancy patterns follow the TM59 methodology and were programmed into the dynamic software model for the overheating assessment calculations. Keys areas are: Master Bedroom, Bedroom 2, Bedroom 4, and Bedroom 5 as Double Bedrooms; Bedroom 3 as a Single Bedroom; and the Reception and Sitting Room as a 5-bedroom apartment: living room.
- Internal gains: Internal gains (lighting, equipment, people) for occupied areas are incorporated within the model in line with the guidance set out in TM59, similar to the predicted occupancy hours.
- Ventilation: Natural ventilation is possible through the series of windows to allow air flow and alleviate heat buildup during periods of hot weather. The assumption of window type in most rooms in main house are sash window with 50% openable area, except bedroom4 which has side-hung window with 90% openable area.

It should be noted that the findings of this assessment are related to planning stage design only, and any changes to the ventilation strategy, façade opening areas and window operation and shading elements will impact the performance of the building and may void the results of the current assessment.

ASSESSMENT CRITERIA

The CIBSE TM59 overheating risk criteria relevant to this development are as follows:

1. **For living rooms, kitchens and bedrooms:** the number of hours during which ΔT is greater than or equal to one degree (K) during the period May to September inclusive shall not be more than 3% of occupied hours.
2. **For bedrooms only:** to guarantee comfort during the sleeping hours the operative temperature in the bedroom from 10 pm to 7 am shall not exceed 26°C for more than 1% of annual hours (< 32 hours).

MODELLING ITERATIONS

All modelling iterations were based on natural ventilated scenario with separate passive strategy has been applied to each iteration. It should be noted that all iterations have been assessed independently to ensure clarity of results.

- **Existing Baseline (ID 0):** A naturally ventilated scenario of the main house without any additional passive measures or cooling. Sash windows are assumed to be fully open during daytime and restricted at night to 10% open for security reasons. The existing single-glazed windows are assumed to have a g-value of 0.85.
- **Iteration1 (ID 1):** Ceiling fans have been modelled, with an elevated fan speed of 0.10 m/s for the bedrooms and reception room in the main house.
- **Iteration2 (ID 2):** The use of Mechanical Ventilation with Heat Recovery (MVHR) year-round is introduced. The estimated ventilation flow rates have been included in the model in line with Part F ventilation requirements, utilising 6 l/s in bedrooms and 13 l/s in living rooms.
- **Iteration3 (ID 3):** Internal blinds are added on the front west-facing façade.
- **Iteration4 (ID 4):** External shading is installed to the front west-facing façade.
- **Iteration 5 (ID 5):** Security railings or grilles are modelled to enable windows to open fully at night.
- **Iteration 6 (ID 6):** The g-value of the windows on the front façade is reduced from 0.85 to 0.5.
- **Iteration 7 (ID 7):** Comfort cooling as proposed.

APPLICATION OF THE COOLING HIERARCHY

The London Plan Cooling Hierarchy has been followed throughout the initial overheating risk assessment and this analysis for the addendum in response to Camden Council's comments. The following points describe how each of the Cooling Hierarchy topics have been considered for the development, arranged as per Camden Planning Guidance document 'Energy efficiency and adaptation', para 10.7:

1. **Minimise internal heat generation through energy efficient design**

- *Layout and uses: locate any spaces that need to be kept cool or that generate heat on cooler sides of developments* – would involve full reconfiguration of internal layout, therefore not feasible for main house.

- *Reducing heat gains e.g. including low energy lighting* – provision of low energy lighting has already been assumed for the baseline model.
- *Seal/ insulate heat generating processes* – heat gain from poor insulation of services has not been assumed in the overheating risk modelling.
- *Reduce the distance heat needs to travel and insulate pipework* – would involve reconfiguration of building services strategy, therefore not feasible for main house.
- *Design layouts to promote natural ventilation e.g. shallow floor plans and high floor to ceiling heights* - would involve full reconfiguration of internal layout, therefore not feasible for main house.

2. **Reduce the amount of heat entering a building in summer**

- *Consider the angle of the sun and optimum daylight and solar gain balance* – existing building orientation is fixed, however solar gain balance has been reviewed as part of Iteration 6 of this study.
- *Orientate and recess windows and openings to avoid excessive solar gain* - existing building orientation and façade design is fixed, however solar gain impact has been reviewed as part of Iteration 6 of this study.
- *Consider low g-values and the proportion, size and location of windows* – size and location of windows cannot be changed for the listed building façade, however low g-value glazing has been considered as part of Iteration 6 of this study.
- *Make use of shadowing from other buildings* - existing building form, orientation and surrounding context is fixed.
- *Include adequate insulation* – certain upgrades to the existing house have been considered as part of the Energy Strategy proposals for the proposed scheme, which could provide a small benefit to overheating risk, however this is likely to be negligible since a major refurbishment is not planned due to heritage constraints.
- *Design in shading: e.g. include internal courtyards, large shade-providing trees and vegetation, balconies, louvers, internal or external blinds, and shutters* – balconies, courtyards and shade-providing trees are not feasible for the development, and additional shading measures have been considered and modelled under Iterations 3 and 4 of this study.
- *Make use of the albedo effect (use light coloured or reflective materials to reflect the sun's rays)* – could be considered, however not likely to offer a significant benefit to performance against CIBSE TM59 criteria.
- *Include green infrastructure e.g. green wall, green/blue roofs and landscaping, to regulate temperatures* – could be considered, however not likely to offer a significant benefit to performance against CIBSE TM59 criteria.

3. **Manage the heat within the building through exposed internal thermal mass and high ceilings** – already present within the main house.

4. **Passive ventilation**

- *Natural ventilation, openable windows, the 'stack effect' system* – openable sash windows with reasonable capacity for natural ventilation are already present within the main house, offering overheating risk mitigation.
- *Design layouts to promote natural ventilation e.g. shallow floor plans and high floor to ceiling height* - would involve full reconfiguration of internal layout, therefore not feasible for main house.
- *Consider evaporation cooling which cools air through the evaporation of water* – this could be considered, however would not offer a significant impact within the overheating risk modelling and its benefit would be difficult to quantify.
- *Consider 'free cooling' or 'night cooling', which uses the cooling capacity of ambient air to directly cool the space* – cooling effect of external air is considered under ventilation.

5. **Mechanical ventilation**

- *Ensuring the most efficient system possible* – MVHR has been considered and modelled under Iteration 2 of this study.
- *Consider mechanical ventilation with heat recovery* - MVHR has been considered and modelled under Iteration 2 of this study.

6. **Active cooling**

- *Ensuring they are the lowest carbon options* – units with high Energy Efficiency Ratio (EER) values are proposed to minimise energy use.

- *Ground Source Heat Pumps and Air Source Heat Pumps can be used in reverse to provide cooling to buildings* – GSHP would not be feasible due to space constraints. ASHP could be considered, however this would involve significant building services retrofit which is not currently proposed, this would also likely not achieve any energy savings for cooling in comparison with a dedicated comfort cooling system.
- *Water based cooling systems also reduce the need for air conditioning by running cold water through pipes in the floor and/or ceiling to cool the air* – this could be considered however would not likely offer a significant impact, and would also involve significant retrofit of the floors/ceilings of the property.

RESULTS

This section presents the results summary for each of the tests carried out for the existing main house building of the proposed development. These results expand on the findings of the Energy & Overheating Risk Statement produced by XCO2, dated July 2024, by providing additional modelling of mitigation strategies, following Camden Council's feedback regarding passive mitigation strategies and the application of the Cooling Hierarchy, with the aim of seeking a suitable compliant alternative strategy than the proposed comfort cooling.

Table 1 shows the modelling iterations of these spaces under London Weather Centre DSY1, 2020s, high emissions, 50th percentile scenario weather data, and how each compare against CIBSE TM59 criteria. The improvement measures have been tested independently of each other, and the number of rooms that were found to not meet the CIBSE TM59 criteria have been reported.

Table 1. Overheating assessment results for alternative mitigation measures tested, London Weather Centre DSY1

ID	Overheating Risk Mitigation Measure	Bedrooms TM59 night-time 26°C criterion	Bedrooms TM52 Criterion 1	Living Rooms TM52 Criterion 1	CIBSE TM59 Compliance (Pass/Fail)	Overheating Risk Impact	Suitability of Measure
		No. of rooms not meeting criteria					
0	Existing baseline	5/5	1/5	1/2	Fail	-	-
1	Ceiling fans	5/5	2/5	1/2	Fail	Found to be ineffective in reducing overheating risk.	n/a
2	MVHR	5/5	0/5	1/2	Fail	Achieves small reduction in overheating risk, but not significant.	Likely unsuitable due to ductwork requirements. Plant space would also need to be considered.
3	Internal blinds	5/5	0/5	0/2	Fail	Achieves reasonable reduction in overheating risk in daytime, but not significant at night-time. Also not a permissible strategy under Part O.	Could be used in conjunction with comfort cooling to help reduce energy demand, but does not offer significant benefit.
4	External shading	5/5	0/5	0/2	Fail	Achieves reasonable reduction in overheating risk in daytime, but not significant at night-time.	Deemed not feasible due to heritage constraints, since external shading would likely be unacceptable on the front façade.
5	Security grilles for secure night-time window opening	1/5	0/5	1/2	Fail	Achieves significant reduction in overheating risk in daytime and night-time. Could achieve compliance in conjunction with other options.	Deemed not feasible due to heritage constraints, since window railings/grilles would likely be unacceptable on the front façade. Utilising greater levels of natural ventilation at night-time could also expose the occupants to high noise levels during sleeping hours.
6	Reduce g-value of the front façade windows	5/5	0/5	0/2	Fail	Achieves reasonable reduction in overheating risk in daytime, but not significant at night-time.	Likely to be deemed unfeasible due to the heritage constraints pertaining to the front façade.

							New double glazing has been discounted by the Council; therefore the remaining option would be a solar film which may damage the aesthetic of the front façade.
7	Comfort Cooling (as proposed)	0/5	0/5	0/2	Pass	Effective in mitigating overheating risk.	Feasible. As proposed.

The results for the habitable spaces in the main house of the proposed development show a risk of overheating based on the alternative passive measures tested. This includes the master bedroom, bedroom 2, bedroom 3, bedroom 4, bedroom 5 and the reception room not achieving compliance for the DSY1 scenario. While several passive strategies, such as restricting window openings at night and the inclusion of MVHR for ventilation were shown to reduce overheating risk, they did not achieve full compliance with CIBSE TM59 criteria. Solar control strategies on the front façade, such as external shading and reducing the window g-value, helped mitigate solar gain but were not sufficient to achieve full compliance, and are also likely to be deemed unfeasible due to heritage constraints.

None of the passive measures tested achieved full compliance with CIBSE TM59 criteria. Given the constraints imposed by the heritage status of the proposed development, passive measures that meet the targeted overheating risk criteria could not be implemented. As a result, comfort cooling is identified as the most viable solution and would be the most suitable to ensure occupant comfort and future-proof the scheme against rising ambient temperatures due to climate change.