Dynamic Overheating Report

Bellway Homes Limited

Southern Gas Network Belvedere Holders Stations, Yarnton Way, DA17 6JP

Final

Harry Fry
BEng (hons), MSc

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Executive Summary

The purpose of this report is to provide the overheating mitigation strategy for the proposed development at Southern Gas Network Belvedere Holders Stations by Bellway London Partnerships in the London Borough of Bexley to demonstrate that the development is compliant with relevant Local Planning Conditions and Part O (2021) of the Building Regulations.

The performance of dwellings and communal corridors has been assessed against the Charted Institution of Building Services Engineers (CIBSE) guidance TM59 *Design methodology for the assessment of overheating risk in homes* (2017) and Approved Document O Overheating (2021).

A sample of dwellings and communal corridors has been selected for the dynamic overheating assessment based on design characteristics that establish them as representative of the overall proposed scheme. This selection of dwellings includes consideration of varying floor levels, orientations, occupancy types and exposure to risks such as noise, air quality and security risk.

For the purpose of this report, passive mitigation measures including maximising openable window areas, utilising balconies and external reveal depths for shading and increasing MVHR ventilation rates have been explored as far as practicable to reduce overheating risk in line with the London Plan cooling hierarchy.

All dwellings tested demonstrate compliance with the CIBSE TM59 and AD(O) overheating assessment criteria under the mandatory weather file (DSY1 for the 2020s, high emissions, 50% percentile scenario). The key design features and passive mitigation measures following the London Plan cooling hierarchy, as outlined within Table i.

Table i: Design features incorporated in accordance with the London Plan cooling hierarchy

Cooling hierarchy	Design feature	Discussion
1. Reduce amount of heat entering the building	Efficient building fabric and air tightness standards	In line with energy strategy
	Solar control glazing with G-value ranging from 0.40 - 0.30 (frame factor ranging from 0.80 – 0.70) (mark-up provided in Appendix D)	A low G-value reduces solar gain, but has implications on CO_2 emissions, fabric energy efficiency and internal daylight levels and has therefore been optimised to balance all aspects as far as possible
	External shading provided by balcony overhangs	In line with design proposals

Cooling hierarchy	Design feature	Discussion
2. Minimise internal heat generation	Energy efficient design of building services	In line with energy strategy
3. Manage the heat	Concrete floor slab between dwellings in apartment blocks	The thermal mass of this will help reduce the risk of overheating by absorbing heat during the daytime
4. Passive ventilation	Openable windows used as the primary means of ventilation for overheating (window opening schedule provided in Table 3)	Windows are simulated to start to open when the internal temperature exceeds 22°C and the external temperature is lower than the internal temperature, and be fully open when internal temperatures reach 26°C. If bedroom temperatures exceed 23°C at 23:00, windows are simulated open through the night. Otherwise, bedroom windows are simulated to be closed during sleeping hours.
5. Mechanical ventilation	Background mechanical ventilation rate in line with minimum Part F for houses. Boost rates to achieve 100 L/s in flats.	Minimum Part F ventilation rates range from 0.39-0.74 ach for the assessed dwellings
6. Active cooling	N/A	No requirement for active cooling

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CONTENTS

1. INTRODUCTION

1.1 This document has been prepared by Hodkinson Consultancy, a specialist energy and environmental consultancy for planning and development, to present the overheating mitigation strategy for the proposed development at SGN Belvedere by Bellway Homes Limited.

Site Location

1.2 The proposed development site is located on Yarnton Way in the London Borough of Bexley. The site is set in a mixed commercial and residential area. Yarnton Way lies to the north and a railway line to the south. To the east of the site are residential dwellings and to the west a number of small commercial units. The site location is shown in Figure 1 below, however please note that the eastern gas holder is now removed.

Figure 1: Site Location (Google Maps © 2023)

Development Description

1.3 The proposed development is described as follows:

"Redevelopment of the site to provide residential units including affordable housing (Use Class C3) and commercial floorspace (Class E) in new buildings ranging between 3 to 5 storeys in height, together with associated car parking and cycle storage, landscaping including new areas of public open space and a reptile retention zone, associated infrastructure including new junctions off Yarnton Way, drainage and land raising."

1.4 Figure 2 below indicates the proposed site plan.

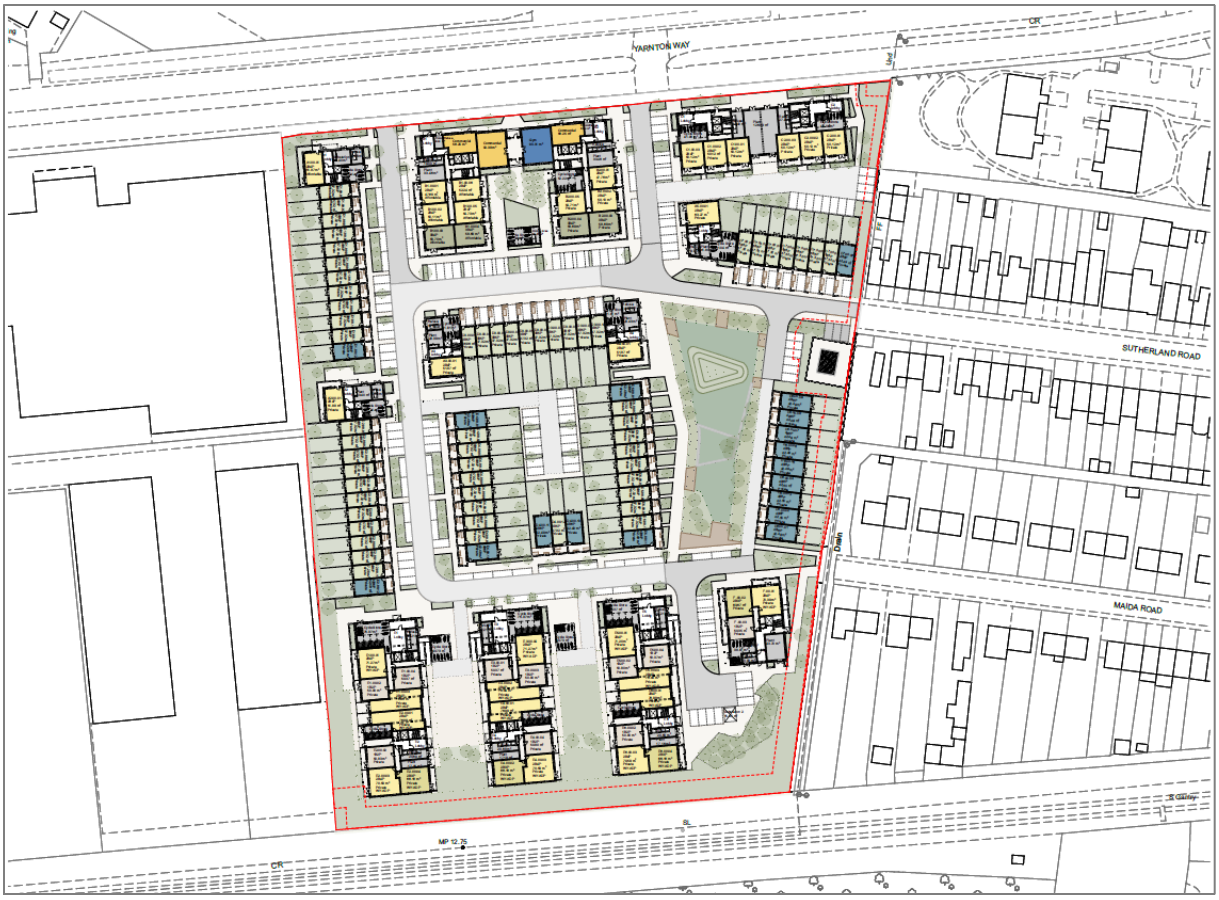

Figure 2: Proposed Site Layout – (Stockwool, July 2023)

Overheating and Thermal Comfort

1.5 Maintaining comfortable thermal comfort conditions in the face of climate change and increasing temperatures is one of the greatest challenges to be addressed by designers. The main objective is to achieve thermal comfort and minimise summertime overheating without the use of conventional air conditioning systems, which typically have associated greenhouse gas emissions and impact on the urban heat island effect.

1.6 Dynamic thermal simulations have been carried out for representative dwellings, to determine whether there is a risk of overheating. Appropriate mitigation measures have been recommended to mitigate the overheating risk and ensure that comfortable thermal conditions are achieved.

2. PLANNING POLICY

2.1 The following planning policies and requirements have informed the sustainable design of the proposed development.

National Planning Policy: NPPF

2.2 The revised National Planning Policy Framework (NPPF) was published on the 20th July 2021 and sets out the Government's planning policies for England. It describes a proactive approach that plans should take to mitigating and adapting to climate change, considering the risk of overheating from rising temperatures.

2.3 New developments should be planned for in ways that avoid increased vulnerability to the range of impacts arising from climate change.

Regional Planning Policy: The London Plan (2021)

2.4 The following key policy of the London Plan is considered relevant to the proposed development and this Overheating Assessment:

2.5 **Policy SI4 Managing Heat Risk** states that development proposals should minimise adverse impacts on urban heat island through design, layout, orientation, materials and the incorporation of green infrastructure and that major development proposals should demonstrate through an energy strategy how they will reduce the potential for internal overheating and reliance on air conditioning systems in accordance with the following cooling hierarchy (Figure 3):

2.6 Low-energy measures should be used to mitigate overheating risk. These include solar shading, building orientation and solar-controlled glazing. Occupant behaviour will also have an impact on overheating risk.

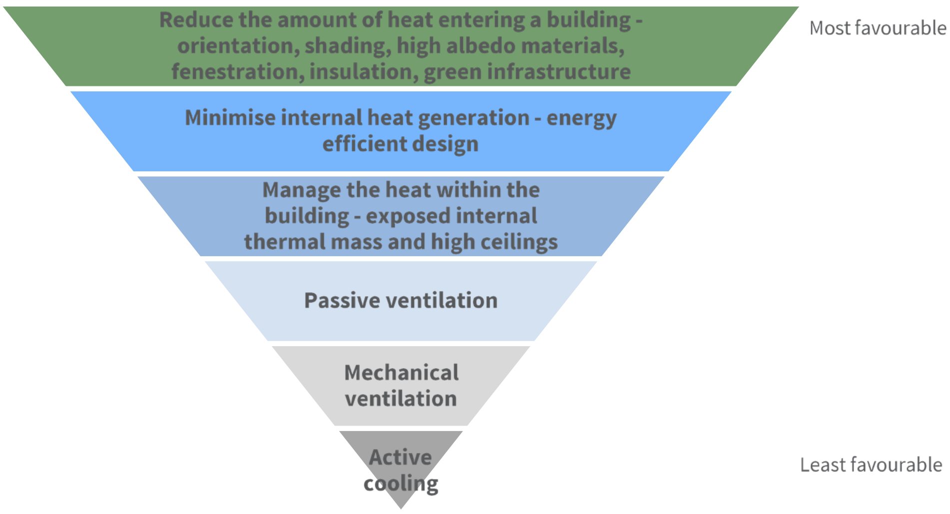

Figure 3: Cooling Hierarchy (London Plan 2021)

2.7 Passive ventilation should be prioritised, (accounting for external noise issues and local air quality). The increased use of air conditioning systems is not desirable. If active cooling systems, such as air conditioning systems, are unavoidable, these should be designed to reuse the waste heat they produce.

GLA Energy Assessment Guidance (2022)

2.8 The GLA Energy Assessment Guidance (2022) requires all developments to undertake a detailed analysis of the risk of overheating. The GHA Early Stage Overheating Risk Tool should be included within the assessment (see Appendix E).

2.9 For dwellings, final proposals must demonstrate compliance with Building Regulations Part O (2021) and CIBSE TM59 (2017).

2.10 For non-domestic areas, CIBSE TM52 methodology should be followed. There are exceptions to the overheating requirements where opportunities for reducing cooling demands via passive measures are constrained, for example supermarkets, cinemas, and retail outlets where doors may remain open to allow customer access.

Local Planning Policy: London Borough of Bexley Local Plan (2023)

2.11 The Bexley Local Plan was adopted on 26th April 2023 and sets out the planning framework for the borough, covering issues such as housing provision; the economy, retail and town centres; local character and design; infrastructure provision; and the environment.

2.12 Whilst the Bexley Local Plan does not make specific reference to overheating, an overheating assessment is evidence of best practice towards climate change adaptation, such as that outlined in **Policy SP14: Mitigating and adapting to climate change**.

Local Planning Policy: Bexley Sustainable Design and Construction Guide SPD (2007)

2.13 A number of supplementary planning documents provide guidance on Policies in the Local Plan. The Bexley Sustainable Design and Construction Guide makes reference to now outdated London Plan policies. This report addresses current policies as set out in the London Plan and outlined in preceding sections.

3. OVERHEATING CRITERIA

3.1 The following building regulations and guidance provide a standardised approach to predicting overheating risk in residential dwellings within the UK. They set out the criteria by which the risk of overheating can be assessed or identified.

Approved Document O (2021)

3.2 The proposed development will be subject to Part O of the Building Regulations, for which requirements are set out within Approved Document O (AD(O)) for Overheating (2021). Compliance is based on meeting the following requirements:

> Reasonable provision to limit unwanted solar gains in summer and to provide adequate means to remove excess heat;

> Taking account of safety, noise, pollution, protection of falling and entrapment when developing the strategy. Mechanical cooling should only be considered when feasible passive means are insufficient.

3.3 There are two methods for demonstrating compliance under AD(O):

> **Simplified**: The simplified method requires dwellings to accommodate design limitations on maximum glazed areas, minimum openable areas for natural ventilation and external shading.

> **Dynamic**: The dynamic method requires dwellings to demonstrate compliance with CIBSE TM59 criteria (with a few specific limitations on use of the TM59 methodology) via dynamic thermal modelling.

CIBSE TM59 (2017) Assessment Criteria

3.4 The criteria for the assessment of overheating risk have been specified by the Chartered Institute of Building Services Engineers (CIBSE) in TM59 *Design methodology for the assessment of overheating risk in homes* (2017). CIBSE TM59 provides a standardised approach to predicting overheating risk for both naturally and mechanically ventilated residential buildings.

3.5 The following criteria must be met in order to demonstrate compliance:

> **Criterion A**: The indoor operative temperature should not exceed the threshold comfort temperature by 1ºC or more for more than 3% of occupied hours in living rooms, kitchens and bedrooms.

> **Criterion B**: To guarantee comfort during the sleeping hours the operative temperature in the bedroom from 10 pm to 7 am should not exceed 26°C for more than 1% of annual hours.

3.6 Whilst there is no mandatory target to meet for communal corridors, TM59 suggests a threshold temperature of 28ºC to be exceeded for no more than 3% of the total annual hours.

4. MODELLING APPROACH

4.1 Dynamic thermal modelling has been undertaken using DesignBuilder Software (v.7). The performance of the units has been assessed following CIBSE TM59 and the adaptive thermal comfort method for a primarily natural ventilated scenario. Additional modelling limitations set by AD(O) have also been applied.

4.2 Thermal comfort category II has been used as the default category based on CIBSE TM52 (2013) guidance, where the development is not intended for vulnerable residents and does not consist of existing buildings.

Unit Selection

4.3 Representative dwelling units with different layouts, sizes, orientation and external shading have been assessed. The selection of the units for overheating risk assessment was based on the following design characteristics:

> Façade orientation;

> Number of occupants;

> Floor levels;

- Single/Dual aspect;
- Exposure to noise, air quality and security issues;
- Types covering flats and houses; and
- Worst-case scenario units.

4.4 The location and the internal layouts of the homes and communal corridors selected for assessment are presented in Appendix A. Design modelling inputs for the assessed dwellings can be found in Appendix B.

4.5 Commercial units have not been assessed against CIBSE TM59 criteria as these will be built to a shell and core specification. Therefore, actual uses (and associated internal gains), internal layouts, and building services are not known at this stage.

Site External Weather Conditions

4.6 External temperatures and incident solar gains are greatest during summer months, coinciding with periods of lower wind speeds. Solar altitude is also highest during summer months, increasing the effects of façade shading from balcony overhangs and window reveals. Such considerations should be accounted for when designing for overheating risk.

4.7 The effects of external conditions are vital in an overheating assessment as they influence:

- Solar heat gains (a function of incident direct and diffuse solar radiation and solar altitude); and
- Calculated natural ventilation rates (a function of external temperature, wind directions and speeds).

4.8 CIBSE design summer year (DSY) weather data for London Heathrow (representative of lower density urban and suburban areas) has been used for the 2020s, high emissions, 50 % percentile scenario as required by CIBSE TM59.

4.9 The assessment of overheating risk has been undertaken using the DSY1 weather file, in accordance with the requirements of TM59 and AD(O). The final mitigation strategy has also been tested under the more extreme DSY2 and DSY3 weather files and the results are presented in Appendix C.

Model Geometry and Local Shading

4.10 Overshadowing from the building blocks has been taken into account during the simulation, based on the model geometry and the site orientation.

4.11 Solar control forms an integral part of overheating mitigation strategies. External shading in the form of balconies is applied across many of the façades as part of the design proposals. These were incorporated in the simulation model as shown in Figures 4 and 5.

4.12 Horizontal shading devices such as balconies and overhangs are more efficient when applied in south oriented façades and during midday when the solar angle is high. Their role in reducing solar gains in the summer period is considered to be paramount.

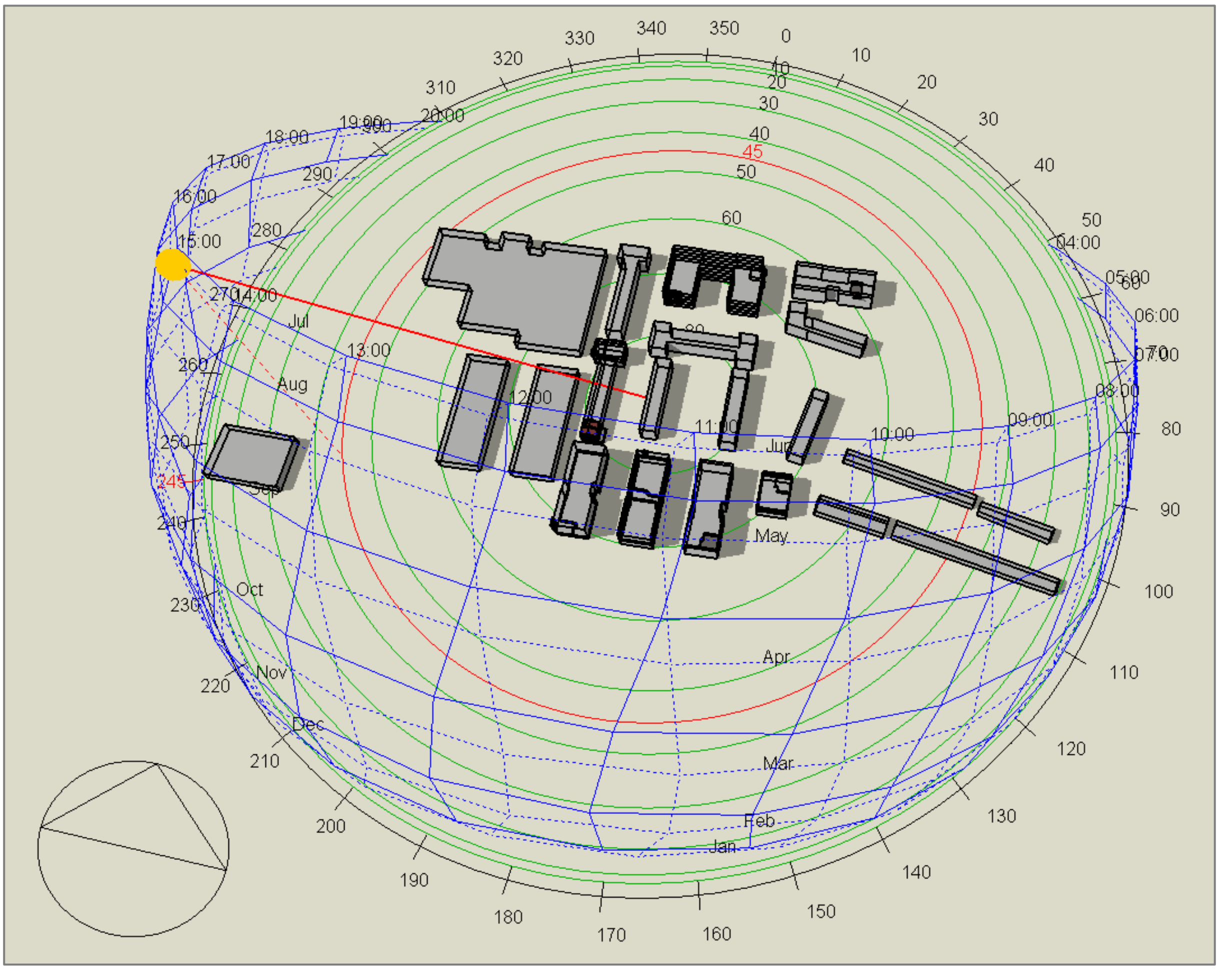

Figure 4: Simulation model from DesignBuilder.

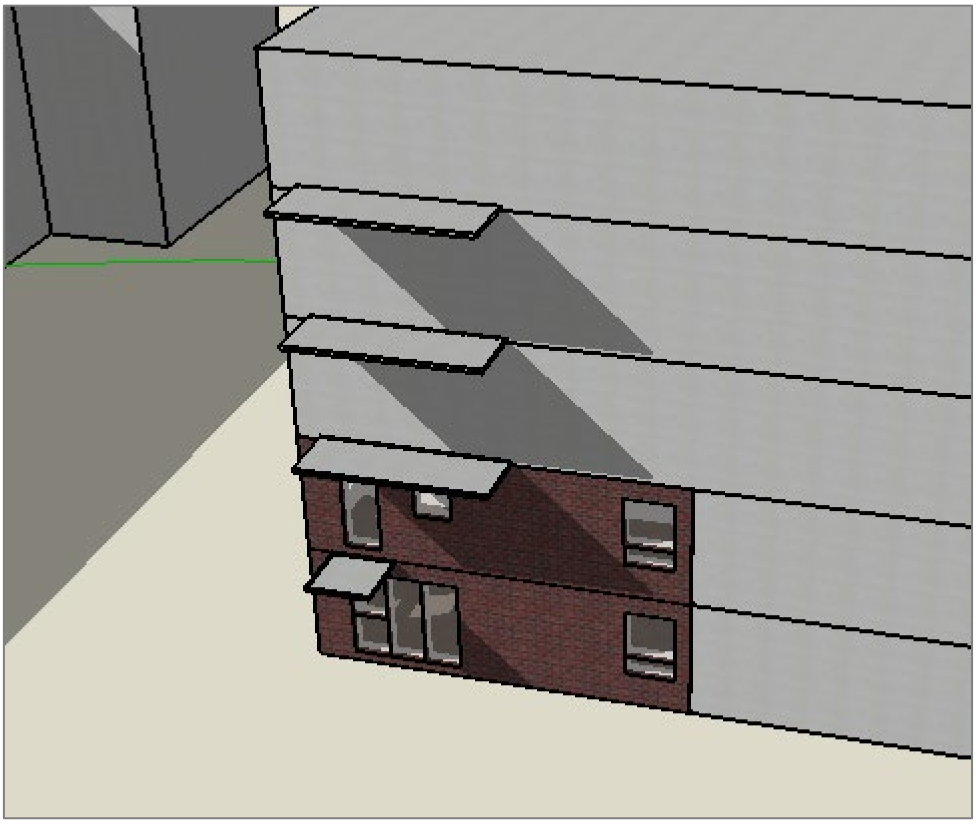

Figure 5: Local Shading example from DesignBuilder.

5. EXTERNAL NOISE AND AIR QUALITY CONSTRAINTS

5.1 Ardent Consulting Engineers have produced AD-O noise markups for the development shown in Figure 6 (August 2023) highlighting affected façades that exceed AD-O noise requirements. Façades highlighted in red are assumed to require closed windows at night.

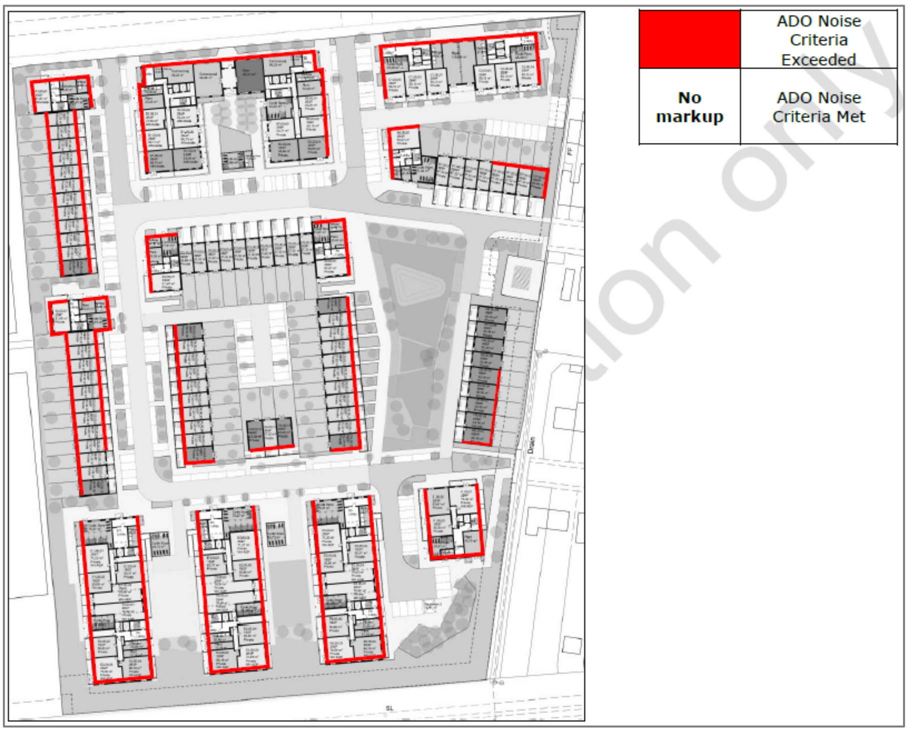

Figure 6: ADO noise affected façades (Ardent Consulting Engineers, August 2023)

5.2 Table 1 outlines the window opening schedule, based on the outlined risk from noise and air quality impacts.

Table 1: Proposed natural ventilation strategy for dwellings

Façade	Room	Part O Window Opening Schedule	Window opening schedule
All façades below 45.0 dB Night-time dB LA_{eq}, 8 hour	Kitchen / Living areas	08:00-23:00	Easily Accessible Units 08:00 – 23:00 Other Units 24/7

Façade	Room	Part O Window Opening Schedule	Window opening schedule
	Bedrooms	24/7 (allowing for use as home office or daytime resting in addition to night-time use)	24/7
All façades above 45.0 dB Night-time dB LA_{eq}, 8 hour	Kitchen / Living areas	08:00-23:00	Easily Accessible Units 08:00 – 23:00 Other Units 24/7
	Bedrooms	24/7 (allowing for use as home office or daytime resting in addition to night-time use)	07:00 – 23:00 (closed during sleeping hours)

5.3 In accordance with TM59 and additional limits set by AD(O), windows are simulated to gradually open when the internal temperature exceeds 22°C and the external temperature is lower than the internal temperature, to be fully open when internal temperatures reach 26°C.

5.4 For those apartments without external noise constraints, bedroom windows will be simulated to remain open through the night if the internal temperature exceeds 23°C at 23:00. If the bedroom temperature is below 23°C at 23:00, windows will be simulated to remain closed until 07:00.

6. OVERHEATING MITIGATION STRATEGY

Proposed Passive Measures

6.1 The following passive design measures have been incorporated as far as reasonably practicable in order to reduce the risk of overheating to an acceptable level, as determined by CIBSE TM59:

> Highly efficient fabric envelope and high efficiency building services heating system, lighting and appliances are proposed in all dwellings to reduce internal gains;

> High performance solar control glazing with the following g-values. These have been balanced to mitigate overheating risk whilst achieving fabric energy efficiency targets and natural daylight provision:

  > Exposed East-facing façades: 0.30

  > All other façades: 0.40

> External shading is provided to some windows in form of balconies and overhangs;

> A concrete floor slab within the apartment blocks provides some thermal capacity to absorb excessive heat within the building;

> Enhanced mechanical ventilation rates to 100 L/s in flats and Minimum Part F in houses.

Dwelling Results – No Usability Constraints

6.2 The assessment is first conducted under a scenario where noise risk and security risk are not considered (bedroom windows are considered to be open 24/7 where these are not easily accessible). Achieving compliance under this scenario demonstrates best practice in pushing passive mitigation measures as far as reasonably practicable.

6.3 On the design modelling inputs in Appendix B, window opening schedules presented in Table 1 and passive overheating mitigation measures outlined above, all assessed rooms meet the CIBSE TM59 criteria and therefore demonstrate an acceptable level of overheating risk under the ‘no occupancy constraints’ scenario.

6.4 The overheating risk has also been investigated using the more extreme weather files DSY2 and DSY3 and the results are presented in Appendix C.

Table 2: TM59 overheating results for dwellings under DSY1 2020s

Unit	Room	TM59 Criterion A: Hours of exceedance (pass ≤ 3 %)	TM59 Criterion B: Bedroom temperature hours > 26 °C (pass ≤ 32)	Overall compliance with TM59
		% Hours of overheating	Hours of overheating	
Block A, Flat, Mid Floor, 1B2P	Bedroom	0.1	19	PASS
	LDK	0.3	-	PASS
Block B, Duplex, Ground Floor, 3B4P	Bedroom 1	0.2	19	PASS
	Bedroom 2	0.1	31	PASS
	Bedroom 3	0.1	32	PASS
	LDK	0.2	-	PASS
Block C, Flat, Top Floor, 1B2P	Bedroom	0.0	23	PASS
	LDK	0.1	-	PASS
Block D House 1, Mid-terrace, 3B4P	Bedroom 1	0.0	24	PASS
	Bedroom 2	0.1	30	PASS
	Bedroom 3	0.1	32	PASS
	Living Room	0.6	-	PASS
	Kitchen Diner	0.2	-	PASS
Block D House 2, End-of-terrace, 4B6P	Bedroom 1	0.1	23	PASS
	Bedroom 2	0.1	20	PASS
	Bedroom 3	0.1	31	PASS
	Bedroom 4	0.1	32	PASS
	Kitchen Diner	0.1	-	PASS
	Living Room	0.3	-	PASS
Block E, Flat, Ground Floor, 2B3P	Bedroom 1	0.1	30	PASS
	Bedroom 2	0.2	31	PASS
	LDK	1.7	-	PASS
Block E, Flat, Mid Floor, 2B4P	Bedroom 1	0.0	27	PASS
	Bedroom 2	0.0	30	PASS
	LDK	0.2	-	PASS
Block E, Flat, Top Floor, 2B4P	Bedroom 1	0.0	30	PASS
	Bedroom 2	0.1	31	PASS
	LDK	0.5	-	PASS
Block F, Flat, Mid Floor, 2B4P	Bedroom 1	0.1	32	PASS
	Bedroom 2	0.1	32	PASS
	LDK	0.2	-	PASS

Dwelling Results – Usability Constraints

6.5 As discussed in Section 5 of this report, the development is subject to noise risk constraints, as well as security risk to ground floor units. When this is taken into consideration, compliance via passive means alone is impracticable.

6.6 It is proposed that peak-lopping MVHR is installed to units that are subject to noise and/or security risk constraints. Peak-lopping MVHR involves a bolt-on addition to an MVHR unit is not considered to be full comfort cooling.

6.7 The following results presented in Table 3 indicate that, based on installation of peak-lopping MVHR to affected units, CIBSE TM59 compliance is achieved in a scenario considering noise risk.

Table 3: TM59 overheating results for dwellings under DSY1 2020s in an 'occupancy constraints' scenario

Unit	Room	TM59 Criterion B: Bedroom temperature hours > 26 °C (pass ≤ 32)	Overall compliance with TM59
		Hours of overheating	
Block B, Duplex, Ground Floor, 3B4P	Bedroom 1	18	PASS
	Bedroom 2	32	PASS
	Bedroom 3	14	PASS
Block D House 2, End-of-terrace, 4B6P	Bedroom 1	12	PASS
	Bedroom 2	12	PASS
	Bedroom 3	18	PASS
	Bedroom 4	19	PASS
Block E, Flat, Ground Floor, 2B3P	Bedroom 1	32	PASS
	Bedroom 2	24	PASS
Block E, Flat, Mid Floor, 2B4P	Bedroom 1	11	PASS
	Bedroom 2	15	PASS
Block E, Flat, Top Floor, 2B4P	Bedroom 1	28	PASS
	Bedroom 2	24	PASS

Corridor Results

6.8 The following results presented in Table 4 indicate that, based on the design modelling inputs in Appendix B, window opening schedules presented in Table 1 and passive overheating mitigation measures outlined above, all assessed corridors meet the CIBSE TM59 criteria and therefore demonstrate an acceptable level of overheating risk.

Table 4: TM59 overheating results for corridors under DSY1 2020s

Block	TM59 Criterion: ≤ 3 % hours over 28°C	Overall compliance with TM59
	% Hours of overheating	
Corridor 1	0.2	Pass
Corridor 2	0.0	Pass

6.9 Therefore, the overheating risk is deemed to be acceptable, as there is no exceedance of CIBSE TM59 requirements.

7. CONCLUSION

7.1 The purpose of this report is to provide the overheating mitigation strategy for the proposed development at Southern Gas Network Belvedere Holders Stations by Bellway Homes Limited in the London Borough of Bexley to demonstrate that the development is compliant with relevant Local Planning Conditions and Part O (2021) of the Building Regulations.

7.2 The performance of dwellings and communal corridors has been assessed against the Charted Institution of Building Services Engineers (CIBSE) guidance TM59 *Design methodology for the assessment of overheating risk in homes* (2017) and Approved Document O Overheating (2021).

7.3 A sample of dwellings and communal corridors has been selected for the dynamic overheating assessment based on design characteristics that establish them as representative of the overall proposed scheme. This selection of dwellings includes consideration of varying floor levels, orientations, occupancy types and exposure to risks such as noise, air quality and security risk.

7.4 For the purpose of this report, passive mitigation measures including maximising openable window areas, utilising balconies and external reveal depths for shading and increasing MVHR ventilation rates have been explored as far as practicable to reduce overheating risk in line with the London Plan cooling hierarchy.

7.5 All dwellings tested demonstrate compliance with the CIBSE TM59 and AD(O) overheating assessment criteria under the mandatory weather file (DSY1 for the 2020s, high emissions, 50% percentile scenario).

APPENDICES

Appendix A
Assessed Dwellings and Communal Corridors

Appendix B
Design Modelling Inputs

Appendix C
Results of DSY2 and DSY3 Weather Scenarios

Appendix D
Strategy / G-value Mark-up

Appendix E
GHA Early Stage Overheating Risk Tool

Appendix A
Assessed Dwellings and Communal Corridors

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Appendix B
Design Modelling Inputs

The following modelling inputs have been included in the baseline dynamic thermal simulation.

Table B.1: Baseline dynamic thermal modelling design assumptions

Data Input			Discussion
Weather data	**Location**	CIBSE London Heathrow Design Summer Years (DSYs) for 2020s, high emissions, 50% percentile scenario	*Geographically closest and most representative industry-standard CIBSE weather data file*
Building Fabric Construction details	**External walls**	0.15 W/m²K in flats 0.24 W/m²K in houses	*As per the Energy Statement (Hodkinson Consultancy, August 2023)* *Traditional construction in houses, RC in flats.*
	Roofs	0.10 W/m²K	*As per the Energy Statement (Hodkinson Consultancy, August 2023)*
	Ground floor	0.10 W/m²K	*As per the Energy Statement (Hodkinson Consultancy, August 2023)*
	Ceilings/floors	Assumed to be adiabatic between adjacent floors	*Concrete slabs will add to the thermal capacity of the building* *When dwelling units above / below heat loss is assumed to be zero*
	Party walls between units and houses	Assumed to be adiabatic between adjacent dwellings	*Walls adjacent to other units are assumed to be lightweight partitions* *Adjacent units have been included in the dynamic simulation calculations*
	Partitions within units	Plasterboard partitions, 100 mm.	*Assumed thicknesses as per drawings*
	Internal doors	0.90 m width	*As per drawings (Stockwool, August 2023)*
Windows	**Windows and Glazed Doors**	U value 0.9 W/m²K	*As per the Energy Statement (Hodkinson Consultancy, August 2023)*
	Reveal depth	External reveal houses: 200 mm, flats: 180 mm	*As per drawings (Stockwool, August 2023)*
	Discharge Coefficient	Discharge coefficient: between 0.53 and 0.55	*Calculated from window dimensions as per drawings (Stockwool, August 2023)using the BB101 discharge coefficient calculator stated within Approved Document O (2021)*

Data Input			Discussion
Infiltration	**Air Tightness**	3.0 $m^3/hr\text{-}m^2$ @ 50 pascals 4.0 $m^3/hr\text{-}m^2$ @ 50 pascals	*As per the Energy Statement (Hodkinson Consultancy, August 2023)*

The following occupancy schedules and internal gains assumptions have been used, in accordance with CIBSE TM59 guidance.

Table B.2: Occupancy and equipment gains for dwellings (CIBSE TM59)

Unit/room type	Occupancy	Equipment Load
1-bedroom apartment: living room/kitchen	1 person from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 450 W from 6 pm to 8 pm 200 W from 8 pm to 10 pm 110 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 85 W for the rest of the day
2-bedroom apartment: living room/kitchen	2 people from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 450 W from 6 pm to 8 pm 200 W from 8 pm to 10 pm 110 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 85 W for the rest of the day
3-bedroom apartment: living room/kitchen	3 people from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 450 W from 6 pm to 8 pm 200W from 8 pm to 10 pm 110 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 85 W for the rest of the day
Double bedroom	2 people at 70% gains from 11 pm to 8 am, 2 people at full gains from 8 am to 9 am and from 10 pm to 11 pm, 1 person at full gain in the bedroom from 9 am to 10 pm	Peak load of 80 W from 8 am to 11 pm Base load of 10 W during the sleeping hours
Single bedroom	1 person at 70% gains from 11 pm to 8 am, 1 person at full gains from 8 am to 11 pm	Peak load of 80 W from 8 am to 11 pm Base load of 10 W during sleeping hours
Utility cupboard	N/A	10 W on 24/7

A mechanical ventilation system should be provided which is capable of achieving background mechanical ventilation meeting minimum Part F requirements.

Table B.3: Mechanical ventilation rates for dwellings (minimum Part F)

Dwelling	D2.00.10	E2.00.04	E6.04.04	D1.00.10	E3.01.05
Floor area / m²	111.96	64.68	70.6	127.47	77.84
Storey height /	2.695	2.825	2.825	2.695	2.825
Volume / m³	301.7322	182.721	199.445	343.53165	219.898
Kitchen	13	13	13	13	13
Utility cupboard					8
Bathroom	24	16	16	24	16
Ensuite					
Boost rate / l/s	37	29	29	37	37
Whole dwelling ventilation rate / cu.m/hr	133.2	104.4	104.4	133.2	133.2
Air change rate / ach	0.44	0.57	0.52	0.39	0.61
Dwelling	F.01.01	A1.02.01	B2.01.02	B1.00.03	C2.04.03
Floor area / m²	70.39	51.87	52.65	117.4	50.12
Storey height /	2.825	2.825	2.825	2.825	2.825
Volume / m³	198.85175	146.53275	148.73625	331.655	141.589
Kitchen	13	13	13	13	13
Utility cupboard	8	8	8	8	8
Bathroom	8	8	8	16	8
Ensuite					
Boost rate / l/s	29	29	29	37	29
Whole dwelling ventilation rate / cu.m/hr	104.4	104.4	104.4	133.2	104.4
Air change rate / ach	0.53	0.71	0.70	0.40	0.74

Corridor inputs

The same building fabric details and glazing properties used in the modelling of the selected homes (Table B.1) were used in the modelling of the corridors. The baseline assumptions were based on information received and involve:

> Flow and return temperatures of 60^{o}C and 35^{o}C respectively;

> 25 mm pipe insulation with maximum thermal conductivity of 0.025W/mK;

The corridor will utilise environmental push pull system which inlet cool air through AVO shaft and extract hot air via smoke vent system. The system will be capable of operating at 1.0 air changes per hour.

LTHW heat gains calculated for the assessed corridor is presented in Table B.4.

Table B.4: LTHW Pipework Heat Gains

Location	Pipe Diameter (mm)	Pipe Length- Flow & Return (m)	Flow & Return Temperatures (°C)	Calculated Losses (W)
LTHW Riser	32	6.15	60/35 °C	22.2
Corridor Block B - 2nd floor	32	22.7		82.1
Corridor Block A - 2nd floor	32	7.58		27.4

Lengths of pipework were determined through measurements from floor plans as provided by Stockwool Architects.

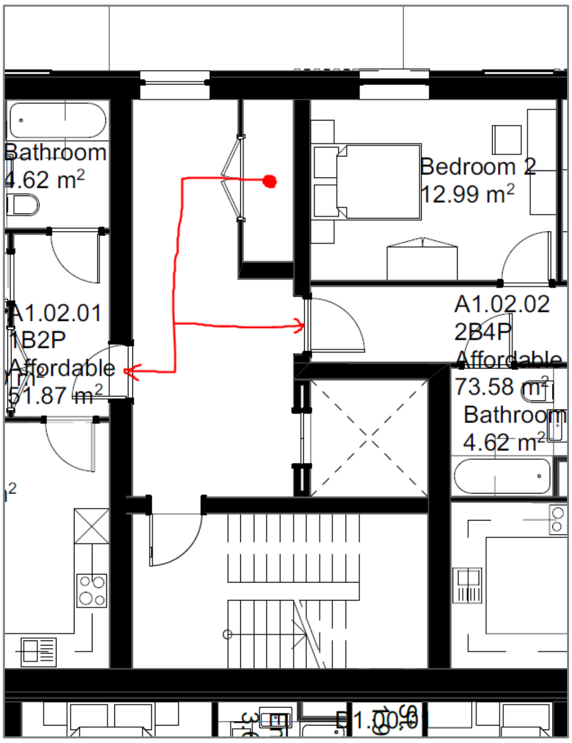

Figure B.1: Corridor LTHW pipework

Appendix C

Result of DSY2 and DSY3 Weather Scenarios

The dynamic overheating assessment has also been run under the more extreme DSY2 and DSY3 weather files, with results presented in Tables C.1 and C.2.

TM59 states that compliance should be met for the DSY1 weather scenario, and that additional testing can be undertaken using the 2020 versions of DSY2 and DSY3. However, it is acknowledged that meeting the CIBSE compliance criteria is challenging for the DSY2 and DSY3 weather files.

The overheating mitigation strategy presented within the main body of this report demonstrates the passive measures that have been implemented to reduce the risk of overheating as far as practicable. In the future, residents could use further adaptation measures to combat any additional overheating risk such as the use of fans.

Table C.1: Dwelling overheating results for DSY2 2020s – TM59

Unit	Room	TM59 Criterion A: Hours of exceedance (pass ≤ 3 %)	TM59 Criterion B: Bedroom temperature hours > 26 °C (pass ≤ 32)	Overall compliance with TM59
		% Hours of overheating	Hours of overheating	
Block A, Flat, Mid Floor, 1B2P	Bedroom	0.5	60	FAIL
	LDK	1.9	-	PASS
Block B, Duplex, Ground Floor, 3B4P	Bedroom 1	0.9	61	FAIL
	Bedroom 2	0.5	94	FAIL
	Bedroom 3	0.4	93	FAIL
	LDK	1.7	-	PASS
Block C, Flat, Top Floor, 1B2P	Bedroom	0.0	75	FAIL
	LDK	0.5	-	PASS
Block D House 1, Mid-terrace, 3B4P	Bedroom 1	0.7	77	FAIL
	Bedroom 2	0.7	89	FAIL
	Bedroom 3	0.7	87	FAIL
	Living Room	1.5	-	PASS
	Kitchen Diner	3.6	-	FAIL
Block D House 2, End-of-terrace, 4B6P	Bedroom 1	0.6	76	FAIL
	Bedroom 2	0.4	63	FAIL
	Bedroom 3	0.7	89	FAIL
	Bedroom 4	0.5	86	FAIL
	Kitchen Diner	0.2	-	PASS

Unit	Room	TM59 Criterion A: Hours of exceedance (pass ≤ 3 %)	TM59 Criterion B: Bedroom temperature hours > 26 °C (pass ≤ 32)	Overall compliance with TM59
		% Hours of overheating	Hours of overheating	
	Living Room	2.8	-	PASS
Block E, Flat, Ground Floor, 2B3P	Bedroom 1	0.8	79	FAIL
	Bedroom 2	0.7	86	FAIL
	LDK	5.4	-	FAIL
Block E, Flat, Mid Floor, 2B4P	Bedroom 1	0.4	90	FAIL
	Bedroom 2	0.5	92	FAIL
	LDK	0.3	-	PASS
Block E, Flat, Top Floor, 2B4P	Bedroom 1	0.2	95	FAIL
	Bedroom 2	0.2	83	FAIL
	LDK	1.8	-	PASS
Block F, Flat, Mid Floor, 2B4P	Bedroom 1	0.2	88	FAIL
	Bedroom 2	0.3	88	FAIL
	LDK	1.3	-	PASS

Table C.2: Dwelling overheating results for DSY3 2020s – TM59

Unit	Room	TM59 Criterion A: Hours of exceedance (pass ≤ 3 %)	TM59 Criterion B: Bedroom temperature hours > 26 °C (pass ≤ 32)	Overall compliance with TM59
		% Hours of overheating	Hours of overheating	
Block A, Flat, Mid Floor, 1B2P	Bedroom	0.5	40	FAIL
	LDK	1.4	-	PASS
Block B, Duplex, Ground Floor, 3B4P	Bedroom 1	0.8	46	FAIL
	Bedroom 2	0.5	66	FAIL
	Bedroom 3	0.8	70	FAIL
	LDK	1.4	-	PASS
Block C, Flat, Top Floor, 1B2P	Bedroom	0.3	60	FAIL
	LDK	1.5	-	PASS
Block D House 1, Mid-terrace, 3B4P	Bedroom 1	0.7	55	FAIL
	Bedroom 2	0.7	67	FAIL
	Bedroom 3	0.7	65	FAIL
	Living Room	0.6	-	PASS
	Kitchen Diner	1.8	-	PASS

Unit	Room	TM59 Criterion A: Hours of exceedance (pass ≤ 3 %)	TM59 Criterion B: Bedroom temperature hours > 26 °C (pass ≤ 32)	Overall compliance with TM59
		% Hours of overheating	Hours of overheating	
Block D House 2, End-of-terrace, 4B6P	Bedroom 1	0.6	55	FAIL
	Bedroom 2	0.6	47	FAIL
	Bedroom 3	0.7	67	FAIL
	Bedroom 4	0.6	67	FAIL
	Kitchen Diner	0.5	-	PASS
	Living Room	1.4	-	PASS
Block E, Flat, Ground Floor, 2B3P	Bedroom 1	0.7	60	FAIL
	Bedroom 2	0.9	68	FAIL
	LDK	3.5	-	FAIL
Block E, Flat, Mid Floor, 2B4P	Bedroom 1	0.4	64	FAIL
	Bedroom 2	0.5	67	FAIL
	LDK	0.7	-	PASS
Block E, Flat, Top Floor, 2B4P	Bedroom 1	0.7	71	FAIL
	Bedroom 2	0.2	60	FAIL
	LDK	1.9	-	PASS
Block F, Flat, Mid Floor, 2B4P	Bedroom 1	0.4	65	FAIL
	Bedroom 2	0.4	64	FAIL
	LDK	1.1	-	PASS

Table C.3: TM59 overheating results for corridors under DSY2 2020s

Block	TM59 Criterion: ≤ 3 % hours over 28°C	Overall compliance with TM59
	% Hours of overheating	
Corridor 1	0.2	Pass
Corridor 2	0.0	Pass

Table C.4: TM59 overheating results for corridors under DSY3 2020s

Block	TM59 Criterion: ≤ 3 % hours over 28°C	Overall compliance with TM59
	% Hours of overheating	
Corridor 1	3.6	Fail
Corridor 2	0.0	Pass

Appendix D
Overheating Mitigation Strategy Mark-up

Appendix E
GHA Overheating Checklist